Document ID #P112744
Report covers work performed under BPA contract #37822
Report was completed under BPA contract #42445

YAKIMA/KLICKITAT FISHERIES PROJECT MONITORING AND EVALUATION

PROJECT NUMBER 1995-063-25
CONTRACT NUMBER 00037822

THE CONFEDERATED TRIBES AND BANDS OF THE YAKAMA NATION

FINAL REPORT
For the Performance Period
May 1, 2008 through April 30, 2009

Submitted: July 31, 2009

PREPARED FOR:

Patricia Smith
COTR

BONNEVILLE POWER ADMINISTRATION
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208-3621

Prepared By:
Yakama Nation
Yakima/Klickitat Fisheries Project

Melvin R. Sampson, Policy Advisor/Project Coordinator
Dr. David Fast, Research Manager
Bill Bosch, Editor

P.O. Box 151
Toppenish, WA 98948

Table of Contents

Executive Summary

The Yakima-Klickitat Fisheries Project (YKFP) is a joint project of the Yakama Nation (lead entity) and the Washington State Department of Fish and Wildlife (WDFW) and is sponsored in large part by the Bonneville Power Administration (BPA) with oversight and guidance from the Northwest Power and Conservation Council (NPCC). It is among the largest and most complex fisheries management projects in the Columbia Basin in terms of data collection and management, physical facilities, habitat enhancement and management, and experimental design and research on fisheries resources. Using principles of adaptive management, the YKFP is attempting to evaluate all stocks historically present in the Yakima subbasin and apply a combination of habitat restoration and hatchery supplementation or reintroduction, to restore the Yakima Subbasin ecosystem with sustainable and harvestable populations of salmon, steelhead and other at-risk species.

The original impetus for the YKFP resulted from the landmark fishing disputes of the 1970s, the ensuing legal decisions in *United States versus Washington* and *United States versus Oregon*, and the region's realization that lost natural production needed to be mitigated in upriver areas where these losses primarily occurred. The YKFP was first identified in the NPCC's 1982 Fish and Wildlife Program (FWP) and supported in the *U.S. v Oregon* 1988 Columbia River Fish Management Plan (CRFMP). A draft Master Plan was presented to the NPCC in 1987 and the Preliminary Design Report was presented in 1990. In both circumstances, the NPCC instructed the Yakama Nation, WDFW and BPA to carry out planning functions that addressed uncertainties in regard to the adequacy of hatchery supplementation for meeting production objectives and limiting adverse ecological and genetic impacts. At the same time, the NPCC underscored the importance of using adaptive management principles to manage the direction of the Project. The 1994 FWP reiterated the importance of proceeding with the YKFP because of the added production and learning potential the project would provide. The YKFP is unique in having been designed to rigorously test the efficacy of hatchery supplementation. Given the current dire situation of many salmon and steelhead stocks, and the heavy reliance on artificial propagation as a recovery tool, YKFP monitoring results will have great region-wide significance.

Supplementation is envisioned as a means to enhance and sustain the abundance of wild and naturally-spawning populations at levels exceeding the cumulative mortality burden imposed on those populations by habitat degradation and by natural cycles in environmental conditions. A supplementation hatchery is properly operated as an adjunct to the natural production system in a watershed. By fully integrating the hatchery with a naturally-producing population, high survival rates for the component of the population in the hatchery can raise the average abundance of the total population (hatchery component + naturally-producing component) to a level that compensates for the high mortalities imposed by human development activities and fully seeds the natural environment.

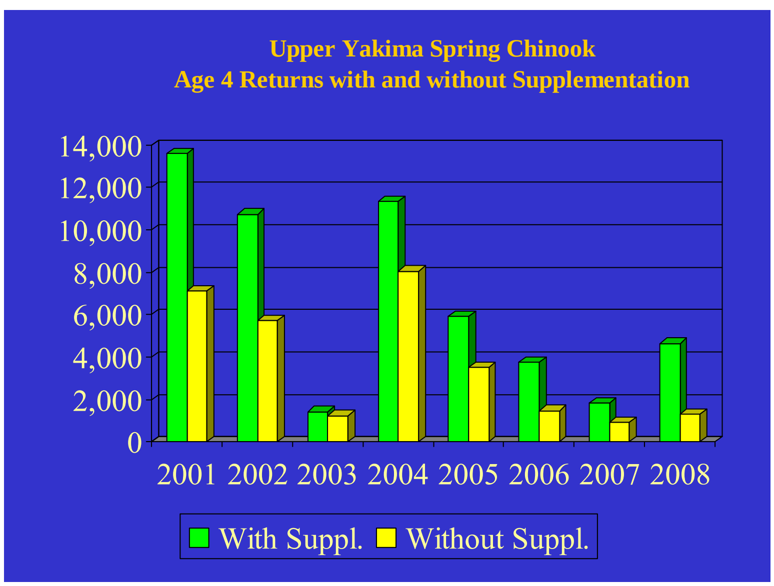
The objectives of the YKFP are to: use Ecosystem Diagnosis and Treatment (EDT) and other modeling tools to facilitate planning for project activities, enhance existing stocks, re-introduce extirpated stocks, protect and restore habitat in the Yakima Subbasin, and operate using a scientifically rigorous process that will foster application of the knowledge gained about hatchery supplementation and habitat restoration throughout the Columbia River Basin. The YKFP is still in the early stages of evaluation, and as such the data and findings presented in this report should be considered preliminary until results are published in the peer-reviewed literature. The following is a brief summary of current YKFP activities by species.

Spring Chinook

The Cle Elum Supplementation and Research Facility (CESRF) collected its first spring Chinook brood stock in 1997, released its first fish in 1999, and age-4 adults have been returning since 2001, with the first F2 generation (offspring of CESRF and wild fish spawning in the wild) returning as adults in 2005. In these initial years of CESRF operation, recruitment of hatchery origin fish has exceeded that of fish spawning in the natural environment, but early indications are that hatchery origin fish are not as successful at spawning in the natural environment as natural origin fish. Preliminary results indicate that significant differences have been detected among hatchery and natural origin fish in about half of the traits measured in our monitoring plan and that these differences can be attributed to both environmental and genetic causes. For example, we have detected differences in hatchery and natural origin fish after only one generation of hatchery exposure for the following variables measured on adults: age composition, size-at-age, sex ratio, spawning timing, fecundity, egg weight, adult morphology at spawning, and spawning success. Significant differences in juvenile traits have also been detected: food conversion efficiency, length-weight relationships, agonistic competitive behavior, predator avoidance, and incidence of precocious maturation. Most of the differences have been 10% or less.

Distribution of spawners has increased as a result of acclimation site location and salmon homing fidelity. Semi-natural rearing and predator avoidance training have not resulted in significant increases in survival of hatchery fish. Growth manipulations in the hatchery appear to be reducing the number of precocious males produced by the YKFP and consequently increasing the number of migrants, however post-release survival of treated fish appears to be significantly lower than conventionally reared fish. Genetic impacts to non-target populations appear to be low because of the low stray rates of YKFP fish. Ecological impacts to valued non-target taxa were generally within containment objectives, or impacts that were outside of containment objectives were not caused by supplementation activities. Fish and bird piscivores consume large numbers of salmonids in the Yakima Basin. Natural production of Chinook salmon in the upper Yakima Basin appears to be density dependent under current conditions and may constrain the benefits of supplementation. However, such constraints could be countered by YKFP habitat actions (see summary below). Additional habitat improvements implemented by other entities, including the Conservation Districts, counties and private interests are also continuing in the basin. Harvest opportunities for tribal and non-tribal fishers have also been enhanced, but are variable among years.

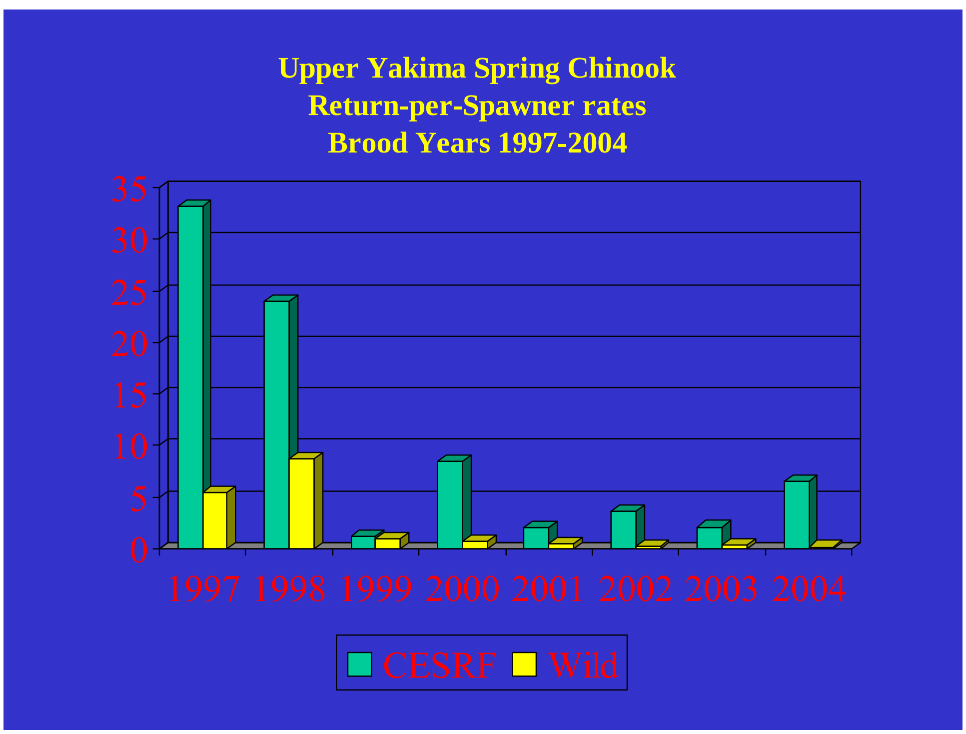
Figure 1. Actual returns (green bar) of age-4 Upper Yakima spring Chinook to the Yakima River mouth compared to estimated returns (yellow bar) if the Cle Elum Supplementation and Research Facility (CESRF) had not been constructed. Data are for age-4 return years 2001-2008.



Methods and Discussion: For all years, actual returns with supplementation (green bars) are derived from actual counts of marked (CESRF) and unmarked (wild/natural) fish at Roza Dam backed through harvest to the Yakima River mouth. For F1 returns (returns from wild fish spawned in the hatchery) in

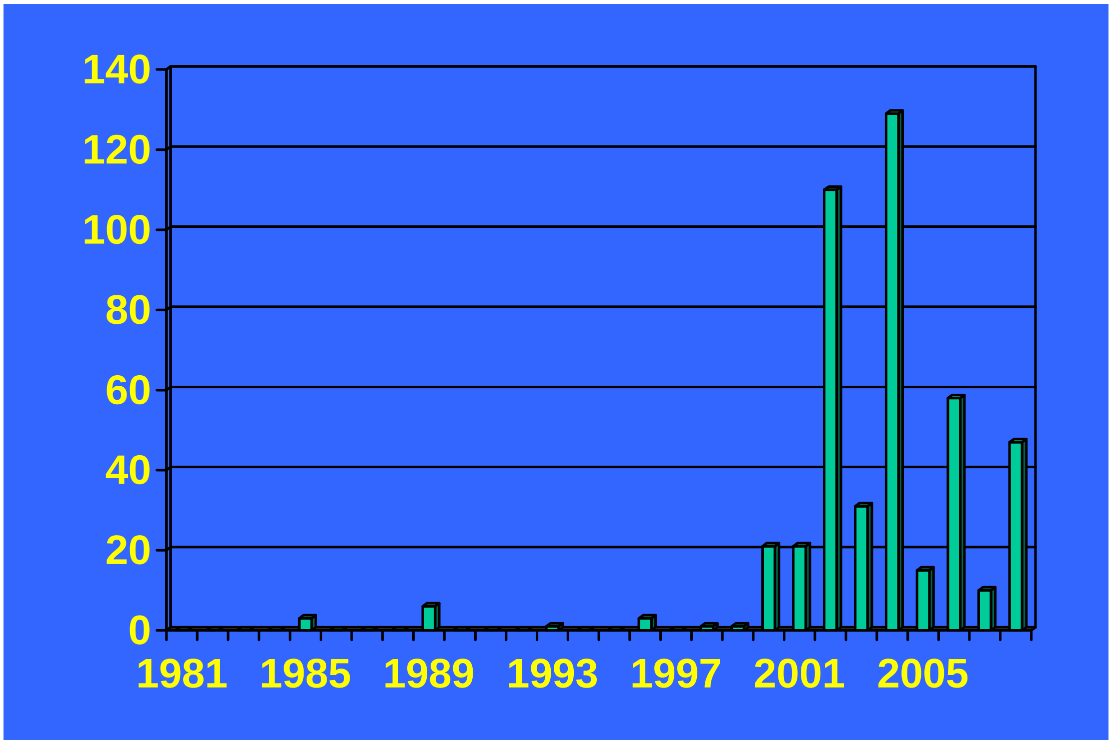
2001-2004, the yellow bars (estimated returns without supplementation) are calculated as the actual returns of unmarked (wild) fish at Roza backed to the river mouth plus estimated returns from fish taken for CESRF broodstock had these fish been allowed to spawn in the wild and returned at observed wild/natural return per spawner rates. For F2 and later generation returns from 2005 forward (where wild/natural returns are comprised of crosses of wild/natural and CESRF fish spawning together in the wild), estimated returns without supplementation are calculated as if the estimated "without supplementation" return four years earlier had been the total escapement, spawned in the wild, and their progeny returned at observed wild/natural return per spawner rates. Using this method the estimated benefit (increase in abundance of natural spawners) from supplementation ranged from 15% in return year 2003 to 250% in return year 2008 and averaged 79% from 2001-2008.

Figure 2. Yakima River mouth return per spawner (adult-to-adult productivity) rates of Cle Elum Supplementation and Research Facility (CESRF) and wild/natural upper Yakima spring Chinook for brood years 1997-2004. Note: Age-5 returns are not yet included for brood year 2004.



Methods and Discussion: Return per spawner rates for both CESRF and wild/natural upper Yakima spring Chinook are calculated using standard run reconstruction and brood/cohort methods from counts of marked (CESRF) and unmarked (wild/natural) fish at Roza Dam, age data from scale samples taken at Roza Dam, and in-basin harvest data. The CESRF is resulting in increased abundance of spring Chinook on the natural spawning grounds even in years when wild/natural productivity rates are less than 1.

Figure 3. Teanaway River Spring Chinook Redd Counts, 1981 – 2008.



Methods and Discussion: Redd surveys in the Teanaway River have been conducted annually by Yakama Nation staff since 1981. The Jack Creek acclimation site began releasing CESRF spring chinook in 2000, with the first age-4 females returning from these releases in 2002. Redd counts in this tributary have increased from a pre-supplementation average of 3 redds per year to a post supplementation average of 57 redds per year. In addition, the number of natural origin spawners has increased in the targeted Teanaway River indicating this approach may be successful for reintroduction of salmonids into underutilized habitat.

For detailed data and supporting information, see Appendix A of this report and the references to WDFW reports shown under tasks 1.b, 1.k, 1.l, 3.a-3.b, and 4.c-4.d of this report.

Fall Chinook

The YKFP is presently studying the release of over 2.0 million Upriver Bright fall Chinook smolts annually from the Prosser and Marion Drain Hatcheries. These fish are a combination of in-basin production from brood stock collected in the vicinity of Prosser Dam plus out-of-basin Priest Rapids stock fish reared at Little White National Fish Hatchery and moved to Prosser Hatchery for final rearing and release. Marion Drain broodstock are collected from adult returns to a fishwheel in the drain. These fish contributed to the improved returns of fall Chinook to the Columbia River in recent years. The YKFP is investigating ways to improve the productivity of fish released from Prosser Hatchery and to improve in-basin natural production of fall Chinook. For example, rearing conditions designed to accelerate smoltification of Yakima Basin fall Chinook have resulted in smolt-to-smolt survival indices that exceeded those of conventionally reared fall Chinook in five of the six years for which results are available.

Coho

The YKFP is presently studying the release of over 1.0 million coho smolts annually from acclimation sites in the Naches and Upper Yakima subbasins. These fish are a combination of in-basin production from brood stock collected in the vicinity of Prosser Dam plus out-of-basin stock generally reared at Willard or Eagle Creek National Fish Hatcheries and moved to the Yakima Subbasin for final rearing and release. YKFP monitoring of these efforts to re-introduce a sustainable, naturally spawning coho population in the Yakima Basin have indicated that adult coho returns averaged over 3,600 fish from 1997-2008 (an order of magnitude greater than the average for years prior to the project) including estimated returns of wild/natural coho averaging nearly 1,400 fish since 2001. Coho re-introduction research has demonstrated that hatchery-reared coho can successfully reproduce in the wild. The project is working to further develop a locally adapted broodstock and to establish specific release sites and strategies that optimize natural reproduction and survival.

Habitat

The project objectives include habitat protection and restoration in the most productive reaches of the Yakima Subbasin. The YKFP's Ecosystem Diagnosis Treatment (EDT) analysis will provide additional information related to habitat projects that will improve salmonid production in the Yakima Subbasin. Major accomplishments to date include protection of 1,300 acres of prime floodplain habitat, reconnection and screening of over 20 miles of tributary habitat, substantial water savings through irrigation improvements, and restoration of over 80 acres of floodplain and side channels. Restoration designs are now being completed for high priority reaches in Taneum and Swauk Creek.

Research

One of the YKFP's primary objectives is to provide knowledge about hatchery supplementation to resource managers and scientists throughout the Columbia River Basin, to determine if it may be used to mitigate effects of hydroelectric operations on anadromous fisheries. To facilitate this objective, the Project created a Data and Information Center (Center) in 1999. The Center's purpose is to gather, synthesize, catalogue, and disseminate data and information related to project research and production activities. Dissemination of accumulated project information occurs through the Project Annual Review (PAR) conference, the project web site (ykfp.org), numerous technical reports (such as these annual reports) and publications, and other means. Data and results are published in the peer-reviewed literature as they become ripe. Since its inception, the YKFP has generated a number of technical manuscripts that are either in final internal review, in peer review, are in press, or are published. Please refer to the project web site for a complete list of project technical reports and publications. Project publications for this performance period relevant to this specific contract include:

Fast, D. E., D. Neeley, D.T. Lind, M. V. Johnston, C.R. Strom, W. J. Bosch, C. M. Knudsen, S. L. Schroder, and B.D. Watson. 2008. Survival Comparison of Spring Chinook Salmon Reared in a Production Hatchery under Optimum Conventional and Seminatural Conditions. Transactions of the American Fisheries Society 137:1507–1518.

Knudsen, C.M., S.L. Schroder, C. Busack, M.V. Johnston, T.N. Pearsons, and C.R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, T. W. Kassler, S. F. Young, C. A. Busack, and D. E. Fast. 2008. Breeding Success of Wild and First-Generation Hatchery Female Spring Chinook Salmon Spawning in an Artificial Stream. Transactions of the American Fisheries Society, 137:1475-1489.

Introduction

While the statement of work for this contract period was provided in work element format, we believe that annual progress is best organized and communicated by task as presented in our FY2007-2009 proposal. The monitoring and evaluation program for the YKFP was organized into four categories- Natural Production (tasks 1.a - 1.p), Harvest (tasks 2.a and 2.b), Genetics (tasks 3.a and 3.b) and Ecological Interactions (tasks 4.a – 4.d). This annual report specifically discusses tasks directly conducted by the Yakama Nation during fiscal year 2008. Those tasks that are conducted directly by the Washington State Department of Fish and Wildlife cite the written report where a complete discussion of that task can be found. International Statistical Training and Technical Services (IntStats) provides the biometrical support for the YKFP and IntStats' written reports for tasks 1.c, 1.d, 1.f, and 1.g are included in full as appendices to this report. Some tasks have been completed or have been discontinued; information regarding these tasks was published in prior annual reports.

Contributing authors from the Yakama Nation YKFP in alphabetical order are: Bill Bosch, Melinda Davis, Chris Frederiksen, David Lind, Jim Matthews, Todd Newsome, Michael Porter and Sara Sohappy. Doug Neeley of Intstats Consulting also provided material used in this report, some or all of which are included as appendices.

Special acknowledgement and recognition is owed to all of the dedicated YKFP personnel who are working on various tasks. The referenced accomplishments and achievements are a direct result of their dedication and desire to seek positive results for the betterment of the resource. The readers of this report are requested to pay special attention to the Personnel Acknowledgements. Also, these achievements are attainable because of the efficient and essential administrative support received from all of the office and administrative support personnel for the YKFP.

We also wish to thank the Bonneville Power Administration for their continued support of these projects which we consider vital to salmon restoration efforts in the Yakima River Basin.

NATURAL PRODUCTION

Overall Objective: Determine if supplementation and habitat actions increase natural production. Evaluate changes in natural production with specified statistical power.

Task 1.a Modeling

Rationale: To design complementary supplementation/habitat enhancement programs for targeted stocks with computer models incorporating empirical estimates of life-stage-specific survival and habitat quality and quantity.

Methods: To diagnose the fundamental environmental factors limiting natural production, and to estimate the relative improvements in production that would result from a combination of habitat enhancement and supplementation using the "Ecosystem Diagnosis and Treatment" (EDT) and All-H analyzer (AHA) models. Additional information about these models can be obtained through Mobrand, Jones, and Stokes (see www.mobrand.com).

Progress:

Summer run Chinook Reintroduction modeling analysis:

Introduction:

The Eco-systems Diagnostic & Treatment (EDT) was used to analyze the theoretical performance of a reintroduced summer run Chinook stock in the Yakima River Subbasin. In order to characterize the life history patterns most suitable to environmental conditions in the Yakima Subbasin, the existing Yakima summer Chinook EDT database was expanded to include all summer Chinook freshwater adult and juvenile life history patterns documented in the donor stock populations residing in the Upper Columbia. Biologically plausible combinations of life history patterns were used to evaluate critical uncertainties concerning the biological responses to anticipated temporal and spatial characteristics of the environment. The results of the analysis hypothesize the suitable characteristics of a summer Chinook population adapted to the Yakima Basin, the feasibility of summer Chinook reintroduction, and estimate the natural production potential of the Yakima Subbasin. This information will assist future planning efforts with artificial production strategies through multiple phases of the reintroduction process. Potential limiting factors affecting the productivity and capacity of the river system can also be identified for the stock given the projected spawning and rearing distribution in the modeling analysis.

Background of Modeling Analysis:

The EDT model is a habitat based model where quality and quantity of available habitat is characterized by numerous abiotic and biotic attributes for individual stream reaches. Stream reaches are typically defined as a section of river with fairly homogenous physical and biological characteristics. Environmental variability is captured on a monthly time step for primary attributes known to exhibit large amounts of seasonal variability. Examples of these include hydrologic conditions, stream channel wetted width, habitat composition, temperature, and turbidity. The model also requires the user to characterize life history patterns that are typically defined by a population's demographics and temporal/spatial characteristics of individual life stages. These include adult & juvenile age structures, sex ratios, fecundity, spawn timing and distribution, adult migration & holding patterns and juvenile rearing & migration patterns. The above demographics were further broken into two separate classes defined as either static or complex for the analysis. Static attributes are life history traits that were held constant for the analysis. These consisted of adult age structures, sex ratios and fecundity. As important as they are, alteration of these was not included in the analysis due to our inability to specifically define and predict environmental mechanisms potentially affecting them at the population scale. Summary of these are listed in Table 1 below.

Table 1. Age structure, fecundity and % females of upper Columbia summer Chinook. Information is based on 1997- 2001 brood year information of Wells hatchery stock.

Upper Columbia Summer Chinook Demographics			
Ocean Age	Age Composition	Fecundity	% Females
0	-	-	-
1	4.1%	2000	0%
2	10.7%	4700	7.2%
3	54.4%	5700	49.9%
4	30.5%	7000	73.0%
5	0.3%	7000	60.0%

The complex life history traits consisted of adult migration and holding, spawning and emergence timing, and juvenile rearing/migration patterns.

Natural selection of these life history traits can be significantly influenced by the temporal and spatial characteristics of the environment and can therefore affect the productivity and viability of a population. Several patterns were created for each of the complex life history traits based on the observed traits of the donor stock's natural populations, anticipated response to the environmental conditions, or a combination of both. Additional information for each of these is discussed in the proceeding paragraphs below.

Adult Migration and Holding:

Adult migration and holding patterns associated with timing of arrival and movement through the lower Yakima River is a critical uncertainty in the reintroduction effort. In terms of estimating the arrival time to the mouth of the Yakima River, run timing and distribution was estimated with the use of upper Columbia summer Chinook pit-tagged information at McNary Dam. For the combined years of 2006 & 2007, roughly 23% of the run had passed by the end of June with the majority of the run passing McNary in the month of July (~60%) and about 17% passing by in the month of August (Figure 4). Combining run-timing information of the donor stock with Lower Yakima temperature profiles (Figure 5) illustrates a potential thermal barrier for the majority of migrating summer Chinook.

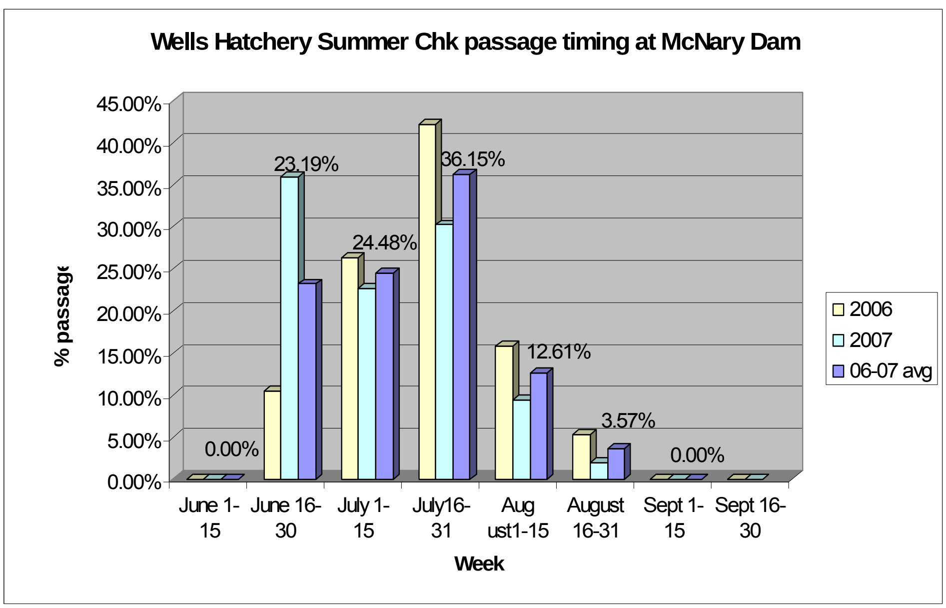


Figure 4. Run-timing distribution of Upper Columbia Summer run Chinook at McNary Dam for 2006-2007.

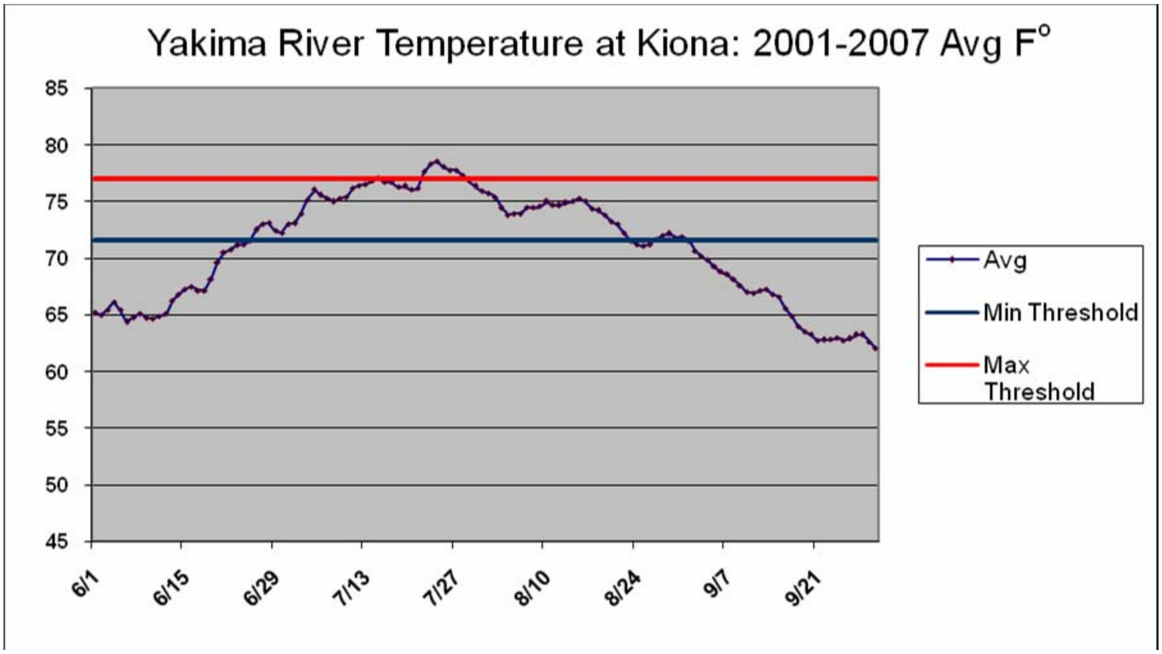


Figure 5. 2000-2007 mean temperature profile of Yakima River near mouth for summer months. Min and max thresholds represent lethal incipient temperatures documented for Chinook salmon.

Upon arrival to the mouth of the Yakima, average temperatures will be above 22 degrees Celsius or 71 degrees Fahrenheit when the majority of summer Chinook arrive (Figures 4 and 5). Ironically, the temperature profiles in the Okanogan River are very similar to the Yakima for the months of July and August. Adults returning to the Okanogan simply hold in the Columbia until the temperatures subside below 21 before migrating upstream. Some radio telemetry work done by WDFW showed very few Chinook moving into the system when temperatures were above 21 degrees Celsius (WDFW 2007). Based on projected run-timing to the mouth of the Yakima and observed movement and holding patterns in the upper Columbia, several adult migration and holding patterns are possible. The first 25%-30% of the run has the potential to enter and migrate through the lower Yakima before the onset of the thermal barrier while the remaining 70%-75% of the run would be expected to hold at the mouth until temperatures subside below 71 degrees F^{o}. On average, temperatures near the mouth subside below this threshold sometime around the 21st of August. The least likely, but possible migrating option for returning adults is the possibility that adults will not hold and simply attempt migration through the lower Yakima River regardless of temperatures. Using the above information, three different adult migration patterns were created for the analysis including early entry timing, no hold (entry upon arrival to Yakima River mouth), and late entry. These migration patterns are summarized in Table 2 below.

Table 2. Summary of adult migration patterns used in modeling analysis.

Adult Entry Migration Pattern	Definition
Early Entry	Adult arrival time to mouth of Yakima River occurs between the middle of June and first week of July. Adults continue migration through lower Yakima River without delay near the mouth.
No Hold	Adult arrival time to mouth of Yakima River occurs between middle of June and the end of August. Adults continue migration through lower Yakima River regardless of arrival time and temperatures of lower Yakima.
Late Entry	Adult arrival time to mouth of Yakima River occurs between the first week of July and the end of August. Regardless of arrival time to mouth of Yakima, adults are held in Columbia until the 3rd week of August.

Spawning and Emergence Timing:

Spawn timing can be heavily influenced and constrained by excessive temperatures greater than 13^{o} C thus resulting in delayed spawn timing, pre-spawn mortality, or a reduction in reproductive success (Andrew, Green 1960 as cited by McCullough 1999). As a result, the temperature regime of a given stream segment can be an acting mechanism influencing the spawn timing of a population or segment of a population. Salmon will typically continue their upstream migration until suitable temperatures are found for holding and spawning life-stages. As a result, Salmon commonly spawn earlier at higher latitudes and elevations, an apparent adaptation to their local environment (T. Quinn 2005). This phenomenon is commonly observed in many Rivers and Salmon populations including the donor stock populations of the upper Columbia. In the Okanogan, a seasonal shift in spawn timing distribution is observed between high and low elevation spawning reaches (Figure 6). Spawning periods are defined as early, mid, and late timed with calendar periods of Sept. 22 – Oct. 15, Oct.16 – Oct. 29, and Oct.30 – Nov.16th respectively.

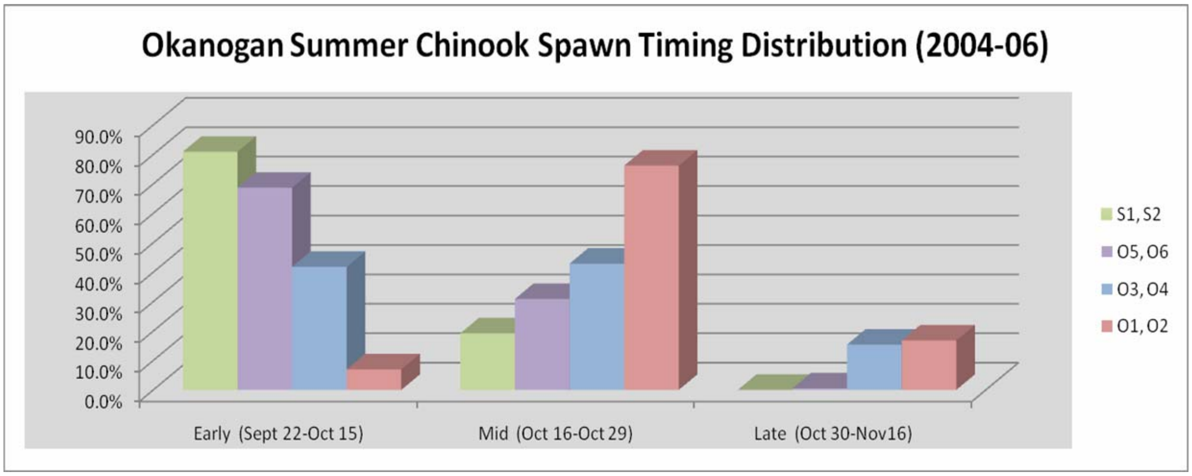


Figure 6. Okanogan summer Chinook spawn timing distribution. Spawn timing is binned into early mid and late timed spawning periods for defined stream reach segments. S1 and S2 are the highest elevation spawning reaches located in the Similkameen followed by progressively lower elevation spawn reaches in the Okanogan (O5/O6, O4/O3, O2/O1).

The historical spawning distribution of summer Chinook in the Yakima consisted primarily of the mid portions of the basin extending from Marion Drain upstream to the vicinity of Roza dam, and up the Naches from the mouth to the confluence with the Tieton. Temperature profiles vary greatly within the mid portion of the Yakima River. Because of this, spawn timing and emergence timing were estimated individually for four different reach segments. For spawn timing, the observed distributions in stream reaches of the Okanogan (Figure 3) were used as a surrogate pattern for the Yakima reaches. As an example, the highest elevation spawning reach in the Yakima basin is the mid Naches; which used the Similkameen's (S1, S2) distribution and spawn timing (Figure 3). The lowest spawning reach in the Yakima is the area from Sunnyside dam to Marion drain; which used the Lower Okanogan's (O1,O2) distribution and spawn timing (figure 3). Spawn timing and distribution for individual stream segments of the Yakima are summarized in table 3 below.

Table 3. Summer Chinook Spawn timing and distribution for individual stream reaches of the Yakima and Naches.

	Spawn Timing		
Stream Reach	Early (Sept 22-Oct 15)	Mid (Oct 16-Oct 29)	Late (Oct 30-Nov16)
Parker	7.0%	76.2%	16.8%
Gap to Gap	41.8%	42.9%	15.4%
Lower Naches	68.7%	30.9%	0.5%
Mid Naches	80.9%	19.2%	0.0%

Emergence timing (swim-up) can be estimated by the number of degree days required to reach 1600 temperature units once the eggs are deposited in the gravel. A degree day is defined as the average temperature for a 24 hour period as °F - 32°F. Emergence timing of salmonid juveniles is function of both spawn timing and duration needed to reach 1600 temperature units. The duration needed for incubation is a direct function of the stream reach thermal profile. Because thermal profiles can vary greatly at a local stream reach scale, emergence timing can vary greatly across spawning reaches where fish typically spawn at a similar time period. For this analysis, individual stream reach thermal profiles where used for estimated emergence timing for each of the three spawning periods and for each individual stream reach segment.

Juvenile rearing Patterns: Three different juvenile rearing patterns were included in the analysis. Defining the juvenile rearing strategies was based upon the observed rearing and movement patterns of Upper Columbia Summer Chinook. The likely donor stock to be used for the reintroduction effort has been identified as the Wells integrated hatchery stock which uses a combination of hatchery and natural origin fish for its programmatic broodstock needs. Natural origin fish incorporated into the program are made up of fish destined for the Methow and Okanogan watersheds located above Wells dam and hatchery. Juvenile rearing patterns of these natural producing populations are similar in nature, and include three distinct rearing strategies consisting of an ocean type, a reservoir type, and a stream type. Further detail of these three different rearing strategies is provided below:

1.) Ocean type (OT)- This pattern is considered the classic ocean type where sub-yearlings exhibit spring and early summer movement from the natal freshwater areas down into the Columbia River. Once in the Columbia River, juveniles have the tendency to continue moving downstream through the mainstem until reaching the Columbia estuary.

2.) Reservoir type (RT)- Juveniles of this rearing type consist of sub-yearlings exhibiting a late spring to midsummer movement from their natal headwaters downstream toward the Columbia River. Rate of movement of these juveniles may be protracted with intermittent periods of rearing resulting in juveniles over wintering in lower river segments of the subbasin or the Columbia mainstem before continuing on to the estuary the following spring.

3.) Stream type (ST)- This rearing pattern is similar in nature to the classic stream type juvenile rearing pattern observed in spring run populations of chinook. Juveniles of this rearing type will take up resident rearing in the vicinity of emergence for an entire year before migrating the following spring as a yearling.

Analysis scenarios and results: Two modeling scenarios were included in the analysis. Each of these represents a potential adult migration and holding pattern through the lower Yakima River given the timing of arrival to the mouth, and lower River temperatures. The "no hold" scenario allows the adults to move freely through the lower River without delay. A second scenario allows roughly 25% of returning adults to move through the lower river before temperatures meet or exceed 21°C. After temperatures exceed this threshold, the remaining Chinook are held at the mouth of the Yakima until temperatures subside below this, which typically occurs around the second to third week of August. Both scenarios used the same assumptions about juvenile rearing patterns and spawn timing/emergence timing for individual stream reaches. Spawn timing and emergence timing patterns are summarized in the preceding paragraph. Juvenile rearing patterns assumed 49% ocean type, 49% reservoir type, and 2% stream type. Juvenile production was equally split between the ocean and reservoir types due to the lack of empirical data on juvenile production of Upper Columbia Summer Chinook. Bearing this in mind, scale analysis of spawners has demonstrated varying production of each, dependent on brood year. Production of stream type juveniles has been consistently low so the use of 2% seemed like a logical proportion given the data. The projected equilibrium abundance of each scenario represents on average, the number of adults escaping to the spawning grounds. Results of the modeling scenarios are listed below in Table 4. These results are the second in a series of Yakima River reintroduction modeling analysis of summer run Chinook.

Table 4. Model scenario results for each juvenile rearing pattern

Adult migration scenario	Equilibrium Abundance
No Hold	935
25% Early Entry/ 75% Late	2,212

Task 1.b Percent habitat saturation and limiting factors

The WDFW annual report for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications/. This year's report is expected to be available soon. The most recent report is:

Pearsons, T. N., C. L. Johnson, and G. M.Temple. 2008. Spring Chinook Salmon Interactions Indices and Residual/Precocious Male Monitoring in the Upper Yakima Basin; Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Annual Report 2007. DOE/BP-00034450.

Task 1.c Yakima River Juvenile Spring Chinook Marking

Rationale: Estimate hatchery spring Chinook smolt-to-smolt survival at CJMF and Columbia River projects, and smolt-to-adult survival at Bonneville (PIT tags) and Roza (PIT and CWT) dams.

Method: Brood year 2001 marked the last brood year of the OCT/SNT treatment cycle. The last five-year old adults returned from this experiment in 2006 (see Fast et al 2008 for results). For brood years 2002-2004, the YKFP is testing two different feeding regimes to determine whether a slowed-growth regime can reduce the incidence of precocialism (Larsen et al 2004 and 2006) without a reduction in post-release survival. The two growth regimes being tested are a normal (HI) growth regime resulting in fish which are about 30/pound at release and a slowed growth regime (LO) resulting in fish which are about 45/pound at release. For brood year 2005, we are testing a saltwater transition feed during the acclimation rearing phase to see if it improves survival to returning adult relative to standard nutritional feeds. For brood year 2006, we are testing a moist feed (EWOS, Canada) against a standard feed (BioVita, BioOregon, Inc., Oregon). However, because of high mortality rates associated with the EWOS feed, all fish were put on the same BioVita diet on May 3, 2007 after approximately two months of experimental and control diets. In addition to these treatments, the YKFP initiated a hatchery-control line in 2002 to test differences in fish that have only one generation of exposure to the hatchery environment (supplementation line whose parents are always natural-origin fish) to fish that have multiple generations of hatchery exposure (hatchery control line whose parents are always hatchery-origin fish).

To estimate smolt-to-smolt survival by rearing treatment, acclimation location and raceway, we PIT tagged and adipose clipped the minimum number to determine statistically meaningful differences detected at CJMF and lower Columbia River projects. The remaining fish are adipose fin clipped and tagged with visual implant elastomer (VIE) tags in the adipose eyelid tissue and also with coded wire tags in either the snout or the posterior dorsal area. This allows unique marking for rearing treatment, acclimation location, and raceway. Returning adults that are adipose clipped at Roza Dam Broodstock Collection Facility (RDBCF) are interrogated using a hand-held CWT detector to determine the presence/absence of body tags. We recover coded-wire tags during spawning ground surveys. We will use ANOVA to determine significant differences between treatment groups for both smolt-to-smolt and smolt-to-adult survival and report on these data annually.

Progress: Tagging of brood year 2007 fish began at the Cle Elum hatchery on October 13, 2008 and was completed on December 4, 2008. Marking results are summarized in Table 5. Appendix A contains mark summary data for brood years since 2002 (see previous annual reports for earlier brood years). As in prior years, all fish were adipose fin-clipped. Between 2,000 and 4,000 fish (4.4% to 8.5% of the fish) in each of 18 raceways were CWT tagged in the either the snout or the posterior dorsal area and then PIT tagged. The remaining progeny of natural brood parents (~647,200 fish) had a CWT placed in their snout, while the remaining progeny of hatchery brood parents (hatchery contol line; ~87,100 fish) had a CWT placed near their posterior dorsal fin. Previously CWTs were placed in one of six body locations to designate acclimation site raceways at release. However, beginning with brood year 2004, it was determined that placing CWTs in the snout would provide more information about harvest of CESRF fish in out-of-basin fisheries. All fish which were not PIT-tagged had a colored elastomer dye placed into the adipose eyelid. The three colors of elastomer dye in the adipose eyelid corresponded to the three acclimation sites (red = Clark Flat, green = Easton, and orange = Jack Creek). A final quality control check by YN staff took place on January 6, 2009 (ponds 1-9) and January 7, 2009 (ponds 10-18). Estimated tag retention was generally good, ranging from 92-100% for CWT and 85-96% for elastomer tags.

Smolt-to-smolt and smolt-to-adult survival data and analyses for brood years 1997-2001 OCT/SNT treatments were published (see Fast et al 2008).

Appendix B contains an analysis of smolt-to-smolt survivals and mini-jack percentages for various feed treatment and control groups for release years 2004-2008 (brood years 2002-2006). Appendix C contains an analysis of various smolt measures including smolt-to-smolt survival for supplementation (natural-by-natural crosses) and hatchery-control (hatchery-by-hatchery crosses) fish for release years 2004-2008 (brood years 2002-2006). Additional survival data across years are given in Appendix A.

Table 5. Summary of 2007 brood year marking activities at the Cle Elum Supplementation and Research Facility.

CE RW ID	Treat-ment	Accl ID	Cross Type	Elastomer Eye Site	Elastomer Eye Color	CWT Body site	Number Tagged CWT	Number Tagged PIT	Number Tagged Total	Start Date	Finish Date
CLE01	BIO	JCJ06	WW	Right	Orange	Snout	38044	2000	40044	13-Oct-08	16-Oct-08
CLE02	BIO	JCJ05	WW	Left	Orange	Snout	40066	2000	42066	16-Oct-08	21-Oct-08
CLE03	BIO	JCJ04	WW	Right	Orange	Snout	40843	2000	42843	21-Oct-08	23-Oct-08
CLE04	BIO	JCJ03	WW	Left	Orange	Snout	40196	2000	42196	24-Oct-08	28-Oct-08
CLE05	BIO	CFJ06	WW	Right	Red	Snout	40855	2000	42855	29-Oct-08	31-Oct-08
CLE06	BIO	CFJ05	WW	Left	Red	Snout	40475	2000	42475	03-Nov-08	05-Nov-08
CLE07	BIO	ESJ06	WW	Right	Green	Snout	42549	2000	44549	05-Nov-08	13-Nov-08
CLE08	BIO	ESJ05	WW	Left	Green	Snout	43243	2000	45243	13-Nov-08	18-Nov-08
CLE09	BIO	CFJ02	HH	Right	Red	Posterior Dorsal	43803	4000	47803	18-Nov-08	21-Nov-08
CLE10	BIO	CFJ01	HH	Left	Red	Posterior Dorsal	43256	4000	47256	24-Nov-08	02-Dec-08
CLE11	BIO	ESJ02	WW	Right	Green	Snout	41098	2000	43098	02-Dec-08	04-Dec-08
CLE12	BIO	ESJ01	WW	Left	Green	Snout	40535	2001	42536	25-Nov-08	02-Dec-08
CLE13	BIO	ESJ04	WW	Right	Green	Snout	39308	2009	41317	20-Nov-08	25-Nov-08
CLE14	BIO	ESJ03	WW	Left	Green	Snout	36663	2000	38663	17-Nov-08	20-Nov-08
CLE15	BIO	JCJ02	WW	Right	Orange	Snout	40312	2000	42312	07-Nov-08	17-Nov-08
CLE16	BIO	JCJ01	WW	Left	Orange	Snout	40594	2000	42594	04-Nov-08	07-Nov-08
CLE17	BIO	CFJ03	WW	Right	Red	Snout	40687	2000	42687	29-Oct-08	04-Nov-08
CLE18	BIO	CFJ04	WW	Left	Red	Snout	41704	2000	43704	24-Oct-08	29-Oct-08

Task 1.d Roza Juvenile Wild/Hatchery Spring Chinook Smolt PIT Tagging

Rationale: To capture and PIT tag wild and hatchery spring Chinook to estimate: 1) wild and hatchery smolt-to-smolt survival to CJMF and the lower Columbia River projects, and 2) to estimate differential smolt-to-adult survival between winter and spring migrant fish.

Methods: The Roza Dam juvenile fish bypass trap was used to capture wild and hatchery spring Chinook pre-smolts. The trap was operated from February 13, 2008 through May 7, 2008. The trap was fished five days per week, 24 hours per day. Fish were removed from the trap each morning, PIT tagged on site, and released the following day after recovery. Fish tagged on Friday mornings were released on Friday afternoons.

Progress: A total of 6,081 (1,675 wild and 4,406 hatchery) juvenile spring Chinook were PIT tagged from fish collected at the Roza juvenile fish bypass trap. Wild fish were tagged from February 13, 2008 through May 7, 2008; and hatchery fish March 19 through May 7, 2008.

Appendix D contains a detailed analysis of wild/natural and CESRF (hatchery) smolt-to-smolt survival for Roza-tagged releases for brood year 2006 (migration year 2008) and summarizes these data for prior brood years 1997-

2006 (migration years 1999-2008). Additional data on this task are provided in Appendix A.

Task 1.e Yakima River Wild/Hatchery Salmonid Survival and Enumeration (CJMF)

Rationale: As referenced in the YKFP Monitoring Plan (Busack et al. 1997), CJMF is a vital aspect of the overall M&E for YKFP. The baseline data collected at CJMF includes: stock composition of smolts, outmigration timing, egg-to-smolt and/or smolt-to-smolt survival rates, hatchery versus wild (mark) enumeration, and differences in fish survival rates between rearing treatments for CESRF spring Chinook. Monitoring of these parameters is essential to determine whether post-supplementation changes are consistent with increased natural production. This data can be gathered for all anadromous salmonids within the basin.

In addition, the ongoing fish entrainment study is used to refine smolt count estimates, both present and historic, as adjustments are made to the CJMF fish entrainment to river discharge logistical relationship.

The facility also collects steelhead kelts for the kelt reconditioning project, and conducts trap and haul operations when conditions in the lower Yakima are not favorable to smolt survival.

Methods: The CJMF is operated on an annual basis, with smolt enumeration efforts conducted from late winter through early summer corresponding with salmonid smolt out-migrations. A sub-sample of salmonid outmigrants is bio-sampled on a daily basis and all PIT tagged fish are interrogated.

Replicate releases of PIT tagged smolts were made in order to estimate the fish entrainment and canal survival rates in relation to river conditions. The entrainment rate estimates were used in concert with a suite of independent environmental variables to generate a multi-variate smolt passage relationship and subsequently to derive passage estimates with confidence intervals (see Appendix F in our 2005 annual report for details).

PIT tag detections were expanded to calculate passage of hatchery fish, although hand-held CWT detectors were also used to scan for body-tags on hatchery spring Chinook smolts. This monitoring and evaluation protocol is built in as a backup in the event that the corresponding PIT tagged fish from each CESRF treatment group failed to be accurately detected by the PIT detectors stationed at the CJMF. Fortunately there was good correspondence between the detection rates between the two mark groups.

Progress: The 2008 smolt passage estimates were as follows: wild spring Chinook–76,859; control (standard diet, Bio-Oregon) spring Chinook– 92,914; treatment (EWOS feed) spring Chinook– 71,623; unmarked fall Chinook– 88,905; Marion Drain hatchery fall Chinook– 22,295; wild coho– 11,887; hatchery coho– 133,686; and wild steelhead– 26,327. These estimates are provisional and subject to change as better entrainment estimates are developed. Appendix F in our 2005 annual report contains a detailed analysis of data obtained from these studies. An update to this report is being reviewed and is expected to be available in the near future. Additional data on this task are also provided in Appendix A.

Personnel Acknowledgements: Biologist Mark Johnston and Fisheries Technician Leroy Senator are, respectively, the project supervisors and on-site supervisor of CJMF operations. Other Technicians that assisted are Sy Billy, Wayne Smartlowit, Morales Ganuelas, Pharamond Johnson, Steve Salinas, Shiela Decoteau, Jimmy Joe Olney and Tammy Swan. Biologist David Lind uploads and queries PIT tag information, and performs daily passage calculations based on entrainment and canal survival estimates developed by consultant Doug Neeley.

Task 1.f.1 Yakima River Fall Run Chinook Survival Monitoring & Evaluation

Rationale: To determine optimal rearing treatments and acclimation site location(s) to increase overall smolt and smolt-to-adult survival. Previous modeling of subyearling chinook growth and survival in the lower Yakima River suggests that juvenile survival through the lower Yakima River may be higher for the lowermost portions of the mainstem (Mabton-to-Horn and Horn-to-delta reaches), and that smolt-to-smolt survival is perhaps the major limitation on natural production in the Yakima.

Method: In BY2007, we implemented two new experiments: 1) Using our in-basin stock, we compared a group of the accelerated subyearlings versus a group of yearling releases (BY2006). This experiment is on-going. Both groups were 100% adipose clipped and PIT tagged for monitoring and 2) Using our out-of-basin Little White Salmon (LWS) stock, we compared a group of 500,000 fish brought in as eyed eggs and reared under accelerated conditions versus the remainder of the group, 1.2 million fish, that comes in as pre-smolts reared conventionally with final acclimation at Prosser Hatchery. Both experimental groups were monitored using PIT tags.

Progress: Using the BY2007 in-basin stock (subyearlings), we entered into the second year release comparison of the subyearling vs. yearling rearing treatments. The subyearlings were reared using an accelerated strategy already determined to have better survival than the traditional conventional method. Survival of smolts to McNary Dam was monitored via PIT tags. For the initial releases in 2008 (BY2006), we marked 100% of the fish either with a PIT tag or an Adipose (AD) fin clip. We released 1,811 yearlings and 10,007 subyearlings. Both Tagging-to-McNary and Release-to-McNary Survivals were substantially and significantly greater for yearling compared to sub-yearling releases (respectively 61.6% and 37.4% for Tagging-to-McNary Survival, $P < 0.020$; and 65.2% and 49.9% for Release-to-McNary Survival, $P = 0.039$); whereas Pre-Release survivals from time of tagging were nearly the same (respectively 94.6% and 92.3%, $P = 0.81$; D. Neeley, Appendix E). As was the case for other comparisons, the higher survival to McNary was associated with an earlier detection date (04/22 for Yearling and 05/31 for Sub-Yearling, $P < 0.0001$; D. Neeley, Appendix E).

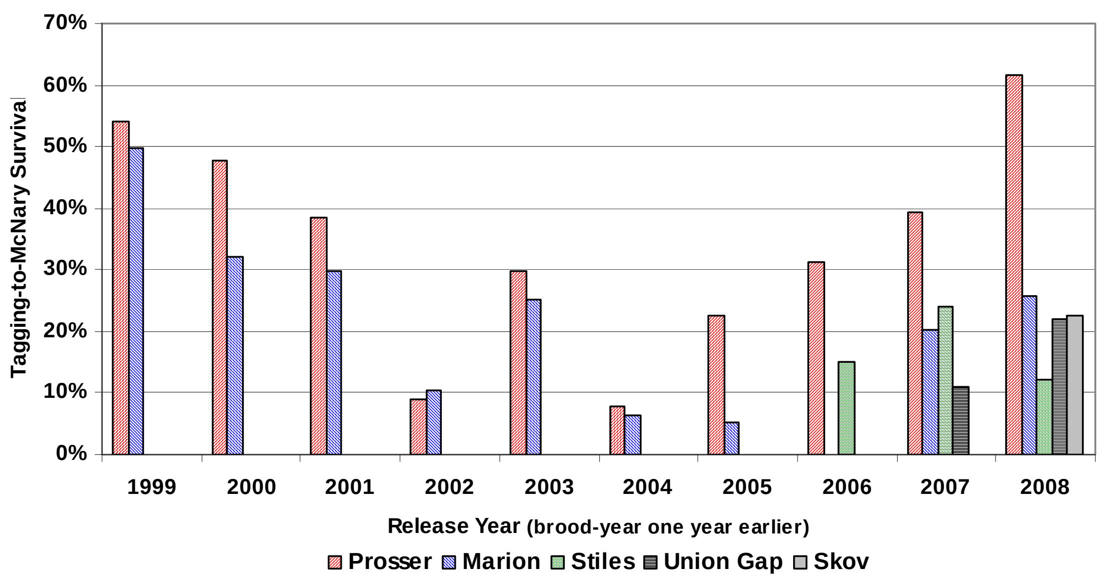
For the 2009 (BY2007) releases, we PIT tagged approximately 7,516 yearlings and 7,567 (BY2008) subyearlings. Analysis of juvenile survival for these releases will not be available until next year. However, the yearlings have had a higher number of "raw" detections at McNary Dam. The US Fish and Wildlife service began to implement a 100% marking requirement for the LWS fish using 10% CWT + AD clip and 100% AD only. We will not be using the AD clip mark for the future Yakima stock releases, including 2009.

For the LWS stock, Release-to-McNary survival was significantly higher under accelerated rearing than under conventional rearing (47.0 % versus 36.6% mean survivals respectively for accelerated and conventional, $P = 0.049$; D. Neeley, Appendix E). This is what we expected to see based on the same study that we did using our Yakima stock, in which the accelerated fish out-performed the conventional fish in 6 out of 7 release years. The LWS accelerated versus conventional experiment will not be repeated in the future due to a limited amount of PIT tags. We do plan to continue importing approximately 500,000 of the 1.7 million LWS fish as eyed eggs for accelerated rearing. The remaining 1.2 million fish will continue to come in as conventionally reared pre-smolts. We will PIT tag 4,000 of the accelerated fish to monitor smolt-survival to McNary Dam.

Historically, we have released fall run Chinook from Prosser Hatchery, Marion Drain, Stiles pond (lower Naches River), Billy's pond (Union Gap) and a one time release from Skov pond (Selah, WA). Fish released in 2008 (BY2007) were the last fall run Chinook to be released above Prosser Hatchery. Beginning with BY2008, we intend to release fall run Chinook at or below Prosser Hatchery. Broodstock will continue to be collected in the Marion Drain and their offspring will be directly released into the Marion Drain. Marion Drain fish will no longer be marked with PIT tags.

Brood year 2008 marked the beginning of a Yakama Nation initiative to restore summer run Chinook (NOAA Fisheries grouped summer and fall run Chinook together as part of the Upper Columbia River ESU) to the Yakima Basin (Task 1.f.2). Summer run Chinook (BY2008) were imported from Wells Hatchery as green eggs, incubated and reared at Prosser Hatchery with final acclimation rearing and release at Stiles pond. With the exception of the Marion Drain fall run fish, summer run Chinook will be the only fish acclimated and released above Prosser Hatchery in the future.

Figure 7. Historic Tagging-to-McNary Survivals of Fall Chinook from multi-year release sites in the Yakima Basin (D. Neeley, Appendix E).



Task 1.f.2 Yakima River Summer Run Chinook Monitoring & Evaluation

Rationale: To initiate investigation of the feasibility of re-establishing a summer run Chinook population in the Yakima River.

Method: The Yakama Nation imported approximately 200,000 green eggs and milt from an equal number of individual females and males from the Washington State Department of Fisheries Wells Hatchery in Pateros, WA. The YN in cooperation with Wells Hatchery staff spawned the fish at Wells Hatchery and transferred the eggs and milt to the Yakama Nation Prosser Hatchery in Prosser, WA. All of the individual females were tested for virus and BKD at Wells Hatchery. Pathology was conducted by the US Fish and Wildlife Service. Eggs from the individual females were fertilized at Prosser Hatchery using the imported milt from Wells Hatchery males. The individual lots of eggs were quarantined until fish health sampling results were confirmed negative. These BY2008 fish were incubated and reared to the sub-yearling stage entirely at Prosser Hatchery.

Progress: Pathology results for 100% of the females were clean and cleared for release. Incubation temperatures were kept below 49▪F to limit mortality resulting from coagulated yolk, a problem associated with this stock of fish at Wells Hatchery. These cooler temperatures resulted in low mortality, however growth was slow. Therefore coded-wire tagging did not occur until the first week of May with PIT tagging occurring into the second week. The 2009 brood will likely be incubated and reared at slightly warmer temperatures to increase growth and allow for earlier marking time and a longer acclimation period. Approximately, 180,911 summer run Chinook were transferred for final acclimation at Stiles Pond located at RM 3.4 on the lower Naches River. Fish were acclimated for approximately three to four weeks and volitionally released on June 12, 2009. Fish were 100% marked, with approximately 30,000 PIT and 150,911 CWT tags. Smolt-to-Adult survival will be monitored using PIT tag detections at both McNary and Prosser Dams.

Task 1.g Yakima River Coho Optimal Stock, Temporal, and Geographic Study

Objective: The ultimate goal of the Yakima coho reintroduction project is to determine whether adaptation and recolonization success is feasible and to reestablish sustainable populations in the wild.

Rationale: Determine the optimal locations, life stage, release timing, and brood source that will maximize opportunities to achieve the long-term objective. Monitor trends in returning adults (e.g., abundance of natural- and hatchery-origin returns, spawning distribution, return timing, age and size at return, etc.) to evaluate progress towards achieving objectives. Continue to investigate the coho life history in the Yakima Basin. Assess ecological interactions (see tasks under Objective 4). Develop and test use of additional culturing, acclimation, and monitoring sites.

By the middle 1980s, coho were extirpated from the Yakima Basin and large portions of the middle and upper Columbia River Basins. This project is attempting to restore some of this loss pursuant to mitigation and treaty trust obligations embodied in the NPCC FWP and *U.S. v Oregon* agreements. Questions regarding rates of naturalization for hatchery-origin fish allowed to spawn in the wild and integration of hatchery and natural populations have been identified as high priority research needs by the NPCC. Restoration of coho salmon to the Yakima Basin and other middle and upper Columbia River Basins is also consistent with stated ecosystem restoration goals in the FWP and subbasin plans. Monitoring and evaluation results will facilitate decision making regarding long-term facility needs for coho.

Method: ***Phase I (1999-2003)*** Phase I of the coho study was designed to collect some preliminary information relative to the project's long-term objective and to test for survival differences between: out-of-basin and local (Prosser Hatchery) brood sources; release location (acclimation sites in the upper Yakima and Naches sub basins); and early versus late release date (May 7 and May 31). Phase I has been completed and results are published:

> Bosch, W. J., T. H. Newsome, J. L. Dunnigan, J. D. Hubble, D. Neeley, D. T. Lind, D. E. Fast, L. L. Lamebull, and J. W. Blodgett. 2007. Evaluating the Feasibility of Reestablishing a Coho Salmon Population in the Yakima River, Washington. North American Journal of Fisheries Management 27:198-214.

Phase II (2004-2011) Implementation plans and guidance for phase II of the coho feasibility study are documented in the current coho master plan (Hubble et al. 2004). We are continuing to test survival from specific acclimation sites: Holmes and Boone ponds in the Upper Yakima and Lost Creek and Stiles ponds in the Naches subbasins. Each acclimation site releases fish from both local and out-of-basin brood sources and approximately 2,500

PIT tags represent each group at each acclimation site during the normal acclimation period of February through May. Acclimation sites have PIT tag detectors to evaluate fish movement during the late winter and early spring. Fish are released volitionally, beginning the first Monday of April. However, in an extreme drought emergency, project guidelines allow coho to be moved to acclimation sites earlier and forced out of acclimation sites in March. Up to 3,000 PIT-tagged coho (parr stage) are also planted into select tributaries during late summer to assess and monitor over winter survival and adults are also planted in select tributaries to assess spawning and rearing success.

Progress:

The program completed an interim phase (2004-2006) including necessary planning and environmental assessment work and moved to Phase II implementation activities in 2007. The 4 progressive goals of Phase I continue to be monitored in Phase II:

1. Increase juvenile survival out of the Yakima sub-basin (metric: smolt passage estimates at Chandler and estimated smolt survival from tagging and release to McNary Dam using PIT-tagged fish)
2. Increase natural production (metrics: dam counts and sampling, redd counts)
3. Continue to develop a local (Yakima Basin) coho brood stock
4. Increase smolt to adult return rates for both natural- and hatchery-origin coho (metric: Chandler juvenile and Prosser adult counts and sampling).

Estimated hatchery-origin coho smolt passage decreased in 2008, but redd counts increased dramatically due to tributary out-plants. Development of the local coho brood source continues and smolt-to-adult return rates are encouraging, especially for natural-origin coho. Redd surveys are showing increased spawning in areas above Wapato Dam. Radio telemetry has provided evidence of more adults using tributaries and venturing into new, unseeded areas, and some adult coho are returning to the furthest upriver acclimation sites (e.g., Lost Creek and Easton Acclimation Sites).

Phase II Goals

1. Monitor and evaluate juvenile coho survival in tributaries.
2. Monitor and assess overall spawning success in select tributaries.
3. Test and monitor possible new acclimation techniques.

4. Continue to advance to a 100% in basin (local brood source) coho program.

2008 Methods

The 2008 juvenile coho releases again tested in-basin vs. out of basin stocks within acclimation sites. Approximately, 2,500 pit tags (two 1,250 independent replicates) of each stock were put in each acclimation site, totaling 5,000 PIT tags per site (except Easton). Each acclimation site was fitted with multiple outlet PIT tag detectors. The fish were released volitionally on the first Monday in April. Adult returns were monitored at the Prosser Right Bank Alaskan Steep Pass Denil, Roza Dam and by radio tracking. Redd surveys were conducted from October through December in the maintsem Yakima and Naches Rivers as well as select tributaries.

2008 Results

Juvenile Survival

In 2008, dual PIT tag detectors were used at Prosser, Holmes, Lost Creek and Stiles to evaluate survival of PIT tagged coho from acclimation sites to McNary Dam. Using two detectors enabled significant gains in detection efficiency. Lost Creek and Stiles had tag detection efficiencies between 95% and 100%. The Holmes acclimation site had very few detections because of flooding and mechanical trouble. Prosser also had very few detections because of one power spike that shutdown the PIT tag readers and because large numbers of zero aged fall chinook were migrating at the same time severely impacting detection efficiency.

Survival estimates were calculated for the number of juvenile smolts that were PIT-tagged and released from the acclimation sites to passage at McNary Dam. Survival was greater for Naches subbasin releases than for upper Yakima River releases (Table 6). This was true for both out-of-basin (Eagle Creek NFH) and local brood source fish. Within the Naches subbasin, the Stiles Pond survival index was higher than Lost Creek. The Boone acclimation site was used in 2008, but had a relatively small release level and was not included in the analysis. Tagging-to-McNary Dam survival of smolts migrating in 2008 was greater at all upriver release sites when compared to 2007 migrant survival (D. Neeley, Appendix F). The mean estimated survival from tagging to McNary Dam passage over all 3 upriver release sites was about 29% for the Yakima (local) brood source compared to about 28% for Eagle Creek brood source smolts. There was no significant difference in release-year 2006 through 2008 tagging-to-McNary smolt-to-smolt survivals between the Eagle Creek and the Yakima (local) brood sources (P = 0.60; D. Neeley, Appendix F).

The pre-release survival (tagging to release) of the Eagle Creek brood-stock was significantly higher than that of the Yakima (local) brood-stock (P = 0.0008; D. Neeley, Appendix F), but the survival from detection at time of volitional release from acclimation sites to McNary passage was significantly lower for Eagle Creek brood source than for the Yakima (local) brood source (P = 0.0012; D. Neeley, Appendix F). The combined effects of the significantly higher pre-release survival and the significantly lower release-to-McNary survival of the Eagle Creek brood-stock probably contributed to the failure to detect a significant difference between the two brood sources' tagging-to-McNary survival which is a combination of pre-release and release-to-McNary survivals. These data may indicate differential tagging-induced mortality effects between the two brood sources. We intend to investigate this further in subsequent years. See Appendix F for a detailed report and analysis of coho juvenile survival indices for 2008 and prior year releases.

Table 6. Estimated percentage of 2008 smolts that were PIT-tagged and released from acclimation sites and survived to McNary Dam (tagging-to-McNary juvenile survival indices) by brood source and acclimation site (D. Neeley, Appendix F).

	Acclimation Site[1]			Pooled
Brood Source	Stiles	Lost Cr.	Holmes	Mean
Yakima (local)	46.6	28.6	11.2	28.8
Eagle Creek	43.1	26.8	13.9	27.8

[1] Boone pond was not used in the analysis for 2008 due to small number of releases.

Parr Releases

Summer Parr were released into tributaries throughout both the Upper Yakima and Naches basins. About 3,000 PIT-tagged parr were released in North Fork Little Naches, Cowiche Creek, Nile Creek, Wilson Creek, Reecer Creek, and Big Creek. The summer coho parr were approximately 70-85mm in length and were in excellent shape. The fish were scatter planted throughout each system. The coho were distributed using buckets with aerators. In addition, one last release of parr into Boone Pond was done to assess over winter release; however, instead of planting the pond in late July the release was done in mid October.

Appendix F gives estimated tagging to McNary survivals for parr releases from 2005 through 2008. Coho parr survival (tagging-to-McNary) has generally been good, with survival estimates close to or exceeding smolt survival estimates for some sites in some years. The highest tagging-to-McNary survival estimate at any site in any year was 31% in 2008 for parr released in July of 2007 into the lowest elevation tributary, Reecer Creek. South Fork Cowiche Creek also had excellent survival for July 2007 parr plants (2008 outmigrants) at nearly 30% estimated tagging-to-McNary smolt survival. Most other tributaries also had good survival (3-20 percent tagging-to-McNary smolt survival). We intend to use these data over the next 3 years to better target our tributary recovery efforts.

Adult Outplants

Adult Coho were out planted in Nile Creek, Cowiche Creek and Taneum Creek. Twenty pairs of coho were put into Nile and Cowiche Creeks in mid November. Approximately 300 adults were planted into 3 separate sections of Taneum Creek. Each section contained 50 males and 50 females. All adults were of unknown hatchery origin and collected off the right bank Steep Pass Denil at Prosser Dam. The fish were held until 300 adults were captured. Large 2,000 gallon fish hauling trucks were used to haul up to 50 adults at a time over a 3 day period. Spawning was initiated within days and continued for at least 4 weeks. All females in South Fork Cowiche Creek and Nile Creek were radio tagged. Spawning coho were observed within days of release, however flooding conditions blew out pvc racks and spread fish outside their designated areas in all 3 tributaries. Redd characteristics were measured in December.

The adults experienced very low mortality due to transportation and movement into the stream, however, adults did experience mortality from animals such as bear, bobcat and otter. Using radio tracking receivers, fish were located both before and after the floods. Coho were observed spawning in all 3 tributaries both before and after the floods. Nearly all female coho remained within feet of the original locations. A total of 10 redds were located in Nile Creek, 11 in S. Fork Cowiche Creek, and 55 in Taneum Creek for a total of 76 redds. These data are similar to 2007 observations when 6 redds were observed in Nile Creek, 4 in Cowiche Creek, and 75 in Taneum Creek. In 2008, Taneum Creek experienced very high flows (greater than 450 cfs), washing many fish out of designated reaches, affecting spawning activity, and our ability to locate redds.

The progeny of the 2007 Taneum Creek adult outplants were monitored in conjunction with the WDFW Ecological Interactions Team. Beginning in mid-summer (2008), sections of the Taneum system were electrofished to PIT-tag the natural-origin juvenile progeny of adult coho outplanted in 2007. Approximately 1,300 wild juvenile coho salmon were PIT-tagged. Condition of these juvenile coho fry was excellent. Juvenile survival estimates and adult return data for these fish will be available in 2009.

Aggregate smolt passage and smolt-to-adult survival rates (SAR)

Overall smolt passage at Prosser in 2008 was estimated at about 225,000 coho (adjusted from Chandler counts using PIT tag survival to McNary Dam). This compared to a range of 14,000 to 285,000 coho smolts for the 2002-2007 migration years. In 2008, the estimated smolt-to-adult survival rate for 9,420 wild/natural origin coho smolts (counted at CJMF in 2007) was 7.4%. The estimated smolt-to-adult survival rate for 284,898 hatchery coho smolts (counted at CJMF in 2007) from releases in the Upper Yakima and Naches Rivers was 1%.

The 2008 adult coho run was comprised of 665 wild/natural (14%) and 3,925 (86%) hatchery-origin adult coho which includes 3,225 over the Prosser Dam and an estimated 700 adults into the Prosser Hatchery swim-in trap. This was the eighth year this break down has been possible. The entire hatchery release group was 100% adipose fin clipped.

The upward trends in overall smolt passage have ultimately increased the returns of hatchery-origin adults since 2006. Beginning in 2007, the adults that were PIT-tagged and unmarked escaped back to the upper Columbia River at much higher Smolt to Adult (SAR) return rates than the remaining marked fish. This difference was observed again in 2008 and we expect it will continue for at least 2 more years. The ocean and river fisheries target adipose clipped fish, therefore our PIT-tagged, unmarked adults are not representing the general release groups that are 100% adipose clipped. In 2008, we estimated SAR's for adipose-clipped fish from the Lost Creek release groups of nearly 8% at Bonneville; this SAR drops dramatically at McNary to 6% then only 3% at Prosser (compared to an estimated SAR to Prosser of over 7% for unmarked, PIT-tagged fish). If all the coho released were unmarked, we estimate that adult returns to Prosser could regularly exceed 6,000 to 9,000 adults. Therefore, beginning in 2009 all coho releases from Yakima (local) brood source will be coded wire tagged but not adipose-clipped to minimize their harvest in selective fisheries. This strategy should work to accelerate the local brood source production program.

Results of 2008 Radio Telemetry Studies for Yakima Basin

For the 2008 adult migration season it was decided to only radio tag adult coho that had PIT tags from their juvenile migration. This would give managers much more information than randomly tagging large groups of coho. A total of 37 (20 hatchery-origin and 17 natural-origin) coho were radio tagged at the Prosser Dam denil ladder in the fall of 2008, each containing a juvenile PIT tag. Of the 20 hatchery-origin radio-tagged fish, only one hatchery-origin jack coho homed back to or near its acclimation area. This jack was a PIT-tagged coho parr released in Wilson Creek in the summer of 2007. The 17 natural-origin radio-tagged fish were all females. Of these fish, three ended up in the Naches River, 5 spawned in the Union Gap section of the main-stem Yakima River, 8 were either mortalities or regurgitated their tags and 1 spawned in the upper Yakima River.

Spawning Ground Observations

Since 1999 all smolts have been released in the Naches and the Upper Yakima Rivers, and in 1998 a portion of the smolts were released from Lost Creek in the Upper Naches River. Acclimation sites are now located in the Upper Yakima and Naches Rivers. While the majority of spawning continues to occur in sections of the mainstem Yakima River and in the lower Naches River, there is also increasing evidence that coho are establishing themselves in areas that were previously unused. In 2005, two redds and a wild female carcass was found in Nile Creek. In 2006, 30 redds were found in Cowiche Creek and 3 redds were found in Reecer Creek in the Upper Yakima River. In 2007, over 60 redds were found in Nelson Springs, Cowiche Creek had 10 redds, and coho were again found spawning at the Lost Creek acclimation site on the Naches River. In 2008, there where 9 redds found in Rock Creek, a tributary of the Naches River, 19 found in Lower Nile Creek, and at least half of the 60 redds observed in the Naches system were located above Wapatox Dam. In addition, 59 adults (the most ever observed near these ponds) were captured out of the Lost Creek Ponds and released back into the river to spawn. In the upper Yakima River (above Roza Dam), redd counts rose from the previous year of 56 to approximately, 76 in 2006 to 96 in 2007. In 2008, there were 49 redds found in the main-stem and 59 found in Reecer and Taneum Creeks. See task 1.j below for additional data on 2008 coho redd surveys.

Snorkel Surveys

Snorkel surveys to look for residualized juvenile coho were also conducted again in 2008. Surveys were conducted on the Upper Yakima River (Cle Elum Reach) from the Cle Elum Hatchery (Rkm 299) to the confluence of the Teanaway River (Rkm 283). In the Naches River (Lost Creek reach), surveys were done from the Lost Creek acclimation site (Rkm 61.8) to the confluence with Rock Creek (Rkm 53.9). A total of 1,500 meters of river was snorkeled in these surveys in 2005 and we found no incidence of age-0 precocials. There were significant numbers of sub yearling coho observed in the lower Naches River in 2008 surveys, indicating good natural production is occurring.

Personnel Acknowledgements: Special thanks to all the people involved in the coho monitoring and evaluation activities which also include redd surveys. These people include but are not limited to Joe Jay Pinkham III, Conan Northwind, Quincy Wallahee, Andrew Lewis, Denny Nagle, Nate Pinkham, Germaine Hart and Marlin Colfax. Also, thanks to the staff at the Prosser Fish Hatchery for their excellent fish culturing skills and year round cooperation. Ida Sohappy is the YKFP book keeper, Rachel Rounds is the NEPA representative for BPA, and Patricia Smith is the contracting officer and technical representative for BPA for this project.

Task 1.h Adult Salmonid Enumeration at Prosser Dam

Rationale: To estimate the total number of adult salmonids returning to the Yakima Basin by species (spring and fall chinook, coho and steelhead), including the estimated return of externally marked fish (i.e., adipose clipped fish). In addition, biotic and abiotic data are recorded for each fish run.

Methods: In the past, monitoring was accomplished through use of time-lapse video recorders (VHS) and a video camera located at each of the three fishways. The use of digital video recorders (DVR) and progressive scan cameras (to replace the VHS systems) was tested at each of the three Prosser fishways in 2007 and became fully functional in February of 2008. The new system functions very similarly to the VHS system but allows video data to be downloaded directly from the equipment at Prosser to the viewing stations in Toppenish. This new system also allows technicians in Toppenish to scan directly to images of fish giving a quicker and more accurate fish count. The technicians review the images and record various types of data for each fish that migrates upstream via the ladders. These images and information are entered into a Microsoft Access database, and daily dam count reports are regularly posted to the ykfp.org web site. Post-season, counts are reviewed and adjusted for data gaps and knowledge about adult and jack lengths from sampling activities. Historical final counts are posted to the ykfp.org and Data Access in Real-Time (DART) web sites.

Progress:

Spring Chinook (2008)

An estimated 8,059 spring Chinook passed upstream of Prosser Dam in 2008. The total adult count was 6,391 (79%) fish, while the jack count was 1,668 (21%) fish. Of the adult count, 3,264 were identified as hatchery origin. Returning hatchery adults this year comprised 4 and 5 year olds (brood years 2003 and 2004). The ratios of wild to hatchery fish were 49:51 and 30:70, for adults and jacks respectively. The 25%, 50% and 75% dates of cumulative passage were May 20, May 26 and June 6, respectively.

Fall Run (coho and fall chinook)

Coho (2008)

The estimated coho return to Prosser Dam was 5,699 fish. Adults comprised 68% and jacks 32% of the run. Of the estimated run, 37.1% were processed at the Denil and mark sampling there indicated the run was comprised of approximately 25.9% wild/natural and 74.1% hatchery-origin coho. The 25%, 50% and 75% dates of cumulative passage were October 2, October 17, and October 22, respectively.

Note that some coho return to the Yakima River but are not reflected in the Prosser counts. Some fish may have been harvested or spawned below Prosser Dam while others may have been falsely attracted into tributaries such as Spring Creek.

Fall Chinook (2008)

Estimated fall chinook passage at Prosser Dam was 2,863 fish. Adults comprised 95.7% of the run, and jacks 4.3%. Of the total number of fish, 306 were adipose clipped or otherwise identified as of definite hatchery-origin (272 adults and 34 jacks). The median passage date was October 7, while the 25% and 75% dates of cumulative passage were September 19 and October 20, respectively. Of the total fish estimate, 205 (7.2%) were counted at the Denil.

Steelhead (2007-08 run)

The estimated steelhead run was 3,310 fish. Of the total, 285 (8.6%) were adipose clipped fish, which were all out-of-basin strays (hatchery-origin steelhead have not been released in the Yakima River since the early 1990s). The median passage date was November 11th, 2007, while the 25% and 75% cumulative dates of passage were October 16th, 2007 and February 23rd, 2008 respectively.

Personnel Acknowledgements: Biologist Mike Berger, Data Manager Bill Bosch, and Fisheries Technicians Winna Switzler, Florence Wallahee and Sara Sohappy.

Task 1.i Adult Salmonid Enumeration and Broodstock Collection at Roza and Cowiche Dams.

Rationale: The purpose is to estimate the total number of adult salmonids returning to the upper Yakima Basin for spring and fall Chinook, coho and steelhead at Roza Dam, and for coho only into the Naches Basin at Cowiche Dam. This includes the count of externally marked fish (i.e., adipose clipped). In addition, biotic and abiotic data are recorded for each fish run.

Methods: Monitoring was accomplished through use of time-lapse video recorders (VHS) and a video camera located at each fishway. The videotapes are played back and various types of data are recorded for each fish that passes. Spring Chinook passing Roza Dam are virtually entirely enumerated through the Cle Elum Supplementation and Research Facility trap operation activity. Roza Dam in-season counts and historical final counts are posted to the ykfp.org and Data Access in Real-Time (DART) web sites.

Progress:

Roza Dam

Steelhead

A total of 169 steelhead were counted past Roza Dam for the 2007-08 run. As shown in Figure 8, most steelhead migrated past Roza Dam from February through early May of 2008.

Spring Chinook

At Roza Dam 5,478 (75% adults and 25% jacks) spring Chinook were counted at the adult facility between May 5 and September 4, 2008. The adult return was comprised of natural- (35%) and CESRF-origin (65%) fish. The jack return was comprised of natural- (18.7%) and CESRF-origin (81.3%) fish. Figure 9 shows spring Chinook passage timing at Roza in 2008.

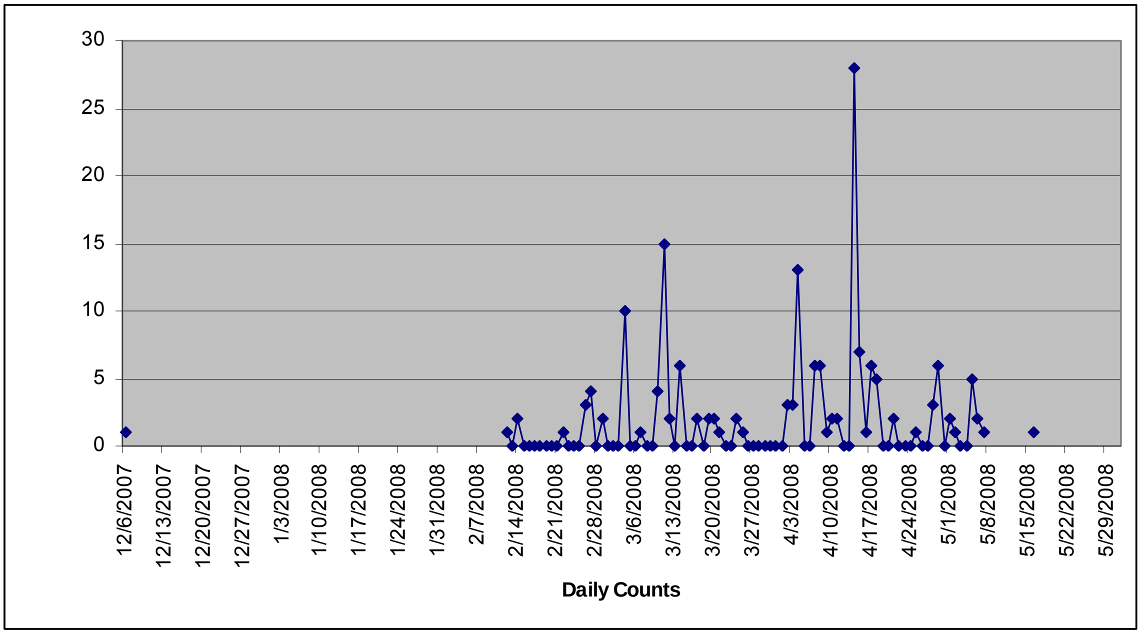


Figure 8. Daily steelhead passage at Roza Dam, 2007-08.

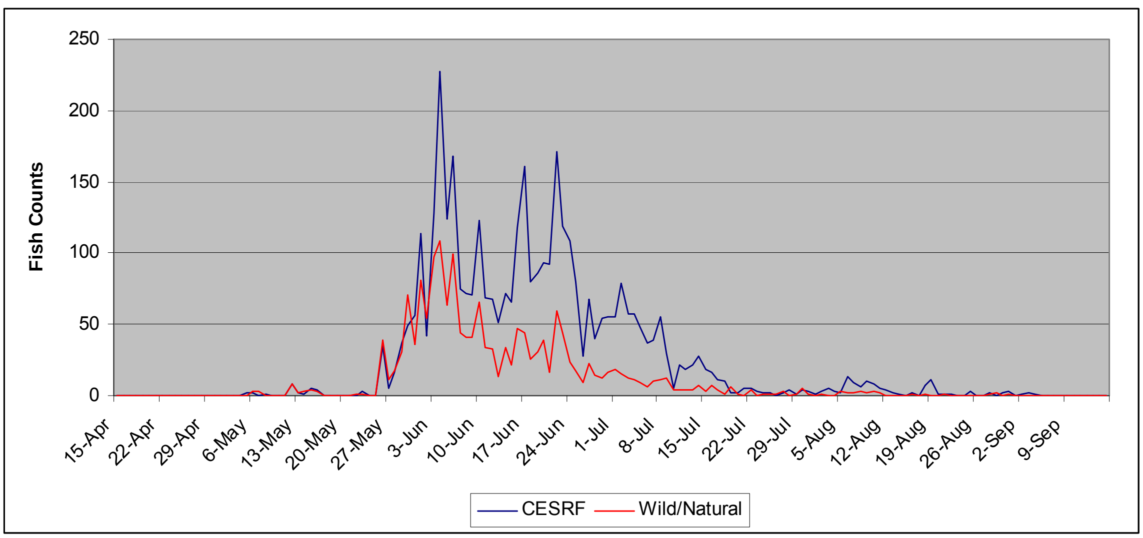


Figure 9. Daily passage counts for natural- and CESRF-origin spring Chinook at Roza Dam, 2008.

Coho

Video observations were conducted at Roza during the fall and winter months of 2008. However, due to debris and lighting problems in the video counting area no fish were observed.

Cowiche Dam

Coho

Video observations were not conducted at Cowiche Dam in 2008.

Task 1.j Spawning Ground Surveys (Redd Counts)

Rationale: Spawning ground surveys (redd counts): Monitor spatial and temporal redd distribution in the Yakima Subbasin (spring chinook, Marion Drain fall chinook, coho, Satus/Toppenish steelhead), and collect carcass data.

Methods: Regular foot and/or boat surveys were conducted within the established geographic range for each species (this is increasing for coho as acclimation sites are located upriver and as the run increases in size). Redds were individually marked during each survey and carcasses were sampled to collect-egg retention, scale sample, sex, body length and to check for possible experimental marks.

Progress: A summary of the spawning ground surveys by species are as follows.

Steelhead: The Yakama Nation conducted steelhead spawner surveys in Satus and Toppenish basins and Ahtanum Creek in the spring of 2009. Total redd counts by subbasin were as follows: Satus basin- 119 (3 passes), Toppenish basin- 79 (2 passes; except for the North Fork and mainstem Toppenish above the north fork—where we were only able to complete one pass), and Ahtanum Creek- 3 (1 pass). In addition, 2 redds were found in Harrah and Marion drains this year in 2 passes. For all three basins a total of 201 redds were counted. Survey conditions were typical for each watershed: poor to fair for Ahtanum and Toppenish and good for Satus.

Steelhead redd surveys in the Naches River system in the spring of 2009 were conducted jointly by the U.S. Forest Service and the Washington Dept. of Fish and Wildlife. Because of high flows in the Little Naches River drainage and other streams, survey coverage was again limited to 2 passes each on Nile and Oak Creeks. Twenty (20) redds were observed in Nile Creek and nine (9) redds were observed in Oak Creek during these surveys (G. Toretta, USFS, personal communication). Historical steelhead redd count and Prosser and Roza escapement data can be obtained at http://www.ykfp.org/.

Spring Chinook: Redd counts began in late July 2008 in the American River and ended in early October 2008 in the upper Yakima River. Total counts for the American, Bumping, Little Naches, Naches, and Rattlesnake rivers were respectively: 158, 102, 70, 158, and 7 redds. Redd counts in the upper Yakima, Teanaway and the Cle Elum rivers were: 1191, 47, and 137, respectively. The entire Yakima basin had a total of 1,870 redds (Naches- 495 redds, upper Yakima- 1,375). Historical spring Chinook redd count data are provided in Appendix A.

Fall Chinook: Redd counts in the Yakima River Basin above Prosser Dam began in mid-September and ended in late November. The river was divided into sections and surveyed every 7-10 days via raft or foot. Redd distribution for the Yakima, Naches, and Marion Drain was as follows:

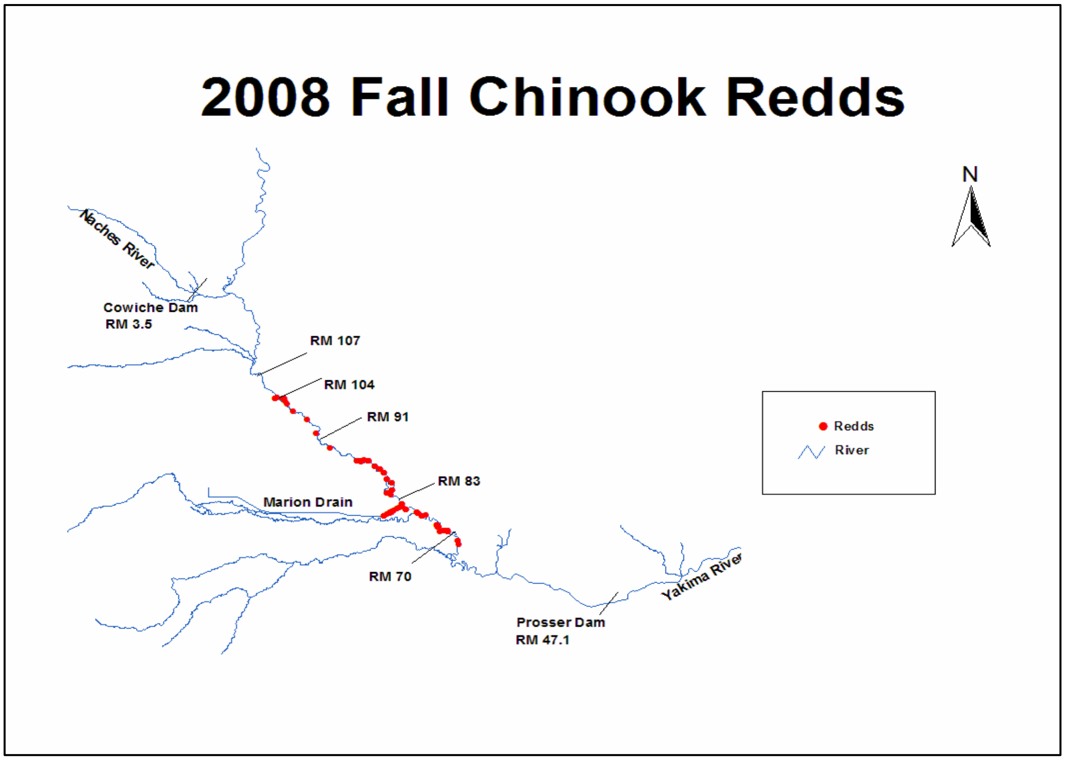
Yakima R.: 201 redds. All redds were located between RM 70 and RM 100.3 with 46.8% located between RM 70 and 83, 47.2% located between RM 83 and 91, and 6% located between RM 91 and 100.3.

Naches R.: 0 redds. Surveys were conducted from Wapatox Dam to the mouth of the river.

Marion Drain: 46 redds. 17.4% of the redds were located above Hwy 97 up to Old Goldendale Road. The remaining 82.6% were located below Hwy 97 down to the Hwy 22 bridge.

Historical fall Chinook redd count data can be obtained at http://www.ykfp.org/.

Figure 10. Distribution of fall Chinook redds in the Yakima River Basin in 2008.



Coho: Surveys began the third week of October and ended in late December. Redd surveys were conducted daily in conjunction with fall Chinook surveys. The Yakima and Naches Rivers are broken into sections that are checked by boat or ground surveys. Winter freshets and weather only hindered spawning surveys after the first week of November. The 2008 coho redd count was the highest the YN has recorded.

Table 7. Yakima Basin Coho Redd Counts, 1998-2008.

River	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Yakima River	53	104	142	27	4	32	78	107	109	63	49
Naches River	6	NA	137	95	23	56	87	72	44	87	60
Tributaries	193	62	67	29	16	21	92	93	99	153	242
Total	252	166	346	151	43	109	257	272	252	303	351

One of the overall goals of Phase II is to evaluate the transition of redds from the maintsem river into historic tributaries. With the beginning of Phase II of the Coho Program we have observed large increases in tributary spawning. Since 2004, tributary spawning has averaged close to 100 redds (Table 7). Many redds were located intermixed with fall chinook redds, tucked under cut banks and/or were found in many side channels. Tributary redd enumeration and identification continues to be accurate due to the fall low water levels, improving interagency cooperation and relatively good weather. Figure 11 shows the distribution of coho redds through the Yakima Basin in 2007 and 2008. Figure 12 shows the increasing proportion of redds located in tributaries.

Figure 11. Distribution of coho redds in the Yakima River Basin, 2007-08.

