B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

Yakima/Klickitat Fisheries Project

Monitoring and Evaluation

Annual Report 2005 - 2006 | July 2006 | DOE/BP-00022449-1

This Document should be cited as follows:

Bosch, Bill, David Fast, "Yakima/Klickitat Fisheries Project; Monitoring and Evaluation", 2005-2006 Annual Report, Project No. 199506325, 222 electronic pages, (BPA Report DOE/BP-00022449-1)

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

YAKIMA/KLICKITAT FISHERIES PROJECT MONITORING AND EVALUATION

PROJECT NUMBER 1995-063-25
CONTRACT NUMBER 00022449

THE CONFEDERATED TRIBES AND BANDS OF THE YAKAMA NATION

FINAL REPORT
For the Performance Period
May 1, 2005 through April 30, 2006

Submitted: July 20, 2006

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 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.

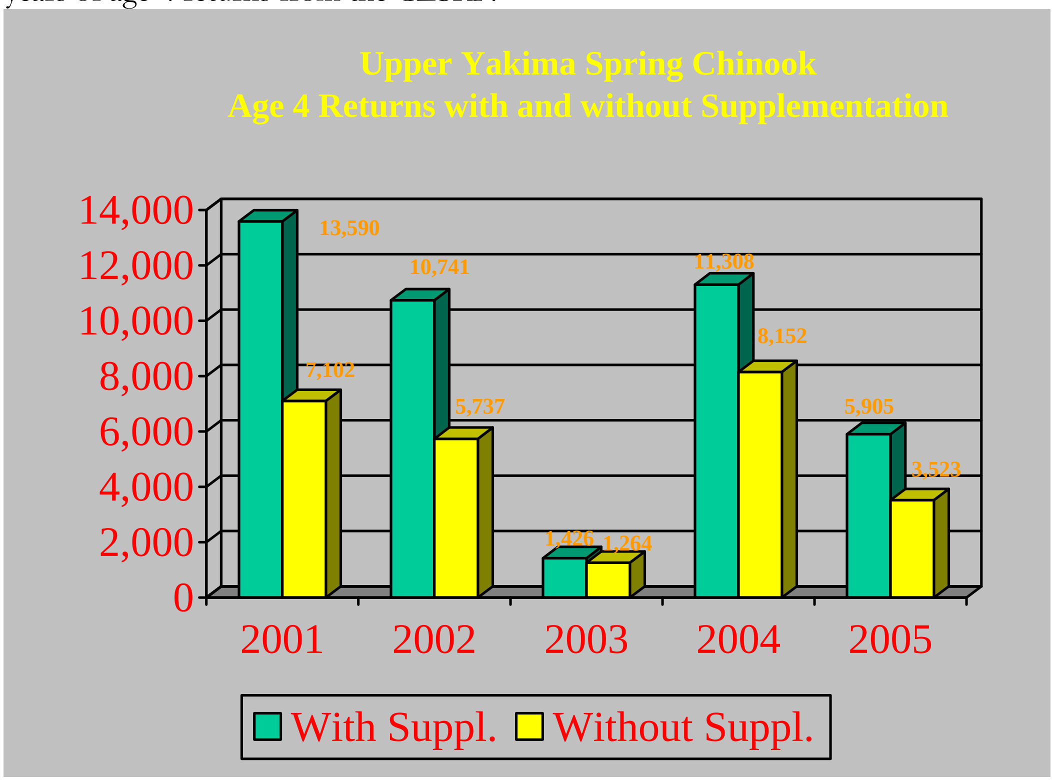
Supplementation is envisioned as a means to enhance and sustain the abundance of wild and naturally-spawning populations at levels exceeding the cumulative mortality burden imposed on those populations by habitat degradation and by natural cycles in environmental conditions. A supplementation hatchery 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