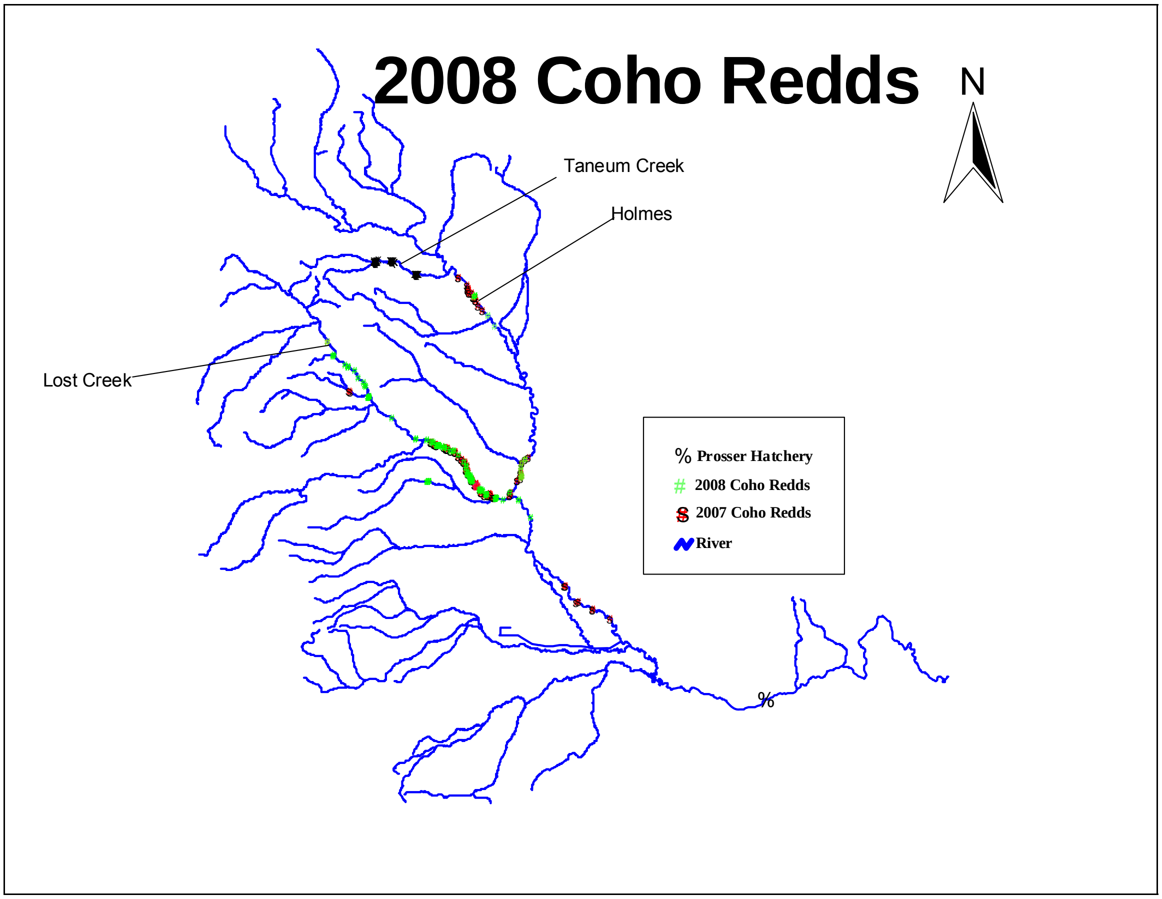
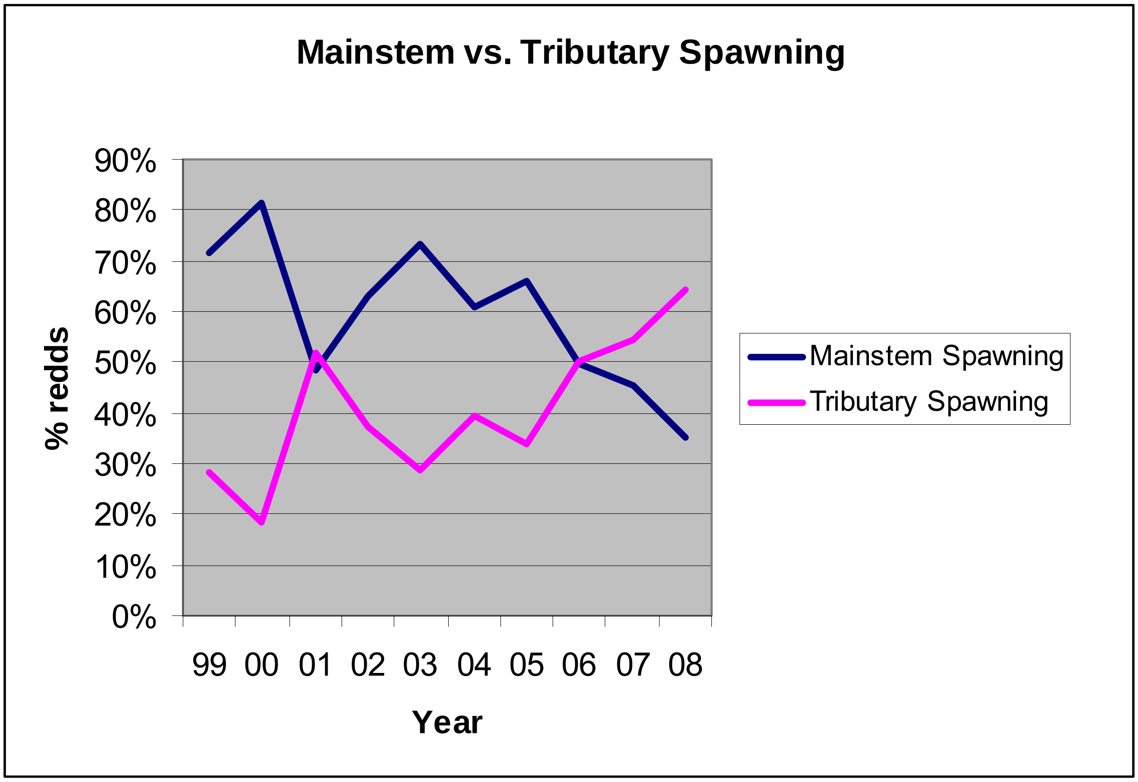


Figure 12. Proportion of coho redds in the Yakima River Basin that were located in mainstem versus tributary spawning areas, 1999-2008.



Task 1.k Yakima Spring Chinook Residual/Precocial Studies

The WDFW annual report for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications/ . This year's report is expected to be available soon. The most recent report is:

Pearsons, T. N., C. L. Johnson, and G. M. Temple. 2008. Spring Chinook Salmon Interactions Indices and Residual/Precocious Male Monitoring in the Upper Yakima Basin; Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Annual Report 2007. DOE/BP-00034450.

Task 1.1 Yakima River Relative Hatchery/Wild Spring Chinook Reproductive Success

The latest information on these studies are available on the BPA website: http://www.efw.bpa.gov/searchpublications/ and in:

Schroder, S. L., C.M. Knudsen, T. N. Pearsons, T. W. Kassler, S. F. Young, E.

P. Beall, and D. E. Fast. 2009. Breeding success of four male life history types in spring Chinook salmon spawning under quasi-natural conditions. Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Annual Report, June 2009.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, S. F. Young, T. W. Kassler, D. E. Fast, and B. D. Watson. 2006. Comparing the Reproductive Success of Yakima River Hatchery- and Wild-Origin Spring Chinook. Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2005. BPA Report DOE/BP-00022370-3.

Knudsen, C.M., S.L. Schroder, C. Busack, M.V. Johnston, T.N. Pearsons, and C.R. Strom. 2008. Comparison of Female Reproductive Traits and Progeny of First-Generation Hatchery and Wild Upper Yakima River Spring Chinook Salmon. Transactions of the American Fisheries Society 137:1433-1445.

Schroder, S. L., C. M. Knudsen, T. N. Pearsons, T. W. Kassler, S. F. Young, C. A. Busack, and D. E. Fast. 2008. Breeding Success of Wild and First-Generation Hatchery Female Spring Chinook Salmon Spawning in an Artificial Stream. Transactions of the American Fisheries Society, 137:1475-1489.

Task 1.m Scale Analysis

Rationale: Determine age and stock composition of juvenile and adult salmonid stocks in the Yakima basin.

Methods: Random scale samples are collected at broodstock collection sites (Prosser and Roza dams and Chandler Canal) and from spawner surveys. Acetate impressions are made from scale samples and then are read for age and stock type using a microfiche reader. Data are entered into the YKFP database maintained by the Data Management staff.

Progress: Juvenile scale sample results for 2008 were not available at the time this report was produced. Available adult scale sample results for 2008 are summarized in Table 8 by species and sampling method. Historical data from age and length sampling activities of adult spring Chinook in the Yakima Basin are presented in Appendix A.

Table 8. Age composition of salmonid adults sampled in the Yakima Basin in 2008.

	Age 2		Age 3		Age 4		Age 5	
	Count	Length	Count	Length	Count	Length	Count	Length
Yakima R. Spring Chinook								
Roza Dam Samples								
Upper Yakima Supplementation	11	15.4	95	45.0	251	60.3	1	67.0
Upper Yakima Wild/Natural			38	45.8	394	61.0	16	70.8
Spawner Survey Samples								
Upper Yakima Supplementation	No data were available at the time this report was produced.							
Upper Yakima Wild/Natural								
American River Wild/Natural					7	67.4	59	80.5
Naches River Wild/Natural			4	42.0	25	61.5	5	79.8
Yakima R. Fall Chinook								
Hatchery	No data were available at the time this report was produced.							
Wild/Natural								
Yakima R. Coho								
Hatchery								
Wild/Natural								

Note: Yak. SpCh Lengths are average post-eye to hypural plate length.
Yak. FaCh/Coho lengths are average mid-eye to hypural plate lengths from denil trap sampling.

Task 1.n Habitat inventory, aerial videos and ground truthing

Rationale: Measure critical environmental variables by analyzing data extracted from aerial videos and verified by ground observations. These data are critical to validating EDT and AHA model outputs which are used to guide Project decisions.

Methods: Aerial videos of the Yakima Subbasin will be conducted and analyzed. The habitat conditions (e.g. area of "watered" side channels, LWD, pool/riffle ratio, etc.) from the videos will be checked by dispatching technicians to specific areas to verify that conditions are in fact as they appear on video.

Progress: No ground survey work was conducted in fiscal year 2008.

Task 1.o Sediment Impacts on Habitat

Rationale: To monitor stream sediment loads associated with the operation of dams and other anthropogenic factors (e.g. logging, agriculture and road building) which can affect survival of salmonids in the Yakima Basin.

Methods: Representative gravel samples were collected from various reaches in the Little Naches, South Fork Tieton, and Upper Yakima Rivers in the fall of 2008. Each sample was analyzed to estimate the percentage of fine or small particles present (<0.85 mm). The Washington State TFW program guidelines on sediments were used to specify the impacts that estimated sedimentation levels have had on salmonid egg-to-smolt survival. These impacts will be incorporated in analyses of impacts of "extrinsic" factors on natural production.

Progress:

<u>Little Naches</u>

A total of 120 samples were collected and processed from the Little Naches drainage this past year (10 reaches, 120 samples). All of the regular sites in the Little Naches were sampled. With this year's monitoring work, the data set for the Little Naches drainage now covers a time period of 24 years for the two historical reaches, and 17 years for the expanded sampling area that includes several tributary streams.

The average percent fine sediment less than 0.85mm for the entire Little Naches drainage was reduced (cumulative average of 10.6%) compared to the prior five years when overall fine sediment conditions in the Little Naches drainage were stable and just under 12% fines (Figure 13). The relatively low level of fine sediment found in spawning substrate is encouraging and should minimize mortality on incubating eggs and alevins.

The factors affecting spawning gravel conditions in the Little Naches are not completely understood, but some activities probably have had an effect. In the early 1990's, overall average fine sediment levels in the Little Naches were quite high and peaked at 19.7% fines in 1993. At that time, a considerable amount of road building and timber harvest was taking place in the upper portions of the drainage. Due to the high level of fine sediment found in spawning substrate, significant road improvement, abandonment and drainage work was accomplished by landowners in 1994 and 1995. In addition, the Northwest Forest Plan (1994) and the Plum Creek Habitat Conservation Plan (1996) initiated greater stream and riparian protection measures during this time period. From 1995 through 2001 fine sediment levels dropped and remained relatively constant at about 14-15.5% average overall fines in the spawning substrate. Overall average fine sediment levels in the Little Naches declined further to approximately 11.5-13% from 2002-2007, and to 10.6% in 2008. The improved spawning conditions may be attributed to factors such as: sediment abatement work on roads and trails, better logging practices, reduced precipitation and stream flows, and/or forest re-growth in previously harvested areas. These factors and others need to be further evaluated to determine how much they have contributed to or deterred fine sediment delivery, and ultimately their effect on observed spawning conditions.

At the reach scale, several of the sampling sites had relatively similar results to those in 2007. Five, or half, of the sampling reaches had comparable average fine sediment conditions between 2008 and 2007, with 1.0% point difference or less (Little Naches Reach 2, Little Naches Reach 3, Bear Creek Reach 2, Little Naches Reach 4, and North Fork Reach 2). The remaining five reaches had greater than a 1.0% point decrease in average fines from the previous year (Little Naches Reach 1, South Fork Reach 1, Bear Creek Reach 1, North Fork Reach 1, and Pyramid Reach 1). Of note, 4 out of these 5 reaches experiencing reduced sediment had more than a 2.0% point drop compared to 2007. Overall sampling variability within reaches decreased slightly in 2008. Three of the reaches had a lower standard deviation, six reaches had a similar standard deviation, and one reach had a higher standard deviation than in 2007.

Monitoring information from individual reaches can sometimes help identify site-specific sediment conditions or factors. This past year though, most of the reaches had relatively similar fine sediment conditions in the range between 9.1 to 11.6%. The one exception was Bear Creek Reach 2 that had an average fine sediment level of 13.4%. This upper reach on the West Fork of Bear Creek may be receiving additional fine sediment from a few sources. One apparent sediment source is an illegal OHV/Jeep trail that has been pioneered through a tributary stream to the West Fork. This trail around the 780 road gate has caused considerable mud and sediment delivery to the stream, as well as bank damage. Other possible sediment sources could be the 943 dirt bike trail that runs along much of the West Fork, and some additional new logging in the watershed.

A review of the data from the two historical reaches (Little Naches Reach 1 and North Fork Reach 1) provides a greater time period of record for assessing sediment trends in the drainage. Sampling began on these two reaches in 1985. In the early years of 1985-1986 average fine sediment levels were fairly low (8-10%). From 1987 until 1993, reach average fine sediment increased dramatically up to about 19-20%. Considerable road building and timber harvest activity was taking place in this time frame. The Falls Creek Fire also occurred during this period (1988) and burned substantial portions of the North Fork, Pyramid, and Blowout Creek sub-watersheds. After 1993, the fine sediment levels receded for two or three years at these historical sampling reaches, before moving back up. From 1998 through 2001 the rate of fine sediment in these two reaches remained relatively constant between 16 and 18 percent for reach average fines. The last several years the average percentage of fine sediment declined to a range of 11-13%. This year the average fine sediment levels in these two reaches were comparable to the previous few years (10.5% at Little Naches Reach 1 and 11.4% at North Fork Reach 1).

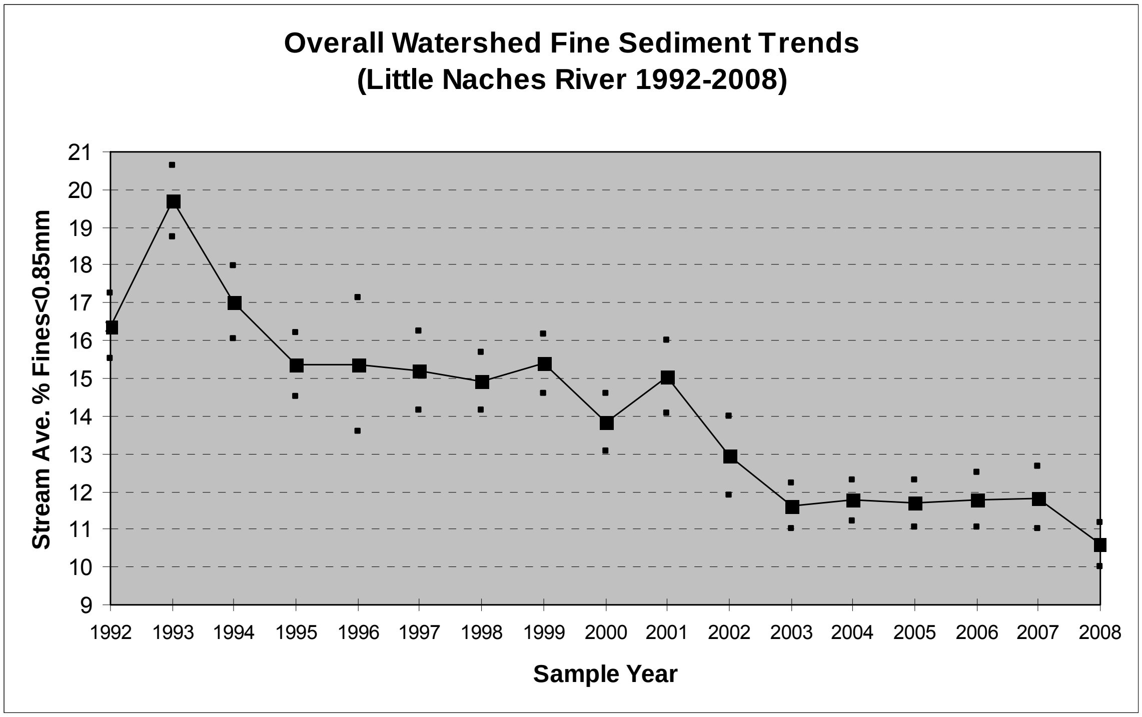


Figure 13. Overall Fine Sediment (<0.85mm) Trends with 95% confidence bounds in the Little Naches River Drainage, 1991-2008.

South Fork Tieton

One reach on the South Fork Tieton River (in the vicinity of Minnie Meadows) was sampled again this past season by the U.S. Forest Service. Credit goes to the Forest Service for their continued efforts to collect data in other drainages outside the Little Naches River. This stream reach typically receives considerable bull trout spawning activity and the sampling provides additional information on spawning conditions. Average fine sediment levels in this reach dropped to 11.2% in 2008. The reduced fines should increase the survival rate of bull trout eggs and alevins, although the percentage of fine sediment is still higher than observed in 1999.

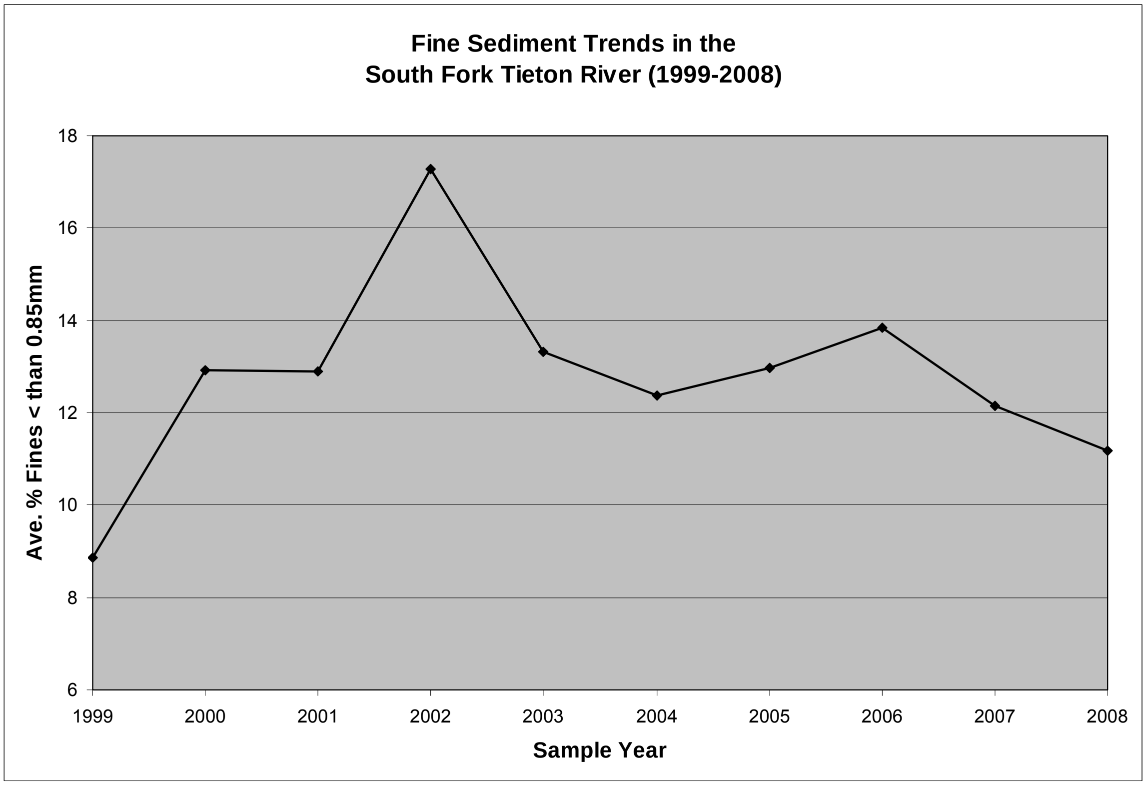


Figure 14. Fine Sediment Trends in the South Fork Tieton River, 1999-2008. Note: 2007 Year Data only contains data collected from 1 Riffle.

<u>Upper Yakima</u>

A total of 60 samples were collected and processed from the Upper Yakima River drainage this past year (5 reaches, 12 samples from each reach). The same reaches (Stampede Pass, Easton, Camelot to Ensign Ranch, Elk Meadows, and Cle Elum) have been sampled annually for the past 12 years. With the exception of the Stampede Pass reach, average percent fine sediment less than 0.85mm by reach and for the combined Upper Yakima drainage was higher than the average observed over the twelve years of sampling (Figure 15).

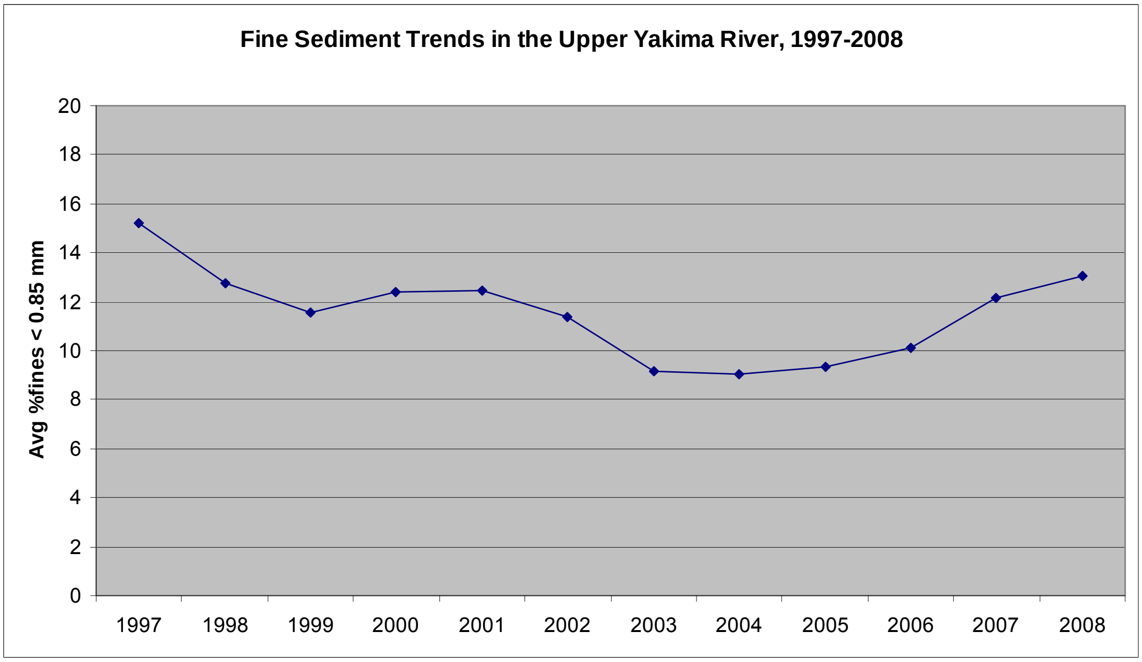


Figure 15. Overall average percent fine sediment (< 0.85 mm) in spawning gravels of the Upper Yakima River, 1997-2008.

<u>Summary</u>

The overall average fine sediment level in the Little Naches this past season was lower than in previous four years. Overall average fine sediment in 2008 was 10.6%. This marks the lowest overall fine sediment in the watershed since sampling was expanded in 1992. These conditions should favor salmonid spawning success. However, the overall fine sediment rate in the Little Naches is still somewhat higher than observed in a neighboring, unmanaged watershed (American River). Sediment monitoring work in the Little Naches should be continued to make sure productive spawning conditions are maintained and improved.

The results of the USFS sampling in the South Fork Tieton River were also encouraging Reach average fines in the South Fork dropped to 11.2% in 2008. The latest decline in fine sediment should improve bull trout spawning success. For the Upper Yakima system, overall average fine sediment in 2008 was 13.0% compared to an average of 11.6% for all 12 years of sampling data.

Fine sediment sources and their causes should continue to be investigated, identified and addressed in all drainages. At the present time the amount of fine sediment being delivered from individual sources is not completely understood. Sediment sources such as dispersed camping sites and off road vehicle activities near streams, stream-adjacent roads, road crossings, timber harvest activities, bank erosion, and unstable slopes need to be assessed to determine their influence or impact on spawning conditions.

Detailed field data including additional tables and graphs for samples collected in the upper Yakima and Naches basins can be obtained from Jim Mathews, fisheries biologist for the Yakama Nation (jmatthews@yakama.com).

Personnel Acknowledgements: Credit needs to go to all parties involved with this last year's sampling effort. The U.S. Forest Service staff collected all the samples from the upper South Fork Tieton River this past season. Fisheries technicians from the Yakama Nation did another great job coring the samples from the Little Naches and processing all the samples this winter.

Task 1.p Biometrical Support

Doug Neeley of International Statistical Training and Technical Services (IntSTATS) was contracted by the YKFP to conduct the following statistical analyses:

- Comparison of Different Feed Treatments on Smolt-to-Smolt Survivals and Mini-Jack Percentages of Upper Yakima Spring Chinook for Brood-Years 2002-2006 from Naturally Spawned Parents (Appendix B)

- Annual Report: Comparisons between Smolt Measures of Hatchery x Hatchery- and Natural x Natural-Brood Stock from Upper Yakima Spring Chinook for Brood-Years 2002-2006 (Appendix C)

- Annual Report: Smolt Survival to McNary Dam of Year-2008 Spring Chinook Releases at Roza Dam (Appendix D)

- 2008 Annual Report: Smolt-to-smolt Survival to McNary Dam of Main-stem Yakima Fall Chinook (Appendix E)

- Annual Report: 2006-2008 Coho Smolt-to-smolt Survival of Eagle Creek and Yakima Brood Releases into the Yakima Basin (Appendix F)

All of these reports are attached to this YKFP M&E annual report as appendices as noted above, and summaries of results have been incorporated within the appropriate M&E task.

HARVEST

Task 2.a Out-of-basin Harvest Monitoring

Rationale: Estimate harvest of hatchery- and natural-origin anadromous salmonids outside of the Yakima Subbasin.

Method: Monitor recoveries of CWTs and PIT tags in out-of-basin fisheries using queries of regional RMIS and PTAGIS databases. Coordinate with agencies responsible for harvest management (WDFW, ODFW, USFWS, CRITFC, etc.) to estimate the harvest of target stocks.

Progress: Additional detail about methods used to evaluate harvest of Yakima Basin spring Chinook in Columbia Basin and marine fisheries is given in Appendix A. Historical results of this evaluation including results for the present year are given in Tables 45 and 46 of Appendix A.

Task 2.b Yakima Subbasin Harvest Monitoring

Rationale: Estimate harvest of hatchery- and natural-origin anadromous salmonids within the Yakima Subbasin. Harvest monitoring is a critical element of project evaluation. Harvest data are also important for deriving overall smolt-to-adult survival estimates of hatchery- and natural-origin fish.

Method: The two co-managers, Yakama Nation and WDFW, are responsible for monitoring their respective fisheries in the Yakima River. Each agency employs fish monitors dedicated to creel surveys and/or fisher interviews at the most utilized fishing locations and/or boat ramps. From these surveys, standard techniques are employed to expand fishery sample data for total effort and open areas and times to derive total harvest estimates. Fish are interrogated for various marks. This information is used along with other adult contribution data (i.e. broodstock, dam counts, spawner ground surveys) to determine overall project success.

Progress: Yakima River in-basin Tribal harvest for salmon and steelhead are presented in Table 9.

Personnel Acknowledgements: Data Manager Bill Bosch, biologists Mark Johnston and Roger Dick Jr., and Fisheries Technicians Steve Blodgett and Arnold Barney.

Table 9. A summary of Yakama Nation tributary estimated harvest in the Yakima Subbasin, 2008.

River	Dates	Weekly Schedule	Notes	Chinook	Jacks	Steelhead	Coho
Yakima River	4/8-6/28	Noon Tues to 6 PM Saturday		1,229	304	0	0
Yakima River	9/16-11/22	Noon Tues to 6 PM Saturday		0	0	0	0

GENETICS

Overall Objective: Monitor and evaluate genetic change due to domestication and potential genetic change due to in-basin and out-of-basin stray rates.

Progress: All Tasks within this Section are assigned to WDFW and are reported in written progress reports submitted to BPA. These tasks are the following:

- Task 3.a Yakima spring Chinook domestication.
- Task 3.b Stray recovery on Naches and American river spawning grounds.

The WDFW annual report for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications/. This year's report is expected to be available soon. The most recent report is:

Blankenship, S., C. Busack, A. Fritts, D. Hawkins, T. Kassler, T. Pearsons, S. Schroder, J. Von Bargen, C. Knudsen, W. Bosch, D. Fast, M. Johnston, and D. Lind. 2008. Yakima/Klickitat Fisheries Project Genetic Studies, Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2007. Project No. 1995-063-25; BPA Report DOE/BP-00034450.

ECOLOGICAL INTERACTIONS

Overall Objective: Monitor and evaluate ecological impacts of supplementation on non-target taxa, and impacts of strong interactor taxa on productivity of targeted stocks.

Task 4.a Avian Predation Index

Rationale: Monitor, evaluate, and index the impact of avian predation on annual salmon and steelhead smolt production in the Yakima Subbasin. Avian predators are capable of significantly depressing smolt production and accurate methods of indexing avian predation across years have been developed. The loss of wild spring Chinook salmon juveniles to various types of avian predators has long been suspected as a significant constraint on production and could limit the success of supplementation. The index consists of two main components: 1) an index of bird abundance along sample reaches of the Yakima River and 2) an index of consumption along both sample reaches and at key dam and bypass locations (called hotspots). Due to a major shift in the major avian predator, first observed in 2003, from Ring-Billed and California Gulls (*Larus delawarensis* and *L. californicus*) to American White Pelican (*Pelecanus erythrorhynchos*) in the lower Yakima River, changes in piscivorous predation have occurred and warrant further study to quantify consumption rates of salmonids and other preferred prey species.

Methods: The methods used to monitor avian predation on the Yakima River in 2008 were consistent with the techniques used in 2001-2007. Consumption by gulls at hotspots was based on direct observations of gull foraging success and modeled abundance. Consumption by pelicans and all other piscivorous birds on river reaches and hotspots were estimated using published dietary requirements and modeled abundance. Seasonal patterns of avian piscivore abundance were identified, diurnal patterns of gull and pelican abundance at hotspots were identified, and predation indices were calculated for hotspots and river reaches for the spring and summer. In addition three aerial surveys for pelicans were conducted on the lower Yakima River from Union Gap to the mouth of the Columbia River.

A new method was also instituted in 2006 and continued in 2007-08: Pelican, Double-crested Cormorant, Great Blue Heron and Common Merganser roosting and nesting sites were examined for the presence of salmon PIT tags in August and September. Sites surveyed included the Roza recreation site gravel bar, cormorant and heron rookeries along the Yakima River near Selah, areas near the Selah gravel ponds (both pond islands and a gravel bar in the Yakima River itself), and the Chandler pipe outfall. In 2006 and 2008, cormorant and heron rookeries at Satus Wildlife Management Area on the Yakama Reservation were also surveyed.

Details of survey, analytical methods and results can be found in Appendix G of this annual report.

Progress (Executive Summary, see Appendix G for additional detail, tables and figures):

Gull numbers remain low in the Yakima River Basin and the focus of future studies has shifted towards; Pelican numbers and diet, management of extreme numbers of piscivorous birds in given areas, and surveys of PIT tags where mortality can be linked to predation.

Mergansers on their breeding grounds in the upper and middle Yakima River have not shown a numeric response to hatchery supplementation of spring Chinook and Coho salmon smolts yet remain a concern as they are known to congregate in large numbers below Roza Dam.

Pelican numbers remain a concern as in previous years. Aerial surveys in 2008 showed that pelican numbers peaked at near 280 birds in the Yakima Basin. Pelican numbers at Chandler were only consistently high after smolt passage was largely complete and flows returned to a forgeable level. High numbers of pelicans in Yakima Canyon in spring appeared to correlate with sucker runs. New data of Pelican diet is presented and Pelican impact on salmon runs will be proposed for a diet and site use study at Chandler.

The Chandler Bypass outfall pipe makes fish of all species vulnerable to predation at low water, as the fish are disoriented and upwelling occurs at right angles to the current. The presence of large dead and disabled fish exiting from the bypass pipe may attract avian predators to the site. PIT tag detection at Chandler outlet pipe did show high mortality for both juvenile and adult salmonids (see Appendix K of Appendix G).

PIT tag surveys in 2008 proved very productive as over 4100 tags were discovered in the Yakima Basin. Tags detected were linked to sources of release and 4022 of these tags were from Yakima River juvenile salmonids. Predation by Herons showed correlation with river flow. High flow eliminates opportunity for wading bird foraging in many parts of the river. Conversely low flow creates foraging opportunities for Herons.

PIT tag survey of Toppenish Creek Great Blue Heron rookery showed predation increases when juvenile salmonids have late migration timing.

Plans for the 2009 field season include continued monitoring of river reaches and at hotspots with a focus on Pelican foraging. Heron rookeries and cormorant nesting colonies will continue to be surveyed. PIT tags found at pelican, heron nesting and roosting sites will be used to assign smolt predation estimates to specific bird species.

PIT tag analysis will continue to develop and new sites will be added to surveys. Detection efficiencies will be conducted in 3 diverse rookeries to assess a number of undetected PIT tags.

Personnel Acknowledgements: Michael Porter served as the project biologist for this task. Sara Sohappy and Ted Martin collected the majority of the field data for this project. Dave Lind, Bill Bosch and Chris Fredrickson contributed to the analysis. Some photographs were taken by Ann Stephenson. Paul Huffman supplied the maps. Bird surveys at smolt acclimation ponds were conducted by Farrell Aleck, Marlin Colfax, Nate Pinkham, William Manuel, Terrance Compo and Levi Piel.

Task 4.b Fish Predation Index

Rationale: Monitor, evaluate, and index impact of piscivorous fish on annual smolt production of Yakima Subbasin salmon and steelhead. Fish predators are capable of significantly depressing smolt production. By indexing the mortality rate of upper Yakima spring chinook attributable to piscivorous fish in the lower Yakima River, the contribution of in-basin predation to fluctuations in hatchery and wild smolt-to-adult survival rate can be deduced.

Methods: Monthly mark-recapture Northern pikeminnow (NPM, *Ptychocheilus oregonensis*) population estimates are attempted from March through June at Selah Gap to Union Gap (Section 1-4), Parker Dam to Toppenish (Sections 5-8), and Toppenish to Granger (Sections 9-13). Transects were adjusted to 1 mile sections separated by 2 mile gaps at start of the 2006 season (Figure 16). We sampled the entire transect for presence of NPM. No pit tags were used, only fin clips for visual identification of recaptures was applied. The less invasive marking technique was employed to improve survival and increase the possibility of recapture. Sampling transects was much more efficient this way.

In addition to population estimates, stomach samples were collected from every 5^{th} fish greater than 200 cm in fork length within the transects. NPM stomachs with fish present were further analyzed to determine the number and types of species consumed. This analysis was performed using diagnostic bones which allows determination of species (though for salmonids this is more difficult) and approximate body length.

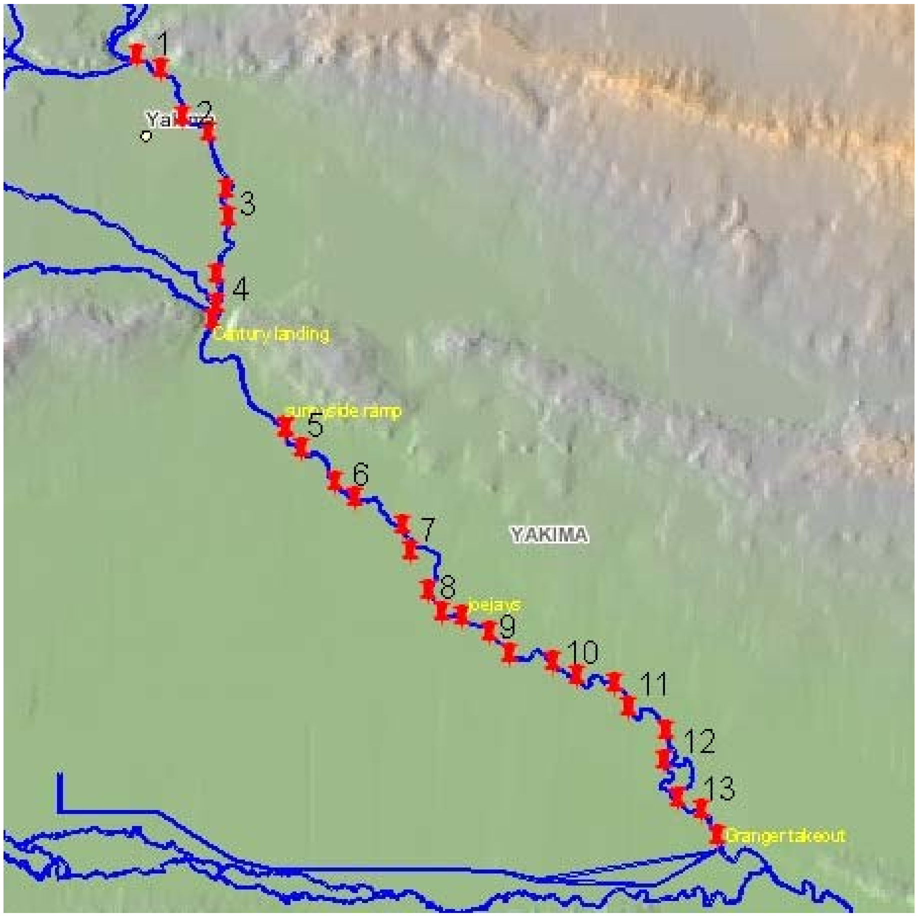
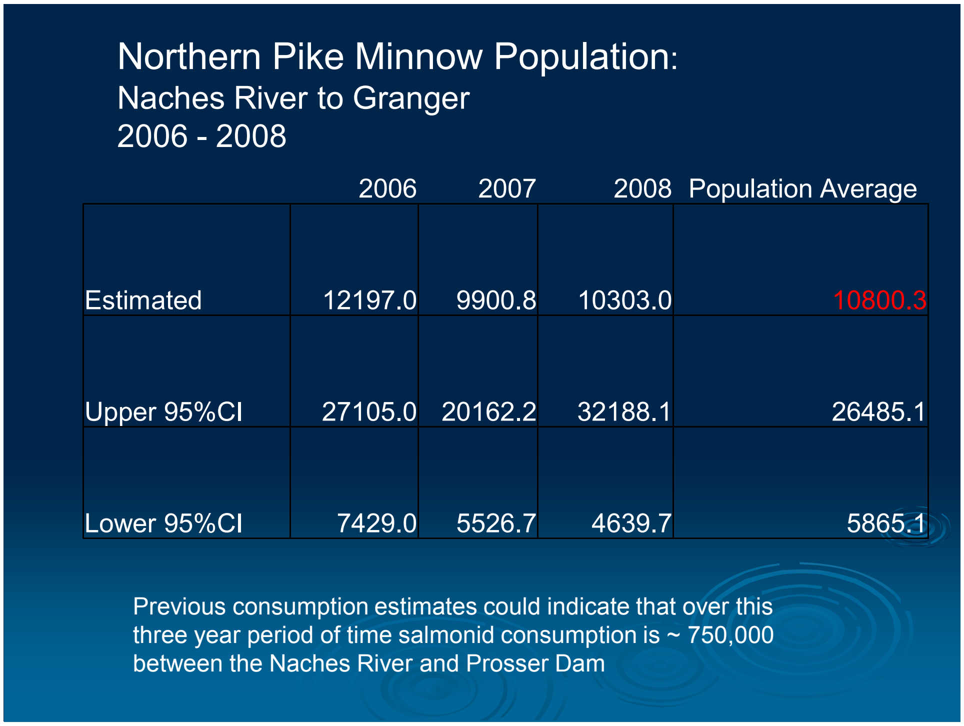


Figure 16. Norther Pikeminnow transects in the Yakima River.

Progress:

The predation crew adjusted the transect locations and refined the lengths for accuracy in Spring 2006 (Figure 16). These one mile sites and associated habitats are the areas that receive intensive electro-shocking treatment for the various size classes of NPM. All fish received a dorsal fin clip on at least half of the fin rays present. In 2008, a total of 228 Northern Pike Minnow were marked and 5 recaptured. These same fish were recaptured in subsequent weeks and tallies were kept for estimating population numbers based on equations given by Ricker 1975. Using the equation for multiple censuses, the estimated population for NPM in 2008 from the Naches confluence to the Granger boat ramp (39Rm) was 10,303. With the 95% confidence interval the population was between 4,639 and 32,188. While the interval would seem large it represents the best approximation given the difficulties associated with sampling such a large river system. Population average of 10,800 over three years of survey of is summarized for 2006-2008 in Figure 17.



Northern Pike Minnow Population:
Naches River to Granger
2006 - 2008

	2006	2007	2008	Population Average
Estimated	12197.0	9900.8	10303.0	10800.3
Upper 95%CI	27105.0	20162.2	32188.1	26485.1
Lower 95%CI	7429.0	5526.7	4639.7	5865.1

Previous consumption estimates could indicate that over this three year period of time salmonid consumption is ~ 750,000 between the Naches River and Prosser Dam

Figure 17. Norther Pikeminnow population estimates for the Yakima River.

A total of 26 stomachs were collected during the spring 2008 field season. Of these, invertebrates seemed to be the main prey species found in the gut. All stomachs with fish present were further analyzed to determine the species using diagnostic bones to identify them. Out of the 26 stomachs only 5 contained fish remains. A limited number of stomachs were sampled as a result of survey conflicts from weather, turbidity, and water flow. Diet composition was given in our 2007 Annual Report (approximately 27% salmonids). Using data from the very limited number of stomachs sampled from 2006 to 2008, we estimate that over these 3 survey years NPM could have consumed 750,000 salmonids in the river section between the Naches River and Granger. We are unable to provide confidence intervals on these estimates but they are likely to be high due to the small sample size.

Task 4.c Upper Yakima Spring Chinook NTTOC Monitoring

The WDFW annual report for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications. This year's report is expected to be available soon. The most recent report is:

Pearsons, T. N., G. M. Temple, A. L. Fritts, C. L. Johnson, and T. D. Webster. 2008. Ecological Interactions between Non-target Taxa of Concern and Hatchery Supplemented Salmon. Yakima/Klickitat Fisheries Project Monitoring and Evaluation Report. Annual Report 2007, Project No. 199506325, DOE/BP-00034450. Bonneville Power Administration, Portland, Oregon.

Task 4.d Pathogen Sampling

This project was discontinued. The latest WDFW annual report for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications

Thomas, J. B. 2007. Pathogen Screening of Naturally Produced Yakima River Spring Chinook Smolts; Yakima/Klickitat Fisheries Project Monitoring and Evaluation Report. Annual Report 2006. DOE/BP-00027871.

Literature Cited

Busack, Craig, Todd Pearsons, Curt Knudsen, Steve Phelps, Washington Department of Fish and Wildlife, Bruce Watson, Mark Johnston, Yakama Nation, U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. 1997. Yakima Fisheries Project spring Chinook supplementation monitoring plan. Project Number 195-065, Contract Number DE-BI79-1996 BPA64878. http://www.efw.bpa.gov/Publications/P64878-1.pdf

Hubble J., T. Newsome, and J. Woodward. 2004. Yakima Coho Master Plan. Prepared by Yakama Nation in cooperation with Washington State Department of Fish and Wildlife. September 2004. Yakima Klickitat Fisheries Project, Toppenish, WA. See www.ykfp.org Technical Reports and Publications to obtain an electronic copy of this report.

Larsen, D. A., B. R. Beckman, K. A. Cooper, D. Barrett, M. Johnston, P. Swanson, and W. W. Dickhoff. 2004. Assessment of High Rates of Precocious Male Maturation in a Spring Chinook Salmon Supplementation Hatchery Program. Transactions of the American Fisheries Society 133:98-120, 2004.

Larsen, D. A., B. R. Beckman, C. R. Strom, P. J. Parkins, K. A. Cooper, D. E. Fast, and W. W. Dickhoff. 2006. Growth Modulation Alters the Incidence of Early Male Maturation and Physiological Development of Hatchery-Reared Spring Chinook Salmon: A Comparison with Wild Fish. Transactions of the American Fisheries Society 135:1017-1032.

APPENDICES A through G

	Task	
A.		Yakima River / CESRF Spring Chinook Salmon – Yakama Nation Data Summary
B.	1.c.	IntStats, Inc. Comparison of Different Feed Treatments on Smolt-to-Smolt Survivals and Mini-Jack Percentages of Upper Yakima Spring Chinook for Brood-Years 2002-2006 from Naturally Spawned Parents
C.	1.c.	IntStats, Inc. Annual Report: Hatchery x Hatchery and Natural x Natural Smolt-to-Smolt Survivals and Mini-Jack Proportions of Upper Yakima Spring Chinook for Brood-Years 2002-2005
D.	1.d.	IntStats, Inc. Smolt Survival to McNary Dam of Year-2007 Spring Chinook Releases at Roza Dam
E.	1.f.	IntStats, Inc. Smolt-to-Smolt Survival to McNary Dam of Main-Stem-Yakima Fall Chinook
F.	1.g.	Intstats, Inc. 2006-2007 Coho Smolt-to-Smolt Survival of Eagle Creek and Yakima Brood Releases into the Yakima Basin
G.	4.a.	Avian Predation Annual Report

Appendix A

Summary of Data Collected by the Yakama Nation relative to Yakima River Spring Chinook Salmon and the Cle Elum Spring Chinook Supplementation and Research Facility

2008 Annual Report

July, 2009

Prepared by:

Bill Bosch
Yakima/Klickitat Fisheries Project
Yakama Nation Fisheries
760 Pence Road
Yakima, WA 98902

Prepared for:

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208
Project Numbers: 1995-063-25
Contract Numbers: 00037822

Acknowledgments

Monitoring and evaluation efforts for the Cle Elum Supplementation and Research Facility (CESRF) and Yakima River spring Chinook salmon are the result of a cooperative effort by many individuals from a variety of agencies including the Yakama Nation Fisheries Program (YN), the Washington Department of Fish and Wildlife (WDFW), the United States Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration Fisheries department (NOAA Fisheries) as well as some consultants and contractors.

The core project team includes the following individuals: Dave Fast, Mark Johnston, Bill Bosch, David Lind, Paul Huffman, Joe Hoptowit, Jerry Lewis, and a number of technicians from the YN; Charles Strom and a number of assistants from the CESRF; Andrew Murdoch, Steve Schroder, Anthony Fritts, Gabe Temple, Christopher Johnson, and a number of assistants from the WDFW; Curt Knudsen from Oncorh Consulting and Doug Neeley from IntSTATS Consulting; Ray Brunson and assistants from the USFWS; and Don Larsen, Andy Dittman, and assistants from NOAA Fisheries. The technicians and assistants are too numerous and varied to mention each by name (and risk leaving some out). However, their hard work in the field is the source of much of the raw data needed to complete this report. We sincerely appreciate their hard work and dedication to this project.

We would especially like to thank former members of the Yakima/Klickitat Fisheries Project, Bruce Watson, Joel Hubble, Bill Hopley, Todd Pearsons, and Craig Busack. These individuals put in countless hours of hard work during the planning, design, and implementation of this project. Their contributions helped to lay a solid foundation for this project and our monitoring and evaluation efforts. Dan Barrett (retired) served as the manager of the CESRF from 1997-2002. He helped to lay a solid foundation for the critical work done day in and day out at the Cle Elum facility.

We also need to recognize and thank the Columbia River Inter-Tribal Fish Commission, the University of Idaho, the Pacific States Marine Fisheries Commission, Mobrand, Jones, and Stokes, and Central Washington University for their many contributions to this project including both recommendations and data services.

This work is funded by the Bonneville Power Administration (BPA) through the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program. Patricia Smith is BPA's contracting officer and technical representative (COTR) for this project. David Byrnes preceded Patricia in this position and contributed substantially to the project over the years.

Abstract

Historically, the return of spring Chinook salmon (*Oncorhynchus tshawytscha)* to the Yakima River numbered about 200,000 fish annually (BPA, 1990). Spring Chinook returns to the Yakima River averaged fewer than 3,500 fish per year through most of the 1980s and 1990s (less than 2% of the historical run size).

In an attempt to reverse this trend the Northwest Power and Conservation Council (formerly the Northwest Power Planning Council, NPPC) in 1982 first encouraged Bonneville Power Administration (BPA) to "fund the design, construction, operation, and maintenance of a hatchery to enhance the fishery for the Yakima Indian Nation as well as all other harvesters" (NPPC 1982). After years of planning and design, an Environmental Impact Statement (EIS) was completed in 1996 and the CESRF was authorized under the NPCC's Fish and Wildlife Program with the stated purpose being "to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits". The CESRF became operational in 1997. This project is co-managed by the Yakama Nation and the Washington Department of Fish and Wildlife (WDFW) with the Yakama Nation as the lead entity.

This report documents data collected from Yakama Nation tasks related to monitoring and evaluation of the CESRF and its effect on natural populations of spring Chinook in the Yakima Basin through 2008. This report is not intended to be a scientific evaluation of spring Chinook supplementation efforts in the Yakima Basin. Rather, it is a summary of methods and data (additional information about methods used to collect these data may be found in the main section of this annual report) relating to Yakima River spring Chinook collected by Yakama Nation biologists and technicians from 1982 (when the Yakama Nation fisheries program was implemented) to present. Data summarized in this report include:

- Adult-to-adult returns
- Annual run size and escapement
- Adult traits (e.g., age composition, size-at-age, sex ratios, migration timing, etc.)
- CESRF reproductive statistics (including fecundity and fish health profiles)
- CESRF juvenile survival (egg-to-fry, fry-to-smolt, smolt-to-smolt, and smolt-to-adult)
- CESRF juvenile traits (e.g., length-weight relationships, migration timing, etc.)
- Harvest impacts

The data presented here are, for the most part, "raw" data and should not be used without paying attention to caveats associated with these data and/or consultation with project biologists. No attempt is made to explain the significance of these data in this report as this is left to more comprehensive reports and publications produced by the project. Data in this report should be considered preliminary until published in the peer reviewed literature.

Table of Contents

List of Tables

List of Figures

List of Appendices

Introduction

Program Objectives

The CESRF was authorized in 1996 under the NPCC's Fish and Wildlife Program with the stated purpose being "to test the assumption that new artificial production can be used to increase harvest and natural production while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits". The CESRF became operational in 1997. The experimental design calls for a total release of 810,000 smolts annually from each of three acclimation sites associated with the facility (see facility descriptions). The first program cycle (brood years 1997 through 2001) also included testing new Semi-Natural rearing Treatments (SNT) against the Optimum Conventional Treatments (OCT) of existing successful hatcheries in the Pacific Northwest. The second program cycle (brood years 2002-2004) tested whether a slower, more natural growth regime could be used to reduce the incidence of precocialism that may occur in hatchery releases without adversely impacting overall survival to adult returns. Brood year 2005-2006 tested survival using different types of feed treatment. Subsequent broods have used a standard treatment in all raceways. With guidance and input from the NPCC and the Independent Scientific Review Panel (ISRP) in 2001, the Naches subbasin population of spring Chinook was established as a wild/natural control. A hatchery control line at the CESRF was also established with the first brood production for this line collected in 2002. Please refer to the project's "Supplementation Monitoring Plan" (Chapter 7 in 2005 annual report on project genetic studies) for additional information regarding these control lines.

Facility Descriptions

Returning adult spring Chinook are monitored at the Roza adult trapping facility located on the Yakima River (Rkm 205.8). This facility provides the means to monitor every fish returning to the upper Yakima Basin and to collect adults for the CESRF program. All returning CESRF fish (adipose-clipped fish) are sampled for biological characteristics and marks and returned to the river with the exception of fish collected for experimental sampling and hatchery control line broodstock. Through 2006, all wild/natural fish passing through the Roza trap were returned directly to the river with the exception of fish collected for broodstock or fish with metal tag detections which were sampled for marks and biological characteristics. Beginning in 2007, all wild/natural fish were sampled (as described above) and tissue samples were collected for a "Whole Population" Pedigree Study of Upper Yakima Spring Chinook.

The CESRF is located on the Yakima River just south of the town of Cle Elum (rkm 295.5). It is used for adult broodstock holding and spawning, and early life incubation and rearing. Fish are spawned in September and October of a given brood year (BY). Fish are typically ponded in March or April of BY+1. The juveniles are reared at Cle Elum, marked in October through December of BY+1, and moved to one of three acclimation sites for final rearing in January to February of BY+2. Acclimation sites are located at Easton (ESJ, rkm 317.8), Clark Flats near the town of Thorp (CFJ, rkm 266.6), and Jack Creek (JCJ, approximately 32.5 km north of Cle Elum) on the North Fork Teanaway River (rkm 10.2). Fish are volitionally released from the acclimation sites beginning on March 15 of BY+2, with any remaining fish "flushed out" of the acclimation sites by May 15 of BY+2. The annual production goal for the CESRF program is 810,000 fish for release as yearlings at 30 g/fish or 15 fish per pound (fpp) although size-at-release may vary depending on experimental protocols (see Program Objectives).

Yakima River Basin Overview

The Yakima River Basin is located in south central Washington. From its headwaters near the crest of the Cascade Range, the Yakima River flows 344 km (214 miles) southeastward to its confluence with the Columbia River (Rkm 539.5; Figure 1).

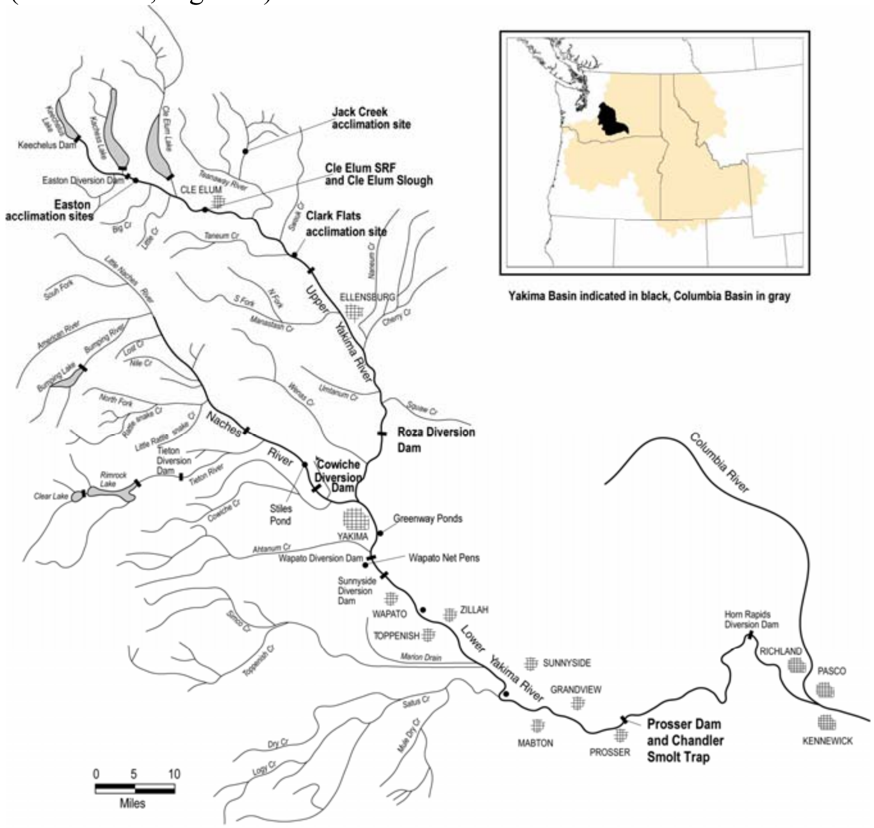


Figure 1. Yakima River Basin.

Three genetically distinguishable populations of spring Chinook salmon exist in the Yakima basin: the American River, the Naches, and the Upper Yakima Stocks (Figure 1). The upper Yakima was selected as the population best suited for supplementation and associated evaluation and research efforts.

Local habitat problems related to irrigation, logging, road building, recreation, agriculture, and livestock grazing have limited the production potential of spring Chinook in the Yakima River basin. It is hoped that recent initiatives to improve habitat within the Yakima Basin, such as those being funded through the NPCC's fish and wildlife program, the Pacific Coastal Salmon Recovery Fund, and the Washington State salmon recovery fund, will: 1) restore and maintain natural stream stability; 2) reduce water temperatures; 3) reduce upland erosion and sediment delivery rates; 4) improve and re-establish riparian vegetation; and 5) re-connect critical habitats throughout the basin. These habitat restoration efforts should permit increased utilization of habitat by spring Chinook salmon in the Yakima basin thereby increasing fish survival and productivity.

Adult Salmon Evaluation

Broodstock Collection and Representation

One of the program's goals is to collect broodstock from a representative portion of the population throughout the run. If the total run size could be known in advance, collecting brood stock on a daily basis in exact proportion to total brood need as a proportion of total run size would result in ideal run representation. Since it is not possible to know the run size in advance, the CESRF program uses a brood collection schedule that is based on average run timing once the first fish arrive at Roza Dam. We have found that, while river conditions dictate run timing (i.e., fish may arriver earlier or later depending on flow and temperature), once fish begin to move at Roza, the pattern in terms of relative run strength over time is very similar from year to year. Thus a brood collection schedule matching normal run timing patterns was developed to assure that fish are collected from all portions of the run (Figure 2).

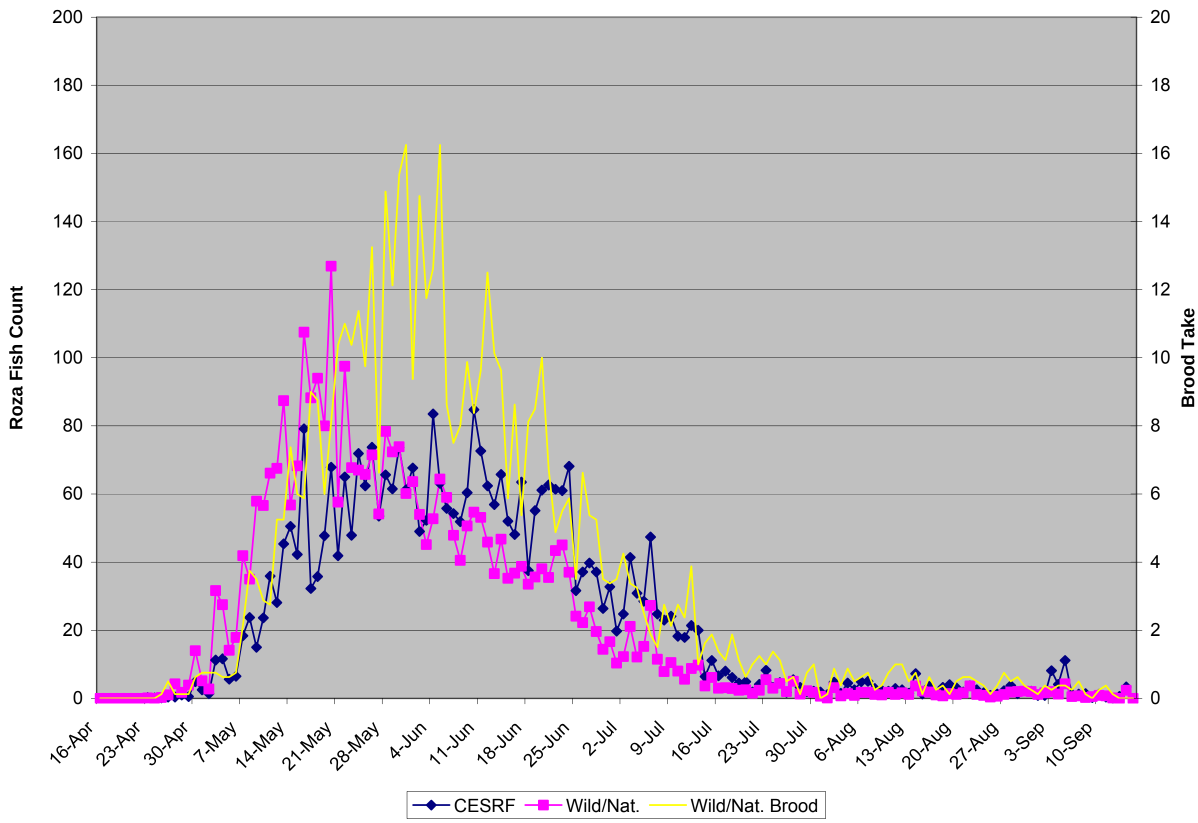


Figure 2. Mean spring Chinook run timing and broodstock collection at Roza Dam, 2001-2008.

Another program goal is to take no more than 50% of the wild/natural adult return to Roza Dam for broodstock. Given this goal and with a set brood collection schedule at Roza Dam, the project imposed a rule that no more than 50% of the fish arriving on any given day be taken for broodstock. Under-collection relative to the schedule is "carried over" to subsequent days and weeks. This allows brood collection to adjust relative to actual run timing and run strength. Performance across years with respect to these brood collection goals is given in Table 1.

Table 1. Counts of wild/natural spring Chinook (including jacks), brood collection, and brood representation of wild/natural run at Roza Dam, 1997 – present.

Year	Trap Count	Brood Take	Brood %	Portion of run collected:[1] Early[3]	Middle[3]	Late[3]	Portion of collection from:[2] Early[3]	Middle[3]	Late[3]
1997	1,445	261	18.1%	26.4%	17.6%	17.7%	7.3%	83.1%	9.6%
1998	795	408	51.3%	51.1%	51.3%	51.9%	5.6%	84.3%	10.0%
1999	1,704	738	43.3%	44.6%	44.1%	35.9%	5.6%	86.3%	8.1%
2000	11,639	567	4.9%	10.7%	4.5%	4.4%	12.5%	77.8%	9.7%
2001	5,346	595	11.1%	6.9%	11.4%	10.7%	3.0%	87.7%	9.2%
2002	2,538	629	24.8%	15.7%	25.2%	26.1%	3.2%	86.3%	10.5%
2003	1,558	441	28.3%	52.5%	25.9%	36.4%	9.5%	77.8%	12.7%
2004	7,804	597	7.6%	2.6%	7.4%	12.8%	2.0%	81.6%	16.4%
2005	5,086	510	10.0%	2.2%	9.5%	21.9%	1.3%	77.0%	21.7%
2006	2,050	419	20.4%	48.5%	22.2%	41.0%	9.1%	75.1%	15.8%
2007	1,293	449	34.7%	25.0%	34.4%	60.6%	3.2%	80.0%	16.9%
2008	1,677	457	27.3%	57.7%	26.7%	32.4%	9.3%	79.0%	11.6%

1. This is the proportion of the earliest, middle, and latest running components of the entire wild/natural run which were taken for broodstock. Ideally, this collection percentage would be equal throughout the run and would match the "Brood %".
2. This is the proportion of the total broodstock collection taken from the earliest, middle, and latest components of the entire wild/natural run. Ideally, these proportions would match the definitions for early, middle, and late given in 3.
3. Early is defined as the first 5% of the run, middle is defined as the middle 85%, and late as the final 10% of the run.

Natural- and Hatchery-Origin Escapement

While the project does not actively manage for a specific spawning escapement proportion (natural- to hatchery-origin adults), we are monitoring the proportion of natural influence (PNI; Table 2). The project will adaptively manage this parameter considering factors such as: policy input regarding surplusing of fish, meeting overall production goals of the project, guidance from the literature relative to percentage of hatchery fish on the spawning grounds with fitness loss, considerations about what risk is acceptable in a project designed to evaluate impacts from that risk, and the numerous risk containment measures already in place in the project. The State of Washington is using mark-selective fisheries in the lower Columbia River and, when possible, in the lower Yakima River in part as a tool to manage escapement proportions. Natural- and hatchery-origin escapement to the upper Yakima Basin is given in Table 2. Wild/natural escapement to the Naches subbasin is given in Table 3.

Table 2. Escapement (Roza Dam counts less brood stock collection and harvest above Roza) of natural- (NoR) and hatchery-origin (HoR) spring Chinook to the upper Yakima subbasin, 1982 – present.

	Wild/Natural (NoR)			CESRF (HoR)			Total				
Year	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	PHOS[1]	PNI[1]
1982			1,146								
1983			1,007								
1984			1,535								
1985			2,331								
1986			3,251								
1987			1,734								
1988			1,340								
1989			2,331								
1990			2,016								
1991			*1,583*[2]								
1992			3,009								
1993			1,869								
1994			563								
1995			355								
1996			1,631								
1997	1,141	43	1,184								
1998	369	18	387								
1999	498	468	966								
2000	10,491	481	10,972		688	688	10,491	1,169	11,660	5.9%	
2001	4,454	297	4,751	6,065	982	7,047	10,519	1,279	11,798	59.7%	62.6%
2002	1,820	89	1,909	6,064	71	6,135	7,884	160	8,044	76.3%	56.7%
2003	394	723	1,117	1,036	1,105	2,141	1,430	1,828	3,258	65.7%	60.3%
2004	6,536	671	7,207	2,876	204	3,080	9,412	875	10,287	29.9%	77.0%
2005	4,401	175	4,576	627	482	1,109	5,028	657	5,685	19.5%	83.7%
2006	1,510	121	1,631	1,622	111	1,733	3,132	232	3,364	51.5%	66.0%
2007	683	161	844	734	731	1,465	1,417	892	2,309	63.4%	61.2%
2008	988	232	1,220	2,157	957	3,114	3,145	1,189	4,334	71.9%	58.2%
Mean[3]	2,774	290	3,064	2,648	580	3,228	5,246	889	6,135	54.7%	65.7%

1. Proportion Natural Influence equals Proportion Natural-Origin Broodstock (PNOB; 1.0 as only NoR fish are used for supplementation line brood stock) divided by PNOB plus Proportion Hatchery-Origin Spawners (PHOS; % HoR).
2. This is a rough estimate since Roza counts are not available for 1991.
3. For NoR columns, mean of 1997-present values. For all other columns, mean of 2001-present values.

Adult-to-adult Returns

The overall status of Yakima Basin spring Chinook is summarized in Table 3. Adult-to-adult return and productivity data for the various populations are given in Tables 4-8 (Means are for 1988 to present).

Table 3. Yakima River spring Chinook run (CESRF and wild, adults and jacks combined) reconstruction, 1982-present.

Year	River Mouth Run Size[1] Adults	Jacks	Total	Harvest Below Prosser	Prosser Count	Harvest Above Prosser	Spawners Below Roza[2]	Roza Count	Roza Removals[3]	Est. Escapement Upper Y.R.[4]	Naches[5]	Redd Counts Upper Y.R.	Naches
1982	1,681	142	1,822	88	1,499	346	134	1,146	0	1,146	*108*	573	54
1983	1,231	210	1,441	72	867	12	118	1,007	0	1,007	*232*	360	83
1984	2,251	407	2,658	119	2,539	170	180	1,619	84	1,535	570	634	220
1985	4,109	451	4,560	321	4,239	544	247	2,428	97	2,331	1,020	860	427
1986	8,841	598	9,439	530	8,909	810	709	3,267	16	3,251	4,123	1,472	1,313
1987	4,187	256	4,443	359	4,084	158	269	1,928	194	1,734	1,729	903	677
1988	3,919	327	4,246	333	3,913	111	60	1,575	235	1,340	2,167	424	490
1989	4,640	274	4,914	560	4,354	187	135	2,515	184	2,331	1,517	915	541
1990	4,280	92	4,372	131	*2,255*	532	282	2,047	31	2,016	*1,380*	678	464
1991	2,802	104	2,906	27	2,879	5	131		40	*1,583*	*1,121*	582	460
1992	4,492	107	4,599	184	4,415	161	39	3,027	18	3,009	1,188	1,230	425
1993	3,800	119	3,919	44	3,875	85	56	1,869	0	1,869	1,865	637	554
1994	1,282	20	1,302	0	1,302	25	10	563	0	563	704	285	272
1995	526	140	666	0	666	79	9	355	0	355	223	114	104
1996	3,060	119	3,179	100	3,079	375	26	1,631	0	1,631	1,047	801	184
1997	3,092	81	3,173	0	3,173	575	20	1,445	261	1,184	1,133	413	339
1998	1,771	132	1,903	0	1,903	188	3	795	408	387	917	147	330
1999	1,513	1,268	2,781	8	2,773	596	55	1,704	738	966	418	212	186
2000	17,519	1,582	19,101	90	19,011	2,368	204	12,327	667	11,660	4,112	3,770	887
2001	21,225	2,040	23,265	1,793	21,472	2,838	286	12,516	718	11,798	5,832	3,260	1,192
2002	14,616	483	15,099	328	14,771	2,780	29	8,922	878	8,044	3,041	2,816	943
2003	4,868	2,089	6,957	59	6,898	381	83	3,842	584	3,258	2,592	868	935
2004	13,974	1,315	15,289	135	15,154	1,544	90	11,005	718	10,287	2,515	3,414	719
2005	8,059	699	8,758	34	8,724	440	28	6,352	667	5,685	1,904	2,009	576
2006	5,951	363	6,314	0	6,314	600	14	4,028	664	3,364	1,672	1,245	444
2007	2,968	1,335	4,303	10	4,293	269	13	3,025	716	2,309	986	722	314
2008	6,615	1,983	8,598	539	8,059	993	9	5,478	1,144	4,334	1,578	1,372	495
Mean[6]	9,731	1,316	11,046	300	10,747	1,281	81	6,920	749	6,171	2,465	1,969	669

1. River Mouth run size is the greater of the Prosser count plus lower river harvest or estimated escapement plus all known harvest and removals.
2. Estimated as the average number of fish per redd in the upper Yakima times the number of redds between the Naches confluence and Roza Dam.
3. Roza removals include harvest above Roza, hatchery removals, and/or wild broodstock removals.
4. Estimated escapement into the upper Yakima River is the Roza count less harvest or broodstock removals above Roza Dam except in 1991 when Upper Yakima River escapement is estimated as the (Prosser count - harvest above Prosser - Roza subtractions) times the proportion of redds counted in the upper Yakima.
5. Naches River escapement is estimated as the Prosser count less harvest above Prosser and the Roza counts, except in 1982, 1983 and 1990 when it is estimated as the upper Yakima fish/redd times the Naches redd count.
6. Recent 10-year average (1999-2008).

Estimated spawners for the Upper Yakima River are calculated as the estimated escapement to the Upper Yakima plus the estimated number of spawners in the Upper Yakima between the confluence with the Naches River and Roza Dam (Table 3). Total returns are based on the information compiled in Table 3. Age composition for Upper Yakima returns is estimated from spawning ground carcass scale samples for the years 1982-1996 (Table 11) and from Roza Dam brood stock collection samples for the years 1997 to present (Table 13). Since age-3 fish (jacks) are not collected for brood stock in proportion to the jack run size, the proportion of age-3 fish in the upper Yakima for 1997 to present is estimated using the proportion of jacks (based on visual observation) counted at Roza Dam relative to the total run size.

Table 4. Adult-to-adult productivity for upper Yakima wild/natural stock.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns				Returns/ Spawner
		Age-3	Age-4	Age-5	Total	
1982	1,280	324	4,016	411	4,751	3.71
1983	1,125	408	1,882	204	2,494	2.22
1984	1,715	92	1,348	139	1,578	0.92
1985	2,578	114	2,746	105	2,965	1.15
1986	3,960	171	2,574	149	2,893	0.73
1987	2,003	53	1,571	109	1,733	0.87
1988	1,400	53	3,138	132	3,323	2.37
1989	2,466	68	1,779	9	1,856	0.75
1990	2,298	79	566	0	645	0.28
1991	1,713	9	326	22	358	0.21
1992	3,048	87	1,861	95	2,043	0.67
1993	1,925	66	1,606	57	1,729	0.90
1994	573	60	737	92	890	1.55
1995	364	59	1,036	129	1,224	3.36
1996	1,657	1,059	12,882	630	14,571	8.79
1997	1,204	621	5,837	155	6,613	5.49
1998	390	434	2,803	145	3,381	8.68
1999	1,021[1]	164	722	45	930	0.91
2000	11,864	856	7,689	127	8,672	0.73
2001	12,084	775	5,074	222	6,071	0.50
2002	8,073	224	1,875	148	2,247	0.28
2003	3,341[1]	158	1,036	63	1,257	0.38
2004	10,377	207	1,547		1,754	0.17
2005	5,713	293				
2006	3,378					
2007	2,322					
2008	4,343[1]					
Mean	3,788	293	2,971	130	3,386	0.89

1. Jack proportions for 1999, 2003, and 2008 respectively were: 0.48, 0.56, and 0.27.

Estimated spawners for the Naches/American aggregate population (Table 7) are calculated as the estimated escapement to the Naches Basin (Table 3). Estimated spawners for the individual Naches and American populations are calculated using the proportion of redds counted in the Naches Basin (excluding the American River) and the American River, respectively (see Table 31). Total returns are based on the information compiled in Table 3. Age composition for Naches Basin age-4 and age-5 returns are estimated from spawning ground carcass scale samples (see Tables 9-12). The proportion of age-3 fish is estimated after reviewing jack count (based on visual observations) data at Prosser and Roza dams. Since sample sizes for carcass surveys in the American and Naches Rivers can be very low in some years (Tables 9 and 10), it is recommended that the data in Tables 5 and 6 be used as indices only. Table 7 likely provides the most accurate view of overall productivity rates in the Naches River Subbasin.

Table 5. Adult-to-adult productivity for Naches River wild/natural stock.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns					Returns/ Spawner
		Age-3	Age-4	Age-5	Age-6	Total	
1982	86	85	1,275	324	0	1,683	19.57
1983	131	123	928	757	10	1,818	13.83
1984	383	110	706	564	0	1,381	3.60
1985	683	132	574	396	0	1,102	1.61
1986	2,666	68	712	499	15	1,294	0.49
1987	1,162	27	183	197	0	407	0.35
1988	1,340	32	682	828	0	1,542	1.15
1989	992	28	331	306	0	665	0.67
1990	954	24	170	74	0	269	0.28
1991	706	7	37	121	57	222	0.31
1992	852	29	877	285	0	1,191	1.40
1993	1,145	45	593	372	0	1,010	0.88
1994	474	14	164	164	0	343	0.72
1995	124	40	164	251	0	455	3.66
1996	887	179	3,983	1,620	0	5,782	6.52
1997	762	207	3,081	708	0	3,996	5.24
1998	503	245	1,460	1,128	0	2,833	5.63
1999	358[1]	113	322	190	0	626	1.75
2000	3,862	71	2,060	215	0	2,345	0.61
2001	3,914	126	1,250	474	0	1,849	0.47
2002	1,861	59	758	153	0	970	0.52
2003	1,400	52	238	175		465	0.33
2004	2,197	107	875			982	0.45
2005	1,434	167					
2006	1,171						
2007	465						
2008	1,074						
Mean	1,261	86	1,003	442	4	1,503	1.19

1. Approximately 48% of these fish were jacks.

Table 6. Adult-to-adult productivity for American River wild/natural stock.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns Age-3	Age-4	Age-5	Age-6	Total	Returns/ Spawner
1982	22	42	223	248	0	513	23.32
1983	101	67	359	602	0	1,028	10.21
1984	187	54	301	458	0	813	4.36
1985	337	81	149	360	0	590	1.75
1986	1,457	36	134	329	11	509	0.35
1987	567	12	71	134	0	216	0.38
1988	827	19	208	661	5	892	1.08
1989	524	11	69	113	0	193	0.37
1990	425	15	113	84	0	213	0.50
1991	414	3	5	22	0	30	0.07
1992	335	23	157	237	0	417	1.24
1993	721	8	218	405	8	639	0.89
1994	230	7	36	16	0	59	0.26
1995	98	33	32	98	0	163	1.65
1996	159	30	176	760	0	967	6.07
1997	371	13	1,544	610	0	2,167	5.84
1998	414	120	766	1,136	0	2,022	4.88
1999	61	72	99	163	0	334	5.50
2000	250	60	163	111	0	335	1.34
2001	1,918	18	368	253	0	638	0.33
2002	1,180	19	274	256	0	550	0.47
2003	1,192	22	182	440		644	0.54
2004	318	120	52			172	0.54
2005	469	79					
2006	501						
2007	521						
2008	504						
Mean	545	37	262	335	1	614	1.13

Table 7. Adult-to-adult productivity for Naches/American aggregate (wild/natural) population.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns Age-3	Age-4	Age-5	Age-6	Total	Returns/ Spawner
1982	108	127	1,274	601	0	2,002	18.54
1983	232	190	1,257	1,257	8	2,713	11.68
1984	570	164	1,109	1,080	0	2,354	4.13
1985	1,020	213	667	931	0	1,811	1.77
1986	4,123	103	670	852	31	1,657	0.40
1987	1,729	39	231	400	0	669	0.39
1988	2,167	51	815	1,557	11	2,434	1.12
1989	1,517	39	332	371	0	741	0.49
1990	1,380	40	326	168	0	533	0.39
1991	1,121	10	32	144	127	314	0.28
1992	1,188	52	1,034	661	0	1,747	1.47
1993	1,865	53	603	817	17	1,489	0.80
1994	704	21	160	167	0	348	0.49
1995	223	73	201	498	0	771	3.46
1996	1,047	209	4,010	2,360	0	6,580	6.29
1997	1,133	220	4,645	1,377	0	6,242	5.51
1998	917	364	2,167	2,316	0	4,847	5.28
1999	418[1]	185	369	280	0	835	2.00
2000	4,112	131	2,296	346	0	2,773	0.67
2001	5,832	144	1,598	785	0	2,526	0.43
2002	3,041	78	975	443	0	1,496	0.49
2003	2,592	75	387	1,028		1,489	0.57
2004	2,515	227	514			741	0.29
2005	1,904	246					
2006	1,672						
2007	986						
2008	1,578						
Mean	1,805	123	1,204	832	10	2,112	1.17

1. Approximately 48% of these fish were jacks.

Estimated spawners at the CESRF are the total number of wild/natural fish collected at Roza Dam and taken to the CESRF for production brood stock. Total returns are based on the information compiled in Table 3 and at Roza dam sampling operations. Age composition for CESRF fish is estimated using scales and PIT tag detections from CESRF fish sampled passing upstream through the Roza Dam adult monitoring facility.

Table 8. Adult-to-adult productivity for Cle Elum SRF spring Chinook.

Brood Year	Estimated Spawners	Estimated Yakima R. Mouth Returns				Returns/ Spawner
		Age-3	Age-4	Age-5	Total	
1997	261	741	7,753	176	8,670	33.22
1998	408	1,242	7,939	602	9,782	23.98
1999	738[1]	134	714	16	864	1.17
2000	567	1,103	3,647	70	4,819	8.50
2001	595	396	845	9	1,251	2.10
2002	629	345	1,886	69	2,300	3.66
2003	441	121	800	12	932	2.11
2004	597	805	3,101		3,906	6.54
2005	510	1,305				
2006	419					
2007	449					
2008	457					
Mean	506	688	3,336	136	4,066	8.04

1. 357 or 48% of these fish were jacks.

Age Composition

Comparisons of the age composition in the Roza adult monitoring facility (RAMF) samples and spawning ground carcass recovery samples show that older, larger fish are recovered as carcasses on the spawning grounds at significantly higher rates than younger, smaller fish (Knudsen et al. 2003 and Knudsen et al. 2004). Based on historical scale-sampled carcass recoveries between 1986 and 2008, age composition of American River spring Chinook has averaged 0, 39, 59, and 2 percent age-3, -4, –5, and -6, respectively (Table 9). Naches system spring Chinook averaged 2, 57, 40 and 1 percent age-3, -4, –5 and -6, respectively (Table 10). The upper Yakima River natural origin fish averaged 6, 88, and 6 percent age-3, -4, and –5, respectively (Table 11; 2008 data not available at the time this report was produced). While these ages are biased toward the older age classes, we believe the bias is approximately equal across populations and is a good relative indicator of differences in age composition between populations. The data show distinct differences with the American River population having the oldest age of maturation, followed closely by the Naches system and then the upper Yakima River which has significantly more age-3's, fewer age-5's and no age-6 fish.

Table 9. Percentage by sex and age of American River wild/natural spring Chinook carcasses sampled on the spawning grounds and sample size (n), 1986-present.

Return	Males					Females					Total			
Year	3	4	5	6	n	3	4	5	6	n	3	4	5	6
1986		23.8	76.2		21		8.9	86.7	4.4	45		13.6	83.3	3.0
1987		70.8	25.0	4.2	24		42.9	57.1		21		57.8	40.0	2.2
1988			100.0		1		100.0			1		33.3	66.7	
1989		39.6	60.4		48		10.0	90.0		50		24.5	75.5	
1990	2.5	25.0	72.5		40		28.3	71.7		46	1.2	26.7	72.1	
1991		23.8	76.2		42		13.3	86.7		60		17.6	82.4	
1992		71.2	23.1	5.8	52		45.8	54.2		48		59.0	38.0	3.0
1993	4.8	14.3	81.0		21		8.0	92.0		75	1.0	9.4	89.6	
1994		44.4	55.6		18		50.0	46.7	3.3	30		49.0	49.0	2.0
1995	14.3	14.3	71.4		7			100.0		13	5.0	5.0	90.0	
1996		100.0			2		83.3	16.7		6		87.5	12.5	
1997		40.0	60.0		5		22.2	64.4	13.3	45		24.0	64.0	12.0
1998		12.1	87.9		33		6.6	93.4		76		8.3	91.7	
1999		100.0			2		40.0	40.0	20.0	5		57.1	28.6	14.3
2000		66.7	33.3		15		61.5	38.5		13		64.3	35.7	
2001		65.6	34.4		90		67.9	32.1		106		67.0	33.0	
2002	1.7	53.4	44.8		58		56.4	43.6		110	0.6	55.4	44.0	
2003		8.1	91.9		74		7.9	92.1		151		8.0	92.0	
2004		100.0			3		20.0	80.0		5		50.0	50.0	
2005		64.7	35.3		17		84.0	16.0		25		76.7	23.3	
2006		61.5	38.5		13		48.6	51.4		35		52.1	47.9	
2007	10.5	31.6	57.9		19		43.8	56.3		48	3.0	40.3	56.7	
2008		8.7	91.3		23		11.9	88.1		42		10.6	89.4	
Mean	1.5	45.2	52.9	0.4			37.4	60.8	1.8		0.5	39.0	58.9	1.6

Table 10. Percentage by sex and age of Naches River wild/natural spring Chinook carcasses sampled on the spawning grounds and sample size (n), 1986-present.

Return	Males					Females					Total			
Year	3	4	5	6	n	3	4	5	6	n	3	4	5	6
1986	5.0	60.0	30.0	5.0	20		33.3	64.3	2.4	42	1.6	41.9	53.2	3.2
1987	5.9	76.5	11.8	5.9	17		69.0	31.0		42	1.7	71.7	25.0	1.7
1988		50.0	50.0		8	5.6	38.9	55.6		18	3.3	46.7	50.0	
1989		70.2	29.8		47		34.9	63.5	1.6	63		50.0	49.1	0.9
1990	9.1	60.6	30.3		33	10.7	57.1	32.1		28	11.1	57.1	31.7	
1991	4.3	52.2	43.5		23		13.3	86.7		45	1.5	26.5	72.1	
1992	4.0	80.0	12.0	4.0	25		70.6	29.4		34	1.7	75.0	21.7	1.7
1993		42.3	57.7		26		18.6	81.4		43		28.6	71.4	
1994		50.0	50.0		4		30.0	70.0		10		35.7	64.3	
1995		25.0	75.0		4		28.6	71.4		7		33.3	66.7	
1996		100.0			17		75.0	25.0		16		87.9	12.1	
1997	2.9	70.6	20.6	5.9	34		57.1	36.7	6.1	49	1.2	62.7	30.1	6.0
1998		29.4	70.6		17		27.9	72.1		43		30.6	69.4	
1999	12.5	62.5	25.0		8		33.3	66.7		9	5.9	47.1	47.1	
2000	1.7	94.9	3.4		59		92.2	7.8		77	0.7	93.4	5.9	
2001	1.7	72.9	25.4		59		61.0	39.0		118	0.6	65.2	34.3	
2002	2.1	78.7	19.1		47		63.3	36.7		98	0.7	66.9	32.4	
2003	7.8	25.0	67.2		64	1.1	18.9	80.0		95	3.8	21.4	74.8	
2004	7.5	87.5	5.0		40		91.3	8.7		92	2.3	89.5	8.3	
2005		81.8	18.2		11		83.8	16.2		37		83.7	16.3	
2006		61.5	38.5		13		61.5	38.5		13		61.5	38.5	
2007		75.0	25.0		4		57.9	42.1		19		60.9	39.1	
2008	36.4	45.5	18.2		11		87.0	13.0		23	11.8	73.5	14.7	
Mean	4.4	63.1	31.6	0.9		0.8	52.4	46.4	0.4		2.1	57.0	40.4	0.6

Table 11. Percentage by sex and age of upper Yakima River wild/natural spring Chinook carcasses sampled on the spawning grounds and sample size (n), 1986-present.

Return	Males				Females				Total		
Year	3	4	5	n	3	4	5	n	3	4	5
1986		100.0		12		94.1	5.9	51		95.2	4.8
1987	10.8	81.5	7.7	65		77.8	22.2	126	3.7	79.1	17.3
1988	22.5	70.0	7.5	40	10.4	75.0	14.6	48	15.6	73.3	11.1
1989	0.8	93.1	6.2	130	0.4	95.5	4.1	246	0.5	94.7	4.8
1990	6.3	88.4	5.3	95	2.1	94.8	3.1	194	3.4	92.8	3.8
1991	9.1	87.3	3.6	55		89.2	10.8	111	3.0	88.6	8.4
1992	2.4	91.6	6.0	167		98.1	1.9	315	0.8	95.9	3.3
1993	4.0	90.0	6.0	50	0.9	92.0	7.1	112	1.9	91.4	6.8
1994		100.0		16		98.0	2.0	50		98.5	1.5
1995	20.0	80.0		5		100.0		12	5.6	94.4	
1996	9.1	89.6	1.3	154	0.7	98.2	1.1	282	3.7	95.2	1.1
1997		96.7	3.3	61		96.3	3.7	136		96.4	3.6
1998	14.3	85.7		21	5.3	86.8	7.9	38	8.5	86.4	5.1
1999	61.8	38.2		34		94.4	5.6	36	31.0	66.2	2.8
2000	2.8	97.2		72		100.0		219	1.0	99.0	
2001	2.7	89.2	8.1	37		83.6	16.4	122	0.6	85.0	14.4
2002	2.4	58.5	39.0	41	3.6	87.5	8.9	56	5.1	73.7	21.2
2003	60.5	39.5		38	4.3	82.6	13.0	23	39.3	55.7	4.9
2004	6.5	93.5		108	0.0	99.5	0.5	198	2.3	97.4	0.3
2005	9.2	90.0		120	1.4	97.2	1.4	214	4.2	94.7	1.2
2006	23.7	74.6		59	2.3	96.5	1.2	86	11.0	87.6	1.4
2007		100.0		3		100.0		10		100.0	
2008						Data not yet available					
Mean	12.2	83.4	4.3		1.4	92.6	6.0		6.4	88.2	5.4

Carcasses from upper Yakima River CESRF origin fish allowed to spawn naturally have also been sampled since age-4 adults began returning in 2001. Data for 2008 were not yet available at the time this report was produced. These fish averaged 17, 81, and 2 percent age-3, -4, and –5, respectively (Table 12) from 2001-2007 compared to 9, 85, and 6 percent respectively for their wild/natural counterparts in the upper Yakima for the same years (Table 11). The observed difference in age distribution between wild/natural and CESRF sampled on the spawning grounds may be due in part to the carcass recovery bias described above. A better comparison of age distribution between upper Yakima wild/natural and CESRF fish is from samples collected at Roza Dam which are displayed in Tables 13 and 14. However, it must be noted that jacks (age-3 males) were collected at Roza in proportion to run size from 1997 to 1999, but from 2000-present we have attempted to collect them at their mean brood representation rate (approximately 7% of the spawning population). Age-3 females do occur rarely in the Upper Yakima population, but it is likely that the data in Table 13 slightly over-represent the proportion of age-3 females due to human error associated with scale collection, handling, processing, and management and entry of these data.

Table 12. Percentage by sex and age of upper Yakima River CESRF spring Chinook carcasses sampled on the spawning grounds and sample size (n), 2001-present.

Return	Males				Females				Total		
Year	3	4	5	n	3	4	5	n	3	4	5
2001	23.5	76.5		34	0.9	99.1		108	6.3	93.7	
2002	8.0	81.3	10.7	75		88.6	11.4	140	2.8	86.2	11.1
2003	100.0			1		100.0		1	50.0	50.0	
2004	9.5	90.5		21		98.0	2.0	51	2.8	95.8	1.4
2005	42.9	57.1		21		90.9	4.5	22	23.3	74.4	2.3
2006	26.7	73.3		15		100.0		43	6.9	93.1	
2007	80.0	20.0		5		100.0		10	26.7	73.3	
2008					Data not yet available						
Mean	41.5	57.0	1.5		0.1	96.7	2.6		17.0	80.9	2.1

Table 13. Percentage by sex and age of upper Yakima River wild/natural spring Chinook collected for brood stock at Roza Dam and sample size (n), 1997-present.

Return	Males				Females				Total		
Year	3	4	5	n	3	4	5	n	3	4	5
1997	4.5	92.0	3.4	88		94.6	5.4	111	2.0	93.5	4.5
1998	22.4	73.1	4.5	134		91.6	8.4	179	9.6	83.7	6.7
1999	71.1	26.1	2.8	425		92.6	7.4	215	48.8	47.0	4.2
2000	17.8	81.7	0.4	230		98.7	1.3	313	7.5	91.5	0.9
2001	12.4	77.4	10.3	234	0.9	90.5	8.5	328	5.7	85.2	9.2
2002	16.4	78.3	5.3	226	0.6	94.8	4.7	343	6.9	88.2	4.9
2003	27.4	60.2	12.4	201		83.3	16.7	228	12.8	72.6	14.7
2004	15.1	84.5	0.4	239	0.3	99.0	0.7	305	6.8	92.6	0.6
2005	15.5	82.3	2.2	181	0.4	97.1	2.5	276	6.3	91.2	2.4
2006	11.1	77.4	11.5	226		89.4	10.6	255	5.2	83.8	11.0
2007	13.6	74.7	11.7	162		87.8	12.2	255	5.3	82.7	12.0
2008	20.0	77.4	2.6	190		95.6	4.4	252	8.6	87.8	3.6
Mean	20.6	73.8	5.6		0.2	92.9	6.9		10.5	83.3	6.2

Table 14. Percentage by sex and age of upper Yakima River CESRF spring Chinook collected for research or brood stock at Roza Dam and sample size (n), 2001-present.

Return Year	Males				Females				Total		
	3	4	5	n	3	4	5	n	3	4	5
2001	12.5	87.5		40		100.0		75	5.1	94.9	
2002	14.7	83.8	1.5	68		98.3	1.7	115	5.5	92.9	1.6
2003	36.1	34.7	29.2	72		61.2	38.8	67	18.7	47.5	33.8
2004	19.6	80.4		46		100.0		60	8.5	91.5	
2005	17.8	75.6	6.7	45		88.1	11.9	59	7.7	82.7	9.6
2006	18.3	80.0	1.7	60		100.0		65	8.8	90.4	0.8
2007	33.3	60.8	5.9	51		87.5	12.5	56	15.9	74.8	9.3
2008	50.0	50.0		40		100.0		56	20.8	79.2	
Mean	25.3	69.1	5.6			91.9	8.1		11.4	81.7	6.9

Sex Composition

In the American River, the mean proportion of males to females in wild/natural carcasses sampled on the spawning grounds from 1986-2008 was 45:55 for age-4 and 33:67 for age-5 spring Chinook (Table 15). In the Naches River, the mean proportion of males to females was 43:57 for age-4 and 26:74 for age-5 fish (Table 16). In the upper Yakima River, the mean proportion of males to females was 32:68 for age-4 and 26:74 for age-5 fish (Table 17; 2008 data not available at the time this report was produced).

For upper Yakima fish collected at Roza Dam for brood stock or research purposes from 1997-2007, the mean proportion of males to females was 38:62 and 36:64 for age-4 fish from the wild/natural and CESRF populations, respectively (Tables 19 and 20). For these same samples, the mean proportion of males to females was 37:63 and 35:65 for age-5 fish from the wild/natural and CESRF populations (excluding years with very small age-5 sample sizes), respectively (Tables 19 and 20). For adult fish, the mean proportion of males to females in spawning ground carcass recoveries was substantially lower than the ratio found at RAMF (Tables 17 and 19), indicating that sex ratios estimated from hatchery origin carcass recoveries were biased due to female carcasses being recovered at higher rates than male carcasses (Knudsen et al, 2003 and 2004). Again, despite these biases, we believe these data are good relative indicators of differences in sex composition between populations and between years.

Sample sizes for Tables 15-20 were given in Tables 9-14. As noted earlier, few age-6 fish are found in carcass surveys and those that have been found were located in the American and Naches systems. The data indicate that age-3 females may occasionally occur in the upper Yakima and, to a lesser extent, the Naches systems.

Table 15. Percent of American River wild/natural spring Chinook carcasses sampled on the spawning grounds by age and sex, 1986-present.

Return Year	Age-3		Age-4		Age-5		Age-6	
	M	F	M	F	M	F	M	F
1986			55.6	44.4	29.1	70.9		100.0
1987			65.4	34.6	33.3	66.7	100.0	
1988			0.0	100.0	100.0	0.0		
1989			79.2	20.8	39.2	60.8		
1990	100.0		43.5	56.5	46.8	53.2		
1991			55.6	44.4	38.1	61.9		
1992			62.7	37.3	31.6	68.4	100.0	
1993	100.0		33.3	66.7	19.8	80.2		
1994			34.8	65.2	41.7	58.3		100.0
1995	100.0		100.0	0.0	27.8	72.2		
1996			28.6	71.4	0.0	100.0		
1997			16.7	83.3	9.4	90.6		100.0
1998			44.4	55.6	29.0	71.0		
1999			50.0	50.0	0.0	100.0		100.0
2000			55.6	44.4	50.0	50.0		
2001			45.0	55.0	47.7	52.3		
2002	100.0		33.3	66.7	35.1	64.9		
2003			33.3	66.7	32.9	67.1		
2004			75.0	25.0	0.0	100.0		
2005			34.4	65.6	60.0	40.0		
2006			32.0	68.0	21.7	78.3		
2007	100.0		22.2	77.8	28.9	71.1		
2008			28.6	71.4	36.2	63.8		
mean			44.7	55.3	33.0	67.0		

Table 16. Percent of Naches River wild/natural spring Chinook carcasses sampled on the spawning grounds by age and sex, 1986-present.

Return	Age-3		Age-4		Age-5		Age-6	
Year	M	F	M	F	M	F	M	F
1986	100.0		46.2	53.8	18.2	81.8	50.0	50.0
1987	100.0		31.0	69.0	13.3	86.7	100.0	
1988		100.0	36.4	63.6	28.6	71.4		
1989			60.0	40.0	25.9	74.1		100.0
1990	50.0	50.0	55.6	44.4	52.6	47.4		
1991	100.0		66.7	33.3	20.4	79.6		
1992	100.0		45.5	54.5	23.1	76.9	100.0	
1993			57.9	42.1	30.0	70.0		
1994			40.0	60.0	22.2	77.8		
1995			33.3	66.7	37.5	62.5		
1996			58.6	41.4		100.0		
1997	100.0		46.2	53.8	28.0	72.0	40.0	60.0
1998			29.4	70.6	27.9	72.1		
1999	100.0		62.5	37.5	25.0	75.0		
2000	100.0		44.1	55.9	25.0	75.0		
2001	100.0		37.4	62.6	24.6	75.4		
2002	100.0		37.4	62.6	20.0	80.0		
2003	83.3	16.7	47.1	52.9	36.1	63.9		
2004	100.0		29.4	70.6	20.0	80.0		
2005			22.5	77.5	25.0	75.0		
2006			50.0	50.0	50.0	50.0		
2007			21.4	78.6	11.1	88.9		
2008	100.0		20.0	80.0	40.0	60.0		
mean			42.5	57.5	26.3	73.7		

Table 17. Percent of Upper Yakima River wild/natural spring Chinook carcasses sampled on the spawning grounds by age and sex, 1986-present.

Return	Age-3		Age-4		Age-5	
Year	M	F	M	F	M	F
1986			20.0	80.0		100.0
1987	100.0		35.1	64.9	15.2	84.8
1988	64.3	35.7	43.8	56.3	30.0	70.0
1989	50.0	50.0	34.0	66.0	44.4	55.6
1990	60.0	40.0	31.3	68.7	45.5	54.5
1991	100.0		32.7	67.3	14.3	85.7
1992	100.0		33.1	66.9	62.5	37.5
1993	66.7	33.3	30.4	69.6	27.3	72.7
1994			24.6	75.4		100.0
1995	100.0		25.0	75.0		
1996	87.5	12.5	33.3	66.7	40.0	60.0
1997			31.1	68.9	28.6	71.4
1998	60.0	40.0	35.3	64.7		100.0
1999	100.0		27.7	72.3		100.0
2000	100.0		24.2	75.8		
2001	100.0		24.4	75.6	13.0	87.0
2002	33.3	66.7	32.9	67.1	76.2	23.8
2003	95.8	4.2	44.1	55.9		100.0
2004	100.0		33.9	66.1		100.0
2005	78.6	21.4	34.2	65.8	25.0	75.0
2006	87.5	12.5	34.6	65.4	50.0	50.0
2007			23.1	76.9		
2008			Data not yet available			
mean	82.4	17.6	31.8	68.2	26.2	73.8

Table 18. Percent of upper Yakima River CESRF spring Chinook carcasses sampled on the spawning grounds by age and sex, 2001-present.

Return	Age-3		Age-4		Age-5	
Year	M	F	M	F	M	F
2001	88.9	11.1	19.5	80.5		
2002	100.0		33.0	67.0	33.3	66.7
2003	100.0			100.0		
2004	100.0		27.5	72.5		100.0
2005	90.0	10.0	37.5	62.5		100.0
2006	100.0		20.4	79.6		
2007	100.0		9.1	90.9		
2008			Data not yet available			
mean	97.0	3.0	21.0	79.0		

Table 19. Percent of upper Yakima River wild/natural spring Chinook collected for brood stock at Roza Dam by age and sex, 1997-present.

Return	Age-3		Age-4		Age-5	
Year	M	F	M	F	M	F
1997	100.0		43.5	56.5	33.3	66.7
1998	100.0		37.4	62.6	28.6	71.4
1999	100.0		35.8	64.2	42.9	57.1
2000	100.0		37.8	62.2	20.0	80.0
2001	90.6	9.4	37.9	62.1	46.2	53.8
2002	94.9	5.1	35.3	64.7	42.9	57.1
2003	100.0		38.9	61.1	39.7	60.3
2004	97.3	2.7	40.1	59.9	33.3	66.7
2005	96.6	3.4	35.7	64.3	36.4	63.6
2006	100.0		43.4	56.6	49.1	50.9
2007	100.0		35.1	64.9	38.0	62.0
2008	100.0		37.9	62.1	31.3	68.8
mean	98.3	1.7	38.2	61.8	36.8	63.2

Table 20. Percent of Upper Yakima River CESRF spring Chinook collected for research or brood stock at Roza Dam by age and sex, 2001-present.

Return	Age-3		Age-4		Age-5	
Year	M	F	M	F	M	F
2001	100.0	0.0	31.8	68.2		
2002	100.0	0.0	33.5	66.5	33.3	66.7
2003	100.0	0.0	37.9	62.1	44.7	55.3
2004	100.0	0.0	38.1	61.9		
2005	100.0	0.0	39.5	60.5	30.0	70.0
2006	100.0	0.0	42.5	57.5	100.0	
2007	100.0	0.0	38.8	61.3	30.0	70.0
2008	100.0	0.0	26.3	73.7		
mean	100.0	0.0	36.1	63.9	34.5	65.5

Size at Age

Prior to 1996, samplers were instructed to collect mid-eye to hypural plate (MEHP) lengths from carcasses surveyed on the spawning grounds. From 1996 to present the method was changed and post-eye to hypural plate (POHP) lengths have been recorded. Mean POHP lengths averaged 39, 60, and 77 cm for age-3, -4, and -5 males, and averaged 62 and 73 cm for age-4 and -5 females, respectively, from carcasses sampled on the spawning grounds in the American River from 1996-2008 (Table 21). In the Naches River, mean POHP lengths averaged 41, 60, and 76 cm for age-3, -4, and -5 males, and averaged 61 and 73 cm for age-4 and -5 females, respectively (Table 22). For wild/natural spring Chinook sampled on the spawning grounds in the upper Yakima River, mean POHP lengths averaged 43, 60, and 72 cm for age-3, -4, and -5 males, and averaged 60 and 69 cm for age-4 and -5 females, respectively (Table 23; 2008 data not available at the time this report was produced). From 2001-2008, CESRF fish returning to the upper Yakima have been generally smaller in size-at-age than their wild/natural counterparts (Tables 23-28).

Table 21. Counts and mean mid-eye (MEHP) or post-orbital (POHP) to hypural plate lengths (cm) of American River wild/natural spring Chinook from carcasses sampled on the spawning grounds by sex and age, 1986-present.

	Males								Females					
Return	Age 3		Age 4		Age 5		Age 6		Age 4		Age 5		Age 6	
Year	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP
1986			5	57.1	16	80.9			4	65.8	39	75.2	2	74.0
1987			17	58.0	6	80.8	1.0	86.0	9	64.5	12	76.9		
1988					1	79.0			1	63.0				
1989			19	61.1	29	77.4			5	63.0	45	73.5		
1990	1	41.0	10	63.6	29	77.3			13	62.5	33	73.6		
1991			10	59.5	32	77.1			8	65.1	52	73.4		
1992			37	60.6	12	76.2	3.0	86.7	22	64.1	26	76.4		
1993	1	47.0	3	64.0	17	80.2			6	63.7	69	75.5		
1994			8	67.3	10	83.0			15	70.8	14	76.4	1	85.0
1995	1	44.4	1	70.0	4	83.5					12	76.4		
		POHP		POHP		POHP		POHP		POHP		POHP		POHP
1996			2	56.3					5	59.0	1	67.0		
1997[1]			2	62.0	1	63.0			4	62.8	14	64.4	5	71.0
1998			4	58.3	29	79.1			5	64.0	71	73.4		
1999			2	50.5					2	61.0	2	73.0	1	77.0
2000			10	57.9	5	83.2			8	63.9	5	76.2		
2001			59	65.9	31	77.6			72	63.6	34	73.0		
2002	1	40.0	31	63.0	26	77.3			62	64.4	48	74.7		
2003			6	63.0	68	79.4			12	64.3	139	76.7		
2004			3	56.0					1	58.0	4	77.5		
2005			11	60.6	6	80.2			21	62.6	4	74.8		
2006			8	60.8	5	75.4			17	61.8	18	71.7		
2007	2	37.0	6	62.8	11	76.5			21	60.0	27	73.3		
2008			2	67.5	21	83.1			5	67.4	37	78.9		
Mean[2]		38.5		60.3		77.5				62.5		73.4		74.0

[1] Carcasses sampled in 1997 had a mix of MEHP and POHP lengths taken. Only POHP samples are given here.
[2] Mean of mean values for 1996-2008 post-eye to hypural plate lengths.

Table 22. Counts and mean mid-eye (MEHP) or post-orbital (POHP) to hypural plate lengths (cm) of Naches River wild/natural spring Chinook from carcasses sampled on the spawning grounds by sex and age, 1986-present.

Return	Males								Females							
	Age 3		Age 4		Age 5		Age 6		Age 3		Age 4		Age 5		Age 6	
Year	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP
1986	1	45.0	12	62.7	6	74.3	1.0	80.0			14	64.5	27	73.6	1	83.5
1987	1	37.0	12	64.2	2	80.5	1.0	94.0			29	67.9	13	75.7		
1988			4	62.0	4	74.6			1	45.0	7	69.1	10	73.6		
1989			33	58.4	14	77.5					22	61.7	40	73.2	1	75.0
1990	3	53.0	20	59.4	10	75.9			3	51.7	16	60.9	9	73.7		
1991	1	31.0	12	56.3	10	72.8					6	62.5	39	71.1		
1992	1	42.0	20	58.8	3	72.3	1.0	83.0			24	62.4	10	71.7		
1993			11	60.0	15	77.7					8	63.3	35	72.5		
1994			2	62.5	2	77.0					3	63.7	7	73.1		
1995			1	59.0	3	73.0					2	64.0	5	73.8		
		POHP		POHP		POHP		POHP		POHP		POHP		POHP		POHP
1996			17	58.1							12	60.3	4	69.6		
1997[1]	1	39.0	24	59.8	4	71.5	2.0	78.0			28	60.0	15	68.6	1	75.0
1998			5	57.8	12	75.0					12	61.1	31	71.6		
1999	1	40.0	5	61.2	2	73.0					3	58.7	6	75.0		
2000	1	35.0	56	58.2	2	84.0					71	59.5	6	72.8		
2001	1	45.0	43	61.4	15	73.4					72	62.2	46	74.5		
2002	1	40.0	37	63.6	9	77.3					62	62.4	36	71.8		
2003	5	41.4	16	62.2	43	79.4			1	41.0	18	62.8	76	75.6		
2004	3	46.0	35	59.8	2	74.5					84	61.5	8	75.8		
2005			9	60.1	2	78.0					31	61.7	6	71.7		
2006			8	56.9	5	76.0					8	63.8	5	71.2		
2007			3	61.3	1	67.0					11	56.9	8	72.1		
2008	4	42.0	5	59.6	2	81.5					20	62.0	3	78.7		
Mean[2]		41.1		60.0		75.9		78.0		41.0		61.0		73.0		75.0

[1] Carcasses sampled in 1997 had a mix of MEHP and POHP lengths taken. Only POHP samples are given here.
[2] Mean of mean values for 1996-2008 post-eye to hypural plate lengths.

Table 23. Counts and mean mid-eye (MEHP) or post-orbital (POHP) to hypural plate lengths (cm) of upper Yakima River wild / natural spring Chinook from carcasses sampled on the spawning grounds by sex and age, 1986-present.

	Males						Females					
Return	Age 3		Age 4		Age 5		Age 3		Age 4		Age 5	
Year	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP	Count	MEHP
1986			12	60.8					48	58.7	3	70.3
1987	7	45.3	53	58.5	5	73.0			96	59.3	28	70.6
1988	9	40.0	28	59.0	3	79.0	5	52.6	36	59.2	7	70.3
1989	1	50.0	121	59.7	8	70.6	1	40.0	235	58.6	10	67.2
1990	6	47.0	84	58.0	5	77.0	4	51.5	184	59.3	6	72.5
1991	5	39.6	48	56.2	2	67.5			99	57.6	12	68.8
1992	4	43.0	153	58.4	10	71.2			309	58.2	6	69.5
1993	2	44.0	45	60.7	3	75.0	1	56.0	101	59.5	8	70.3
1994			15	62.9					49	61.3	1	72.0
1995	1	43.0	4	62.0					12	61.4	0	
		POHP		POHP		POHP		POHP		POHP		POHP
1996	14	40.9	138	59.1	2	66.5	2	41.0	277	58.6	3	68.0
1997			59	59.3	2	74.0			131	58.6	5	69.4
1998	3	38.7	18	56.4			2	47.0	33	57.5	3	66.7
1999	21	38.8	13	57.4					34	58.9	2	69.8
2000	2	41.0	70	60.3					219	58.3	0	
2001	1	43.0	33	60.7	3	74.7			102	60.6	20	69.8
2002	1	44.0	24	64.9	16	69.3	2	46.0	49	62.5	5	70.2
2003	23	44.4	15	59.8					19	62.4	3	67.8
2004	7	47.3	101	59.9					197	58.7	1	67.0
2005	11	49.2	108	60.6	1	75.0	3	48.7	207	59.5	3	67.3
2006	14	41.8	44	59.4	1	72.0	2	39.5	82	58.3	1	71.0
2007			3	59.0					10	59.8		
2008						Data not yet available						
Mean[1]		42.9		59.7		71.9		44.4		59.5		68.7

[1] Mean of mean values for 1996-2007 post-eye to hypural plate lengths.

Table 24. Counts and mean post-orbital to hypural plate (POHP) lengths (cm) of upper Yakima River CESRF spring Chinook from carcasses sampled on the spawning grounds by sex and age, 2001-present.

	Males						Females					
Return	Age 3		Age 4		Age 5		Age 3		Age 4		Age 5	
Year	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP
2001	8	40.5	25	59.0	1	69.5	1	41.0	107	59.0		
2002	6	47.7	61	61.2	8	68.9			124	60.6	16	71.2
2003	1	42.0							1	69.0		
2004	2	52.0	19	60.8					50	57.9	1	68.0
2005	8	41.8	12	59.9			1	46.0	20	59.6	1	72.0
2006	4	42.3	11	54.0					43	57.0		
2007	4	44.3	1	60.0					10	60.3		
2008						Data not yet available						
Mean		44.4		59.1		69.2				60.5		70.4

Table 25. Counts and mean post-orbital to hypural plate (POHP) lengths (cm) of upper Yakima River wild/natural spring Chinook from carcasses sampled at the CESRF prior to spawning by sex and age, 1997-present.

	Males						Females					
Return	Age 3		Age 4		Age 5		Age 3		Age 4		Age 5	
Year	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP
1997	4	39.7	81	59.7	3	73.3			105	60.5	6	68.9
1998	28	43.0	95	57.3	6	67.0			161	59.2	15	65.6
1999	124	41.4	75	59.5	10	64.6			199	60.4	16	67.4
2000	19	42.0	145	59.0	1	77.0			263	59.4	3	69.4
2001	17	42.9	115	59.6	14	74.1			196	60.5	19	69.8
2002	23	42.1	113	60.6	5	72.9	1	36.6	233	61.2	9	70.9
2003	37	42.7	92	60.4	19	73.7			164	61.4	31	69.4
2004	18	42.4	108	58.9	1	67.8			225	58.3	2	66.5
2005	19	42.1	113	60.0	2	67.3	1	42.6	223	59.8	5	67.8
2006	17	41.0	82	56.7	20	70.4			197	57.8	24	68.1
2007	20	44.6	108	58.8	17	67.6			181	59.4	24	67.2
2008	17	45.5	121	59.6	4	71.1			209	59.7	11	68.4
Mean		42.4		59.2		70.6				59.8		68.3

Table 26. Counts and mean post-orbital to hypural plate (POHP) lengths (cm) of upper Yakima River CESRF spring Chinook from carcasses sampled at the CESRF prior to spawning by sex and age, 2001-present.

	Males						Females					
Return	Age 3		Age 4		Age 5		Age 3		Age 4		Age 5	
Year	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP	Count	POHP
2001			4	61.3					33	60.4		
2002	2	40.2	25	59.6					63	59.4	2	66.1
2003	17	42.6	16	57.8	15	74.0			31	59.7	19	70.4
2004	6	39.4	9	57.1					42	59.3		
2005	6	37.9	21	58.4	2	68.7			38	58.6	5	68.0
2006[1]			3	57.2					3	56.3		
2007	8	40.4	18	59.3	1	71.4			35	58.2	5	67.6
2008	17	43.8	9	59.1					28	59.4		
Mean		40.7		58.7		71.4				58.9		68.0

[1] Few length samples were collected since these fish were not spawned in 2006.

Table 27. Counts and mean post-orbital to hypural plate (POHP) lengths (cm) of upper Yakima River wild/natural spring Chinook from fish sampled at Roza Dam by age, 1997-present.

Return	Age 2		Age 3		Age 4		Age 5	
Year	Count	POHP	Count	POHP	Count	POHP	Count	POHP
1997			4	39.6	202	60.5	12	71.0
1998			37	42.8	309	59.1	24	67.3
1999			352	40.7	336	60.0	30	68.0
2000			41	41.4	499	60.3	5	73.1
2001			32	42.9	482	61.4	52	72.4
2002			45	42.1	525	60.8	29	71.1
2003			55	43.5	314	62.3	63	72.4
2004	2	15.5	41	43.4	515	59.8	3	69.3
2005			35	43.2	441	60.9	11	71.0
2006			28	41.5	413	58.9	49	70.9
2007	2	14.5	32	43.2	363	60.6	52	69.8
2008			38	45.8	394	61.0	16	70.8
Mean				42.5		60.5		70.6

Table 28. Counts and mean post-orbital to hypural plate (POHP) lengths (cm) of upper Yakima River CESRF spring Chinook from fish sampled at Roza Dam by age, 2000-present.

Return	Age 2		Age 3		Age 4		Age 5	
Year	Count	POHP	Count	POHP	Count	POHP	Count	POHP
2000	66	15.9	633	38.3				
2001	893	15.2	474	40.0	2343	59.3		
2002	475	15.2	26	38.7	1535	59.2	34	67.0
2003	137	15.7	394	41.8	255	60.6	215	71.4
2004	83	15.5	49	40.4	451	59.5	2	71.0
2005	137	15.6	98	40.4	218	59.3	18	70.1
2006	26	14.5	26	40.4	407	57.6	2	70.5
2007	54	15.5	175	41.4	231	59.4	19	70.4
2008	11	15.4	95	45.0	251	60.3	1	67.0
Mean		15.4		40.7		59.4		69.6

Migration Timing

Wild/natural spring Chinook adults returning to the upper Yakima River have generally shown earlier passage timing at Roza Dam than CESRF spring Chinook (Figures 2 and 3).

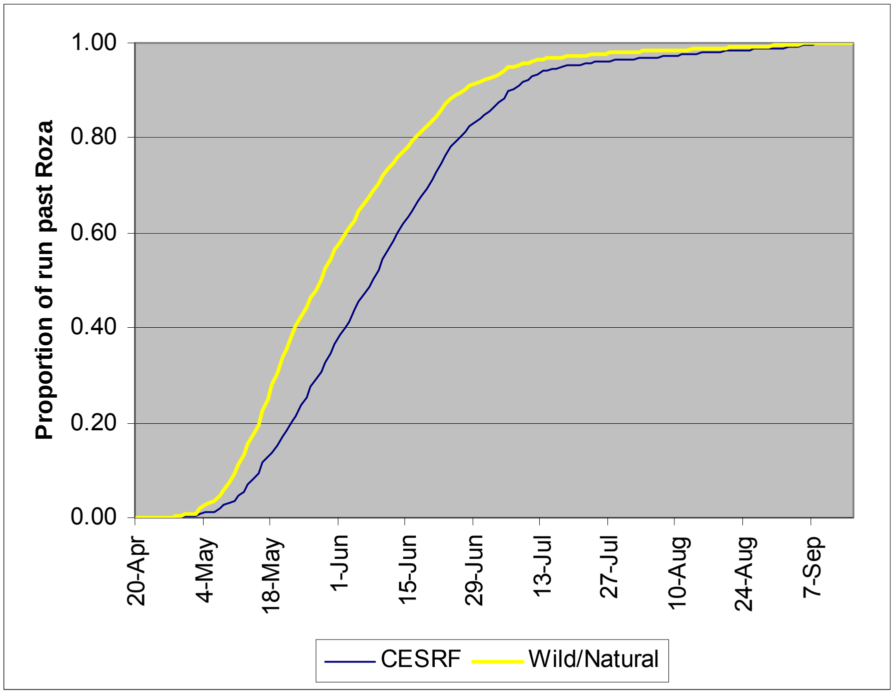


Figure 3. Proportionate passage timing at Roza Dam of wild/natural and CESRF adult spring Chinook (including jacks), 2001-2008.

Table 29. Comparison of 5%, median (50%), and 95% passage dates of wild/natural and CESRF adult spring Chinook (including jacks) at Roza Dam, 1997-Present.

	Wild/Natural Passage			CESRF Passage		
Year	5%	Median	95%	5%	Median	95%
1997	10-Jun	17-Jun	21-Jul			
1998	22-May	10-Jun	10-Jul			
1999	31-May	24-Jun	4-Aug			
2000	12-May	24-May	12-Jul	21-May[1]	15-Jun[1]	27-Jul[1]
2001	4-May	23-May	11-Jul	8-May	28-May	15-Jul
2002	16-May	10-Jun	6-Aug	20-May	13-Jun	12-Aug
2003	13-May	11-Jun	19-Aug	13-May	10-Jun	24-Aug
2004	4-May	20-May	24-Jun	5-May	22-May	26-Jun
2005	9-May	22-May	23-Jun	15-May	31-May	2-Jul
2006	1-Jun	14-Jun	18-Jul	3-Jun	18-Jun	19-Jul
2007	16-May	5-Jun	9-Jul	24-May	14-Jun	19-Jul
2008	27-May	9-Jun	9-Jul	31-May	17-Jun	14-Jul

1. In 2000 all returning CESRF fish were age-3 (jacks).

Spawning Timing

Median spawn timing for CESRF spring Chinook is earlier than that observed for wild/natural fish in the Upper Yakima River. These differences are due in part to environmental conditions and spawning procedures at the hatchery. It must also be noted that spawning dates in the wild are only a coarse approximation, derived from weekly redd counts not actual dates of redd deposition. A clear delineation of wild/natural spawn timing between subbasins is apparent, with American River fish spawning about 1 month earlier than Naches Basin fish which spawn about 2 weeks earlier than Upper Yakima fish.

Table 30. Median spawn[1] dates for spring Chinook in the Yakima Basin.

Year	American	Naches	Upper Yakima	CESRF
1988	14-Aug	7-Sep	3-Oct	
1989	14-Aug	7-Sep	19-Sep	
1990	14-Aug	12-Sep	25-Sep	
1991	12-Aug	12-Sep	24-Sep	
1992	11-Aug	10-Sep	22-Sep	
1993	9-Aug	8-Sep	27-Sep	
1994	16-Aug	14-Sep	26-Sep	
1995	14-Aug	7-Sep	1-Oct	
1996	20-Aug	18-Sep	23-Sep	
1997	12-Aug	11-Sep	23-Sep	23-Sep
1998	11-Aug	15-Sep	30-Sep	22-Sep
1999	24-Aug	8-Sep	27-Sep	21-Sep
2000	7-Aug	20-Sep	19-Sep	19-Sep
2001	14-Aug	13-Sep	25-Sep	18-Sep
2002	12-Aug	11-Sep	23-Sep	24-Sep
2003	11-Aug	14-Sep	28-Sep	23-Sep
2004	17-Aug	12-Sep	27-Sep	21-Sep
2005	15-Aug	15-Sep	27-Sep	20-Sep
2006	15-Aug	14-Sep	26-Sep	19-Sep
2007	14-Aug	12-Sep	25-Sep	25-Sep
2008	11-Aug	12-Sep	23-Sep	23-Sep
Mean	13-Aug	12-Sep	25-Sep	21-Sep

1. Approximately one-half of the redds in the system were counted by this date and one-half were counted after this date. For the CESRF, approximately one-half of the total broodstock were spawned by this date and one-half were spawned after this date.

Redd Counts and Distribution

Table 31. Yakima Basin spring Chinook redd count summary, 1981 – present.

	Upper Yakima River System				Naches River System				
Year	Mainstem[1]	Cle Elum	Teanaway	Total	American	Naches[1]	Bumping	Little Naches	Total
1981	237	57	0	294	72	64	20	16	172
1982	610	30	0	640	11	25	6	12	54
1983	387	15	0	402	36	27	11	9	83
1984	677	31	0	708	72	81	26	41	220
1985	795	153	3	951	141	168	74	44	427
1986	1,716	77	0	1,793	464	543	196	110	1,313
1987	968	75	0	1,043	222	281	133	41	677
1988	369	74	0	443	187	145	111	47	490
1989	770	192	6	968	187	200	101	53	541
1990	727	46	0	773	143	159	111	51	464
1991	568	62	0	630	170	161	84	45	460
1992	1,082	164	0	1,246	120	155	99	51	425
1993	550	105	1	656	214	189	88	63	554
1994	226	64	0	290	89	93	70	20	272
1995	105	12	0	117	46	25	27	6	104
1996	711	100	3	814	28	102	29	25	184
1997	364	56	0	420	111	108	72	48	339
1998	123	24	1	148	149	104	54	23	330
1999	199	24	1	224	27	95	39	25	186
2000	3,349	466	21	3,836	53	483	278	73	887
2001	2,932	386	21	3,339	392	436	257	107	1,192
2002	2,441	275	110	2,826	366	226	262	89	943
2003	772	87	31	890	430	228	216	61	935
2004	2,985	330	129	3,444	91	348	205	75	719
2005	1,717	287	15	2,019	142	203	163	68	576
2006	1,077	100	58	1,235	133	163	115	33	444
2007	665	51	10	726	166	60	60	28	314
2008	1,191	137	47	1,375	158	165	102	70	495
Mean	1,012	124	16	1,152	158	180	107	48	493

[1] Including minor tributaries.

Homing

A team from NOAA fisheries has conducted studies to determine the spatial and temporal patterns of homing and spawning by wild and hatchery-reared salmon released from CESRF facilities from 2001 to present. These studies collected GPS information on each redd and carcass recovered within a survey reach. Carcass surveys were conducted annually in late-September to early October by NOAA personnel in cooperation with Yakama Nation survey crews over five different reaches of the upper Yakima River and recorded the location of each redd flagged and carcass recovered. For each carcass sex, hatchery/wild, male status (full adult, jack, mini-jack), and CWT location was recorded. Data collected on the body location of CWTs allowed the identification of the release site of some fish. While these studies were not designed to comprehensively map carcasses and redds in all spawning reaches in the upper watershed, preliminary data indicate that fish from the Easton, Jack Creek, and Clark Flat acclimation facilities had distinct spawner distributions. A more complete description of this project including preliminary results is available from NOAA fisheries.

Straying

The regional PTAGIS (PIT tag) and RMIS (CWT) databases were queried in February 2009 to determine the number of CESRF releases not returning to the Yakima River Basin. For adult (age-3, -4, or -5) PIT tagged fish, a stray is defined as detection at an out-of-basin facility in the Snake (Ice Harbor or Lower Granite) or Upper Columbia (Priest Rapids, Rock Island, or Wells) without a subsequent detection at Prosser or Roza Dam. For coded-wire tagged fish, a stray is generally defined as a tag recovery in tributaries of the Columbia River upstream (and including the Snake River Basin) of its' confluence with the Yakima River. Marked (adipose fin clipped) fish are occasionally found during carcass surveys in the Naches River system. All marked fish observed in spawning ground carcass surveys in the Naches Basin are assumed to be CESRF fish and are used to estimate in-basin stray rates.

Table 32. Estimated number of PIT- and CWT-tagged CESRF fish not returning to the Yakima River Basin (strays), and marked fish sampled during spawner surveys in the Naches Basin, per number of returning fish, brood years 1997-present.

	CESRF PIT-Tagged Fish			All CESRF Fish			CESRF Age-4 Fish		
Brood Year	Roza Adult Returns	Adult Strays	Stray Rate	Yakima River Mth Return	CWT Strays	Stray Rate	Yak R. MthRtn	In-Basin Strays	Stray Rate
1997	598	2	0.33%	8,670	1	0.01%	7,753		
1998	398	0	0.00%	9,782			7,939	1	0.01%
1999	23	0	0.00%	864			714		
2000	150	4	2.67%	4,819	3	0.06%	3,647	4	0.11%
2001	80	3	3.75%	1,251			845	2	0.24%
2002	97	5	5.15%	2,300			1,886	1	0.05%
2003	31	0	0.00%	932			800		
2004	122			3,906			3,101		

CESRF Spawning and Survival

As described earlier, a portion of natural- and hatchery-origin (NoR and HoR, respectively) returning adults are captured at Roza Dam during the adult migration and taken to the CESRF for broodstock and/or research purposes. Fish are held in adult holding ponds at the CESRF from capture in the spring and summer until spawning in September through early October. All mortalities during the holding period are documented by sex and origin. During the spawning period data are kept on the number of males and females of each origin used for spawning or other purposes. All females have samples taken that are later evaluated for presence of BKD-causative agents. Eggs from females with high BKD-presence indicators are generally excluded (see Female BKD Profiles). Once fertilized, eggs are placed in holding troughs until shock time. Dead eggs are then sorted and hand-counted. All live eggs are machine counted, sorted into two lots per female (treatment and control) and placed into incubation (heath) trays. Using hand counts of egg samples from a subsample of female egg lots, WDFW staff determined that machine counts are biased and that the best approximation of live egg counts is given by the following equation:

$$\left(\left(\frac{\text{no. eggs in subsample}}{\text{wt. of subsample}} * \text{total egg mass wt}\right) * 0.945\right) - \text{dead eggs}$$

where
the first 3 parameters are from egg samples taken from females at spawn time,
dead eggs are the number of dead or unfertilized eggs counted at shock time, and
the 0.945 value is a correction factor from 1997 and 2000 WDFW studies.

Total egg take is calculated as the total number of live eggs, dead eggs, and all documented egg loss (e.g. spilled at spawn time, etc.). Heath trays are periodically sampled during incubation and dead fry are culled and counted. The number of live eggs less documented fry loss is the estimate of the number of fry ponded. Once fry are ponded, mortalities are counted and recorded daily during the rearing period. Fish are hand counted in the fall prior to their release as they are 100-percent marked. This hand-count less documented mortalities from marking through release is the estimate of smolts released. Survival statistics by origin and life-stage are given in Tables 33 and 34.

Table 33. Cle Elum Supplementation and Research Facility spawning and survival statistics (NoR brood only), 1997 - present.

Brood Year	Total Collected	Total Morts.	PreSpawn Survival	No. Fish Spawned[1] Males[2]	Females	% BKD Loss	Total Egg Take	Live Eggs	% Egg Loss[3]	Fry Ponded	Live-Egg-Fry Survival	Smolts Released[4]	Fry-Smolt Survival	Live-Egg-Smolt Survival
1997	261	23	91.2%	106	132	2.6%	500,750	463,948	7.3%	456,981	98.5%	386,048	84.5%	83.2%
1998	408	70	82.8%	140	198	1.4%	739,802	664,125	10.2%	655,249	98.7%	589,683	90.0%	88.8%
1999	738[5]	24	96.7%	213	222	2.7%	818,816	777,984	5.0%	756,592	97.3%	758,789	100.0%	97.5%
2000	567	61	89.2%	170	278	9.2%	916,292	851,128	7.1%	828,055	97.3%	834,285	100.0%	98.0%
2001	595	171	71.3%	145	223	53.2%	341,648	316,254	7.4%	311,751	98.6%	370,236	100.0%	100.0%
2002	629	89	85.9%	125	261	10.0%	919,776	817,841	11.1%	801,141	98.0%	749,067	93.5%	91.6%
2003	441	54	87.8%	115	200	0.0%	856,574	787,933	8.0%	775,619	98.4%	735,959	94.9%	93.4%
2004	597	70	88.3%	125	245	0.4%	873,815	806,375	7.7%	789,028	97.8%	691,109[6]	87.6%	85.7%
2005	526	57	89.2%	136	241	0.0%	907,199	835,890	7.9%	819,861	98.1%	769,484	93.9%	92.1%
2006	519	45	91.3%	122	239	1.7%	772,357	703,657	8.9%	684,918	97.3%	574,361	83.9%	81.6%
2007	473	49	89.6%	149	216	0.9%	798,729	760,189	4.8%	751,586	98.9%	676,602	90.0%	89.0%
2008	480	38	92.1%	151	253	2.0%	915,563	832,938	9.0%	824,586	99.0%			
Mean	520	63	87.9%	141	226	7.0%	780,110	718,188	7.8%	704,614	98.2%	648,693	92.6%	91.0%

1. Total collected minus total mortalities does not equal total spawned. This is because some fish are used in the spawning channel, some have been released back to the river, and some have not been used.
2. Includes jacks.
3. All documented egg loss at spawn time plus dead eggs counted at shock divided by the estimated total egg take.
4. May be greater than fry ponded due to adjusted counts from marking operations.
5. Approximately one-half of these were jacks, many of which were not used in spawning.
6. Approximately 45,000 smolts lost at Jack Creek due to frozen equipment in February, 2006.
7. Table 34 -- From 2002 to present this is the estimated total egg take from all HxH crosses. Due to the large surplus of eggs over the approximately 100K needed for the HxH line, many surplus fry were planted in nearby land-locked lakes and some surplus eggs were destroyed.
8. Tabke 34 -- For only those HxH fish which were actually ponded.

Table 34. Cle Elum Supplementation and Research Facility spawning and survival statistics (HoR brood only), 2002 - present.

Brood Year	Total Collected	Total Morts.	PreSpawn Survival	No. Fish Spawned[1] Males[2]	Females	% BKD Loss	Total Egg Take[7]	Live Eggs[8]	% Egg Loss[3]	Fry Ponded	Live-Egg-Fry Survival	Smolts Released[4]	Fry-Smolt Survival	Live-Egg-Smolt Survival
2002	201	22	89.1%	26	72	4.2%	258,226	100,011	7.8%	98,294	98.3%	87,837	89.4%	87.8%
2003	143	12	91.6%	30	51	0.0%	219,901	83,128	7.3%	82,021	98.7%	88,733	100.0%	100.0%
2004	126	19	84.9%	22	49	0.0%	187,406	94,659	5.9%	92,960	98.2%	94,339	100.0%	99.7%
2005	109	6	94.5%	26	45	0.0%	168,160	89,066	12.2%	87,299	98.0%	90,518	100.0%	100.0%
2006	136	21	84.6%	28	41	2.4%	112,576	80,121	8.6%	78,291	97.7%	68,434	87.4%	85.4%
2007	110	15	86.4%	26	35	0.0%	125,755	90,162	3.2%	89,399	99.2%	94,663	100.0%	100.0%
2008	194	10	94.8%	51	67	1.5%	247,503	106,122	5.1%	104,890	98.8%			
Mean	146	15	89.4%	30	51	1.2%	188,504	91,896	7.2%	90,451	98.4%	87,421	96.1%	95.5%

See footnotes for Table 33 above.

Female BKD Profiles

Adults used for spawning and their progeny are tested for a variety of pathogens accepted as important in salmonid culture (USFWS Inspection Manual, 2003), on a population or "lot" basis. At the CESRF, and in the Columbia Basin it has been accepted that the most significant fish pathogen for spring Chinook is *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD). All adult females and 60 juveniles from each acclimation pond are individually tested for levels of *Renibacterium salmoninarum* using ELISA (Enzyme linked Immuno-sorbant Assay). ELISA data are reported annually to CESRF and YKFP staff for management purposes, eventual data entry and comparisons of ponds and rearing parameters. To date, no significant occurrences of other pathogens have been observed. Periodic field exams for external parasites and any signs of disease are performed on an "as needed" basis. Facility staff have been trained to recognize early signs of behavior changes or diseases and would report any abnormalities to the USFWS, Olympia Fish Health Center for further diagnostic work.

Adult females are ranked from 0 to 13 based on the relative amounts of BKD in the tissue samples of the tested fish. All BKD ranks below 5 are considered low risk for transferring significant BKD organisms through the egg to cause significant disease in progeny receiving proper care. The progeny of adults with BKD rank 6 are considered to be moderate risk and those with BKD rank 7 or greater are considered to be high risk. Given these data, the CESRF chose to rear only the progeny of females with a BKD rank of 6 or less through brood year 2001. Beginning with brood year 2002, the progeny of fish with BKD rank 6 (moderate risk) or greater (high risk) have not been used for production purposes at the CESRF.

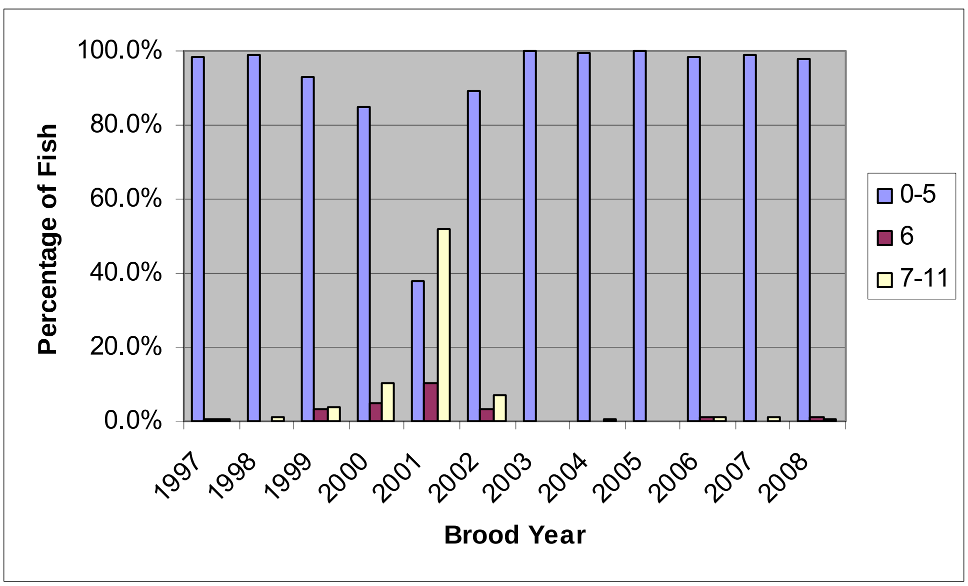


Figure 4. Proportion of wild/natural females spawned at CESRF by BKD rank, 1997 – present.

Fecundity

Fish collected at Roza Dam are taken to the CESRF for spawning and/or research purposes. Egg loss due to spill or other reasons at spawn time is documented. When eggs are shocked, unfertilized (dead) eggs are hand-counted and remaining eggs are machine counted. Due to error associated with machine counts, average fecundity is calculated using spawn-time egg sample data (see discussion above under CESRF Spawning and Survival) and adding in documented egg loss for all females divided by the number of females (N) in the sample.

Table 35. Mean fecundity by age of adult females (BKD rank < 6) spawned at CESRF, 1997-present.

	Wild/Natural (SN)						CESRF (HC)					
Brood	Age-3		Age-4		Age-5		Age-3		Age-4		Age-5	
Year	N	Fecundity	N	Fecundity	N	Fecundity	N	Fecundity	N	Fecundity	N	Fecundity
1997			105	3,842.0	4	4,069.9						
1998			161	3,730.3	15	4,322.5						
1999			183	3,968.1	14	4,448.6						
2000			224	3,876.5	2	5,737.9						
2001			72	3,966.9	9	4,991.2			18	4,178.9		
2002	1	1,038.0	205	3,934.7	7	4,329.4			60	3,820.0	1	4,449.0
2003			163	4,160.2	31	5,092.8			30	3,584.1	19	5,459.9
2004			224	3,555.4	2	4,508.3			42	3,827.2		
2005	1	1,769.0	218	3,815.5	5	4,675.1			38	3,723.9	5	4,014.7
2006			196	3,396.4	24	4,338.9			36	3,087.3		
2007			178	3,658.3	24	4,403.3			33	3,545.2	2	4,381.9
2008			207	3,814.0	10	4,139.9			58	3,898.0		
Mean				3,809.9		4,588.2				3,708.1		4,576.4

Juvenile Salmon Evaluation

Food Conversion Efficiency

At the end of each month that fish are in the rearing ponds at the CESRF or the acclimation sites, a sample of fish are weighed and measured to estimate growth. These data, in addition to monthly mortality and pond feed data are entered into the juvenile growth and survival tracking database. Hatchery managers monitor food conversion (total pounds fed during a month divided by the total pounds gained by the fish) to track how well fish are converting feed into body mass and to evaluate the amount of feed that needs to be provided on a monthly basis. Average monthly food conversion and growth statistics for the CESRF facilities by brood year are provided in the following tables and figures.

Table 36. Mean food conversion (lbs fed/lbs gained) of CESRF juveniles by brood year and growth month, 1997 – present.

Brood Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1997	2.2		1.1	0.8	1.2	0.8	1.5	1.5		1.9		5.3	0.7
1998		1.0	0.9	1.0	0.9	0.8	2.4	1.4	2.1	-0.3	1.0	1.2	0.8
1999		1.0	1.1	1.1	1.2	1.5	1.8	1.0		-0.5	0.3	1.7	0.7
2000	0.8	0.8	1.0	1.5	1.2	1.4	2.2	2.0	1.6	2.1	2.5	2.4	
2001	1.1	1.1	2.6	1.1	1.3	1.2	1.6	2.0	2.3	2.5	2.8	0.9	
2002	0.9	1.0	1.4	1.2	1.4	1.1	1.5	2.2	4.0	-1.4	2.9	1.0	
2003	0.6	1.0	0.9	1.4	1.2	1.2	4.6	0.7	0.9	-0.2	1.8	1.0	
2004	0.9	1.0	1.2	1.6	2.4	1.2	1.7	2.0	2.8	0.9	-2.6	1.1	
2005	0.8	0.7	1.3	1.0	1.3	1.2	1.5	-0.8	0.4	-0.4	2.2		
2006	0.8	0.7	0.6	0.9	0.8	1.0	1.6	-1.0	10.1	-2.6	0.6	0.6	
2007	0.7	0.7	0.9	0.9	1.0	0.8	2.2	-1.6	1.9	2.0	0.7	0.9	
Mean	1.0	0.9	1.2	1.1	1.3	1.1	2.1	0.9	2.0	0.7	1.2	1.2	0.7

Length and Weight Growth Profiles

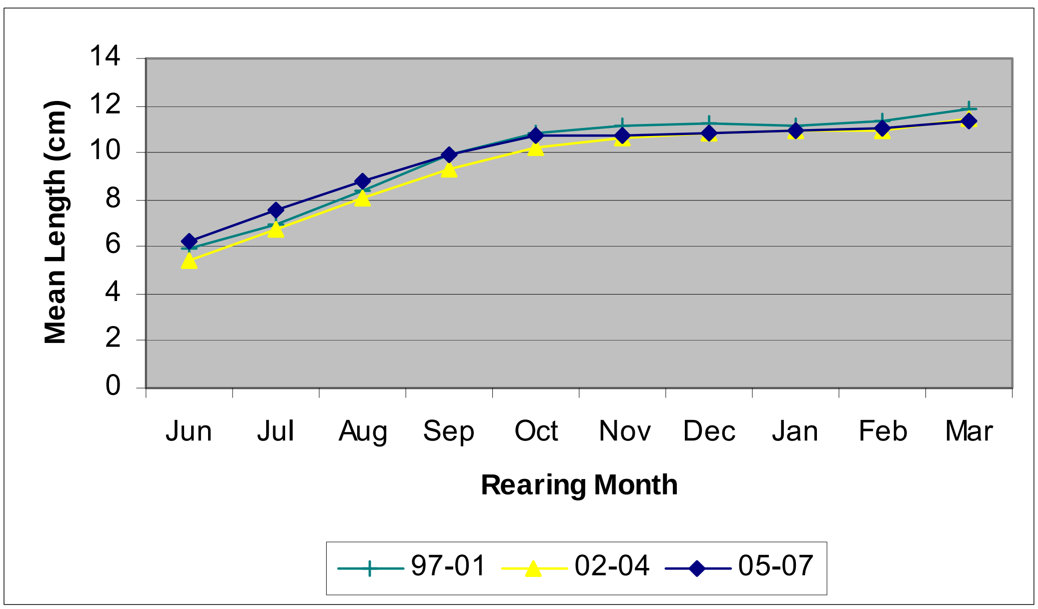


Figure 5. Mean length (cm) of "standard growth treatment (Hi)" CESRF juveniles by brood year and growth month, 1997 - present.

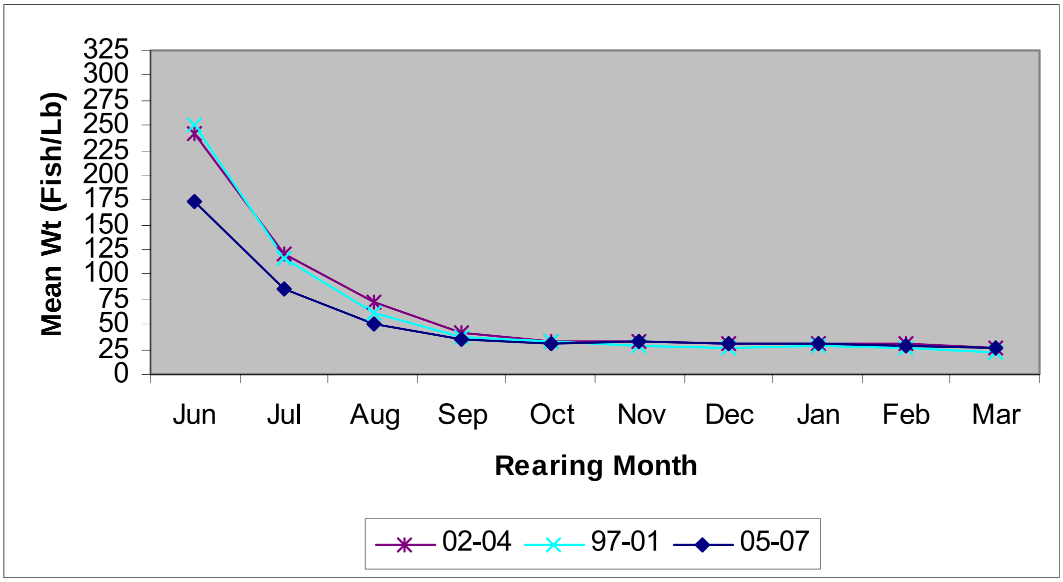


Figure 6. Mean Weight (fish/lb) of "standard growth treatment (Hi)" CESRF juveniles by brood year and growth month, 1997 - present.

Juvenile Fish Health Profile

Approximately 60 fish from each acclimation site pond are sacrificed for juvenile fish health samples in the spring (usually in March) of their release year. Tissue samples from these fish are processed at USFWS laboratories in Olympia, Washington for presence of bacterial kidney disease (BKD) using enzyme-linked immunosorbent assay (ELISA) tests (see Female BKD Profiles for additional discussion). Fish are ranked from 0 to 13 based on the relative amounts of BKD in the tissue samples of the tested fish. Based on empirical evidence, fish with BKD ranks of 0-5 are considered to be low risk for incidence of BKD in the presence of a good fish culture and rearing environment (i.e., water temperature and flows, nutrition, densities, etc. all must be conducive to good fish health).

Table 37. Mean BKD rank of juvenile fish sampled at CESRF acclimation sites by brood year and raceway, 1997-present.

	Brood Year[1]							
Raceway	1997	1998	2000	2001[2]	2002	2003	2006	Mean
CFJ01	0.80	0.53	2.17	1.90	0.28	0.28	2.10	1.15
CFJ02	1.08	1.88	1.33	1.10	0.18	0.25	1.87	1.10
CFJ03	2.38	0.82	1.50		0.22	0.28	1.79	1.16
CFJ04	1.15	0.58	1.18		0.16	0.14	1.96	0.86
CFJ05	0.85	0.78	1.20		0.06	0.75	2.34	1.00
CFJ06	1.05	0.70	1.02		0.21	0.02	1.71	0.78
ESJ01	2.03	0.50	1.97	1.19	0.10	0.55	1.73	1.15
ESJ02	1.68	0.53	1.17	1.50	0.05	0.43	1.63	1.00
ESJ03	2.23	1.37	2.47	0.86	0.07	0.33	1.97	1.33
ESJ04	1.33	0.55	1.35	0.79	0.15	0.60	1.41	0.88
ESJ05		1.15	3.12	0.73	0.04	0.68	2.07	1.30
ESJ06		0.67	1.30	0.80	0.05	0.23	2.05	0.85
JCJ01		0.67	1.93	1.47	0.04	0.10	1.43	0.94
JCJ02		0.48	1.30	1.52	0.19	0.08	2.00	0.93
JCJ03		0.33	1.45	1.62	0.06	0.20	1.66	0.89
JCJ04		0.62	1.50	1.56	0.05	0.13	1.40	0.88
JCJ05			1.55	1.67	0.00	1.35	1.83	1.28
JCJ06			1.25	1.46	0.03	0.10	1.31	0.83
Clark Flat	1.22	0.88	1.40	1.50	0.18	0.29	1.96	1.06
Easton	1.81	0.80	1.89	0.98	0.08	0.47	1.81	1.12
Jack Creek		0.53	1.50	1.55	0.06	0.33	1.61	0.93
All Ponds	1.46	0.76	1.60	1.30	0.11	0.36	1.79	1.05

1. For the 1999, 2004 and 2005 broods, antibody problems were encountered and the USFWS was unable to process the samples.
2. High BKD incidence in adult broodstock reduced production to just 9 ponds (Clark Flat 1-2, Jack Creek, and Easton). Easton samples were for predator avoidance trained (PAT) fish and were the cumulative equivalent of one Cle Elum pond (i.e., ~6,500 fish per pond).

Incidence of Precocialism

For brood years 2002-2004, the YKFP tested two different feeding regimes to determine whether a slowed-growth regime reduces the incidence of precocialism without a reduction in post-release survival. The two growth regimes tested were a normal (High) growth regime resulting in fish which were about 30/pound at release and a slowed growth regime (Low) resulting in fish which were about 45/pound at release. As a critical part of this study, a team from NOAA Fisheries conducted research to characterize the physiology and development of wild and hatchery-reared spring Chinook salmon in the Yakima River

Basin. While precocious male maturation is a normal life-history strategy, the hatchery environment may be potentiating this developmental pathway beyond natural levels resulting in potential loss of anadromous adults, skewing of sex ratios, and negative genetic and ecological impacts on wild populations. Previous studies have indicated that age of maturation is significantly influenced by endogenous energy stores and growth rate at specific times of the year. These studies will help direct rearing strategies at the CESRF to allow production of hatchery fish with physiological and life-history attributes that are more similar to their wild cohorts.

Relevant Publications:

Larsen, D. A., B. R. Beckman, K. A. Cooper, D. Barrett, M. Johnston, P. Swanson, and W. W. Dickhoff. 2004. Assessment of High Rates of Precocious Male Maturation in a Spring Chinook Salmon Supplementation Hatchery Program. Transactions of the American Fisheries Society 133:98-120.

Beckman, B.R. and Larsen D.A. 2005. Upstream Migration of Minijack (Age-2) Chinook Salmon in the Columbia River: Behavior, Abundance, Distribution, and Origin. Transactions of the American Fisheries Society 134:1520–1541.

Larsen, D.A., B.R. Beckman, C.R. Strom, P.J. Parkins, K.A. Cooper, D.E. Fast, W.W. Dickhoff. 2006. Growth Modulation Alters the Incidence of Early Male Maturation and Physiological Development of Hatchery-reared Spring Chinook Salmon: a Comparison with Wild Fish. Transactions of the American Fisheries Society 135:1017-1032.

CESRF Smolt Releases

The number of release groups and total number of fish released diverged from facility goals in some years. In brood year 1997, the Jack Creek acclimation facility was not yet complete and project policy and technical teams purposely decided to under-collect brood stock to allow a methodical testing of the new facility's operations with less risk to live fish, which resulted in the stocking of only 10 of the 18 raceways. In brood year 1998, the project did not meet facility release goals due to a biological specification that no more than 50% of returning wild fish be taken for brood stock. As a result only 16 raceways were stocked with progeny of the 1998 brood. In the same year, raceway 4 at the Jack Creek acclimation site suffered mechanical failures causing loss of flow and reduced oxygen levels and resulted in the loss of approximately one-half the fish in this raceway prior to release. In the drought year of 2001, a large number of returning adults presented with high enzyme-linked immunosorbent assay (ELISA) levels of *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD). The progeny of these females were purposely destroyed. As a result, only nine raceways were stocked with fish. The project decided to use the fish from an odd raceway for a predator avoidance training sub-experiment (these fish were subsequently acclimated and released from the Easton acclimation site).

Table 38. CESRF total releases by brood year, treatment, and acclimation site.

Brood Year	Control[1]	Treatment[2]	Acclimation Site CFJ	ESJ	JCJ	Total
1997	207,437	178,611	229,290	156,758		386,048
1998[3]	284,673	305,010	221,460	230,860	137,363	589,683
1999	384,563	374,226	232,563	269,502	256,724	758,789
2000	424,554	409,731	285,954	263,061	285,270	834,285
2001[4]	183,963	186,273	80,782	39,106	250,348	370,236
2002	420,764	416,140	266,563	290,552	279,789	836,904
2003	414,175	410,517	273,377	267,711	283,604	824,692
2004[5]	378,740	406,708	280,598	273,440	231,410	785,448
2005	431,536	428,466	287,127	281,150	291,725	860,002
2006	351,063	291,732	209,575	217,932	215,288	642,795
2007	387,055	384,210	265,907	254,540	250,818	771,265
Mean	351,684	344,693	239,381	231,328	248,234	696,377

Table 39. CESRF average pond densities at release by brood year, treatment, and acclimation site.

Brood	Treatment		Acclimation Site		
Year	Control[1]	Treatment[2]	CFJ	ESJ	JCJ
1997	41,487	35,722	38,215	39,190	
1998[3]	35,584	38,126	36,910	38,477	34,341
1999	42,729	41,581	38,761	44,917	42,787
2000	47,173	45,526	47,659	43,844	47,545
2001[4]	41,116	41,667	40,391	6,518	41,725
2002	46,752	46,238	44,427	48,425	46,632
2003	46,019	45,613	45,563	44,619	47,267
2004[5]	42,082	45,190	46,766	45,573	38,568
2005	47,948	47,607	47,855	46,858	48,621
2006	39,007	32,415	34,929	36,322	35,881
2007	43,006	42,690	44,318	42,423	41,803
Mean	42,991	42,034	42,345	43,065	42,517

1. Brood years 1997-2001: Optimum Conventional Treatment (OCT). Brood Years 2002-2004: Normal (High) growth. Brood Years 2005-2007: Normal feed at Cle Elum or accl. sites.
2. Brood years 1997-2001: Semi-natural Treatment (SNT). Brood Years 2002-2004: Slowed (Low) growth. Brood Year 2005, 2007: saltwater transition feed at accl. sites. Brood Year 2006: EWS diet at CESRF through May 3, 2007.
3. At the Jack Creek acclimation site only 4 of 6 raceways were stocked, and raceway 4 suffered mechanical failures resulting in the loss of about 20,000 OCT (control) fish.
4. High BKD incidence in adult broodstock reduced production to just 9 ponds (Clark Flat 1-2, Jack Creek, and Easton). Easton ponds were used for predator avoidance trained (PAT) fish and a single Cle Elum pond was spread between 6 ponds at Easton with crowders used to simulate pond densities for fish at other acclimation sites. These releases were excluded from mean pond density calculations by treatment.
5. At the Jack Creek acclimation site raceway 3 suffered mechanical failures resulting in the loss of about 45,000 high-growth (control) fish.

Mean length and weight at release by brood year are shown in Figures 5 and 6 under Juvenile Salmon Evaluation, length and weight growth profiles. Mark information and volitional release dates are given in Appendix A.

Smolt Outmigration Timing

The Chandler Juvenile Monitoring Facility (CJMF) located on the fish bypass facility of Chandler Canal at Prosser Dam (Rkm 75.6; Figure 1) serves as the cornerstone facility for estimating smolt production in the Yakima Basin for several species and stocks of salmonids. Daily species counts in the livebox at the CJMF are expanded by the canal entrainment, canal survival, and sub-sampling rates in order to estimate daily passage at Prosser Dam (Neeley 2000). Expansion techniques for deriving Chandler smolt passage estimates are continually being reviewed and revised to incorporate new information. A subset of fish passing through the CJMF is sampled for presence of internal (CWT or PIT) or external (fin-clip) marks. All fish with marks are assumed to be of hatchery origin; otherwise, fish are presumed to be of natural origin.

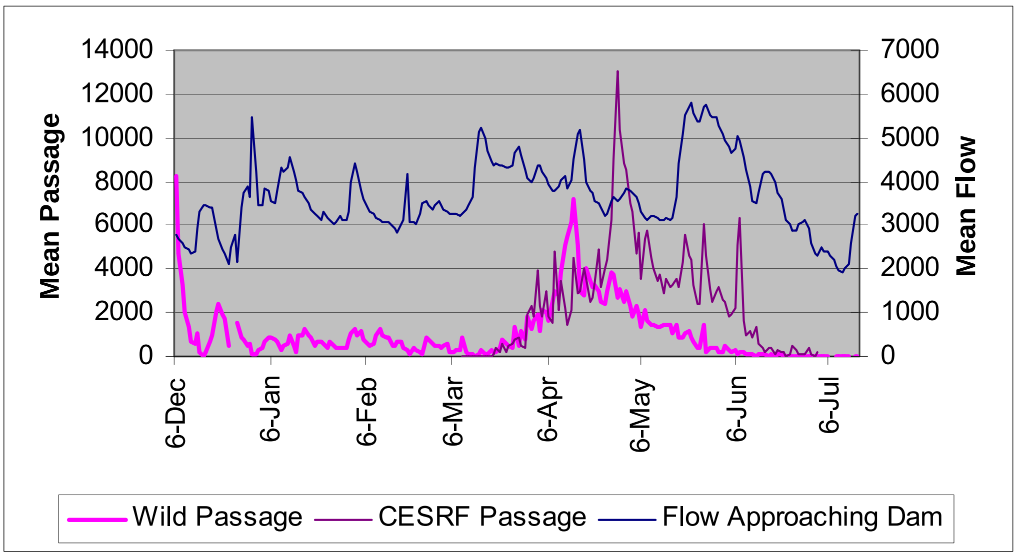


Figure 7. Mean flow approaching Prosser Dam versus mean estimated smolt passage at Prosser of aggregate wild/natural and CESRF spring Chinook for outmigration years 1999-2008.

Smolt-to-Smolt Survival

OCT-SNT Treatment (Brood Years 1997-2001, Migration Years 1999-2003)

Results of this experiment have been published:

Fast, D. E., D. Neeley, D.T. Lind, M. V. Johnston, C.R. Strom, W. J. Bosch, C. M. Knudsen, S. L. Schroder, and B.D. Watson. 2008. Survival Comparison of Spring Chinook Salmon Reared in a Production Hatchery under Optimum Conventional and Seminatural Conditions. Transactions of the American Fisheries Society 137:1507–1518.

Abstract — We found insufficient evidence to conclude that seminatural treatment (SNT; i.e., rearing in camouflage-painted raceways with surface and underwater structures and underwater feeders) of juvenile Chinook salmon *Oncorhynchus tshawytscha* resulted in higher survival indices than did optimum conventional treatment (OCT; i.e., rearing in concrete raceways with surface feeding) for the specific treatments and environmental conditions tested. We reared spring Chinook salmon from fry to smolt in paired raceways under the SNT and OCT rearing treatments for five consecutive years. For four to nine SNT and OCT raceway pairs annually, we used passive integrated transponder, coded wire, and visual implant elastomer tags to compare survival indices for juvenile fish from release at three different acclimation sites 340–400 km downstream to passage at McNary Dam on the Columbia River, and for adults from release to adult return to Roza Dam in the upper Yakima basin. The observed differences in juvenile and adult survival between the SNT and OCT fish were either statistically insignificant, conflicting in their statistical significance, or explained by significant differences in the presence of the causative agents of bacterial kidney disease in juvenile fish at release.

High-Low Growth Treatment (Brood Years 2002-04, Migration Years 2004-2006)

Two early-rearing nutritional regimes were tested using hatchery-reared Yakima Upper spring Chinook for brood years 2002 through 2004. A low nutrition-feeding rate (low treatment or low) was administered at the Cle Elum Hatchery through early rearing to determine whether that treatment would reduce the proportion of precocials produced compared to a conventional feeding rate during early rearing. The conventional feeding rate, which served as a control treatment, is referred to here as a high nutrition-feeding rate (high treatment or high). Feed was administered at a rate of 10 grams/fish for the low treatment and 15 grams/fish for the high treatment through mid-October, after which sufficient feed was administered to both sets of treated fish to meet their feeding demands. The treatments were allocated within pairs of raceways (blocks), there being a total of nine pairs. The Low nutritional feed (Low) had a significantly lower release-to-McNary survival than did the High nutritional feed (High), respective survivals being 18.1% and 21.2% ($P < 0.0001$; D. Neeley, Appendix B of main annual report). The Low survival to McNary was consistently lower than the High at all sites in all years. Low-treated fish were smaller fish at the time of release and had somewhat later McNary passage times than high-treated fish. See Appendix B in the main body of this annual report for detailed information and analyses on this study.

Control versus Saltwater Transfer Treatment (Brood Year 2005, Migration Year 2007)

An STF feed (intended to facilitate smolt fresh-water to salt-water transition) was tested at the Cle Elum facility and compared to the control feed. These two treatments were assigned to different raceways within adjacent raceway pairs, there being up to nine raceway pairs. Each raceway pair was assigned to juvenile progeny from the same diallele crosses, the different raceway pairs being from different diallele crosses. Juveniles were transported to three acclimation sites (Clark Flat, Easton, and Jack Creek), up to three pairs of adjacent Cle Elum raceways assigned to corresponding adjacent raceways at a given site, different Cle Elum raceway pairs to different sites. There were no significant or substantial differences between the two feeding treatments (Appendix B of main annual report).

Control (Bio-Oregon) versus EWOS Feed Comparison (Brood Year 2006, Migration Year 2008)

This experimental design was similar to that described above for the Control versus saltwater transfer treatment study, with the standard Bio-Oregon pellets fed to half of the rearing ponds and an EWOS (www.ewos.com) diet fed to the other ponds. The different feed treatments only lasted about 6 weeks from the time of initial ponding as we found substantially higher mortalities for fish receiving the EWOS feed. From May 7, 2007 until these fish were released in 2008 all fish in this study received the Bio-Oregon diet. For the parameters of interest, we found no significant or substantial differences between the two feeding treatments (Appendix B of main annual report).

Smolt-to-Adult Survival

Calculation of smolt-to-adult survival rates for Yakima River spring Chinook is complicated by the following factors:

1) Downstream of the confluence of the Yakima and Naches rivers the three populations of spring Chinook (Upper Yakima, Naches, and American) are aggregated. A subsample of the aggregate wild/natural populations is PIT-tagged as part of the Chandler juvenile sampling operation but their origin is not known at the time of tagging. Through 2003, the primary purpose of this subsampling effort was to derive entrainment and canal survival estimates (see 2 below). Due to issues such as tag retention and population representation, adult detections of smolts PIT-tagged at Chandler can not be used in any valid smolt-to-adult survival analyses.

2) Smolt accounting at Prosser is based on statistical expansion of Chandler smolt trap sampling data using available flow data and estimated Chandler entrainment rates. Chandler smolt passage estimates are prepared primarily for the purpose of comparing relative wild versus CESRF passage estimates and not for making survival comparisons. While these Chandler smolt passage estimates represent the best available data, there may be a relatively high degree of error associated with these estimates due to inherent complexities, assumptions, and uncertainties in the statistical expansion process. Therefore, these estimates are subject to revision. We are in the process of developing methods to subdivide the wild/natural outmigration into Upper Yakima, Naches, and American components based on DNA samples of juveniles taken at Chandler since 1998.

3) Installation of adult PIT detection equipment at all three ladders at Prosser Dam was not completed until the fall of 2005. Therefore, detection of upstream-migrating PIT-tagged adult spring Chinook at Prosser Dam was not possible for all returning fish until the spring of 2006. Periods of high flow may preclude use of automated detection gear so 100% detection of upstream migrants is not possible in all years.

4) Through 2006, detection of upstream-migrating PIT-tagged adult spring Chinook at Roza Dam presently occurred at an approximate 100% rate only for marked CESRF fish and wild/natural fish taken for broodstock. The majority of wild/natural fish were passed directly back to the river without PIT interrogation.

5) For the 1997 brood (1999 out-migration), 400 Khz PIT-tags were used. Mainstem detection facilities were not configured to detect these tags at nearly the efficiency that they can detect the newer 134.2 kHz ISO tags. Although all marked adult fish are trapped and hand-wanded for PIT detections of adults at Roza Dam, the reliability of the 400kHz detection gear and problems with hand-sampling in general likely precluded a complete accounting of all 1997 brood PIT returns.

6) All CESRF fish are adipose-fin clipped and subjected to higher harvest rates than unmarked wild/natural fish in marine and Columbia River mark-selective fisheries. No adjustments have yet been made in the following tables to account for differential harvest rates in these mark-selective fisheries.

7) PIT tag retention is a factor in estimating survival rates. No attempt has been made to correct the data in the following tables for estimates of tag retention.

8) The ISAB has indicated that "more attention should be given to the apparent documentation that PIT-tagged fish do not survive as well as untagged fish. This point has major implications for all uses of PIT-tagged fish as surrogates for untagged fish." Our data appear to corroborate this point (Tables 43-44). However, these data are not corrected for tag loss. If a fish loses its PIT tag after detection upon leaving the acclimation site, but before it returns as an adult to Roza Dam, it would be included only as a release in Table 43 and only as an adult return in Table 44. Knudsen et al. (2009) found that smolt-to-adult return rates (SARS) based on observed PIT tag recoveries were significantly underestimated by an average of 25% and that after correcting for tag loss, SARS of PIT-tagged fish

were still 10% lower than SARS of non-PIT-tagged fish. Thus, the data in Table 43 under-represent "true" SARS for PIT-tagged fish and SARS for PIT-tagged and non-PIT-tagged fish are likely closer than those reported in Tables 43 and 44.

Given these complicating factors, Tables 40-44 present available smolt-to-adult survival data for Yakima River CESRF and wild/natural spring Chinook. Unfortunately, true "apples-to-apples" comparisons of CESRF and wild/natural smolt-to-adult survival rates are not possible from these tables due to complexities noted above. The reader is cautioned to correct these data for factors noted above prior to any use of these data.

Table 40. Estimated smolt passage at Chandler and smolt-to-adult survival rates (Chandler smolt to Yakima R. mouth adult).

			Estimated Smolt Passage at Chandler				CESRF smolt-	Yakima R. Mouth Adult Returns[6]		Smolt-to-Adult Survival[6]	
Brood Year	Migr. Year	Mean Flow[1]	Wild/ Natural[2]	Control[3]	Treatment[4]	CESRF Total	to-smolt survival[5]	Wild/ Natural[2]	CESRF Total	Wild/ Natural[2]	CESRF Total
1982	1984	4134	381,857					6,753		1.8%	
1983	1985	3421	146,952					5,198		3.5%	
1984	1986	3887	227,932					3,932		1.7%	
1985	1987	3050	261,819					4,776		1.8%	
1986	1988	2454	271,316					4,518		1.7%	
1987	1989	4265	76,362					2,402		3.1%	
1988	1990	4141	140,218					5,746		4.1%	
1989	1991		109,002					2,597		2.4%	
1990	1992	1960	128,457					1,178		0.9%	
1991	1993	3397	92,912					544		0.6%	
1992	1994	1926	167,477					3,790		2.3%	
1993	1995	4882	172,375					3,202		1.9%	
1994	1996	6231	218,578					1,238		0.6%	
1995	1997	12608	52,028					1,995		3.8%	
1996	1998	5466	291,557					21,151		7.3%	
1997	1999	5925	277,087	42,668	55,176	97,844	25.3%	12,855	8,670	4.6%	8.9%
1998	2000	4946	77,009	109,087	116,020	225,107	38.2%	8,228	9,782	10.7%	4.3%
1999	2001	1321	105,422	233,921	216,649	450,570	59.4%	1,765	864	1.7%	0.2%
2000	2002	5015	481,414	193,515	132,228	325,743	39.0%	11,445	4,819	2.4%	1.5%
2001	2003	3504	261,707	49,845	62,232	112,077	30.3%	8,597	1,251	3.3%	1.1%
2002	2004	2439	137,343	155,031	145,056	300,087	35.9%	3,743	2,300	2.7%	0.8%
2003	2005	1285	157,057	124,412	106,253	230,665	28.0%	2,795	969	1.8%	0.4%
2004	2006	5652	92,175	86,308	73,044	159,352	20.3%	2,446[7]	3,869[7]	2.7%[7]	2.4%[7]
2005	2007	4551	130,263	163,151	162,197	325,348	37.8%				
2006	2008	4298	76,859	92,914	71,623	164,537	25.6%				

1. Mean flow (cfs) approaching Prosser Dam March 29-July 4. No data available for migration year 1991. In high flow years (flows at or > 5000 cfs) operation of the Chandler smolt sampling facility may be precluded during portions of the outmigration.
2. Aggregate of Upper Yakima, Naches, and American wild/natural populations.
3. Brood years 1997-2001: Optimum Conventional Treatment (OCT). Brood Years 2002-2006 : Normal (High) growth.
4. Brood years 1997-2001: Semi-natural Treatment (SNT). Brood Years 2002-2004 : Slowed (Low) growth. BY05: transfer diet at accl. Sites. BY06: EWS diet at CESRF through May 3.
5. Estimated smolt-to-smolt (release from upper Yakima River acclimation sites to Chandler) survival for CESRF juveniles.
6. CESRF adult returns and smolt-to-adult survival values are understated relative to wild/natural values since these figures are not adjusted for differential harvest rates in mark selective fisheries in marine and lower Columbia River fisheries.
7. Preliminary; data do not include age-5 adult returns.

Table 41. Estimated wild/natural smolt-to-adult return rates (SAR) based on adult detections of PIT tagged fish. Roza tagged smolts to Bonneville Dam adult returns.

		Wild/Natural smolts tagged at Roza				
Brood Year	Number Tagged	Adult Returns at Age[1]				
		Age 3	Age 4	Age 5	Total	SAR[1]
1997	310	0	1	0	1	0.32%[2]
1998	6,209	15	171	14	200	3.22%
1999	2,179	2	8	0	10	0.46%
2000	8,718	1	51	1	53	0.61%
2001	7,804	9	52	3	64	0.82%
2002	3,931	2	41	4	47	1.20%
2003	1,733	0	6	1	7	0.40%
2004	2,333	1	8		9	0.39%
2005	1,401	0				

Table 42. Estimated CESRF smolt-to-adult return rates (SAR) based on adult detections of PIT tagged fish. Roza tagged smolts to Bonneville Dam adult returns.

		CESRF smolts tagged at Roza				
Brood Year	Number Tagged	Adult Returns at Age[1]				
		Age 3	Age 4	Age 5	Total	SAR[1]
1997	407	0	2	0	2	0.49%[2]
1998	2,999	5	42	2	49	1.63%
1999	1,744	1	0	0	1	0.06%
2000	1,503	0	1	0	1	0.07%
2001	2,146	0	4	0	4	0.19%
2002	2,201	4	5	0	9	0.41%
2003	1,418	0	3	1	4	0.28%
2004	4,194	3	13		16	0.38%
2005	2,473	0				

1. CESRF adult returns and smolt-to-adult survival values are understated relative to wild/natural values since these figures are not adjusted for differential harvest rates in mark selective fisheries in marine and lower Columbia River fisheries.
2. The reliability of the 400kHz detection gear precluded an accurate accounting of all 1997 brood PIT returns. Therefore, this is not a true SAR. It is presented for relative within-year comparison only and should NOT be compared to SARs for other years.

Table 43. Estimated release-to-adult survival of PIT-tagged CESRF fish (CESRF tagged smolts to Bonneville and Roza Dam adult returns).

Brood Year	Number Tagged[1]	Adult Detections at Bonn. Dam					Adult Detections at Roza Dam				
		Age3	Age4	Age5	Total	SAR	Age3	Age4	Age5	Total	SAR
1997[2]	39,892	18	182	4	204	0.51%	65	517	16	598	1.50%
1998	37,388	49	478	48	575	1.54%	54	310	34	398	1.06%
1999	38,793	1	25	1	27	0.07%	1	22	0	23	0.06%
2000	37,582	42	159	2	203	0.54%	37	112	1	150	0.40%
2001	36,523	32	71	0	103	0.28%	22	58	0	80	0.22%
2002[3]	39,003	25	119	4	148	0.38%	15	80	2	97	0.25%
2003	38,916	7	37	1	45	0.12%	3	27	1	31	0.08%
2004	36,426	37	123		160	0.44%	24	98		122	0.33%
2005	39,119	63					44				

1. When tag detection data are available, this is the number of unique PIT tags physically detected leaving the acclimation sites. Otherwise, this is the number of fish PIT tagged less documented mortalities of PIT-tagged fish from tagging to release.
2. BY1997 used 400 kHz tags and Bonneville Dam was not fully configured for adult detection of this type of tag; therefore we saw more detections at Roza Dam where fish were manually wanded for adult PIT detections.
3. Includes HxH fish beginning with this brood year.

Table 44. Estimated release-to-adult survival of non-PIT-tagged CESRF fish (CESRF tagged smolts to Roza Dam adult returns).

Brood Year	Number Tagged[1]	Adult Detections at Roza Dam				
		Age3	Age4	Age5	Total	SAR
1997[2]	346,156	623	5,663	120	6,406	1.85%
1998	552,295	936	5,834	534	7,304	1.32%
1999	719,996	103	652	13	768	0.11%
2000	796,703	1,005	2,764	69	3,837	0.48%
2001	333,713	290	791	9	1,091	0.33%
2002[3]	797,901	332	1,771	135	2,238	0.28%
2003	785,776	115	1,568	14	1,696	0.22%
2004	749,022	683	3,688		4,372	0.58%
2005	820,883	1,012				

1. These fish were adipose fin-clipped, coded-wire tagged, and (beginning with 4 of 16 ponds in 1998) elastomer eye tagged. This is the number of fish physically counted at tagging.
2. BY1997 used 400 kHz tags and Bonneville Dam was not fully configured for adult detection of this type of tag; therefore we saw more detections at Roza Dam where fish were manually wanded for adult PIT detections.
3. Includes HxH fish beginning with this brood year.

Harvest Monitoring

Yakima Basin Fisheries

For spring fisheries in the Yakima River Basin, both the WDFW and the Yakama Nation employ two technicians and one biologist to monitor and evaluate in-basin harvest in the respective sport and tribal fisheries. Harvest monitoring consists of on-the-water surveys to collect catch data and to record CWT presence information for adipose-clipped fish. Survey data are expanded for time, area, and effort using standard methods to derive estimates of total in-basin harvest by fishery type (sport and tribal) and catch type (CESRF or wild denoted by adipose presence/absence).

Table 45. Spring Chinook harvest in the Yakima River Basin, 1982-present.

	Tribal		Non-Tribal		River Totals			Harvest
Year	CESRF	Wild	CESRF	Wild	CESRF	Wild	Total	Rate[1]
1982	0	434	0	0	0	434	434	23.8%
1983	0	84	0	0	0	84	84	5.8%
1984	0	289	0	0	0	289	289	10.9%
1985	0	865	0	0	0	865	865	19.0%
1986	0	1,340	0	0	0	1,340	1,340	14.2%
1987	0	517	0	0	0	517	517	11.6%
1988	0	444	0	0	0	444	444	10.5%
1989	0	747	0	0	0	747	747	15.2%
1990	0	663	0	0	0	663	663	15.2%
1991	0	32	0	0	0	32	32	1.1%
1992	0	345	0	0	0	345	345	7.5%
1993	0	129	0	0	0	129	129	3.3%
1994	0	25	0	0	0	25	25	1.9%
1995	0	79	0	0	0	79	79	11.9%
1996	0	475	0	0	0	475	475	14.9%
1997	0	575	0	0	0	575	575	18.1%
1998	0	188	0	0	0	188	188	9.9%
1999	0	604	0	0	0	604	604	21.7%
2000	53	2,305	0	100	53	2,405	2,458	12.9%
2001	572	2,034	1,252	772	1,825	2,806	4,630	19.9%
2002	1,373	1,207	492	36[2]	1,865	1,243	3,108	20.6%
2003	134	306	0	0	134	306	440	6.3%
2004	289	712	569	109[2]	858	820	1,679	11.0%
2005	46	428	0	0	46	428	474	5.4%
2006	246	354	0	0	246	354	600	9.5%
2007	123	156	0	0	123	156	279	6.5%
2008	521	414	586	11[2]	1,107	426	1,532	17.8%
Mean	413	583	362	116	776	621	853	12.1%

1. Harvest rate is the total Yakima Basin harvest as a percentage of the Yakima River mouth run size.
2. Includes estimate of post-release mortality of unmarked fish.

Columbia Basin Fisheries

Standard run reconstruction techniques are employed to derive estimates of harvest from the Columbia River mouth to the Yakima River mouth for spring Chinook. Data from databases maintained by the *United States versus Oregon* Technical Advisory Committee (TAC) are used to obtain harvest rate estimates downstream of the Yakima River for the aggregate Yakima River spring Chinook population and to estimate passage losses from Bonneville through McNary reservoirs. These data, combined with the Prosser Dam counts and estimated harvest below Prosser, are used to derive a Columbia River mouth run size estimate and Columbia River mainstem harvest estimate for Yakima spring Chinook.

Table 46. Estimated run size, harvest, and harvest rates of Yakima Basin spring Chinook in Columbia River mainstem and terminal area fisheries, 1982-present.

Year	Columbia R. Mouth Run Size	Col. R. Mouth to BON Harvest	BON to McNary Harvest	Yakima R. Mouth Run Size	Yakima River Harvest	Columbia Basin Harvest Summary			Col. Basin Harvest Rate	
						Total	Wild	CESRF	Total	Wild
1982	3,916	69	269	1,822	434	772	772	0	19.7%	
1983	2,493	120	100	1,441	84	304	304	0	12.2%	
1984	3,955	137	262	2,658	289	688	688	0	17.4%	
1985	5,278	193	180	4,560	865	1,238	1,238	0	23.5%	
1986	13,730	284	796	9,439	1,340	2,420	2,420	0	17.6%	
1987	6,341	99	383	4,443	517	999	999	0	15.8%	
1988	5,763	369	381	4,246	444	1,194	1,194	0	20.7%	
1989	9,040	217	679	4,914	747	1,644	1,644	0	18.2%	
1990	6,991	355	460	4,372	663	1,479	1,479	0	21.2%	
1991	4,680	186	282	2,906	32	500	500	0	10.7%	
1992	6,362	105	383	4,599	345	833	833	0	13.1%	
1993	5,265	45	320	3,919	129	494	494	0	9.4%	
1994	2,417	94	116	1,302	25	235	235	0	9.7%	
1995	1,392	1	69	666	79	149	149	0	10.7%	
1996	5,663	6	297	3,179	475	778	778	0	13.7%	
1997	5,187	3	349	3,173	575	926	926	0	17.9%	
1998	2,772	3	142	1,903	188	332	332	0	12.0%	
1999	4,118	5	190	2,781	604	798	798	0	19.4%	
2000	28,858	57	1,755	19,100	2,458	4,269	4,146	123	14.8%	
2001	30,821	976	3,838	23,265	4,630	9,444	5,427	4,017	30.6%	29.3%
2002	23,978	1,306	2,399	15,099	3,108	6,812	2,519	4,293	28.4%	24.2%
2003	9,905	304	747	6,957	440	1,491	885	606	15.0%	13.9%
2004	21,923	1,017	1,731	15,289	1,679	4,426	2,410	2,017	20.2%	15.4%
2005	12,271	346	707	8,758	474	1,528	1,191	337	12.5%	11.6%
2006	12,125	320	771	6,314	600	1,690	952	738	13.9%	12.3%
2007	5,304	197	346	4,303	279	822	385	437	15.5%	13.1%
2008[1]	11,278	1,173	1,348	8,598	1,532	4,054	1,095	2,959	35.9%	25.0%
Mean	9,327	296	715	6,297	853	1,864	1,289	1,925	17.4%	16.4%

1. Preliminary.

Marine Fisheries

Based on available CWT information, harvest managers have long assumed that Columbia River spring Chinook are not harvested in any abundance in marine fisheries as the timing of their ocean migration does not generally overlap either spatially or temporally with the occurrence of marine fisheries (TAC 1997). The Regional Mark Information System (RMIS) will be queried regularly for any CWT recoveries of CESRF releases in ocean or Columbia River mainstem fisheries. Table 48 gives the results of a query of the RMIS database run on Feb. 23, 2009 for CESRF spring Chinook CWTs released in brood years 1997-2005. Based on the information reported to RMIS to date, it is believed that marine harvest accounts for about 0-2% of the total harvest of Yakima Basin spring Chinook.

Table 47. Marine and freshwater recoveries of CWTs from brood year 1997-2005 releases of spring Chinook from the CESRF as reported to the Regional Mark Information System (RMIS) 23 Feb, 2009.

Brood	Observed CWT Recoveries			Expanded CWT Recoveries		
Year	Marine	Fresh	Marine %	Marine	Fresh	Marine %
1997	5	56	8.2%	8	321	2.4%
1998	2	53	3.6%	2	228	0.9%
1999		2	0.0%		9	0.0%
2000		14	0.0%		35	0.0%
2001		1	0.0%		1	0.0%
2002		7	0.0%		36	0.0%
2003		4	0.0%		10	0.0%
2004[1]		113	0.0%		343	0.0%
2005[1]		1	0.0%		1	0.0%

1. Reporting of CWT recoveries to the RMIS database typically lags actual fisheries by one to two years. Therefore, CWT recovery data for brood years 2004-2005 are considered incomplete.

Literature Cited

BPA (Bonneville Power Administration). 1990. Yakima-Klickitat Production Project Preliminary Design Report and Appendices. Bonneville Power Administration, Portland, OR.

C.M. Knudsen, S.L. Schroder, T.N. Pearsons, J.A. Rau, A.L. Fritts, and C.R. Strom. 2003. Monitoring Phenotypic and Demographic Traits of upper Yakima River Hatchery and Wild Spring Chinook: Gametic and juvenile Traits. YKFP Annual Report 2002.

Knudsen, C.M. (editor). 2004. Reproductive Ecology of Yakima River hatchery and wild spring Chinook. Annual Report 2003, Project Number 1995-063-25. BPA Report DOE/BP-00013756-3.

Knudsen, C. M., M. V. Johnston, S. L. Schroder, W. J. Bosch, D. E. Fast, and C. R. Strom. 2009. Effects of Passive Integrated Transponder Tags on Smolt-to-Adult Recruit Survival, Growth, and Behavior of Hatchery Spring Chinook Salmon. North American Journal of Fisheries Management 29:658-669.

Maynard, D. J., T. A. Flagg, and C. V. W. Mahnken. 1995. A review of seminatural culture strategies for enhancing the post-release survival of anadromous salmonids. Am. Fish. Soc. Symp. 15:307-314.

Neeley, D. 2000. Annual Report: Outmigration Year 2000, Part 2- Chandler Certification and Calibration (Spring Chinook and Coho). Appendix E in Sampson and Fast, Yakama Nation "Monitoring And Evaluation" Project Number 95-063-25, The Confederated Tribes And Bands Of The Yakama Nation, "Yakima/Klickitat Fisheries Project" Final Report 2000, Report to Bonneville Power Administration, Contract No. 00000650, Project No. 199506325, 265 electronic pages (BPA Report DOE/BP-00000650-1).

NPPC (Northwest Power Planning Council). 1982. Columbia River Basin Fish and Wildlife Program. Adopted November 15, 1982. Northwest Power Planning Council, Portland, OR.

TAC (United States versus Oregon Technical Advisory Committee). 1997. 1996 All Species Review, Columbia River Fish Management Plan. August 4, 1997. Columbia River Inter-Tribal Fish Commission, Portland, Oregon.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2002	CLE01	JCJ06	HI	WW	2.0	Right	Green	Anal Fin	3/15/2004	5/14/2004	613400	2,222	45,007	46,875
2002	CLE02	JCJ05	LO	WW	2.0	Left	Green	Adipose Fin	3/15/2004	5/14/2004	613401	2,222	46,273	46,588
2002	CLE03	ESJ03	HI	WW	1.6	Right	Orange	Anterior Dorsal	3/15/2004	5/14/2004	613402	2,222	49,027	50,924
2002	CLE04	ESJ04	LO	WW	1.6	Left	Orange	Posterior Dorsal	3/15/2004	5/14/2004	613403	2,222	50,347	52,115
2002	CLE05	CFJ05	LO	WW	2.2	Left	Red	Adipose Fin	3/15/2004	5/14/2004	613404	2,222	45,816	46,584
2002	CLE06	CFJ06	HI	WW	2.2	Right	Red	Anal Fin	3/15/2004	5/14/2004	613405	2,222	46,468	48,496
2002	CLE07	ESJ05	LO	WW	1.9	Left	Orange	Adipose Fin	3/15/2004	5/14/2004	613406	2,222	45,047	45,491
2002	CLE08	ESJ06	HI	WW	1.9	Right	Orange	Anal Fin	3/15/2004	5/14/2004	613407	2,222	48,293	50,316
2002	CLE09	JCJ03	LO	WW	1.8	Left	Green	Anterior Dorsal	3/15/2004	5/14/2004	613408	2,222	41,622	43,512
2002	CLE10	JCJ04	HI	WW	4.9	Right	Green	Posterior Dorsal	3/15/2004	5/14/2004	613409	2,222	46,346	48,279
2002	CLE11	ESJ02	LO	WW	1.9	Left	Orange	Right Cheek	3/15/2004	5/14/2004	613410	2,222	43,619	45,594
2002	CLE12	ESJ01	HI	WW	1.9	Right	Orange	Left Cheek	3/15/2004	5/14/2004	613411	2,222	44,091	46,112
2002	CLE13	JCJ01	HI	WW	1.8	Right	Green	Right Cheek	3/15/2004	5/14/2004	613412	2,222	44,379	46,327
2002	CLE14	JCJ02	LO	WW	1.8	Left	Green	Left Cheek	3/15/2004	5/14/2004	613413	2,222	46,241	48,208
2002	CLE15	CFJ01	LO	HH	1.3	Left	Red	Snout	3/15/2004	5/14/2004	613414	2,222	42,192	44,184
2002	CLE16	CFJ02	HI	HH	1.3	Right	Red	Snout	3/15/2004	5/14/2004	613415	2,222	41,702	43,653
2002	CLE17	CFJ03	HI	WW	1.6	Right	Red	Anterior Dorsal	3/15/2004	5/14/2004	613416	2,222	37,769	39,782
2002	CLE18	CFJ04	LO	WW	1.6	Left	Red	Posterior Dorsal	3/15/2004	5/14/2004	613417	2,222	42,066	43,864

[1] HI = normal growth or LO = slowed growth for brood years 2002 – 2004. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line beginning with brood year 2002. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2003	CLE01	CFJ02	HI	WW	0.2	Left	Red	Anal Fin	3/9/2005	4/27/2005	610126	2,222	43,712	45,785
2003	CLE02	CFJ01	LO	WW	0.2	Right	Red	Adipose Fin	3/9/2005	4/27/2005	610127	2,222	42,730	44,551
2003	CLE03	ESJ04	LO	WW	0.1	Right	Green	Left Cheek	3/9/2005	4/27/2005	610128	2,222	41,555	43,544
2003	CLE04	ESJ03	HI	WW	0.1	Left	Green	Right Cheek	3/9/2005	4/27/2005	610129	2,222	43,159	45,215
2003	CLE05	JCJ02	LO	WW	0.2	Right	Orange	Anal Fin	3/9/2005	4/27/2005	610130	2,222	45,401	47,443
2003	CLE06	JCJ01	HI	WW	0.2	Left	Orange	Adipose Fin	3/9/2005	4/27/2005	610131	2,222	46,079	48,095
2003	CLE07	ESJ02	LO	WW	0.3	Right	Green	Anal Fin	3/9/2005	4/27/2005	610132	2,222	43,418	45,464
2003	CLE08	ESJ01	HI	WW	0.3	Left	Green	Adipose Fin	3/9/2005	4/27/2005	610133	2,222	43,261	45,310
2003	CLE09	ESJ06	LO	WW	0.2	Right	Green	Posterior Dorsal	3/9/2005	4/27/2005	610134	2,222	43,410	45,402
2003	CLE10	ESJ05	HI	WW	0.2	Left	Green	Anterior Dorsal	3/9/2005	4/27/2005	610135	2,222	44,255	42,776
2003	CLE11	CFJ04	LO	HH	0.1	Right	Red	Snout	3/9/2005	4/27/2005	610136	2,222	41,017	43,021
2003	CLE12	CFJ03	HI	HH	0.1	Left	Red	Snout	3/9/2005	4/27/2005	610137	2,222	43,680	45,712
2003	CLE13	JCJ04	LO	WW	0.2	Right	Orange	Left Cheek	3/9/2005	4/27/2005	610138	2,222	44,569	46,413
2003	CLE14	JCJ03	HI	WW	0.2	Left	Orange	Right Cheek	3/9/2005	4/27/2005	610139	2,222	45,218	47,079
2003	CLE15	CFJ06	LO	WW	0.1	Right	Red	Posterior Dorsal	3/9/2005	4/27/2005	610140	2,222	45,697	47,468
2003	CLE16	CFJ05	HI	WW	0.1	Left	Red	Anterior Dorsal	3/9/2005	4/27/2005	610141	2,222	44,815	46,840
2003	CLE17	JCJ06	LO	WW	0.1	Right	Orange	Posterior Dorsal	3/9/2005	4/27/2005	610142	2,222	45,375	47,211
2003	CLE18	JCJ05	HI	WW	0.1	Left	Orange	Anterior Dorsal	3/9/2005	4/27/2005	610143	2,222	45,420	47,363

[1] HI = normal growth or LO = slowed growth for brood years 2002 – 2004. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line beginning with brood year 2002. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2004	CLE01	CFJ03	HI	WW	0.3	Right	Red	Snout	3/15/2006	5/15/2006	610156	2,222	44,771	46,906
2004	CLE02	CFJ04	LO	WW	0.3	Left	Red	Snout	3/15/2006	5/15/2006	610157	2,222	43,957	46,030
2004	CLE03	ESJ03	HI	WW	0.4	Right	Orange	Snout	3/15/2006	5/15/2006	610158	2,222	43,991	46,083
2004	CLE04	ESJ04	LO	WW	0.4	Left	Orange	Snout	3/15/2006	5/15/2006	610159	2,222	43,045	45,155
2004	CLE05	JCJ03	HI	WW	0.3	Right	Green	Snout	3/15/2006	4/28/2006	610160	2,222	45,803	2,248
2004	CLE06	JCJ04	LO	WW	0.3	Left	Green	Snout	3/15/2006	4/28/2006	610161	2,222	43,843	45,920
2004	CLE07	ESJ05	HI	WW	0.3	Right	Orange	Snout	3/15/2006	5/15/2006	610162	2,222	43,913	46,035
2004	CLE08	ESJ06	LO	WW	0.3	Left	Orange	Snout	3/15/2006	5/15/2006	610163	2,222	42,560	44,668
2004	CLE09	JCJ05	LO	WW	0.4	Left	Green	Snout	3/15/2006	4/28/2006	610164	2,222	42,416	44,485
2004	CLE10	JCJ06	HI	WW	0.4	Right	Green	Snout	3/15/2006	4/28/2006	610165	2,222	43,842	45,942
2004	CLE11	JCJ01	HI	WW	0.3	Right	Green	Snout	3/15/2006	4/28/2006	610166	2,222	45,892	47,993
2004	CLE12	JCJ02	LO	WW	0.3	Left	Green	Snout	3/15/2006	4/28/2006	610167	2,222	42,749	44,822
2004	CLE13	ESJ01	HI	WW	0.3	Right	Orange	Snout	3/15/2006	5/15/2006	610168	2,222	44,887	46,981
2004	CLE14	ESJ02	LO	WW	0.3	Left	Orange	Snout	3/15/2006	5/15/2006	610169	2,222	42,451	44,518
2004	CLE15	CFJ01	HI	HH	0.3	Right	Red	Posterior Dorsal	3/15/2006	5/15/2006	610170	2,222	45,790	47,920
2004	CLE16	CFJ02	LO	HH	0.3	Left	Red	Posterior Dorsal	3/15/2006	5/15/2006	610171	2,222	44,364	46,419
2004	CLE17	CFJ05	HI	WW	0.4	Right	Red	Snout	3/15/2006	5/15/2006	610172	2,222	46,512	48,632
2004	CLE18	CFJ06	LO	WW	0.4	Left	Red	Snout	3/15/2006	5/15/2006	610173	2,222	42,578	44,691

[1] HI = normal growth or LO = slowed growth for brood years 2002 – 2004. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line beginning with brood year 2002. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2005	CLE01	JCJ06	STF	WW	2.4	Left	Orange	Snout	3/15/2007	5/15/2007	613418	2,222	45,991	47,913
2005	CLE02	JCJ05	CON	WW	2.4	Right	Orange	Snout	3/15/2007	5/15/2007	613419	2,222	46,172	48,189
2005	CLE03	JCJ04	STF	WW	2.6	Right	Orange	Snout	3/15/2007	5/15/2007	613420	2,222	47,604	49,605
2005	CLE04	JCJ03	CON	WW	2.6	Left	Orange	Snout	3/15/2007	5/15/2007	613421	2,222	47,852	49,865
2005	CLE05	CFJ06	CON	WW	2.5	Right	Red	Snout	3/15/2007	5/15/2007	613422	2,222	46,258	48,282
2005	CLE06	CFJ05	STF	WW	2.5	Left	Red	Snout	3/15/2007	5/15/2007	613423	2,222	47,129	49,155
2005	CLE07	ESJ06	CON	WW	2.5	Right	Green	Snout	3/15/2007	5/15/2007	613424	2,222	41,808	43,871
2005	CLE08	ESJ05	STF	WW	2.5	Left	Green	Snout	3/15/2007	5/15/2007	613425	2,222	42,094	44,193
2005	CLE09	CFJ02	CON	HH	2.3	Right	Red	Posterior Dorsal	3/15/2007	5/15/2007	613431	2,222	43,580	45,616
2005	CLE10	CFJ01	STF	HH	2.3	Left	Red	Posterior Dorsal	3/15/2007	5/15/2007	613427	2,222	42,971	44,902
2005	CLE11	ESJ02	CON	WW	2.5	Right	Green	Snout	3/15/2007	5/15/2007	613428	2,222	50,108	52,186
2005	CLE12	ESJ01	STF	WW	2.5	Left	Green	Snout	3/15/2007	5/15/2007	613429	2,222	44,487	46,550
2005	CLE13	ESJ04	CON	WW	2.5	Right	Green	Snout	3/15/2007	5/15/2007	613430	2,222	45,040	47,132
2005	CLE14	ESJ03	STF	WW	2.5	Left	Green	Snout	3/15/2007	5/15/2007	613426	2,222	45,132	47,218
2005	CLE15	JCJ02	STF	WW	2.5	Right	Orange	Snout	3/15/2007	5/15/2007	613432	2,222	46,178	48,266
2005	CLE16	JCJ01	CON	WW	2.5	Left	Orange	Snout	3/15/2007	5/15/2007	613433	2,222	45,804	47,887
2005	CLE17	CFJ04	CON	WW	2.5	Right	Red	Snout	3/15/2007	5/15/2007	613434	2,222	46,476	48,508
2005	CLE18	CFJ03	STF	WW	2.4	Left	Red	Snout	3/15/2007	5/15/2007	613435	2,222	48,638	50,664

[1] CON = normal feed or STF = salt-water transition diet at acclimation sites. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line beginning with brood year 2002. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2006	CLE01	CFJ04	BIO	WW	3.5	Right	Red	Snout	3/15/2008	5/14/2008	190101	2,000	36,945	38,607
2006	CLE02	CFJ03	EWS	WW	3.5	Left	Red	Snout	3/15/2008	5/14/2008	190102	2,000	31,027	32,790
2006	CLE03	ESJ02	BIO	WW	3.2	Right	Green	Snout	3/15/2008	5/14/2008	190103	2,000	36,931	38,762
2006	CLE04	ESJ01	EWS	WW	3.2	Left	Green	Snout	3/15/2008	5/14/2008	190104	2,000	29,635	31,400
2006	CLE05	JCJ02	BIO	WW	3.3	Right	Orange	Snout	3/15/2008	5/14/2008	190105	2,000	36,735	38,383
2006	CLE06	JCJ01	EWS	WW	3.3	Left	Orange	Snout	3/15/2008	5/14/2008	190106	2,000	28,984	30,680
2006	CLE07	ESJ04	BIO	WW	3.4	Right	Green	Snout	3/15/2008	5/14/2008	190107	2,000	38,212	40,006
2006	CLE08	ESJ03	EWS	WW	3.4	Left	Green	Snout	3/15/2008	5/14/2008	190108	2,000	32,726	34,519
2006	CLE09	CFJ02	BIO	WW	3.4	Right	Red	Snout	3/15/2008	5/14/2008	190109	2,000	36,485	38,097
2006	CLE10	CFJ01	EWS	WW	3.4	Left	Red	Snout	3/15/2008	5/14/2008	190110	2,000	29,907	31,647
2006	CLE11	JCJ04	BIO	WW	3.3	Right	Orange	Snout	3/15/2008	5/14/2008	190111	2,000	39,491	40,703
2006	CLE12	JCJ03	EWS	WW	3.3	Left	Orange	Snout	3/15/2008	5/14/2008	190112	2,000	33,418	35,273
2006	CLE13	ESJ06	BIO	WW	3.4	Right	Green	Snout	3/15/2008	5/14/2008	190113	2,000	38,609	39,841
2006	CLE14	ESJ05	EWS	WW	3.4	Left	Green	Snout	3/15/2008	5/14/2008	190114	2,000	31,573	33,404
2006	CLE15	JCJ06	BIO	WW	3.4	Right	Orange	Snout	3/15/2008	5/14/2008	190115	2,000	36,844	38,619
2006	CLE16	JCJ05	EWS	WW	3.4	Left	Orange	Snout	3/15/2008	5/14/2008	190116	2,000	29,857	31,630
2006	CLE17	CFJ06	BIO	HH	3.2	Right	Red	Posterior Dorsal	3/15/2008	5/14/2008	190117	4,000	34,299	38,045
2006	CLE18	CFJ05	EWS	HH	3.2	Left	Red	Posterior Dorsal	3/15/2008	5/14/2008	190118	4,000	26,643	30,389

[1] BIO = BioVita (BioOregon Protein Inc.) or control diet; EWS = EWOS (EWOS Canada Ltd.). All fish were switched to BioVita diet beginning May 3, 2007. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix A. Tag and Release Information by Cle Elum Pond Id, Brood Years 2002-2007.

Brood Year	C.E. Pond	Accl. Pond	Treatment[1] /Avg BKD			Tag Information			First Release	Last Release	CWT Code	No. PIT	No. CWT	Est. Tot. Release[2]
2007	CLE01	JCJ06	BIO	WW	2.8	Right	Orange	Snout	3/15/2009	5/15/2009	190151	2,000	38,044	39,840
2007	CLE02	JCJ05	STF	WW	2.8	Left	Orange	Snout	3/15/2009	5/15/2009	190152	2,000	40,066	41,843
2007	CLE03	JCJ04	BIO	WW	2.7	Right	Orange	Snout	3/15/2009	5/15/2009	190153	2,000	40,843	42,647
2007	CLE04	JCJ03	STF	WW	2.7	Left	Orange	Snout	3/15/2009	5/15/2009	190154	2,000	40,196	41,979
2007	CLE05	CFJ06	BIO	WW	2.8	Right	Red	Snout	3/15/2009	5/15/2009	190155	2,000	40,855	42,717
2007	CLE06	CFJ05	STF	WW	2.8	Left	Red	Snout	3/15/2009	5/15/2009	190156	2,000	40,475	42,345
2007	CLE07	ESJ06	BIO	WW	2.6	Right	Green	Snout	3/15/2009	5/15/2009	190157	2,000	42,549	44,387
2007	CLE08	ESJ05	STF	WW	2.6	Left	Green	Snout	3/15/2009	5/15/2009	190158	2,000	43,243	45,080
2007	CLE09	CFJ02	BIO	HH	2.7	Right	Red	Posterior Dorsal	3/15/2009	5/15/2009	190159	4,000	43,803	47,625
2007	CLE10	CFJ01	STF	HH	2.7	Left	Red	Posterior Dorsal	3/15/2009	5/15/2009	190160	4,000	43,256	47,038
2007	CLE11	ESJ02	BIO	WW	2.8	Right	Green	Snout	3/15/2009	5/15/2009	190161	2,000	41,098	42,945
2007	CLE12	ESJ01	STF	WW	2.8	Left	Green	Snout	3/15/2009	5/15/2009	190162	2,001	40,535	42,405
2007	CLE13	ESJ04	BIO	WW	2.7	Right	Green	Snout	3/15/2009	5/15/2009	190163	2,009	39,308	41,190
2007	CLE14	ESJ03	STF	WW	2.7	Left	Green	Snout	3/15/2009	5/15/2009	190164	2,000	36,663	38,533
2007	CLE15	JCJ02	BIO	WW	2.9	Right	Orange	Snout	3/15/2009	5/15/2009	190165	2,000	40,312	42,083
2007	CLE16	JCJ01	STF	WW	2.9	Left	Orange	Snout	3/15/2009	5/15/2009	190166	2,000	40,594	42,426
2007	CLE17	CFJ03	STF	WW	2.8	Right	Red	Snout	3/15/2009	5/15/2009	190167	2,000	40,687	42,561
2007	CLE18	CFJ04	BIO	WW	2.8	Left	Red	Snout	3/15/2009	5/15/2009	190168	2,000	41,704	43,621

[1] BIO = BioVita (BioOregon Protein Inc.) or control diet; STF = salt-water transition diet at acclimation sites. All fish are progeny of wild/natural parents unless denoted as HH which designates the hatchery control line beginning with brood year 2002. "Avg BKD" denotes the average BKD ELISA ranking of the female parents whose progeny were in these ponds.

[2] The number of fish released is estimated as the total number of fish counted at marking less mortalities documented from mark to release.

Appendix B

IntSTATS

International Statistical Training
and Technical Services
712 12th Street
Oregon City, Oregon 97045
United States
Voice: (503) 650-5035
e-mail: intstats@sbcglobal.net

Comparison of Different Feed Treatments on Smolt-to-Smolt Survivals and Mini Jack Percentages of Upper Yakima Spring Chinook for Brood-Years 2002-2006 from Naturally Spawned Parents

Doug Neeley, Consultant to Yakama Nation

Introduction

Previous summaries have been from analyses that included the Hatchery x Hatchery (HxH) stock acclimated at the Clark Flat site in addition to the Natural x Natural (NxN) stock acclimated at all three acclimation sites (Clark Flat, Easton, and Jack Creek). However, with significant Year x Stock interaction, it seemed more appropriate to present nutrition comparisons for only the NxN crosses in this report and to discuss stock comparisons, including their potential interactions with years and treatments in a separate report[1].

The decision was also made to remove the data from a raceway pair[2] for release year 2006 (BY 2004) from the analysis, one raceway of which had a major non-treatment-related die-off prior to acclimation that could bias treatment comparisons. The data for several trait measures from these raceways' fish were included in previous years' annual reports. Another change from analyses in previous reports is the database used for assessing fish weights. In previous years' reports, a volumetric measure was used to assess the number-of-fish/pound, and this measure was converted into grams/fish. The analyses used in this report is based on actual individual fish weights from fish sampled to assess the gender and the precocial of proportion of male smolt prior to release. Fish biologists felt this latter measure would provide a more accurate estimate of fish weight.

The analyses for the NxN stock are presented in this report. Data summaries for 1) release-to-McNary smolt survival, 2) percentage of smolt detected voluntarily leaving acclimation ponds, 3) percentage of pre-release males that are mini-jacks, 4) mean Julian detection-date at McNary Dam (McNary-passage date at McNary), 5) mean detection-date at acclimation site (volitional

1 Annual Report: Comparisons between Smolt Measures of Hatchery x Hatchery- and Natural x Natural-Brood Stock from Upper Yakima Spring Chinook for Brood-Years 2002-2006
2 Raceways within raceway-pairs share common sets of parents. Raceways from different raceways do not. The data removed are from Cle Elum Hatchery raceways 5 and 6, respectively acclimated at Jack Creek raceways 3 and 4; the die-off being associated Cle Elum raceway 6.

release date) and 6) pre-release fish weight are presented and discussed for each treatment set. Analyses of variation on the effect of the feed levels are presented in Appendix A. The feed-level comparison sets are presented below, beginning with most recent set:

Set 1: EWS versus (vs.) Bio (BY 2006, release year 2008)
Set 2 STF vs. Control (BY 2005, release year 2007)
Set 3: Low- vs. High-feed levels (BY2002-BY2004, release years 2004-2006)

The EWS treatment was tested to determine whether it increased the rate of smoltification relative to Bio within Set 1, and the STF treatment was tested to determine whether it increased the rate of smoltification relative to the Control within Set 2. The Low feed level within Set 3 was intended to determine whether a lower nutritional feed rate would reduce the percentage mini-jacks (sexually mature or precocial male "smolt") compared to the standard nutrition level (High).

Feed comparisons EWS versus Bio (BY 2006)

For brood-year-2006 smolts, none of the differences in the measured trait effects between the EWS and Bio feeds attained significance at 5% level[3]. The release-to-McNary smolt-survival percentages of the EWS and Bio treatments were nearly identical, 30.0% and 29.8% respectively (P = 0.85), as were the percentage of smolt detected leaving the pond, 97.1% and 97.2% respectively (P = 0.72). The mini-jack percentages were not significantly different (53.0% for EWS and 47.7% for Bio, P = 0.13); the mini-jack percentage for EWS exceeded that of Bio for only two of the three sites. The mean Julian release-dates of 111 for EWS and 114 for Bio were also not significantly different (P = 0.17), nor were the mean McNary passage dates (Julian dates of passage --138 for EWS and 136 for Bio, P = 0.12). The mean pre-release weights did not differ significantly between the EWS and Bio treatments (respectively 16.5 and 15.0 grams/ fish, P =0.22).

Tables 1.a through 1.f present the means of the measures in the order discussed above as do respective Figures 1.a through 1.f. See Appendix A.1 for the statistical analyses.

Feed comparisons STF versus Control (BY 2005)

It appears that there was an error in the 2007 Annual Report: survival from time of tagging to McNary passage based on all tagged fish was presented instead of survival from time of release to McNary passage based on PIT-tagged fish detected leaving the acclimation sites. This error has been corrected in this report.

With the exception of pre-release fish size, there were no significant differences in the measured trait effects between the STF and Control feeds. The release-to-McNary smolt-survival percentages of the STF and Control treatments were nearly identical, respectively 31.4% and 31.5% (P = 0.94), as were the percentages of smolt detected leaving the pond, respectively 98.0% and 97.7% (P = 0.17). The mini-jack percentage did not significantly differ between feeds (28.5% for STF and 30.6% for Control, P = 0.52). A nearly significant mini-jack (STF vs. Control) x Site Interaction (P = 0.090) was driven by a large difference in the treatment means at Clack Flat (19.0% for STF and 29.4% for Control) versus smaller differences at the other sites

3 Differences attaining the 10% but not the 5% level of significance are referred to in the report as being "nearly" significant, and those attaining the 5% level are referred to as significant.

(Table 1.c.) and by the fact that STF had a smaller mini-jack percentage at two sites but not at the third. The mean release dates were nearly identical for the two treatments (Julian dates of release – 89 for STF and 88 for Control, P = 0.63), and the McNary Julian passage-dates were identical to the rounded date (126 for both STF and Control, P = 0.99)[4]. The mean pre-release weights did differ significantly (respectively 14.4 and 16.2 grams/fish for STF and Control, P =0.047).

It should be noted that there were a combined total of twelve comparisons made for the STF and Control and the EWS and Bio treatment sets. If there were no differences among any of the traits, the probability of detecting at least one least significant difference at that 5% level for twelve independent comparisons is 0.46, so the significant STF-Bio difference for pre-release fish size should be viewed as possibly being a chance occurrence.

Tables 1.a through 1.f present the means of the measures in the order discussed above, as do respective Figures 1.a through 1.f. See Appendix A. for the statistical analyses.

4 Note from the tables that the mean release dates ranged from 17 to 31 days earlier for the BY 2005 releases in 2007 than the BY 2006 releases in 2008, the mean McNary passage dates were also earlier, ranging from 7 to 15 days earlier.

Table.1.a. Release Years 2007-2008 Mean Release-to-McNary Survival-Indices (BY 2005-2006, respectively)

STF versus Control (2007)

Site: Clark Flat		
Treatment		
Control	**Release-to-McNary Survival**	**35.4%**
	Number Voilitionally Released*	4,364
STF	**Release-to-McNary Survival**	**33.4%**
	Number Voilitionally Released*	4,379
Site: Easton		
Treatment		
Control	**Release-to-McNary Survival**	**28.6%**
	Number Voilitionally Released*	6,462
STF	**Release-to-McNary Survival**	**30.2%**
	Number Voilitionally Released*	6,473
Site: Jack Creek		
Treatment		
Control	**Release-to-McNary Survival**	**31.6%**
	Number Voilitionally Released*	6,544
STF	**Release-to-McNary Survival**	**31.2%**
	Number Voilitionally Released*	6,574

EWS versus BIO (2008)

Site: Clark Flat		
Treatment		
Bio	**Release-to-McNary Survival**	**36.0%**
	Number Voilitionally Released*	3,846
EWS	**Release-to-McNary Survival**	**35.8%**
	Number Voilitionally Released*	3,823
Site: Easton		
Treatment		
Bio	**Release-to-McNary Survival**	**28.2%**
	Number Voilitionally Released*	5,833
EWS	**Release-to-McNary Survival**	**26.6%**
	Number Voilitionally Released*	5,821
Site: Jack Creek		
Treatment		
Bio	**Release-to-McNary Survival**	**27.5%**
	Number Voilitionally Released*	5,873
EWS	**Release-to-McNary Survival**	**29.6%**
	Number Voilitionally Released*	5,891

Pooled over Sites

Treatment	Year >	2007
Control	**Release-to-McNary Survival**	**31.5%**
	Number Voilitionally Released*	17,370
STF	**Release-to-McNary Survival**	**31.4%**
	Number Voilitionally Released*	17,426

Pooled over Sites

Treatment	Year >	2008
Bio	**Release-to-McNary Survival**	**29.8%**
	Number Voilitionally Released*	15,552
EWS	**Release-to-McNary Survival**	**30.0%**
	Number Voilitionally Released*	15,535

* Number detected leaving Acclimation Site, used as weights in analyses

Table 1.b. Release Years 2007-2008 Percentage Detected Leaving Ponds (BY 2005-2006, respectively)

STF versus Control (2007)

Site: Clark Flat		
Treatment		
Control	**Percent Detected at Release**	**98.1%**
	Number Tagged	4,450
STF	**Percent Detected at Release**	**98.5%**
	Number Tagged	4,444
Site: Easton		
Treatment		
Control	**Percent Detected at Release**	**96.9%**
	Number Tagged	6,669
STF	**Percent Detected at Release**	**97.1%**
	Number Tagged	6,666
Site: Jack Creek		
Treatment		
Control	**Percent Detected at Release**	**98.2%**
	Number Tagged	6,666
STF	**Percent Detected at Release**	**98.6%**
	Number Tagged	6,666
Pooled over Sites		
Treatment		
Control	**Percent Detected at Release**	**97.7%**
	Number Tagged	17,785
STF	**Percent Detected at Release**	**98.0%**
	Number Tagged	17,776

* Used as weights in analyses

EWS versus BIO (2008)

Site: Clark Flat		
Bio	**Percent Detected at Release**	**96.2%**
	Number Tagged	4,000
EWS	**Percent Detected at Release**	**95.6%**
	Number Tagged	4,000
Site: Easton		
Bio	**Percent Detected at Release**	**97.2%**
	Number Tagged	6,000
EWS	**Percent Detected at Release**	**97.0%**
	Number Tagged	6,000
Site: Jack Creek		
Bio	**Percent Detected at Release**	**97.9%**
	Number Tagged	6,000
EWS	**Percent Detected at Release**	**98.2%**
	Number Tagged	6,001
Pooled over Sites		
Bio	**Percent Detected at Release**	**97.2%**
	Number Tagged	16,000
EWS	**Percent Detected at Release**	**97.1%**
	Number Tagged	16,001

Table 1.c. Release Years 2007-2008 Pre-release Percentage of Males that were Mini-Jacks (Brood Years 2005-2006, respectively)

STF versus Control (2007)

Site: Clark Flat		
Treatment		
Control	**Mini-Jack Percentage**	**29.4%**
	Number of Sampled Males	66
STF	**Mini-Jack Percentage**	**19.0%**
	Number of Sampled Males	63
Site: Easton		
Treatment		
Control	**Mini-Jack Percentage**	**25.0%**
	Number of Sampled Males	96
STF	**Mini-Jack Percentage**	**32.6%**
	Number of Sampled Males	89
Site: Jack Creek		
Treatment		
Control	**Mini-Jack Percentage**	**37.3%**
	Number of Sampled Males	91
STF	**Mini-Jack Percentage**	**31.0%**
	Number of Sampled Males	87
Pooled over Sites		
Treatment		
Control	**Mini-Jack Percentage**	**30.6%**
	Number of Sampled Males	253
STF	**Mini-Jack Percentage**	**28.5%**
	Number of Sampled Males	239

* Used as weights in analyses

EWS versus BIO (2008)

Site: Clark Flat		
Treatment		
Bio	**Mini-Jack Percentage**	**42.4%**
	Number of Sampled Males	68
EWS	**Mini-Jack Percentage**	**36.9%**
	Number of Sampled Males	65
Site: Easton		
Treatment		
Bio	**Mini-Jack Percentage**	**43.8%**
	Number of Sampled Males	96
EWS	**Mini-Jack Percentage**	**56.2%**
	Number of Sampled Males	105
Site: Jack Creek		
Treatment		
Bio	**Mini-Jack Percentage**	**54.9%**
	Number of Sampled Males	102
EWS	**Mini-Jack Percentage**	**60.4%**
	Number of Sampled Males	96
Pooled over Sites		
Treatment		
Bio	**Mini-Jack Percentage**	**47.7%**
	Number of Sampled Males	266
EWS	**Mini-Jack Percentage**	**53.0%**
	Number of Sampled Males	266

Table 1.d. Release Years 2007-2008 Mean Julian-Release-Date. (BY 2005-2006, respectively)

STF versus Control (2007)

Site: Clark Flat		
Treatment		
Control	**Mean Date of Detection**	**89**
	Number Detected leaving Ponds*	4,364
STF	**Mean Date of Detection**	**89**
	Number Detected leaving Ponds*	6,569
Site: Easton		
Treatment		
Control	**Mean Date of Detection**	**81**
	Number Detected leaving Ponds*	4,308
STF	**Mean Date of Detection**	**86**
	Number Detected leaving Ponds*	6,473
Site: Jack Creek		
Treatment		
Control	**Mean Date of Detection**	**94**
	Number Detected leaving Ponds*	4,363
STF	**Mean Date of Detection**	**92**
	Number Detected leaving Ponds*	6,574

Pooled over Sites

Treatment		
Control	**Mean Date of Detection**	**88**
	Number Detected leaving Ponds*	13,035
STF	**Mean Date of Detection**	**89**
	Number Detected leaving Ponds*	19,616

EWS versus BIO (2008)

Site: Clark Flat		
Treatment		
Bio	**Mean Date of Detection**	**117**
	Number Detected leaving Ponds*	5,769
EWS	**Mean Date of Detection**	**116**
	Number Detected leaving Ponds*	3,823
Site: Easton		
Treatment		
Bio	**Mean Date of Detection**	**112**
	Number Detected leaving Ponds*	5,833
EWS	**Mean Date of Detection**	**109**
	Number Detected leaving Ponds*	3,881
Site: Jack Creek		
Treatment		
Bio	**Mean Date of Detection**	**114**
	Number Detected leaving Ponds*	5,873
EWS	**Mean Date of Detection**	**109**
	Number Detected leaving Ponds*	3,927

Pooled over Sites

Treatment		
Bio	**Mean Date of Detection**	**114**
	Number Detected leaving Ponds*	17,475
EWS	**Mean Date of Detection**	**111**
	Number Detected leaving Ponds*	11,631

Table 1.e. Release Years 2007-2008 Mean McNary Julian-Detection-Date. (BY 2005-2006, respectively)

STF versus Control (2007)

Site: Clark Flat	**Treatment**		
	Control	**Mean Release Date**	**127**
		Number Passing McNary*	1,545
	STF	**Mean Release Date**	**126**
		Number Passing McNary*	2,197
Site: Easton	**Treatment**	Year >	
	Control	**Mean Release Date**	**124**
		Number Passing McNary*	1,234
	STF	**Mean Release Date**	**125**
		Number Passing McNary*	1,957
Site: Jack Creek	**Treatment**	Year >	
	Control	**Mean Release Date**	**129**
		Number Passing McNary*	1,380
	STF	**Mean Release Date**	**128**
		Number Passing McNary*	2,053

EWS versus BIO (2008)

Site: Clark Flat	**Treatment**		
	Bio	**Mean Release Date**	**136**
		Number Passing McNary*	2,074
	EWS	**Mean Release Date**	**137**
		Number Passing McNary*	1,370
Site: Easton	**Treatment**	Year >	
	Bio	**Mean Release Date**	**139**
		Number Passing McNary*	1,644
	EWS	**Mean Release Date**	**139**
		Number Passing McNary*	1,031
Site: Jack Creek	**Treatment**	Year >	
	Bio	**Mean Release Date**	**136**
		Number Passing McNary*	1,613
	EWS	**Mean Release Date**	**139**
		Number Passing McNary*	1,163

Pooled over Sites

Treatment	Year >	
Control	**Mean Release Date**	**126**
	Number Passing McNary*	4,159
STF	**Mean Release Date**	**126**
	Number Passing McNary*	6,207

Pooled over Sites

Treatment	Year >	
Bio	**Mean Release Date**	**137**
	Number Passing McNary*	5,331
EWS	**Mean Release Date**	**138**
	Number Passing McNary*	3,564

* Number detected at McNary multiplied by proportion Detected at McNary, used as weights in analyses

Table 1.f. **Release Years 2007-2008 Mean Pre-release weight (grams/fish). (BY 2005-2006, respectively)**

STF versus Control (2007)

Site: Clark Flat		
Treatment		
Control	**Fish Weight**	**15.5**
	NumberSampled*	120
STF	**Fish Weight**	**14.4**
	NumberSampled*	120
Site: Easton		
Treatment	Year >	
Control	**Fish Weight**	**16.1**
	NumberSampled*	180
STF	**Fish Weight**	**14.7**
	NumberSampled*	180
Site: Jack Creek		
Treatment	Year >	
Control	**Fish Weight**	**16.7**
	NumberSampled*	180
STF	**Fish Weight**	**14.1**
	NumberSampled*	180
Pooled over Sites		
Treatment	Year >	
Control	**Fish Weight**	**16.2**
	NumberSampled*	480
STF	**Fish Weight**	**14.4**
	NumberSampled*	480

EWS versus BIO (2008)

Site: Clark Flat		
Treatment		
Bio	**Fish Weight**	**15.1**
	NumberSampled*	120
EWS	**Fish Weight**	**15.1**
	NumberSampled*	120
Site: Easton		
Treatment	Year >	
Bio	**Fish Weight**	**14.9**
	NumberSampled*	180
EWS	**Fish Weight**	**16.7**
	NumberSampled*	180
Site: Jack Creek		
Treatment	Year >	
Bio	**Fish Weight**	**15.0**
	NumberSampled*	180
EWS	**Fish Weight**	**17.2**
	NumberSampled*	180
Pooled over Sites		
Treatment	Year >	
Bio	**Fish Weight**	**15.0**
	NumberSampled*	480
EWS	**Fish Weight**	**16.5**
	NumberSampled*	480

* Number detected at McNary multiplied by proportion Detected at McNary, used as weights in analyses

Low feed versus High feed levels (BY 2002-2004)

A summary of results is presented here because the 2006 Annual Report presented Hatchery x Hatchery Stock survivals as well as Natural x Natural and because of database alterations discussed earlier. The Low nutritional feed (Low) had a significantly lower release-to-McNary survival than did the High nutritional feed (High), respective survivals being 18.1% and 21.2% ($P < 0.0001$). The Low survival to McNary was consistently lower than the High at all sites in all years. When averaged over sites, the Low also had a significantly lower percentage of smolt detected leaving the pond than the High ($P = 0.020$). However, there was a significant Site x (Low versus High) Interaction ($P = 0.0013$), and the only consistent difference was for release year 2006 (BY 2004) in which the High percentage leaving the ponds was higher than the Low for all seven pairs of raceways. In that year, the over-site mean percentages were 95.1% for Low and 97.1% for High. In the other years, the percentages were nearly equal, with the yearly means between 97% and 98% for Low and High in both release years 2004 and 2005 (BY 2002 and BY 2003). The mini-jack percentages were significantly and substantially lower for the Low versus High treatment (respectively 20.8% and 36.0%, $P = 0.0005$). Lowering the mini-jack percentage using the Low level was the objective of the experiment. The mean release date for the Low was nearly significantly earlier for Low compared to the High (Julian dates of release – 94 for Low and 96 for High, $P = 0.084$); however, the mean McNary passage date for the Low was significantly later compared to the high (Julian dates 127 for Low and 124 for High, $P < 0.0001$). While the difference between the mean McNary passage dates is not substantial, the Low was later for each release site within each year. As would be expected, the mean pre-release weights were significantly lower for the Low (11.7.and 15.4 grams/ fish respectively for the Low and High, $P < 0.0001$), the Low having the lowest mean weight within each site within each year. Tables 2.a through 2.f present respective estimates for each site within each Brood Year. See Appendix A.2 for the statistical analyses.

Table.2.a. Release-Years 2004-2006 Mean Release-to-McNary Survival-Indices (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments

Site: Clark Flat

Treatment	Year >	2004	2005	2006	Mean
High	**Release-to-McNary Survival**	**22.7%**	**16.6%**	**34.4%**	**24.6%**
	Number Voilitionally Released*	4,352	4,343	4,344	13,039
Low	**Release-to-McNary Survival**	**21.2%**	**14.2%**	**26.5%**	**20.6%**
	Number Voilitionally Released*	4,355	4,294	4,307	12,956

Site: Easton

	Year >	2004	2005	2006	Mean
High	**Release-to-McNary Survival**	**17.8%**	**14.2%**	**26.7%**	**19.6%**
	Number Voilitionally Released*	6,453	6,474	6,462	19,389
Low	**Release-to-McNary Survival**	**16.5%**	**12.5%**	**24.9%**	**17.9%**
	Number Voilitionally Released*	6,508	6,499	6,299	19,306

Site: Jack Creek

	Year >	2004	2005	2006	Mean
High	**Release-to-McNary Survival**	**19.7%**	**16.1%**	**27.8%**	**20.3%**
	Number Voilitionally Released*	6,515	6,514	4,304	17,333
Low	**Release-to-McNary Survival**	**15.7%**	**12.8%**	**23.4%**	**16.5%**
	Number Voilitionally Released*	6,532	6,521	4,195	17,248

Pooled over Sites

	Year >	2004	2005	2006	Mean
High	**Release-to-McNary Survival**	**19.7%**	**15.5%**	**29.2%**	**21.2%**
	Number Voilitionally Released*	17320	17331	15110	49761
Low	**Release-to-McNary Survival**	**17.4%**	**13.0%**	**24.9%**	**18.1%**
	Number Voilitionally Released*	17395	17314	14801	49510

* Number detected leaving Acclimation Site, used as weights in analyses

Table 2.b. Release-Years 2004-2006 Percentage Detected Leaving Ponds (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments

Site: Clark Flat

Treatment	**Year >**	**2004**	**2005**	**2006**	**Mean**
High	**Percent Detected at Release**	**97.9%**	**97.7%**	**97.7%**	**97.8%**
	Number Tagged	4,446	4,444	4,444	13,334
Low	**Percent Detected at Release**	**98.0%**	**96.6%**	**96.9%**	**97.2%**
	Number Tagged	4,446	4,445	4,445	13,336

Site: Easton

	Year >	**2004**	**2005**	**2006**	**Mean**
High	**Percent Detected at Release**	**96.7%**	**97.1%**	**96.9%**	**96.9%**
	Number Tagged	6,670	6,668	6,667	20,005
Low	**Percent Detected at Release**	**97.6%**	**97.5%**	**94.5%**	**96.5%**
	Number Tagged	6,670	6,665	6,668	20,003

Site: Jack Creek

	Year >	**2004**	**2005**	**2006**	**Mean**
High	**Percent Detected at Release**	**97.7%**	**97.7%**	**96.8%**	**97.5%**
	Number Tagged	6,668	6,667	4,444	17,779
Low	**Percent Detected at Release**	**97.9%**	**97.8%**	**94.4%**	**97.0%**
	Number Tagged	6,669	6,667	4,444	17,780

Pooled over Sites

	Year >	**2004**	**2005**	**2006**	**Mean**
High	**Percent Detected at Release**	**97.4%**	**97.5%**	**97.1%**	**97.3%**
	Number Tagged	17784	17779	15555	51118
Low	**Percent Detected at Release**	**97.8%**	**97.4%**	**95.1%**	**96.9%**
	Number Tagged	17785	17777	15557	51119

* Used as weights in analyses

Table 2.c. Release-Years 2004-2006 Pre-release Percentage of Males that were Mini-Jacks (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments

Site: Clark Flat

Treatment	Year >	2004	2005	2006	Mean
High	**Mini-Jack Percentage**	**53.7%**	**30.2%**	**45.8%**	**42.6%**
	Number of Sampled Males	54	63	59	176
Low	**Mini-Jack Percentage**	**37.3%**	**15.5%**	**11.9%**	**22.3%**
	Number of Sampled Males	67	58	59	184

Site: Easton

	Year >	2004	2005	2006	Mean
High	**Mini-Jack Percentage**	**49.4%**	**29.3%**	**20.0%**	**32.4%**
	Number of Sampled Males	81	82	90	253
Low	**Mini-Jack Percentage**	**27.0%**	**17.8%**	**17.4%**	**20.8%**
	Number of Sampled Males	89	90	86	265

Site: Jack Creek

	Year >	2004	2005	2006	Mean
High	**Mini-Jack Percentage**	**41.1%**	**25.6%**	**37.5%**	**34.9%**
	Number of Sampled Males	90	78	64	232
Low	**Mini-Jack Percentage**	**30.4%**	**8.8%**	**22.4%**	**19.8%**
	Number of Sampled Males	92	102	58	252

Pooled over Sites

	Year >	2004	2005	2006	Mean
High	**Mini-Jack Percentage**	**47.1%**	**28.3%**	**32.4%**	**36.0%**
	Number of Sampled Males	225	223	213	661
Low	**Mini-Jack Percentage**	**31.0%**	**13.6%**	**17.2%**	**20.8%**
	Number of Sampled Males	248	250	203	701

* Used as weights in analyses

Table 2.d. **Release-Years 2004-2006 Mean Julian-Release-Date. (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments**

Site: Clark Flat

Treatment	Year >	2004	2005	2006	Mean
High	Mean Date of Detection	100	77	103	93
	Number Detected leaving Ponds*	4,352	4,343	4,344	13,039
Low	Mean Date of Detection	95	77	101	91
	Number Detected leaving Ponds*	4,355	4,294	4,307	12,956

Site: Easton

Treatment		2004	2005	2006	Mean
High	Mean Date of Detection	101	88	100	96
	Number Detected leaving Ponds*	6,453	6,474	6,462	19,389
Low	Mean Date of Detection	98	86	100	94
	Number Detected leaving Ponds*	6,508	6,499	6,299	19,306

Site: Jack Creek

Treatment		2004	2005	2006	Mean
High	Mean Date of Detection	99	96	96	97
	Number Detected leaving Ponds*	6,515	6,514	2,926	15,955
Low	Mean Date of Detection	99	94	96	96
	Number Detected leaving Ponds*	6,532	6,521	4,197	17,250

Pooled over Sites

Treatment		2004	2005	2006	Mean
High	Mean Date of Detection	100	88	100	96
	Number Detected leaving Ponds*	17,320	17,331	13,732	48,383
Low	Mean Date of Detection	98	87	99	94
	Number Detected leaving Ponds*	17,395	17,314	14,803	49,512

* Used as weights in analyses

Table 2.e. Release-Years 2004-2006 Mean McNary Julian-Detection-Date. (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments

Site: Clark Flat

Treatment	Year >	2004	2005	2006	Mean
High	**Mean Release Date**	**121**	**123**	**125**	**123**
	Number Passing McNary*	987	721	1,494	3,202
Low	**Mean Release Date**	**123**	**124**	**128**	**125**
	Number Passing McNary*	924	608	1,140	2,672

Site: Easton

Treatment	Year >	2004	2005	2006	Mean
High	**Mean Release Date**	**124**	**124**	**127**	**125**
	Number Passing McNary*	1,151	921	1,727	3,799
Low	**Mean Release Date**	**128**	**126**	**129**	**128**
	Number Passing McNary*	1,073	811	1,568	3,452

Site: Jack Creek

Treatment	Year >	2004	2005	2006	Mean
High	**Mean Release Date**	**124**	**126**	**125**	**125**
	Number Passing McNary*	1,281	1,049	1,194	3,524
Low	**Mean Release Date**	**128**	**128**	**127**	**128**
	Number Passing McNary*	1,024	837	982	2,843

Pooled over Sites

Treatment	Year >	2004	2005	2006	Mean
High	**Mean Release Date**	**123**	**125**	**126**	**124**
	Number Passing McNary*	3,419	2,691	4,415	10,525
Low	**Mean Release Date**	**127**	**126**	**128**	**127**
	Number Passing McNary*	3,021	2,256	3,690	8,967

* Number detected at McNary multiplied by proportion Detected at McNary, used as weights in analyses

Table 2.f. Release-Years 2004-2006 Mean Pre-release weight (grams/fish) (BY 2002-2004, respectively) for Low and High Nutrition-Feed Treatments

Site: Clark Flat

Treatment	Year >	2004	2005	2006	Mean
High	Fish Weight	16.0	15.0	15.3	15.5
	NumberSampled*	120	120	120	360
Low	Fish Weight	11.4	11.3	11.3	11.3
	NumberSampled*	120	120	120	360

Site: Easton

Treatment	Year >	2004	2005	2006	Mean
High	Fish Weight	15.6	15.8	14.5	15.3
	NumberSampled*	180	180	179	539
Low	Fish Weight	11.6	11.9	12.0	11.9
	NumberSampled*	180	180	180	540

Site: Jack Creek

Treatment	Year >	2004	2005	2006	Mean
High	Fish Weight	15.4	15.4	15.6	15.4
	NumberSampled*	180	180	120	480
Low	Fish Weight	12.4	10.8	12.1	11.7
	NumberSampled*	180	180	120	480

Pooled over Sites

Treatment	Year >	2004	2005	2006	Mean
High	Fish Weight	15.6	15.4	15.1	15.4
	NumberSampled*	480	480	419	1,379
Low	Fish Weight	11.8	11.3	11.8	11.7
	NumberSampled*	480	480	420	1,380

* Number detected at McNary multiplied by proportion Detected at McNary, used as weights in analyses

Appendix A

1. 2007-2008 releases (BY 2005-2006)

a. Logistical Analysis of Variation for Release-to-McNary Smolt Survival

2007-2008 Mean Release-to-McNary Survival-Index Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P	
Year	17	1	17	2.10	0.1776	*
Site	209	2	105	12.76	**0.0018**	*
Year x Site Interaction (YxS)	24	2	12	1.47	0.2749	*
Block within YxS	82	10	8	2.18	0.1170	**
STF vs Control	0.02	1	0.02	0.01	0.9433	**
STF vs Control x Site	8	2	4	1.06	0.3837	**
EWS vs Bio	0	1	0	0.04	0.8509	**
EWS vs Bio x Site	10	2	5	1.38	0.2962	**
Error	38	10	4			

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

Note: Data bases for McNary Survival to McNary given in Appendix B**.**

b. Logistical Analysis of Variation for Proportion Detected leaving Raceway

2007-2008 Volitional Release-Proportion Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P	
Year	35	1	35	5.47	**0.0415**	*
Site	87	2	44	6.92	**0.0130**	*
Year x Site Interaction (YxS)	63	2	31	4.95	**0.0320**	*
Block within YxS	63	10	6	2.40	**0.0920**	**
STF vs Control	5.64	1	5.64	2.14	0.1742	**
STF vs Control x Site	2	2	1	0.40	0.6816	**
EWS vs Bio	0	1	0	0.14	0.7157	**
EWS vs Bio x Site	3	2	1	0.57	0.5854	**
Error	26	10	3			

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

Note: Data bases for Proportion Detected leaving Raceway given in Appendix B.

c. Logistical Analysis of Variation for Proportion Mini-Jacks

2007-2008 Mean pre-release Mini-Jack Proportion Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P	
Year	46	1	46	68.23	**0.0000**	*
Site	13	2	7	9.87	**0.0043**	*
Year x Site Interaction (YxS)	1	2	0	0.41	0.6728	*
Block within YxS	7	10	1	1.10	0.4393	**
STF vs Control	0.27	1	0.27	0.44	0.5226	**
STF vs Control x Site	4	2	2	3.10	**0.0898**	**
EWS vs Bio	2	1	2	2.76	0.1274	**
EWS vs Bio x Site	3	2	1	2.15	0.1677	**
Error	6	10	1			

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

d. Analysis of Variance for Julian Release-Site Detection Date

2007-2008 Mean Julian-Release-Date Analysis of Variance

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P
Year	9,401,525	1	9,401,525	219.81	**0.0000** *
Site	444,270	2	222,135	5.19	**0.0284** *
Year x Site Interaction (YxS)	310,281	2	155,141	3.63	**0.0654** *
Block within YxS	427,714	10	42,771	1.24	0.3715 **
STF vs Control	8,292	1	8,292	0.24	0.6349 **
STF vs Control x Site	81,320	2	40,660	1.18	0.3478 **
EWS vs Bio	76,644	1	76,644	2.22	0.1673 **
EWS vs Bio x Site	18,510	2	9,255	0.27	0.7704 **
Error	345,714	10	34,571		

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

** Tested against Error Mean Square as F-test denominator Mean Square

e. Analysis of Variance for Julian Expanded McNary-Detection Date

2007-2008 Julian McNary-Detection-Date Analysis of Variation

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P	
Year	634,119	1	634,119	404.65	**0.0000**	*
Site	12,898	2	6,449	4.12	**0.0497**	*
Year x Site Interaction (YxS)	33,616	2	16,808	10.73	**0.0032**	*
Block within YxS	15,671	10	1,567	1.23	0.3759	**
STF vs Control	0.10	1	0.10	0.00	0.9931	**
STF vs Control x Site	1,184	2	592	0.46	0.6417	**
EWS vs Bio	3,698	1	3,698	2.90	0.1195	**
EWS vs Bio x Site	1,927	2	964	0.75	0.4950	**
Error	12,763	10	1,276			

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

** Tested against Error Mean Square as F-test denominator Mean Square

f. Analysis of Variance for Pre-Release Fish Weight (grams/fish)

2007-2008 Pre-Release Weight (gr) Analysis of Variance

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P	
Year	1,287	1	1,287	18.18	**0.0017**	*
Site	150	2	75	1.06	0.3826	*
Year x Site Interaction (YxS)	247	2	124	1.74	0.2239	*
Block within YxS	708	10	71	4.99	**0.0090**	**
STF vs Control	73.00	1	73.00	5.14	**0.0468**	**
STF vs Control x Site	19	2	10	0.67	0.5337	**
EWS vs Bio	24	1	24	1.69	0.2227	**
EWS vs Bio x Site	35	2	18	1.23	0.3323	**
Error	142	10	14			

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

** Tested against Error Mean Square as F-test denominator Mean Square

2. 2004-2006 Releases (BY 2002-2004)

a. Logistical Analysis of Variation for Release-to-McNary Smolt Survival

2004-2006 Mean Release-to-McNary Survival-Index Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P
Year	1,641	2	821	121.37	**0.0000** *
Site	156	2	78	11.51	**0.0011** *
Year x Site Interaction (YxS)	18	4	5	0.68	0.6177 *
Block within YxS	95	14	7	2.35	**0.0610** **
Hi vs Lo	144	1	144	50.12	**0.0000** **
Hi vs Lo x Year	4	2	2	0.61	0.5573 **
Hi vs Lo x Site	18	2	9	3.04	**0.0798** **
Hi vs Lo x Year x Site	16	4	4	1.37	0.2945 **
Error	40	14	3		

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

Note: Data bases for McNary Survival to McNary given in Appendix B**.**

b. Logistical Analysis of Variation for Proportion Detected leaving Raceway

2004-2006 Volitional Release-Proportion Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P
Year	138	2	69	21.39	**0.0001** *
Site	33	2	16	5.13	**0.0213** *
Year x Site Interaction (YxS)	44	4	11	3.43	**0.0373** *
Block within YxS	69	14	5	1.53	0.2190 **
Hi vs Lo	22	1	22	6.88	**0.0201** **
Hi vs Lo x Year	71	2	35	11.02	**0.0013** **
Hi vs Lo x Site	3	2	2	0.51	0.6140 **
Hi vs Lo x Year x Site	15	4	4	1.18	0.3613 **
Error	45	14	3		**

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

Note: Data bases for McNary Survival to McNary given in Appendix B**.**

c. Logistical Analysis of Variation for Proportion Mini-Jacks

2004-2006 Mean pre-release Mini-Jack Proportion Logistic Analysis of Variation

Source	Deviance	Degrees of Freedom	Mean Deviance	F-Ratio	Type 1 Error P
Year (Y)	41	2	21	9.85	**0.0021** *
Site (S)	4	2	2	1.00	0.3930 *
Year x Site Interaction (YxS)	8	4	2	1.01	0.4371 *
Block within YxS	14	14	1	0.49	0.9055 **
Hi vs Lo	43	1	43	20.30	**0.0005** **
Hi vs Lo x Year	1	2	0	0.12	0.8885 **
Hi vs Lo x Site	2	2	1	0.46	0.6375 **
Hi vs Lo x Year x Site	9	4	2	1.12	0.3850 **
Error	29	14	2		

* Tested against Block within YxS's Mean Deviance as F-test denominator Mean Deviance

** Tested against Error Mean Deviance as F-test denominator Mean Deviance

d. Analysis of Variance for Julian Release-Site Detection Date

2004-2006 Mean Julian-Release-Date Analysis of Variance

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P
Year	3,176,302	2	1,588,151	88.95	**0.0000** *
Site	373,738	2	186,869	10.47	**0.0017** *
Year x Site Interaction (YxS)	1,476,696	4	369,174	20.68	**0.0000** *
Block within YxS	102,375	14	7,313	0.41	0.9468 **
Hi vs Lo	61,761	1	61,761	3.46	**0.0840** **
Hi vs Lo x Year	11,053	2	5,527	0.31	0.7387 **
Hi vs Lo x Site	20,116	2	10,058	0.56	0.5817 **
Hi vs Lo x Year x Site	52,112	4	13,028	0.73	0.5865 **
Error	249,952	14	17,854		

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

** Tested against Error Mean Square as F-test denominator Mean Square

e. Analysis of Variance for Julian Expanded McNary-Detection Date

2004-2006 Julian McNary-Detection-Date Analysis of Variance

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P
Year	17,680	2	8,840	14.74	**0.0004** *
Site	23,261	2	11,630	19.39	**0.0001** *
Year x Site Interaction (YxS)	13,602	4	3,401	5.67	**0.0063** *
Block within YxS	12,688	14	906	1.51	0.2248 **
Hi vs Lo	36,500	1	36,500	60.87	**0.0000** **
Hi vs Lo x Year	3,799	2	1,899	3.17	**0.0733** **
Hi vs Lo x Site	45	2	23	0.04	0.9631 **
Hi vs Lo x Year x Site	2,239	4	560	0.93	0.4728 **
Error	8,396	14	600		

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

f. Analysis of Variance for Pre-Release Fish Weight (grams/fish)

2004-2006 Pre-Release Weight (gr) Analysis of Variance

Source	Sums of Squares	Degrees of Freedom	Mean Square	F-Ratio	Type 1 Error P
Year	58	2	29	0.75	0.4908 *
Site	18	2	9	0.23	0.7956 *
Year x Site Interaction (YxS)	167	4	42	1.08	0.4041 *
Block within YxS	654	14	47	1.21	0.3651 **
Hi vs Lo	9,609	1	9,609	248.20	**0.0000** **
Hi vs Lo x Year	85	2	43	1.10	0.3607 **
Hi vs Lo x Site	50	2	25	0.65	0.5392 **
Hi vs Lo x Year x Site	185	4	46	1.19	0.3560 **
Error	542	14	39		

* Tested against Block within YxS's Mean Square as F-test denominator Mean Square

** Tested against Error Mean Square as F-test denominator Mean Square

Appendix B

1. McNary Detection Rates used to Expand McNary Counts (by release year)

Year	Julian Date Strata Beginning	Julian Date Strata Ending	Bonneville (Bonn.) Based Total Bonn.Det.	Joint Bonn. McN.Det.	McN. Det. Rate	John Day (J.D.) Based Total J.D.Det.	Joint J.D. McN.Det.	McN. Det. Rate	Pooled over Bonn. and J.D. Pooled Total Det.	Pooled Joint Det.	McN. Det. Rate
2004		103	29	19	0.6631	72	48	0.6673	101	67	0.6661
	104	121	409	247	0.6046	905	507	0.5604	1313	754	0.5742
	122	124	112	58	0.5186	246	122	0.4958	358	180	0.5029
	125	127	72	32	0.4463	142	62	0.4369	214	94	0.4400
	128	131	83	35	0.4207	312	123	0.3941	395	158	0.3997
	132		184	57	0.3096	337	113	0.3350	521	170	0.3260
	Total		888	448	0.5045	2014	975	0.4841	2902	1423	0.4904
2005	85.0	112.0	53	29	0.5434	251	106	0.4228	304	135	0.4440
	113.0	126.0	648	265	0.4089	1865	730	0.3915	2513	995	0.3960
	127.0	128.0	38	17	0.4523	126	55	0.4378	163	72	0.4411
	129.0	141.0	73	36	0.4934	219	107	0.4890	292	143	0.4901
	Total		812	347	0.4273	2460	998	0.4057	3272	1345	0.4111
2006		109	18	3	0.1638	100	19	0.1908	118	22	0.1866
	110	117	118	30	0.2545	443	123	0.2778	561	153	0.2729
	118	123	452	148	0.3274	1262	397	0.3145	1715	545	0.3179
	124	126	251	101	0.4016	569	194	0.3409	821	295	0.3595
	127	138	423	185	0.4376	990	382	0.3857	1413	567	0.4012
	139		36	12	0.3294	305	73	0.2396	341	85	0.2492
	Total		1299	479	0.3687	3669	1188	0.3238	4968	1667	0.3355
2007		113	172	43	0.2503	569	177	0.3113	740	220	0.2971
	114	117	171	51	0.2977	748	267	0.3571	919	318	0.3460
	118	125	535	225	0.4209	2475	913	0.3690	3009	1138	0.3782
	126	133	445	119	0.2672	1547	497	0.3212	1992	616	0.3092
	134	147	342	145	0.4239	1389	521	0.3752	1731	666	0.3848
	148	152	8	7	0.8698	89	45	0.5058	97	52	0.5360
	153		21	6	0.2870	45	18	0.3975	66	24	0.3626
	Total		1694	596	0.3518	6861	2438	0.3553	8555	3034	0.3546
2008		131	1031	356	0.3454	1095	341	0.3114	2126	697	0.3279
	132	138	377	118	0.3126	867	255	0.2940	1245	373	0.2997
	139	139	57	11	0.1943	326	84	0.2579	382	95	0.2485
	140	142	157	27	0.1724	717	156	0.2176	873	183	0.2095
	143		145	22	0.1521	421	67	0.1591	566	89	0.1573
	Total		1694	596	0.3518	6861	2438	0.3553	8555	3034	0.3546

2. Raceway Summaries

Subsequent to 2004, almost no PIT-tagged fish were directed toward barges at McNary (removed from the river). Consequently no adjustments for removal are made, and it is only 2004 (below) that have removal adjustments.

a. 2004 Release (BY 2002)

	Acclimation Site	Clark Flat					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	Low	High	High	Low	Low	High
	Cross	HxH	HxH	NxN	NxN	NxN	NxN
Stratum 1	Total	1	0	3	0	0	0
	Removed	0	0	0	0	0	0
	Subtotal	1	0	3	0	0	0
	Expanded Total	1.50	0.00	4.50	0.00	0.00	0.00
Stratum 2	Total	84	151	188	122	87	116
	Removed	2	4	2	2	1	4
	Subtotal	82	147	186	120	86	112
	Expanded Total	144.81	260.02	325.95	211.00	150.78	199.06
Stratum 3	Total	41	37	40	48	42	32
	Removed	1	1	1	1	0	0
	Subtotal	40	36	39	47	42	32
	Expanded Total	80.53	72.58	78.55	94.45	83.51	63.63
Stratum 4	Total	20	14	13	25	33	24
	Removed	0	1	0	0	2	0
	Subtotal	20	13	13	25	31	24
	Expanded Total	45.45	30.54	29.54	56.81	72.45	54.54
Stratum 5	Total	29	32	20	20	22	28
	Removed	0	1	1	0	1	3
	Subtotal	29	31	19	20	21	25
	Expanded Total	72.55	78.55	48.53	50.04	53.54	65.54
Stratum 6	Total	27	26	20	24	26	19
	Removed	0	0	0	0	1	1
	Subtotal	27	26	20	24	25	18
	Expanded Total	82.81	79.74	61.34	73.61	77.68	56.21
	Expanded Total over Strata	427.66	521.44	548.41	485.91	437.96	438.98
	Volitional Releases	2124	2162	2171	2177	2178	2181
	Release-to-McN Survival	0.2013	0.2412	0.2526	0.2232	0.2011	0.2013
	Tagged	2223	2223	2223	2223	2223	2223
	Proportion Released	0.9555	0.9726	0.9766	0.9793	0.9798	0.9811

Acclimation Site		Easton					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	High	Low	Low	High
	Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1	Total	2	0	0	0	0	0
	Removed	0	0	0	0	0	0
	Subtotal	2	0	0	0	0	0
	Expanded Total	3.00	0.00	0.00	0.00	0.00	0.00
Stratum 2	Total	119	46	76	39	65	82
	Removed	1	1	2	0	1	3
	Subtotal	118	45	74	39	64	79
	Expanded Total	206.51	79.37	130.88	67.92	112.46	140.59
Stratum 3	Total	25	27	19	19	22	18
	Removed	0	0	0	0	0	0
	Subtotal	25	27	19	19	22	18
	Expanded Total	49.71	53.69	37.78	37.78	43.74	35.79
Stratum 4	Total	16	19	16	13	10	9
	Removed	0	0	0	0	0	0
	Subtotal	16	19	16	13	10	9
	Expanded Total	36.36	43.18	36.36	29.54	22.73	20.45
Stratum 5	Total	24	26	21	19	30	17
	Removed	0	1	2	0	2	1
	Subtotal	24	25	19	19	28	16
	Expanded Total	60.04	63.54	49.53	47.53	72.05	41.03
Stratum 6	Total	34	58	35	40	37	33
	Removed	4	1	0	4	2	1
	Subtotal	30	57	35	36	35	32
	Expanded Total	96.01	175.82	107.35	114.42	109.35	99.15
	Expanded Total over Strata	451.64	415.61	361.90	297.20	360.33	337.01
	Volitional Releases	2157	2176	2182	2171	2161	2114
	Release-to-McN Survival	0.2094	0.1910	0.1659	0.1369	0.1667	0.1594
	Tagged	2223	2223	2224	2224	2223	2223
	Proportion Released	0.9703	0.9789	0.9811	0.9762	0.9721	0.9510

Acclimation Site		Jack Creek					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	Low	High	Low	High
	Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1	Total	0	0	3	0	0	2
	Removed	0	0	0	0	0	0
	Subtotal	0	0	3	0	0	2
	Expanded Total	0.00	0.00	4.50	0.00	0.00	3.00
Stratum 2	Total	87	46	58	124	36	110
	Removed	0	0	0	1	0	4
	Subtotal	87	46	58	123	36	106
	Expanded Total	151.52	80.12	101.02	215.22	62.70	188.61
Stratum 3	Total	25	22	27	24	10	28
	Removed	0	0	1	0	0	0
	Subtotal	25	22	26	24	10	28
	Expanded Total	49.71	43.74	52.70	47.72	19.88	55.67
Stratum 4	Total	9	14	12	16	10	13
	Removed	0	1	0	0	0	0
	Subtotal	9	13	12	16	10	13
	Expanded Total	20.45	30.54	27.27	36.36	22.73	29.54
Stratum 5	Total	25	33	27	21	21	21
	Removed	0	1	0	2	2	1
	Subtotal	25	32	27	19	19	20
	Expanded Total	62.54	81.06	67.55	49.53	49.53	51.04
Stratum 6	Total	37	32	40	38	52	32
	Removed	1	0	0	2	0	1
	Subtotal	36	32	40	36	52	31
	Expanded Total	111.42	98.15	122.68	112.42	159.49	96.08
	Expanded Total over Strata	395.64	333.61	375.72	461.25	314.33	423.95
	Volitional Releases	2175	2165	2184	2177	2183	2163
	Release-to-McN Survival	0.1819	0.1541	0.1720	0.2119	0.1440	0.1960
	Tagged	2223	2223	2223	2223	2223	2222
	Proportion Released	0.9784	0.9739	0.9825	0.9793	0.9820	0.9734

b. 2005 Release (BY 2003)

Acclimation Site		Clark Flat					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	Low	High	High	Low	High	Low
	Cross	NxN	NxN	HxH	HxH	NxN	NxN
Stratum 1	Total	1	2	5	0	1	0
	Removed	0	0	0	0	0	0
	Subtotal	1	2	5	0	1	0
	Expanded Total	2.25	4.50	11.26	0.00	2.25	0.00
Stratum 2	Total	98	147	130	121	110	98
	Removed	0	0	1	1	1	0
	Subtotal	98	147	129	120	109	98
	Expanded Total	247.50	371.26	326.80	304.07	276.29	247.50
Stratum 3	Total	2	5	7	7	3	10
	Removed	0	0	0	0	0	0
	Subtotal	2	5	7	7	3	10
	Expanded Total	4.53	11.33	15.87	15.87	6.80	22.67
Stratum 4	Total	16	10	9	18	14	25
	Removed	0	0	1	0	0	0
	Subtotal	16	10	8	18	14	25
	Expanded Total	32.65	20.40	17.32	36.73	28.57	51.01
	Expanded Total over Strata	286.94	407.50	371.25	356.66	313.91	321.19
	Volitional Releases	2139	2166	2135	2134	2177	2155
	Release-to-McN Survival	0.1341	0.1881	0.1739	0.1671	0.1442	0.1490
	Tagged	2222	2223	2222	2222	2222	2223
	Proportion Detected	0.9626	0.9744	0.9608	0.9604	0.9797	0.9694

Acclimation Site		Easton					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	High	Low	High	Low
	Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1	Total	1	0	0	0	1	0
	Removed	0	0	0	0	0	0
	Subtotal	1	0	0	0	1	0
	Expanded Total	2.25	0.00	0.00	0.00	2.25	0.00
Stratum 2	Total	92	70	109	79	103	77
	Removed	0	1	0	0	0	1
	Subtotal	92	69	109	79	103	76
	Expanded Total	232.35	175.26	275.29	199.52	260.13	192.94
Stratum 3	Total	5	6	6	5	4	12
	Removed	0	0	0	0	0	0
	Subtotal	5	6	6	5	4	12
	Expanded Total	11.33	13.60	13.60	11.33	9.07	27.20
Stratum 4	Total	19	32	12	30	26	32
	Removed	0	0	0	0	1	1
	Subtotal	19	32	12	30	25	31
	Expanded Total	38.77	65.30	24.49	61.21	52.01	64.25
	Expanded Total over Strata	284.71	254.16	313.37	272.07	323.46	284.40
	Volitional Releases	2136	2170	2180	2178	2158	2151
	Release-to-McN Survival	0.1333	0.1171	0.1437	0.1249	0.1499	0.1322
	Tagged	2222	2224	2221	2222	2222	2222
	Proportion Detected	0.9613	0.9757	0.9815	0.9802	0.9712	0.9680

Acclimation Site	Jack Creek					
Acclimation Raceway	01	02	03	04	05	06
Treatment	High	Low	High	Low	High	Low
Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1 Total	0	0	0	0	0	0
Removed	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0
Expanded Total	0.00	0.00	0.00	0.00	0.00	0.00
Stratum 2 Total	88	55	103	77	103	60
Removed	0	0	1	0	1	0
Subtotal	88	55	102	77	102	60
Expanded Total	222.25	138.91	258.61	194.47	258.61	151.53
Stratum 3 Total	15	17	20	17	7	4
Removed	0	0	1	0	0	0
Subtotal	15	17	19	17	7	4
Expanded Total	34.00	38.54	44.07	38.54	15.87	9.07
Stratum 4 Total	43	53	28	36	35	42
Removed	1	0	0	0	0	1
Subtotal	42	53	28	36	35	41
Expanded Total	86.70	108.15	57.13	73.46	71.42	84.66
Expanded Total over Strata	342.95	285.59	359.81	306.46	345.89	245.26
Volitional Releases	2186	2183	2161	2178	2167	2160
Release-to-McN Survival	0.1569	0.1308	0.1665	0.1407	0.1596	0.1135
Tagged	2223	2222	2222	2222	2222	2222
Proportion Detected	0.9834	0.9824	0.9725	0.9802	0.9752	0.9721

c. 2006 Release (BY 2004)

Acclimation Site		Clark Flat					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	High	Low	High	Low
	Cross	HxH	HxH	WxW	WxW	WxW	WxW
Stratum 1	Total	2	2	1	0	3	0
	Removed	0	0	0	0	0	0
	Subtotal	2	2	1	0	3	0
	Expanded Total	10.72	10.72	5.36	0.00	16.08	0.00
Stratum 2	Total	28	13	25	19	23	9
	Removed	0	0	0	0	0	0
	Subtotal	28	13	25	19	23	9
	Expanded Total	102.59	47.63	91.60	69.61	84.27	32.97
Stratum 3	Total	87	67	81	36	82	36
	Removed	0	0	0	0	0	0
	Subtotal	87	67	81	36	82	36
	Expanded Total	273.70	210.78	254.82	113.26	257.97	113.26
Stratum 4	Total	53	39	41	31	50	42
	Removed	0	0	0	0	0	0
	Subtotal	53	39	41	31	50	42
	Expanded Total	147.42	108.48	114.05	86.23	139.08	116.83
Stratum 5	Total	113	112	105	104	87	93
	Removed	0	0	0	0	0	0
	Subtotal	113	112	105	104	87	93
	Expanded Total	281.65	279.16	261.71	259.22	216.85	231.80
Stratum 6	Total	9	15	7	10	6	19
	Removed	0	0	0	0	0	0
	Subtotal	9	15	7	10	6	19
	Expanded Total	36.12	60.20	28.09	40.13	24.08	76.25
	Expanded Total over Strata	852.21	716.97	755.63	568.45	738.33	571.11
	Volitional Releases	2147	2164	2166	2143	2178	2164
	Release-to-McN Survival	0.3969	0.3313	0.3489	0.2653	0.3390	0.2639
	Tagged	2222	2224	2222	2223	2222	2222
	Proportion Detected	0.9662	0.9730	0.9748	0.9640	0.9802	0.9739

Acclimation Site		Easton					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	High	Low	High	Low
	Cross	WxW	WxW	WxW	WxW	WxW	WxW
Stratum 1	Total	1	0	1	1	0	0
	Removed	0	0	0	0	0	0
	Subtotal	1	0	1	1	0	0
	Expanded Total	5.36	0.00	5.36	5.36	0.00	0.00
Stratum 2	Total	6	8	15	6	9	6
	Removed	0	0	0	0	0	0
	Subtotal	6	8	15	6	9	6
	Expanded Total	21.98	29.31	54.96	21.98	32.97	21.98
Stratum 3	Total	51	31	70	46	57	40
	Removed	0	0	0	0	0	0
	Subtotal	51	31	70	46	57	40
	Expanded Total	160.44	97.53	220.22	144.71	179.32	125.84
Stratum 4	Total	39	31	41	27	35	38
	Removed	0	0	0	0	0	0
	Subtotal	39	31	41	27	35	38
	Expanded Total	108.48	86.23	114.05	75.10	97.36	105.70
Stratum 5	Total	82	88	67	87	78	63
	Removed	0	0	0	0	0	0
	Subtotal	82	88	67	87	78	63
	Expanded Total	204.39	219.34	167.00	216.85	194.42	157.03
Stratum 6	Total	17	22	12	19	11	24
	Removed	0	0	0	0	0	0
	Subtotal	17	22	12	19	11	24
	Expanded Total	68.23	88.29	48.16	76.25	44.15	96.32
	Expanded Total over Strata	568.88	520.70	609.74	540.26	548.21	506.87
	Volitional Releases	2151	2111	2169	2099	2142	2089
	Release-to-McN Survival	0.2645	0.2467	0.2811	0.2574	0.2559	0.2426
	Tagged	2222	2222	2223	2224	2222	2222
	Proportion Detected	0.9680	0.9500	0.9757	0.9438	0.9640	0.9401

Acclimation Site		Jack Creek					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	High	Low	High	Low	Low	High
	Cross	WxW	WxW	WxW	WxW	WxW	WxW
Stratum 1	Total	0	1	0	0	1	3
	Removed	0	0	0	0	0	0
	Subtotal	0	1	0	0	1	3
	Expanded Total	0.00	5.36	0.00	0.00	5.36	16.08
Stratum 2	Total	13	5	0	10	13	41
	Removed	0	0	0	0	0	0
	Subtotal	13	5	0	10	13	41
	Expanded Total	47.63	18.32	0.00	36.64	47.63	150.22
Stratum 3	Total	41	45	3	31	47	72
	Removed	0	0	0	0	0	0
	Subtotal	41	45	3	31	47	72
	Expanded Total	128.98	141.57	9.44	97.53	147.86	226.51
Stratum 4	Total	26	38	5	26	25	32
	Removed	0	0	0	0	0	0
	Subtotal	26	38	5	26	25	32
	Expanded Total	72.32	105.70	13.91	72.32	69.54	89.01
Stratum 5	Total	93	73	1	66	62	64
	Removed	0	0	0	0	0	0
	Subtotal	93	73	1	66	62	64
	Expanded Total	231.80	181.95	2.49	164.51	154.54	159.52
Stratum 6	Total	11	13	0	12	13	7
	Removed	0	0	0	0	0	0
	Subtotal	11	13	0	12	13	7
	Expanded Total	44.15	52.17	0.00	48.16	52.17	28.09
	Expanded Total over Strata	524.89	505.07	25.84	419.15	477.10	669.43
	Volitional Releases	2140	2127	85	2101	2068	2164
	Release-to-McN Survival	0.2453	0.2375	0.3040	0.1995	0.2307	0.3094
	Tagged	2222	2222	2224	2222	2222	2222
	Proportion Detected	0.9631	0.9572	0.0382	0.9455	0.9307	0.9739

d. 2007 Release (BY 2005)

Acclimation Site		Clark Flat					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	STF	Control	STF	Control	STF	Control
	Cross	HxH	HxH	NxN	NxN	NxN	NxN
Stratum 1	Total	34	42	29	30	27	28
	Removed	0	0	0	0	0	0
	Subtotal	34	42	29	30	27	28
	Expanded Total	114.43	141.35	97.60	100.97	90.87	94.24
Stratum 2	Total	29	44	38	22	34	22
	Removed	0	0	0	0	0	0
	Subtotal	29	44	38	22	34	22
	Expanded Total	83.81	127.17	109.83	63.58	98.27	63.58
Stratum 3	Total	86	87	73	85	81	98
	Removed	0	0	0	0	0	0
	Subtotal	86	87	73	85	81	98
	Expanded Total	227.41	230.05	193.03	224.76	214.18	259.14
Stratum 4	Total	39	39	29	38	41	54
	Removed	0	0	0	0	0	0
	Subtotal	39	39	29	38	41	54
	Expanded Total	126.14	126.14	93.80	122.91	132.61	174.66
Stratum 5	Total	34	50	83	80	78	81
	Removed	0	0	0	0	0	0
	Subtotal	34	50	83	80	78	81
	Expanded Total	88.36	129.93	215.69	207.89	202.70	210.49
Stratum 6	Total	1	6	3	5	4	4
	Removed	0	0	0	0	0	0
	Subtotal	1	6	3	5	4	4
	Expanded Total	1.87	11.19	5.60	9.33	7.46	7.46
Stratum 7	Total	1	1	1	1	0	1
	Removed	0	0	0	0	0	0
	Subtotal	1	1	1	1	0	1
	Expanded Total	2.76	2.76	2.76	2.76	0.00	2.76
	Expanded Total over Strata	644.77	768.60	718.30	732.20	746.09	812.33
	Volitional Releases	2150	2172	2184	2173	2195	2191
	Release-to-McN Survival	0.2999	0.3539	0.3289	0.3370	0.3399	0.3708
	Tagged	2223	2222	2222	2222	2222	2228
	Proportion Detected	0.9672	0.9775	0.9829	0.9779	0.9878	0.9834

Acclimation Site	Easton					
Acclimation Raceway	01	02	03	04	05	06
Treatment	STF	Control	STF	Control	STF	Control
Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1 Total	18	24	18	27	31	19
Removed	0	0	0	0	0	0
Subtotal	18	24	18	27	31	19
Expanded Total	60.58	80.77	60.58	90.87	104.33	63.95
Stratum 2 Total	19	22	27	44	41	23
Removed	0	0	0	0	0	0
Subtotal	19	22	27	44	41	23
Expanded Total	54.91	63.58	78.03	127.17	118.50	66.47
Stratum 3 Total	81	86	82	85	87	78
Removed	0	0	0	0	0	0
Subtotal	81	86	82	85	87	78
Expanded Total	214.18	227.41	216.83	224.76	230.05	206.25
Stratum 4 Total	46	44	58	35	45	45
Removed	0	0	0	0	0	0
Subtotal	46	44	58	35	45	45
Expanded Total	148.78	142.32	187.60	113.21	145.55	145.55
Stratum 5 Total	45	48	39	16	34	40
Removed	0	0	0	0	0	0
Subtotal	45	48	39	16	34	40
Expanded Total	116.94	124.74	101.35	41.58	88.36	103.95
Stratum 6 Total	1	5	2	0	3	1
Removed	0	0	0	0	0	0
Subtotal	1	5	2	0	3	1
Expanded Total	1.87	9.33	3.73	0.00	5.60	1.87
Stratum 7 Total	4	3	2	1	1	2
Removed	0	0	0	0	0	0
Subtotal	4	3	2	1	1	2
Expanded Total	11.03	8.27	5.52	2.76	2.76	5.52
Expanded Total over Strata	608.30	656.42	653.64	600.34	695.14	593.55
Volitional Releases	2165	2167	2164	2152	2144	2143
Release-to-McN Survival	0.2810	0.3029	0.3021	0.2790	0.3242	0.2770
Tagged	2222	2223	2222	2224	2222	2222
Proportion Detected	0.9743	0.9748	0.9739	0.9676	0.9649	0.9644

Acclimation Site	Jack Creek					
Acclimation Raceway	01	02	03	04	05	06
Treatment	STF	Control	STF	Control	STF	Control
Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1 Total	32	12	18	17	13	13
Removed	0	0	0	0	0	0
Subtotal	32	12	18	17	13	13
Expanded Total	107.70	40.39	60.58	57.21	43.75	43.75
Stratum 2 Total	27	13	23	26	19	18
Removed	0	0	0	0	0	0
Subtotal	27	13	23	26	19	18
Expanded Total	78.03	37.57	66.47	75.14	54.91	52.02
Stratum 3 Total	63	68	81	94	76	88
Removed	0	0	0	0	0	0
Subtotal	63	68	81	94	76	88
Expanded Total	166.59	179.81	214.18	248.56	200.96	232.69
Stratum 4 Total	35	55	45	43	54	52
Removed	0	0	0	0	0	0
Subtotal	35	55	45	43	54	52
Expanded Total	113.21	177.89	145.55	139.08	174.66	168.19
Stratum 5 Total	65	82	58	68	58	45
Removed	0	0	0	0	0	0
Subtotal	65	82	58	68	58	45
Expanded Total	168.91	213.09	150.72	176.71	150.72	116.94
Stratum 6 Total	15	17	19	9	14	10
Removed	0	0	0	0	0	0
Subtotal	15	17	19	9	14	10
Expanded Total	27.98	31.72	35.45	16.79	26.12	18.66
Stratum 7 Total	9	8	11	3	4	5
Removed	0	0	0	0	0	0
Subtotal	9	8	11	3	4	5
Expanded Total	24.82	22.06	30.34	8.27	11.03	13.79
Expanded Total over Strata	687.25	702.53	703.30	721.77	662.16	646.05
Volitional Releases	2203	2188	2186	2174	2185	2182
Release-to-McN Survival	0.3120	0.3211	0.3217	0.3320	0.3030	0.2961
Tagged	2222	2222	2222	2222	2222	2222
Proportion Detected	0.9914	0.9847	0.9838	0.9784	0.9833	0.9820

e. 2008 Release (BY 2006)

Acclimation Site	Clark Flat					
Acclimation Raceway	01	02	03	04	05	06
Treatment	EWS	BIO	EWS	BIO	EWS	BIO
Cross	HxH	HxH	NxN	NxN	NxN	NxN
Stratum 1 Total	78	78	41	73	206	194
Removed	0	0	0	0	0	0
Subtotal	78	78	41	73	206	194
Expanded Total	237.89	237.89	125.04	222.64	628.27	591.67
Stratum 2 Total	45	56	72	52	52	63
Removed	0	0	0	0	0	0
Subtotal	45	56	72	52	52	63
Expanded Total	150.17	186.88	240.27	173.53	173.53	210.24
Stratum 3 Total	19	11	13	18	15	13
Removed	0	0	0	0	0	0
Subtotal	19	11	13	18	15	13
Expanded Total	76.47	44.27	52.32	72.45	60.37	52.32
Stratum 4 Total	31	21	30	23	31	37
Removed	0	0	0	0	0	0
Subtotal	31	21	30	23	31	37
Expanded Total	147.96	100.23	143.19	109.78	147.96	176.60
Stratum 5 Total	12	17	19	20	9	32
Removed	0	0	0	0	0	0
Subtotal	12	17	19	20	9	32
Expanded Total	76.28	108.06	120.77	127.13	57.21	203.40
Expanded Total over Strata	688.77	677.33	681.60	705.52	1067.34	1234.23
Volitional Releases	1918	1912	1905	1934	3703	3805
Release-to-McN Survival	0.3591	0.3543	0.3578	0.3648	0.2882	0.3244
Tagged	2000	2000	2000	2000	4000	4000
Proportion Detected	0.9590	0.9560	0.9525	0.9670	0.9258	0.9513

Acclimation Site	Easton					
Acclimation Raceway	01	02	03	04	05	06
Treatment	EWS	BIO	EWS	BIO	EWS	BIO
Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1 Total	23	29	28	32	32	36
Removed	0	0	0	0	0	0
Subtotal	23	29	28	32	32	36
Expanded Total	70.15	88.45	85.40	97.60	97.60	109.79
Stratum 2 Total	51	33	57	43	31	54
Removed	0	0	0	0	0	0
Subtotal	51	33	57	43	31	54
Expanded Total	170.19	110.12	190.21	143.50	103.45	180.20
Stratum 3 Total	11	22	7	16	11	13
Removed	0	0	0	0	0	0
Subtotal	11	22	7	16	11	13
Expanded Total	44.27	88.54	28.17	64.40	44.27	52.32
Stratum 4 Total	23	29	23	16	22	21
Removed	0	0	0	0	0	0
Subtotal	23	29	23	16	22	21
Expanded Total	109.78	138.41	109.78	76.37	105.00	100.23
Stratum 5 Total	27	30	15	11	19	21
Removed	0	0	0	0	0	0
Subtotal	27	30	15	11	19	21
Expanded Total	171.62	190.69	95.35	69.92	120.77	133.48
Expanded Total over Strata	566.01	616.22	508.91	451.77	471.09	576.03
Volitional Releases	1924	1963	1944	1941	1953	1929
Release-to-McN Survival	0.2942	0.3139	0.2618	0.2328	0.2412	0.2986
Tagged	2000	2000	2000	2000	2000	2000
Proportion Detected	0.9620	0.9815	0.9720	0.9705	0.9765	0.9645

Acclimation Site		Jack Creek					
	Acclimation Raceway	01	02	03	04	05	06
	Treatment	EWS	BIO	EWS	BIO	EWS	BIO
	Cross	NxN	NxN	NxN	NxN	NxN	NxN
Stratum 1	Total	37	47	27	59	46	59
	Removed	0	0	0	0	0	0
	Subtotal	37	47	27	59	46	59
	Expanded Total	112.84	143.34	82.35	179.94	140.29	179.94
Stratum 2	Total	60	53	48	57	51	65
	Removed	0	0	0	0	0	0
	Subtotal	60	53	48	57	51	65
	Expanded Total	200.23	176.87	160.18	190.21	170.19	216.91
Stratum 3	Total	14	14	12	14	7	3
	Removed	0	0	0	0	0	0
	Subtotal	14	14	12	14	7	3
	Expanded Total	56.35	56.35	48.30	56.35	28.17	12.07
Stratum 4	Total	26	25	19	16	14	7
	Removed	0	0	0	0	0	0
	Subtotal	26	25	19	16	14	7
	Expanded Total	124.10	119.32	90.69	76.37	66.82	33.41
Stratum 5	Total	25	15	24	5	24	7
	Removed	0	0	0	0	0	0
	Subtotal	25	15	24	5	24	7
	Expanded Total	158.91	95.35	152.55	31.78	152.55	44.49
	Expanded Total over Strata	652.42	591.22	534.06	534.65	558.03	486.83
	Volitional Releases	1938	1934	1976	1968	1977	1971
	Release-to-McN Survival	0.3366	0.3057	0.2703	0.2717	0.2823	0.2470
	Tagged	2000	2000	2001	2000	2000	2000
	Proportion Detected	0.9690	0.9670	0.9875	0.9840	0.9885	0.9855

Appendix C

IntSTATS

International Statistical Training
and Technical Services
712 12th Street
Oregon City, Oregon 97045
United States
Voice: (503) 650-5035
e-mail: intstats@sbcglobal.net

Annual Report: Comparisons between Smolt Measures of Hatchery x Hatchery- and Natural x Natural-Brood Stock from Upper Yakima Spring Chinook for Brood-Years 2002-2006

Doug Neeley, Consultant to the Yakama Nation

Summary

Hatchery x Hatchery (HxH) and Natural x Natural (NxN) Stock[1] were allocated to Clark Flat acclimation-site raceway pairs within which different pairs of nutrition treatments had been assigned. This report primarily focuses on the Stock comparisons, not the nutrition-treatment comparisons[2]. However, comparisons between Stocks were made within the nutrition levels whenever there was evidence of Stock x Treatment Interaction.

There is a difference in the fish size data set used herein from that used in earlier reports. In previous years' reports, a volumetric measure was used to assess the number-of-fish/pound, and this measure was converted into grams/fish. The analyses used in this report is based on actual individual fish weights from fish sampled to assess the gender and the precocial of proportion of male smolt prior to release. Fish biologists felt this latter measure would provide a more accurate estimate of fish weight.

In every year, two treatments were evaluated. In Brood Years 2002-2004 they were Low and High Nutrition levels, the High level being the standard feed or control. The Low Nutrition was tested to determine whether it would reduce the proportion of male smolts that are sexually mature (mini-jacks). In Brood Year 2005, two feeds (Control and STF) were tested as to whether there was a relative difference in their effects on the rate of smoltification. In Brood Year 2006, a different two feeds (Bio as a control[3] and EWS) were evaluated with the same objective.

---

1 HxH and NxN Stock are part of domestication selection study. The original progenitors of both Stocks were wild Upper-Yakima Stock. Both Stocks are reared in the hatchery, but HxH are progeny of hatchery-spawned parents, and NxN are progeny of naturally spawned parents. HxH progeny are never permitted to spawn outside of the hatchery, and NxN progeny are never spawned in the Hatchery.

2 Nutrition treatments were also allocated to raceways at two other acclimation sites (Eaton and Jack Creek) only Stocked assigned to NxN, and detailed discussions on the nutrition-treatment comparisons for the NxN Stock are presented in another report: Comparison of Different Feed Treatments on Smolt-to-Smolt Survivals and Mini-Jack Percentages of Upper Yakima Spring Chinook for Brood-Years 2002-2006 from Naturally Spawned Parents.

3 The Control feed used in BY 2005 was not available in BY 2006.

For several analyzed measures, there were significant and substantial interactions between stock comparisons with years, particularly between the first three brood years (BY 2002 – BY 2004 involving the mini-jack-proportion study) and the last two brood years (BY 2005 - BY 2006 involving the smoltification-rate study). Analyses indicated significant or nearly significant[4] Year x Stock interactions for the Mini-Jack Proportion, Release-to-McNary Smolt Survival, Julian Date of McNary Juvenile Passage, and Pre-Release Weight. There was no substantial or significant Year x Stock interaction for Pre-Release Survival. Partitions of data into the two groups of brood years (BY 2002-2004 referred to as Group-1 and BY 2005-2006 referred to as Group-2) resulted in a reduction in the significance level of Year x Stock interactions within groups with an associated, and often-times substantial, increase in the significance level associated with brood-year Group x Stock interaction[5] for those four measured parameters demonstrating Year x Stock interaction.

The Mini-Jack Proportion of the HxH Stock was significantly lower than that of the NxN Stock within Group-1 years, but the Stock difference was not significant within Group-2 Years.

Within Group-1 years, the HxH Stock had a significantly higher Survival to McNary than did the NxN Stock, but within Group-2 years; the HxH Stock had a significantly lower Survival to McNary. Possible biological links between these two traits are discussed in this report.

The difference in the mean McNary Passage Date between the two Stocks was nil and non-significant within the Group-1 Years, but the mean Passage Date for the HxH Stock was significantly earlier than for the NxN Stock within Group 2.

The HxH vs. NxN Pre-Release-Weight difference was not significant within Group-1.

Within-year mean Pre-Release Survival was consistently lower for the HxH Stock over years.

There was evidence of Stock interactions with the tested nutrition treatments, which will be discussed.

Design of Experiment

The HxH assignment was superimposed at only the Clark Flat Acclimation Site at which there were three pairs of raceways[6], with the feed treatments allocated to the different raceways within each pair, the HxH Stock being allocated to one of the three pairs[7] of raceways, and the NxN Stock being allocated to the other two pairs[8]. Thus there were twice as many raceways at Clark Flat assigned to the NxN Stock than to the HxH Stock. The design was effectively a Spilt-Plot

---

4 Significant and nearly significant respectively imply estimated Type 1 error $P \leq 0.05$ and $P <= 0.1$.

5 (Group-1 Years versus Group-2 Years) x (HxH versus NxN) interaction.

6 The progeny for each raceway with a pair share the same parental set, the different pairs of raceways having progeny derived from different parental sites.

7 Raceways within each pair were similar in that they were physically adjacent to each other and in that they both received progeny from the same set of diallele crosses, there being different male and female parental sources in the different diallele sets. This could result in smolt within a raceway pairs being more than smolt from different raceway pairs due to genetic and/or parental-effect similarities within pairs.

8 NxN stock was the only stock used at the other two acclimation sites (all three pairs of raceways at both Easton and Jack Creek).

design at Clark Flat with the Stock assigned to the raceway pairs (main plot), and the feed levels assigned to raceways within raceway pairs (subplot).

A portion of the fish in each raceway were PIT-tagged for the purpose of estimating pre-release survival and smolt survival from release to McNary Dam. For the 2006 brood, there were twice as many HxH fish PIT-tagged per raceway than there were NxN fish to give approximately an equal total number of PIT-tagged fish for both Stocks. In previous brood years, there were approximately half as many HxH fish tagged as NxN fish. For the purpose of assessing Mini-Jack Proportions, approximately twice as many fish were sampled from HxH raceways in all but Brood Year 2002.

Analysis

As will be seen in subsequent tables, there were significant differences between the Stock main effects and significant interactions between Stock differences with treatment and year effects, and these are discussed herein.

Five variables were analyzed:

1. Pre-Release Proportion of Mini-Jacks,
2. Release-to-McNary Smolt-to-Smolt Survival
3. Mean McNary Dam Juvenile-Passage Date,
4. Mean Pre-Release Smolt Weight, and
5. Pre-Release Survival

Of these variables, the first three significantly or nearly significantly interacted with years. As mentioned earlier, the years were grouped, one group of years (BY 2002-BY 2004) associated with the Low and High Nutrition treatments tested for their effects on mini-jack rates, and the other group of years (BY 2005 – BY 2006) associated with feed treatments tested for their effects on rate of smoltification[9]. For those three variables, the partitioned Stock x Year interactions resulted in a higher degree of significance for the Stock x Year-Group interaction and a reduced level of significance of Stock x Year interactions within each group of years. This suggests that the Stock x Year interactions were largely attributed to different Stock responses within the two groups of years, and this will be explored below. There might be a temptation to attribute the differences in these Stock responses to the treatment groups (i.e., one Stock response to a treatment set designed to effect mini-jack rates and the other response to a treatment set designed to effect smoltification); however there is no way to assess this because in none of these years are any of the treatment sets combined. There can be differences between Stock x Year interactions that have nothing to do with the changing treatments being assessed over years. The analyses are discussed below.

Pre-Release Proportions of Males that are Mini-Jacks

Appendix A.1 presents the logistic analysis of variation of the Mini-Jacks Proportions. Table 1.a and Figure 1 present the individual year and year-group HxH and NxN mean Mini-Jack Percentages. The HxH Mini-Jack Percentages were significantly less than those of the NxN

9 STF and Control feed treatments in BY2005 and Bio and EWS feed treatments in BY2006, Bio serving as the Control in that year.

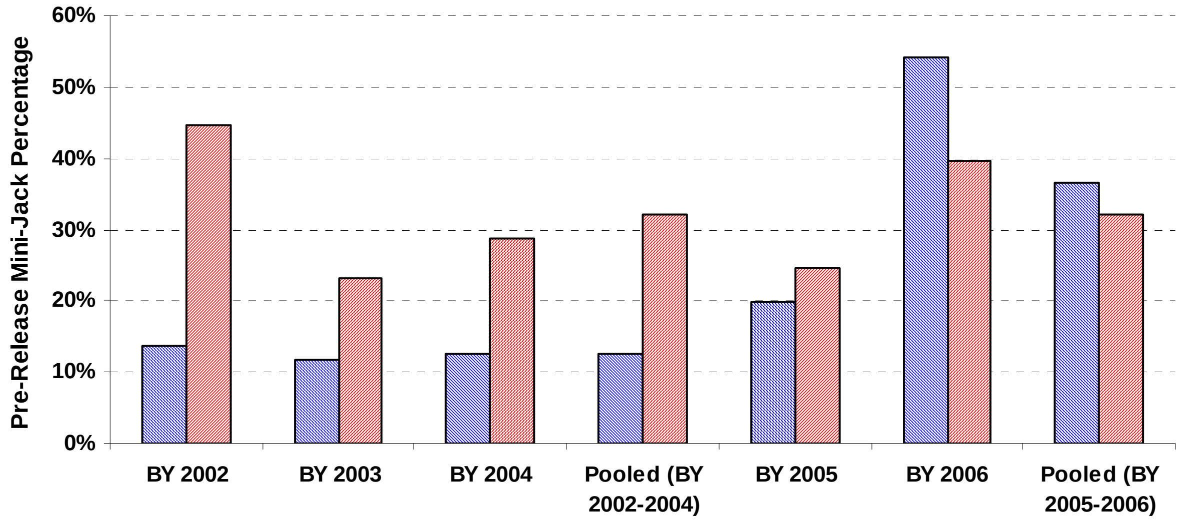
smolt in BY 2002-BY 2004 (P = 0.0002)[10], but there were no overall significant differences between the HxH and NxN effects on Mini-Jack Percentages in BY-2005-2006 (P = 0.26). There was a significant Year x Stock interaction within Group-2 Years (P=0.047) reflecting that the HxH Stock had a slightly and non-significantly smaller Mini-Jack Percentage in BY 2005 but had a substantially and significantly greater mean percentage than the NxN in BY 2006 (the only year in which the HxH main-effect mean exceeded that of the NxN).

Table 1.a. Mini-Jack Percentage of Male Releases of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2006)

		Group 1				**Group 2**		
Source	**Brood Year (BY)** Outmigration Year	**BY 2002** 2004	**BY 2003** 2005	**BY 2004** 2006	**Pooled (BY 2002-2004)**	**BY 2005** 2007	**BY 2006** 2008	**Pooled (BY 2005-2006)**
Hatchery x Hatchery	Mini-Jack Proportion	13.79%	11.59%	12.60%	**12.60%**	19.68%	54.17%	**36.44%**
	Number of Males Sampled	58	69	127	**254**	127	120	**247**
Natural x Natural	Mini-Jack Proportion	44.63%	23.14%	28.81%	**32.22%**	24.43%	39.69%	**32.06%**
	Number of Males Sampled	121	121	118	**360**	131	131	**262**
HxH - NxN Difference		-30.83%	-11.55%	-16.22%	**-19.62%**	-4.74%	14.47%	**4.38%**
Estimated Significance Level in Difference (p)		Group 1 Year x (HxH vs NN) Interaction not Significant (P = 0.3882)			**Significant at 1% Level (P = 0.0002)**	Group 2 Year x (HxH vs NN) Interaction Significant at 5% level (P = 0.0474)		**Not Significant (P = 0.2574)**

10 **NOTE**: All P values (estimated probabilities of a Type 1 error, probability of concluding there is a true difference among the source effects when there is not) presented in the main body of the text are obtained from the Tables in Appendix A.)

Figure 1. Mini-Jack Percentage of Male Releases of Hatchery x Hatchery (Downward Slash) and Natural x Natural (Upward Slash) Upper-Yakima



It should be noted that there was a nearly significant (HxH vs. NxN) x (High vs. Low) interaction within the Group-1 years (P = 0.074). It is postulated that, in the presence of such an interaction, since the Low-nutrition level was to decrease the Mini-Jack Proportion, that the difference between the HxH and NxN Mini-Jack Proportions would be less pronounced for the Low- compared to the High-nutrition levels. As can be seen in Table 2.b., The HxH versus NxN differences in Mini-Jack Proportions are smaller for the Low- than the High-Nutrition feeds within each of the three brood years.

Table 1.b. Separate High- and Low-Nutrition Feed Comparisons of Mini-Jack Percentage of Male Releases for Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2004)

	Treatment >	High-Nutrition Feed			Low-Nutrition Feed		
	Brood Year (BY)	**BY 2002**	**BY 2003**	**BY 2004**	**BY 2002**	**BY 2003**	**BY 2004**
Source	Outmigration Year	2004	2005	2006	2004	2005	2006
Hatchery x Hatchery	Mini-Jack Proportion	14.29%	14.63%	14.06%	13.33%	7.14%	11.11%
Natural x Natural	Mini-Jack Proportion	53.70%	30.16%	45.76%	37.31%	15.52%	11.86%
HxH - NxN Difference		**-39.42%**	**-15.52%**	**-31.70%**	**-23.98%**	**-8.37%**	**-0.75%**

Release-to-McNary Smolt Survival

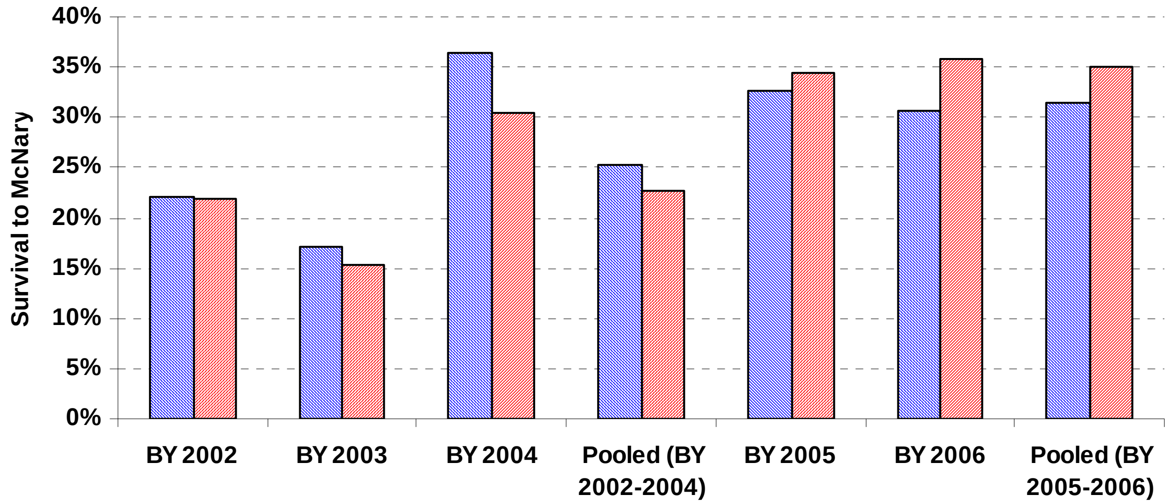
Appendix A.2 presents the logistic analysis of variation of smolt-to-smolt survival from volitional release to McNary passage. Stock x Year means are presented in Table 2 and in Figure 2. Group-1 year HxH smolt survival to McNary was significantly greater than that of the NxN smolt (P = 0.020) and that higher HxH survival was observed in all three years (BY 2002 – BY 2004). There was a reversal in BY 2005 - BY 2006 with the NxN smolt having the significantly higher survival (P = 0.012).

It is possible that the high NxN Mini-Jack Proportion in BY 2004 - BY 2006 is responsible for the low NxN Survival to McNary. Recall that the nutritional levels tested within the Group-1 Years were intended to affect Mini-Jack Proportions. It is possible that most of the mini-jacks return to the spawning grounds before ever getting downstream to McNary Dam. If this were the case, with 32.2% NxN Mini-Jack Proportion over Group1 years compared to the 12.6% for the HxH (Table 1), one would expect a much lower estimated "survival" to McNary for the HxH. Such is the case. With the year-Group-1 "survival" of NxN Stock being only slightly lower than that for the HxH Stock (22.6% for the NxN Stock and 25.2% for the HxH Stock, Table 2), it seems reasonable to assume that the true NxN survival with the inclusion of comparable-time mini-jack upstream survival would be higher for the NxN Stock than for the HxH Stock. With no significant or substantial difference between the Mini-Jack Proportion between the NxN and HxH Stock over the Group-2 years (32.1% for HxH and 36.4% for NxN, Table1) and with no treatments intended to affect the Mini-Jack Proportions, it is not surprising that the there was a reversal in the relative survivals to McNary (35.1% for the NxN Stock and 31.4% for the HxH Stock, Table 2).

Table 2. Release-to-McNary Smolt-to-Smolt Percentage Survival of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2006)

		Group 1				Group 2		
Source	**Brood Year (BY)** Outmigration Year	**BY 2002** 2004	**BY 2003** 2005	**BY 2004** 2006	**Pooled (BY 2002-2004)**	**BY 2005** 2007	**BY 2006** 2008	**Pooled (BY 2005-2006)**
Hatchery x Hatchery	McNary Survival	22.14%	17.05%	36.40%	**25.23%**	32.70%	30.65%	**31.40%**
	Number Released	4286	4269	4311	**12866**	4322	7508	**11830**
Natural x Natural	McNary Survival	21.95%	15.39%	30.44%	**22.60%**	34.42%	35.90%	**35.11%**
	Number Released	8707	8637	8651	**25995**	8743	7669	**16412**
HxH - NxN Difference		0.19%	1.66%	5.95%	**2.63%**	-1.71%	-5.25%	**-3.71%**
Estimated Significance Level in Difference (p)		Group 1 Year x (HxH vs NN) Interaction not Significant (P = 0.1655)			**Significant at 5% Level (P = 0.0203)**	Group 2 Year x (HxH vs NN) Interaction not Significant (P = 0.1758)		**Significant at 5% Level (P = 0.0115)**

Figure 2. Release-to-McNary Smolt Percent Survival of Hatchery x Hatchery (Downward Slash) and Natural x Natural (Upward Slash) Upper-Yakima Spring Chinook (BY 2002 - BY 2006)



There was no significant (HxH vs. NxN) x (High vs. Low) interaction for the Release-to-McNary Survival Rates; recall there was a nearly significant interaction for Mini-Jack Proportions. One might expect, if the associated relation between Survival-to-McNary and Mini-Jack Survival described above were true, such a relation would hold for the interaction as well; but such was not the case.

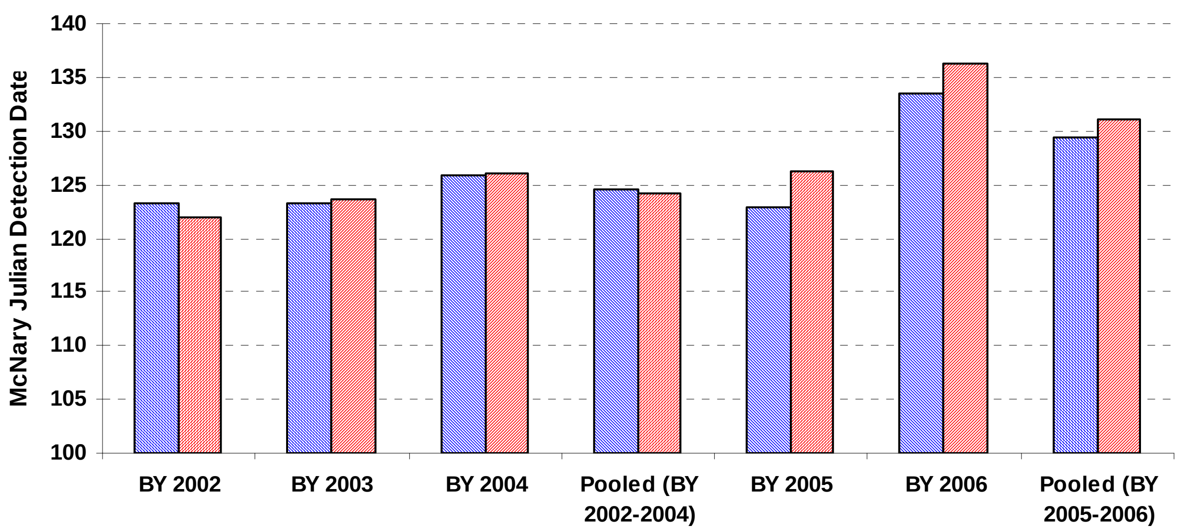
Mean McNary Juvenile Detection Date

Appendix A.3 presents a least-squares analysis of variance of mean McNary Juvenile Detection Date. Table 3 and Figure 3 present the yearly HxH and NxN Mean McNary Julian Detection Dates. There was no significant difference in the mean McNary passage dates between the HxH and NxN Stock in BY 2002 - BY 2004 (P = 0.68) and the mean difference over those years was less than a day. The Mean Detection Date was significantly earlier for the HxH than the NxN Stock in BY 2005 and BY 2006 (P = 0.0030).

Table 3. Mean McNary Julian Detection Date of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)

Source	**Brood Year (BY)** Outmigration Year	Group 1 **BY 2002** 2004	Group 1 **BY 2003** 2005	Group 1 **BY 2004** 2006	Group 1 **Pooled (BY 2002-2004)**	Group 2 **BY 2005** 2007	Group 2 **BY 2006** 2008	Group 2 **Pooled (BY 2005-2006)**
Hatchery x Hatchery	McNary Passage Date	123.3	123.2	125.8	**124.5**	122.9	133.4	**129.4**
	Expanded McN Detections	949.0	727.9	1569.1	**3246.0**	1413.5	2301.5	**3715.0**
Natural x Natural	McNary Passage Date	121.9	123.5	126.0	**124.1**	126.2	136.3	**131.0**
	Expanded McN Detections	1911.33	1329.28	2633.68	**5874.292**	3009.12	2753.31	**5762.428**
HxH - NxN Difference		1.4	-0.3	-0.2	**0.4**	-3.3	-2.9	**-1.6**
Estimated Significance Level in Difference (p)		Group 1 Year x (HxH vs NN) Interaction not Significant (P = 0.4924)			**Not Significant (P = 0.6802)**	Group 2 Year x (HxH vs NN) Interaction not Significant (P = 0.7382)		**Significant at 1% Level (P = 0.003)**

Figure 3. Mean McNary Julian Detection Date of Hatchery x Hatchery (Downward Slash) and Natural x Natural (Upward Slash) Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)



There was a significant (HxH vs. NxN) x (Bio vs. EWS) feed interaction for BY 2006 (P = 0.028), with the EWS treated fish having a somewhat later mean McNary Detection Date than the Bio treated fish for the HxH Stock but a nearly equal McNary Detection Date for the NxN Stock (HxH Mean Julian Dates: 132.3 for EWS and 134.4 for Bio; NxN Mean Julian Dates: 136.6 for EWS and 136.0 for Bio). However, with only one raceway contributing to each of the HxH Bio and EWS means, limited importance should be given to this finding.

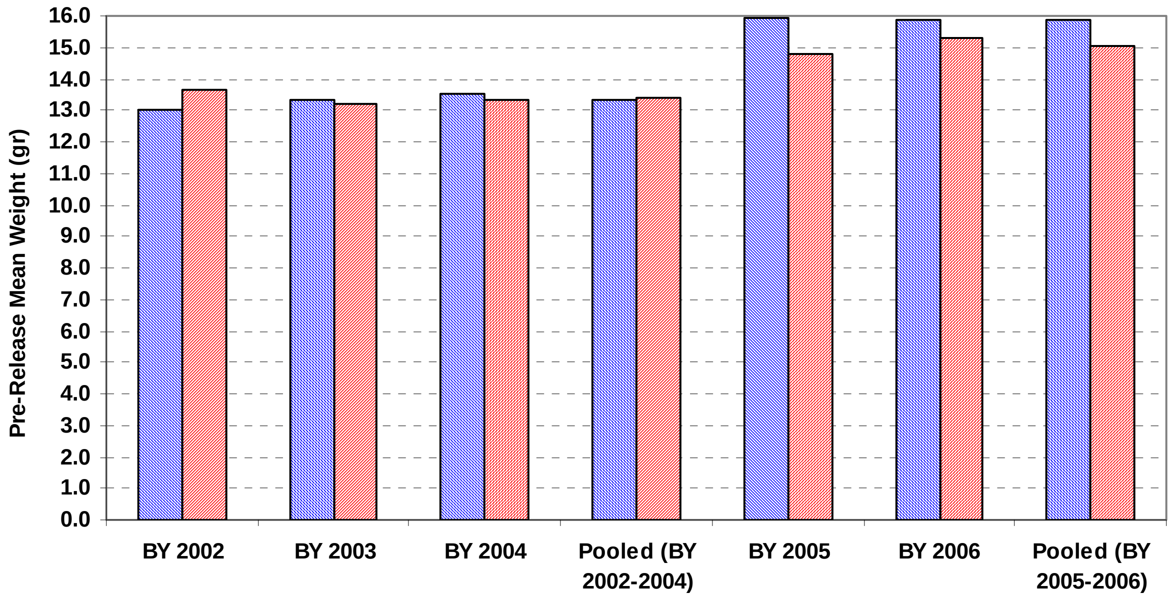
Mean Pre-Release Smolt Weight

Appendix A.4 presents the analysis of variance of mean pre-release smolt weight. Table 4.a. and Figure 4 present the year and year-group HxH and NxN mean pre-release fish-weight estimates. The analysis over all years, irrespective of year groupings, indicates a significant HxH vs. NxN Stock interaction with Group (P = 0.048) but no significant Stock x Year interaction differences among years within groups. The stock interaction with group appears to reflect that there is nearly no Stock mean difference within Group 1 means but nearly a one gram difference between the Stock within Group 2, although neither of those differences are significant (P = 0.91 and P = 0.17 respectively within Groups 1 and 2).

Table 4.a. Mean Pre-Release Weight (grams/fish) of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)

		Group 1				Group 2		
	Brood Year (BY)	**BY 2002**	**BY 2003**	**BY 2004**	**Pooled (BY 2002-2004)**	**BY 2005**	**BY 2006**	**Pooled (BY 2005-2006)**
Source	Outmigration Year	2004	2005	2006		2007	2008	
Hatchery x Hatchery	Pre-Release Weight	13.0	13.3	13.5	**13.3**	16.0	15.8	**15.9**
	Number Sampled	120	120	239	479	240	240	480
Natural x Natural	Pre-Release Weight	13.7	13.2	13.3	**13.4**	14.8	15.3	**15.0**
	Number Sampled	240	240	240	720	240	240	480
HxH - NxN Difference		-0.7	0.1	0.2	**0.0**	1.2	0.5	**0.9**
Estimated Significance Level in Difference (p)		Group 1 Year x (HxH vs NN) Interaction not Significant (P = 0.7587)			Not Significant (P = 0.9096)	Group 2 Year x (HxH vs NN) Interaction not Significant (P = 0.5767)		Not Significant (P = 0.1732)

Figure 4. Mean Pre-Release Weight (grams/fish) of Hatchery x Hatchery (Downward Slash) and Natural x Natural (Upward Slash) Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)



Analyses within year groupings reveal a significant (HxH vs. NxN) x (Control vs. STF) Interaction in BY 2005 (P = 0.042), the interaction reflecting nearly no HxH–NxN difference for the Control (0.2 grams) but a large HxH–NxN difference for the STF treatment (2.2 grams) (Table 4.b.). Again, only one raceway contributed to each of the HxH Control and STF means and limited importance should be given the significance.

Table 4.b. Separate Treatment Control and SFT Mean Comparisons for Pre-Release Weight of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)

Source	Treatment 1 >	Control	STF
	Brood Year (BY)	BY 2005	BY 2005
	Outmigration Year	2007	2007
Hatchery x Hatchery	Pre-Release Weight	15.3	16.6
	Number Sampled	120.0	120.0
Natural x Natural	Pre-Release Weight	15.1	14.4
	Number Sampled	120.0	120.0
HxH - NxN Difference		0.2	2.2

Pre-Release Survival

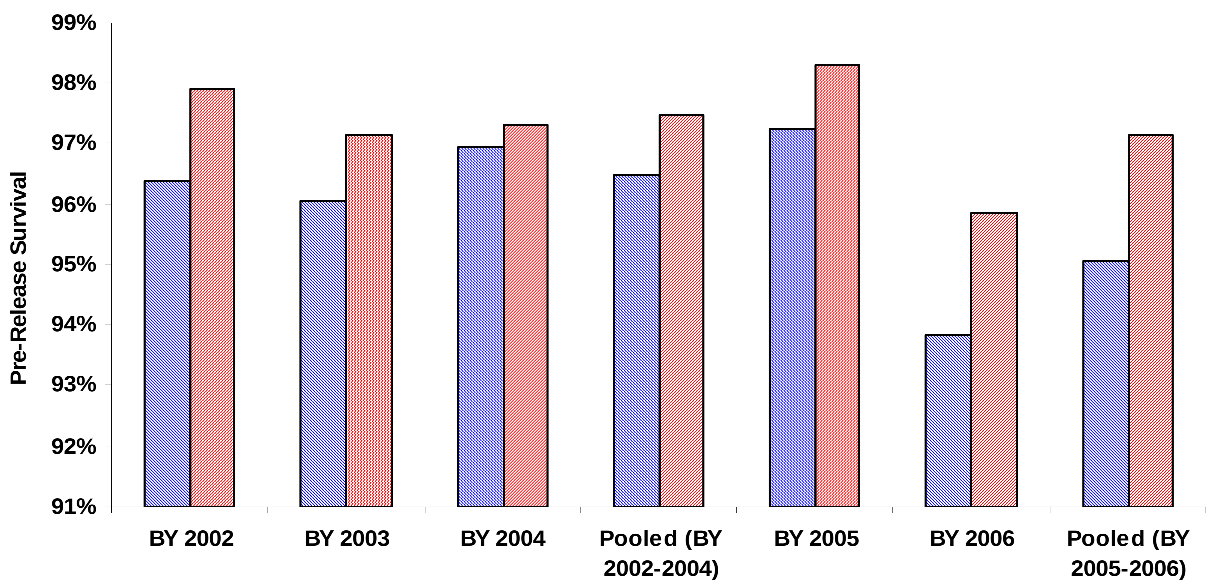
For each raceway, Pre-Release Survival was estimated by computing the proportion of PIT-tagged fish that were detected leaving the acclimation raceways by the detection efficiency of the PIT-tag detector at the acclimation site. The detection efficiency was estimated for each raceway by dividing the number of PIT-tagged fish detected at McNary Dam previously detected at the acclimation site by the total number detected at McNary Dam. The survival estimate is actually an estimate of the proportion of fish that retained their PIT-tags and survived to exit that acclimation facility.

Appendix A.5 presents the logistic analysis of variation of Mean Pre-Release Survival. Table 5.a and Figure 5 present the year and year-group HxH and NxN mean Pre-Release Survival estimates. There are significant HxH versus NxN Stock main-effect differences within in both groups of years (P = 0.0018 within Group-1 Years and P = 0.0003 within Group-2 Years), and the nature of the differences are the same, HxH having a lower Pre-Release Survival in all years.

Table 5. Mean Pre-Release Survival of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)

		Group 1				Group 2		
Source	**Brood Year (BY)** Outmigration Year	**BY 2002** 2004	**BY 2003** 2005	**BY 2004** 2006	**Pooled (BY 2002-2004)**	**BY 2005** 2007	**BY 2006** 2008	**Pooled (BY 2005-2006)**
Hatchery x Hatchery	Proportion Released	96.40%	96.06%	96.96%	**96.48%**	97.23%	93.85%	**95.06%**
	Number Tagged	4446	4444	4446	**13336**	4445	8000	**12445**
Natural x Natural	Proportion Released	97.92%	97.17%	97.32%	**97.47%**	98.30%	95.86%	**97.15%**
	Number Tagged	8892	8889	8889	**26670**	8894	8000	**16894**
HxH - NxN Difference		-1.52%	-1.10%	-0.36%	**-0.99%**	-1.07%	-2.01%	**-2.09%**
Estimated Significance Level in Difference (p)		Group 1 Year x (HxH vs NN) Interaction not Significant (P = 0.1525)			**Significant at 0.5% Level (P = 0.0018)**	Group 2 Year x (HxH vs NN) Interaction not Significant (P = 0.6717)		**Significant at 0.05% Level (P = 0.0003)**

Figure 5. Mean Pre-Release Survival of Hatchery x Hatchery (Downward Slash) and Natural x Natural (Upward Slash) Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)



There was a significant Stock x Year x Nutrition Treatment (Low versus High) interaction within the Group-1 Years (P = 0.047). This was likely primarily driven by a near-zero HxH versus NxN difference (0.4% difference) within the low-nutrition feed in BY 2004 compared to all other differences being negative and larger in absolute value (Table 5.b).

Similar to the case for Pre-Release Fish Size, the interaction of Stock Pre-Release survival differences between the Control and STF feeds in BY 2005 is nearly significant (P = 0.066). The interaction, if present, can be attributed to the relative magnitude of HxH and NxN differences within the Control and STF treatments (only a 0.3% difference within the Control a 2% lower survival than the NxN under the STF feed, Table 5.c). The HxH fish being larger than the NxN fish (Table 4.b) under the STF treatment appeared to have not conveyed a survival advantage over the NxN fish. Recall, however, only one raceway contributed to each of the HxH Control and STF means and without additional years' data, no assumptions should be made with regard to Control vs. STF differences of the HxH and NxN stock.

Table 5.b. Separate High- and Low-Nutrition Feed Comparisons Pre-Release Survival for Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2004)

	Treatment >	High-Nutrition Feed			Low-Nutrition Feed		
	Brood Year (BY)	BY 2002	BY 2003	BY 2004	BY 2002	BY 2003	BY 2004
Source	Outmigration Year	2004	2005	2006	2004	2005	2006
Hatchery x Hatchery	Pre-Release Survival	97.26%	96.08%	96.62%	95.55%	96.04%	97.30%
Natural x Natural	Pre-Release Survival	97.89%	97.73%	97.75%	97.95%	96.60%	96.90%
HxH - NxN Difference		-0.63%	-1.64%	-1.13%	-2.41%	-0.56%	0.41%

Table 5.c. Separate Control- and STF-Feed Comparisons of Pre-Release Survival for Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood year 2006)

	Treatment >	Control	STF
	Brood Year (BY)	BY 2005	BY 2005
Source	Outmigration Year	2007	2007
Hatchery x Hatchery	Pre-Release Survival	97.75%	96.72%
Natural x Natural	Pre-Release Survival	98.07%	98.54%
HxH - NxN Difference		-0.32%	-1.82%

Appendix A. Analyses of Variation for the Five Analyzed Measures

Table A.1. Logistic Analysis of Variation of Mini-Jack Proportions of Releases of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2006)

Main Plot Analysis over all Brood Years (2002-2006)					
Source	**Deviance (Dev)**	**Degrees of Freedom (DF)**	**Mean Deviance (Dev/DF)**	**F-Ratios**	**Type 1 Error P**
Among Years	63.36	4	15.84	21.94 [a]	**0.0023**
HxH vs NxN	8.57	1	8.57	11.87 [a]	**0.0183**
Year x (HxH vs NxN)	29.75	4	7.44	10.30 [a]	**0.0124**
Between Group-1* and Group-2* Years	16.81	1	16.81	23.28 [a]	**0.0048**
Among Group-1 Years	11.76	2	5.88	8.14 [a]	**0.0267**
Among Group-2 Years	34.79	1	34.79	48.19 [a]	**0.0010**
(HxH vs NxN) x Between Groups of Years	23.02	1	23.02	31.88 [a]	**0.0024**
(HxH vs NxN) x Group-1 Years	1.95	2	0.975	1.35 [a]	0.3397
(HxH vs NxN) x Group-2 Years	4.78	1	4.78	6.62 [a]	**0.0499**
Pooled Main-plot Error	77.87	5	0.72	0.63 [b]	0.6890

Main-Plot Analysis and Sub-Plot Analysis within Year-Groups						
Source		**Dev**	**DF**	**Dev/DF**	**F-Ratios**	**Type 1 Error P**
Within Group 1 Years	**Among Years**	11.76	2	5.88	6.28 [c]	**0.0171**
	HxH versus (vs) NxN	30.24	1	30.24	32.31 [c]	**0.0002**
	Year x (HxH vs NxN)	1.95	2	0.97	1.04 [c]	0.3882
	High vs Low	19.10	1	19.10	20.41 [c]	**0.0011**
	(HxH vs NxN) x (High vs Low)	3.74	1	3.74	4.00 [c]	**0.0735**
	Year x (High vs Low)	3.26	2	1.63	1.74 [c]	0.2244
	Year x (HxH vs NxN) x (High vs Low)	2.13	2	1.07	1.14 [c]	0.3587
Within Group 2 Years	**Among Years**	34.79	1	34.79	37.17 [c]	**0.0001**
	HxH vs NxN	1.35	1	1.35	1.44 [c]	0.2574
	Year x (HxH vs NxN)	4.78	1	4.78	5.11 [c]	**0.0474**
	STF vs Control	0.23	1	0.23	0.25 [c]	0.6308
	Bio vs EWS	0.26	1	0.26	0.28 [c]	0.6097
	(HxH vs NxN) x (STF vs Control)	2.36	1	2.36	2.52 [c]	0.1434
	(HxH vs NxN) x (Bio vs EWS)	0.19	1	0.19	0.20 [c]	0.6619
Pooled Main Plot Error		3.61	5	0.72		
Pooled Sub-plot Error		5.75	5	1.15		
Pooled Main Plot and SubPlot (Clark Flat)		9.36	10	0.94		

[a] Tested against Main Plot Error Pooled
[b] Tested against Sub-Plot Error Pooled
[c] Tested against Main- and Sub-Plot Error Pooled (Clark Flat)

Table A.2. **Logistic Analysis of Variation of Release-to-McNary Survival of Releases of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook (brood years 2002 through 2006)**

Main Plot Analysis over all Brood Years (2002-2006)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratios	Type 1 Error P
Among Years	1818.23	4	454.56	87.21 [a]	**0.0001**
HxH vs NxN	0.2	1	0.20	0.04 [a]	0.8524
Year x (HxH vs NxN)	102.66	4	25.67	4.92 [a]	**0.0552**
Between Group-1* and Group-2* Years	821.34	1	821.34	157.59 [a]	**0.0001**
Among Group-1 Years	996.87	2	498.435	95.63 [a]	**0.0001**
Among Group-2 Years	0.02	1	0.02	0.00 [a]	0.9530
(HxH vs NxN) x Between Groups of Years	74.51	1	74.51	14.30 [a]	**0.0129**
(HxH vs NxN) x Group-1 Years	18.89	2	9.445	1.81 [a]	0.2559
(HxH vs NxN) x Group-2 Years	9.26	1	9.26	1.78 [a]	0.2401
Pooled Main-Plot Error	26.06	5	5.21	1.48 [b]	0.3379

Main-Plot Analysis and Sub-Plot Analysis within Year-Groups

Source		Dev	DF	Dev/DF	F-Ratios	Type 1 Error P
Within BY 2002-2004	**Among Years**	996.87	2	498.44	114.24 [c]	**0.0000**
	HxH versus (vs) NxN	33.10	1	33.10	7.59 [c]	**0.0203**
	Year x (HxH vs NxN)	18.89	2	9.44	2.16 [c]	0.1655
	High vs Low	84.04	1	84.04	19.26 [c]	**0.0014**
	(HxH vs NxN) x (High vs Low)	0.30	1	0.30	0.07 [c]	0.7985
	Year x (High vs Low)	17.61	2	8.81	2.02 [c]	0.1835
	Year x (HxH vs NxN) x (High vs Low)	5.61	2	2.81	0.64 [c]	0.5462
Within BY 2005-2006	Among Years	0.02	1	0.02	0.00 [c]	0.9474
	HxH vs NxN	41.61	1	41.61	9.54 [c]	**0.0115**
	Year x (HxH vs NxN)	9.26	1	9.26	2.12 [c]	0.1758
	STF vs Control [BY 2005]	13.98	1	13.98	3.20 [c]	0.1037
	Bio vs EWS [BY 2006]	5.85	1	5.85	1.34 [c]	0.2738
	(HxH vs NxN) x (STF vs Control) [BY 2005]	4.05	1	4.05	0.93 [c]	0.3580
	(HxH vs NxN) x (Bio vs EWS) [BY 2006]	5.74	1	5.74	1.32 [c]	0.2781
Pooled Main Plot Error		26.06	5	5.21		
Pooled Sub-plot Error		17.57	5	3.51		
Pooled Main Plot and SubPlot (Clark Flat)		43.63	10	4.36		

[a] Tested against Main Plot Error Pooled

[b] Tested against Sub-Plot Error Pooled

[c] Tested against Main- and Sub-Plot Error Pooled (Clark Flat)

Table A.3. **Analysis of Variance of McNary Julian Detection Date of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)**

Main Plot Analysis over all Brood Years (2002-2006)

Source	Sums of Squares (SS)	Degrees of Freedom (DF)	Mean Deviance (SS/DF)	F-Ratios	Type 1 Error P
Among Years	434159.5	4	108539.88	150.00 [a]	**0.0000**
HxH vs NxN	9160.4	1	9160.40	12.66 [a]	**0.0162**
Year x (HxH vs NxN)	13222.6	4	3305.65	4.57 [a]	**0.0634**
Between Group-1* and Group-2* Years	167510.7	1	167510.7	231.49 [a]	**0.0000**
Among Group-1 Years	22,874.80	2	11437.4	15.81 [a]	**0.0069**
Among Group-2 Years	243,774.00	1	243774	336.88 [a]	**0.0000**
(HxH vs NxN) x Between Groups of Years	11946.74	1	11946.74	16.51 [a]	**0.0097**
(HxH vs NxN) x Group-1 Years	1,185.50	2	592.75	0.82 [a]	0.4924
(HxH vs NxN) x Group-2 Years	90.36	1	90.36	0.12 [a]	0.7382
Pooled Main-plot Error	3,618.00	5	723.60	3.11 [b]	0.1191

Main-Plot Analysis and Sub-Plot Analysis within Year-Groups

Source		SS	DF	Mean Square (SS/DF)	F-Ratios	Type 1 Error P
Within Group 1 Years	**Among Years**	22,874.80	2	11,437.40	15.81 [a]	**0.0069**
	HxH versus (vs) NxN	138.30	1	138.30	0.19 [a]	0.6802
	Year x (HxH vs NxN)	1,185.50	2	592.75	0.82 [a]	0.4924
	High vs Low	12,290.89	1	12,290.89	52.88 [b]	**0.0008**
	(HxH vs NxN) x (High vs Low)	344.51	1	344.51	1.48 [b]	0.2777
	Year x (High vs Low)	648.44	2	324.22	1.39 [b]	0.3301
	Year x (HxH vs NxN) x (High vs Low)	241.51	2	120.76	0.52 [b]	0.6237
Within Group 2 Years	**Among Years**	243,774.00	1	243,774.00	336.88 [a]	**0.0000**
	HxH vs NxN	20,968.80	1	20,968.80	28.98 [a]	**0.0030**
	Year x (HxH vs NxN)	90.36	1	90.36	0.12 [a]	0.7382
	STF vs Control	362.38	1	362.38	1.56 [b]	0.2671
	Bio vs EWS	502.30	1	502.30	2.16 [b]	0.2015
	(HxH vs NxN) x (STF vs Control)	28.17	1	28.17	0.12 [b]	0.7419
	(HxH vs NxN) x (Bio vs EWS)	2,188.54	1	2,188.54	9.42 [b]	**0.0278**
Pooled Main Plot Error		3,618.06	5	723.61	3.11326 6	0.1191
Pooled Sub-plot Error		1,162.15	5	232.43		
Pooled Main Plot and SubPlot (Clark Flat)		4,780.21	10	478.02		

[a] Tested against Main Plot Error Pooled

[b] Tested against Sub-Plot Error Pooled

[c] Tested against Main- and Sub-Plot Error Pooled (Clark Flat)

Table A.4. **Analysis of Variance of Pre-Release Weight of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)**

Main Plot Analysis over all Brood Years (2002-2006)					
Source	**Sums of Squares (SS)**	**Degrees of Freedom (DF)**	**Mean Deviance (SS/DF)**	**F-Ratios**	**Type 1 Error P**
Among Years	2262.000	4	565.500	35.34 [a]	**0.0007**
HxH vs NxN	70.000	1	70.000	4.38 [a]	0.0907
Year x (HxH vs NxN)	174.000	4	43.500	1.01 [a]	**0.4473**
Between Group-1* and Group-2* Years	2240.000	1	2240.000	4.39 [a]	**0.0652**
Among Group-1 Years	12.000	2	6.000	0.09 [a]	**0.9194**
Among Group-2 Years	10.000	1	10.000	0.14 [a]	**0.7213**
(HxH vs NxN) x Between Groups of Years	108.000	1	108.000	6.75 [a]	**0.0484**
(HxH vs NxN) x Group-1 Years	41.000	2	20.500	0.29 [a]	0.7587
(HxH vs NxN) x Group-2 Years	25.000	1	25.000	0.36 [a]	0.5767
Pooled Main-plot Error	351.000	5	70.200	140.00 [b]	**0.0001**

Main-Plot Analysis and Sub-Plot Analysis within Year-Groups						
Source		**SS**	**DF**	**Mean Square (SS/DF)**	**F-Ratios**	**Type 1 Error P**
Within Group 1 Years	Among Years	12.000	2	6.000	0.09 [a]	**0.9194**
	HxH versus (vs) NxN	1.000	1	1.000	0.01 [a]	0.9096
	Year x (HxH vs NxN)	41.000	2	20.500	0.29 [a]	0.7587
	High vs Low	5131.000	1	5131.000	320.69 [b]	**0.0000**
	(HxH vs NxN) x (High vs Low)	2.000	1	2.000	0.13 [b]	**0.7381**
	Year x (High vs Low)	41.000	2	20.500	1.28 [b]	**0.3554**
	Year x (HxH vs NxN) x (High vs Low)	38.000	2	19.000	1.19 [b]	**0.3785**
Within Group 2 Years	**Among Years**	10.000	1	10.000	0.14 [a]	**0.7213**
	HxH vs NxN	177.000	1	177.000	2.52 [a]	**0.1732**
	Year x (HxH vs NxN)	25.000	1	25.000	0.36 [a]	0.5767
	STF vs Control [BY 2005]	9.000	1	9.000	0.56 [b]	0.4870
	Bio vs EWS [BY 2006]	0.000	1	0.000	0.00 [b]	**1.0000**
	(HxH vs NxN) x (STF vs Control) [BY 2005]	118.000	1	118.000	7.38 [b]	**0.0420**
	(HxH vs NxN) x (Bio vs EWS) [BY 2006]	15.000	1	15.000	0.94 [b]	0.3774
Pooled Main Plot Error		351.000	5	70.200	4.3875 6	0.06519
Pooled Sub-plot Error		80.000	5	16.000		
Pooled Main Plot and SubPlot (Clark Flat)		431.000	10	43.100		

[a] Tested against Main Plot Error Pooled

[b] Tested against Sub-Plot Error Pooled

[c] Tested against Main- and Sub-Plot Error Pooled (Clark Flat)

Table A.5. **Logistic Analysis of Variation of Pre-Release Survival of Hatchery x Hatchery and Natural x Natural Upper-Yakima Spring Chinook Juveniles (brood years 2002 through 2006)**

Main Plot Analysis over all Brood Years (2002-2006)					
Source	**Deviance (Dev)**	**Degrees of Freedom (DF)**	**Mean Deviance (Dev/DF)**	**F-Ratios**	**Type 1 Error P**
Among Years	211.88	4	52.97	20.79 [a]	**0.0026**
HxH vs NxN	78.52	1	78.52	30.82 [a]	**0.0026**
Year x (HxH vs NxN)	9.47	4	2.37	0.93 [a]	0.5148
Between Group-1* and Group-2* Years	35	1	35	13.74 [a]	**0.0139**
Among Group-1 Years	9.33	2	4.665	1.83 [a]	0.2532
Among Group-2 Years	167.55	1	167.55	65.76 [a]	**0.0005**
(HxH vs NxN) x Between Groups of Years	1.23	1	1.23	0.48 [a]	0.5181
(HxH vs NxN) x Group-1 Years	7.91	2	3.955	1.55 [a]	0.2990
(HxH vs NxN) x Group-2 Years	0.33	1	0.33	0.13 [a]	0.7336
Pooled Main-plot Error	12.73	5	52.97	2.78 [b]	0.1430

Main-Plot Analysis and Sub-Plot Analysis within Year-Groups						
Source		**Dev**	**DF**	**Dev/DF**	**F-Ratios**	**Type 1 Error P**
Within Group 1 Years	Among Years	9.33	2	4.67	2.69 [c]	0.1159
	HxH versus (vs) NxN	30.56	1	30.56	17.64 [c]	**0.0018**
	Year x (HxH vs NxN)	7.91	2	3.96	2.28 [c]	0.1525
	High vs Low	10.69	1	10.69	6.17 [c]	**0.0323**
	(HxH vs NxN) x (High vs Low)	1.70	1	1.70	0.98 [c]	0.3452
	Year x (High vs Low)	0.85	2	0.43	0.25 [c]	0.7870
	Year x (HxH vs NxN) x (High vs Low)	14.65	2	7.33	4.23 [c]	**0.0467**
Within Group 2 Years	**Among Years**	167.55	1	167.55	96.74 [c]	**0.0000**
	HxH vs NxN	49.18	1	49.18	28.39 [c]	**0.0003**
	Year x (HxH vs NxN)	0.33	1	0.33	0.19 [c]	0.6717
	STF vs Control	0.01	1	0.01	0.01 [c]	0.9409
	Bio vs EWS	20.13	1	20.13	11.62 [c]	**0.0067**
	(HxH vs NxN) x (STF vs Control)	7.39	1	7.39	4.27 [c]	**0.0658**
	(HxH vs NxN) x (Bio vs EWS)	4.23	1	4.23	2.44 [c]	0.1492
Pooled Main Plot Error		12.74	5	2.55		
Pooled Sub-plot Error		4.58	5	0.92		
Pooled Main Plot and SubPlot (Clark Flat)		17.32	10	1.73		

[a] Tested against Main Plot Error Pooled

[b] Tested against Sub-Plot Error Pooled

[c] Tested against Main- and Sub-Plot Error Pooled (Clark Flat)

Appendix D

IntSTATS

International Statistical Training
and Technical Services
712 12th Street
Oregon City, Oregon 97045
United States
Voice: (503) 650-5035
e-mail: intstats@sbcglobal.net

Annual Report: Smolt Survival to McNary Dam of Year-2008 Spring Chinook Releases at Roza Dam

Doug Neeley, Consultant to the Yakama Nation

In addition to individual year analyses for Roza–to-McNary survival[1] that have been presented in previous years, a combined analysis over all release years is presented and discussed. As in previous years, survivals of hatchery-brood smolt (hatchery smolt) are compared to those of natural-brood smolt (natural smolt) passing Roza contemporaneously with hatchery smolt. These contemporaneously passing natural smolt are referred to as "late" natural smolt. The survival of the late natural smolt is also compared to the survival of "early" Roza-passage natural smolt (smolt that pass Roza during the period prior to the passage of the hatchery smolt). Weekly release estimates of natural- and hatchery-smolt survival are presented in Appendix A in the form of figures.

Comparison of Natural- and Hatchery-Origin Smolt Contemporaneously Passing Prosser

As was the case in majority of the previous Roza-release years, in 2008 late natural smolt had a higher survival than hatchery smolt. Figure 1 presents the natural- and hatchery-smolt survivals to McNary for late natural and hatchery smolt for 1999 through 2008 Roza releases. Table 1.a presents the associated survival estimates.

1 Roza-to-McNary survival is an estimated survival index of fish that were sampled while passing Roza Dam (Rosa) on the Upper Yakima Rive and that were then PIT-tagged (if not previously PIT-tagged) and that survived to McNary Dam (McNary) on the Columbia River. The survival was estimated as follows: Within a time stratum of contiguous days having a relatively homogeneous rate of fish detection at McNary, the number of Roza-released PIT-tagged fish detected at McNary within that stratum was expanded (divided) by the stratum's estimated detection rate. The detection rate within a stratum was the proportion of all PIT-tagged Spring Chinook released into the Yakima Basin detected at Bonneville and John Day Dams that were previously detected upstream at McNary within that stratum. These expanded numbers of McNary detections were then added over strata, and the resulting total number was divided by the number of fish released at Roza as an estimate of Roza-to-McNary survival.

Figure 1. Upper-Yakima Spring-Chinook Roza-to-McNary Smolt Survival for Late Natural Smolt (Downward Slash) and Hatchery Smolt (Upward Slash)

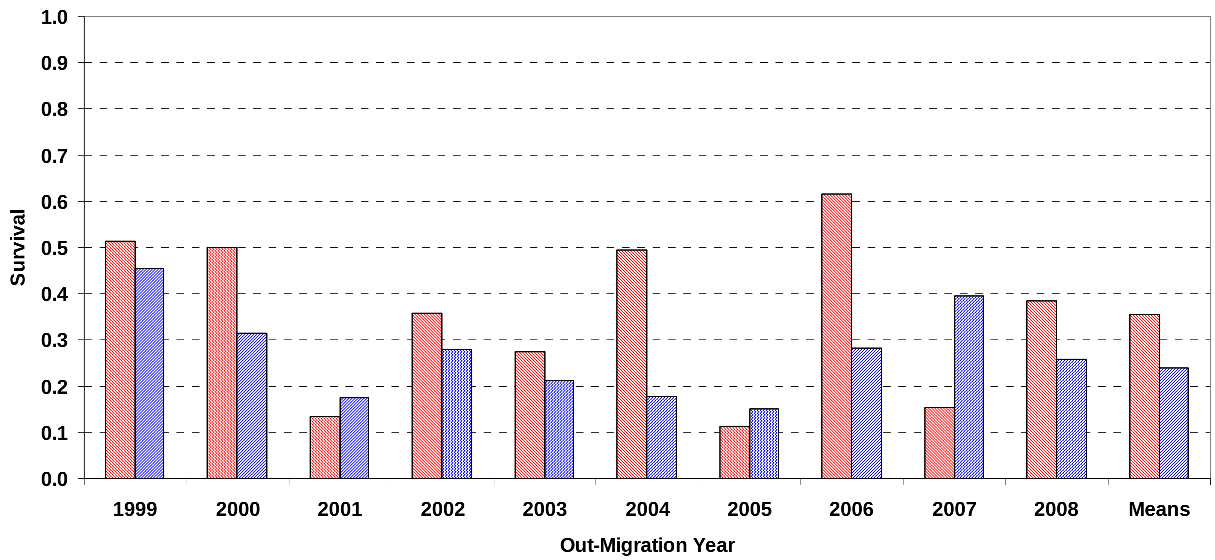


Table 1.a. Upper-Yakima Spring-Chinook Roza-to-McNary Smolt Survival for Late Natural Smolt and Hatchery Smolt (shaded Natural–Hatchery differences are those for which natural smolt had lower survivals than hatchery)

Stock	Measure	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Year-adjusted Means
Natural	**Survival**	**0.5122**	**0.4987**	**0.1339**	**0.3584**	**0.2750**	**0.4935**	**0.1122**	**0.6160**	**0.1529**	**0.3857**	**0.3550**
	Number Released	133	3196	1424	2114	1190	74	45	500	336	421	
Hatchery	**Survival**	**0.4540**	**0.3155**	**0.1759**	**0.2803**	**0.2137**	**0.1768**	**0.1494**	**0.2810**	**0.3955**	**0.2573**	**0.2384**
	Number Released	675	2999	1744	1503	2146	2201	1344	3802	2477	4406	
Diference: Natural-Hatchery		**0.0582**	**0.1832**	**-0.0420**	**0.0781**	**0.0613**	**0.3167**	**-0.0371**	**0.3350**	**-0.2426**	**0.1284**	**0.1167**
1-Sided Type 1 Error P		0.0755	**0.0000**	0.7377	0.0866	0.0749	**0.0243**	0.5295	**0.0006**	0.9977	**0.0096**	**0.0206**

As indicated in the table, the 2008-release late natural smolt survival was significantly greater than that of the hatchery smolt based on a 1-sided test[2] (P = 0.0096). The late natural smolt survival exceeded that of the hatchery smolt in seven of the ten years, significantly so in four of those seven years (P < 0.05). In only one year (2007) was the hatchery smolt deemed to have a significantly and substantially higher survival than the natural smolt. Although the

2 The assumption was that if, there were a difference between the smolt survival of the two broods, the natural smolt would have the greater survival from a point of common release in place and time because natural smolt would have been surviving in the river system from fry stage whereas the hatchery smolt would have survived in the river system only from the time of volitional release as smolt from protected acclimation ponds. The individual year statistical analysis was a weighted two-way logistic analysis of variation on survival with Julian week of Roza release as one factor and brood (natural and hatchery) as the other factor. The individual year analyses are presented in Appendix B with the appropriate conversion of effective two-sided tests converted to appropriate one-sided tests for the alternative hypotheses that late natural smolt have a higher Roza-release-to-McNary survival against the null hypotheses of no differences in the brood survivals.

late-natural survivals for the 2001 and 2005 releases were also lower than the hatchery survivals, the stock differences were neither significant nor substantial (Table 1.a.). The analyses on which the individual year significance levels in Table 1.b. were based are presented in Appendix B.

To assess the overall relative survival of the two broods over years, a two-way weighted logistic analysis of variation was used to assess the main effect differences among years adjusted for stock effects and to assess the main effect difference between the two stocks adjusted for year effects. The results of this analysis are given in Table 1.b. The main-effect stock comparison indicates an overall higher survival for the late-passage natural smolt. The analysis indicates a significant year x stock interaction, which was driven, for the most part, by the 2007 releases.

Table 1.b. Weighted* Logistic Analysis of Variation of Upper-Yakima Spring-Chinook Roza-to-McNary Smolt Survival Indices for Early Natural Smolt and Hatchery Smolt over Years

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Dev (Dev/DF)	F-Ratio	Estimated Type 1 Error P		1-Sided Type 1 Error (Natural > Hatchery)
Wild vs Hatch Brood (adjusted for Years)	244.12	1	244.12	5.66	0.0413	***	0.0206
Among Years (adjusted for Brood)	1174.33	9	130.48	3.03	0.0573	***	
Brood x Year Interaction	388.02	9	43.11	7.93	0.0000	****	
Error (Approximate)**		65	5.44				

* Weights are the separate number of total releases for the late-natural and of the hatchery stock within years.

** Error Mean Deviance is the weighted mean of Yearly Mean Deviances from Appendix B, weights being the total Roza releases over two groups within years. Error Degrees of Freedom based on Satterthwaite's approximation.

*** Tested against Interaction (Denominator Mean Deviance).

**** Tested against Error (Denominator Mean Deviance).

Comparison of Early and Late Roza Passage of Natural-Origin Smolt

Beginning in release-year 2000, a sufficient numbers of natural smolt were made prior to the Roza trapping of hatchery-stock smolt to permit comparisons between early and late natural smolt-passage. Figure 2 presents the survivals to McNary for 2000 through 2008 Roza early and late natural smolt migrations. Table 2.a. presents the associated survival estimates.

Figure 2. Upper-Yakima Spring-Chinook Roza-to-McNary Smolt Survival Indices for Early (Downward Slash) and Late (Upward Slash) Natural Smolt

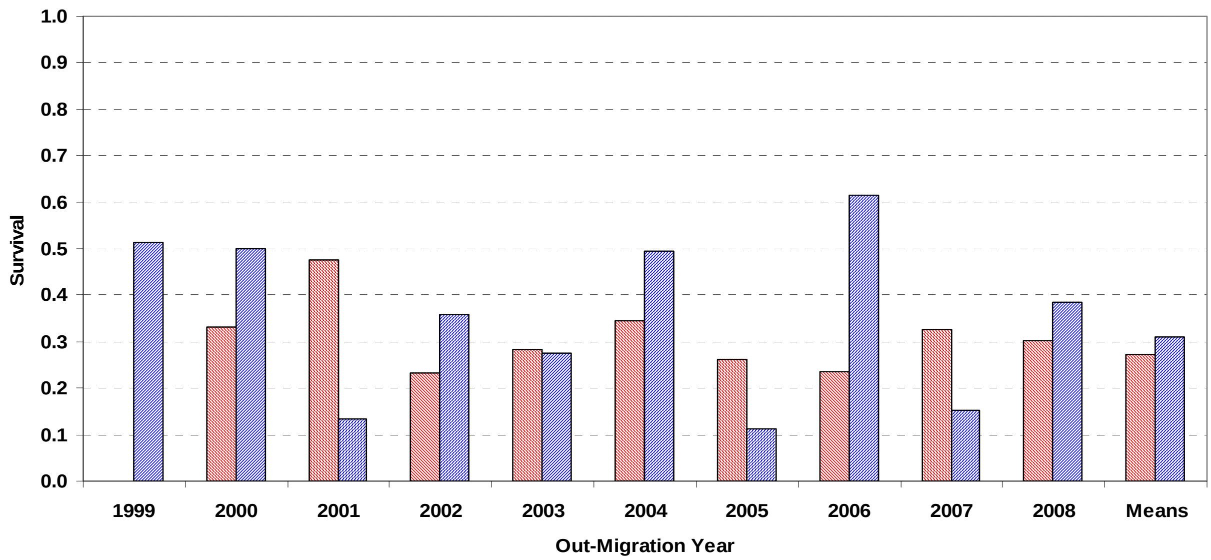


Table 2.a. Upper-Yakima Spring-Chinook Roza-to-McNary Smolt Survival Indices for Early and Late Natural Smolt

Stock	Measure	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Year-adjusted Means
Early-Natural	Survival		0.3307	0.4771	0.2314	0.2837	0.3442	0.2608	0.2361	0.3273	0.3020	0.2718
	Number Released		3013	755	6604	6614	3857	1688	1833	1072	1254	
Late-Natural	Survival	0.5122	0.4987	0.1339	0.3584	0.2750	0.4935	0.1122	0.6160	0.1529	0.3857	0.3479
	Number Released	133	3196	1424	2114	1190	74	45	500	336	421	
Early - Late			-0.1679	0.3432	-0.1270	0.0087	-0.1493	0.1485	-0.3799	0.1744	-0.0837	-0.0761
Type 1 Error P			0.0000	0.0001	0.0004	0.8230	0.4903	0.4035	0.0010	0.0671	0.2458	0.2577

As noted in previous reports, there is no consistency over the release years as to whether the early or late natural-smolt passage had the highest survival to McNary. The 2008 survivals of late- and early-passage natural smolt did not significantly differ (P = 0.24, Table 2.a.). The individual year analyses of variation are given in Appendix C.

Again, a two-way weighted logistic analysis of variation was used to assess the main-effect differences among years adjusted for passage period (early and late) and to assess the main effect difference between early- and late-natural smolt passage adjusted year effects. The results are given in Table 2.b. The main-effect stock comparison indicates that overall early- and late-passage smolt survivals do not differ substantially or significantly (Year-adjusted Means in Table 2.a.). This absence of significant main-effect differences but the presence of significant year x stock interaction indicates that there are significant within-year differences as does Table 2.a., the nature of which is that in some years the early Roza releases had the highest survival and in some years the late had the highest. In one year (2001) the early Roza passage has the significantly highest survival; in other years (2000, 2002, and 2006) the late Roza passage has the significantly highest survival. It turns out, probably coincidentally, that years in which the early-passage survival exceeds the late and years in which late-passage exceeds the early alternate from one year to the next.

Table 2.b. Upper-Yakima Spring-Chinook Weighted* Logistic Analysis of Variation of Roza-to-McNary Smolt Survival for Early and Late Natural Smolt over years

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Dev (Dev/DF)	F-Ratio	Type 1 Error P	
Early vs Late Smolt Passage (adjusted for Years)	143.72	1	143.72	1.49	0.2577	**
Among Years (adjusted for Early and Late Smolt Passage)	466.16	8	58.27	0.60	0.7555	**
Brood x Year Interaction	774.19	8	96.77	11.46	0.0000	***
Error* (Approximate)		87	8.45			

* Weights are the separate number of total releases for the late-natural and of the hatchery stock within years.

** Error Mean Deviance is the weighted mean of Yearly Mean Deviances from Appendix B, weights being the total Roza releases over two groups within years. Error Degrees of Freedom based on Satterthwaite's approximation.

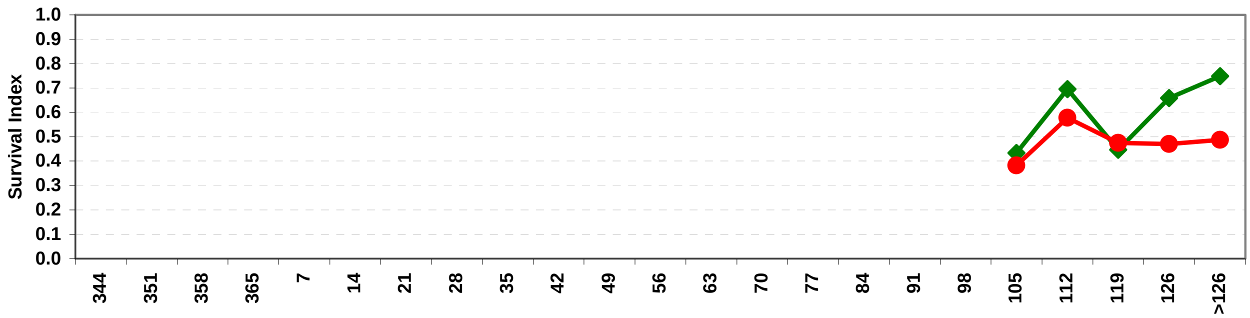
*** Tested against Interaction (Denominator Mean Deviance).

**** Tested against Error (Denominator Mean Deviance).

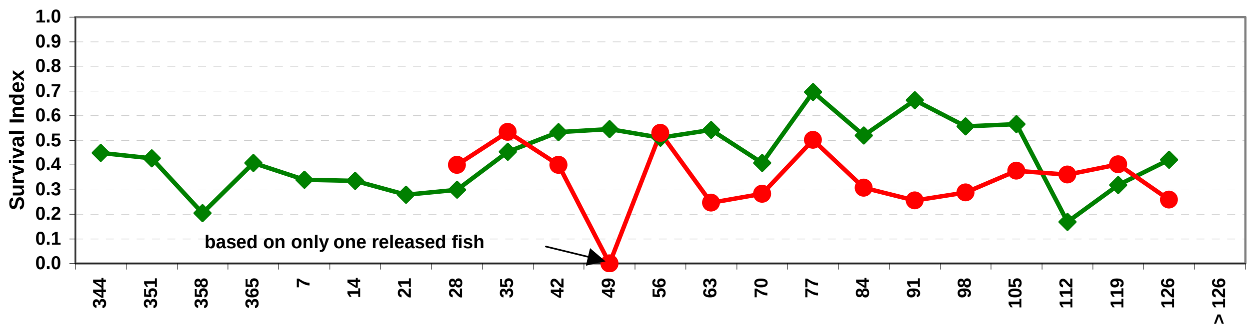
Appendix A

Plotted Roza-Dam-to-McNary Smolt Survival of Roza-Released Upper-Yakima Natural- (diamonds) and Hatchery-Brood (circles) Spring Chinook

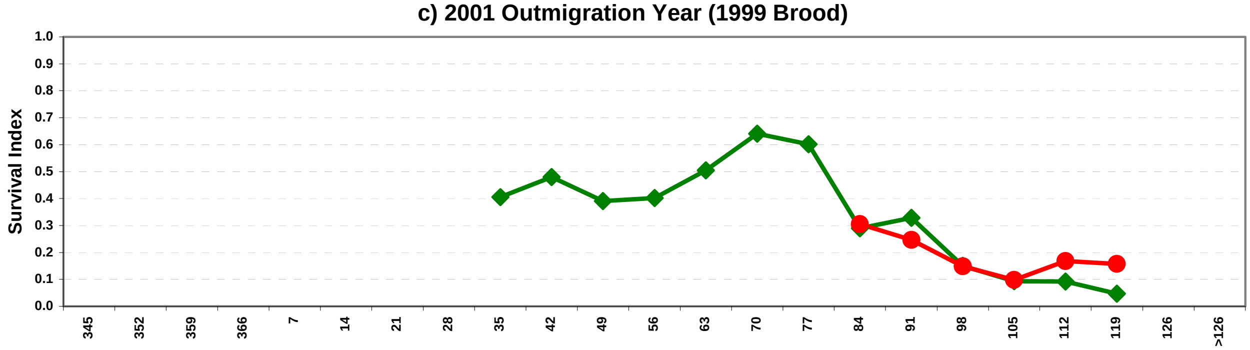
a) 1999 Outmigration Year (1997 Brood)



b) 2000 Outmigration Year (1998 Brood)

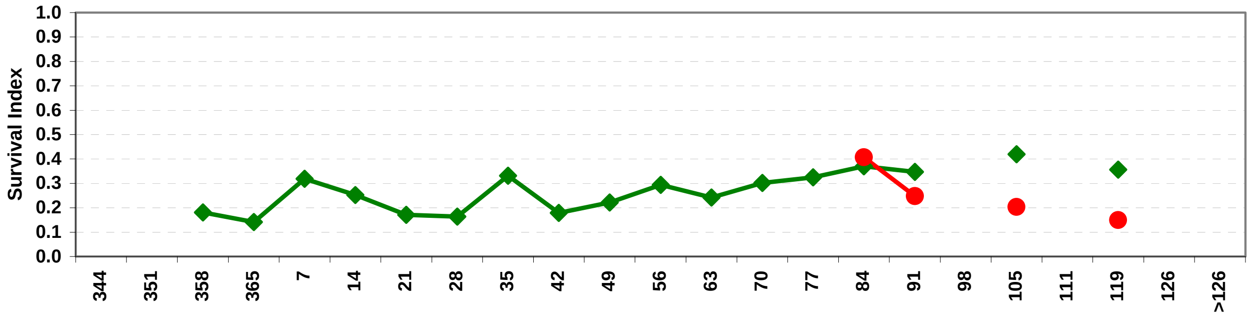


c) 2001 Outmigration Year (1999 Brood)

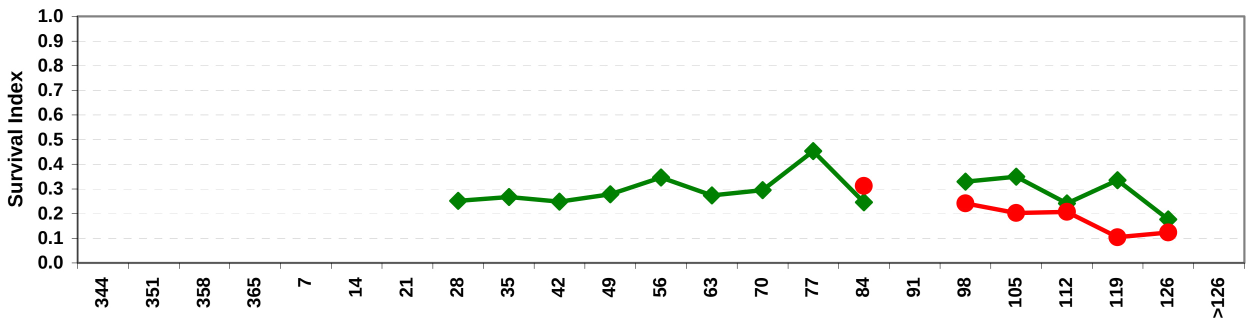


Appendix A. (continued)

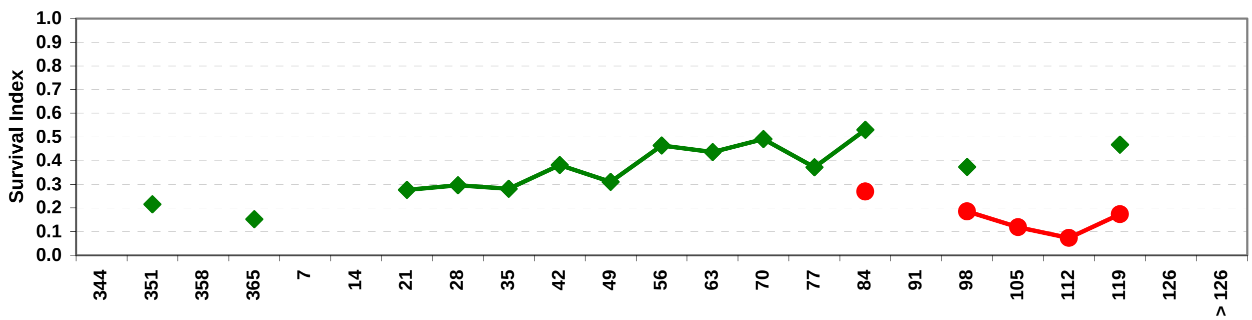
d) 2002 Outmigration Year (2000 Brood)



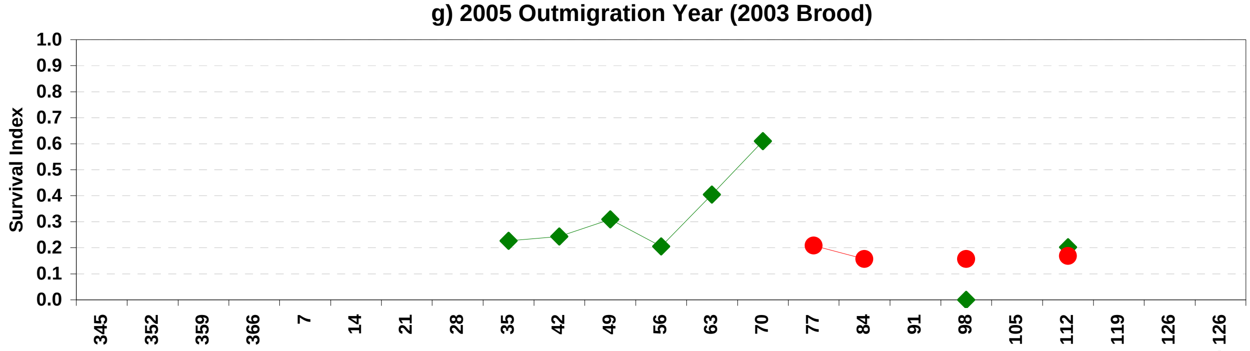
e) 2003 Outmigration Year (2001 Brood)



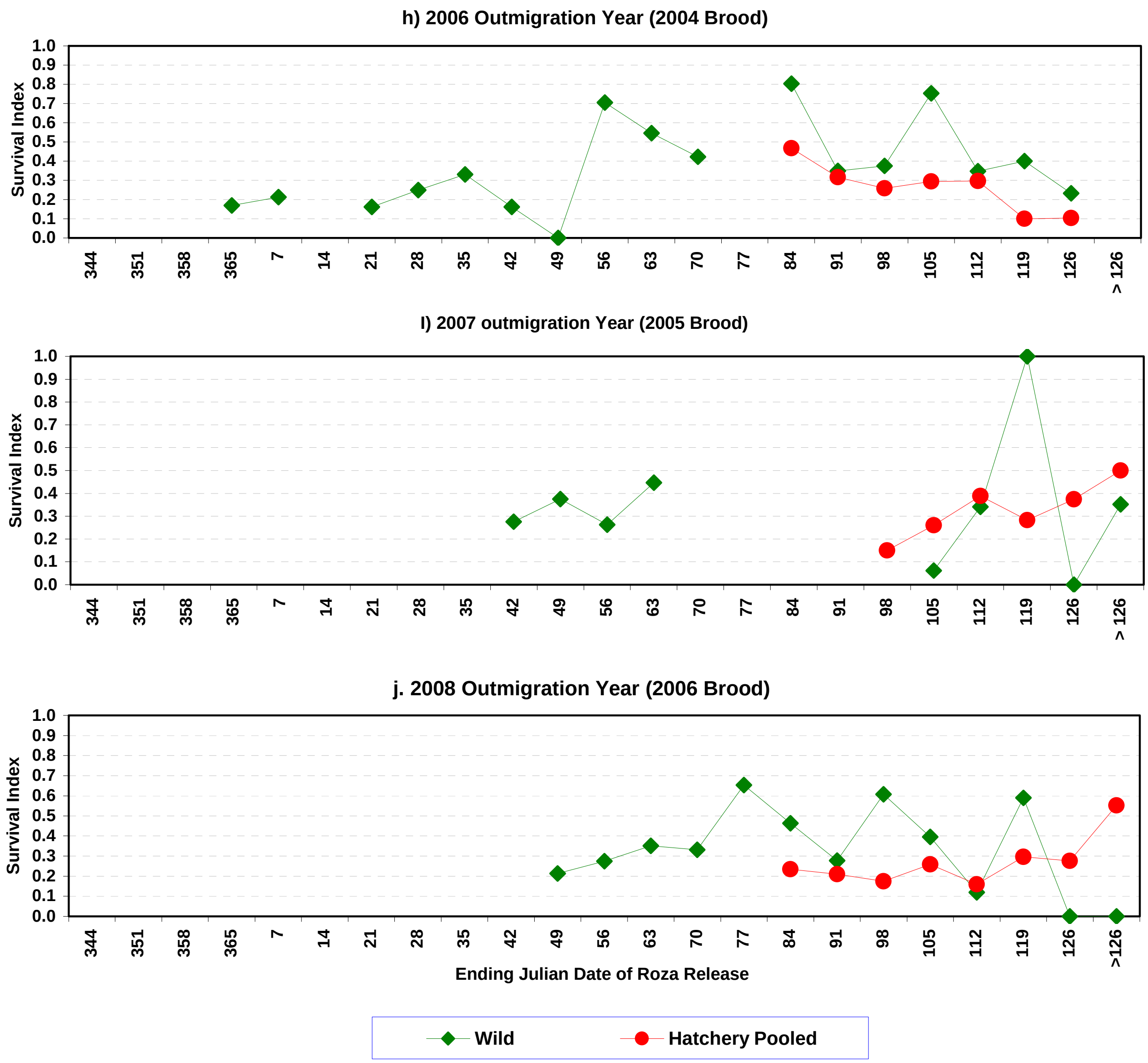
f) 2004 Outmigration Year (2002 Brood)



g) 2005 Outmigration Year (2003 Brood)



Appendix A. (continued)



Appendix B

Weighted* Logistic Analysis of Variation of Roza-to-McNary Smolt Survival** of Contemporarily Roza-Released Natural- and Hatchery-Brood Upper-Yakima Spring Chinook (non-shaded-analysis basis of test)

a) 1999 Outmigration (1997 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	32.55	4	8.14	0.93	0.4943	
Natural Origin versus Hatchery Origin[1]	20.15	1	20.15	2.29	0.1683	
Tagged vs Untagged Hatchery Origin1	8.26	1	8.26	0.94	0.3606	
Error(1)	70.26	8	8.7825			
Natural Origin versus Hatchery Origin[2]	20.15	1	20.15	2.35	0.1511	0.0755
Tagged vs Untagged Hatchery Origin[2]	8.26	1	8.26	0.96	0.3455	
Error(2)[3]	102.81	12	8.57			

b) 2000 Outmigration (1998 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	177.90	14	12.71	3.90	0.0017	
Natural Origin versus Hatchery Origin[1]	135.38	1	135.38	41.51	0.0000	0.0000
Tagged vs Untagged Hatchery Origin1	0.16	1	0.16	0.05	0.8266	
Error(1)	78.27	24	3.26			
Natural Origin versus Hatchery Origin[2]	135.38	1	135.38	20.08	0.0001	
Tagged vs Untagged Hatchery Origin[2]	0.16	1	0.16	0.02	0.8784	
Error(2)[3]	256.17	38	6.74			

c) 2001 Outmigration (1999 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block1	119.01	5	23.80	11.89	0.0006	
Wild versus Hatchery1	0.87	1	0.87	0.43	0.5246	0.8160
Tagged vs Untagged Hatchery1	1.78	1	1.78	0.89	0.3679	
Error(1)	20.02	10	2.002			
Wild versus Hatchery2	0.87	1	0.87	0.09	0.7635	
Tagged vs Untagged Hatchery2	1.78	1	1.78	0.19	0.6675	
Error(2)3	139.03	15	9.27			

Appendix B. (continued)

d) 2002 Outmigration (2000 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	41.93	4	10.48	1.34	0.3553	
Natural Origin versus Hatchery Origin[1]	19.10	1	19.10	2.45	0.1689	
Tagged vs Untagged Hatchery Origin1	3.00	1	3	0.38	0.5582	
Error(1)	46.86	6	7.81			
Natural Origin versus Hatchery Origin[2]	19.10	1	19.1	2.15	0.1732	0.0866
Tagged vs Untagged Hatchery Origin[2]	3.00	1	3.00	0.34	0.5739	
Error(2)[3]	88.79	10	8.88			

e) 2003 Outmigration (2001 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	46.25	5	9.25	1.83	0.1953	
Natural Origin versus Hatchery Origin[1]	12.33	1	12.33	2.43	0.1498	0.0749
Tagged vs Untagged Hatchery Origin1	0.62	1	0.62	0.12	0.7337	
Error(1)	50.65	10	5.065			
Natural Origin versus Hatchery Origin[2]	12.33	1	12.33	1.91	0.1873	
Tagged vs Untagged Hatchery Origin[2]	0.62	1	0.62	0.10	0.7610	
Error(2)[3]	96.90	15	6.46			

f) 2004 Outmigration (2002 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	87.14	4	21.79	6.15	0.0257	
Natural Origin versus Hatchery Origin[1]	21.55	1	21.55	6.08	0.0487	0.0243
Tagged vs Untagged Hatchery Origin1	21.85	1	21.85	6.17	0.0476	
Error(1)	21.25	6	3.54166667			
Natural Origin versus Hatchery Origin[2]	21.55	1	21.55	1.99	0.1889	
Tagged vs Untagged Hatchery Origin[2]	21.85	1	21.85	2.02	0.1861	
Error(2)[3]	108.39	10	10.84			

g) 2005 Outmigration (2003 Brood Year)

NOTE: Errors dicovered for this analysis in previous reports that are corrected below.

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block1	15.16	3	5.05	0.98	0.4845	
Natural versus Hatchery1	0.03	1	0.03	0.01	0.9427	
Tagged vs Untagged Hatchery	0.01	1	0.01	0.00	0.9669	
Error(1)	20.54	4	5.135			
Natural versus Hatchery2	0.03	1	0.03	0.01	0.9410	0.5295
Tagged vs Untagged Hatchery2	0.01	1	0.01	0.00	0.9659	
Error(2)3	35.70	7	5.10			

Appendix B. (continued)

h) 2006 Outmigration (2004 Brood Year)

NOTE: Errors dicovered for this analysis in previous reports that are corrected below.

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block[1]	378.21	6	63.04	10.55	0.0003	
Natural Origin versus Hatchery Origin[1]	105.84	1	105.84	17.71	0.0012	0.0006
Tagged vs Untagged Hatchery Origin[1]	0.16	1	0.16	0.03	0.8727	
Error(1)	71.71	12	5.97583333	0.00		
Natural Origin versus Hatchery Origin[2]	105.84	1	105.84	4.23	0.0544	
Tagged vs Untagged Hatchery Origin[2]	0.16	1	0.16	0.01	0.9371	
Error(2)3	449.92	18	25.00			

[1] Block, Natural Origin versus Hatchery Origin, Tagged versus Untagged Hatchery Origin tested against Error(1)

[2] Block, Natural Origin versus Hatchery Origin, Tagged versus Untagged Hatchery Origin tested against Error(2)

[3] Error (2) is pooling of Error(1) and Block

i) 2007 Outmigration (2005 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block1	1018.28	4	254.57	27.24	0.0001	
Natural versus Hatchery1	142.21	1	142.21	15.22	0.0045	0.0023
Tagged vs Untagged Hatchery	0.28	1	0.28	0.03	0.8669	
Error(1)	74.77	8	9.34625			
Natural versus Hatchery2	142.21	1	142.21	1.56	0.2353	
Tagged vs Untagged Hatchery2	0.28	1	0.28	0.00	0.9567	
Error(2)3	1093.05	12	91.09			

j) 2008 Outmigration (2006 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Analysis of Variation Type 1 P	1-sided Type 1 *p****
Block1	272.61	7	38.94	5.84	0.0025	
Natural Origin versus Hatchery Origin1	46.66	1	46.66	7.00	0.0192	0.0014
Tagged vs Untagged Hatchery Origin1	0.78	1	0.78	0.12	0.7374	
Error(1)	93.33	14	6.67			
Natural Origin versus Hatchery Origin2	46.66	1	46.66	2.68	0.1167	
Tagged vs Untagged Hatchery Origin2	0.78	1	0.78	0.04	0.8345	
Error(2)3	365.94	21	17.43			

1 Block, Wild versus Hatchery, Tagged versus Untagged Hatchery tested against Error(1)

2 Block, Wild versus Hatchery, Tagged versus Untagged Hatchery tested against Error(2)

3 Error (2) is pooling of Error(1) and Block. Analysis is based on Error(1) if Block Type 1 Error P < 0.2, otherwise analysis based on Error(2) is used

* Weight is Number Released, Block being Late-Release Week

** Roza-Dam-Release to McNary-Dam -Detection Smolt-to-Smolt Survival

*** Test for Hatchery Survival < Wild Survival

Appendix C.

Weighted* Logistic Analysis of Variation of Smolt Survival** of Early and Late*** Roza-Released Natural Upper-Yakima Spring Chinook

a) 1999 Outmigration (1997 Brood Year)
[No early Roza releases]

b) 2000 Outmigration (1998 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Type 1 Error	Highest Survival Estimate:
Natural Origin Early versus Late	181.10	1	181.10	31.62	0.0000	Late
Error	114.54	20	5.73			

c) 2001 Outmigration (1999 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	297.69	1	297.69	34.62	0.0001	Early
Error	94.60	11	8.60			

d) 2002 Outmigration (2000 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	161.77	1	161.77	20.03	0.0004	Late
Error	121.16	15	8.08			

e) 2003 Outmigration (2001 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	0.38	1	0.38	0.05	0.8230	Early
Error	87.28	12	7.27	0.00		

f) 2004 Outmigration (2002 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	6.81	1	6.81	0.51	0.4903	Late
Error	161.35	12	13.45			

Appendix C. (continued)

g) 2005 Outmigration (2003 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	5.98	1	5.98	0.81	0.4035	Late
Error	44.43	6	7.41			

h) 2006 Outmigration (2004 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	246.57	1	246.57	17.31	0.0010	Late
Error	199.40	14	14.24			

i) 2007 Outmigration (2005 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural-Origin Early versus Late	41.69	1	41.69	4.69	0.0671	Early
Error	62.24	7	8.89			

g) 2008 Outmigration (2006 Brood Year)

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	P	Highest Survival Estimate:
Natural Origin Early versus Late	9.91	1	9.91	1.50	0.2458	Late
Error	72.51	11	6.59			

* Weight is Number Released

** Roza-Dam-Release to McNary-Dam -Detection Smolt-to-Smolt Survival

*** "Late" Outmigrating means migrating contemporaneously with Hatchery-produced Fish and "Early" means oumigrating before Hatchery-produced Fish

Appendix E

IntSTATS

International Statistical Training
and Technical Services
712 12th Street
Oregon City, Oregon 97045
United States
Voice: (503) 650-5035
e-mail: intstats@sbcglobal.net

2008 Annual Report: Smolt-to-Smolt Survival to McNary Dam of Main-Stem-Yakima Fall Chinook

Doug Neeley, Consultant to Yakama Nation

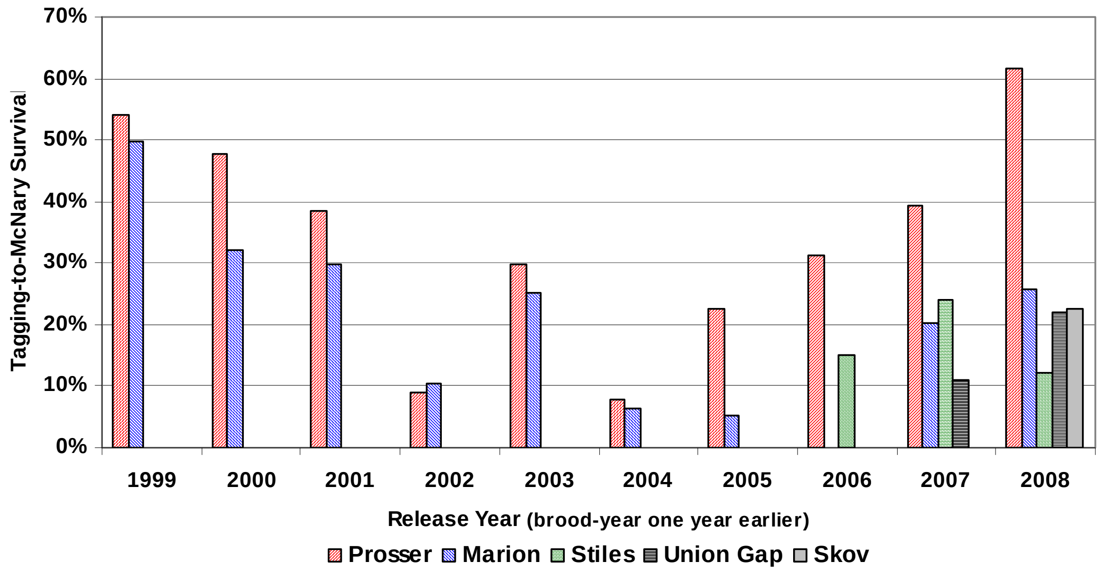
1. Introduction

In most years, two sources of brood-stock were used for hatchery production: 1) main-stem-Yakima Fall Chinook adult returns that were sampled from Prosser Diversion Dam on the Lower Yakima River and 2) Marion Drain returns. For brood-years 1998 through 2004, progeny from crosses of the main-stem-Yakima brood-stock reared at Prosser were assigned to one of two treatments: a) a conventional-rearing treatment as a control or b) a rearing treatment designed to accelerate smolting, permitting an earlier release and out-migration during a period believed to be more optimal for survival. Fish from these treatments were released into the Yakima River downstream of Prosser Diversion Dam on the lower Yakima.

Beginning with brood-year 2005 (release-year 2006), there was a shift in focus: The accelerated treatment was adopted as a standard rearing procedure, and a new production site was established at upper Stiles Pond on the Naches River with the long-term goal of establishing a new brood-stock that spawns in the higher reaches of the Yakima main-stem and in the lower reaches of the Naches and Upper Yakima Rivers, reaches that were historically utilized by Summer Chinook, a stock that is probably extinct in the Yakima basin. In brood-year 2006, another release site upstream of the Marion Drain confluence with the Yakima but below the confluence of the Naches and Upper Yakima Rivers was introduced (Billy Pond at Union Gap). In Brood Year 2007, a fifth site located above the confluence of the Naches River and Upper Yakima was added, Skov pond.

A portion of each of the releases from these sites and years was PIT-tagged, and smolt-to-smolt survival indices of the PIT-tagged fish to McNary Dam (Tagging-to-McNary survival) were estimated using stratified PIT-tag detection tallies at McNary expanded by estimates of McNary's detection efficiencies for the strata. The expanded strata tallies were totaled over strata and then divided by the total number of PIT-tagged fish as an estimated index of survival. The daily-expanded passage estimates were also used to estimate the mean passage date at McNary for each release based on all tagged fish. Figure 1 presents historic tagging-to-McNary-passage smolt survival for the accelerated-reared PIT-tagged fish from those sites.

Figure 1. Historic Tagging-to-McNary Survivals of Fall Chinook from multi-year release Sites in the Yakima Basin



For the 2005 through 2007 broods, detection efficiencies for PIT-tag detectors installed in the Prosser and Stiles pond outfalls were sufficiently high to permit the estimation of in-river survival (release-to-McNary-passage survival) based on those fish detected volitionally exiting the ponds. Pre-release survival was also estimated for these two sites by expanding (dividing) the proportion of tagged fish that were detected at the rearing site by the rearing-pond detection efficiency for each tag group, the detection efficiency being the estimated proportion of the McNary-detected fish that were previously detected at the ponds.

In addition to survival estimates, mean date of detection at McNary is estimated both for all tagged fish and for all fish detected leaving Stiles and Prosser, and the mean date of volitional release is also be estimated.

Detailed estimation methods are presented in my annual report *Hatchery x Hatchery and Natural x Natural Smolt-to-Smolt Survivals and Mini-Jack Proportions of Upper Yakima Spring Chinook for Brood-Years 2002-2006* and are summarized in Appendix A of this report which also gives the Fall Chinook survival estimates for release-year 2006 through 2008.

In Brood Year 2006 (release year 2007), another stock [out-of-basin, Little White Salmon Hatchery (LWS)] that currently has been reared under a conventional rearing strategy and released from Prosser was introduced to an accelerated treatment. Little White previously was reared and volitionally released at Prosser along with the Yakima stock. Beginning with the 2007 brood, the decision was made to compare accelerated and conventional at Prosser for this Little White stock to determine if the juvenile survival was higher under accelerated rearing as was the case for Yakima stock from similar experiments conducted in earlier years. For this experiment, a portion of the LWS fish were brought in as eyed eggs to rear under accelerated conditions while the later cohorts continued to receive a conventional rearing treatment at LWS hatchery until parr stage when transferred to Prosser Hatchery for continued conventional rearing until release.

Also in that year, the decision was made to test whether or not a yearling release of Yakima stock at Prosser would result in higher survival than a sub-yearling release of that stock (Wild Yakima stock normally smolt as sub-yearlings). In 2008, there were releases of brood years 2006 and 2007 smolt to make this test.

The analyses presented in this report are for:

1. Smolt-survival and date-of-detection estimates of accelerated-reared sub-yearlings over release sites within brood years 2005 through 2007.

2. Comparisons between Accelerated and Conventional Rearing treatments for Little White stock at Prosser

3. Comparisons between Yakima and Little White stock releases at Prosser.

4. Comparisons between sub-yearling and yearling releases of Yakima stock at Prosser

Estimates of survival to McNary were significantly higher for: 1) for the Accelerated Rearing treatment than for the Conventional rearing treatment, 2) Yakima stock than for the Little White stock, and 3) for the Yakima-stock Yearling release than for the Sub-Yearling release. Within a given comparison, the treatments with the significantly higher survival also had a significantly earlier mean detection date at McNary. Details are given in the following sections.

2. Analysis

Comparisons between Release Sites

No formal statistical comparisons among sites within years are made, but the mean survival and detection-date are presented in Table 1.

Table 1. Mean Survival and Mean Detection/Release-Date Estimates over Sites within Years for Sub-Yearling Releases under Accelerated Rearing[1]

1) 2006 Release

Site	Tagging-to-McNary Survival	Release-to-McNary Survival	Pre-Release Survival	McNary Detection Date*	Volitional Release Date	Date Screens Pulled
Stiles (BY-2005)	15.07%	15.16%	84.33%	06/14/07	05/23/07	04/27/07
Union Gap						
Marion Drain						
Skov						
Prosser (BY-2005)	31.24%	28.04%	96.43%	05/26/07	04/28/07	04/26/07

2) 2007 Release

Site	Tagging-to-McNary Survival	Release-to-McNary Survival	Pre-Release Survival	McNary Detection Date*	Volitional Release Date	Date Screens Pulled
Stiles (BY-2006)	24.00%	29.42%	81.50%	06/09/07	05/14/07	05/18/07
Union Gap (BY-2006)	10.90%			06/03/07		05/18/07
Marion Drain (BY-2006)	20.26%			06/07/07		04/28/07
Skov						
Prosser (BY-2006)	39.26%	41.15%	96.18%	06/02/07	05/04/07	04/25/07

3) 2008 Release

Site	Tagging-to-McNary Survival	Release-to-McNary Survival	Pre-Release Survival	McNary Detection Date*	Volitional Release Date	Date Screens Pulled
Stiles (BY-2007)	12.03%	15.66%	77.76%	07/03/08	06/04/08	05/14/08
Union Gap (BY-2007)	21.94%			06/01/08		05/11/08
Marion Drain (BY-2007)	25.67%			05/29/08		04/16/08
Skov (BY-2007)	22.56%			06/25/08		05/15/08
Prosser (BY-2007)	37.42%	49.90%	92.26%	05/31/08	04/20/08	04/14/08

1 With the exception of Marion Drain, the stock presented in Table 1 is Yakima stock. Marion Drain is stocked with spawners captured in Marion Drain

Treatment and Stock Comparisons

The number of replications was limited. There were only independent replicated releases at the Marion Drain and Prosser sites for some treatments. For these releases, the dates of release were separated by three to five days to minimize the mixing of fish from the two releases. Mixing would have probably negated an assumption that survival estimates from the two releases were independent, a necessary assumption if the releases are to be used as a measure of experimental error for statistical tests. Because of the limited number of replicated releases, the variation among these replicates is pooled with variation associated with interaction between the effects of treatments with the effects of years and release sites within years.

Analyses of variation are presented in Table 2 for Tagging-to-McNary survival, Release-to-McNary survival, and Pre-Release survival and for Mean McNary-Detection Date for all tagged fish. Associated means for Accelerated and Conventional rearing treatments for Little White stock, for Little White and Yakima Stock, and for Yearling and Sub-Yearling releases for Yakima Stock are respectively presented in Tables 3.a., 3.b., and 3.c.

Accelerated versus Conventional Rearing: The Release-to-McNary survival for Little-White stock was significantly higher under accelerated rearing than under conventional rearing (47.0 % versus 36.6% mean survivals respectively for accelerated and conventional, $P = 0.049$). This is consistent with Tagging-to-McNary survival findings for Yakima stock in earlier years; however, the Tagging-to-McNary survival difference for the Little White stock was smaller and not significant (34.2 %and 31.1% mean survivals respectively for accelerated and conventional, $P = 0.63$). As was the case for the Yakima releases of the past, the mean passage date for accelerated release tagged fish was substantially and significantly earlier than the conventional release (June 3 and June 29, $P < 0.0001$). There was no substantial or significance difference between the mean accelerated and conventional release pre-release survivals (respectively 87.0% and 87.9%, $P = 0.75$). Although the tagging-to-McNary and Pre-Release survivals were not significantly different, the directions of the differences were consistent with the significant Release-to-McNary survivals (Accelerated > Conventional).

Little White versus Yakima Stock: The Yakima Stock had significantly higher Release-to-McNary than the Little White Stock (46.4% and 42.2% for Release-to-McNary, $P < 0.039$) but not significantly higher for Tagging-to-McNary Survival (respectively 38.0% and 32.6%, $P < 0.16$). Pre-Release Survivals did not differ significantly between the stock; however, as with the survivals to McNary, the estimated Yakima Stock's Pre-Release survival was higher than that of the Little White Stock (respectively 93.6% and 87.2%, $P =0.12$). It should be noted that the differences in all survival measures were higher for the 2006 brood than for the 2007 brood (Table 3.b.). The mean McNary-Detection date for all tagged fish was significantly earlier for the Yakima than for Little White stock ($P < 0.0026$, respective dates 6/02 and 6/09 for brood year 2006 and 5/31 and 6/09 for brood year 2007).

Sub-Yearling versus Yearling Releases: Both Tagging-to-McNary and Release-to-McNary Survivals were substantially and significantly greater for yearling than sub-yearly releases (respectively 61.6% and 37.4% for Tagging-to-McNary Survival, $P < 0.020$; and 65.2% and 49.9% for Release-to-McNary Survival, $P = 0.039$); whereas Pre-Release survivals from time of tagging were nearly the same (respectively 94.6% and 92.3%, $P = 0.81$). As was the case for other comparisons, the higher survival to McNary was associated with an earlier detection date (04/22 for Yearling and 05/31 for Sub-Yearling, $P < 0.0001$).

Table 2. Analyses of Variation for four Measures adjusted for Year and Site[2] (comparisons that are significant at 5% level are given in bold-faced font)

a. Logistic Analysis of Variation of Tagging-to-McNary Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Dev (Dev/DF)	F-Ratio	Type 1 Error P
Accelerated versus Conventional	9.73	1	9.73	0.26	0.6291
Yakima versus Little White Stock	95.64	1	95.64	2.51	0.1574
Yearling versus Subyearling	344.35	1	344.35	9.03	**0.0198**
Error	267.07	7	38.15		

b. Logistic Analysis of Variation of Release-to-McNary Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Dev (Dev/DF)	F-Ratio	Type 1 Error P
Accelerated versus Conventional	10.87	1	10.87	6.04	**0.0492**
Yakima versus Little White Stock	6.18	1	6.18	3.44	0.1132
Yearling versus Subyearling	12.43	1	12.43	6.91	**0.0391**
Error	10.79	6	1.80		

c. Logistic Analysis of Variation of Pre-Release Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Dev (Dev/DF)	F-Ratio	Type 1 Error P
Accelerated versus Conventional	12.61	1	12.61	0.11	0.7466
Yakima versus Little White Stock	358.97	1	358.97	3.26	0.1210
Yearling versus Subyearling	6.33	1	6.33	0.06	0.8185
Error	660.78	6	110.13		

d. Least Squares Analysis of Variance Mean McNary-Passage Date (all tagged fish)

Source	Sums of Squares (SS)	Degrees of Freedom (DF)	Mean Square (SS/DF)	F-Ratio	Type 1 Error P
Accelerated versus Conventional	1113467	1	1113467	425.15	**0.0000**
Yakima versus Little White Stock	54637	1	54637	20.86	**0.0026**
Yearling versus Subyearling	1325946	1	1325946	506.28	**0.0000**
Error	18332.9	7	2619		

2 While all treatments were conducted at Prosser, variation among replicated releases was used in the error term to increase the degrees of freedom and the power of the test.

Table 3.a. Means for Conventional- and Accelerated-Rearing Treatments

1) Tagging-McNary Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008
Stock: Little White	**Survival**		**31.10%**
Rearing: Conventional	Number Tagged		10006
Age Subyearling	**Mean McNary Detection Date**		**06/29/08**
Stock: Little White	**Survival**		**34.15%**
Rearing: Accelerated	Number Tagged		10001
Age Subyearling	**Mean McNary Detection Date**		**06/03/08**

2) Release-McNary Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008
Stock: Little White	**Survival**		**36.60%**
Rearing: Conventional	Number Tagged		6202
Age Subyearling	**Mean McNary Detection Date**		**06/28/08**
Stock: Little White	**Survival**		**47.02%**
Rearing: Accelerated	Number Tagged		7231
Age Subyearling	**Mean McNary Detection Date**		**06/02/08**

3) Pre-Release Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008
Stock: Little White	**Survival**		**87.86%**
Rearing: Conventional	Number Tagged		10006
Age Subyearling	**Mean Prosser Detection Date**		**05/29/08**
Stock: Little White	**Survival**		**87.01%**
Rearing: Accelerated	Number Tagged		10001
Age Subyearling	**Mean Prosser Detection Date**		**04/30/08**

* Release Year 2008 = 2007 brood..

Table 3.b. Means for Little White and Yakima Stock

1) Tagging-McNary Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008	Pooled
Stock: Little White	**Survival**	**29.61%**	**34.15%**	**32.64%**
Rearing: Accelerated	Number Tagged	5009	10001	15010
Age Subyearling	**Mean McNary Detection Date**	**06/09/07**	**06/03/08**	
Stock: Yakima	**Survival**	**39.26%**	**37.42%**	**38.03%**
Rearing: Accelerated	Number Tagged	5002	10005	15007
Age Subyearling	**Mean McNary Detection Date**	**06/02/07**	**05/31/08**	

2) Release-McNary Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008	Pooled
Stock: Little White	**Survival**	**33.82%**	**47.02%**	**42.22%**
Rearing: Accelerated	Number Tagged	4142	7231	11373
Age Subyearling	**Mean McNary Detection Date**	**06/09/07**	**06/02/08**	
Stock: Yakima	**Survival**	**41.15%**	**49.90%**	**46.36%**
Rearing: Accelerated	Number Tagged	4209	6187	10396
Age Subyearling	**Mean McNary Detection Date**	**06/01/07**	**05/30/08**	

3) Pre-Release Survival

Stock/Treatment	Measure	Release Year* 2007	Release Year* 2008	Pooled
Stock: Little White	**Survival**	**87.50%**	**87.01%**	**87.18%**
Rearing: Accelerated	Number Tagged	5009	10001	15010
Age Subyearling	**Mean Prosser Detection Date**	**05/07/07**	**04/30/08**	
Stock: Yakima	**Survival**	**96.18%**	**92.26%**	**93.57%**
Rearing: Accelerated	Number Tagged	5002	10005	15007
Age Subyearling	**Mean Prosser Detection Date**	**05/04/07**	**04/20/08**	

* Release Years 2007 and 2008 respectively = 2006 and 2007 brood..

Table 3.c. Means for Sub-yearling and Yearling Releases

1) Tagging-McNary Survival

Stock/Treatment		Measure	Release Year* 2007	Release Year* 2008
Stock:	Yakima	**Survival**		**37.42%**
Rearing:	Accelerated	Number Tagged		10005
Age	**Subyearling**	**Mean McNary Detection Date**		**05/31/08**
Stock:	Yakima	**Survival**		**61.63%**
Rearing:	Accelerated	Number Tagged		1831
Age	**Yearling**	**Mean McNary Detection Date**		**04/22/08**

2) Release-McNary Survival

Stock/Treatment		Measure	Release Year* 2007	Release Year* 2008
Stock:	Yakima	**Survival**		**49.90%**
Rearing:	Accelerated	Number Tagged		6187
Age	**Subyearling**	**Mean McNary Detection Date**		**05/30/08**
Stock:	Yakima	**Survival**		**65.15%**
Rearing:	Accelerated	Number Tagged		1706
Age	**Yearling**	**Mean McNary Detection Date**		**04/21/08**

3) Pre-Release Survival

Stock/Treatment		Measure	Release Year* 2007	Release Year* 2008
Stock:	Yakima	**Survival**		**92.26%**
Rearing:	Accelerated	Number Tagged		10005
Age	**Subyearling**	**Mean Prosser Detection Date**		**04/20/08**
Stock:	Yakima	**Survival**		**94.59%**
Rearing:	Accelerated	Number Tagged		1831
Age	**Yearling**	**Mean Prosser Detection Date**		**04/09/08**

* 2008 Release = 2006 brood for yearling and 2007 brood for subyearling.

Appendix A. Estimated Survival Index

Conceptual Computation

The smolt-to-smolt survival to McNary estimation method for Fall Chinook involves

1. Identifying time-of-passage strata within which estimated daily McNary detection rates of Fall Chinook are reasonably homogeneous. (Daily McNary detection rate is the proportion of all Yakima PIT-tagged Fall Chinook passing McNary Dam for each day that are detected at McNary)

2. Estimating the McNary detection rate for each stratum

3. Expanding (dividing) the given release's number[3] of detected fish not removed for transportation at McNary by the detection rate within the associated stratum and adjusting for the number removed for transportation[4]

4. Totaling the release's expanded numbers over strata

5. Taking that release's expanded total and dividing it by the appropriate "population number[5]"

The methods of identifying strata and estimating the individual stratum detection rates at McNary are discussed in my annual report *Hatchery x Hatchery and Natural x Natural Smolt-to-Smolt Survivals and Mini-Jack Proportions of Upper Yakima Spring Chinook for Brood-Years 2002-2006*.

The steps given above can be basically summarized in the following equations. (In all of the following equations, the term "detections" is actually the number of detections.)

---

3 Total number of tagged fish detected at McNary within stratum in the case of tagging-to-McNary survival, total number of tagged fish detected at McNary within stratum that were previously detected at acclimation site in case of release-to-McNary survival.

4 Adjustment is given in Equation B.2, but so few (usually none) of the fish detected at McNary were transported from 2006 through 2008 that the adjustment was not made.

5 Total number of tagged fish in the case of tagging-to-McNary survival, total number of tagged fish detected at acclimation site in case of release-to-McNary survival.

Equation A.1.

$$\text{Stratum McNary detection rate} = \frac{\text{number of joint detections at McNary and downstream dams within Stratum}}{\text{estimated total number of detections at downstream dams within Stratum}}$$

Equation A.2.

$$\text{Smolt-to-Smolt Survival to McNary for a given release (Rel)} = \frac{\sum_{\text{strata}} \text{For Stratum}\left[\frac{\text{(McNary Rel Detections - Rel Detections Removed)}}{\text{Stratum's McNary Detection Rate (Equation B.1)}} + \text{Detections Rel Removed}\right]}{\text{Rel Number of Fish Tagged or Released}}$$

Pre-release survival was estimated using the Equation A.3.

Equation A.3.

$$\text{Pre-release Survival for a given Release (Rel)} = \text{Tagging-to-Release Survival} = \frac{\left[\frac{\text{Rel Detections at Acclimation Site}}{\text{Rel Number Tagged}}\right]}{\left[\frac{\text{Total Rel Detections at McNary previously Detected at Acclimation Site}}{\text{Total Rel Detections at McNary}}\right]}$$

The denominator [] in the above equation is a measure of the detection efficiency at the acclimation site for the release in question. Initial estimates for this detection efficiency was based on expanded detection numbers using the detection rate in Equation A.1 as the expansion factor rather than the unexpanded detections; however, there were occasional estimates in which the resulting estimated pre-release survival slightly exceeded 1 (100%). While this also happened using the unexpanded numbers[6], it was even more unusual; therefore the unexpanded numbers were used.

6 This happened for Fall Chinook. When this occurred, the pre-release survival was equated to 1 (100%).

Detection Rate Estimates

Estimates for 2006 and 2007 detection rates for Equation A.1 are given Table A.1.

Table A.1. McNary Dam Detection Rates for 2006 and 2007 Fall Releases.

			Bonneville (Bonn.) Based			John Day (J.D. based)			Pooled over Bonn.and J.D.		
	Julian Date Strata		Total	Joint Bonn.	McN. Det.	Total	Joint J.D.	McN. Det.	Pooled	Pooled	Pooled McN.
Year	Beginning	Ending	Bonn. Det.	McN. Det.	Rate	J.D. Det.	McN. Det.	Rate	Total Det.	J.D. Det	Det. Rate
2006		156	122.4	28.0	0.2287	548.8	123.0	0.2241	671.3	151.0	0.2249
	157	162	43.6	5.0	0.1148	142.2	29.0	0.2039	185.8	34.0	0.1830
	163		157.0	54.0	0.3439	299.9	105.0	0.3501	456.9	159.0	0.3480
	Total		323.0	87.0	0.2693	991.0	257.0	0.2593	1314.0	344.0	0.2618
2007		139	41.2	9.0	0.2185	114.8	28.0	0.2439	156.0	37.0	0.2372
	140	143	17.2	7.0	0.4060	62.5	22.0	0.3521	79.7	29.0	0.3637
	144	155	100.0	31.0	0.3101	371.2	107.0	0.2882	471.2	138.0	0.2929
	156		505.6	187.0	0.3698	1177.5	420.0	0.3567	1683.1	607.0	0.3606
	Total		664.0	234.0	0.3524	1726.0	577.0	0.3343	2390.0	811.0	0.3393
2008		142	160.1	25.0	0.1562	384.3	71.0	0.1847	544.4	96.0	0.1763
	143	163	402.4	101.0	0.2510	1427.0	339.0	0.2376	1829.4	440.0	0.2405
	164	175	287.7	90.0	0.3128	313.1	84.0	0.2683	600.8	174.0	0.2896
	176		555.8	114.0	0.2051	502.6	112.0	0.2228	1058.4	226.0	0.2135
	Total		1406.0	330.0	0.2347	2627.0	606.0	0.2307	4033.0	936.0	0.2321

In the Table A.1, individual stratum’s pooled detection rates, pooled over downstream dams, are the detection rate estimates from Equation A.1. that were applied to the stratum McNary detections for each release in Equation A.2 to produce survival estimates, which are detailed in Table A.2.

Survival Rate Estimates

Within-stratum detection numbers, expanded numbers, and other within-stratum numbers, totals over strata and survival estimates are given for each release in Table A.2.

Table A.2. Detection Numbers and Resulting Survival Indices

a. Tagging-to-McNary 2006 Survival

	Rearing Pond >	Stiles		Prosser		Horn Rapids
	Tagging Group (File Extender) >	FS1	FS2	PR1	PR2	HRN
Stratum 1	Total	47	44	309	298	9
	Removed	0	0	0	0	0
	Subtotal	47	44	309	298	9
	Expanded Total	208.9	195.6	1373.7	1324.8	40.0
Stratum 2	Total	69	64	28	31	2
	Removed	0	0	0	0	0
	Subtotal	69	64	28	31	2
	Expanded Total	377.0	349.7	153.0	169.4	10.9
Stratum 3	Total	330	320	16	20	2
	Removed	0	0	0	0	0
	Subtotal	330	320	16	20	2
	Expanded Total	948.4	919.6	46.0	57.5	5.7
	Total over Strata	446	428	353	349	13
	Expanded Total over Strata	1534.3	1464.9	1572.7	1551.6	56.7
	Number Tagged	9999	9902	5001	5000	191
	Tagging-to-McNary Survival	0.1534	0.1479	0.3145	0.3103	0.2968
	Pooled Number Tagged		19901		10001	
	Pooled Tagging-to-McNary Survival		0.1507		0.3124	

Table A.2. (continued)

b. Volitional Release-to-McNary 2006 Survival (and pre-release survival)

	Rearing Pond >	Stiles		Prosser	
	Tagging Group (File Extender) >	FS1	FS2	PR1	PR2
Stratum 1	Total	0	0	3	4
	Removed	0	0	0	0
	Subtotal	0	0	3	4
	Expanded Total	0.0	0.0	13.3	17.8
Stratum 2	Total	3	4	8	23
	Removed	0	0	0	0
	Subtotal	3	4	8	23
	Expanded Total	16.4	21.9	43.7	125.7
Stratum 3	Total	247	244	17	39
	Removed	0	0	0	0
	Subtotal	247	244	17	39
	Expanded Total	709.8	701.2	48.9	112.1
	Total over Strata	250	248	28	66
	Expanded Total over Strata	726.2	723.1	105.9	255.5
	Number Released	4897	4662	411	878
	Released-to-McNary Survival	0.1483	0.1551	0.2577	0.2911
	Pooled Number Released		9559		1289
	Pooled Tagging-to-McNary Survival		0.1516		0.2804
	Pre-Rel Survival*	0.8737	0.8125	1.0000	0.9286
	Pre-Rel Survival**		0.8433		0.9643
	Total Tagged		19901		10001

* [(Volitional Releases)/(Number Tagged)]/
[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

** Weighted by Number Tagged over Tagging Groups with Site

Table A.3. (continued)

c. Tagging-to-McNary 2007 Survival

	Rearing Pond >	Union Gap	Marion Drain		Stiles	Prosser: Little White		Prosser: Yakima	
	Tagging Group (File Extender) >	BY1	MD1	MD3	ST1	LW1	LW3	PR1	PR3
Stratum 1	Total	10	1	0	0	11	13	57	26
	Removed	0	0	0	0	0	0	0	0
	Subtotal	10	1	0	0	11	13	57	26
	Expanded Total	42.2	4.2	0.0	0.0	46.4	54.8	240.3	109.6
Stratum 2	Total	14	1	0	7	14	8	28	15
	Removed	0	0	0	0	0	0	0	0
	Subtotal	14	1	0	7	14	8	28	15
	Expanded Total	38.5	2.7	0.0	19.2	38.5	22.0	77.0	41.2
Stratum 3	Total	41	56	12	87	24	35	95	67
	Removed	0	0	0	0	0	0	0	0
	Subtotal	41	56	12	87	24	35	95	67
	Expanded Total	140.0	191.2	41.0	297.1	81.9	119.5	324.4	228.8
Stratum 4	Total	117	186	89	749	222	182	170	170
	Removed	0	0	0	0	0	0	0	0
	Subtotal	117	186	89	749	222	182	170	170
	Expanded Total	324.4	515.7	246.8	2076.8	615.6	504.6	471.4	471.4
	Total over Strata	182	244	101	843	271	238	350	278
	Expanded Total over Strata	545.1	713.9	287.8	2393.1	782.4	701.0	1113.0	851.0
	Number Tagged	5002	2638	2305	9970	2505	2504	2501	2501
	Tagging-to-McNary Survival	0.1090	0.2706	0.1248	0.2400	0.3123	0.2799	0.4450	0.3403
	Pooled Number Tagged	5002		4943	9970		5009		5002
	Pooled Tagging-to-McNary Survival	0.1090		0.2026	0.2400		0.2961		0.3926

Table A.3. (continued)

d. Volitional Release-to-McNary 2007 Survival (and pre-release survival)

	Rearing Pond >	Stiles	Prosser: Little White		Prosser: Yakima	
	Tagging Group (File Extender) >	ST1	LW1	LW3	PR1	PR3
Stratum 1	Total	0	11	11	55	19
	Removed	0	0	0	0	0
	Subtotal	0	11	11	55	19
	Expanded Total	0.0	46.4	46.4	231.9	80.1
Stratum 2	Total	7	13	7	26	13
	Removed	0	0	0	0	0
	Subtotal	7	13	7	26	13
	Expanded Total	19.2	35.7	19.2	71.5	35.7
Stratum 3	Total	76	22	34	90	50
	Removed	0	0	0	0	0
	Subtotal	76	22	34	90	50
	Expanded Total	259.5	75.1	116.1	307.3	170.7
Stratum 4	Total	694	210	173	159	142
	Removed	0	0	0	0	0
	Subtotal	694	210	173	159	142
	Expanded Total	1924.3	582.3	479.7	440.9	393.7
	Total over Strata	777	256	225	330	224
	Expanded Total over Strata	2203.1	739.5	661.4	1051.5	680.3
	Number Released	7489	2097	2045	2288	1921
	Released-to-McNary Survival	0.2942	0.3527	0.3234	0.4596	0.3541
	Pooled Number Released	7489		4142		4209
	Pooled Tagging-to-McNary Survival	0.2942		0.3382		0.4115
	Pre-Rel Survival*	0.814958	0.88617609	0.86388001	0.97027856	0.95325798
	Pre-Rel Survival**	0.8150		0.8750		0.9618
	Total Tagged	12471		5009		5002

* [(Volitional Releases)/(Number Tagged)]/
[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

** Weighted by Number Tagged over Tagging Groups with Site

Table A.3. (continued)

e. Tagging-to-McNary 2008 Survival

Rearing Pond >	Prosser: Little White, Accelerated		Prosser: Little White, Conventional		Prosser: Yakima, Viltional Rel		Prosser: Yakima, Yearling	
Tagging Group (File Extender) >	LW1	LW3	LW5	LW7	PS1	PS3	PY1	PY2
Total	31	19	0	0	35	20	125	74
Removed	0	0	0	0	0	0	0	0
Subtotal	31	19	0	0	35	20	125	74
Expanded Total	175.8	107.7	0.0	0.0	198.5	113.4	708.9	419.6
Total	259	266	55	42	336	356	0	0
Removed	0	0	0	0	0	0	0	0
Subtotal	259	266	55	42	336	356	0	0
Expanded Total	1076.8	1105.9	228.7	174.6	1397.0	1480.1	0.0	0.0
Total	106	112	52	34	62	81	0	0
Removed	0	0	0	0	0	0	0	0
Subtotal	106	112	52	34	62	81	0	0
Expanded Total	366.0	386.7	179.5	117.4	214.1	279.7	0.0	0.0
Total	16	26	274	241	8	5	0	0
Removed	0	0	0	0	0	0	0	0
Subtotal	16	26	274	241	8	5	0	0
Expanded Total	74.9	121.8	1283.2	1128.7	37.5	23.4	0.0	0.0
Total over Strata	412	423	381	317	441	462	125	74
Expanded Total over Strata	1693.6	1722.2	1691.4	1420.7	1847.0	1896.6	708.9	419.6
Number Tagged	5000	5001	5001	5005	5001	5004	1089	742
Tagging-to-McNary Survival	0.3387	0.3444	0.3382	0.2839	0.3693	0.3790	0.6509	0.5656
Pooled Number Tagged		10001		10006		10005		1831
Pooled Tagging-to-McNary Survival		0.3415		0.3110		0.3742		0.6163

Table A.3. (continued)

e. Tagging-to-McNary 2008 Survival (continued)

Rearing Pond >	Union Gap	Marion Drain	Skov	Stiles	
Tagging Group (File Extender) >	BY1	MD1	SK1	ST1	ST2
Total	19	18	0	0	0
Removed	0	0	0	0	0
Subtotal	19	18	0	0	0
Expanded Total	107.7	102.1	0.0	0.0	0.0
Total	182	224	31	0	2
Removed	0	0	0	0	0
Subtotal	182	224	31	0	2
Expanded Total	756.7	931.3	128.9	0.0	8.3
Total	57	32	82	10	8
Removed	0	0	0	0	0
Subtotal	57	32	82	10	8
Expanded Total	196.8	110.5	283.1	34.5	27.6
Total	8	3	153	138	104
Removed	0	0	0	0	0
Subtotal	8	3	153	138	104
Expanded Total	37.5	14.0	716.5	646.3	487.1
Total over Strata	266	277	266	148	114
Expanded Total over Strata	1098.7	1157.9	1128.6	680.8	523.0
Number Tagged	5008	4510	5002	5105	4902
Tagging-to-McNary Survival	0.2194	0.2567	0.2256	0.1334	0.1067
Pooled Number Tagged	5008	4510	5002		10007
Pooled Tagging-to-McNary Survival	0.2194	0.2567	0.2256		0.1203

Table A.3. (continued)

f. Volitional Release-to-McNary 2008 Survival (and pre-release survival)

	Rearing Pond >	Prosser: Little White, Accelerated		Prosser: Little White, Conventional		Prosser: Yakima, Viltional Rel		Prosser: Yakima, Yearling		Stiles	
	Tagging Group (File Extender) >	LW1	LW3	LW5	LW7	PS1	PS3	PY1	PY2	ST1	ST2
Stratum 1	Total	179	217	34	5	230	194	123	73	0	2
	Removed	0	0	0	0	0	0	0	0	0	0
	Subtotal	179	217	34	5	230	194	123	73	0	2
	Expanded Total	1015.1	1230.6	192.8	28.4	1304.3	1100.1	697.5	414.0	0.0	11.3
Stratum 2	Total	31	22	4	13	24	26	0	0	0	0
	Removed	0	0	0	0	0	0	0	0	0	0
	Subtotal	31	22	4	13	24	26	0	0	0	0
	Expanded Total	128.9	91.5	16.6	54.0	99.8	108.1	0.0	0.0	0.0	0.0
Stratum 3	Total	86	91	20	28	52	53	0	0	2	5
	Removed	0	0	0	0	0	0	0	0	0	0
	Subtotal	86	91	20	28	52	53	0	0	2	5
	Expanded Total	296.9	314.2	69.1	96.7	179.5	183.0	0.0	0.0	6.9	17.3
Stratum 4	Total	26	43	200	187	11	13	0	0	117	92
	Removed	0	0	0	0	0	0	0	0	0	0
	Subtotal	26	43	200	187	11	13	0	0	117	92
	Expanded Total	121.8	201.4	936.7	875.8	51.5	60.9	0.0	0.0	547.9	430.9
	Total over Strata	322	373	258	233	317	286	123	73	119	99
	Expanded Total over Strata	1562.7	1837.6	1215.2	1054.9	1635.1	1452.1	697.5	414.0	554.9	459.5
	Number Released	3450	3781	3042	3160	3405	2782	1022	684	3517	2959
	Released-to-McNary Survival	0.4529	0.4860	0.3995	0.3338	0.4802	0.5220	0.6825	0.6052	0.1578	0.1553
	Pooled Number Released		7231		6202		6187		1706		6476
	Pooled Tagging-to-McNary Survival		0.4702		0.3660		0.4990		0.6515		0.1566
	Pre-Rel Survival*	0.8829	0.8574	0.8983	0.8590	0.9472	0.8981	0.9537	0.9345	0.8568	0.6951
	Pre-Rel Survival**		0.8701		0.8786		0.9226		0.9459		0.7776
	Total Tagged		10001		10006		10005		1831		10007

* [(Volitional Releases)/(Number Tagged)]/[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

** Weighted by Number Tagged over Tagging Groups with Site

Appendix F

IntSTATS

International Statistical Training
and Technical Services
712 12th Street
Oregon City, Oregon 97045
United States
Voice: (503) 650-5035
e-mail: intstats@sbcglobal.net

Annual Report: 2006-2008 Coho Smolt-to-Smolt Survival of Eagle Creek and Yakima Brood Releases into the Yakima Basin

Doug Neeley, Consultant to Yakama Nation

Introduction and Summary

This annual report focuses on the comparisons between early-release[1] PIT-tagged smolt-to-smolt survivals from tagging or volitional release[2] to McNary Dam (McNary) based on PIT-tagged fish from brood-years 2004 through 2006 (respectively released from 2006 through 2008) during which years two primary brood stock sources were compared: Yakima returns (Yakima) and Eagle Creek Hatchery brood. Other hatchery brood-stock sources for comparison to the Yakima brood were used in previous years: Willard hatchery brood-stock in brood-years 1999 through 2001 (respectively released in 2001 through 2003) and Cascade Hatchery brood-stock in brood-year 1997 (release year 1999) [3]. For all brood years with exception of 1997 the Yakima-return brood had significantly[4] higher smolt-to-smolt survival than the hatchery-source brood-stock. The Cascade stock used in Brood-Year 1997 had a significantly higher survival than did the Yakima-return brood-stock.

Parr-release survival estimates are also presented.

---

1 In earlier years, treatments were compared that involved early and late releases of Coho. Those early releases had higher smolt-to smolt survivals and have become standard releases in later years. The term "early-release" is still used here because those survivals from the earlier years that are presented in this report for reference purposes are those from the early-release not the late-release treatments.

2 In early brood-years there were no PIT-tag detectors at the rearing ponds, so McNary survival was measured from time of tagging (tagging-to-McNary survival). In later years most ponds were equipped with PIT-tag detectors, and survival was parsed into two components, pre-release survival and release-to-McNary survival.

3 There were some brood years in which a third brood source was used; however the third source was not used at all of those sites used for the primary hatchery source and are not included in this presentation, although they were discussed in the annual report for the release year in which they used.

4 Significant refers to a difference in brood-source survival estimates is significantly different from 0 at the 5% level (probability = 0.05 of incorrectly concluding that there is a difference between the estimated survivals when there is no real difference in the population survivals).

Smolt Survival and Time of McNary Passage

The discussion of the 2006 through 2008 survival comparisons between the Yakima-return and Eagle Creek brood-stock sources will be the focus of subsequent sections in this report. The relative survival of the two groups in 2008 was the same as those in the previous years of the release from these two brood-stock sources. There was no significant difference between the two stocks from the time of pre-release tagging to McNary smolt passage; however, Eagle Creek had a significantly higher pre-release survival than the Yakima stock, but, conversely, the Yakima stock had a significantly higher survival from the time of release to McNary passage.

The Eagle Creek versus Yakima return brood-stock comparisons for these three survival estimates are summarized below:

> The first comparison, which is based on all PIT-tags detected at McNary, is the brood-source difference between **tagging-to-McNary** mean survivals, and this difference was not significantly different than 0.
>
> The second comparison, which is based on an expanded proportion of the release's tagged fish that are detected at the acclimation site, is the brood source difference between **pre-release** mean survivals and is significantly different than 0 with Eagle Creek source having a higher pre-release survival.
>
> The third comparison, which is based on McNary detection of tags previously detected exiting rearing ponds, is the brood-source difference between **release-to-McNary** mean survivals and is significantly different than 0 with the Yakima-return brood source having a higher survival.

These survivals are detailed in the following sections and associated tables and figures.

Tagging-to-McNary Survival

There was no significant difference in release-year 2006 through 2008 tagging-to-McNary smolt-to-smolt survivals between the Eagle Creek and the Yakima-return brood sources (P = 0.60, Appendix Table A.1.). The survival means and their graph are respectively presented in Table 1. for all ponds in each year, and Figure 1 presents the survivals pooled over ponds into sub-basin summaries for each year. Seven pond comparisons had higher Yakima-brood survivals and four had higher Eagle-Creek brood survivals. The method of tagging-to-McNary survival estimation is presented in Appendix B along with individual site survival estimates.

There was inconsistency between the tagging-to-McNary and release-to-McNary survivals in terms of the significance of the difference between the brood sources that can be explained by partitioning the survival into pre-release and release-to-McNary components.

Pre-release Survival

Pre-release survival was the proportion of tagged fish detected at the acclimation sight divided by the rearing-pond detection efficiency for each tag group (detailed in Appendix B.). The pre-release survival from the Eagle Creek brood-stock was significantly higher than that for Yakima-return brood-stock (P = 0.0008, Appendix Table A.2.). Eight of ten pond comparisons demonstrated a higher pre-release survival of the Eagle Creek stock. The pre-release survival means and their graph are respectively presented in Table 2. for all ponds in each year, and Figure 2 presents the survivals pooled over ponds into sub-basin summaries for each year.

Release-to-McNary Survival

Unlike pre-release survival, the survival from detection at time of volitional release from acclimation sites to McNary passage was significantly lower for Eagle Creek brood source than for the Yakima-return brood source (P = 0.0012, Appendix Table A.3.). All ten comparisons demonstrated a higher release-to-McNary survival for Yakima-stock smolt detected leaving the ponds. The survival means and their graph are respectively presented in Table 3. for all ponds in each year, and Figure 3. presents the survivals pooled over ponds into sub-basin summaries for each year. The method of release-to-McNary survival estimation is presented in Appendix B along with individual site survival estimates.

The combined effects of the significantly higher pre-release survival and the significantly lower release-to-McNary survival of the Eagle Creek brood-stock probably contributed to the failure to detect a significant difference between the two brood sources' tagging-to-McNary survival which is a combination of pre-release and release-to-McNary survivals.

Mean Detection Date at McNary

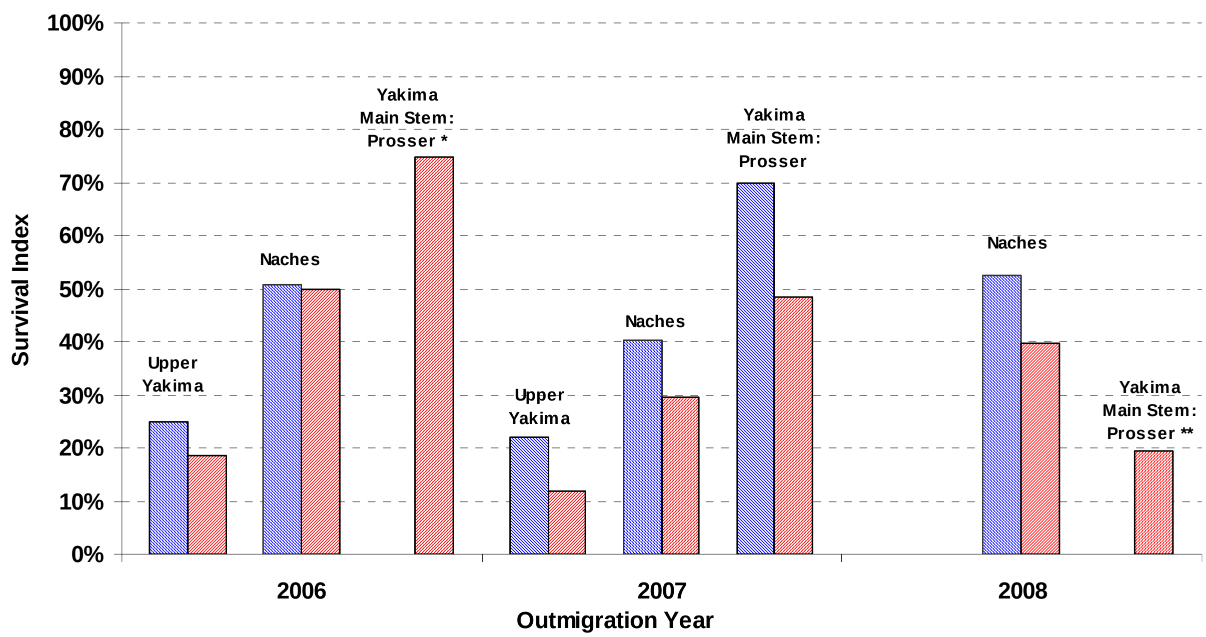
One possible reason for the higher survival from release of the Yakima stock is the significantly earlier McNary Passage date (P = 0.036). This measure was made for all ponds with PIT-tagged fish, whether or not there was a PIT-tag detector to enumerate the fish leaving the pond. Eight of the eleven ponds demonstrated earlier McNary detection dates for the Yakima stock; one of the eleven had equal mean dates of detection. The mean detection dates and their graph are respectively presented in Table 3 for all ponds in each year, and Figure 3. presents the mean detection dates pooled over ponds into sub-basin summaries for each year.

Note: Tables and Figures 1 though 4 present release years, the brood year is two years earlier than the release year.

Table 1. 2006-2008 Coho Tagging-to-McNary Smolt-to-Smolt Survival

			Release Site - Sub-basin and Pond within Sub-basin						
			Upper Yakima			Naches			Main Stem Yakima
Release Year	Stock	Measure	Holmes	Boone	Pooled	Stiles	Lost Creek	Pooled	Prosser
2006	**Yakima**	**Survival to McNary**	**12.48%**	**3.69%**	**8.10%**	**34.99%**	**34.76%**	**34.87%**	
		Number Tagged	2512	2501	5013	2490	2491	4981	0
	Eagle Creek	**Survival to McNary**	**11.82%**	**2.57%**	**7.21%**	**35.05%**	**43.81%**	**39.44%**	**60.52%**
		Number Tagged	2514	2500	5014	2506	2515	5021	1231
	Pooled over Stock	**Survival to McNary**	**12.15%**	**3.13%**	**7.65%**	**35.02%**	**39.31%**	**37.17%**	**60.52%**
		Number Tagged	5026	5001	10027	4996	5006	10002	1231
2007	**Yakima**	**Survival to McNary**	**10.77%**		**10.77%**	**25.65%**	**23.94%**	**24.79%**	**59.84%**
		Number Tagged	2460	0	2460	2449	2501	4950	2499
	Eagle Creek	**Survival to McNary**	**7.08%**		**7.08%**	**32.07%**	**17.39%**	**24.73%**	**44.30%**
		Number Tagged	2504	0	2504	2513	2511	5024	1246
	Pooled over Stock	**Survival to McNary**	**8.91%**		**8.91%**	**28.90%**	**20.66%**	**24.76%**	**54.67%**
		Number Tagged	4964	0	4964	4962	5012	9974	3745
2008	**Yakima**	**Survival to McNary**	**11.17%**		**11.17%**	**46.59%**	**28.58%**	**37.57%**	
		Number Tagged	2493	0	2493	2492	2499	4991	0
	Eagle Creek	**Survival to McNary**	**13.89%**		**13.89%**	**43.08%**	**26.76%**	**34.81%**	**20.13%**
		Number Tagged	2508	0	2508	2453	2524	4977	0
	Pooled over Stock	**Survival to McNary**	**12.53%**		**12.53%**	**44.85%**	**27.67%**	**36.19%**	**20.13%**
		Number Tagged	5001	0	5001	4945	5023	9968	0

Figure 1. 2006-2008 Coho Tagging-to-McNary Smolt Survival (Downward Slant – Yakima Brood-Stock, Upward Slant - Hatchery Brood-Stock)



* Outmigration Year 2006, Only Eagle Creek Stock released at Prosser

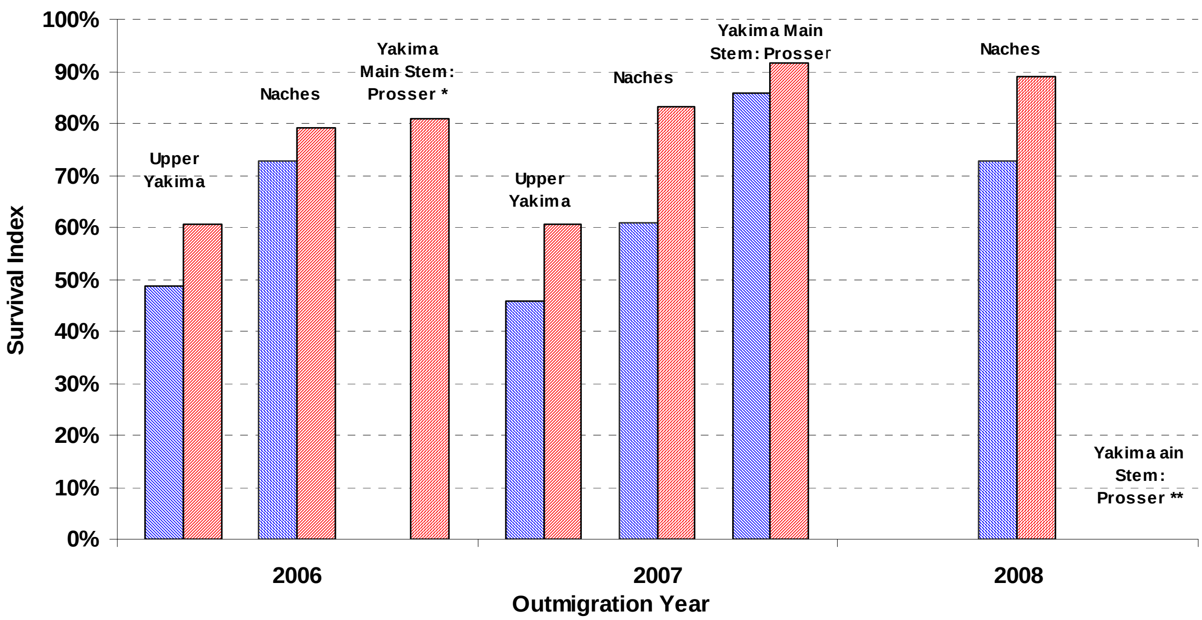
** Outmigration Year 2008, Only Eagle Creek Stock released at Prosser.

Table 2. Coho Pre-Release Survival

Release Year	Stock	Measure	Release Site - Sub-basin and Pond within Sub-basin: Upper Yakima – Holmes	Upper Yakima – Boone	Upper Yakima – Pooled	Naches – Stiles	Naches – Lost Creek	Naches – Pooled	Main Stem Yakima – Prosser
2006	Yakima	Pre-Release Survival	48.69%		48.69%	91.75%	53.84%	72.79%	
		Number Tagged	2512	*	2512	2490	2491	4981	0
	Eagle Creek	Pre-Release Survival	60.50%		60.50%	88.55%	69.56%	79.04%	80.82%
		Number Tagged	2514	*	2514	2506	2515	5021	1231
	Pooled over Stock	Pre-Release Survival	54.60%		54.60%	90.14%	61.74%	75.93%	
		Number Tagged	5026	*	5026	4996	5006	10002	1231
2007	Yakima	Pre-Release Survival	45.83%		45.83%	54.95%	66.81%	60.95%	85.88%
		Number Tagged	2460	0	2460	2449	2501	4950	2499
	Eagle Creek	Pre-Release Survival	60.70%		60.70%	82.54%	84.13%	83.33%	91.67%
		Number Tagged	2504	0	2504	2513	2511	5024	1246
	Pooled over Stock	Pre-Release Survival	53.33%		53.33%	68.92%	75.49%	72.22%	87.81%
		Number Tagged	4964	0	4964	4962	5012	9974	3745
2008	Yakima	Pre-Release Survival				71.96%	73.70%	72.83%	
		Number Tagged	*	0	0	2492	2499	4991	0
	Eagle Creek	Pre-Release Survival				86.02%	91.91%	89.01%	
		Number Tagged	*	0	0	2453	2524	4977	854
	Pooled over Stock	Pre-Release Survival				78.93%	82.85%	80.91%	
		Number Tagged	*	0	0	4945	5023	9968	854

* Fish tagged, but no functional PIT-tag detector at acclimation site

Figure 2. Coho Pre-Release Smolt Survival (Downward Slant – Yakima Brood-Stock, Upward Slant - Hatchery Brood-Stock)



* Outmigration Year 2006, Only Eagle Creek Stock released at Prosser
** Outmigration Year 2008, Only Eagle Creek Stock released at Prosser but required detections were to small for reliable estimate

Table 3. Coho Release-to-McNary Smolt-Smolt Survival

Release Year	Stock	Measure	Release Site - Sub-basin and Pond within Sub-basin: Upper Yakima: Holmes	Upper Yakima: Boone	Upper Yakima: Pooled	Naches: Stiles	Naches: Lost Creek	Naches: Pooled	Main Stem Yakima: Prosser
2006	Yakima	**Survival to McNary**	**25.01%**		**25.01%**	**39.15%**	**68.02%**	**50.64%**	
		Number Volitionally Released	781	*	781	1598	1057	2655	0
	Eagle Creek	**Survival to McNary**	**18.62%**		**18.62%**	**38.81%**	**62.66%**	**49.72%**	**74.78%**
		Number Volitionally Released	636	*	636	1974	1663	3637	912
	Pooled over Stock	**Survival to McNary**	**22.14%**		**22.14%**	**38.96%**	**64.74%**	**50.11%**	**74.78%**
		Volitionally Released	1417	*	1417	3572	2720	6292	912
2007	Yakima	**Survival to McNary**	**22.01%**		**22.01%**	**46.76%**	**35.83%**	**40.41%**	**69.75%**
		Number Volitionally Released	920	0	920	1204	1671	2875	2112
	Eagle Creek	**Survival to McNary**	**12.02%**		**12.02%**	**39.39%**	**20.68%**	**29.53%**	**48.35%**
		Number Volitionally Released	1293	0	1293	1881	2092	3973	1136
	Pooled over Stock	**Survival to McNary**	**16.17%**		**16.17%**	**42.27%**	**27.41%**	**34.10%**	**62.26%**
		Volitionally Released	2213	0	2213	3085	3763	6848	3248
2008	Yakima	**Survival to McNary**				**64.75%**	**39.25%**	**52.37%**	
		Number Volitionally Released	*	0	0	1731	1633	3364	0
	Eagle Creek	**Survival to McNary**				**50.09%**	**28.37%**	**39.64%**	**5.53%**
		Number Volitionally Released	*	0	0	2110	1956	4066	507
	Pooled over Stock	**Survival to McNary**				**56.69%**	**33.32%**	**45.40%**	**5.53%**
		Volitionally Released	*	0	0	3841	3589	7430	507

* Fish tagged, but no functional PIT-tag detector at acclimation site

Figure 3. Coho Release-to-McNary Smolt Survival (Downward Slant – Yakima Brood-Stock, Upward Slant - Hatchery Brood-Stock)

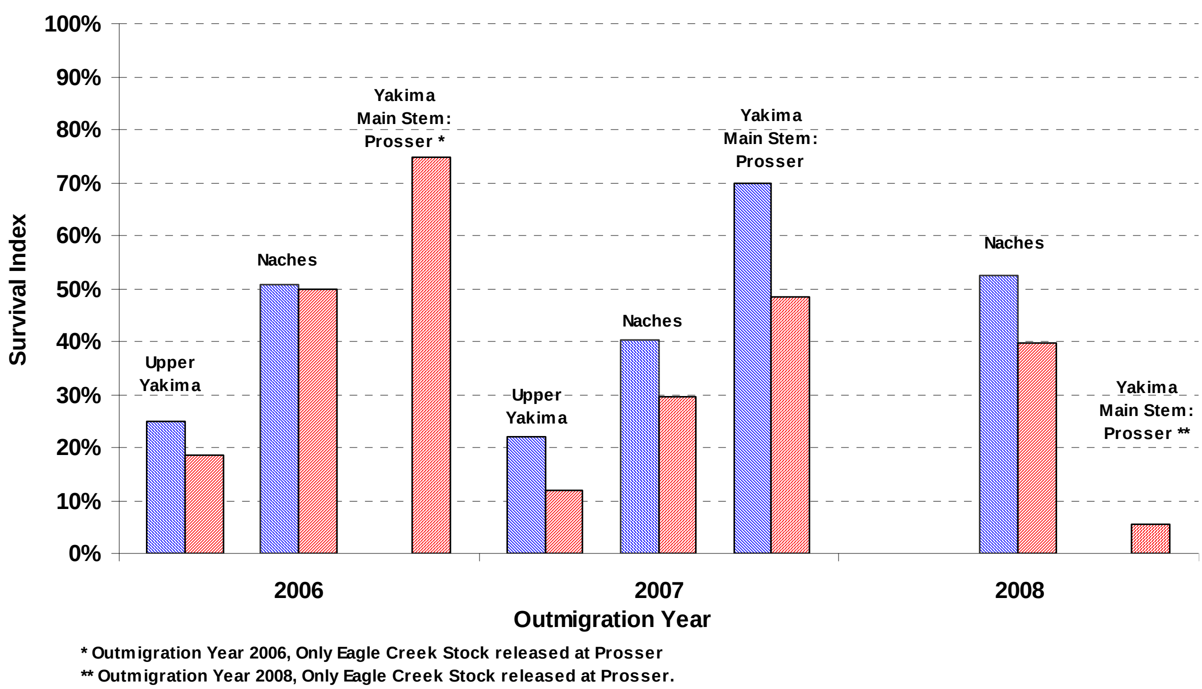
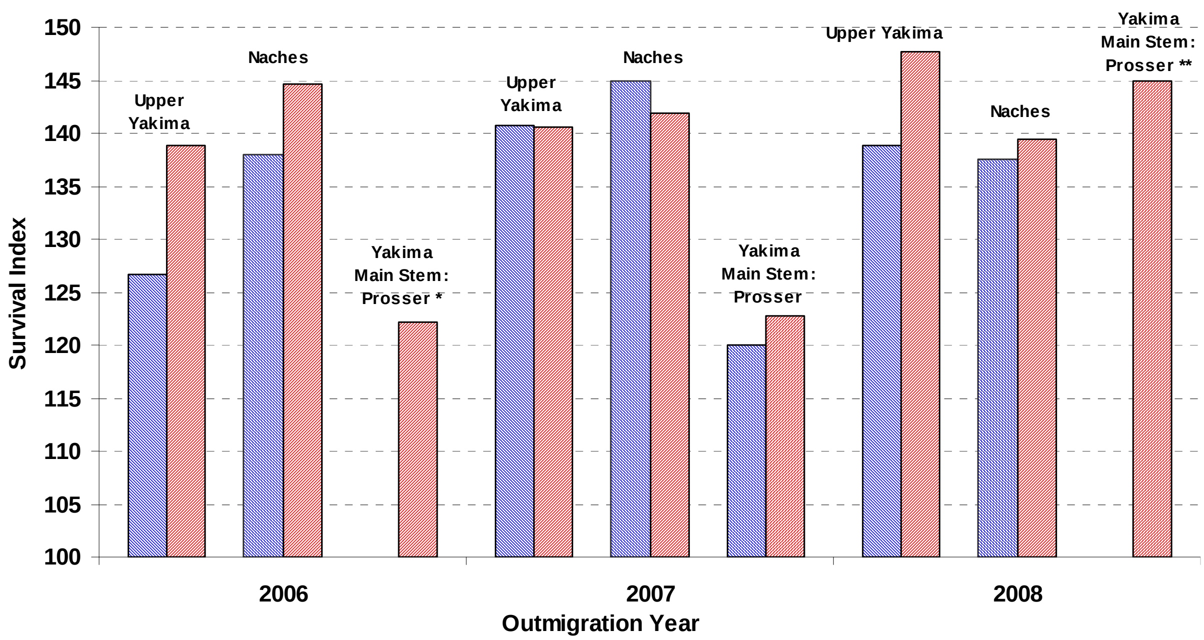


Table 4. Coho Smolt Mean Julian Passage-Date at McNary Dam

Release Year	Stock	Measure	Upper Yakima: Holmes	Upper Yakima: Boone	Upper Yakima: Pooled	Naches: Stiles	Naches: Lost Creek	Naches: Pooled	Main Stem Yakima: Prosser
2006	Yakima	Julian Detection Date	125	133	127	132	144	138	
		Number Passing McNary	314	92	406	871	866	1737	
	Eagle Creek	Julian Detection Date	138	145	139	138	150	145	122
		Number Passing McNary	297	64	362	878	1102	1980	745
	Pooled over Stock	Julian Detection Date	131	138	132	135	147	142	122
		Number Passing McNary	611	157	767	1750	1968	3717	745
2007	Yakima	Julian Detection Date	141		141	137	153	145	120
		Number Passing McNary	265		265	628	599	1227	1496
	Eagle Creek	Julian Detection Date	141		141	138	148	142	123
		Number Passing McNary	177		177	806	437	1243	552
	Pooled over Stock	Julian Detection Date	141		141	138	151	143	123
		Number Passing McNary	442		442	1434	1035	2470	552
2008	Yakima	Julian Detection Date	139		139	135	142	138	
		Number Passing McNary	278		278	1161	714	1875	
	Eagle Creek	Julian Detection Date	148		148	133	149	139	145
		Number Passing McNary	348		348	1057	676	1732	172
	Pooled over Stock	Julian Detection Date	144		144	134	145	138	145
		Number Passing McNary	627		627	2218	1390	3608	172

Figure 4. Coho Smolt Mean Julian Passage-Date at McNary Dam (Downward Slant – Yakima Brood-Stock, Upward Slant - Hatchery Brood-Stock)



* Outmigration Year 2006, Only Eagle Creek Stock released at Prosser
* Outmigration Year 2008, Only Eagle Creek Stock released at Prosser but Pond Detections were too few for meaningful

Parr Survival

Parr releases have been made in recent years. These did not involve statistical comparisons. Tagging-to-McNary survivals are presented in Table 5. There were no estimates of pre-release or release-to-McNary survival. (Note parr are released one year before Outmigration year).

2008 Outmigrants

File	DTL07193.CWY	DTL07192.NLY	DTL07193.LTY	DTL07194.WLY	DTL07197.RCY	DTL07197.BNY	DTL07194.BGY
Release Site	RELEASED INTO COWICHE CREEK	RELEASED INTO NILE CREEK	RELEASED INTO N FK LITTLE NACHES	RELEASED INTO WILSON CREEK	PARR RELEASE INTO REECER CREEK	RELEASED FROM BOONE POND	RELEASED INTO BIG CREEK
Release Date	07/27/07	07/27/07	07/27/07	07/27/07	07/27/07	07/27/07	07/27/07
Number Tagged	3001	3000	3001	3000	3001	2519	3001
McNary Survival	29.40%	17.69%	13.58%	10.28%	30.94%	2.91%	12.90%
McNary Detection Date (Julian)	153	155	157	138	136	149	150

2007 Outmigrants

File	DTL06193.UCE	DTL06193.NSP	DTL06193.LCK	DTL06193.BUB	DTL06193.HLM	DTL06193.HSP	DTL06193.HSR	R
Release Site	RELEASED IN CLE ELUM R AT LK TUCQUALA	RELEASED IN BUCKSKIN SLOUGH	RELEASED FROM LOST CREEK POND	RELEASED INTO BUMPING LAKE	RELEASED FROM HOLMES POND	RELEASED FROM HANSON PONDS	RELEASED IN YAKIMA RIVER AT HANSON	RELEASED IN YAKIMA RIVER AT
Release Date	07/27/06	07/27/06	07/27/06	07/27/06	07/27/06	07/27/06	07/27/06	08/22/06
Number Tagged	2998	1026	1026	3002	1025	1026	1026	23
McNary Survival	1.22%	8.16%	25.25%	11.83%	7.48%	16.94%	8.13%	0.00%
McNary Detection Date	162	122	148	159	141	144	144	0

2006 Outmigrants

File	DTL05193.BNW	DTL05192.HMW	DTL05193.HPW	DTL05193.HRW	DTL05192.LCW	DTL05192.UCW	DTL05237.WNR	R
Release Site	RELEASED FROM BOONE POND	RELEASED FROM HOLMES POND	RELEASED FROM HANSON PONDS	RELEASED IN RIVER AT HANSON	RELEASED FROM LOST CREEK PONDS	RELEASED IN UPPER LAKE CLE ELUM	WILD PARR RELEASED IN NACHES RIVER	RELEASED IN YAKIMA RIVER
Release Date	07/26/05	07/26/05	07/26/05	07/26/05	07/26/05	07/26/05	08/30/05	08/31/05
Number Tagged	1026	1024	1006	1009	1022	3004	30	70
McNary Survival	1.70%	3.12%	2.77%	5.13%	28.17%	0.48%	19.30%	0.00%
McNary Detection Date	162	158	150	150	155	169	147	

2005 Outmigrants

File	DTL04194.BNW	DTL04194.HMW	DTL04194.HPY	DTL04194.HRY
Stock	Washougal?	Washougal?	Yakima?	Yakima?
Release Site	RELEASED FROM BOONE POND	RELEASED FROM HOLMES POND	RELEASED FROM HANSON PONDS	RELEASED IN RIVER AT HANSON
Release Date	07/26/04	07/26/04	07/26/04	07/26/04
Number Tagged	2529	2527	994	997
McNary Survival	0.00%	1.45%	10.12%	2.54%
McNary Detection Date		138	142	133

Appendices

A. Weighted[5] Logistic Analyses of Variation of Coho Juvenile Survivals and Analysis of Variance of Mean McNary Date of Detection

A.1. Tagging-to-McNary Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Type 1 Error P
Ponds, Years adjusted for Stock	7596.89	12	633.074	28.91	**0.0000**
Stock adjusted for Ponds, Years	6.28	1	6.280	0.29	0.6040
Stock interactions with Ponds, Years*	219	10	21.900	2.55	

Note: In two years (release-years 2006 and 2008), the Prosser ponds had only Eagle Creek Brood.

A.2. Pre-release Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Type 1 Error P
Ponds, Years adjusted for Stock	3994.74	8	499.343	12.14	**0.0010**
Stock adjusted for Ponds, Years	1138.85	1	1138.850	27.68	**0.0008**
Stock interactions with Ponds, Years*	329.13	8	41.141		

A.3. Release-to-McNary Survival

Source	Deviance (Dev)	Degrees of Freedom (DF)	Mean Deviance (Dev/DF)	F-Ratio	Type 1 Error P
Ponds, Years adjusted for Stock	2810.65	8	351.331	24.66	**0.0001**
Stock adjusted for Ponds, Years	338.56	1	338.560	23.76	**0.0012**
Stock interactions with Ponds, Years*	113.98	8	14.248	1.64	

A.4. Mean McNary Julian Passage Date

Source	Sums of Squares (SS)	Degrees of Freedom (DF)	Mean Square	F-Ratio	Type 1 Error P
Ponds, Years adjusted for Stock	1305642	12	108803	16.89	**0.0000**
Stock adjusted for Ponds, Years	37885	1	37885	5.88	**0.0357**
Stock interactions with Ponds, Years*	64418	10	6442		

Note: In two years (release-years 2006 and 2008), the Prosser ponds had only Eagle Creek Brood.

* Serves as Error Mean Deviance/Square for Denominator in F-Ratios

5 Logistic analysis of variation assumes that survival estimates have an underlying binomial-like distribution with a variance proportional to what would be expected from a binomial. Weights used were the number of fish tagged (for tagging-to-McNary survival and pre-release survival estimates), number of fish detected at acclimation site (for release-to-McNary survival), expanded number of fish detected at McNary Dam (for Mean Julian Date of Detection at McNary).

Appendix B. Estimated Survival Index

Conceptual Computation

The smolt-to-smolt survival to McNary estimation method for Coho involves

6. Identifying time-of-passage strata within which estimated daily McNary detection rates of Coho are reasonably homogeneous. (Daily McNary detection rate is the proportion of all Yakima PIT-tagged Coho passing McNary Dam for each day that fish are detected at McNary)

7. Estimating the McNary detection rate for each stratum

8. Expanding (dividing) the given release's number[6] of detected fish not removed for transportation at McNary by the detection rate within the associated stratum and adjusting for the number removed for transportation[7]

9. Totaling the release's expanded numbers over strata

10. Taking that release's expanded total and dividing it by the appropriate "population number[8]"

The steps given above can be basically summarized in the following equations. (In all of the following equations, the term "detections" is actually the number of detections.)

Equation B.1.

$$\text{Stratum McNary detection rate} = \frac{\text{number of joint detections at McNary and downstream dams within Stratum}}{\text{estimated total number of detections at downstream dams within Stratum}}$$

---

6 Total number of tagged fish detected at McNary within stratum in the case of tagging-to-McNary survival, total number of tagged fish detected at McNary within stratum that were previously detected at acclimation site in case of release-to-McNary survival.

7 Adjustment is given in Equation B.2, but so few (usually none) of the fish detected at McNary were transported in 2006 and 2007 that the adjustment was not made.

8 Total number of tagged fish in the case of tagging-to-McNary survival, total number of tagged fish detected at acclimation site in case of release-to-McNary survival.

Equation B.2.

$$\text{Smolt-to-Smolt Survival to McNary for a given release (Rel)}$$
$$=$$
$$\frac{\sum_{\text{strata}} \text{For Stratum}\left[\frac{\text{(McNary Rel Detections - Rel Detections Removed)}}{\text{Stratum's McNary Detection Rate (Equation B.1)}} + \text{Detections Rel Removed}\right]}{\text{Rel Number of Fish Tagged or Released}}$$

Pre-release survival was estimated using the Equation B.3.

Equation B.3.

$$\text{Pre} - \text{release Survival for a given Release (Rel)} =$$

$$\text{Tagging-to-Release Survival} =$$

$$\frac{\left[\frac{\text{Rel Detections at Acclimation Site}}{\text{Rel Number Tagged}}\right]}{\left[\frac{\text{Total Rel Detections at McNary previously Detected at Acclimation Site}}{\text{Total Rel Detections at McNary}}\right]}$$

The denominator [] in the above equation is a measure of the detection efficiency at the acclimation site for the release in question. Initial estimates for this detection efficiency was based on expanded detection numbers using the detection rate in Equation B.1 as the expansion factor rather than the unexpanded detections; however, there were occasional estimates in which the resulting estimated pre-release survival slightly exceeded 1 (100%). While this also happened using the unexpanded numbers[9], it was even more unusual; therefore the unexpanded numbers were used.

9 This happened for Fall Chinook, not Coho. When this occurred, the pre-release survival was equated to 1 (100%).

Detection Rate Estimates

Estimates for 2006 - 2008 detection rates for Equation B.1 are given Table B.1.

Table B.1. McNary Dam Detection Rates for 2006 - 2008 Coho Releases.

	Julian Date Strata		Bonneville (Bonn.) Based			John Day (J.D. based)			**Pooled over Bonn.and J.D.**		
Year	Beginning	Ending	Total Bonn. Det.	Joint Bonn. McN. Det.	McN. Det. Rate	Total J.D. Det.	Joint J.D. McN. Det.	McN. Det. Rate	**Pooled Total Det.**	**Pooled J.D. Det**	**Pooled McN. Det. Rate**
2006		132	197.4	64.0	0.3242	379.5	107.0	0.2819	**576.9**	**171.0**	**0.2964**
	133	142	72.6	9.0	0.1240	352.6	38.0	0.1078	**425.2**	**47.0**	**0.1105**
	143	148	18.0	7.0	0.3884	112.2	38.0	0.3385	**130.3**	**45.0**	**0.3454**
	149		56.0	11.0	0.1964	277.7	35.0	0.1261	**333.7**	**46.0**	**0.1379**
	Total		344.0	91.0	0.2645	1122.0	218.0	0.1943	**1466.0**	**309.0**	**0.2108**
2007		127	201.9	67.0	0.3319	605.0	221.0	0.3653	**806.9**	**288.0**	**0.3569**
	128	137	233.5	59.0	0.2526	422.8	111.0	0.2625	**656.4**	**170.0**	**0.2590**
	138	149	237.3	41.0	0.1728	320.1	71.0	0.2218	**557.4**	**112.0**	**0.2010**
	150	156	121.4	20.0	0.1647	152.7	26.0	0.1703	**274.1**	**46.0**	**0.1678**
	157		130.9	31.0	0.2367	124.4	32.0	0.2572	**255.4**	**63.0**	**0.2467**
	Total		723.1	151.0	0.2088	1020.0	240.0	0.2353	**1743.1**	**391.0**	**0.2243**
2008		128	49.0	11.0	0.2245	30.4	9.0	0.2964	**79.4**	**20.0**	**0.2520**
	129	138	178.1	21.0	0.1179	157.8	16.0	0.1014	**335.9**	**37.0**	**0.1102**
	139	150	319.4	88.0	0.2755	117.4	21.0	0.1789	**436.7**	**109.0**	**0.2496**
	151	157	315.7	34.0	0.1077	544.0	70.0	0.1287	**859.8**	**104.0**	**0.1210**
	158	162	231.4	39.0	0.1685	663.5	148.0	0.2231	**894.9**	**187.0**	**0.2090**
	158		142.0	17.0	0.1197	34.2	6.0	0.1755	**176.2**	**23.0**	**0.1305**
	Total		1235.7	210.0	0.1699	1547.1	270.0	0.1745	**2782.8**	**480.0**	**0.1725**

In the Table B.1, individual stratum's pooled detection rates, pooled over downstream dams, are the detection rate estimates from Equation B.1. that were applied to the stratum McNary detections for each release in Equation B.2 to produce survival estimates, which are detailed in Table B.2.

Survival Rate Estimates

Within-stratum detection numbers, expanded numbers, and other within-stratum numbers, totals over strata and survival estimates are given for each release in Table B.2.

Table B.2. Detection Numbers and Resulting Survival Indices

g. Tagging-to-McNary 2006 Survival

	Rearing Pond >	Holmes		Boone		Stiles		Lost Creek		Prosser
	Stock >	Yakima	Eagle Creek	Yakima	Eagle Creek	Yakima	Eagle Creek	Yakima	Eagle Creek	Eagle Creek
		HMY	HME	BNY	BNE	STY	STE	LCY	LCE	PRE
Stratum 1	Total	76	28	16	2	126	45	29	1	194
	Removed	0	0	0	0	0	0	0	0	0
	Subtotal	76	28	16	2	126	45	29	1	194
	Expanded Total	256.4	94.5	54.0	6.7	425.1	151.8	97.8	3.4	654.5
Stratum 2	Total	6	16	2	3	45	64	32	19	10
	Removed	0	0	0	0	0	0	0	0	0
	Subtotal	6	16	2	3	45	64	32	19	10
	Expanded Total	54.3	144.7	18.1	27.1	407.1	578.9	289.5	171.9	90.5
Stratum 3	Total	1	5	2	3	11	41	40	57	0
	Removed	0	0	0	0	0	0	0	0	0
	Subtotal	1	5	2	3	11	41	40	57	0
	Expanded Total	2.9	14.5	5.8	8.7	31.8	118.7	115.8	165.0	0.0
Stratum 4	Total	0	6	2	3	1	4	50	105	105
	Removed	0	0	0	0	0	0	0	0	0
	Subtotal	0	6	2	3	1	4	50	105	105
	Expanded Total	0.0	43.5	14.5	21.8	7.3	29.0	362.7	761.6	761.6
	Total over Strata	83	55	22	11	183	154	151	182	204
	Expanded Total over Strata	313.6	297.2	92.4	64.3	871.3	878.5	865.8	1101.9	745.0
	Number Tagged	2512	2514	2501	2500	2490	2506	2491	2515	1231
	Tagging-to-McN Survival	0.1248	0.1182	0.0369	0.0257	0.3499	0.3505	0.3476	0.4381	0.6052

Table B.2. (continued)

b. Volitional Release-to-McNary 2006 Survival (and pre-release survival)

	Rearing Pond >	Holmes		Boone		Stiles		Lost Creek		Prosser
	Stock >	Yakima	Eagle Creek	Yakima	Eagle Creek	Yakima	Eagle Creek	Yakima	Eagle Creek	Eagle Creek
		HMY	HME	BNY	BNE	STY	STE	LCY	LCE	PRE
Stratum 1	Total	49	13			83	38	9	0	178
	Removed	0	0			0	0	0	0	0
	Subtotal	49	13			83	38	9	0	178
	Expanded Total	165.3	43.9			280.0	128.2	30.4	0.0	600.5
Stratum 2	Total	3	6			35	55	29	15	9
	Removed	0	0			0	0	0	0	0
	Subtotal	3	6			35	55	29	15	9
	Expanded Total	27.1	54.3			316.6	497.5	262.3	135.7	81.4
Stratum 3	Total	1	2			10	41	37	55	0
	Removed	0	0			0	0	0	0	0
	Subtotal	1	2			10	41	37	55	0
	Expanded Total	2.9	5.8			28.9	118.7	107.1	159.2	0.0
Stratum 4	Total	0	6			1	4	50	105	105
	Removed	0	0			0	0	0	0	0
	Subtotal	0	6			1	4	50	105	105
	Expanded Total	0.0	43.5			7.3	29.0	362.7	761.6	761.6
	Total over Strata	53	23			128	137	119	173	187
	Expanded Total over Strata	195.3	118.4			625.6	766.2	719.0	1042.0	682.0
	Volitional Release	781	636			1598	1974	1057	1663	912
	Release-to-McN Survival	0.2501	0.1862			0.3915	0.3881	0.6802	0.6266	0.7478
	Pre-Rel Survival*	0.4869	0.6050			0.9175	0.8855	0.5384	0.6956	0.8082

* [(Volitional Releases)/(Number Tagged)]/[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

Table B.3. (continued)

c. Tagging-to-McNary 2007 Survival

	Rearing Pond >	Holmes				Stiles				Lost Creek				Prosser	
	Stock >	Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima	Eagle Creek
	Extender) >	HY1	HY2	HM1	HM3	SY1	SY2	ST1	ST3	LY1	LY2	LC1	LC3	PRY	PRE
Stratum 1	Total	11	5	2	2	6	6	0	1	0	1	0	0	431	148
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	11	5	2	2	6	6	0	1	0	1	0	0	431	148
	Expanded Total	30.8	14.0	5.6	5.6	16.8	16.8	0.0	2.8	0.0	2.8	0.0	0.0	1207.5	414.6
Stratum 2	Total	13	12	15	5	67	22	53	65	5	2	7	4	63	33
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	13	12	15	5	67	22	53	65	5	2	7	4	63	33
	Expanded Total	50.2	46.3	57.9	19.3	258.7	84.9	204.6	251.0	19.3	7.7	27.0	15.4	243.2	127.4
Stratum 3	Total	14	4	5	4	32	10	24	31	7	18	15	22	9	2
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	14	4	5	4	32	10	24	31	7	18	15	22	9	2
	Expanded Total	69.7	19.9	24.9	19.9	159.2	49.8	119.4	154.3	34.8	89.6	74.6	109.5	44.8	10.0
Stratum 4	Total	2	1	3	1	4	1	4	5	25	19	9	14	0	0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	2	1	3	1	4	1	4	5	25	19	9	14	0	0
	Expanded Total	11.9	6.0	17.9	6.0	23.8	6.0	23.8	29.8	148.9	113.2	53.6	83.4	0.0	0.0
Stratum 5	Total	4	0	3	2	2	1	4	1	23	22	6	12	0	0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	4	0	3	2	2	1	4	1	23	22	6	12	0	0
	Expanded Total	16.2	0.0	12.2	8.1	8.1	4.1	16.2	4.1	93.2	89.2	24.3	48.6	0.0	0.0
	Total over Strata	44	22	28	14	111	40	85	103	60	62	37	52	503	183
	Expanded Total over Strata	178.8	86.2	118.4	58.9	466.7	161.5	364.1	441.9	296.3	302.5	179.6	257.0	1495.5	552.0
	Number Tagged	1250	1210	1253	1251	1251	1198	1261	1252	1237	1264	1259	1252	2499	1246
	Tagging-to-McN Survival	0.1430	0.0712	0.0945	0.0471	0.3730	0.1348	0.2887	0.3529	0.2395	0.2393	0.1427	0.2053	0.5984	0.4430
	Pooled Number Tagged		2460		2504		2449		2513		2501		2511		3745
	Pooled Tagging-to_McN Survival		0.1077		0.0708		0.2565		0.3207		0.2394		0.1739		0.5467

Table B.3. (continued)

d. Volitional Release-to-McNary 2007 Survival (and pre-release survival)

	Rearing Pond >	Holmes				Stiles				Lost Creek				Prosser	
	Stock >	Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima	Eagle Creek
	Tagging Group (File Extender) >	HY1	HY2	HM1	HM3	SY1	SY2	ST1	ST3	LY1	LY2	LC1	LC3	PRY	PRE
Stratum 1	Total	8	5	2	1	6	5	0	1	0	1	0	0	423	147
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	8	5	2	1	6	5	0	1	0	1	0	0	423	147
	Expanded Total	22.4	14.0	5.6	2.8	16.8	14.0	0.0	2.8	0.0	2.8	0.0	0.0	1185.1	411.8
Stratum 2	Total	8	12	15	5	59	19	42	63	5	2	7	4	63	33
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	8	12	15	5	59	19	42	63	5	2	7	4	63	33
	Expanded Total	30.9	46.3	57.9	19.3	227.8	73.4	162.2	243.2	19.3	7.7	27.0	15.4	243.2	127.4
Stratum 3	Total	7	4	4	4	29	9	23	29	7	18	15	22	9	2
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	7	4	4	4	29	9	23	29	7	18	15	22	9	2
	Expanded Total	34.8	19.9	19.9	19.9	144.3	44.8	114.5	144.3	34.8	89.6	74.6	109.5	44.8	10.0
Stratum 4	Total	2	1	3	0	4	1	4	5	25	19	9	14	0	0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	2	1	3	0	4	1	4	5	25	19	9	14	0	0
	Expanded Total	11.9	6.0	17.9	0.0	23.8	6.0	23.8	29.8	148.9	113.2	53.6	83.4	0.0	0.0
Stratum 5	Total	4	0	2	1	2	1	4	1	23	22	6	11	0	0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	4	0	2	1	2	1	4	1	23	22	6	11	0	0
	Expanded Total	16.2	0.0	8.1	4.1	8.1	4.1	16.2	4.1	93.2	89.2	24.3	44.6	0.0	0.0
	Total over Strata	29	22	26	11	100	35	73	99	60	62	37	51	495	182
	Expanded Total over Strata	116.3	86.2	109.4	46.1	420.9	142.2	316.7	424.2	296.3	302.5	179.6	252.9	1473.1	549.2
	Volitional Releases	401	519	642	651	919	285	945	936	796	875	1048	1044	2112	1136
	Release-to-McN Survival	0.2899	0.1661	0.1704	0.0708	0.4579	0.4988	0.3351	0.4532	0.3723	0.3457	0.1714	0.2423	0.6975	0.4835
	Pooled Number Released		920		1293		1204		1881		1671		2092		3248
	Pooled Release-to-McN Survival		0.2201		0.1202		0.4676		0.3939		0.3583		0.2068		0.6226
	Pre-Rel Survival*	0.4867	0.4289	0.5518	0.6623	0.8154	0.2719	0.8726	0.7778	0.6435	0.6922	0.8324	0.8502	0.8588	0.9167
	Pre-Rel Survival**		0.4583		0.607		0.5495		0.8254		0.6681		0.8413	0.8588	0.9167

* [(Volitional Releases)/(Number Tagged)]/[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

** Weighted by Number Tagged over Tagging Groups with Site

Table B.3. (continued)

e. Tagging-to-McNary 2008

	Rearing Pond >	Holmes				Stiles				Lost Creek				Prosser	
	Stock >	Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima	Eagle Creek
	Tagging Group (File Extender) >	HY1	HY2	HE1	HE3	SY1	SY3	SE1	SE3	LY1	LY2	LE1	LE3		PE1
Stratum 1	Total	0	0	0	0	2	1	0	0	2	1	0	0		0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0		0
	Subtotal	0	0	0	0	2	1	0	0	2	1	0	0		0
	Expanded Total	0.0	0.0	0.0	0.0	7.9	4.0	0.0	0.0	7.9	4.0	0.0	0.0		0.0
Stratum 2	Total	2	14	0	0	65	51	45	44	19	10	3	4		0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0		0
	Subtotal	2	14	0	0	65	51	45	44	19	10	3	4		0
	Expanded Total	18.2	127.1	0.0	0.0	590.0	463.0	408.5	399.4	172.5	90.8	27.2	36.3		0.0
Stratum 3	Total	4	21	21	36	12	12	27	31	45	24	37	44		41
	Removed	0	0	0	0	0	0	0	0	0	0	0	0		0
	Subtotal	4	21	21	36	12	12	27	31	45	24	37	44		41
	Expanded Total	16.0	84.1	84.1	144.2	48.1	48.1	108.2	124.2	180.3	96.2	148.2	176.3		164.3
Stratum 4	Total	1	3	9	4	0	0	0	2	7	10	13	11		0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0		0
	Subtotal	1	3	9	4	0	0	0	2	7	10	13	11		0
	Expanded Total	8.3	24.8	74.4	33.1	0.0	0.0	0.0	16.5	57.9	82.7	107.5	90.9		0.0
Stratum 5	Total	0	0	1	0	0	0	0	0	1	2	4	5		0
	Removed	0	0	0	0	0	0	0	0	0	0	0	0		0
	Subtotal	0	0	1	0	0	0	0	0	1	2	4	5		0
	Expanded Total	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	4.8	9.6	19.1	23.9		0.0
		0	0	1	0	0	0	0	0	0	1	3	3		1
	Total over Strata	7	38	32	40	79	64	72	77	74	48	60	67		42
	Expanded Total over Strata	42.4	236.0	171.0	177.3	646.1	515.0	516.7	540.2	423.4	290.8	325.1	350.4		171.9
	Number Tagged	1244	1249	1253	1255	1247	1245	1235	1218	1249	1250	1252	1272		854
	Tagging-to-McN Survival	0.0341	0.1890	0.1365	0.1413	0.5181	0.4137	0.4184	0.4435	0.3390	0.2326	0.2596	0.2755		0.2013
	McN Detection Date	139.9	138.7	149.5	146.2	135.8	133.2	133.2	133.4	140.7	144.5	149.1	148.8		145.0
	Release Date	96.4	96.4	96.4	96.4	96.4	96.4	-269.6	96.4	96.4	96.4	96.4	96.4		145.0
	Pooled Number Tagged		2493		2508		2492		2453		2499		2524		
	Pooled Tagging-to-McN Survival		0.1117		0.13887		0.46592		0.43083		0.28578		0.26764		

Table B.3. (continued)

f. Volitional Release-to-McNary 2008 Survival (and pre-release survival)

	Rearing Pond >	Stiles				Lost Creek				Prosser	
	Stock >	Yakima		Eagle Creek		Yakima		Eagle Creek		Yakima	Eagle Creek
	Tagging Group (File Extender) >	SY1	SY3	SE1	SE3	LY1	LY2	LE1	LE3		PE1
Stratum 1	Total	2	0	0	0	0	1	0	0		0
	Removed	0	0	0	0	0	0	0	0		0
	Subtotal	2	0	0	0	0	1	0	0		0
	Expanded Total	7.9	0.0	0.0	0.0	0.0	4.0	0.0	0.0		0.0
Stratum 2	Total	63	49	45	44	19	10	3	3		0
	Removed	0	0	0	0	0	0	0	0		0
	Subtotal	63	49	45	44	19	10	3	3		0
	Expanded Total	571.9	444.8	408.5	399.4	172.5	90.8	27.2	27.2		0.0
Stratum 3	Total	12	12	27	31	39	23	34	41		7
	Removed	0	0	0	0	0	0	0	0		0
	Subtotal	12	12	27	31	39	23	34	41		7
	Expanded Total	48.1	48.1	108.2	124.2	156.3	92.2	136.2	164.3		28.0
Stratum 4	Total	0	0	0	2	5	9	8	9		0
	Removed	0	0	0	0	0	0	0	0		0
	Subtotal	0	0	0	2	5	9	8	9		0
	Expanded Total	0.0	0.0	0.0	16.5	41.3	74.4	66.1	74.4		0.0
Stratum 5	Total	0	0	0	0	0	2	1	5		0
	Removed	0	0	0	0	0	0	0	0		0
	Subtotal	0	0	0	0	0	2	1	5		0
	Expanded Total	0.0	0.0	0.0	0.0	0.0	9.6	4.8	23.9		0.0
	Total over Strata	77	61	72	77	63	45	47	61		7
	Expanded Total over Strata	627.9	492.9	516.7	540.2	370.1	270.9	242.0	312.8		28.0
	Volitional Releases	988	743	1083	1027	926	707	962	994		507
	Release-to-McN Survival	0.6355	0.6634	0.4771	0.5260	0.3996	0.3831	0.2516	0.3147		0.0553
	Pooled Number Released		0.6475		0.5009		0.3925		0.2837		
	Pooled Release-to-McN Survival										
	Total Tagged	1247	1245	1235	1218	1249	1250	1252	1272		854
	Pre-Rel Survival*	0.8129	0.6261	0.8769	0.8432	0.8708	0.6033	0.9809	0.8583		3.5621
	Pre-Rel Survival**		0.7196		0.8602		0.7370		0.9191		3.5621

* [(Volitional Releases)/(Number Tagged)]/[(Total Released detected at McNary)/(Total Tagged detected at McNary)]

** Weighted by Number Tagged over Tagging Groups with Site

Appendix G

Monitoring and Evaluation of Avian Predation on Juvenile Salmonids on the Yakima River, Washington

Annual Report 2008

Michael Porter
Biologist

Sara Sohappy
Technician

David E. Fast
Research Manager

Yakima Klickitat Fisheries Project
Yakama Nation Fisheries Program
Confederated Tribes and Bands of the Yakama Nation
151 Fort Road, Toppenish, WA 98948

Prepared for:
U.S. Department of Energy, Bonneville Power Administration
Environment, Fish & Wildlife
P.O. Box 3621
Portland, OR 97208

July 2009

Contents

LIST OF TABLES

LIST OF FIGURES

Appendices

EXECUTIVE SUMMARY

Gull numbers remain low in the Yakima River Basin and the focus of future studies has shifted towards; Pelican numbers and diet, management of extreme numbers of piscivorous birds in given areas, and surveys of PIT tags where mortality can be linked to predation.

Mergansers on their breeding grounds in the upper and middle Yakima River have not shown a numeric response to hatchery supplementation of spring Chinook and Coho salmon smolts yet remain a concern as they are known to congregate in large numbers below Roza Dam.

Pelican numbers remain a concern as in previous years. Aerial surveys in 2008 showed that pelican numbers peaked at near 280 birds in the Yakima Basin. Pelican numbers at Chandler were only consistently high after smolt passage was largely complete and flows returned to a forgeable level. High numbers of pelicans in Yakima Canyon in spring appeared to correlate with sucker runs. New data of Pelican diet is presented and Pelican impact on salmon runs will be proposed for a diet and site use study at Chandler.

The Chandler Bypass outfall pipe makes fish of all species vulnerable to predation at low water, as the fish are disoriented and upwelling occurs at right angles to the current. The presence of large dead and disabled fish exiting from the bypass pipe may attract avian predators to the site. PIT tag detection at Chandler outlet pipe did show high mortality for both juvenile and adult salmonids (Appendix K).

PIT tag surveys in 2008 proved very productive as over 4100 tags were discovered in the Yakima Basin. Tags detected were linked to sources of release and 4022 of these tags were from Yakima River juvenile salmonids. Predation by Herons showed correlation with river flow. High flow eliminates opportunity for wading bird foraging in many parts of the river. Conversely low flow creates foraging opportunities for Herons.

PIT tag survey of Toppenish Creek Great Blue Heron rookery showed predation increases when juvenile salmonids have late migration timing.

Plans for the 2009 field season include continued monitoring of river reaches and at hotspots with a focus on Pelican foraging. Heron rookeries and cormorant nesting colonies will continue to be surveyed. PIT tags found at pelican, heron nesting and roosting sites will be used to assign smolt predation estimates to specific bird species.

PIT tag analysis will continue to develop and new sites will be added to surveys. Detection efficiencies will be conducted in 3 diverse rookeries to assess a number of undetected PIT tags.

INTRODUCTION

Note:
For the purposes of this document the phrase "juvenile salmonids" refers to immature fish of the following stocks: Spring Chinook and Fall Chinook (*Oncorhynchus tshawytscha*), Coho (*O. kisutch*), and summer steelhead (*O. mykiss*). Please review the 2005 report for the goals and history of the avian predation project. For a more detailed description of previous years' results and the statistical methods involved in this monitoring effort please refer to this project's previous annual reports located on the Yakima Klickitat Fisheries Project's website, www.ykfp.org or the Bonneville Power Administration's fish and wildlife technical publications and draft reports website, http://www.efw.bpa.gov/IntegratedFWP/reportcenter.aspx.

Avian Predation of Juvenile Salmon

Bird predation of juvenile salmonids is common throughout the Columbia River Basin, which supports some of the highest populations of piscivorous birds in North America and Europe (Ruggerone 1986; Roby et al. 1998). Many piscivorous birds within this basin are colonial nesters, including Ring-billed and California Gulls, Caspian and Forster's Terns, Double-crested Cormorants, Great Blue Herons, Black-crowned Night-herons, Great Egrets and American White Pelicans (See table 1 for Latin names). Colonial nesters are particularly suited to the exploitation of prey fish with fluctuating densities (Alcock 1968; Ward and Zahavi 1996). Prey fish density fluctuations can result from large migratory accumulations, releases from hatcheries, physical obstructions that concentrate or disorient fish, and other features and events which occur in complex river systems. Table 1 includes surveys piscivorous birds and acronyms they are referred to in this document.

Common Merganser (*Mergus merganser*) COME
American White Pelican (*Pelecanus erythrorhynchos*) AWPE
California Gull (*Larus californicus*) GULL
Ring-billed Gull (*Larus delawarensis*) GULL
Belted Kingfisher (*Ceryle alcyon*) BEKI
Great Blue Heron (*Ardea herodias*) GBHE
Double-crested Cormorant (*Phalacrocorax auritus*) DCCO
Black-crowned Night-Heron (*Nycticorax nycticorax*) BCHE
Forster's Tern (*Sterna forsteri*) FOTE
Great Egret (*Ardea alba*) GREG
Hooded Merganser (*Lophodytes cucullatus*) HOME
Bald Eagle (*Haliaeetus leucocephalus*)
Osprey (*Pandion haliaetus*) OSPR
Caspian Tern (*Sterna caspia*) CATE

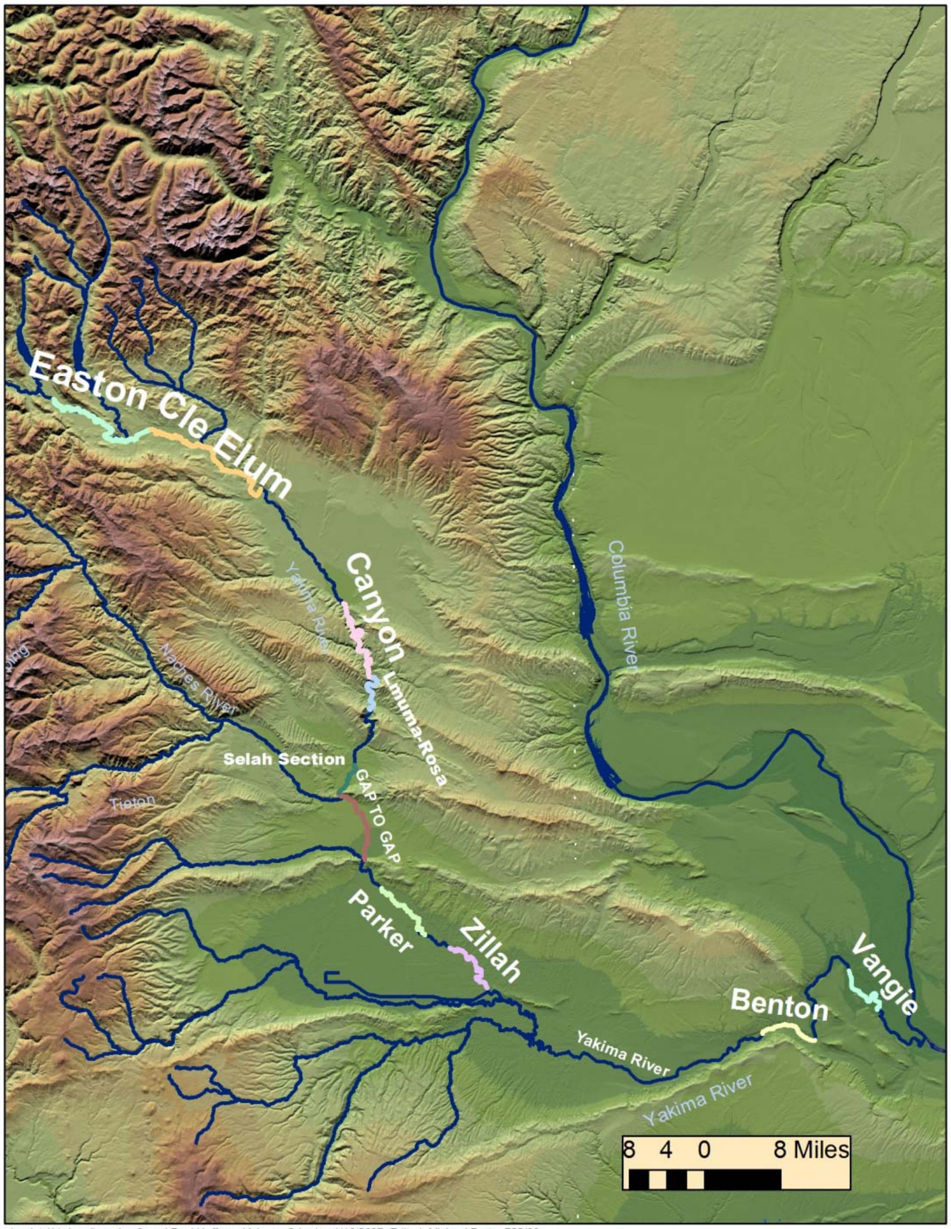
Table 48. Piscivorous birds observed along the Yakama River (note codes for graphs)

Study Area

The Yakima River Basin encompasses a total of 15,900 square kilometers in south-central Washington State. The Yakima River runs along the eastern slopes of the Cascade mountain range for a total length of approximately 330 kilometers (Figures 2). The terrain and habitat varies greatly along its length, which begins at 2,440 meters in elevation at the headwaters and ends at 104 meters elevation at its mouth on the Columbia River near the City of Richland, WA.

The upper reaches of the Yakima River, above the town of Cle Elum, are high gradient areas dominated by mixed conifer forests in association with a high degree of river braiding, log jams and woody debris. Middle reaches from Cle Elum to Selah are areas of intermediate gradient with less braiding and more varied terrain, including mixed hardwoods and conifers proximate to the river channel, frequent canyon type geography, and increasingly frequent arid shrub-steppe and irrigated agricultural lands. The lower reaches of the river, from Selah to the Columbia River, exhibit a low gradient, an infrequently braided river channel, and are dominated by hardwoods proximate to the river channel with some arid steppe and irrigated agricultural lands abutting the shoreline.

In 2008 river surveys included sections of the Yakima River near the towns Selah (6.42 km), Parker (18.31), and Yakima near the Greenway (15.85). These sections include areas where piscivorous birds are commonly seen and a section of the river thought to be a high source of mortality of juvenile salmonids. These river sections are included in the updated 2008 river drift map (Figure 1).



c:\avdata\birdpred\reaches3.mxd Paul Huffman Yakama fisheries 4/10/2007. Edited: Michael Porter 725/09

Figure 8. Yakima River Basin with locations of 2008 surveyed reaches

Yakima River Basin with locations of 2008 surveyed reaches.

Developing Studies

Survey of PIT tags in the Yakima Basin: Water Flow effect on Predation Rate

Within the Yakima Basin YKFP is implementing a study to assess the impacts of the Great Blue Heron on anadromous salmonids. Goals of the study are to identify, map, and survey heron rookeries for salmonid PIT Tags. Heron Rookeries have been discovered to contain PIT tags under Nested trees (Sampson and Fast 2000). In 2007 testing with a portable Pit Tag reader was conducted to determine whether surveys of Bird Colonies/Rookeries and gravel bars was possible. Testing found that it was possible for the portable Pit Tag reader to detect defecated pit tags. In 2008 YKFP will began development of survey methods for Pit Tags within Great Blue Heron Colonies.

For over a decade, research and supplementation of the various salmon run has been conducted within the Yakima Basin. Research to assess the survivability and return rates of supplemented salmon using information gathered from Passive Integrated Transponder (PIT Tags) is a designated work task for YKFP. PIT tags are implanted within a low percentage of Hatchery and wild salmon stocks, and were initially uses as a method to determine the returning number of adult salmon. Pit tag readers are strategically placed along salmon migration routes for interrogating outgoing and incoming PIT tagged salmon. Portable Pit Tag readers have been developed to assist in research and hatchery operation. The use of PIT tags for discovering the mortality rate of salmonid smolts will be the focus of this study. Pit tag data for the region is currently managed by the Pacific Marine Fisheries Commissions.

PIT tags contain a variety of information about the fish it is associated with. The type of information included is determined by the biologist and organization the tag was issued to. This information has helped fisheries biologists find the success of PIT tag fish returns as adult spawners and show the overall success of fisheries programs. Examples of some types of information available within PIT tags are; species, run, rear type, length, acclimation site, release, fish groups (tag file id) along with messages and organization info. The Pacific Marine States Fisheries Commission under the data program maintains PTAGIS, "PIT Tag Information System (PTAGIS) is a data collection, distribution, and coordination project. The fundamental purpose of PTAGIS is to monitor the migratory habits of fish in migrating through the federal Columbia River power system dams (FCRPS) by collecting and distributing data via electronic PIT Tags" (PSMFC 2006).

Selah Rookery along interstate 82 will be the focus of the study. The rookery consists of over 30 nests and comprises an area of 12.25 acres (GPS data). PIT tag numbers gained by survey of this rookery will by used in a comparison with flow below Roza Dam. Data gathered from the Bureau of Reclamation (BOR) records of water flow, corresponding to the years of the sampled PIT tags, will be used. 2000-2008 years of flow, between the time period beginning in March and ending in June, will examine water flow in the reach between Roza Dam and ending at the confluence of the Yakima and Naches Rivers. This reach is unique due to its low flow from the Roza Power Plant and irrigation system diversion at Roza Dam.

All rookeries in the Yakima Basin will be surveyed and a nest count along with bird counts will be conducted. If feasible all rookeries will be scanned for PIT tags. Selah rookery along with two other rookeries will be chosen for a future detection efficiency estimate.

Along with rookery survey of PIT tags a survey of Dams/Diversions was conducted in 2008. The initial focus was to identify PIT tags below the Chandler outlet pipe and Prosser hatchery release outlet. As a result of a high number of PIT tags survey in this area a follow survey of the Chandler canal area of fish screens to trash racks was conducted. A high number of PIT tags were observed in this area. Subsequently surveys were expanded to include a number of other dams/diversions along the Yakima River.

American White Pelican in the Mid-Columbia Region

The American White Pelicans (pelican) appeared as a Washington breeder in 1994, when 50 birds nested on Crescent Island in the Columbia River, near Burbank, WA. They are currently listed as a Washington State endangered species. At present, the only breeding site in Washington is on Badger Island on the Columbia River, downstream from the mouth of the Yakima River. The Badger Island colony consists of about 500 breeding pairs. These colonial nesters are known to travel 50-80 km in search of food, so some of the birds observed on the Yakima River could be coming from this colony (Motschenbacher 1984). However, the behavior of the birds at Chandler and other Yakima River sites suggests most of these individuals are non-breeders. Leg bands that were recovered from three pelicans found dead on the lower Yakima Basin in recent years indicated the birds came from British Columbia, eastern Montana, and the Klamath National Wildlife Refuge in Oregon border (Tracy Hames, YNWRP, personal communication). Those findings suggest that Yakima River pelicans are birds dispersing from much of the western breeding range of the species.

In the YKFP study, pelicans were first recorded during hotspot surveys at Chandler in 2000 and during river reach surveys along the lower Yakima River in 2001. Based on the river reach model, pelicans in the lower Yakima River, below the Yakima Canyon to its mouth on the Columbia River, accounted for about half of the total fish biomass depredated by piscivorous birds in the entire Yakima River in spring 2001-2002.

There was a dramatic increase in the number of pelicans found at Chandler Fish Bypass in Prosser between 2002 and 2004 with some leveling off in numbers in 2005. Between the spring and summer of 2002-2005, water levels were low and abundant rocks were exposed giving pelicans numerous sites to rest and launch foraging attempts at disoriented fish exiting from the bypass pipe. Based on the river reach model, pelicans accounted for over 70% of the total fish biomass depredated by piscivorous birds in the entire Yakima River in spring 2004-2005. During the years 2006-2007, spring water levels were high, and pelicans had few sites to rest and feed. Subsequently fewer pelicans were found at Prosser and elsewhere, with a particularly significant drop in 2007. However pelicans still consumed about 64% of the total fish biomass consumed by birds along the entire Yakima River in 2006-2007. Data from 2008 gathered from Chandler Outlet pipe PIT tag surveys (Table 13) confirms juvenile and adult salmon mortality.

Data collected from the previous year's studies have influenced a decision by YKFP biologists to look more closely at Pelican impacts on salmon runs. Study proposal plans will likely focus on Pelican use of Chandler Pipe Outlet with hopes of gaining Pelican diet preference, and their impacts on juvenile salmonids

Common Mergansers

One of the original concerns of YKFP managers focused on whether mergansers and other avian predators are becoming more abundant in response to increases in Yakama Nation hatchery releases of Chinook and Coho salmon in the Yakima River over time. Data from 2004-2008 appears to indicate that mergansers are not showing a numeric response to increases in the numbers of salmon smolts in the Yakima River over time.

The diet analysis of 20 Common Mergansers collected along the middle and lower Yakima River by Phinney et al. (1998) challenges the assumptions of the worst case scenario above. During that study, only in fall/winter did salmonids make up a significant proportion of the prey, 42.2% (comprised of 15.8% Chinook salmon, 21.1% rainbow trout and 5.3% unidentified salmonids). In spring, middle Yakima River mergansers readily consumed sculpin (alone making up 71.9%), while lower river mergansers readily consumed chiselmouth (alone making up 50%). Yakima River mergansers consumed a wide variety of fish species based on their availability.

Based on the river reach model, Common Mergansers consumed an estimated 21.2% of the fish biomass consumed by birds in the entire Yakima River during the spring 2007 period. This is higher than the 11.3 -12.0% estimated consumption by mergansers during spring 2005-2006. Based on past WDFW data, small fish suitable as prey for small avian predators (5-75 g) make up an estimated average of 21.0% of the fish biomass in the entire Yakima River in spring (2.3% salmonids and 18.7% other taxa), although salmon smolt numbers may be under-estimated (WDFW 1997-2001). These three statistics suggest that mergansers consume salmonids and other fish taxa of the appropriate prey size at a proportion that is less than or equal to their availability in the Yakima River.

A conclusion that could be drawn from these varied data sources is that mergansers breeding along the Yakima River eat small fish of a diversity of species based on their local and seasonal availability. It should not be assumed that mergansers eat only juvenile salmonids. Nor can it be assumed that mergansers select salmonids in a greater proportion than their availability out of the entire fish community assemblage.

Previous data along with large numbers of mergansers located below Roza Dam in 2007 prompted a study of diet and management to be proposed to and permitted by the United States Forest and Wildlife Service. The proposed study was not implemented as drop in the numbers of mergansers was seen in 2008. The study permit carries into 2009 and is attached as appendix A.

METHODS

Survey Seasonality

River reach and Hotspot surveys are organized into two specific time frames within which the impacts of bird predation on juvenile salmon were assessed. The first time frame, from April 1 to June 30, “spring”, addressed the impacts of avian predators on juvenile salmon during the spring migration of smolts out of the Yakima River. The second time frame, from July 1 to August 31, “summer”, addressed impacts to Coho and Spring Chinook parr and/or residual Coho and Spring Chinook in the upper reaches of the Yakima River. Dividing the survey dates into these time periods allowed for all future sampling efforts to be accomplished on even numbers of 2-week blocks which best fits the consumption model. These two time frames followed the methodological design set forward in the 1999 annual report (Grassley and Grue 2001) and are referred to within this document as “spring” and “summer”. This report and subsequent analysis is organized into these two generalized time frames in an effort to focus on impacts to particular salmonid life histories. Pit tag surveys occur in the fall and winter after PIT tag deposition, Heron nesting, and water diversion.

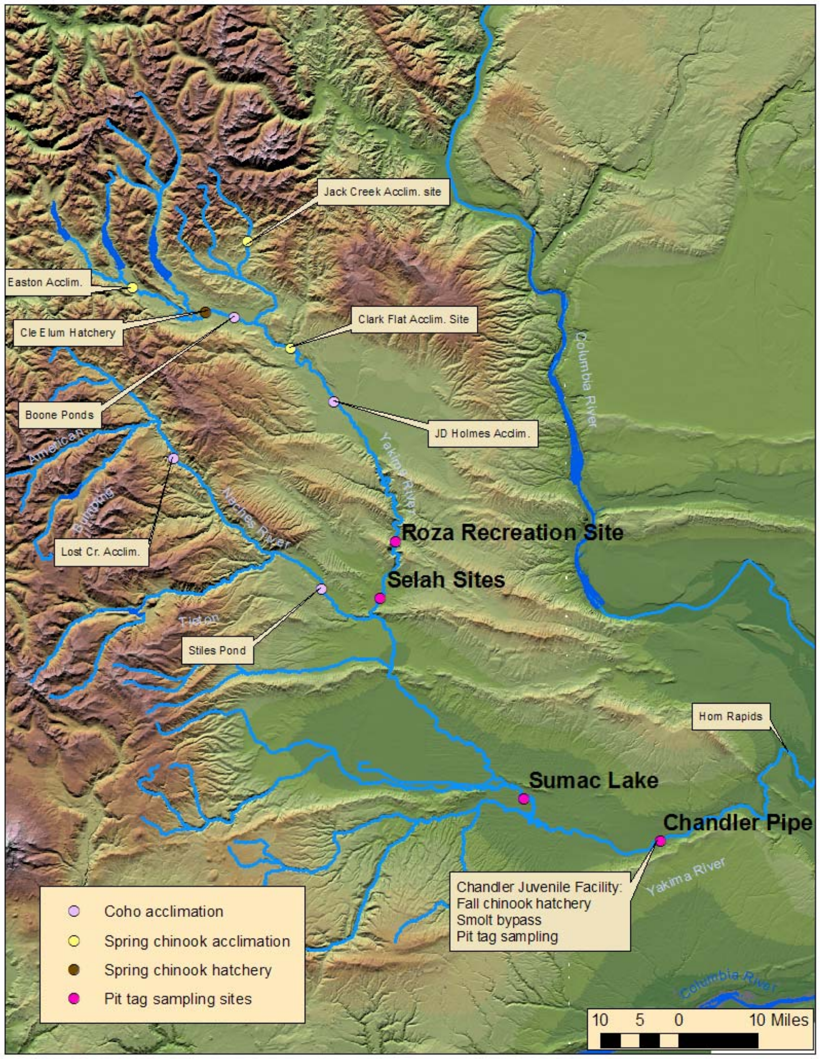
Data Collection Methods

Hotspot Surveys

Study areas are shown in Figure 2, which also includes areas of concern for high concentrations of piscivorous birds. At Chandler Bypass and Wanawish (Horn Rapids) Dam the abundance of gulls, pelicans and other predatory birds was estimated. Horn Rapids seasonal and diurnal patterns of gull abundance at hotspots were identified.

In 2007, 16 hotspot surveys were conducted at Chandler Bypass and 16 at Horn Rapids between April 2 and June 26. Both sites were generally surveyed on the same day at the same time period by different individuals. Leica 10x42 binoculars were used to help monitor bird behavior. The survey area for Chandler included 50 meters of river above the outfall pipe and 150 meters of river below the outfall pipe. All birds resting upon the shoreline lateral to the specified area at both hotspots were included in the abundance counts. The survey area for Horn Rapids included the area 50 meters of river above the dam and 150 meters below the dam. The buoy located above the dam was not included within the survey area; therefore any birds resting upon the buoy were not included in abundance counts. Observations at both sites were made from the shore. At Horn Rapids observations were made from the south bank of the river, either inside or outside an automobile. At Chandler observations were made from a blind just downstream of the outlet pipe from the juvenile fish facility.

The hotspot survey design for 2007 was consistent with methods used since 2001 (Table 2). Observations either began on the nearest 15-minute interval after sunrise and ran for eight hours, or began at midday and ended on the nearest 15-minute interval before sunset. This allowed for observations during all periods of the day, to account for the diurnal patterns of avian piscivores. Regionally calibrated tables obtained from the National Oceanic and Atmospheric Administration was used to determine sunrise and sunset times at Richland, WA. Depending upon the length of the day and the start time, between seven and eight 2-hour windows existed for each day. Each day was divided into 2-hour survey windows, consisting of three 15-minute abundance and feeding blocks. Between each of these three blocks was a 15-minute period of no observation, unless a feeding interval was still being measured, in which case the observation period was extended into the next 15 minutes. This 75-minute cycle of blocks was followed by a 45-minute rest period before a new 2-hour window was begun. Within each 15-minute survey block the abundance of all piscivorous birds was counted. Sometimes survey periods were truncated because no birds were present for 1-2 hours, usually because of high water.



c:\avdata\birdpred\pelicanpoints2.mxd Paul Huffman 4/10/2007

Figure 9 Yakima River Basin with locations of hotspots (Chandler & Horn Rapids), Spring Chinook acclimation sites, and areas of concern of high concentrations of piscivorous birds.

River Reach Surveys

The spring river surveys included nine river reaches (Figure 1, Table 2). All reaches surveyed in both the spring and summers were identical in length and location to those conducted in previous years, with the exception of the middle reach, Canyon, and new lower reaches Gap to Gap, and Selah Section, added in 2008. The entire Canyon from Ellensburg to Roza was surveyed this year in spring before fishermen and boaters disturbed pelicans and other birds in the Lmuma to Roza stretch. Afterward the lower stretch above Roza Recreation Site was avoided. The survey accounts for coverage of approximately 40% of the total length of the Yakima River.

Name	Start	End	Length (km)
Easton	Easton Acclimation Site	Bridge	29.3
Cle Elum	South Cle Elum Bridge	Thorp Hwy Bridge	28.3
Canyon	Ringer Road	Lmuma or Roza Recreation Site	20.8 or 29.8
Selah Section	Harrison Rd Bridge	Harlan Landing Park	6.42
Gap to gap	Harlan Landing Park	Union Gap	15.85
Parker	Below Parker Dam US Hwy 97	Hwy 8 Bridge	20.3
Zillah	US Hwy 97/ Hwy 8 Bridge	Granger Bridge Ave Hwy Bridge	16.0
Benton	Chandler Canal Power Plant	Benton City Bridge	9.6
Vangie	1.6 km above Twin Bridges	Van Giesen St Hwy Bridge	9.3

Table 49. River reach survey starting and end locations, and total length of reach.

All river reach surveys were conducted by a two-person team from a 16 foot drift boat on all reaches except Easton, which was surveyed from a two-person raft. Surveys began between 8:00 am and 9:00 am and lasted between 2 to 6 hours depending upon the length of the reach and the water level. All surveys were conducted while actively rowing the drift boat or raft downstream to decrease the interval of time required to traverse the reach. One person rowed the boat while the other person recorded piscivorous birds encountered.

All birds detected visually or aurally were recorded, including time of observation, species, and sex and age if distinguishable. Leica 10x42 binoculars were used to help observe birds. All piscivorous birds encountered on the river were recorded at the point of initial observation. Most birds observed were only mildly disturbed by the presence of the survey boat and were quickly passed. Navigation of the survey boat to the opposite side of the river away from encountered birds minimized escape behaviors. If the bird attempted to escape from the survey boat by moving down river a note was made that the bird was being pushed. Birds being pushed were usually kept in sight until passed by the survey boat. If the bird being pushed down river moved out of sight of the survey personnel, a note was made, and the next bird of the same species/age/sex to be encountered within the next 1000 meters of river was assumed to be the pushed bird. If a bird of the same species/age/sex was not encountered in the subsequent 1000 meters, the bird was assumed to have departed the river or passed the survey boat without detection, and the next identification of a bird of the same species/age/sex was recorded as a new observation.

Acclimation Site Surveys

Three Spring Chinook acclimation sites in upper Yakima River (Clark Flat, Jack Creek, & Easton) and one Coho site (Holmes) were surveyed for piscivorous birds in 2008 (Figure 2). Surveys were conducted between January 23 and June 10, though dates varied for each site. Three surveys were conducted at the Spring Chinook sites each day, at 8:00 am, 12:00 noon, and 4:00 pm. The Coho site was surveyed once or twice on days hatchery personnel were feeding smolts. Surveys were conducted on foot. All piscivorous birds within the acclimation facility, along the length of the artificial acclimation stream, and 50 meters above and 150 meters below the acclimation stream outlet, into the main stem of the Yakima River or North Fork Teanaway, were recorded.

Pelican Aerial Surveys

Three aerial surveys were conducted to identity the abundance and distribution of pelicans. Surveys area focused along the Yakima River from its confluence with the Columbia River to the city of Ellensburg between May 30 and September 4. Based on aerial surveys conducted on the Yakima River in the past, surveys of the Yakima River were divided into 8 geographic reaches extending from the mouth of the Yakima to the northern part of the Canyon south of Ellensburg. Surveys were conducted in the morning between 0600 – 0730. Surveys lasted approximately three hours.

Salmon PIT Tag Surveys at Great Blue Heron Rookeries and Dams and Diversions

A Passive Integrated Transponder (PIT) tag reader was used to survey for PIT tags deposited in various Yakima River Great Blue Rookeries and Fish Bypass Dams/Diversions in late summer and early fall.

Areas surveyed included: Chandler Fish Bypass/Canal, Wapato Diversion Canal in front and behind Screens, and Wanawish Dam canal right, ; the Great Blue Heron Rookery on the Yakima River in Selah, Toppenish Creek, Buena, Wapato Wildlife area, Grandview, and Satus. Based on the salmon tags found at these sites consumption could be assigned to one or two bird species. For example, the Chandler Bypass has been heavily used by pelicans since 2003 while the Selah Heronry supports herons and sometimes cormorants. Dams and Diversion canals sources of mortality may vary by source, possibly piscivorous fish, structure, avian, and flow.

Pit Tags surveys will be conducted using the *Portable Transceiver System: PTS Model FS2001F-ISO from Biomark.* The transceiver is designed to scan for Pit tags and identify them by their given code. A Garmin GPS unit will be used to navigate and map rookeries along with survey plots or points. Additional equipment will include the use of camouflage to limit disturbance for bird nest identification and counts.

Rookeries were surveyed to determine total rookery numbers and Great Blue Heron population numbers via jet boat, plane, and foot. Rookeries are surveyed in the spring and summer for population numbers using binoculars, rookeries are not entered for fear of causing bird abandonment. Once birds have fledged rookeries are cleared of debris under nests to scan for defecated/regurgitated PIT tags.

Dams/Diversions are scanned for PIT tags during the BOR annual maintenance in November and December.

Selah Rookery was chosen as an area of focus due to high concentrations of PIT tags surveyed in 2008. Methods for a study were developed and fall under these general criteria;

- Identify all Rookeries in the Yakima Basin

- Population surveys during nesting
- Detection efficiencies by seeding PIT Tags
- Clearing PIT Tag deposit areas after fledging
- PIT Tag reading post fledge and after flooding
- PIT Tag removal (Tag collision causes interference)
- Aerial flights and river surveys monitor populations

RESULTS & DISCUSSION

River Reach Surveys

In 2008, 14 different piscivorous bird species were observed on the Yakima River (see Table 1 for English and Latin names and alphabetic codes used in figures). These were the typical species observed in previous years.

The middle river reach, Canyon, exhibited the lowest diversity of bird species and the Zillah and Parker drift in the lower river had the highest. The Great Blue Heron and Common Merganser were the only species found on all seven reaches in the spring. The Parker reach appears to have the highest density of avian predators supporting higher numbers of pelicans, Common Mergansers and Great Blue Herons than any other reach.

Common Mergansers were most abundant in the upper reaches of the river as has been the case in all 9 previous years surveyed, followed by Belted Kingfishers (Figure 3 & 4). In the middle reach, Common Mergansers were the most common species in spring and summer as well (Figure 3 & 4). The species distribution along the lower reaches was more variable: pelicans were the most abundant bird at Parker, mergansers were the most abundant bird at Zillah; and gulls were the most abundant bird at Benton and Vangie (Figure 3 & 4)). The number of pelicans counted during the river reach surveys was significantly reduced from the counts in 2006 and similar to 2007. Caspian Terns, another major fish predator on the Lower Columbia River, were occasionally seen in the lower and middle Yakima, Chandler, Horn Rapids, and the Selah Ponds.

Common Mergansers are of particular importance because of their known utilization of salmon smolts in Europe and North America (White 1957; Wood and Hand 1985) and because as in the previous 9 years, they remain the primary avian predator of the upper Yakima River in both the spring and summer periods. Pelicans are important because of their high populations in the lower river and their high daily dietary requirements.

Double-crested Cormorants, a major fish predator on the Lower Columbia River, were found in increasingly high numbers in the lower river and occasionally in the middle river and seen up in the Easton river reach. Cormorants although only common in the river below the Yakima Canyon are the fourth most significant bird predator of small fish in the entire river and appear to have increased in numbers in the middle river and upper stretches of the lower river the last few years. Cormorants also invaded a Great Blue Heron rookery in the spring, taking over nests and roosting. Figure 5 shows a map of the rookery and nesting cormorants located within the WDFW Sunnyside wildlife area.

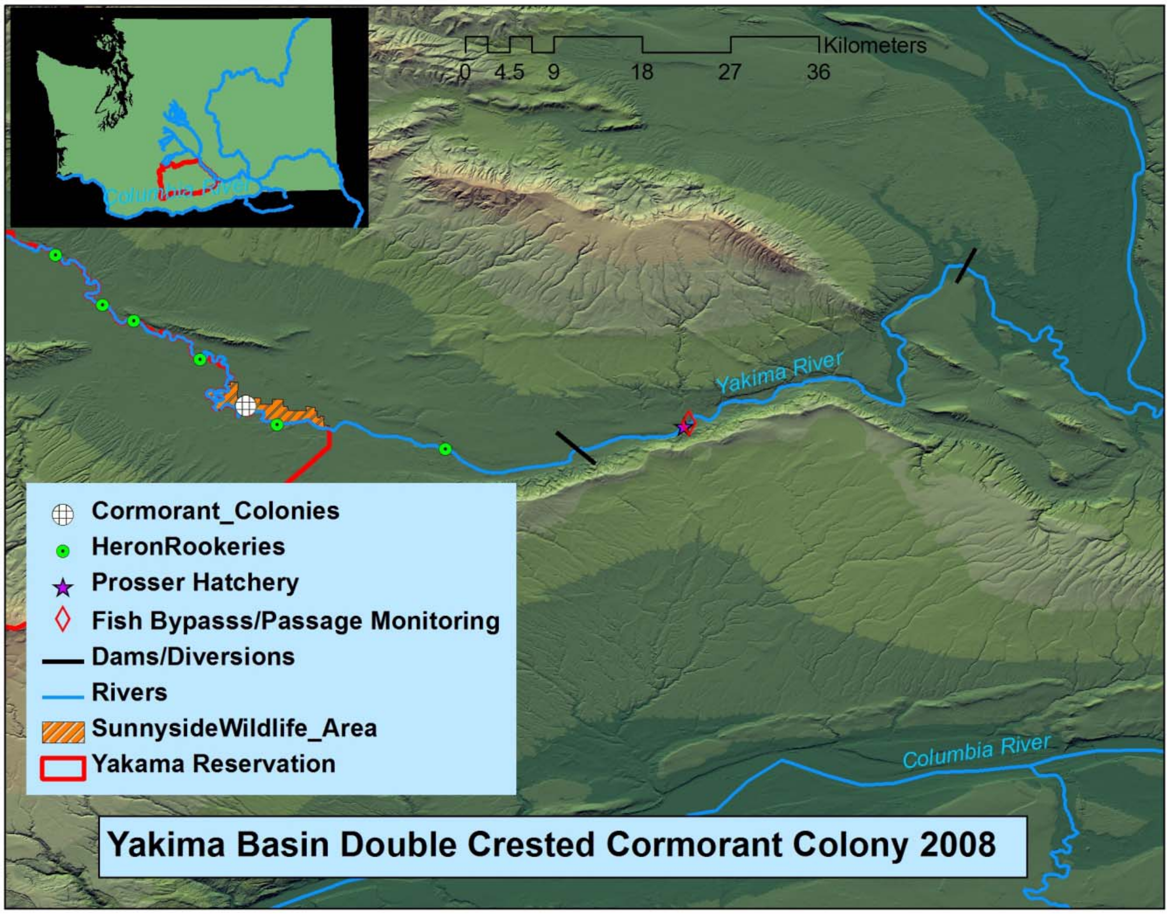


Figure 10. Double Crested Cormorant Colony

Lastly, the Great Blue Heron was the third most common piscivores in the Yakima Basin, previously considered a less significant consumer of smolts because they are known to prey on a wide variety of aquatic and terrestrial species including frogs, crayfish and rodents. New PIT tag studies have shown the Great Blue heron may have a more significant impact to juvenile salmonids than previously believed.

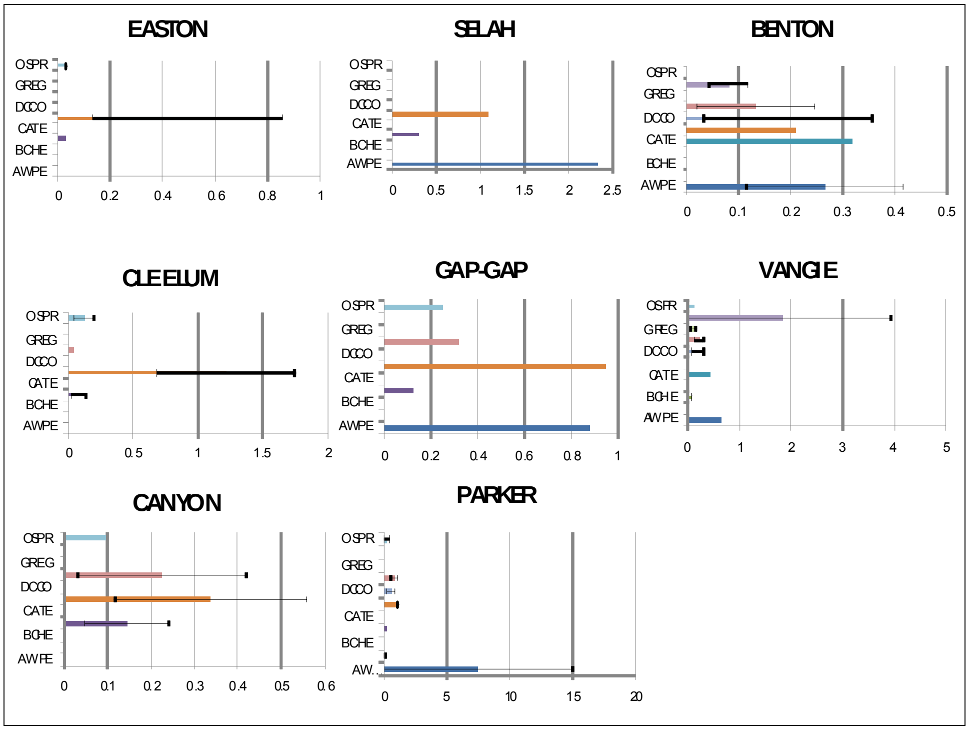


Figure 11. Spring bird abundance graphs

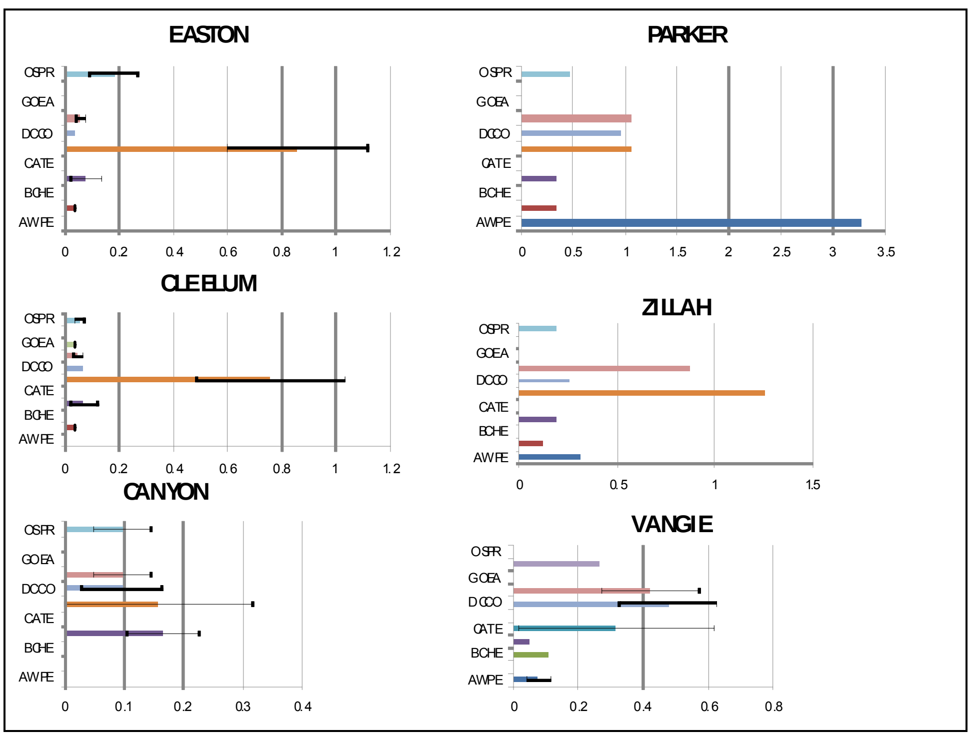


Figure 12. Summer bird abundance graphs

Aundance for all bird species along with standard deviations is given for the spring (Figure 5) and the summer (Figure 6). These bird abundance show pelicans are found in high numbers in the spring in the Yakima from selah to the confluence of the

Columbia River. Pelican numbers are greatly reduced in the summer in this area as nesting at badger island and greater foraging success at hotspots occurs during this time of year.

Total numbers of birds per reach are given by tables 3 & 4. Along the Yakima River and the Yakama reservation boundary it is notable that reaches of Parker and Zillah show the largest amount of piscivorous birds and the number in the reaches significantly increases between April and May.

REACH	REACH LENGTH (KM)	DATE	TOTAL NUMBER BIRDS	TOTAL BIRDS PER KM
BENTON	18.9	4/15/2008	7	0.37037037
BENTON	18.9	5/1/2008	2	0.105820106
BENTON	18.9	6/17/2008	30	1.587301587
CANYON	20.8	4/16/2008	14	0.673076923
CANYON	20.8	5/7/2008	10	0.480769231
CANYON	20.8	5/27/2008	22	1.057692308
CLE ELUM	28.3	4/17/2008	26	0.918727915
CLE ELUM	28.3	5/13/2008	35	1.236749117
CLE ELUM	28.3	6/18/2008	57	2.014134276
EASTON	29.3	4/22/2008	9	0.307167235
EASTON	29.3	5/15/2008	23	0.784982935
GAP-GAP	15.85	4/24/2008	40	2.523659306
PARKER	18.31	4/29/2008	93	5.079191699
PARKER	18.31	6/5/2008	280	15.29219006
SELAH	6.42	4/24/2008	24	3.738317757
VANGIE	18.9	4/15/2008	7	0.37037037
VANGIE	18.9	5/1/2008	73	3.862433862
VANGIE	18.9	6/17/2008	44	2.328042328
ZILLAH	16	5/7/2008	99	6.1875
ZILLAH	16	6/10/2008	241	15.0625

Table 50. Spring total of piscivorous birds per km and section shown by survey date.

REACH	REACH LENGTH (KM)	DATE	TOTAL NUMBER BIRDS	TOTAL BIRDS PER KM
CANYON	20.8	7/16/2008	16	0.769230769
CANYON	20.8	7/23/2008	6	0.288461538
CANYON	20.8	7/30/2008	7	0.336538462
CANYON	20.8	8/5/2008	9	0.432692308
CANYON	20.8	8/13/2008	8	0.384615385
CANYON	20.8	8/19/2008	9	0.432692308
CANYON	20.8	8/28/2008	16	0.769230769
CLE ELUM	28.3	7/15/2008	4	0.141342756
CLE ELUM	28.3	7/22/2008	26	0.918727915
CLE ELUM	28.3	7/29/2008	21	0.74204947
CLE ELUM	28.3	8/5/2008	42	1.48409894
CLE ELUM	28.3	8/12/2008	23	0.812720848
CLE ELUM	28.3	8/20/2008	27	0.954063604
CLE ELUM	28.3	8/25/2008	15	0.530035336
EASTON	29.3	7/14/2008	27	0.921501706
EASTON	29.3	7/21/2008	37	1.262798635
EASTON	29.3	7/31/2008	36	1.228668942
EASTON	29.3	8/4/2008	43	1.467576792
EASTON	29.3	8/11/2008	20	0.682593857
EASTON	29.3	8/21/2008	30	1.023890785
EASTON	29.3	8/27/2008	46	1.56996587
PARKER	18.31	7/1/2008	134	7.318405243
PARKER	18.31	7/23/2008	128	6.990715456
VANGIE	18.9	7/7/2008	41	2.169312169
VANGIE	18.9	8/7/2008	16	0.846560847
ZILLAH	16	7/8/2008	51	3.1875

Table 51. Summer total of piscivorous birds per km and section shown by survey date.

Common Mergansers along River Reaches

Abundance of Common Merganser in 2008 showed the continuing trend of mergansers as the primary piscivorous bird in the upper Yakima River. Figure 7 reflects this pattern and depicts total merganser numbers by reaches in river order.

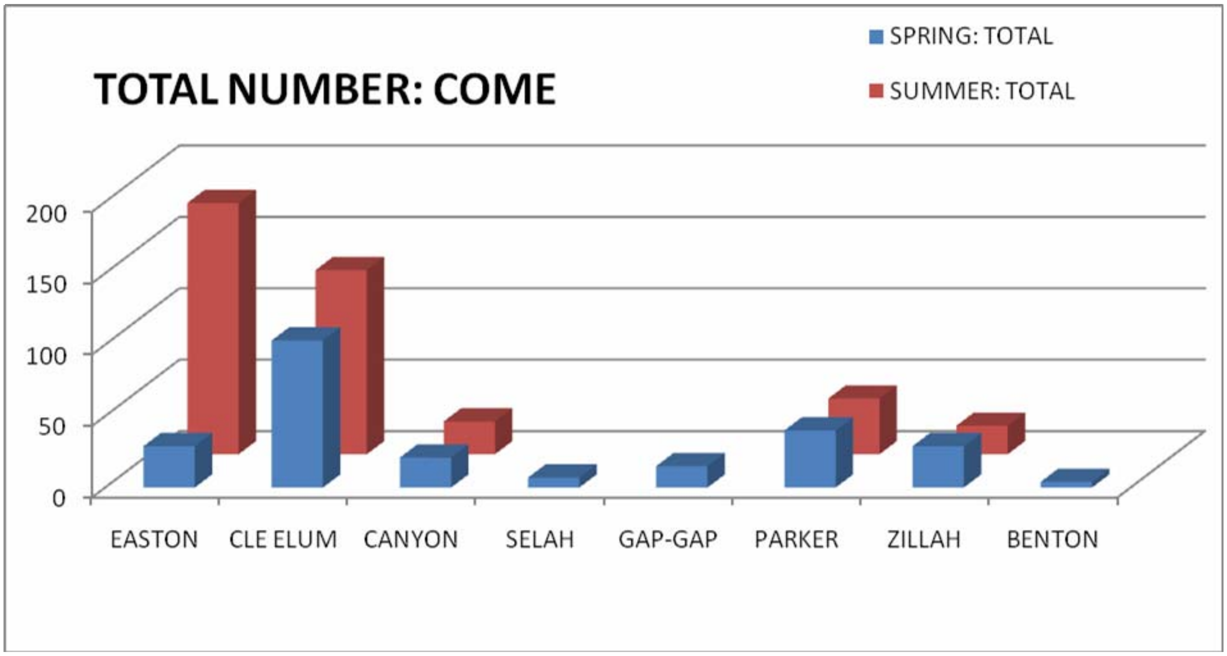


Figure 13. River reaches total number of surveyed COME for spring and summer 2008.

A breeding pair of Common Mergansers

<u>American White Pelicans along River Reaches</u>

Pelicans were the most abundant avian piscivorous in the lower river in spring 2008, as in 2003-2006. Pelicans were common in the lower and middle river in spring.

Pelicans averaged 7 birds/km at Parker and Zillah in the spring, 1.85 birds/km at Parker and 0.40 birds/km in Zillah in the summer (Figures 3 & 4). In 2006, pelicans averaged 2.6 birds/km at Parker, 1.5 birds/km in Zillah, 0.8 birds/km in Vangie and 0.02 birds/km in Benton. The birds per km number may be misleading as Pelicans could total anywhere between 250 to 300 birds on a given day in Parker and Zillah in the Spring while summer numbers drop off dramatically (Figure 7).

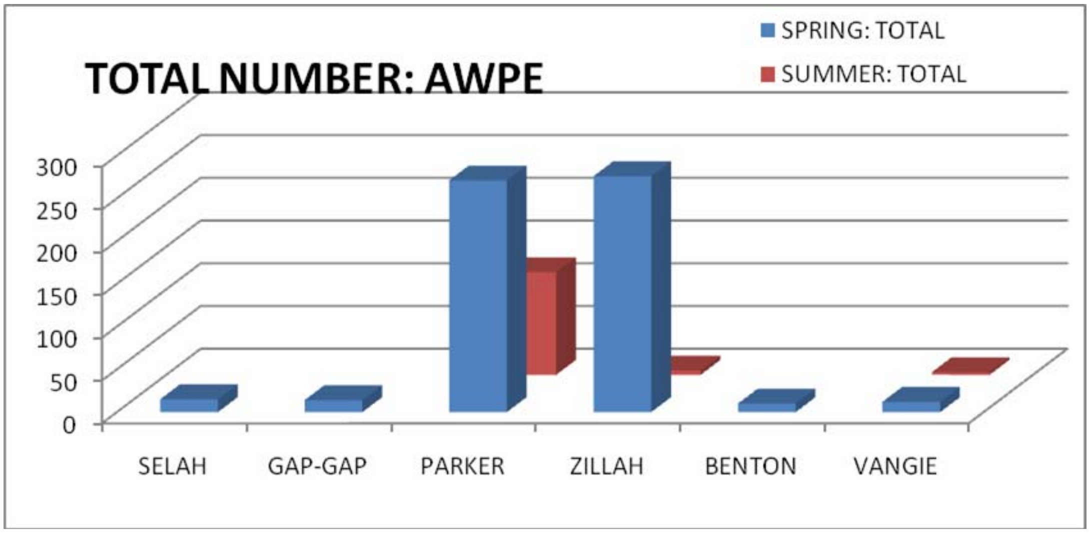


Figure 14. River reaches total number of surveyed American White Pelicans for spring and summer 2008.

Great Blue Heron along River Reaches

On average, the number of Great Blue Herons in the lower river remained low and maintained similar numbers of 2007, when they averaged 0.5 birds/km, similar to the average of 0.8 birds/km in 2006. Heron numbers are more prevalent in along the Parker and Zillah reaches and it is possible to see up to 40 birds on a float in the Parker reach and 15 in the Zillah reach (Figure 8). This is to be expected as most Heron rookeries of the Yakima Basin are located along this reach.

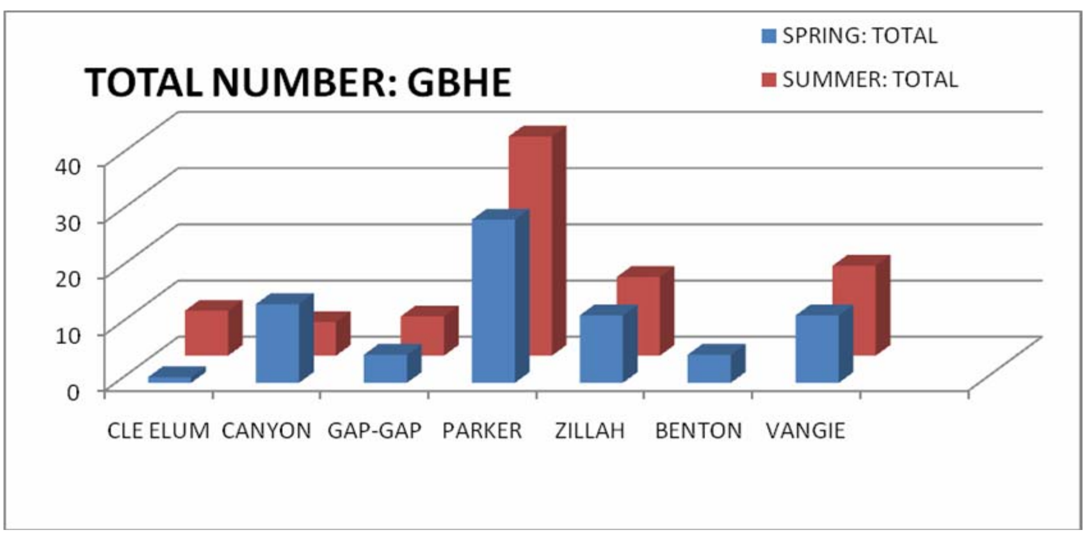


Figure 15. River reaches total number of surveyed Great Blue Herons for spring and summer 2008.

Hotspot Surveys

Gulls Chandler

Over the last 5 years, pelicans have completely displaced gulls as the dominant predatory bird at Chandler. However, over the last three years, pelican numbers have dropped from an average of 56.5 birds/day (high of 256) in 2005 and an average of 17.5 birds/day (high of 66) in 2006, to an average of 9.9 birds/day (high of 38) in 2007.

Gull numbers remained low in 2008 and averaged less than 1.5 on any given survey day, averaging 0.7 birds/day, compared to 0.5 birds/day in 2006 and 1.4 birds/day in 2005. The estimated consumption of smolts by gulls at Chandler continued to decrease from previous years, declining to near zero in 2007, similar to estimates in 2006.

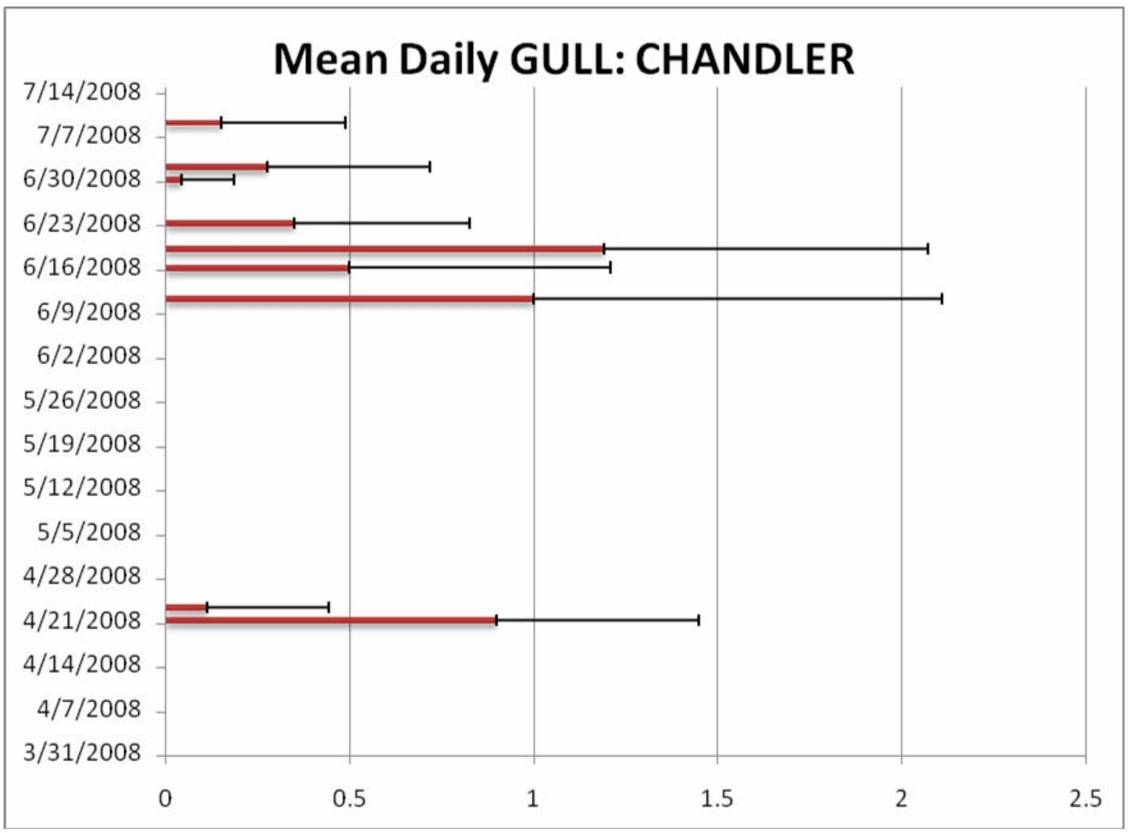


Figure 16. Mean Daily GULL at Chandler shown with positive standard deviations.

Pelicans at Chandler

When Chandler water levels declined in early June exposing numerous perching sites, pelicans would often roost and preen for long periods without attempting to feed, a pattern similar to that in 2004-2006. Foraging pelicans attempted to catch fish discharged directly out of the Chandler fish bypass pipe with most attempts unsuccessful. Pelicans in the foraging group often jostled each other for discharged fish. Because pelicans typically feed by grabbing and engulfing fish in their pouch, it was usually difficult to identify prey items before they disappear into their gullet. However, pelicans were observed foraging on both non-salmonid fish and salmon smolts at Chandler bypass pipe. Non-salmonids consumed include sucker, chiselmouth, and pikeminnow, typically of size classes larger than that of any smolts. Observers periodically visited the bypass facility to see what species were moving through the system. It often seemed pelican numbers were higher during times of decreased flow in summer when large numbers of chiselmouth and sucker were being bypassed. However, counts of chiselmouth and sucker were not systematic enough to correlate with pelican numbers.

The design of the Chandler Bypass Pipe caused fish to exit at right angles to the current disorienting them and making them vulnerable to bird predation. On various days in July, immature pelicans at Chandler were observed taking fish from the bypass pipe. Inside the facility, significant numbers of chiselmouths, suckers and wild Fall Chinook smolts were passing through. Some suckers and chiselmouths were dying on the separator and when exiting the pipe were presumably consumed by pelicans waiting at the other end. This may have served as an undesirable attractant for the birds.

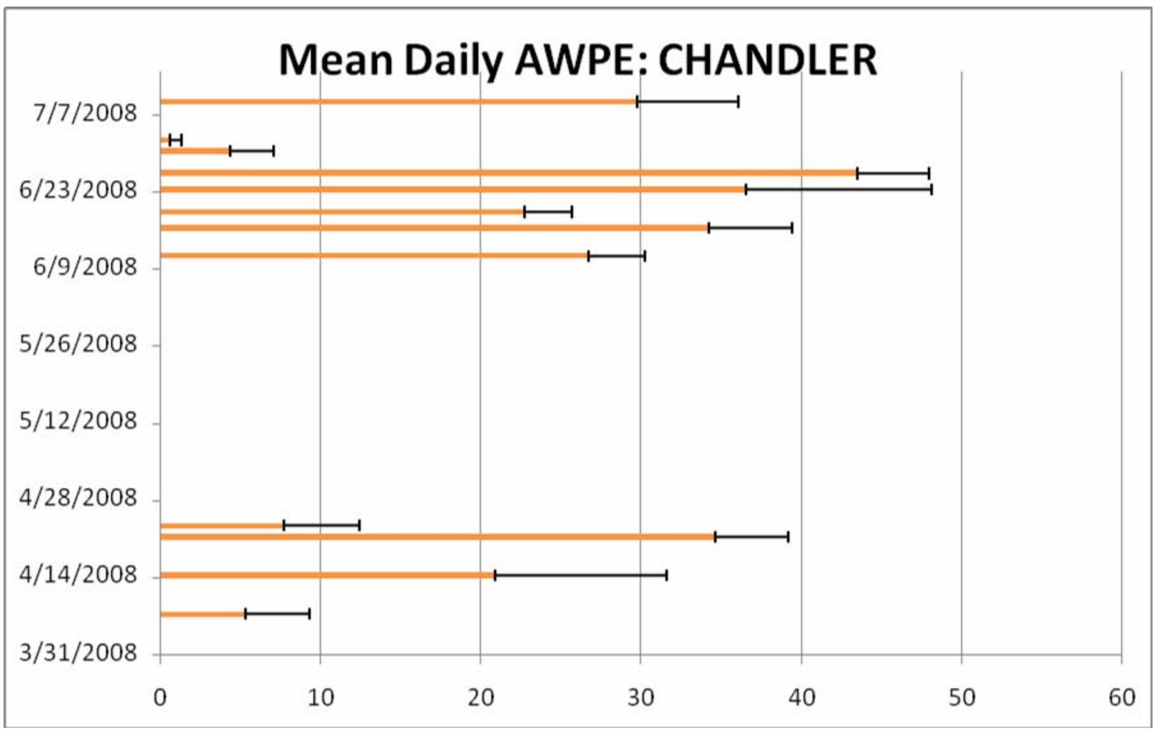


Figure 17. Mean Daily AWPE at Chandler shown with positive standard deviations

Mean daily numbers of Pelicans are given for survey dates in Figure 9. Due to high water between late April and early June Pelicans were not observed at Chandler and limited surveys were conducted during this time period (site was checked if no birds then no survey). Pelicans were prevalent during the initial part of the smolt outmigration in early April and returned to Chandler in June for the later part of smolt outmigration. It was observed that Pelicans began to return to the Yakima River in the early part of April following the Sucker run (anecdotal observation Joe Jay Pinkham YN Fisheries).

Other Avian Piscivorous at Chandler

Other piscivorous bird species observed at Chandler include Great Blue Heron, Caspian Tern, Great Egret, Double-crested Cormorant, Common Merganser and Black Crowned Night Heron. These 6 species as well as Foster's Tern, Great Egret and Osprey Based on observed foraging by gulls over 13 days of observation at Chandler, the birds are estimated to have consumed few smolts this field season. Daily totals of species observed, other than Pelicans and Gulls, are given in Figure 11.

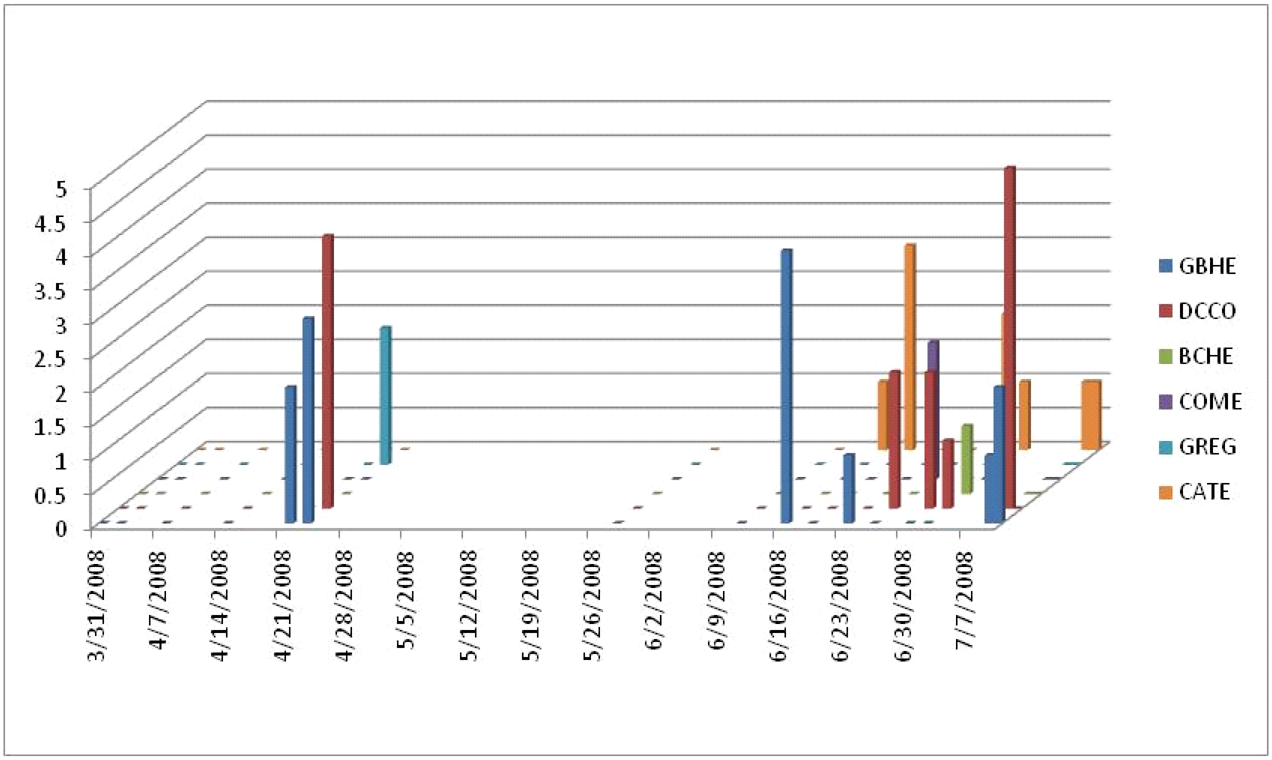


Figure 18. Piscivorous bird species observed at Chandler.

Gulls at Horn Rapids

Gulls did not remained the primary fish predator at Horn Rapids Dam as in all previous years before 2007, with an average high of less than 10 birds/day (Figure 13). Pelican presence seems to significantly reduce Gull numbers at Horn Rapids. Consumption of salmonid smolts by Gulls at Horn Rapids has become a null factor for smolt survival.

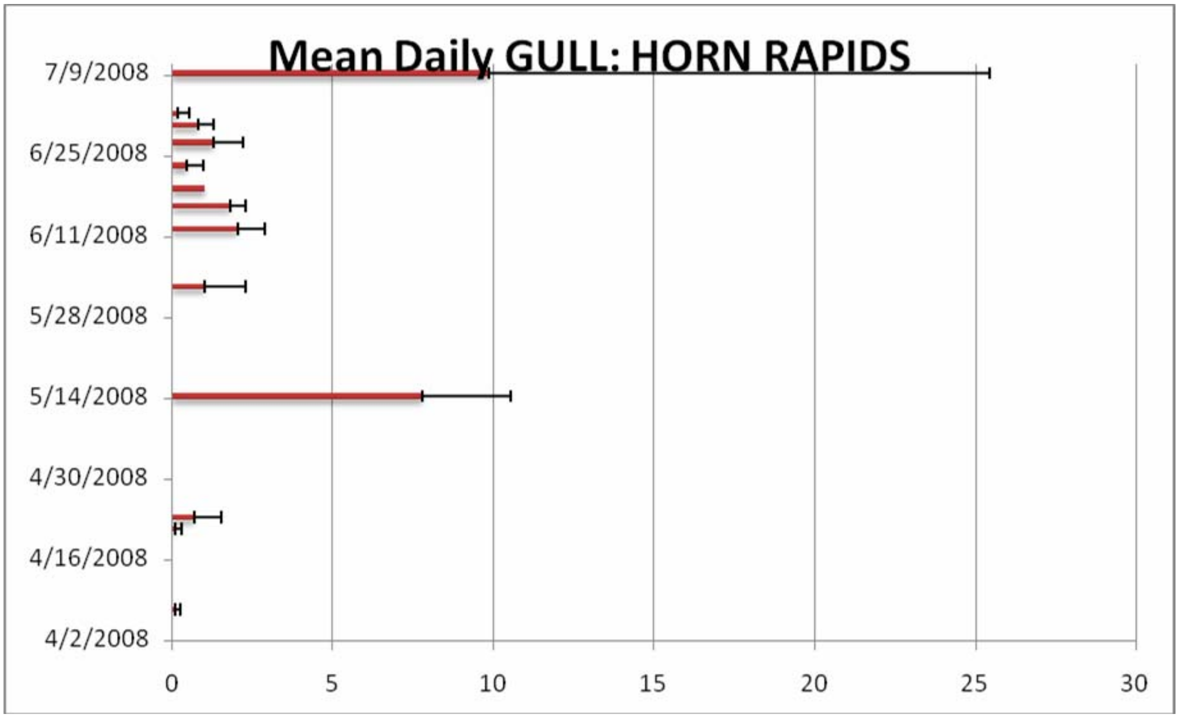


Figure 19. Mean daily GULL at Horn Rapids shown with positive standard deviations.

Pelicans at Horn Rapids

Pelicans were the dominant avian piscivorous at Horn Rapids in 2008 a surprising figure as over 20,000 gulls are known to frequent the confluence of the Yakima River at the Columbia River. Pelican numbers could average up to 35 a day at Horn rapids (Figure 12) and commonly seen fishing in the back eddies of the Dam. Pelicans lines up along the back eddies spill of the dam and gather the disoriented fish caused by water disruption. Pelican numbers increase in the summer at Horn Rapids (Figure 12) possibly focusing on late out migrants of Yakama Nation Coho smolts.

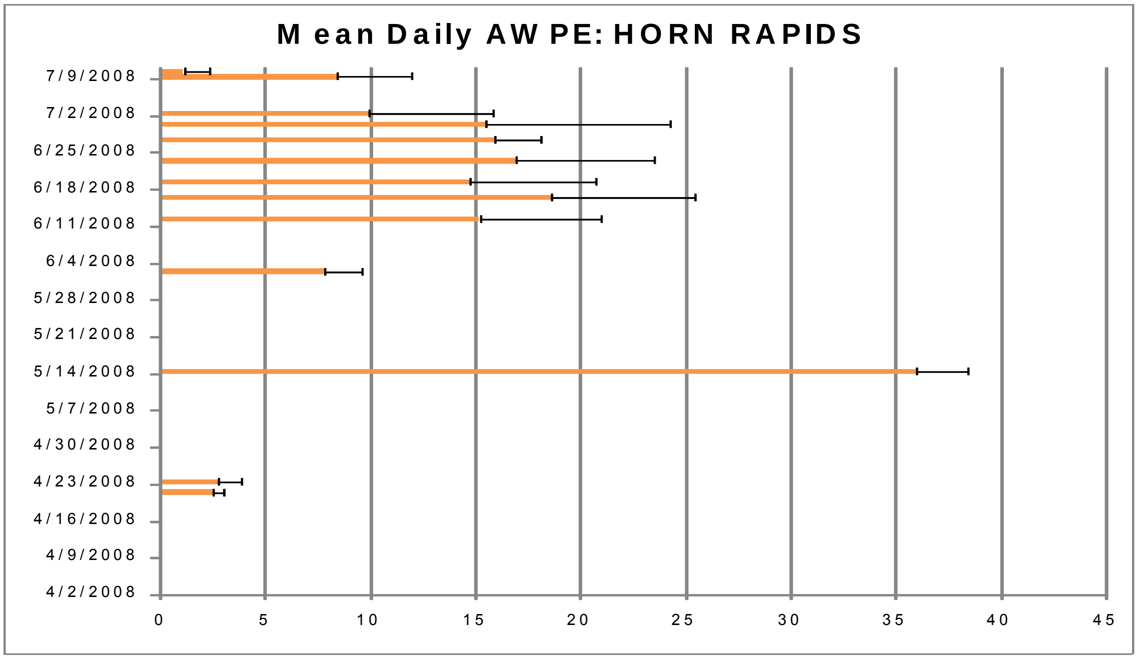


Figure 20. Mean daily AWPE at Horn Rapids shown with positive standard deviations.

<u>Other Avian Piscivorous at Horn Rapids</u>

Other piscivorous bird species observed at Chandler include Great Blue Heron, Caspian Tern, Double-crested Cormorant, and Black Crowned Night Heron. These 4 species as well as Foster's Tern and Osprey Based on observed foraging by gulls over 13 days of observation at Chandler, the birds are estimated to have consumed few smolts this field season. Daily totals of species observed, other than Pelicans and Gulls, are given in Figure 14.

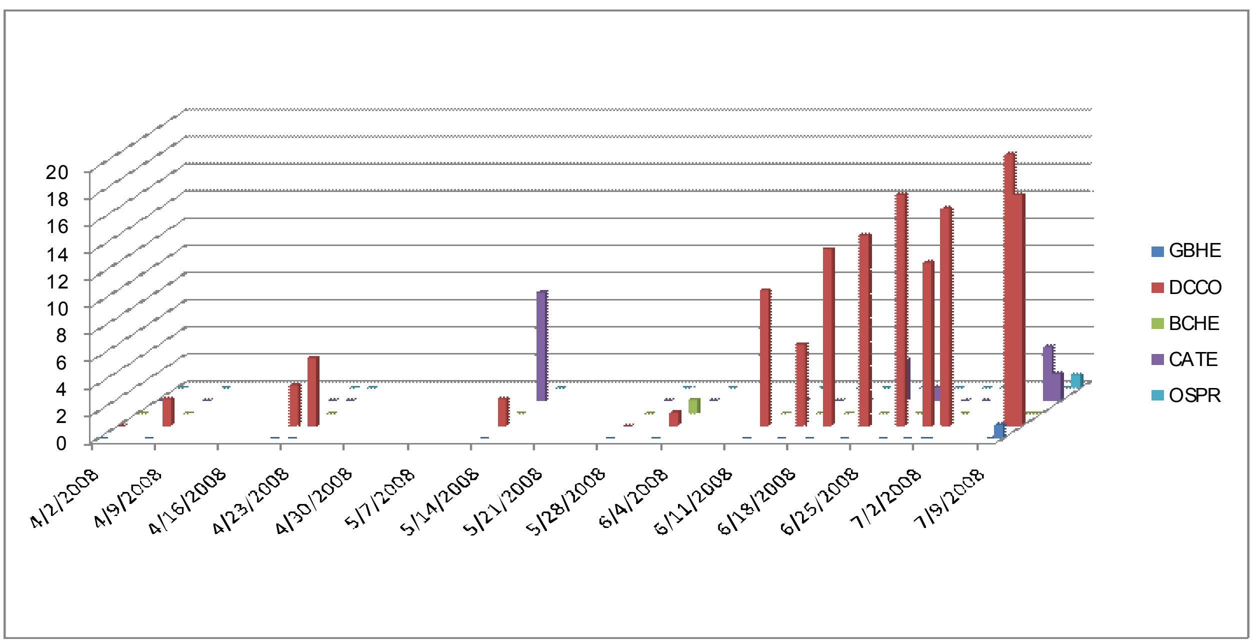


Figure 21. Piscivorous bird species observed at Horn Rapids.

Smolts Consumed at Acclimation Sites

As in the years 2004-2006, smolt consumption in 2007 at the three Spring Chinook acclimation sites in the upper Yakima Basin (Clark Flat, Easton and Jack Creek), was insignificant. The most common smolt-eating birds present were Common Merganser, Great Blue Heron and Belted Kingfisher. If it is assumed that birds feeding in acclimation ponds were subsisting solely on smolts, based on the average number of counts at each site conducted over a three month period, daily energy requirements of birds, and the average size of smolts, it was estimated that these three bird species together consumed 352-895 smolts per site (average 560). Mergansers, herons and kingfishers consumed 55%, 37% and 8% of the smolts, respectively at the three sites. However, these avian predation rates represent only 0.21% of the 785,457 smolts present in the ponds in 2007. These totals are similar to 2006, when birds consumed 169-635 smolts per site (average 418) and to 2005 when it was estimated that these same three bird species together consumed 703-832 smolts per site (average 757).

Of the three Coho acclimation sites (Holmes, Lost Creek and Stiles) only Holmes was systematically surveyed in 2007. Lost Creek and Stiles have not been systematically surveyed since 2005. Boone Pond, the scene of high merganser predation in 2005-2006 (estimated at 64% in 2005), was subsequently not utilized for acclimating smolts this year. In 2007, only mergansers and herons were observed at Holmes, with mergansers being common numbering 2.8 birds/day and herons 0.4 birds/day. Together both birds were estimated to have consumed 5,363 smolts, 1.9% of the 288,127 smolts present in the pond in 2007, with mergansers consuming nearly 90%. Bird consumption in 2007 at Holmes was up from 0.8% in 2006 and 0.02% in 2005. Smolts reared in the six Spring Chinook and Coho acclimation sites are largely secure from predation by birds. Only limited bird monitoring appears warranted at the present time.

Pelican Aerial Surveys

Aerial surveys for American White Pelican on the Yakima River began in 2004. Flights were used to look at the abundance and distribution of American White Pelicans along the Yakima River and allow for a 100% survey of the lower river. Surveys were initially conducted monthly in the spring and summer. In 2008 four aerial surveys were carried out between May and August. Survey data has shown a dramatic increase of American White Pelicans from 2004-2006 with a drop of numbers in 2007 with similar numbers for 2008 (Figure 15). Pelican numbers peaked in the spring of 2006 at approximately 550 pelicans within the aerial survey area. In 2008, numbers in the spring totaled just over 130 a similar number to the previous year. As in 2007 this drop is most likely due to high water flows. High, fast moving water, limiting gravel bar and rock exposure within the river, eliminates perches and severely restrains pelican ability to prey on smolts. Pelican numbers are expected to vary with amount of yearly flows.

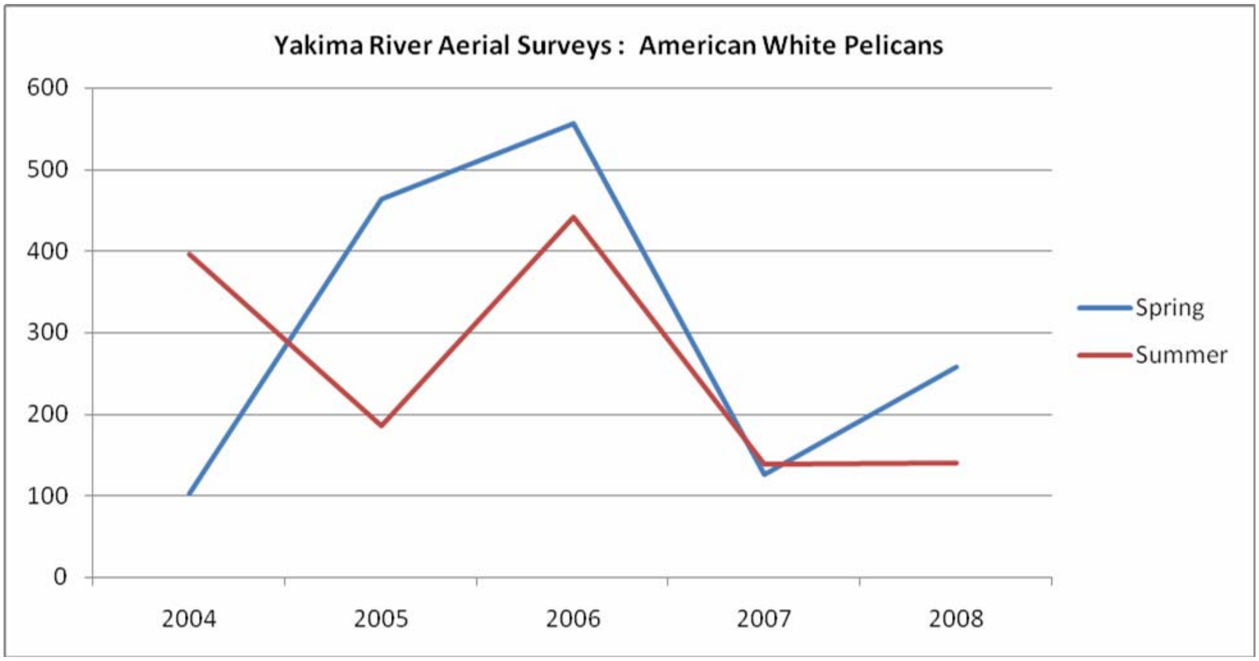


Figure 22. Yakima River Aerial Survey of pelican abundance, 2004-2008. Y-axis is number of pelicans observed.

PIT Tag Surveys

2008 PIT tag surveys yielded a total of 4195 distinct tags discovered within the 9 survey sites (Figure16) (106 tags from Selah Rookery 2007 survey included). Of this total number, 4022 of the PIT tags were from Yakama Nation juvenile salmonid tagged fish.

4 PIT tag sites were intensively surveyed and 3 of these contributed large numbers of PIT tags. Numbers of the 3 main contributors were; Chandler canal and outlet pipe with 1389, Wapato Dam/Diversion with 763, and Selah Heron Rookery with 1354. (Note all tags are sorted by year of release in all subsequent tables and figures)

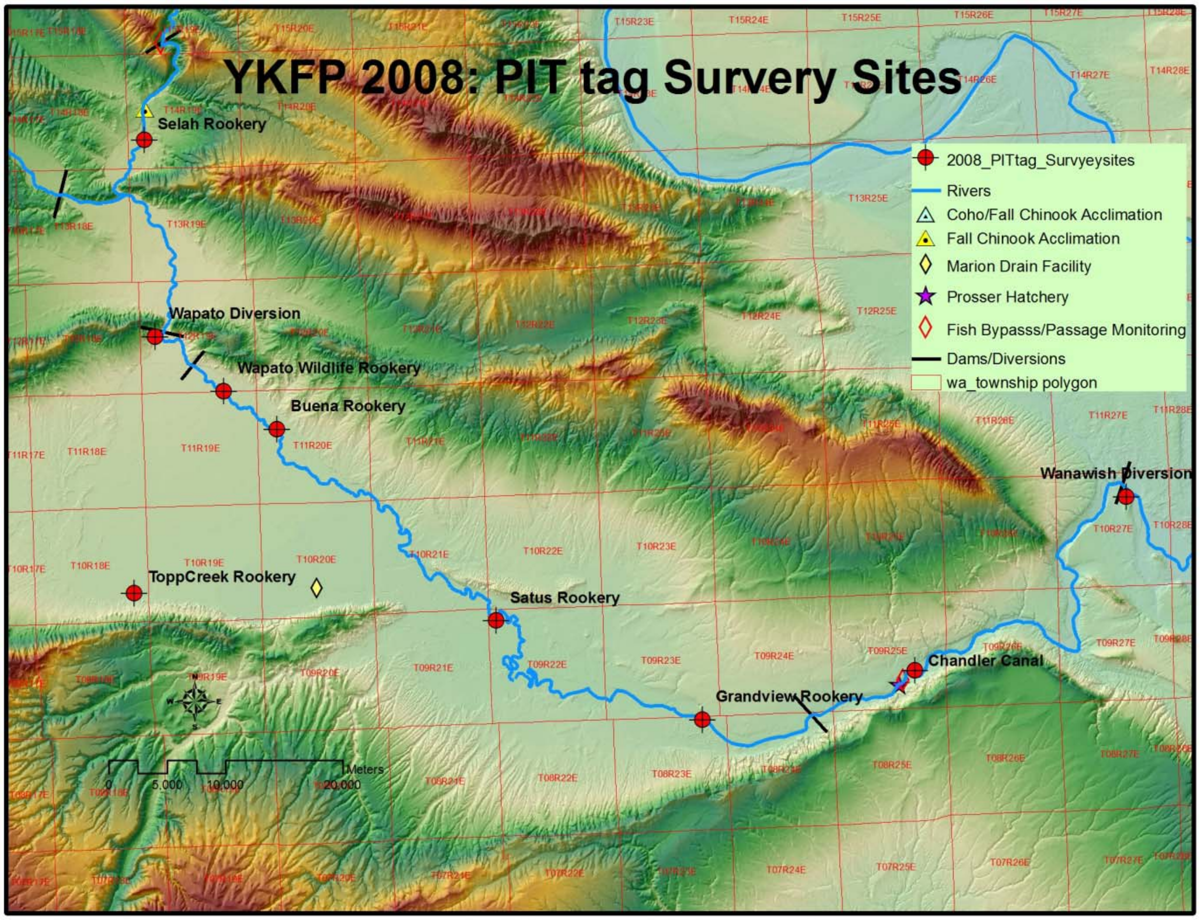


Figure 23. YKFP 2008 PIT Tag Survey Sites

Selah Heron Rookery

A total of 1246 PIT tags returned a tagging detail from the Selah rookery (Table 5). 5 PIT tags are sorted by release year and species and showed significant correlation to flows varying by year. The foraging source of these tags is believed to be primarily gathered from the River Reach of Roza Dam to the confluence of the Naches (Figure 17).

Selah Heron Rookery – PIT tag Numbers					
Release Year	Total Tags	Spring Chinook	Coho	Fall Chinook	Rainbow Trout
2008	321	141	115	65	
2007	80	37	38	4	1
2006	291	136	59	96	
2005	335	171	158	6	
2004	102	71	31		
2003	30	25	5		
2002	54	43	11		
2001	13	10	3		
2000	20	14	6		
Totals	**1246**	**648**	**426**	**171**	**1**

Table 52. Selah Rookery PIT tag totals by species and year released.

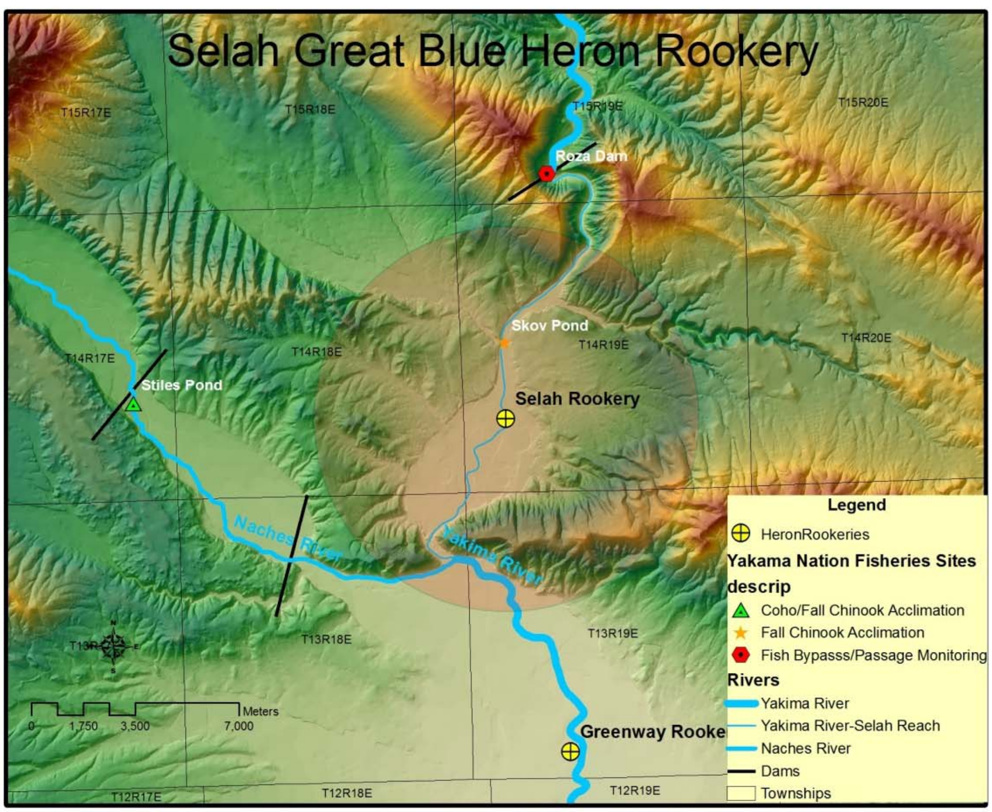


Figure 24. Selah Great Blue Heron Rookery.

Analysis of the data for this research project will attempt to answer the primary question; what effects do water flows have on the rate of Great Blue Heron predation on anadromous salmonids for the Selah Heron Rookery. For this analysis, variables of river flow (CFS) by date, PIT tag fish release timing, and species of fish will be analyzed by a comparing variable value across data source years. Data from the rookery varied with PIT tag sources over a time period of 2000 to 2008. Water flow recorded by the Bureau of Reclamation below Roza dam, provided baseline data to be used for comparison with PIT tags (BOR 2009).

Significant factors based on the life history and migration patterns of anadromous salmonid show a direct link to flow. Freshets (spikes in CFS) may be a main determining factor for migration and the number of freshets within migration period may directly affect predation. PIT tag numbers may be associated with Smolt Flushing Flows, which have been determined to be 1000 CFS for a period of three days. Flushing flow requirements for out-migrating smolts were agreed upon by biologists of the Yakama Nation, BOR, and WDFW under the SOAC group. Table 6 shows number of flushing flows within the Roza Reach by year and month. Red text within table 6 highlights 2005 low numbers of flushing flows and large numbers of Spring Chinook PIT tags (Table 5) and 2007 high numbers of flushing flows and low numbers of Spring Chinook PIT tags (Table 5).

Number of Flushing Flows for 2008		Number of Flushing Flows for 2007		Number of Flushing Flows for 2006		Number of Flushing Flows for 2005	
March	0	March	0	March	0	March	0
April	4	April	3	April	6	April	2
May	10	May	10	May	5	May	3
June	3	June	3	June	5	June	8
Total	16	Total	16	Total	20	Total	14
Average QD	1187		1988		1240		860

Table 53. Number of Flushing Flows for the Roza Reach

Yakima River water flow (CFS) below Roza dam for years of 2005 and 2008, combined with PIT tags found for the corresponding years is shown in figure 18. In an extreme low flow year of 2005, and extreme low flow into late April, a high amount of PIT tags with release year 2005 were found within the Selah Rookery. With high flows in 2008, consistently above 1000 CFS by the third week of March, only 80 tags of release year 2008 were found at the Selah rookery.

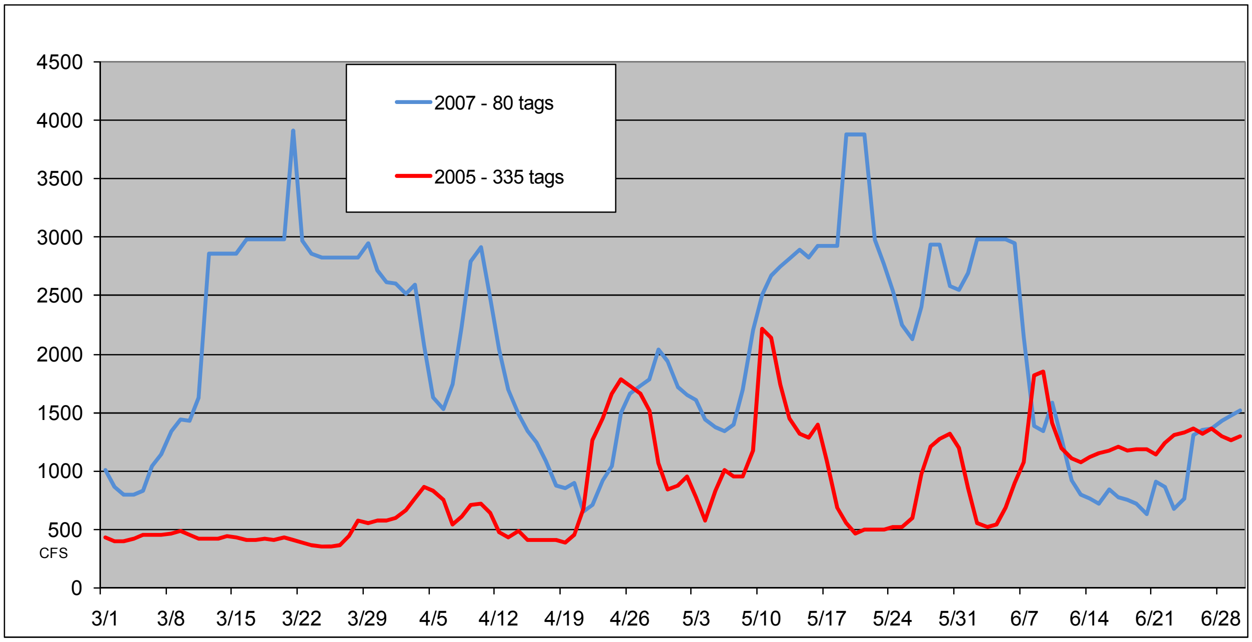


Figure 25. Yakima River water flow (CFS) below Roza dam for years of 2005 and 2008. Shown with number of tags found at the Selah Rookery for corresponding years.

Analysis of Species Composition within the Selah rookery found that near 50 percent of the tags belonged to Spring Chinook salmon smolts (Figure 19). This along value of the species has focused the Selah Rookery Study on Spring Chinook Salmon. Analysis of Spring Chinook tag data is added by the fact that; Hatchery smolts of Spring Chinook are released in a consistent ratio of PIT tagged fish release and total hatchery smolts released. These Spring Chinook from Cle Elum hatchery have been released in this fashion since 2001.

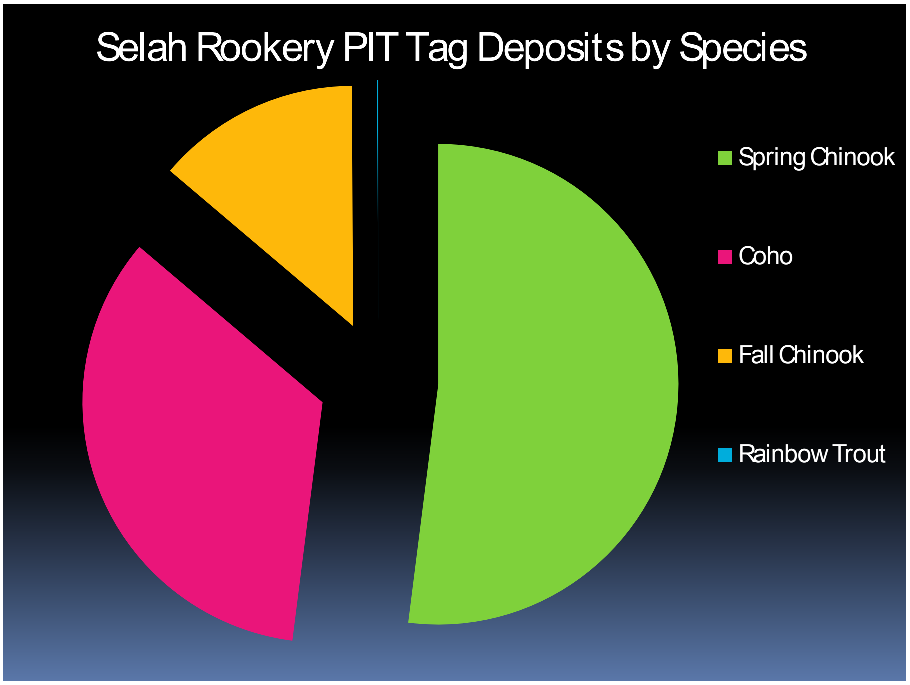


Figure 26. Selah Heron Rookery PIT tags pie chart of species composition.

Attached as appendix B is Selah rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

<u>PIT Survey Sites Data</u>

Pit tag surveys in 2008 were carried out in 5 rookeries other than Selah rookery. Rookery surveys were done in a limited basis to test whether they would yield PIT tags. Surveys were also carried out in depth at 3 Dams/Diversion sites. Tables 7-11 show rookeries surveyed PIT tags by release year and species. Tables 12-17 show Dams/Diversions by site and area surveyed and PIT tags by release year and species. Figure 21 shows PIT tag survey site locations

Rookeries

Buena Rookery

	2008	2007	2006	2005	2004	2003	2002	2001	2000	Yrs combined
Spring		1								1
Fall										0
Coho	1									1
Steelhead		1	1							2
Total	1	2	1	0	0	0	0	0	0	4

Table 54. Pit tag numbers by year/species surveyed in Buena Rookery.

Attached as appendix C is Buena rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Grandview Rookery

[redacted]

Table 55. Pit tag numbers by year/species surveyed in Grandview Rookery.

Attached as appendix D is Grandview rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Satus Rookery

[redacted]

Table 56. Pit tag numbers by year/species surveyed in Satus Rookery.

Attached as appendix E is Satus rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Toppenish Creek Rookery

[redacted]

Table 57. Pit tag numbers by year/species surveyed in Toppenish Creek Rookery.

Out of these 260 PIT tags which returned a tagging detail 215 belonged to one tag file (Appendix F). These 215 were Coho released from a net pen in Cle Elum Lake in 2008 and it is thought that these Coho were late migrators (Tags were not detected at Cle Elum passage detector).

Attached as appendix F is Toppenish Creek rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Wapato Wildlife Rookery

[redacted]

Table 58. Pit tag numbers by year/species surveyed in Wapato Wildlife Rookery.

Attached as appendix G is Wapato Wildlife rookery PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Dams/Diversions

Chandler Canal (Trash rack to Fish Screen) and Outlet Pipe

Canal (Trash rack to Fish Screen)

[redacted]

Table 59. Pit tag numbers by year/species surveyed Chandler Canal (Trash rack to Fish Screen)

Outlet Pipe

[redacted]

Table 60. Pit tag numbers by year/species surveyed Chandler Canal Outlet Pipe

Attached as appendix H is Chandler canal PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Wapato Dam/Diversion

Canal (Diversion to Trash Rack)

[redacted]

Table 61. Pit tag numbers by year/species surveyed at Wapato Dam/Diversion (Canal: Diversion to Trash Rack)

Canal (Trash rack to Fish Screen)

[redacted]

Table 62. Pit tag numbers by year/species surveyed at Wapato Dam/Diversion (Canal: Trash Rack to Fish Screen)

Behind Fish Screen

[redacted]

Table 63. Pit tag numbers by year/species surveyed at Wapato Dam/Diversion (Behind Fish Screen)

Attached as appendix I is Wapato Dam/Diversion PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Wanawish Dam/Diversion

Canal Right (Trash Rack to Fish Screen)

[redacted]

Table 64. Pit tag numbers by year/species surveyed at Wanawish Dam/Diversion (Canal Right: Trash Rack to Fish Screen)

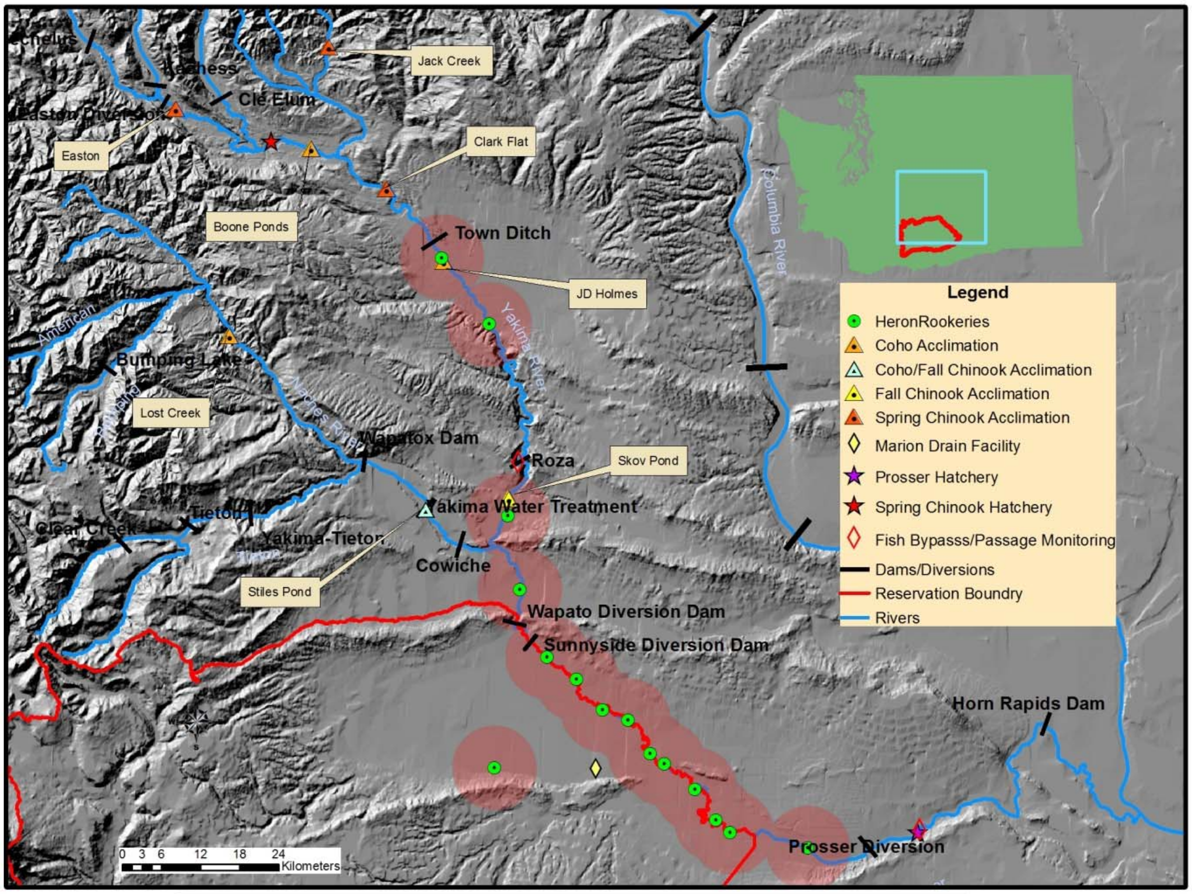
Attached as appendix J is Wanawish Dam/Diversion PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

PIT tags total 2008

Attached as appendix K is total PIT tags surveyed in 2008, tags shown as a percentage of their respective tag file.

Yakima Basin Rookeries Surveyed

In 2008 16 Great Blue Herons Rookeries were surveyed in the Yakima Basin (Figure 20). Of these 16 rookeries 13 were active with nesting Great Blue Herons. A nest count found that within these 16 rookeries there are approximately 395 Nests.



Heron Rookeries are outlined with a 6.5 km transparent buffer representing an upper mean foraging area.

Figure 20. Map of Yakima Basin Great Blue Heron Rookeries surveyed in 2008.

The Wapato Wildlife Rookery and the Holmes rookery were selected for tag detection efficiencies as each displays habitat characteristics of Rookeries within their give Stratum. These rookeries will be intensely scanned for PIT tags in the upcoming years.

CONCLUSIONS

Gull numbers remain low in the Yakima River Basin and the focus of future studies have shifted towards; Pelican numbers and diet, management of extreme numbers of piscivorous birds in given areas, and surveys of PIT tags where mortality can be linked to predation.

Pelican numbers remain a concern as in previous years. Aerial surveys in 2008 showed that pelican numbers peaked at near 280 birds in the Yakima Basin this year down from highs of 660 birds in 2005 and higher than 2007 peak at near 150. Gulls were only common in one reach in the lower river. Mergansers on their breeding grounds in the upper and middle Yakima River have not shown a numeric response to hatchery supplementation of Spring Chinook and Coho salmon smolts yet remain a concern as they are known to congregate in large numbers below Roza Dam.

Pelican numbers at Chandler were only consistently high after smolt passage was largely complete and flows returned to a forgeable level. When observed feeding at Chandler, pelicans have frequently consumed non-salmonid species, including chiselmouth, sucker and pikeminnow exiting the pipe. Most of these non-salmonid fish taken were significantly larger than the average size of salmon smolts. High numbers of pelicans in Yakima Canyon in spring appeared to correlate with sucker runs. Yet with these previous observations questions are left as new data of Pelican diet is presented and Pelican impact on salmon runs needs more study.

The greater the amount of water that passes over Prosser and Horn Rapids Dams during peak smolt out-migration periods, the lesser the impact of bird predation on smolt survival. The Chandler Bypass outfall pipe makes fish of all species vulnerable to predation at low water, as the fish are disoriented and upwelling at right angles to the current. A simple reconfiguring of the outfall could largely eliminate smolt vulnerability at Chandler. The presence of large dead and disabled fish exiting from the bypass pipe may attract avian predators to the site. PIT tag detection at Chandler outlet pipe did show high mortality for both juvenile and adult salmonids (Appendix K).

PIT tag surveys in 2008 proved very productive as over 4100 tags were discovered in the Yakima Basin. Tags detected show a source of mortality for Yakima River juvenile salmonids as 4022 of these tags were from juvenile salmonids. Predation by Herons shows correlation with flow, not surprising as high flow eliminates opportunity for wading bird foraging in many parts of the river. Conversely low flow creates foraging opportunities for Herons.

Late migration of juvenile salmonids was shown to increase predation levels. Coho PIT tags found in Toppenish Creek Rookery support earlier release times or improved fish passage at Cle Elum Lake.

Plans for the 2009 field season include continued monitoring of river reaches and at hotspots with a focus on Pelican foraging. Heron rookeries and cormorant nesting colonies will continue to be surveyed. PIT tags found at pelican, heron nesting and roosting sites will be used to assign smolt predation estimates to specific bird species.

PIT tag analysis will continue to develop and new sites will be added to surveys. Detection efficiencies will be conducted in 3 diverse rookeries to assess a number of undetected tags. PIT tags will be assessed by extrapolating a wild component utilizing salmon red data and juvenile fish passage facilities. Temporal trends of predation will be tested by attempting to simulate smolt river travel through river flows and acclimation site detection. Work towards developing a PIT tag array will begin in an attempt to gain real time PIT tag deposition.

Management Options will be assessed by looking at: flow bumps during smolt migration, improving fish passage, earlier smolt releases, acclimation site placement/attributes, developing Pelican diet studies, testing Merganser hazing/lethal control effectiveness, expanded PIT tag surveys, expanded studies of flow vs. smolt rate of travel, and Dam/Diversion fish bypass mortality studies.

ACKNOWLEDGEMENTS

Sara Sohappy and Ted Martin collected the majority of the field data for this project. Dave Lind, Bill Bosch and Chris Fredrickson contributed to the analysis. All photographs were taken by Ann Stephenson. Paul Huffman helped with the maps. Bird surveys at smolt acclimation ponds were conducted by Farrell Aleck, Marlin Colfax, Nate Pinkham, William Manuel, Terrance Compo, and Levi Piel.

LITERATURE CITED

Alcock, J. 1968. Observational learning in three species of birds. Ibis 111:308-321.

BOR [Bureau of Reclamation] 2009. Yakima Project Hydromet System. http://www.usbr.gov/pn/hydromet/yakima/index.html

Grassley, J. M. and C. E. Grue 2001. Development of an Index to Bird Predation of Juvenile Salmonids within the Yakima River, Annual Report 1999. Submitted to Washington Department of Fish and Wildlife by the Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, WA. 39 pp.

Major III, Walter, J.M. Grassley, K. Ryding, C. Grue, T. Pearsons, and A. Stephenson. 2003. Abundance, distribution and Estimated Consumption (kg fish) of Piscivorous Birds Along the Yakima River, Washington State, Implications for Fisheries Management, Annual Report 2002. Project No. 1995-06424. BPA Report DOE/DP-00004666-11.

Motschenbacher, M.D. 1984. The feasibility of restoring a breeding white pelican population in the state of Washington. Thesis, Washington State University, Pullman, Washington, USA.

Pacific States Marine Commission 2006. http://www.psmfc.org

Phinney, D.D., S.B. Mathews and T.N. Pearsons 1998. Development of a Bird Predation Index, Annual Report 1998. Report to Bonneville Power Administration, Contract No. 1998AT02689, Project No. 199506408, (BPA Report DOE/BP-64878-3) 133 pp.

Roby, D.D., D.P. Craig, K. Collis, and S.L. Adamany. 1998. Avian predation on juvenile salmonids in the lower Columbia River. Annual Report for 1997. Bonneville Power Administration, Portland, Oregon.

Ruggerone, G.T. 1986. Consumption of migrating juvenile salmonids by gulls foraging below a Columbia River Dam. Transactions of the American Fisheries Society 115:736-742.

Ward, P. and A. Zahavi. 1973. The importance of certain assemblages of birds as “information centers” for food finding. Ibis 115:517-534.

White, H. C. 1957. Food and natural history of mergansers on salmon waters in the maritime provinces of Canada. Bulletin of the Fisheries Research Board of Canada 116:19-35

Wood, C.C. and C.M. Hand. 1985. Food-searching behavior of the common merganser (Mergus merganser) I: Functional responses to prey and predator density. Canadian Journal of Zoology 63:1260-1270.

http://www.efw.bpa.gov/IntegratedFWP/reportcenter.aspx.

www.ykfp.org

Appendix A. Common Merganser Study 2008

Yakima Klickitat Fisheries Project: Monitoring and Evaluating Avian Predation on Juvenile Salmonids on the Yakima River, Washington.

Common Merganser Smolt Consumption near Roza Dam, WA.

Anadromous fish of the Yakima Basin have experienced severe declines in populations as a result of anthropogenic actions. In response to these declines, millions of dollars are spent annually in efforts to restore anadromous fish runs (Yakima Basin Fish and Wildlife Planning Board 2004).   The Yakima Klickitat Fisheries Project (YKFP), co-managed by the Yakama Nation and Washington Department of Fish and Wildlife (WDFW), with funding from the Bonneville Power Administration, is leading the effort to restore salmon runs in the Yakima River. YKFP seeks to "test the hypothesis that new supplementation techniques can be used in the Yakima River Basin to increase natural production and to improve harvest opportunities, while maintaining the long-term genetic fitness of the wild and native salmonid populations and keeping adverse ecological interactions within acceptable limits" (Sampson and Fast 2000).

Predator and prey relationships have demonstrated considerable change as the result of developments within the Yakima River Basin. Some changes have resulted in “hotspots,” areas experiencing high predation of anadromous salmonids (Sampson, Fast, and Bosch 2008). Common Mergansers (Mergus Merganser) were found to be the major predator on the upper reaches of the Yakima River (Phinney, et al.1998.) Surveys conducted from 1999 through 2002, by the Washington Cooperative Fish and Wildlife Research Unit, found that this trend is continuing thru time (Grassley and Grue 2001;Grassley, et al 2002; Major, et al 2002). The Common Merganser has altered its predator prey relation with anadromous salmonids as a result of the development of Roza Dam, located in the upper Yakima River. Roza Dam has seen increased population numbers of Common Mergansers and has now become a “hotspot” for predation salmonids (Sampson, Fast, and Bosch 2008).

Under YKFP’s avian predation monitor and evaluation study, stomach content analysis and management studies of the Common Merganser will be implemented at Roza Dam. Roza Dam is fitted with passage via fish ladders for returning adults and bypass structures for migrating smolts. Structures of passage along with dam effects concentrate many fish in small areas during species migration timing (Sampson, Fast, and Bosch 2008). As a result of structure, Roza Dam becomes an area of high concentrations of smolts during this migration. Piscivorous species such as the Common Merganser is then attracted to Roza Dam and consumes large numbers of migrating smolts. YKFP is hoping to obtain a permit for the lethal taking of the Common Merganser to complete a stomach content analysis and assess anadromous salmonid consumption and management techniques. With study results YKFP will assess the impact these Mergansers are having on migrating smolts and possible management strategies.

Location

The area of study collection is located below Roza Dam on the Yakima River of Washington. Migrating Smolts pool above and below the dam from March to June between this time period it is expected that over 1 million smolts pass the dam. Mergansers have congregated in numbers reaching 150+ during days of smolt migration at the dam and are thought to have a severe impact on smolts through consumption (personnel communication, Mark Johnston Biologist YKFP).

Methods

The Common Merganser at Roza Dam they will be taken by shotgun. Dogs and boats will be used to recover the birds from the river below Horn Rapids Dam**.** 50 Mergansers will be taken over a period of 5 weeks, twice a week, 5 per day, during a timing of peak smolt migration of the second week of March to the third week of April. Smolt consumption thru diet analysis would entail species of fish identification using bone diagnostics. The study would involve using personnel from YKFP, Yakama Nation and WDFW, who have in the past taken Mergansers and completed bone diagnostics (Fritts and Pearsons 2006). Stomach contents of avian predators taken during lethal control efforts will be processed for whole and partial fish, diagnostic cranial bones, and otoliths.

Fish will be individually bagged and tagged with the date and place of collection, and kept frozen at -20oC at the Prosser Fish Hatchery until processed. Stomach contents will be collected, analyzed, and preserved according to techniques described in the Field Manual of Wildlife Diseases, General Field Procedure and Diseases of Birds (USGS 1999).

Conditioned Response for Management

Management of the Common Merganser for the smolt consumption near Roza Dam may be deemed necessary. A study concurrent with the lethal take for stomach content analysis would attempt to assess lethal control and conditioned response as a management tool. YKFP would study the effectiveness of lethal control combined with frightening techniques, which when combined have shown to be an effective management tool (Littauer 1990). After a count of Common Mergansers at the collection site a handheld horn would be blown during each lethal take as a frightening technique. Frightening techniques would extend for a period 5 weeks after lethal collection is completed. Numbers of Common Mergansers would be recorded over the 5 week period of lethal collection and a period extending 5 weeks after lethal collection.

Results

Results for the scientific collection study will be incorporated into the annual report, “The Monitoring and Evaluation of Avian Predation of Juvenile Salmonids on the Yakima River, Washington”, for the Yakima Klickitat Fisheries Project, submitted to the U.S. Department of Energy, Bonneville Power Administration.

Results may also be submitted to relevant scientific journals for publication. For a more detailed description of previous years' results of the monitoring effort and statistical methods involved please refer to the annual reports located at YKFP's website, www.ykfp.org or the Bonneville Power Administration website,
www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/YAKIMA

Literature Cited

Fritts, A. L. and T. N. Pearsons. 2006. Effects of Predation by Nonnative Smallmouth Bass on Native Salmonid Prey: the Role of Predator and Prey Size. Transactions of the American Fisheries Society 135:853-860.

Grassley, J.M. and C.E. Grue 2001. Development of an Index to Bird Predation of Juvenile Salmonids within the Yakima River, Annual Report 1999. Submitted to Washington Department of Fish and Wildlife by the Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, WA. 39 pp.

Grassley, J. M., W. Major, K. Ryding and C. E. Grue 2002. Development of an Index to Bird Predation of Juvenile Salmonids within the Yakima River, Annual Report 2000. Submitted to Washington Department of Fish and Wildlife by the Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, WA. 38 pp.

Littaauer, G. 1990. Frightening Techniques for Reducing Bird Damage at Aquaculture Facilities. Southern Regional Aquaculture Center. Publication No. 401.

Major, W., J.M. Grassley, K. Ryding, and C.E. Grue 2002. Development of an Index to Bird Predation of Juvenile Salmonids within the Yakima River, Annual Report 2001. Submitted to Washington Department of Fish and Wildlife by the Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, WA. 39 pp. 41.

Major, W., J.M. Grassley, K. Ryding, C.E. Grue, T. N. Pearsons, A.E. Stephenson 2003. Abundance, Distribution and Estimated Consumption (kg fish) of Piscivorous Birds along the Yakima River, Washington State: Implications for Fisheries Management. Yakima/Klickitat Fisheries Project Monitoring and Evaluation Annual Report 2002. Phinney, D.D., S.B. Mathews and T.N. Pearsons 1998. Development of a Bird Predation Index, Annual Report 1998. Report to Bonneville Power Administration, Contract No. 1998AT02689, Project No. 199506408, (BPA Report DOE/BP-64878-3) 133 pp.

Sampson, M. and D. Fast. 2000. Yakima/Klickitat Fisheries Project Final Report 2000. Report to Bonneville Power Administration, Contract No. 00000650, Confederated Tribes and Bands of the Yakama Nation, Project No. 95-063-25. 265 pp.

Sampson, M., B. Bosch, and D. Fast. 2008. Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Report to Bonneville Power Administration, Contract No. 00000650, Confederated Tribes and Bands of the Yakama Nation, Project No. 1995-063-25.

U.S. Geological Survey, U.S. Dept. of Interior 1999-2001. Field Manual of Wildlife Diseases. General Field Procedures and Diseases of Birds, Biological Resources Division. Information and Technology Report 1999-2001.

Yakima Subbasin Fish and Wildlife Planning Board 2004. Yakima Subbasin Plan. Prepared for the Northwest Power and Conservation Council.

Appendix B. Selah Rookery PIT tags percentage of Tag files

[redacted]

Appendix C. Buena Rookery PIT tags percentage of Tag files

[redacted]

Appendix D. Grandview Rookery PIT tags percentage of Tag files

[redacted]

Appendix E. Satus Rookery PIT tags percentage of Tag files

FileName	TagDate	ReleaseDate	SessionMessage	PITtagsRelesed	Satus Tags	Tags % File
BDW00040.LWE	2/9/2000	5/7/2000	LOST CREEK EARLY RW 29 AND 30 CWT 05-44-61	2500	1	0.04%
BDW01043.LWE	2/12/2001	5/7/2001	LOST CREEK WILLARD EARLY CWT 5-45-08 WILLARD RW 5	1250	1	0.08%
BDW01289.O4C	10/16/2001	4/1/2002	CLE04 OCT1, ELAST=LEFT/GREEN, CWT=63-13-63, POND=JCJ04	2226	1	0.04%
BDW01289.S3C	10/16/2001	4/1/2002	CLE03 SNT1, ELAST=RIGHT/GREEN, CWT=63-13-60, POND=JCJ03	2226	1	0.04%
BDW01297.OEC	10/24/2001	4/1/2002	CLE14 OCT4, ELAST=LEFT/ORANGE, CWT=63-09-74, POND=ESJ04	2225	1	0.04%
BDW01298.OGC	10/25/2001	4/1/2002	CLE16 OCT6, ELAST=LEFT/GREEN, CWT=63-09-72, POND=JCJ06	2229	2	0.09%
BDW99301.OEC	10/28/1999	3/15/2000	CLE14 OCT4, ELAST=LEFT/GREEN, CWT=631114, POND=ESJ02	2502	1	0.04%
DTL03290.C09	10/17/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 03	2223	1	0.04%
DTL03294.C14	10/21/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 02	2223	1	0.04%
DTL04106.MA2	4/15/2004	4/22/2004	MARION DRAIN FALL CHINOOK 2004, GROUP 2	1001	1	0.10%
DTL04292.C17	10/18/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 06	2222	1	0.05%
DTL04294.C14	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 03	2222	1	0.05%
DTL04295.C10	10/21/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 05	2222	1	0.05%
DTL04296.C09	10/22/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 06	2223	1	0.04%
DTL04299.C06	10/25/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 01	2223	1	0.04%
DTL04300.C04	10/26/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2222	1	0.05%
DTL04341.STE	12/6/2004	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	5006	1	0.02%
DTL05091.R18	4/1/2005	4/1/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	195	1	0.51%
DTL05105.MD1	4/15/2005	4/22/2005	MARION DRAIN FALL CHINOOK 2005, GROUP 1	2129	2	0.09%
DTL05109.STI	4/19/2005	4/25/2005	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	4203	1	0.02%
DTL05111.BRD	4/21/2005	4/27/2005	COHO PASSAGE EXPERIMENT, RELEASED BELOW ROZA DAM	3334	1	0.03%
DTL05193.HMY	7/12/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	2512	1	0.04%
DTL05193.LCY	7/12/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2517	2	0.08%
DTL05298.H01	10/25/2005	3/15/2006	CLE ELUM RW1 TO CLARK FLATS RW3	2223	1	0.04%
DTL05298.H03	10/25/2005	3/15/2006	CLE ELUM RW 3 TO EASTON 03	2223	1	0.04%
DTL05298.L04	10/25/2005	3/15/2006	CLE ELUM RW 4 TO EASTON RW 4	2224	1	0.04%
DTL05298.L06	10/25/2005	3/15/2006	CLE ELUM RW 6 TO JACK CREEK RW 4	2222	2	0.09%
DTL05300.H07	10/27/2005	3/15/2006	CLE ELUM RW 7 TO EASTON RW 5	2222	1	0.05%
DTL05301.L09	10/28/2005	3/15/2006	CLE ELUM RW 9 TO JACK CREEK RW 5	2222	2	0.09%
DTL05306.L16	11/2/2005	3/15/2006	CLE ELUM RW 16 TO CLARK FLATS RW 2	2224	1	0.04%
DTL05307.H17	11/3/2005	3/15/2006	CLE ELUM RW 17 TO CLARK FLATS RW 5	2222	1	0.05%
DTL05319.LCE	11/15/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2516	1	0.04%
DTL06080.FS1	3/21/2006	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9999	1	0.01%
DTL06109.R33	4/19/2006	4/20/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	221	1	0.45%
DTL06289.C01	10/16/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06289.C03	10/16/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06290.C04	10/17/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06296.C13	10/23/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2224	1	0.04%
DTL06297.C14	10/24/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06298.C17	10/25/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06352.HM3	12/18/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1253	1	0.08%
DTL07100.ST1	4/10/2007	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	9970	1	0.01%

Appendix F. Toppenish Creek Rookery PIT tags percentage of Tag files

FileName	TagDate	ReleaseDate	SessionMessage	PITtagsRe	ToppCreekRooktags	tags%File
BDW03015.TU2	1/15/2003	1/15/2003	TOPPENISH CREEK SCREW TRAP - STEELHEAD RELEASED BELOW UNIT 2 DAM	36	1	2.78%
DTL03286.C04	10/13/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 04	2224	1	0.04%
DTL03294.C13	10/21/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 01	2223	1	0.04%
DTL03350.TU2	12/16/2003	12/16/2003	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	3	1	33.33%
DTL04036.TU2	2/5/2004	2/5/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	165	1	0.61%
DTL04040.TU2	2/9/2004	2/9/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL04044.TU2	2/13/2004	2/13/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	31	1	3.23%
DTL05132.TU2	5/12/2005	5/12/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	58	1	1.72%
DTL05133.TU2	5/13/2005	5/13/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	14	1	7.14%
DTL05141.TU2	5/21/2005	5/21/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	16	1	6.25%
DTL05142.TU2	5/22/2005	5/22/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	15	1	6.67%
DTL05362.TU2	12/28/2005	12/28/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	99	1	1.01%
DTL06145.TU2	5/25/2006	5/25/2006	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	10	1	10.00%
DTL06147.TU2	5/27/2006	5/27/2006	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	5	1	20.00%
DTL07117.TU2	4/27/2007	4/27/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	33	1	3.03%
DTL07124.TU2	5/4/2007	5/4/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL07142.TU2	5/22/2007	5/22/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL07143.TU2	5/23/2007	5/23/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	10	1	10.00%
DTL07324.TU2	11/20/2007	11/20/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	83	1	1.20%
DTL07325.TU2	11/21/2007	11/21/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	44	1	2.27%
DTL07327.TU2	11/23/2007	11/23/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	42	1	2.38%
DTL07344.PE1	12/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM PROSSER HATCHERY	1003	5	0.50%
DTL07346.TU2	12/12/2007	12/12/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	101	2	1.98%
DTL07347.TU2	12/13/2007	12/13/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	63	2	3.17%
DTL08084.CLN	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO FOREBAY	6056	215	3.55%
DTL08084.DBL	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; KNOWN DOUBLE TAGS FROM CLN AND UCL FILES	149	3	2.01%
DTL08084.UCL	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED DIRECTLY INTO UPPER LAKE	6011	6	0.10%
DTL08097.TU2	4/6/2008	4/6/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	22	1	4.55%
DTL08100.TU2	4/9/2008	4/9/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	15	2	13.33%
DTL08102.TU2	4/11/2008	4/11/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL08326.TU2	11/21/2008	11/21/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	22	1	4.55%
DTL08345.TU2	12/10/2008	12/10/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	1	1	100.00%

Appendix G. Wapato Wildlife Rookery PIT tags percentage of Tag files

FileName	TagDate	ReleaseDa	SessionMessage	PITtagsRelesed	NumberRookeryTags	Tags% of File
BDW00294.O1C	10/17/2000	4/1/2001	CLE01 OCT2, ELAST=RIGHT/RED, CWT=630480, POND=ESJ04	2226	1	0.04%
BDW00294.OEC	10/25/2000	4/1/2001	CLE14 OCT1, ELAST=RIGHT/ORANGE, CWT=630493, POND=JCJ02	2225	1	0.04%
BDW00294.OIC	10/27/2000	4/1/2001	CLE18 OCT5, ELAST=RIGHT/RED, CWT=630485, POND=ESJ02	2226	1	0.04%
BDW03035.EWB	2/4/2003	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 11), RELEASED FROM EASTON POND	833	1	0.12%
DTL03287.C03	10/14/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2224	1	0.04%
DTL03290.C10	10/17/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 04	2223	1	0.04%
DTL04294.C12	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, HI FEED, CLARK FLAT 03	2222	1	0.05%
DTL04294.C13	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 04	2223	1	0.04%
DTL04295.C10	10/21/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 05	2222	1	0.05%
DTL04296.C08	10/22/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 01	2224	1	0.04%
DTL04341.HME	12/6/2004	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	4959	1	0.02%
DTL05109.STI	4/19/2005	4/25/2005	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	4203	2	0.05%
DTL05111.ARD	4/21/2005	4/27/2005	COHO PASSAGE EXPERIMENT, RELEASED ABOVE ROZA DAM	3334	1	0.03%
DTL05130.AHT	5/10/2005	5/10/2005	AHTANUM CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED ABOVE GOODMAN RD	15	1	6.67%
DTL05193.LCY	7/12/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2517	1	0.04%
DTL05304.L12	10/31/2005	3/15/2006	CLE ELUM RW 12 TO JACK CREEK RW 2	2222	1	0.05%
DTL05319.HME	11/15/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	2514	1	0.04%
DTL05319.LCE	11/15/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2516	1	0.04%
DTL06069.R14	3/10/2006	3/10/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	56	1	1.79%
DTL06080.FS2	3/21/2006	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9903	3	0.03%
DTL06193.LY2	7/12/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1265	1	0.08%
DTL06193.SY2	7/12/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1262	1	0.08%
DTL06236.TNW	8/24/2006	8/24/2006	TEANAWAY RIVER JUVENILE O. MYKISS (SEE NOTE)	218	1	0.46%
DTL06292.C08	10/19/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06298.C16	10/25/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06299.C18	10/26/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	0.05%
DTL06352.ST1	12/18/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1261	3	0.24%
DTL07100.ST1	4/10/2007	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	9970	1	0.01%
DTL07191.SY3	7/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1256	1	0.08%
DTL07296.E16	10/23/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	1	0.05%
DTL07344.SE1	12/10/2007	4/5/2007	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1253	1	0.08%
DTL08058.R03	2/27/2008	2/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	270	1	0.37%
DTL08084.UCL	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED DIRECTLY INTO UPPER LAKE	6011	1	0.02%

Appendix H. Chandler Canal PIT tags percentage of Tag files

FileName	TagDate	ReleaseDate	SessionMessage	PIT tags released	tagsOutletPIPE	tagsForebay	Outletpipe%file	Forebay%File	Organizations
BDW00115.CH3	4/24/2000	4/25/2000	HCHK1 SPLIT CANAL RELEASE PAIRED W/ WCHK1 CAUDAL CLIP	150	0	2	0.00%	1.33%	
BDW00125.C1B	5/4/2000	5/5/2000	WCHK1 SPLIT CANAL RELEASE PAIRED W/ HCHK1 UPPER CAUDAL CLIPPED	100	0	1	0.00%	1.00%	
BDW00137.FHG	5/16/2000	5/17/2000	HCHK1 UNSPLIT FOREBAY RELEASE PAIRED W/ WCHK1 UC CLIPPED	200	1	0	0.50%	0.00%	
BDW00139.BHI	5/18/2000	5/19/2000	HCHK1 UNSPLIT BELOW DAM RELEASE PAIRED W/ WCHK1	200	1	0	0.50%	0.00%	
BDW00145.C1L	5/24/2000	5/25/2000	WCHK1 SPLIT CANAL RELEASE PAIRED W/ HCHK1 UC CLIPPED	98	0	1	0.00%	1.02%	
BDW00174.FGU	6/22/2000	6/23/2000	WCHK0 UNSPLIT FOREBAY RELEASE NOT PAIRED W/ ANYTHING, UC CLIPPED.	75	1	0	1.33%	0.00%	
BDW00180.FGX	6/28/2000	6/29/2000	WCHK0 UNSPLIT FOREBAY RELEASE NOT PAIRED W/ ANYTHING, UC CLIPPED.	200	1	0	0.50%	0.00%	
BDW00294.O4C	10/18/2000	4/1/2001	CLE04 OCT4, ELAST=RIGHT/ORANGE, CWT=630487, POND=JCJ04	2225	0	1	0.00%	0.04%	
BDW00294.O8C	10/20/2000	4/1/2001	CLE08 OCT3, ELAST=RIGHT/GREEN, CWT=630491, POND=CFJ06	2226	1	0	0.04%	0.00%	
BDW00294.OEC	10/25/2000	4/1/2001	CLE14 OCT1, ELAST=RIGHT/ORANGE, CWT=630493, POND=JCJ02	2225	1	0	0.04%	0.00%	
BDW00294.S5C	10/19/2000	4/1/2001	CLE05 SNT6, ELAST=LEFT/ORANGE, CWT=630482, POND=JCJ05	2225	1	0	0.04%	0.00%	
BDW01051.LYL	2/20/2001	5/25/2001	YAKIMA LOST CREEK LATE CWT 05-42-61 PROSSER RW 6	1255	1	1	0.08%	0.08%	
BDW01092.FA1	4/2/2001	4/19/2001	PROSSER FALL CHINOOK ACCELERATED RELEASE 1	1010	1	0	0.10%	0.00%	
BDW01109.R35	4/19/2001	4/20/2001	SPRING CHINOOK OUTMIGRANTS AT ROZA 2001	287	0	1	0.00%	0.35%	
BDW01116.CSW	4/26/2001	4/27/2001	2 POINT RELEASE - CANAL - WCHK1 UPPER CAUDAL CLIP	77	1	0	1.30%	0.00%	
BDW01135.CSW	5/15/2001	5/16/2001	2 POINT RELEASE - CANAL - WCHK1 UPPER CAUDAL CLIP	75	0	1	0.00%	1.33%	
BDW01157.FCU	6/6/2001	6/7/2001	2 POINT RELEASE - FOREBAY - COHO UNKNOWN UPPER CAUDAL CLIP	75	0	1	0.00%	1.33%	
BDW01165.FFU	6/14/2001	6/15/2001	3 POINT RELEASE - FOREBAY - FALL UNKNOWN UPPER CAUDAL CLIP	75	0	1	0.00%	1.33%	
BDW01288.S2C	10/15/2001	4/1/2002	CLE02 SNT9, ELAST=RIGHT/GREEN, CWT=63-12-97, POND=JCJ01	2226	0	1	0.00%	0.04%	
BDW01292.OAC	10/19/2001	4/1/2002	CLE10 OCT5, ELAST=LEFT/ORANGE, CWT=63-09-79, POND=ESJ06	2226	2	0	0.09%	0.00%	
BDW01295.OCC	10/22/2001	4/1/2002	CLE12 OCT8, ELAST=LEFT/RED, CWT=63-09-80, POND=CFJ06	2226	1	0	0.04%	0.00%	
BDW02084.FC2	3/25/2002	5/16/2002	YAKIMA RIVER FALL CHINOOK M&E - CONTROL GROUP	1000	1	0	0.10%	0.00%	
BDW02113.C03	4/23/2002	4/25/2002	2002 YAKIMA RIVER WILD/HATCHERY SURVIVAL AND ENUMERATION CHANDLER	50	1	0	2.00%	0.00%	
BDW02295.SDC	10/22/2002	4/1/2003	CLE ELUM RW 13 TO EASTON RW 1 PAT FISH	1333	1	1	0.08%	0.08%	
BDW02295.SFC	10/22/2002	4/1/2003	CLE ELUM RW 15 TO EASTON RW 3 PAT FISH	1336	0	1	0.00%	0.07%	
BDW03086.FOR	3/27/2003	3/28/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	150	0	1	0.00%	0.67%	
BDW03091.CAN	4/1/2003	4/2/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	0	1	0.00%	0.50%	
BDW03091.R30	4/1/2003	4/2/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	211	1	0	0.47%	0.00%	
BDW03093.FOR	4/3/2003	4/4/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	443	0	1	0.00%	0.23%	
BDW03108.R41	4/18/2003	4/19/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	160	0	1	0.00%	0.63%	
BDW03112.CAN	4/22/2003	4/23/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	347	1	2	0.29%	0.58%	
BDW03121.FOR	5/1/2003	5/2/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	600	1	0	0.17%	0.00%	
BDW03126.FOR	5/6/2003	5/7/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	950	1	1	0.11%	0.11%	
BDW03133.FOR	5/13/2003	5/14/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	645	1	0	0.16%	0.00%	
BDW03134.CAN	5/14/2003	5/15/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	233	1	0	0.43%	0.00%	
BDW03161.CAN	6/10/2003	6/11/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	95	1	0	1.05%	0.00%	
BDW03163.CAN	6/12/2003	6/13/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	63	1	0	1.59%	0.00%	
BDW03163.FOR	6/12/2003	6/13/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	2	0	0.67%	0.00%	
BDW03170.BEL	6/19/2003	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	237	1	0	0.42%	0.00%	
BDW03170.CAN	6/19/2003	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	0	1	0.00%	0.50%	
BDW03170.FOR	6/19/2003	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	600	0	1	0.00%	0.17%	
BDW99293.S5C	10/20/1999	3/15/2000	CLE05 SNT5, CWT=RC/POST DOR, CWT=631246, POND=CFJ05	2501	1	1	0.04%	0.04%	
BDW99299.SBC	10/26/1999	3/15/2000	CLE11 SNT1, CWT=RC/ADIPOSE, CWT=631111, POND=ESJ05	2501	0	1	0.00%	0.04%	
DTL03286.C01	10/13/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 06	2223	0	1	0.00%	0.04%	
DTL03286.C02	10/13/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 05	2223	1	0	0.04%	0.00%	
DTL03287.C03	10/14/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2224	1	0	0.04%	0.00%	
DTL03288.C05	10/15/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 05	2223	1	0	0.04%	0.00%	

DTL03290.C09	10/17/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 03	2223	1	0	0.04%	0.00%	
DTL03293.C12	10/20/2003	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 01	2223	1	0	0.04%	0.00%	
DTL03294.C14	10/21/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 02	2223	1	0	0.04%	0.00%	
DTL03295.C15	10/22/2003	3/15/2004	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, LO FEED, CLARK FLAT 01	2223	1	1	0.04%	0.04%	
DTL03296.C18	10/23/2003	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 04	2223	0	1	0.00%	0.04%	
DTL04028.SWC	1/28/2004	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	795	1	0	0.13%	0.00%	
DTL04090.CA2	3/30/2004	4/1/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	142	1	0	0.70%	0.00%	
DTL04092.CA1	4/1/2004	4/2/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	158	0	1	0.00%	0.63%	
DTL04106.MA2	4/15/2004	4/22/2004	MARION DRAIN FALL CHINOOK 2004, GROUP 2	1001	1	1	0.10%	0.10%	
DTL04121.PR1	4/30/2004	5/3/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 1, ACCELERATED	2133	2	0	0.09%	0.00%	
DTL04121.PR2	4/30/2004	5/6/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 2, ACCELERATED	2001	1	0	0.05%	0.00%	
DTL04126.PR3	5/5/2004	5/17/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 3, CONVENTIONAL	2004	1	0	0.05%	0.00%	
DTL04134.CA2	5/13/2004	5/17/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	2	1	1.38%	0.69%	
DTL04135.CA2	5/14/2004	5/17/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	137	1	0	0.73%	0.00%	
DTL04139.CA2	5/18/2004	5/21/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	133	1	0	0.75%	0.00%	
DTL04141.CA2	5/20/2004	5/23/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	133	1	1	0.75%	0.75%	
DTL04142.CA2	5/21/2004	5/23/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	69	1	0	1.45%	0.00%	
DTL04146.CA2	5/25/2004	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	1	0	0.50%	0.00%	
DTL04148.CA1	5/27/2004	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	0	1	0.00%	0.99%	
DTL04148.CA2	5/27/2004	5/30/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	2	0	1.00%	0.00%	
DTL04148.FOR	5/27/2004	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	101	1	0	0.99%	0.00%	
DTL04149.CA2	5/28/2004	5/30/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	2	0	1.00%	0.00%	
DTL04153.CA1	6/1/2004	6/2/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	1	0	1.49%	0.00%	
DTL04162.CA1	6/10/2004	6/11/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	1	0	1.49%	0.00%	
DTL04162.CA2	6/10/2004	6/13/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	0	2	0.00%	1.48%	
DTL04167.CA1	6/15/2004	6/16/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	1	0	1.49%	0.00%	
DTL04167.CA2	6/15/2004	6/18/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	1	1	0.74%	0.74%	
DTL04169.CA2	6/17/2004	6/20/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	2	1	1.48%	0.74%	
DTL04170.CA2	6/18/2004	6/20/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	4	0	2.96%	0.00%	
DTL04292.C17	10/18/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 06	2222	1	0	0.05%	0.00%	
DTL04293.C15	10/19/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 06	2222	0	1	0.00%	0.05%	
DTL04293.C16	10/19/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 05	2222	1	0	0.05%	0.00%	
DTL04294.C12	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, HI FEED, CLARK FLAT 03	2222	2	0	0.09%	0.00%	
DTL04294.C13	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 04	2223	0	1	0.00%	0.04%	
DTL04294.C14	10/20/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 03	2222	1	0	0.05%	0.00%	
DTL04295.C10	10/21/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 05	2222	0	1	0.00%	0.05%	
DTL04300.C04	10/26/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2222	2	0	0.09%	0.00%	
DTL04301.C01	10/27/2004	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 02	2222	0	2	0.00%	0.09%	
DTL04301.C02	10/27/2004	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 01	2223	1	0	0.04%	0.00%	
DTL04341.STE	12/6/2004	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	5006	1	0	0.02%	0.00%	
DTL05046.CA1	2/15/2005	2/16/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	1	0	0.99%	0.00%	
DTL05048.FOR	2/17/2005	2/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	311	2	0	0.64%	0.00%	
DTL05053.FOR	2/22/2005	2/23/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	121	3	0	2.48%	0.00%	
DTL05102.CA1	4/12/2005	4/13/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	34	1	0	2.94%	0.00%	
DTL05103.PR1	4/13/2005	4/22/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 1, ACCELERATED	2128	3	0	0.14%	0.00%	
DTL05105.MD1	4/15/2005	4/22/2005	MARION DRAIN FALL CHINOOK 2005, GROUP 1	2129	1	1	0.05%	0.05%	
DTL05105.MD2	4/15/2005	4/25/2005	MARION DRAIN FALL CHINOOK 2005, GROUP 2	2125	1	0	0.05%	0.00%	
DTL05109.STI	4/19/2005	4/25/2005	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	4203	1	0	0.02%	0.00%	

DTL05111.ARD	4/21/2005	4/27/2005	COHO PASSAGE EXPERIMENT, RELEASED ABOVE ROZA DAM	3334	0	1	0.00%	0.03%	
DTL05111.FOR	4/21/2005	4/22/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	151	1	0	0.66%	0.00%	
DTL05116.FOR	4/26/2005	4/27/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	401	1	0	0.25%	0.00%	
DTL05118.CA1	4/28/2005	4/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	301	1	0	0.33%	0.00%	
DTL05118.CA2	4/28/2005	5/1/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	301	1	0	0.33%	0.00%	
DTL05118.FOR	4/28/2005	4/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	601	1	0	0.17%	0.00%	
DTL05123.CA2	5/3/2005	5/6/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	1	0	0.50%	0.00%	
DTL05123.FOR	5/3/2005	5/4/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	401	0	1	0.00%	0.25%	
DTL05124.PR4	5/4/2005	5/6/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 2, CONVENTIONAL	2126	1	0	0.05%	0.00%	
DTL05125.CA2	5/5/2005	5/8/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	136	0	1	0.00%	0.74%	
DTL05126.CA2	5/6/2005	5/8/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	136	1	0	0.74%	0.00%	
DTL05137.CA1	5/17/2005	5/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	138	1	0	0.72%	0.00%	
DTL05137.CA2	5/17/2005	5/20/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	138	2	0	1.45%	0.00%	
DTL05137.FOR	5/17/2005	5/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	275	1	1	0.36%	0.36%	
DTL05139.CA1	5/19/2005	5/20/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	126	1	0	0.79%	0.00%	
DTL05144.CA1	5/24/2005	5/25/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	42	0	1	0.00%	2.38%	
DTL05146.CA2	5/26/2005	5/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	61	2	1	3.28%	1.64%	
DTL05147.CA2	5/27/2005	5/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	73	1	0	1.37%	0.00%	
DTL05165.CA1	6/14/2005	6/15/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	2	1	1.98%	0.99%	
DTL05165.FOR	6/14/2005	6/15/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	202	1	0	0.50%	0.00%	
DTL05172.FOR	6/21/2005	6/22/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	67	1	0	1.49%	0.00%	
DTL05174.CA2	6/23/2005	6/26/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	21	0	1	0.00%	4.76%	
DTL05193.STY	7/12/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	2524	0	2	0.00%	0.08%	
DTL05298.H01	10/25/2005	3/15/2006	CLE ELUM RW1 TO CLARK FLATS RW3	2223	1	0	0.04%	0.00%	
DTL05298.H03	10/25/2005	3/15/2006	CLE ELUM RW 3 TO EASTON 03	2223	1	0	0.04%	0.00%	
DTL05298.L04	10/25/2005	3/15/2006	CLE ELUM RW 4 TO EASTON RW 4	2224	1	0	0.04%	0.00%	
DTL05298.L06	10/25/2005	3/15/2006	CLE ELUM RW 6 TO JACK CREEK RW 4	2222	0	1	0.00%	0.05%	
DTL05300.H07	10/27/2005	3/15/2006	CLE ELUM RW 7 TO EASTON RW 5	2222	0	1	0.00%	0.05%	
DTL05301.H10	10/28/2005	3/15/2006	CLE ELUM RW 10 TO JACK CREEK RW 6	2222	0	4	0.00%	0.18%	
DTL05301.L08	10/28/2005	3/15/2006	CLE ELUM RW 8 TO EASTON RW 6	2222	0	1	0.00%	0.05%	
DTL05304.H11	10/31/2005	3/15/2006	CLE ELUM RW 11 TO JACK CREEK RW 1	2222	0	3	0.00%	0.14%	
DTL05305.H13	11/1/2005	3/15/2006	CLE ELUM RW 13 TO EASTON RW 1	2222	1	1	0.05%	0.05%	
DTL05305.H15	11/1/2005	3/15/2006	CLE ELUM RW 15 TO CLARK FLATS RW 1	2222	0	1	0.00%	0.05%	
DTL05305.L14	11/1/2005	3/15/2006	CLE ELUM RW 14 TO EASTON RW 2	2222	1	1	0.05%	0.05%	
DTL05306.L16	11/2/2005	3/15/2006	CLE ELUM RW 16 TO CLARK FLATS RW 2	2224	1	2	0.04%	0.09%	
DTL05307.L18	11/3/2005	3/15/2006	CLE ELUM RW 18 TO CLARK FLATS RW 6	2222	0	1	0.00%	0.05%	
DTL05319.LCE	11/15/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2516	0	1	0.00%	0.04%	
DTL05320.STE	11/16/2005	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES PONDS	2506	0	1	0.00%	0.04%	
DTL06045.CA1	2/14/2006	2/15/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	71	1	0	1.41%	0.00%	
DTL06054.FOR	2/23/2006	2/24/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	86	2	0	2.33%	0.00%	
DTL06059.CLE	2/28/2006	6/7/2006	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO LAKE	9999	0	1	0.00%	0.01%	
DTL06080.FS1	3/21/2006	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9999	2	19	0.02%	0.19%	
DTL06080.FS2	3/21/2006	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9903	4	8	0.04%	0.08%	
DTL06097.PR2	4/7/2006	4/28/2006	YAKIMA FALL CHINOOK REARED AT AND RELEASED FROM PROSSER HATCHERY	5001	1	0	0.02%	0.00%	
DTL06110.CA1	4/20/2006	4/21/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	281	0	1	0.00%	0.36%	
DTL06110.CA2	4/20/2006	4/23/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	281	0	1	0.00%	0.36%	
DTL06115.CA1	4/25/2006	4/26/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	201	0	1	0.00%	0.50%	
DTL06115.CA2	4/25/2006	4/28/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	0	2	0.00%	1.00%	

DTL06117.CA1	4/27/2006	4/28/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	205	2	1	0.98%	0.49%	
DTL06129.CA1	5/9/2006	5/10/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	130	1	1	0.77%	0.77%	
DTL06129.CA2	5/9/2006	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	119	0	1	0.00%	0.84%	
DTL06129.FOR	5/9/2006	5/10/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	238	0	1	0.00%	0.42%	
DTL06131.CA1	5/11/2006	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	167	0	3	0.00%	1.80%	
DTL06131.FOR	5/11/2006	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	317	0	1	0.00%	0.32%	
DTL06132.CA2	5/12/2006	5/14/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	170	1	0	0.59%	0.00%	
DTL06136.CA1	5/16/2006	5/17/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	0	4	0.00%	2.00%	
DTL06136.FOR	5/16/2006	5/17/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	1	1	0.25%	0.25%	
DTL06178.CA2	6/27/2006	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	100	3	3	3.00%	3.00%	
DTL06180.CA1	6/29/2006	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	105	1	3	0.95%	2.86%	
DTL06180.CA2	6/29/2006	7/2/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	100	1	7	1.00%	7.00%	
DTL06180.CA3	6/30/2006	7/2/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	86	1	8	1.16%	9.30%	
DTL06180.FOR	6/29/2006	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	200	1	2	0.50%	1.00%	
DTL06191.HY1	7/10/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1251	0	2	0.00%	0.16%	
DTL06193.BUB	7/12/2006	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO BUMPING LAKE	3002	1	2	0.03%	0.07%	
DTL06193.HSP	7/12/2006	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM HANSON PONDS	1026	0	1	0.00%	0.10%	
DTL06193.HY2	7/12/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1251	0	1	0.00%	0.08%	
DTL06193.LY1	7/12/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1250	1	1	0.08%	0.08%	
DTL06193.PRY	7/12/2006	4/15/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM PROSSER HATCHERY	2501	1	0	0.04%	0.00%	
DTL06289.C01	10/16/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	2	0.00%	0.09%	
DTL06289.C02	10/16/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	2	3	0.09%	0.14%	
DTL06289.C03	10/16/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	4	0.00%	0.18%	
DTL06290.C04	10/17/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	2	0.05%	0.09%	
DTL06290.C05	10/17/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2228	0	3	0.00%	0.13%	
DTL06291.C06	10/18/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	2	0.05%	0.09%	
DTL06291.C07	10/18/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	2	0.00%	0.09%	
DTL06292.C08	10/19/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	1	0.00%	0.05%	
DTL06292.C09	10/19/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	2	0.00%	0.09%	
DTL06293.C10	10/20/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2223	3	1	0.13%	0.04%	
DTL06293.C11	10/20/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2223	1	3	0.04%	0.13%	
DTL06296.C12	10/23/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	2	0	0.09%	0.00%	
DTL06296.C13	10/23/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2224	0	2	0.00%	0.09%	
DTL06297.C15	10/24/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	2	0.00%	0.09%	
DTL06298.C16	10/25/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	1	2	0.05%	0.09%	
DTL06298.C17	10/25/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	2	5	0.09%	0.23%	
DTL06299.C18	10/26/2006	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	0	4	0.00%	0.18%	
DTL06352.HM3	12/18/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1253	0	1	0.00%	0.08%	
DTL06352.ST1	12/18/2006	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1261	1	0	0.08%	0.00%	
DTL07040.R04	2/9/2007	2/9/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	104	0	1	0.00%	0.96%	
DTL07087.CLE	3/28/2007	4/23/2007	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO LAKE	9999	3	5	0.03%	0.05%	
DTL07094.R10	4/4/2007	4/4/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	205	0	1	0.00%	0.49%	
DTL07100.CA2	4/10/2007	4/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	68	0	2	0.00%	2.94%	
DTL07100.ST1	4/10/2007	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	9970	39	24	0.39%	0.24%	
DTL07102.BY1	4/12/2007	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM BILLY'S POND	5002	1	0	0.02%	0.00%	
DTL07102.CA2	4/12/2007	4/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	0	2	0.00%	2.38%	
DTL07103.CA2	4/13/2007	4/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	0	1	0.00%	1.19%	
DTL07103.PR3	4/13/2007	4/27/2007	PROSSER HATCHERY IN BASIN FALL CHINOOK, GROUP 2	2501	2	0	0.08%	0.00%	

DTL07106.LW1	4/16/2007	4/27/2007	HAT. FALL CHINOOK TRANSFERRED FROM LITTLE WHITE H TO PROSSER H, GROUP 1	2505	1	0	0.04%	0.00%	
DTL07107.CA1	4/17/2007	4/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	114	0	1	0.00%	0.88%	
DTL07107.CA2	4/17/2007	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	116	2	1	1.72%	0.86%	
DTL07107.FOR	4/17/2007	4/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	224	0	1	0.00%	0.45%	
DTL07107.LW3	4/17/2007	4/23/2007	HAT. FALL CHINOOK TRANSFERRED FROM LITTLE WHITE H TO PROSSER H, GROUP 2	2504	2	0	0.08%	0.00%	
DTL07109.CA1	4/19/2007	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	186	0	1	0.00%	0.54%	
DTL07109.CA2	4/19/2007	4/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	186	1	2	0.54%	1.08%	
DTL07109.FOR	4/19/2007	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	372	2	1	0.54%	0.27%	
DTL07110.CA2	4/20/2007	4/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	186	1	2	0.54%	1.08%	
DTL07110.MD1	4/20/2007	4/27/2007	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN, GROUP 1	2638	5	2	0.19%	0.08%	
DTL07113.MD3	4/23/2007	5/1/2007	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN, GROUP 2	2306	2	0	0.09%	0.00%	
DTL07114.BEL	4/24/2007	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	390	1	0	0.26%	0.00%	
DTL07114.CA1	4/24/2007	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	195	0	1	0.00%	0.51%	
DTL07114.FOR	4/24/2007	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	390	2	1	0.51%	0.26%	
DTL07116.CA1	4/26/2007	4/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	145	1	0	0.69%	0.00%	
DTL07116.CA2	4/26/2007	4/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	0	2	0.00%	1.38%	
DTL07116.FOR	4/26/2007	4/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	290	2	1	0.69%	0.34%	
DTL07116.GRA	4/26/2007	4/26/2007	FALL CHINOOK CAPTURED AND RELEASED BELOW GRANGER/MARION DRAIN	30	1	0	3.33%	0.00%	
DTL07117.CA2	4/27/2007	4/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	1	1	0.69%	0.69%	
DTL07121.CA1	5/1/2007	5/2/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	2	5	1.00%	2.50%	
DTL07121.CA2	5/1/2007	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	200	0	5	0.00%	2.50%	
DTL07121.FOR	5/1/2007	5/2/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	1	2	0.25%	0.50%	
DTL07121.R16	5/1/2007	5/1/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	130	1	0	0.77%	0.00%	
DTL07123.CA1	5/3/2007	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	0	4	0.00%	3.96%	
DTL07123.CA2	5/3/2007	5/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	95	0	4	0.00%	4.21%	
DTL07123.FOR	5/3/2007	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	207	0	1	0.00%	0.48%	
DTL07124.CA2	5/4/2007	5/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	95	4	5	4.21%	5.26%	
DTL07128.CA1	5/8/2007	5/9/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	82	0	2	0.00%	2.44%	
DTL07128.CA2	5/8/2007	5/11/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	82	0	1	0.00%	1.22%	
DTL07128.FOR	5/8/2007	5/9/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	132	0	1	0.00%	0.76%	
DTL07130.CA1	5/10/2007	5/11/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	155	0	2	0.00%	1.29%	
DTL07130.CA2	5/10/2007	5/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	130	0	4	0.00%	3.08%	
DTL07130.R19	5/10/2007	5/11/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	183	0	1	0.00%	0.55%	
DTL07131.CA2	5/11/2007	5/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	131	0	1	0.00%	0.76%	
DTL07137.CA1	5/17/2007	5/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	74	0	2	0.00%	2.70%	
DTL07137.CA2	5/17/2007	5/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	74	1	2	1.35%	2.70%	
DTL07137.R22	5/17/2007	5/18/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	426	1	1	0.23%	0.23%	
DTL07138.CA2	5/18/2007	5/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	74	0	1	0.00%	1.35%	
DTL07142.FOR	5/22/2007	5/23/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	90	0	1	0.00%	1.11%	
DTL07144.CA1	5/24/2007	5/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	62	0	1	0.00%	1.61%	
DTL07144.FOR	5/24/2007	5/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	124	2	0	1.61%	0.00%	
DTL07149.CA1	5/29/2007	5/30/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	120	9	1	7.50%	0.83%	
DTL07149.CA2	5/29/2007	6/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	94	1	3	1.06%	3.19%	
DTL07149.FOR	5/29/2007	5/30/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	240	2	1	0.83%	0.42%	
DTL07151.CA1	5/31/2007	6/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	75	1	1	1.33%	1.33%	
DTL07151.CA2	5/31/2007	6/3/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	92	5	3	5.43%	3.26%	
DTL07152.CA2	6/1/2007	6/3/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	75	1	0	1.33%	0.00%	
DTL07156.CA1	6/5/2007	6/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	79	1	1	1.27%	1.27%	

DTL07156.CA2	6/5/2007	6/8/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	79	2	0	2.53%	0.00%	
DTL07158.CA2	6/7/2007	6/10/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	60	0	2	0.00%	3.33%	
DTL07163.CA1	6/12/2007	6/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	3	6	6.00%	12.00%	
DTL07163.CA2	6/12/2007	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	48	0	1	0.00%	2.08%	
DTL07165.CA1	6/14/2007	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	83	2	1	2.41%	1.20%	
DTL07165.CA2	6/14/2007	6/17/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	83	4	0	4.82%	0.00%	
DTL07165.FOR	6/14/2007	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	162	5	0	3.09%	0.00%	
DTL07166.CA2	6/15/2007	6/17/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	8	1	9.52%	1.19%	
DTL07170.CA1	6/19/2007	6/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	146	6	3	4.11%	2.05%	
DTL07170.CA2	6/19/2007	6/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	142	4	3	2.82%	2.11%	
DTL07170.FOR	6/19/2007	6/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	294	3	4	1.02%	1.36%	
DTL07172.CA1	6/21/2007	6/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	33	1	1	3.03%	3.03%	
DTL07172.CA2	6/21/2007	6/24/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	33	1	1	3.03%	3.03%	
DTL07173.CA2	6/22/2007	6/24/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	33	3	1	9.09%	3.03%	
DTL07177.BEL	6/26/2007	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	250	2	0	0.80%	0.00%	
DTL07177.CA1	6/26/2007	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	125	3	5	2.40%	4.00%	
DTL07177.CA2	6/26/2007	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	125	3	1	2.40%	0.80%	
DTL07177.FOR	6/26/2007	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	250	4	2	1.60%	0.80%	
DTL07179.CA1	6/28/2007	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	93	0	3	0.00%	3.23%	
DTL07179.CA2	6/28/2007	7/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	93	2	7	2.15%	7.53%	
DTL07179.FOR	6/28/2007	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	183	4	4	2.19%	2.19%	
DTL07180.CA2	6/29/2007	7/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	90	1	3	1.11%	3.33%	
DTL07190.LY1	7/9/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1250	0	4	0.00%	0.32%	
DTL07190.SY1	7/9/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1252	0	1	0.00%	0.08%	
DTL07191.HY2	7/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM HOLMES POND	1253	0	1	0.00%	0.08%	
DTL07191.LY2	7/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1255	0	1	0.00%	0.08%	
DTL07191.SY3	7/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1256	1	1	0.08%	0.08%	
DTL07192.EAY	7/11/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM EASTON POND	2501	0	1	0.00%	0.04%	
DTL07192.NLY	7/11/2007	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO NILE CREEK	3026	0	8	0.00%	0.26%	
DTL07193.CWY	7/12/2007	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO COWICHE CREEK	3004	0	2	0.00%	0.07%	
DTL07193.LTY	7/12/2007	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO N FK LITTLE NACHES RIVER	3001	2	3	0.07%	0.10%	
DTL07197.BNY	7/16/2007	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM BOONE POND	2522	0	1	0.00%	0.04%	
DTL07197.RCY	7/16/2007	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO REECER CREEK	3020	1	2	0.03%	0.07%	
DTL07288.B01	10/15/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	0	6	0.00%	0.30%	
DTL07288.B03	10/15/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	0	3	0.00%	0.15%	
DTL07288.E02	10/15/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	1	3	0.05%	0.15%	
DTL07289.B05	10/16/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	2	3	0.10%	0.15%	
DTL07289.E04	10/16/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	0	8	0.00%	0.40%	
DTL07290.B07	10/17/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	2	5	0.10%	0.25%	
DTL07290.E06	10/17/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	1	6	0.05%	0.30%	
DTL07291.B09	10/18/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	1	5	0.05%	0.25%	
DTL07291.E08	10/18/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	2	9	0.10%	0.45%	
DTL07292.B11	10/19/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	2	6	0.10%	0.30%	
DTL07292.E10	10/19/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	3	4	0.15%	0.20%	
DTL07295.B13	10/22/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	1	6	0.05%	0.30%	
DTL07295.E12	10/22/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2001	0	7	0.00%	0.35%	
DTL07296.B15	10/23/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	5	3	0.25%	0.15%	
DTL07296.E16	10/23/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	2	4	0.10%	0.20%	

DTL07297.B17	10/24/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	4000	7	12	0.18%	0.30%	
DTL07298.E18	10/25/2007	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	4000	6	11	0.15%	0.28%	
DTL07344.LE1	12/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1252	0	4	0.00%	0.32%	
DTL07344.LE3	12/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1272	0	3	0.00%	0.24%	
DTL07344.SE1	12/10/2007	4/5/2007	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1253	0	2	0.00%	0.16%	
DTL07344.SE3	12/10/2007	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1254	0	3	0.00%	0.24%	
DTL08044.R01	2/13/2008	2/15/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	337	1	1	0.30%	0.30%	
DTL08058.R03	2/27/2008	2/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	270	1	0	0.37%	0.00%	
DTL08064.R04	3/4/2008	3/5/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	213	0	1	0.00%	0.47%	
DTL08077.MDE	3/17/2008	3/19/2008	HATCHERY COHO RELEASED FROM MARION DRAIN	3013	0	3	0.00%	0.10%	
DTL08080.R10	3/20/2008	3/21/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	158	0	1	0.00%	0.63%	
DTL08084.CLN	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO FOREBAY	6056	5	7	0.08%	0.12%	
DTL08084.DBL	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; KNOWN DOUBLE TAGS FROM CLN AND UCL FILES	149	1	0	0.67%	0.00%	
DTL08084.UCL	3/24/2008	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED DIRECTLY INTO UPPER LAKE	6011	2	3	0.03%	0.05%	
DTL08086.R13	3/26/2008	3/27/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	283	1	2	0.35%	0.71%	
DTL08087.R14	3/27/2008	3/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	241	0	1	0.00%	0.41%	
DTL08088.R15	3/28/2008	3/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	229	0	1	0.00%	0.44%	
DTL08091.MD1	3/31/2008	4/16/2008	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN	4513	5	5	0.11%	0.11%	
DTL08092.R16	4/1/2008	4/2/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	136	0	2	0.00%	1.47%	
DTL08094.PY1	4/3/2008	4/9/2008	YEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 1	1089	0	2	0.00%	0.18%	
DTL08098.PS1	4/7/2008	4/11/2008	SUBYEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 1	5001	1	2	0.02%	0.04%	
DTL08100.R19	4/9/2008	4/10/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	207	1	0	0.48%	0.00%	
DTL08100.SK1	4/9/2008	5/15/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT SKOV POND	5002	18	43	0.36%	0.86%	
DTL08101.CA1	4/10/2008	4/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	1	1	0.99%	0.99%	
DTL08101.R20	4/10/2008	4/10/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	235	0	2	0.00%	0.85%	
DTL08102.BY1	4/11/2008	5/11/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT BILLY'S POND	5008	1	5	0.02%	0.10%	
DTL08105.ST1	4/14/2008	5/14/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT STILES POND	5105	12	26	0.24%	0.51%	
DTL08105.ST2	4/14/2008	5/14/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT STILES POND	4902	12	29	0.24%	0.59%	
DTL08106.CA1	4/15/2008	4/16/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	0	2	0.00%	2.00%	
DTL08106.R21	4/15/2008	4/16/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	482	0	3	0.00%	0.62%	
DTL08108.CA1	4/17/2008	4/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	1	6	0.33%	2.00%	
DTL08108.FOR	4/17/2008	4/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	2	3	0.67%	1.00%	
DTL08110.SAT	4/19/2008	4/19/2008	SATUS CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED IN SATUS WILDLF AREA	3	0	1	0.00%	33.33%	
DTL08113.CA1	4/22/2008	4/23/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	500	1	8	0.20%	1.60%	
DTL08113.FOR	4/22/2008	4/23/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	500	0	6	0.00%	1.20%	
DTL08114.LW1	4/23/2008	4/25/2008	SUBYEARLING LTL WHITE FALL CHINOOK (ACCELERATED) REL. FROM PROSSER, GRP 1	5000	4	0	0.08%	0.00%	
DTL08115.CA1	4/24/2008	4/25/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	401	0	11	0.00%	2.74%	
DTL08115.FOR	4/24/2008	4/25/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	1	3	0.25%	0.75%	
DTL08120.CA1	4/29/2008	4/30/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	0	3	0.00%	1.50%	
DTL08120.FOR	4/29/2008	4/30/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	200	3	1	1.50%	0.50%	
DTL08122.CA1	5/1/2008	5/2/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	0	13	0.00%	4.33%	
DTL08122.FOR	5/1/2008	5/2/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	1	7	0.33%	2.33%	
DTL08127.GRB	5/6/2008	5/6/2008	FALL CHINOOK CAPTURED AND RELEASED BELOW GRANGER/MARION DRAIN	32	0	1	0.00%	3.13%	
DTL08128.CA1	5/7/2008	5/8/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	350	2	14	0.57%	4.00%	
DTL08129.CA1	5/8/2008	5/9/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	1	10	0.33%	3.33%	
DTL08129.FOR	5/8/2008	5/9/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	0	1	0.00%	0.33%	
DTL08134.CA1	5/13/2008	5/14/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	350	4	7	1.14%	2.00%	
DTL08134.FOR	5/13/2008	5/14/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	350	1	5	0.29%	1.43%	

DTL08136.CA1	5/15/2008	5/16/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	2	6	1.00%	3.00%	
DTL08141.LW5	5/20/2008	5/22/2008	SUBYEARLING LTL WHITE FALL CHINOOK (CONVENTIONAL) REL. FROM PROSSER, GRP 1	5001	3	0	0.06%	0.00%	
DTL08141.LW7	5/20/2008	5/27/2008	SUBYEARLING LTL WHITE FALL CHINOOK (CONVENTIONAL) REL. FROM PROSSER, GRP 2	5006	7	1	0.14%	0.02%	
DTL08148.CA1	5/27/2008	5/28/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	0	1	0.00%	2.00%	
DTL08155.CA1	6/3/2008	6/4/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	3	2	6.00%	4.00%	
DTL08162.CA1	6/10/2008	6/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	6	3	6.00%	3.00%	
DTL08162.FOR	6/10/2008	6/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	101	1	3	0.99%	2.97%	
DTL08164.CA1	6/12/2008	6/13/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	102	3	4	2.94%	3.92%	
DTL08169.CA1	6/17/2008	6/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	10	9	3.33%	3.00%	
DTL08169.FOR	6/17/2008	6/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	5	8	1.67%	2.67%	
DTL08170.CA1	6/18/2008	6/19/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	3	3	3.00%	3.00%	
DTL08170.FOR	6/18/2008	6/19/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	100	4	4	4.00%	4.00%	
DTL08182.PRC	6/30/2008	7/30/2009	COHO PARR PLANTS MY2009: REECER CR	2965	0	1	0.00%	0.03%	
DTL08189.PLR	7/7/2008	7/30/2008	COHO PARR PLANTS MY2009: LITTLE RATTLESNAKE CR	3005	0	1	0.00%	0.03%	
WJB08085.PRO	3/25/2008 12:00	3/25/2008 0:00	2008 PROSSER RECONDITIONED KELTS, GREEN RELEASE	13	1	0	7.69%	0.00%	
WJB07284.PRO	10/11/2007 12:00	10/11/2007 12:00	2007 PROSSER RECONDITIONED KELTS, PR1 GROUP 10/11/07 RELEASE	113	1	0	0.88%	0.00%	
WJB03342.PRO	12/8/2003 0:00	12/8/2003 0:00	2003 PROSSER RECONDITIONED KELT 12/8/03 PROSSER RELEASE	299	1	0	0.33%	0.00%	
WDM04133.SH1	5/12/2004 8:40	5/13/2004 7:00	SURVIVAL MARKING - HAT & WILD STEELHEAD 5/12/04	836	1	0	0.12%	0.00%	NMFS
RWS08067.M7B	3/7/2008 8:30	4/24/2008 10:00	HATCHERY PRODUCTION RELEASED INTO THE UMATILLA RIVER	1492	1	0	0.07%	0.00%	ODFW
EWB05130.SAL	5/10/2005 7:38	5/10/2005 8:46		111	1	0	0.90%	0.00%	IDFG
DWW07120.YA2	4/30/2007 12:00	6/3/2007 10:40	TAGGED AT PROSSER W POST ACOUSTIC TRANSMITTERS	44	1	0	2.27%	0.00%	KRC
DWW07104.YA2	4/14/2007 12:00	6/3/2007 10:40	TAGGED AT PROSSER W POST ACOUSTIC TRANSMITTERS	61	2	0	3.28%	0.00%	KRC
DMM05110.WR2	4/20/2005 15:00	4/20/2005 17:00	TX EVAL PROGRAM - MONITORED FISH RELEASE	4413	1	0	0.02%	0.00%	BIOMRK
DMM04280.WI4	10/6/2004 12:21	4/22/2005 14:00	USFWS PIT TAGGING FOR NMFS/COE TRANSPORATION STUDY. WINTHROP NFH	1800	1	0	0.06%	0.00%	USFWS
DMM04268.W2A	9/24/2004 6:21	4/19/2005 20:00	TX EVAL PROGRAM	1212	1	0	0.08%	0.00%	NMFS

Appendix I. Wapato Dam/Diversion PIT tags percentage of Tag files

[redacted]

Appendix J. Wanawish Dam/Diversion right PIT tags percentage of Tag files

[redacted]

Appendix K. Total PIT tags surveyed in 2008 shown as a percentage of Tag files.

FileName	Release Date	SessionMessage	PIT TAGS RELEASE	2008 TAGS	TAGS % FILE
BDW00059.R43	2/29/2000	ROZA DAM WINTER OUTMIGRANTS 2000	589	1	0.17%
BDW99292.S3C	3/15/2000	CLE03 SNT8, CWT=RC/ANAL, CWT=631244, POND=CFJ01	2502	1	0.04%
BDW99293.O4C	3/15/2000	CLE04 OCT8, CWT=LC/ANAL, CWT=631245, POND=CFJ02	2506	2	0.08%
BDW99293.S5C	3/15/2000	CLE05 SNT5, CWT=RC/POST DOR, CWT=631246, POND=CFJ05	2501	3	0.12%
BDW99294.O6C	3/15/2000	CLE06 OCT5, CWT=LC/POST DOR, CWT=631247, POND=CFJ06	2505	1	0.04%
BDW99295.S7C	3/15/2000	CLE07 SNT7, CWT=RC/CAUDAL, CWT=631248, POND=JCJ01	2500	3	0.12%
BDW99299.O8C	3/15/2000	CLE08 OCT7, CWT=LC/CAUDAL, CWT=631249, POND=JCJ02	2500	3	0.12%
BDW99299.SBC	3/15/2000	CLE11 SNT1, CWT=RC/ADIPOSE, CWT=631111, POND=ESJ05	2501	2	0.08%
BDW99301.SDC	3/15/2000	CLE13 SNT4, ELAST=RIGHT/RED, CWT=631113, POND=ESJ01	2500	2	0.08%
BDW99301.OEC	3/15/2000	CLE14 OCT4, ELAST=LEFT/GREEN, CWT=631114, POND=ESJ02	2502	2	0.08%
BDW99305.OGC	3/15/2000	CLE16 OCT6, ELAST=LEFT/RED, CWT=631206, POND=ESJ04	2500	3	0.12%
BDW99291.S2C	3/15/2000	CLE02 SNT2, CWT=RC/ANT DOR, CWT=631243, POND=JCJ03	2503	1	0.04%
BDW00108.R61	4/19/2000	ROZA DAM SPRING OUTMIGRANTS 2000	202	1	0.50%
BDW00115.CH3	4/25/2000	HCHK1 SPLIT CANAL RELEASE PAIRED W/ WCHK1 CAUDAL CLIP	150	2	1.33%
BDW00122.R65	5/2/2000	ROZA DAM SPRING OUTMIGRANTS 2000	177	1	0.56%
BDW00124.CHA	5/4/2000	HCHK1 SPLIT CANAL RELEASE PAIRED W/ WCHK1 UPPER CAUDAL CLIPPED	100	1	1.00%
BDW00125.C1B	5/5/2000	WCHK1 SPLIT CANAL RELEASE PAIRED W/ HCHK1 UPPER CAUDAL CLIPPED	100	1	1.00%
BDW00040.LWE	5/7/2000	LOST CREEK EARLY RW 29 AND 30 CWT 05-44-61	2500	1	0.04%
BDW00040.SWE	5/7/2000	STILES POND EARLY WILLARD RW 33 AND 34 CWT 05-44-63	2499	1	0.04%
BDW00083.EWE	5/7/2000	EASTON WILLARD EARLY RACEWAYS 21 & 22 CWT 05-44-49	2500	2	0.08%
BDW00137.FHG	5/17/2000	HCHK1 UNSPLIT FOREBAY RELEASE PAIRED W/ WCHK1 UC CLIPPED	200	1	0.50%
BDW00139.BHI	5/19/2000	HCHK1 UNSPLIT BELOW DAM RELEASE PAIRED W/ WCHK1	200	1	0.50%
BDW00145.C1L	5/25/2000	WCHK1 SPLIT CANAL RELEASE PAIRED W/ HCHK1 UC CLIPPED	98	1	1.02%
BDW00103.CC5	5/31/2000	PREDATOR AVOIDANCE TRAINING COHO 2000 JACK CREEK	800	1	0.13%
BDW00103.CT5	5/31/2000	PREDATOR AVOIDANCE TRAINING COHO 2000	800	2	0.25%
BDW00103.CC6	5/31/2000	PREDATOR AVOIDANCE TRAINING COHO 2000 JACK CREEK	801	1	0.12%
BDW00103.CT6	5/31/2000	PREDATOR ADOIDANCE TRAINING COHO 2000	799	1	0.13%
BDW00083.EWL	5/31/2000	EASTON WILLARD LATE RACEWAYS 23 & 24 CWT 05-44-50	2500	1	0.04%
BDW00174.FGU	6/23/2000	WCHK0 UNSPLIT FOREBAY RELEASE NOT PAIRED W/ ANYTHING, UC CLIPPED.	75	1	1.33%
BDW00180.FGX	6/29/2000	WCHK0 UNSPLIT FOREBAY RELEASE NOT PAIRED W/ ANYTHING, UC CLIPPED.	200	1	0.50%
BDW00294.O1C	4/1/2001	CLE01 OCT2, ELAST=RIGHT/RED, CWT=630480, POND=ESJ04	2226	4	0.18%
BDW00294.S2C	4/1/2001	CLE02 SNT2, ELAST=LEFT/RED, CWT=630481, POND=ESJ03	2228	1	0.04%
BDW00294.S3C	4/1/2001	CLE03 SNT4, ELAST=LEFT/ORANGE, CWT=630486, POND=JCJ03	2225	3	0.13%
BDW00294.O4C	4/1/2001	CLE04 OCT4, ELAST=RIGHT/ORANGE, CWT=630487, POND=JCJ04	2225	3	0.13%
BDW00294.S5C	4/1/2001	CLE05 SNT6, ELAST=LEFT/ORANGE, CWT=630482, POND=JCJ05	2225	4	0.18%
BDW00294.O6C	4/1/2001	CLE06 OCT6, ELAST=RIGHT/ORANGE, CWT=630483, POND=JCJ06	2225	3	0.13%
BDW00294.S7C	4/1/2001	CLE07 SNT3, ELAST=LEFT/GREEN, CWT=630490, POND=CFJ05	2230	2	0.09%
BDW00294.O8C	4/1/2001	CLE08 OCT3, ELAST=RIGHT/GREEN, CWT=630491, POND=CFJ06	2226	4	0.18%
BDW00294.S9C	4/1/2001	CLE09 SNT8, ELAST=LEFT/GREEN, CWT=630494, POND=CFJ01	2225	5	0.22%
BDW00294.OAC	4/1/2001	CLE10 OCT8, ELAST=RIGHT/GREEN, CWT=630495, POND=CFJ02	2225	1	0.04%
BDW00294.OCC	4/1/2001	CLE12 OCT7, ELAST=RIGHT/RED, CWT=630489, POND=ESJ06	2225	3	0.13%
BDW00294.SDC	4/1/2001	CLE13 SNT1, ELAST=LEFT/ORANGE, CWT=630492, POND=JCJ01	2226	1	0.04%
BDW00294.OEC	4/1/2001	CLE14 OCT1, ELAST=RIGHT/ORANGE, CWT=630493, POND=JCJ02	2225	4	0.18%

BDW00294.SFC	4/1/2001	CLE15 SNT9, ELAST=LEFT/GREEN, CWT=630496, POND=CFJ03	2230	2	0.09%
BDW00294.OGC	4/1/2001	CLE16 OCT9, ELAST=RIGHT/GREEN, CWT=630497, POND=CFJ04	2225	3	0.13%
BDW00294.SHC	4/1/2001	CLE17 SNT5, ELAST=LEFT/RED, CWT=630484, POND=ESJ01	2225	2	0.09%
BDW00294.OIC	4/1/2001	CLE18 OCT5, ELAST=RIGHT/RED, CWT=630485, POND=ESJ02	2226	1	0.04%
BDW01094.R26	4/5/2001	SPRING CHINOOK OUTMIGRANTS AT ROZA 2001	78	1	1.28%
BDW01092.MDS	4/12/2001	MARION DRAIN FALL CHINOOK RELEASE 1	510	1	0.20%
BDW01092.FA1	4/19/2001	PROSSER FALL CHINOOK ACCELERATED RELEASE 1	1010	1	0.10%
BDW01109.R35	4/20/2001	SPRING CHINOOK OUTMIGRANTS AT ROZA 2001	287	2	0.70%
BDW01110.R36	4/20/2001	SPRING CHINOOK OUTMIGRANTS AT ROZA 2001	271	1	0.37%
BDW01116.CSW	4/27/2001	2 POINT RELEASE - CANAL - WCHK1 UPPER CAUDAL CLIP	77	1	1.30%
BDW01043.LWE	5/7/2001	LOST CREEK WILLARD EARLY CWT 5-45-08 WILLARD RW 5	1250	3	0.24%
BDW01045.CWE	5/7/2001	CLE ELUM WILLARD EARLY CWT 5-45-11 WILLARD RW 25	1251	1	0.08%
BDW01052.SYE	5/7/2001	YAKIMA STILES POND EARLY CWT 05-42-62 PROSSER RW 7	1250	1	0.08%
BDW01135.CSW	5/16/2001	2 POINT RELEASE - CANAL - WCHK1 UPPER CAUDAL CLIP	75	1	1.33%
BDW01043.LWL	5/25/2001	WILLARD LOST CREEK LATE CWT 5-45-07 WILLARD RW 7	1257	1	0.08%
BDW01044.SWL	5/25/2001	WILLARD STILES LATE CWT 5-45-05 WILLARD RW 11	1250	1	0.08%
BDW01044.EWL	5/25/2001	EASTON WILLARD LATE CWT 5-45-10 WILLARD RW 23	1253	1	0.08%
BDW01051.LYL	5/25/2001	YAKIMA LOST CREEK LATE CWT 05-42-61 PROSSER RW 6	1255	4	0.32%
BDW01052.SYL	5/25/2001	STILES POND YAKIMA LATE CWT 05-42-44 PROSSER RW 8	1251	1	0.08%
BDW01157.FCU	6/7/2001	2 POINT RELEASE - FOREBAY - COHO UNKNOWN UPPER CAUDAL CLIP	75	1	1.33%
BDW01165.FFU	6/15/2001	3 POINT RELEASE - FOREBAY - FALL UNKNOWN UPPER CAUDAL CLIP	75	1	1.33%
BDW02071.R51	3/13/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	250	1	0.40%
BDW02079.R57	3/21/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	322	2	0.62%
BDW02088.R61	3/29/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	388	1	0.26%
BDW01288.O1C	4/1/2002	CLE01 OCT9, ELAST=LEFT/GREEN CWT=63-12-96 POND=JCJ02	2227	7	0.31%
BDW01288.S2C	4/1/2002	CLE02 SNT9, ELAST=RIGHT/GREEN, CWT=63-12-97, POND=JCJ01	2226	2	0.09%
BDW01289.S3C	4/1/2002	CLE03 SNT1, ELAST=RIGHT/GREEN, CWT=63-13-60, POND=JCJ03	2226	3	0.13%
BDW01289.O4C	4/1/2002	CLE04 OCT1, ELAST=LEFT/GREEN, CWT=63-13-63, POND=JCJ04	2226	6	0.27%
BDW01290.S5C	4/1/2002	CLE05 SNT7, ELAST=RIGHT/ORANGE, CWT=63-12-98, POND=ESJ01	2226	1	0.04%
BDW01290.O6C	4/1/2002	CLE06 OCT7, ELAST=LEFT/ORANGE, CWT=63-12-99, POND=ESJ02	2226	2	0.09%
BDW01291.S7C	4/1/2002	CLE07 SNT2, ELAST=RIGHT/RED, CWT=63-13-64, POND=CFJ03	2225	4	0.18%
BDW01291.O8C	4/1/2002	CLE08 OCT2, ELAST=LEFT/RED, CWT=63-13-65, POND=CFJ04	2225	2	0.09%
BDW01292.S9C	4/1/2002	CLE09 SNT5, ELAST=RIGHT/ORANGE, CWT=63-09-78, POND=ESJ05	2225	1	0.04%
BDW01292.OAC	4/1/2002	CLE10 OCT5, ELAST=LEFT/ORANGE, CWT=63-09-79, POND=ESJ06	2226	4	0.18%
BDW01295.SBC	4/1/2002	CLE11 SNT8, ELAST=RIGHT/RED, CWT=63-09-81, POND=CFJ05	2225	3	0.13%
BDW01295.OCC	4/1/2002	CLE12 OCT8, ELAST=LEFT/RED, CWT=63-09-80, POND=CFJ06	2226	4	0.18%
BDW01296.SDC	4/1/2002	CLE13 SNT4, ELAST=RIGHT/ORANGE, CWT=63-11-76, POND=ESJ03	2225	2	0.09%
BDW01297.OEC	4/1/2002	CLE14 OCT4, ELAST=LEFT/ORANGE, CWT=63-09-74, POND=ESJ04	2225	4	0.18%
BDW01297.SFC	4/1/2002	CLE15 SNT6, ELAST=RIGHT/GREEN, CWT=63-09-73, POND=JCJ05	2228	6	0.27%
BDW01298.OGC	4/1/2002	CLE16 OCT6, ELAST=LEFT/GREEN, CWT=63-09-72, POND=JCJ06	2229	7	0.31%
BDW01298.SHC	4/1/2002	CLE17 SNT3, ELAST=RIGHT/RED, CWT=63-05-82, POND=CFJ01	2225	2	0.09%
BDW01299.OIC	4/1/2002	CLE18 OCT3, ELAST=LEFT/RED, CWT=63-05-83, POND=CFJ02	2226	1	0.04%
BDW02086.MDS	4/1/2002	YAKIMA RIVER FALL CHINOOK M&E - MARION DRAIN STOCK	500	1	0.20%
BDW02092.R63	4/3/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	396	2	0.51%
BDW02094.R65	4/5/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	400	1	0.25%
BDW02113.R68	4/24/2002	SPRING CHINOOK OUTMIGRANTS AT ROZA 2002	115	1	0.87%
BDW02113.C03	4/25/2002	2002 YAKIMA RIVER WILD/HATCHERY SURVIVAL AND ENUMERATION	50	1	2.00%

		CHANDLER			
BDW02022.EWE	5/6/2002	YAKIMA RIVER COHO STUDY: WILLARD STOCK, EASTON, EARLY RELEASE	1253	2	0.16%
BDW02023.SWE	5/6/2002	YAKIMA RIVER COHO STUDY: WILLARD STOCK, STILES POND, EARLY RELEASE	1250	3	0.24%
BDW02023.LWE	5/6/2002	YAKIMA RIVER COHO STUDY: WILLARD STOCK, LOST CREEK, EARLY RELEASE	1250	2	0.16%
BDW02073.LYE	5/6/2002	YAKIMA RIVER COHO STUDY: LOST CREEK, EARLY RELEASE	1193	1	0.08%
BDW02084.FC2	5/16/2002	YAKIMA RIVER FALL CHINOOK M&E - CONTROL GROUP	1000	1	0.10%
BDW02022.EWL	5/25/2002	YAKIMA RIVER COHO STUDY: WILLARD STOCK, EASTON, LATE RELEASE	2501	2	0.08%
BDW02023.SWL	5/25/2002	YAKIMA RIVER COHO STUDY: WILLARD STOCK, STILES POND, LATE RELEASE	1251	2	0.16%
BDW02073.EYL	5/25/2002	YAKIMA RIVER COHO STUDY: MIXED STOCK (SEE NOTE), EASTON, LATE RELEASE	2502	1	0.04%
BDW02074.SYL	5/25/2002	YAKIMA RIVER COHO STUDY: STILES POND, LATE RELEASE	1250	2	0.16%
BDW03015.TU2	1/15/2003	TOPPENISH CREEK SCREW TRAP - STEELHEAD RELEASED BELOW UNIT 2 DAM	36	1	2.78%
BDW03030.R04	1/31/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	394	1	0.25%
BDW03037.R07	2/7/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	400	1	0.25%
BDW03058.R18	2/28/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	392	2	0.51%
BDW03086.FOR	3/28/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	150	1	0.67%
BDW02287.S5C	4/1/2003	CLE ELUM RW 05 TO CLARK FLAT RW 3	4017	2	0.05%
BDW02288.O6C	4/1/2003	CLE ELUM RW 06 TO CLARK FLAT RW 4	4000	4	0.10%
BDW02289.S7C	4/1/2003	CLE ELUM RW 07 TO JACK CREEK RW 1	4000	2	0.05%
BDW02290.O8C	4/1/2003	CLE ELUM RW 08 TO JACK CREEK RW 2	4004	8	0.20%
BDW02291.S9C	4/1/2003	CLE ELUM RW 09 TO JACK CREEK RW 5	4001	4	0.10%
BDW02294.OAC	4/1/2003	CLE ELUM RW 10 TO JACK CREEK RW 6	4000	5	0.13%
BDW02295.SDC	4/1/2003	CLE ELUM RW 13 TO EASTON RW 1 PAT FISH	1333	2	0.15%
BDW02295.SFC	4/1/2003	CLE ELUM RW 15 TO EASTON RW 3 PAT FISH	1336	3	0.22%
BDW02295.OGC	4/1/2003	CLE ELUM RW 16 TO EASTON RW 4 PAT FISH	1338	2	0.15%
BDW02296.SHC	4/1/2003	CLE ELUM RW 17 TO EASTON RW 5 PAT FISH	1334	1	0.07%
BDW02296.OIC	4/1/2003	CLE ELUM RW 18 TO EASTON RW 6 PAT FISH	1333	1	0.08%
BDW02296.O1C	4/1/2003	CLE ELUM RW 01 TO JACK CREEK RW 4	4000	3	0.08%
BDW02297.S2C	4/1/2003	CLE ELUM RW 02 TO JACK CREEK RW 3	4000	4	0.10%
BDW02352.SYV	4/1/2003	YAKIMA RIVER COHO STUDY: YAKIMA STOCK RELEASED FROM STILES POND	3332	3	0.09%
BDW03091.R30	4/2/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	211	1	0.47%
BDW03091.CAN	4/2/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	2	1.00%
BDW03092.R31	4/3/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	227	3	1.32%
BDW03093.FOR	4/4/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	443	1	0.23%
BDW03094.R33	4/5/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	232	1	0.43%
BDW02351.HYV	4/7/2003	YAKIMA RIVER COHO STUDY: YAKIMA STOCK RELEASED FROM HOLMES AND EASTON PONDS	3355	3	0.09%
BDW02352.LYV	4/7/2003	YAKIMA RIVER COHO STUDY: YAKIMA STOCK RELEASED FROM LOST CREEK PONDS	3333	2	0.06%
BDW03034.SW5	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 05), RELEASED FROM STILES POND	1250	1	0.08%
BDW03035.SW7	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 07), RELEASED FROM STILES POND	1251	3	0.24%
BDW03035.HWA	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 10), RELEASED FROM HOLMES POND	1250	1	0.08%
BDW03035.EWB	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 11), RELEASED FROM EASTON POND	833	1	0.12%
BDW03035.EWD	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 13), RELEASED FROM EASTON POND	864	1	0.12%
BDW03035.EWF	4/8/2003	YAKIMA RIVER COHO STUDY: WILLARD STOCK (POND 15), RELEASED FROM EASTON POND	764	1	0.13%
BDW03108.R41	4/19/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	160	1	0.63%
BDW03112.CAN	4/23/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	347	4	1.15%
BDW03113.R42	4/24/2003	SPRING CHINOOK OUTMIGRANTS AT ROZA 2003	101	2	1.98%

BDW03121.FOR	5/2/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	600	1	0.17%
BDW03126.FOR	5/7/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	950	2	0.21%
BDW03133.FOR	5/14/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	645	1	0.16%
BDW03134.CAN	5/15/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	233	1	0.43%
BDW03135.FCO	5/20/2003	PROSSER FALL CHINOOK, CONVENTIONAL GROUP	1987	1	0.05%
BDW03140.FOR	5/21/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	800	1	0.13%
BDW03140.CAN	5/21/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	175	1	0.57%
BDW03147.FOR	5/28/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	850	2	0.24%
BDW03161.CAN	6/11/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	95	1	1.05%
BDW03163.CAN	6/13/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	63	1	1.59%
BDW03163.FOR	6/13/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	2	0.67%
BDW03170.BEL	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	237	1	0.42%
BDW03170.CAN	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	2	1.00%
BDW03170.FOR	6/20/2003	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	600	3	0.50%
DTL03350.TU2	12/16/2003	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	3	1	33.33%
DTL04036.TU2	2/5/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	165	1	0.61%
DTL04037.R10	2/6/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	251	1	0.40%
DTL04040.TU2	2/9/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL04042.R12	2/12/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	256	1	0.39%
DTL04044.TU2	2/13/2004	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	31	1	3.23%
DTL04041.LEY	2/18/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM LAKE EASTON	2502	2	0.08%
DTL04051.R15	2/20/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	139	1	0.72%
DTL04064.R19	3/5/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	179	1	0.56%
DTL03286.C01	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 06	2223	5	0.22%
DTL03286.C02	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 05	2223	9	0.40%
DTL03286.C04	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 04	2224	5	0.22%
DTL03287.C03	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2224	6	0.27%
DTL03288.C05	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 05	2223	8	0.36%
DTL03288.C06	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 06	2223	5	0.22%
DTL03289.C07	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 05	2223	5	0.22%
DTL03289.C08	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 06	2223	8	0.36%
DTL03290.C09	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 03	2223	5	0.22%
DTL03290.C10	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 04	2223	7	0.31%
DTL03293.C11	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 02	2223	4	0.18%
DTL03293.C12	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 01	2223	5	0.22%
DTL03294.C13	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 01	2223	7	0.31%
DTL03294.C14	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 02	2223	12	0.54%
DTL03295.C15	3/15/2004	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, LO FEED, CLARK FLAT 01	2223	4	0.18%
DTL03295.C16	3/15/2004	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, HI FEED, CLARK FLAT 02	2223	4	0.18%
DTL03296.C17	3/15/2004	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 03	2223	4	0.18%
DTL03296.C18	3/15/2004	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 04	2223	5	0.22%
DTL04079.R23	3/19/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	223	1	0.45%
DTL04083.R24	3/24/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	144	1	0.69%
DTL04091.R25	4/1/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	229	1	0.44%
DTL04090.CA2	4/1/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	142	1	0.70%
DTL04092.CA1	4/2/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	158	1	0.63%

DTL04027.HWC	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	836	7	0.84%
DTL04027.HWB	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	834	5	0.60%
DTL04027.HWA	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	852	8	0.94%
DTL04028.SWA	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	832	1	0.12%
DTL04028.SWB	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	830	1	0.12%
DTL04028.SWC	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	795	6	0.75%
DTL04041.BYA	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM BOONE POND	2491	5	0.20%
DTL04041.LYA	4/5/2004	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	2451	5	0.20%
DTL04106.R30	4/16/2004	SPRING CHINOOK OUTMIGRANTS AT ROZA 2004	220	2	0.91%
DTL04106.MA2	4/22/2004	MARION DRAIN FALL CHINOOK 2004, GROUP 2	1001	3	0.30%
DTL04121.PR1	5/3/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 1, ACCELERATED	2133	3	0.14%
DTL04121.PR2	5/6/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 2, ACCELERATED	2001	1	0.05%
DTL04134.CA2	5/17/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	4	2.76%
DTL04135.CA2	5/17/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	137	2	1.46%
DTL04126.PR3	5/17/2004	PROSSER HATCHERY FALL CHINOOK, GROUP 3, CONVENTIONAL	2004	1	0.05%
DTL04139.CA2	5/21/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	133	1	0.75%
DTL04141.CA2	5/23/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	133	2	1.50%
DTL04142.CA2	5/23/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	69	1	1.45%
DTL04146.CA2	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	1	0.50%
DTL04148.CA1	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	1	0.99%
DTL04148.FOR	5/28/2004	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	101	1	0.99%
DTL04148.CA2	5/30/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	2	1.00%
DTL04149.CA2	5/30/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	2	1.00%
DTL04153.CA1	6/2/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	2	2.99%
DTL04160.CA1	6/9/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	66	1	1.52%
DTL04162.CA1	6/11/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	1	1.49%
DTL04162.CA2	6/13/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	2	1.48%
DTL04167.CA1	6/16/2004	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	67	1	1.49%
DTL04167.CA2	6/18/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	2	1.48%
DTL04169.CA2	6/20/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	3	2.22%
DTL04170.CA2	6/20/2004	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	135	4	2.96%
DTL04194.BNW	7/26/2004	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM BOONE POND	2529	4	0.16%
DTL04194.HMW	7/26/2004	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM HOLMES POND	2527	2	0.08%
DTL04194.LCW	7/26/2004	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM LOST CREEK PONDS	2529	5	0.20%
DTL05042.RO7	2/11/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	200	1	0.50%
DTL05046.CA1	2/16/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	1	0.99%
DTL05048.FOR	2/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	311	2	0.64%
DTL05053.FOR	2/23/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	121	3	2.48%
DTL04292.C17	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 06	2222	15	0.68%
DTL04292.C18	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 05	2222	17	0.77%
DTL04293.C15	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 06	2222	14	0.63%
DTL04293.C16	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 05	2222	20	0.90%
DTL04294.C13	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 04	2223	25	1.12%
DTL04294.C14	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 03	2222	14	0.63%
DTL04294.C12	3/9/2005	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, HI FEED, CLARK FLAT 03	2222	20	0.90%
DTL04295.C11	3/9/2005	CLE ELUM SPRING CHINOOK, H/H PARENTAGE, LO FEED, CLARK FLAT 04	2222	22	0.99%

DTL04295.C10	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 05	2222	13	0.59%
DTL04296.C09	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 06	2223	17	0.76%
DTL04296.C08	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 01	2224	13	0.58%
DTL04296.C07	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 02	2222	15	0.68%
DTL04299.C06	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, JACK CREEK 01	2223	21	0.94%
DTL04299.C05	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, JACK CREEK 02	2222	21	0.95%
DTL04300.C04	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, EASTON 03	2222	12	0.54%
DTL04300.C03	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, EASTON 04	2222	18	0.81%
DTL04301.C02	3/9/2005	CLE ELUM SPRING CHINOOK, LO FEED, CLARK FLAT 01	2223	17	0.76%
DTL04301.C01	3/9/2005	CLE ELUM SPRING CHINOOK, HI FEED, CLARK FLAT 02	2222	18	0.81%
DTL04201.LCY	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	5232	5	0.10%
DTL04341.HME	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	4959	21	0.42%
DTL04341.STE	3/14/2005	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	5006	19	0.38%
DTL05074.R14	3/16/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	111	3	2.70%
DTL05082.R16	3/24/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	221	1	0.45%
DTL05083.R17	3/25/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	105	2	1.90%
DTL05089.SAT	3/30/2005	SATUS CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED IN SATUS WILDLF AREA	44	2	4.55%
DTL05091.R18	4/1/2005	SPRING CHINOOK OUTMIGRANTS AT ROZA 2005	195	4	2.05%
DTL05093.TU2	4/3/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	78	1	1.28%
DTL05102.CA1	4/13/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	34	1	2.94%
DTL05105.R19	4/15/2005	ROZA OUTMIGRATION 2005	551	2	0.36%
DTL05110.BLC	4/20/2005	COHO PASSAGE EXPERIMENT, RELEASED BELOW CLE ELUM DAM	3335	10	0.30%
DTL05103.PR1	4/22/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 1, ACCELERATED	2128	3	0.14%
DTL05105.MD1	4/22/2005	MARION DRAIN FALL CHINOOK 2005, GROUP 1	2129	5	0.23%
DTL05111.FOR	4/22/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	151	1	0.66%
DTL05104.PR2	4/25/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 2, ACCELERATED	2139	1	0.05%
DTL05105.MD2	4/25/2005	MARION DRAIN FALL CHINOOK 2005, GROUP 2	2125	2	0.09%
DTL05109.STI	4/25/2005	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	4203	39	0.93%
DTL05111.ARD	4/27/2005	COHO PASSAGE EXPERIMENT, RELEASED ABOVE ROZA DAM	3334	79	2.37%
DTL05111.BRD	4/27/2005	COHO PASSAGE EXPERIMENT, RELEASED BELOW ROZA DAM	3334	77	2.31%
DTL05116.FOR	4/27/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	401	1	0.25%
DTL05118.CA1	4/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	301	1	0.33%
DTL05118.FOR	4/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	601	1	0.17%
DTL05116.CA2	5/1/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	1	0.50%
DTL05118.CA2	5/1/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	301	1	0.33%
DTL05123.HRN	5/3/2005	FALL CHINOOK RELEASED AT HORN RAPIDS DAM	378	1	0.26%
DTL05123.FOR	5/4/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	401	1	0.25%
DTL05124.PR3	5/6/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 1, CONVENTIONAL	2174	1	0.05%
DTL05124.PR4	5/6/2005	PROSSER HATCHERY FALL CHINOOK, GROUP 2, CONVENTIONAL	2126	1	0.05%
DTL05123.CA2	5/6/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	1	0.50%
DTL05125.CA2	5/8/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	136	1	0.74%
DTL05126.CA2	5/8/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	136	2	1.47%
DTL05130.AHT	5/10/2005	AHTANUM CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED ABOVE GOODMAN RD	15	1	6.67%
DTL05131.TU2	5/11/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	43	1	2.33%
DTL05130.CA1	5/11/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	121	1	0.83%
DTL05132.TU2	5/12/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	58	1	1.72%

DTL05133.TU2	5/13/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	14	1	7.14%
DTL05137.CA1	5/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	138	1	0.72%
DTL05137.FOR	5/18/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	275	2	0.73%
DTL05137.CA2	5/20/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	138	2	1.45%
DTL05139.CA1	5/20/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	126	1	0.79%
DTL05139.FOR	5/20/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	251	2	0.80%
DTL05141.TU2	5/21/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	16	1	6.25%
DTL05142.TU2	5/22/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	15	1	6.67%
DTL05144.CA1	5/25/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	42	1	2.38%
DTL05146.CA2	5/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	61	3	4.92%
DTL05147.CA2	5/29/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	73	1	1.37%
DTL05063.FLU	6/2/2005	COHO PASSAGE EXPERIMENT, TEST OF CLE ELUM FLUME ANTENNA	1001	3	0.30%
DTL05165.CA1	6/15/2005	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	3	2.97%
DTL05165.FOR	6/15/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	202	1	0.50%
DTL05172.FOR	6/22/2005	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	67	1	1.49%
DTL05174.CA2	6/26/2005	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	21	1	4.76%
DTL05192.HMW	7/26/2005	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM HOLMES POND	1026	2	0.19%
DTL05192.LCW	7/26/2005	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM LOST CREEK PONDS	1026	3	0.29%
DTL05192.UCW	7/26/2005	YAKIMA RIVER COHO STUDY, PARR RELEASED IN UPPER LAKE CLE ELUM	3010	1	0.03%
DTL05362.TU2	12/28/2005	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	99	1	1.01%
DTL06045.CA1	2/15/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	71	1	1.41%
DTL06055.R12	2/24/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	18	1	5.56%
DTL06054.FOR	2/24/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	86	2	2.33%
DTL06069.R14	3/10/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	56	1	1.79%
DTL05304.L12	3/15/2006	CLE ELUM RW 12 TO JACK CREEK RW 2	2222	9	0.41%
DTL05297.L02	3/15/2006	CLE ELUM RACEWAY 2 TO CLARK FLATS 4	2223	20	0.90%
DTL05298.H01	3/15/2006	CLE ELUM RW1 TO CLARK FLATS RW3	2223	9	0.40%
DTL05298.H03	3/15/2006	CLE ELUM RW 3 TO EASTON 03	2223	15	0.67%
DTL05298.L04	3/15/2006	CLE ELUM RW 4 TO EASTON RW 4	2224	10	0.45%
DTL05298.L06	3/15/2006	CLE ELUM RW 6 TO JACK CREEK RW 4	2222	8	0.36%
DTL05300.H07	3/15/2006	CLE ELUM RW 7 TO EASTON RW 5	2222	6	0.27%
DTL05301.L08	3/15/2006	CLE ELUM RW 8 TO EASTON RW 6	2222	8	0.36%
DTL05301.H10	3/15/2006	CLE ELUM RW 10 TO JACK CREEK RW 6	2222	15	0.68%
DTL05301.L09	3/15/2006	CLE ELUM RW 9 TO JACK CREEK RW 5	2222	16	0.72%
DTL05304.H11	3/15/2006	CLE ELUM RW 11 TO JACK CREEK RW 1	2222	19	0.86%
DTL05305.H13	3/15/2006	CLE ELUM RW 13 TO EASTON RW 1	2222	13	0.59%
DTL05305.H15	3/15/2006	CLE ELUM RW 15 TO CLARK FLATS RW 1	2222	6	0.27%
DTL05305.L14	3/15/2006	CLE ELUM RW 14 TO EASTON RW 2	2222	12	0.54%
DTL05306.L16	3/15/2006	CLE ELUM RW 16 TO CLARK FLATS RW 2	2224	8	0.36%
DTL05307.H17	3/15/2006	CLE ELUM RW 17 TO CLARK FLATS RW 5	2222	11	0.50%
DTL05307.L18	3/15/2006	CLE ELUM RW 18 TO CLARK FLATS RW 6	2222	11	0.50%
DTL05193.BNY	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM BOONE POND	2502	3	0.12%
DTL05193.HMY	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	2512	4	0.16%
DTL05193.LCY	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2517	10	0.40%
DTL05193.STY	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	2524	16	0.63%
DTL05318.BNE	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM BOONE POND	2500	1	0.04%

DTL05319.HME	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	2514	13	0.52%
DTL05319.LCE	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK PONDS	2516	7	0.28%
DTL05320.STE	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES PONDS	2506	26	1.04%
DTL05320.PRE	4/3/2006	YAKIMA RIVER COHO STUDY, RELEASED FROM PROSSER HATCHERY	1255	1	0.08%
DTL06097.R27	4/7/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	216	1	0.46%
DTL06102.R29	4/13/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	222	1	0.45%
DTL06108.F32	4/19/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006, PAIRED FOREBAY RELEASE	213	2	0.94%
DTL06108.R32	4/19/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	231	1	0.43%
DTL06109.R33	4/20/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	221	2	0.90%
DTL06110.F34	4/21/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006, PAIRED FOREBAY RELEASE	214	1	0.47%
DTL06110.R34	4/21/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	257	2	0.78%
DTL06110.CA1	4/21/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	281	1	0.36%
DTL06110.CA2	4/23/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	281	1	0.36%
DTL06096.PR1	4/24/2006	YAKIMA FALL CHINOOK REARED AT AND RELEASED FROM PROSSER HATCHERY	5001	1	0.02%
DTL06061.BLC	4/26/2006	1,001 HATCHERY COHO FOR RELEASE BELOW CLE ELUM DAM	1001	6	0.60%
DTL06115.CA1	4/26/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	201	1	0.50%
DTL06080.FS1	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9999	114	1.14%
DTL06080.FS2	4/27/2006	YAKIMA FALL CHINOOK REARED AT PROSSER AND RELEASED FROM STILES PD	9903	102	1.03%
DTL06097.PR2	4/28/2006	YAKIMA FALL CHINOOK REARED AT AND RELEASED FROM PROSSER HATCHERY	5001	3	0.06%
DTL06115.CA2	4/28/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	201	2	1.00%
DTL06117.CA1	4/28/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	205	3	1.46%
DTL06124.R39	5/5/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	97	2	2.06%
DTL06125.R40	5/5/2006	SPRING CHINOOK OUTMIGRANTS AT ROZA 2006	41	1	2.44%
DTL06129.HRN	5/9/2006	HORN RAPIDS FALL CHINOOK	192	1	0.52%
DTL06129.CA1	5/10/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	130	2	1.54%
DTL06129.FOR	5/10/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	238	1	0.42%
DTL06129.CA2	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	119	1	0.84%
DTL06131.CA1	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	167	3	1.80%
DTL06131.FOR	5/12/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	317	1	0.32%
DTL06132.CA2	5/14/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	170	1	0.59%
DTL06136.CA1	5/17/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	4	2.00%
DTL06136.FOR	5/17/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	2	0.50%
DTL06145.TU2	5/25/2006	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	10	1	10.00%
DTL06147.TU2	5/27/2006	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	5	1	20.00%
DTL06059.CLE	6/7/2006	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO LAKE	9999	4	0.04%
DTL06061.FLU	6/7/2006	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM CLE ELUM DAM FLUME	1000	6	0.60%
DTL06178.CA2	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	100	6	6.00%
DTL06180.CA1	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	105	4	3.81%
DTL06180.FOR	6/30/2006	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	200	3	1.50%
DTL06180.CA2	7/2/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	100	8	8.00%
DTL06180.CA3	7/2/2006	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	86	9	10.47%
DTL06193.BUB	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO BUMPING LAKE	3002	5	0.17%
DTL06193.HSP	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM HANSON PONDS	1026	2	0.19%
DTL06193.UCE	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED IN CLE ELUM R AT LK TUCQUALA OUTLET	3000	1	0.03%
DTL06193.NSP	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED IN BUCKSKIN SLOUGH (NELSON SPRINGS)	1026	1	0.10%

DTL06193.LCK	7/27/2006	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM LOST CREEK POND	1026	4	0.39%
DTL06236.TNW	8/24/2006	TEANAWAY RIVER JUVENILE O. MYKISS (SEE NOTE)	218	1	0.46%
DTL06361.TU2	12/27/2006	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	26	1	3.85%
DTL07040.R04	2/9/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	104	1	0.96%
DTL06289.C01	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	9	0.41%
DTL06289.C02	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	7	0.32%
DTL06289.C03	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	9	0.41%
DTL06290.C04	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	9	0.41%
DTL06290.C05	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2228	6	0.27%
DTL06291.C06	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	8	0.36%
DTL06291.C07	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	6	0.27%
DTL06292.C08	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	7	0.32%
DTL06292.C09	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	4	0.18%
DTL06293.C10	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2223	7	0.31%
DTL06293.C11	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2223	8	0.36%
DTL06296.C12	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	4	0.18%
DTL06296.C13	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2224	7	0.31%
DTL06297.C14	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	6	0.27%
DTL06297.C15	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	3	0.14%
DTL06298.C16	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	10	0.45%
DTL06298.C17	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	11	0.50%
DTL06299.C18	3/15/2007	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2007	2222	12	0.54%
DTL07094.R10	4/4/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	205	2	0.98%
DTL06191.HY1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1251	6	0.48%
DTL06193.HY2	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1251	4	0.32%
DTL06193.LY1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1250	4	0.32%
DTL06193.LY2	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1265	5	0.40%
DTL06193.SY1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1251	2	0.16%
DTL06193.SY2	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1262	2	0.16%
DTL06352.HM1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1253	4	0.32%
DTL06352.HM3	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM HOLMES POND	1253	6	0.48%
DTL06352.LC1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1259	2	0.16%
DTL06352.LC3	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM LOST CREEK POND	1252	5	0.40%
DTL06352.ST1	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1261	8	0.63%
DTL06352.ST3	4/5/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM STILES POND	1253	2	0.16%
DTL07344.SE1	4/5/2007	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1253	10	0.80%
DTL07100.CA2	4/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	68	2	2.94%
DTL07102.R12	4/13/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	228	1	0.44%
DTL07102.CA2	4/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	2	2.38%
DTL07103.CA2	4/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	1	1.19%
DTL06193.PRY	4/15/2007	YAKIMA RIVER COHO STUDY, RELEASED FROM PROSSER HATCHERY	2501	7	0.28%
DTL07107.CA1	4/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	114	1	0.88%
DTL07107.FOR	4/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	224	1	0.45%
DTL07107.CA2	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	116	3	2.59%

DTL07109.CA1	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	186	1	0.54%
DTL07109.FOR	4/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	372	3	0.81%
DTL07109.CA2	4/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	186	3	1.61%
DTL07110.CA2	4/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	186	3	1.61%
DTL07103.PR1	4/23/2007	HATCHERY FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 1	2501	1	0.04%
DTL07107.LW3	4/23/2007	HAT. FALL CHINOOK TRANSFERRED FROM LITTLE WHITE H TO PROSSER H, GROUP 2	2504	3	0.12%
DTL07087.CLE	4/23/2007	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO LAKE	9999	31	0.31%
DTL07114.FOR	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	390	3	0.77%
DTL07114.CA1	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	195	1	0.51%
DTL07114.BEL	4/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	390	1	0.26%
DTL07116.GRA	4/26/2007	FALL CHINOOK CAPTURED AND RELEASED BELOW GRANGER/MARION DRAIN	30	1	3.33%
DTL07103.PR3	4/27/2007	PROSSER HATCHERY IN BASIN FALL CHINOOK, GROUP 2	2501	6	0.24%
DTL07106.LW1	4/27/2007	HAT. FALL CHINOOK TRANSFERRED FROM LITTLE WHITE H TO PROSSER H, GROUP 1	2505	2	0.08%
DTL07110.MD1	4/27/2007	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN, GROUP 1	2638	7	0.27%
DTL07117.TU2	4/27/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	33	1	3.03%
DTL07117.R15	4/27/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	189	4	2.12%
DTL07116.CA1	4/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	145	2	1.38%
DTL07116.FOR	4/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	290	4	1.38%
DTL07116.CA2	4/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	2	1.38%
DTL07117.CA2	4/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	145	3	2.07%
DTL07113.MD3	5/1/2007	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN, GROUP 2	2306	2	0.09%
DTL07121.R16	5/1/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	130	1	0.77%
DTL07121.CA1	5/2/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	7	3.50%
DTL07121.FOR	5/2/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	4	1.00%
DTL07124.TU2	5/4/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL07121.CA2	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	200	7	3.50%
DTL07123.CA1	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	4	3.96%
DTL07123.FOR	5/4/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	207	1	0.48%
DTL07123.CA2	5/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	95	6	6.32%
DTL07124.CA2	5/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	95	9	9.47%
DTL07128.CA1	5/9/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	82	2	2.44%
DTL07128.FOR	5/9/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	132	1	0.76%
DTL07130.R19	5/11/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	183	3	1.64%
DTL07131.R20	5/11/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	126	3	2.38%
DTL07128.CA2	5/11/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	82	2	2.44%
DTL07130.CA1	5/11/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	155	3	1.94%
DTL07131.CA2	5/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	131	1	0.76%
DTL07130.CA2	5/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	130	5	3.85%
DTL07135.TU2	5/15/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	5	1	20.00%
DTL07135.CA1	5/16/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	45	2	4.44%
DTL07100.ST1	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM STILES POND	9970	133	1.33%
DTL07102.BY1	5/18/2007	HATCHERY FALL CHINOOK RELEASED FROM BILLY'S POND	5002	7	0.14%
DTL07137.R22	5/18/2007	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	426	2	0.47%
DTL07137.CA1	5/18/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	74	3	4.05%
DTL07137.CA2	5/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	74	4	5.41%

DTL07138.CA2	5/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	74	6	8.11%
DTL07142.TU2	5/22/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL07143.TU2	5/23/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	10	1	10.00%
DTL07142.CA1	5/23/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	45	4	8.89%
DTL07142.FOR	5/23/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	90	1	1.11%
DTL07142.CA2	5/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	36	1	2.78%
DTL07144.CA1	5/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	62	1	1.61%
DTL07144.FOR	5/25/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	124	2	1.61%
DTL07144.CA2	5/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	75	4	5.33%
DTL07145.CA2	5/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	79	1	1.27%
DTL07149.FOR	5/30/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	240	4	1.67%
DTL07149.CA1	5/30/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	120	13	10.83%
DTL07149.CA2	6/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	94	6	6.38%
DTL07151.CA1	6/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	75	3	4.00%
DTL07151.CA2	6/3/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	92	9	9.78%
DTL07152.CA2	6/3/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	75	1	1.33%
DTL07156.CA1	6/6/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	79	2	2.53%
DTL07156.CA2	6/8/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	79	10	12.66%
DTL07158.CA2	6/10/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	60	6	10.00%
DTL07163.CA1	6/13/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	9	18.00%
DTL07163.CA2	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	48	1	2.08%
DTL07165.CA1	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	83	4	4.82%
DTL07165.FOR	6/15/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	162	5	3.09%
DTL07165.CA2	6/17/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	83	5	6.02%
DTL07166.CA2	6/17/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	84	10	11.90%
DTL07170.CA1	6/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	146	10	6.85%
DTL07170.FOR	6/20/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	294	7	2.38%
DTL07170.CA2	6/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	142	8	5.63%
DTL07172.CA1	6/22/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	33	2	6.06%
DTL07172.CA2	6/24/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	33	2	6.06%
DTL07173.CA2	6/24/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	33	4	12.12%
DTL07176.TNW	6/25/2007	NORTH FORK TEANAWAY RIVER O. MYKISS (SEE NOTE)	596	1	0.17%
DTL07177.BEL	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, BELOW DAM RELEASE	250	2	0.80%
DTL07177.CA1	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	125	8	6.40%
DTL07177.FOR	6/27/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	250	6	2.40%
DTL07179.CA1	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	93	3	3.23%
DTL07177.CA2	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	125	4	3.20%
DTL07179.FOR	6/29/2007	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	183	8	4.37%
DTL07179.CA2	7/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	93	9	9.68%
DTL07180.CA2	7/1/2007	CHANDLER JUVENILE FACILITY CALIBRATION, DELAYED CANAL RELEASE	90	4	4.44%
DTL07192.NLY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO NILE CREEK	3026	17	0.56%
DTL07193.LTY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO N FK LITTLE NACHES RIVER	3001	18	0.60%
DTL07193.CWY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO COWICHE CREEK	3004	7	0.23%
DTL07194.BGY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO BIG CREEK	3001	7	0.23%
DTL07197.RCY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED INTO REECER CREEK	3020	17	0.56%

DTL07197.BNY	7/27/2007	YAKIMA RIVER COHO STUDY, PARR RELEASED FROM BOONE POND	2522	2	0.08%
DTL07324.TU2	11/20/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	83	1	1.20%
DTL07325.TU2	11/21/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	44	1	2.27%
DTL07327.TU2	11/23/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	42	1	2.38%
DTL07346.TU2	12/12/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	101	2	1.98%
DTL07347.TU2	12/13/2007	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	63	2	3.17%
DTL08044.R01	2/15/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	337	2	0.59%
DTL08052.R02	2/22/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	138	1	0.72%
DTL08058.R03	2/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	270	3	1.11%
DTL08064.R04	3/5/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	213	1	0.47%
DTL07288.B01	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	17	0.85%
DTL07288.E02	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	20	1.00%
DTL07288.B03	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	20	1.00%
DTL07289.E04	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	14	0.70%
DTL07289.B05	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	17	0.85%
DTL07290.E06	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	18	0.90%
DTL07290.B07	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	20	1.00%
DTL07291.E08	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	22	1.10%
DTL07291.B09	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	18	0.90%
DTL07292.E10	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	12	0.60%
DTL07292.B11	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	25	1.25%
DTL07295.E12	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2001	28	1.40%
DTL07295.B13	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	20	1.00%
DTL07295.E14	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	17	0.85%
DTL07296.B15	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	25	1.25%
DTL07296.E16	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	2000	26	1.30%
DTL07297.B17	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	4000	36	0.90%
DTL07298.E18	3/15/2008	YAKIMA-KLICKITAT FISHERIES PROJECT, CLE ELUM SPRING CHINOOK RELEASES, 2008	4000	48	1.20%
DTL08077.MDE	3/19/2008	HATCHERY COHO RELEASED FROM MARION DRAIN	3013	10	0.33%
DTL08079.R09	3/20/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	151	2	1.32%
DTL08080.R10	3/21/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	158	1	0.63%
DTL08081.R11	3/21/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	206	1	0.49%
DTL08085.R12	3/26/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	285	1	0.35%
DTL08086.R13	3/27/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	283	4	1.41%
DTL08087.R14	3/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	241	2	0.83%
DTL08088.R15	3/28/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	229	2	0.87%
DTL08092.R16	4/2/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	136	2	1.47%
DTL08093.R17	4/3/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	271	1	0.37%
DTL07190.SY1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1252	9	0.72%
DTL07190.LY1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1250	13	1.04%
DTL07191.SY3	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1256	4	0.32%
DTL07191.LY2	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1255	5	0.40%
DTL07191.HY1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM HOLMES POND	1251	2	0.16%
DTL07191.HY2	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM HOLMES POND	1253	7	0.56%

DTL07192.EAY	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM EASTON POND	2501	15	0.60%
DTL07344.HE1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM HOLMES POND	1253	3	0.24%
DTL07344.HE3	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM HOLMES POND	1255	6	0.48%
DTL07344.LE1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1252	10	0.80%
DTL07344.LE3	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM LOST CREEK POND	1272	5	0.39%
DTL07344.PE1	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM PROSSER HATCHERY	1003	6	0.60%
DTL07344.SE3	4/5/2008	YAKIMA RIVER COHO STUDY, SMOLTS RELEASED FROM STILES POND	1254	12	0.96%
DTL08097.TU2	4/6/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	22	1	4.55%
DTL08100.TU2	4/9/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	15	2	13.33%
DTL08094.PY2	4/9/2008	YEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 2	742	1	0.13%
DTL08094.PY1	4/9/2008	YEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 1	1089	2	0.18%
DTL08100.R19	4/10/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	207	2	0.97%
DTL08101.R20	4/10/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	235	3	1.28%
DTL08102.TU2	4/11/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	9	1	11.11%
DTL08098.PS1	4/11/2008	SUBYEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 1	5001	9	0.18%
DTL08101.CA1	4/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	101	2	1.98%
DTL08099.PS3	4/15/2008	SUBYEARLING YAKIMA FALL CHINOOK RELEASED FROM PROSSER HATCHERY, GROUP 2	5004	1	0.02%
DTL08106.R21	4/16/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	482	9	1.87%
DTL08091.MD1	4/16/2008	HATCHERY FALL CHINOOK RELEASED FROM MARION DRAIN	4513	10	0.22%
DTL08106.CA1	4/16/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	2	2.00%
DTL08107.R22	4/17/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	348	5	1.44%
DTL08108.R23	4/18/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	244	1	0.41%
DTL08108.CA1	4/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	7	2.33%
DTL08108.FOR	4/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	5	1.67%
DTL08110.SAT	4/19/2008	SATUS CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED IN SATUS WILDLF AREA	3	1	33.33%
DTL08113.CA1	4/23/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	500	9	1.80%
DTL08113.FOR	4/23/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	500	6	1.20%
DTL08084.CLN	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED FROM NET PEN INTO FOREBAY	6056	229	3.78%
DTL08084.DBL	4/25/2008	LAKE CLE ELUM PASSAGE TEST; KNOWN DOUBLE TAGS FROM CLN AND UCL FILES	149	4	2.68%
DTL08084.UCL	4/25/2008	LAKE CLE ELUM PASSAGE TEST; COHO RELEASED DIRECTLY INTO UPPER LAKE	6011	76	1.26%
DTL08115.R24	4/25/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	265	6	2.26%
DTL08114.LW1	4/25/2008	SUBYEARLING LTL WHITE FALL CHINOOK (ACCELERATED) REL. FROM PROSSER, GRP 1	5000	9	0.18%
DTL08116.R25	4/25/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	161	3	1.86%
DTL08115.CA1	4/25/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	401	11	2.74%
DTL08115.FOR	4/25/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	400	4	1.00%
DTL08115.LW3	4/29/2008	SUBYEARLING LTL WHITE FALL CHINOOK (ACCELERATED) REL. FROM PROSSER, GRP 2	5001	6	0.12%
DTL08120.CA1	4/30/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	3	1.50%
DTL08120.FOR	4/30/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	200	4	2.00%
DTL08122.R27	5/2/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	235	5	2.13%
DTL08122.CA1	5/2/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	13	4.33%
DTL08122.FOR	5/2/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	8	2.67%
DTL08127.GRB	5/6/2008	FALL CHINOOK CAPTURED AND RELEASED BELOW GRANGER/MARION DRAIN	32	1	3.13%
DTL08127.R29	5/7/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	223	5	2.24%
DTL08128.R30	5/8/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	278	3	1.08%

DTL08128.CA1	5/8/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	350	16	4.57%
DTL08129.CA1	5/9/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	11	3.67%
DTL08129.FOR	5/9/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	1	0.33%
DTL08102.BY1	5/11/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT BILLY'S POND	5008	10	0.20%
DTL08105.ST1	5/14/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT STILES POND	5105	94	1.84%
DTL08105.ST2	5/14/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT STILES POND	4902	90	1.84%
DTL08134.CA1	5/14/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	350	17	4.86%
DTL08134.FOR	5/14/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	350	10	2.86%
DTL08100.SK1	5/15/2008	SUBYEARLING YAKIMA FALL CHINOOK ACCLIMATED AT SKOV POND	5002	111	2.22%
DTL08136.CA1	5/16/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	200	8	4.00%
DTL08141.LW5	5/22/2008	SUBYEARLING LTL WHITE FALL CHINOOK (CONVENTIONAL) REL. FROM PROSSER, GRP 1	5001	3	0.06%
DTL08141.LW7	5/27/2008	SUBYEARLING LTL WHITE FALL CHINOOK (CONVENTIONAL) REL. FROM PROSSER, GRP 2	5006	10	0.20%
DTL08148.CA1	5/28/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	1	2.00%
DTL08155.CA1	6/4/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	50	5	10.00%
DTL08162.CA1	6/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	9	9.00%
DTL08162.FOR	6/11/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	101	4	3.96%
DTL08164.CA1	6/13/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	102	7	6.86%
DTL08169.CA1	6/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	300	20	6.67%
DTL08169.FOR	6/18/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	300	16	5.33%
DTL08170.CA1	6/19/2008	CHANDLER JUVENILE FACILITY CALIBRATION, CANAL RELEASE	100	6	6.00%
DTL08170.FOR	6/19/2008	CHANDLER JUVENILE FACILITY CALIBRATION, FOREBAY RELEASE	100	8	8.00%
DTL08182.PRC	7/30/2008	COHO PARR PLANTS MY2009: REECER CR	2965	1	0.03%
DTL08189.PAH	7/30/2008	COHO PARR PLANTS MY2009: AHTANUM CR	3002	1	0.03%
DTL08189.PLR	7/30/2008	COHO PARR PLANTS MY2009: LITTLE RATTLESNAKE CR	3005	10	0.33%
DTL08190.PNL	7/30/2008	COHO PARR PLANTS MY2009: NILE CR	2999	1	0.03%
DTL08190.PLN	7/30/2008	COHO PARR PLANTS MY2009: LITTLE NACHES R	3000	2	0.07%
DTL08191.PNF	7/30/2008	COHO PARR PLANTS MY2009: NORTH FK LITTLE NACHES R	3003	2	0.07%
DTL08247.RF3	9/4/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	500	1	0.20%
DTL08249.RF5	9/5/2008	SPRING CHINOOK OUTMIGRANTS TRAPPED AND RELEASED AT ROZA DAM	500	2	0.40%
DTL08326.TU2	11/21/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	22	1	4.55%
DTL08345.TU2	12/10/2008	TOPPENISH CREEK SCREW TRAP - STEELHEAD TRAPPED AND RELEASED BELOW UNIT 2 DAM	1	1	100.00%