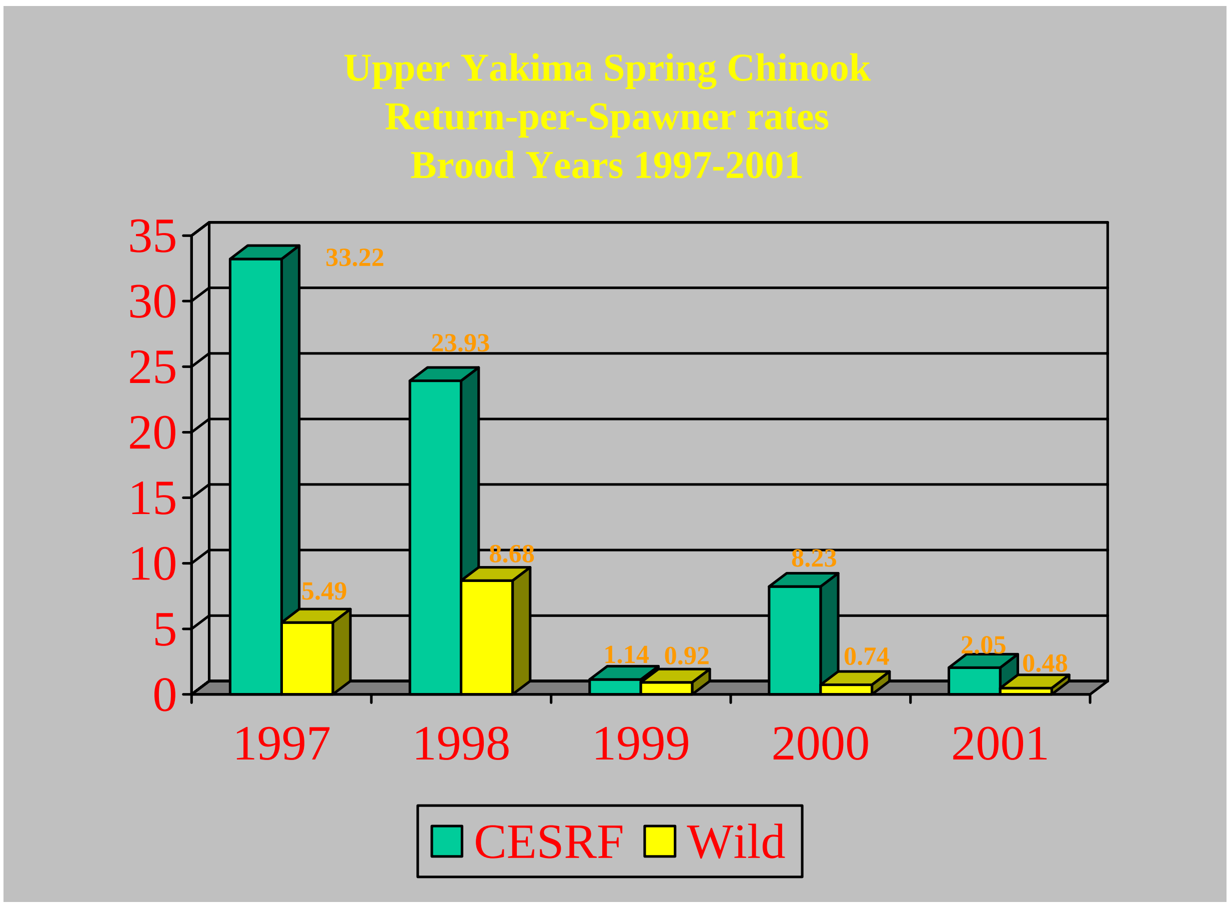
The Cle Elum Supplementation and Research Facility (CESRF) collected its first spring Chinook brood stock in 1997, released its first fish in 1999, and age-4 adults have been returning since 2001, with the first F2 generation (offspring of CESRF and wild fish spawning in the wild) returning as adults 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 when competition is relatively high. When competition is reduced, hatchery fish produced similar numbers of progeny as their wild counterparts. Most demographic variables are similar between natural and hatchery origin fish, however hatchery origin fish were smaller-at-age than natural origin fish. Long-term fitness of the target population is being evaluated by a large-scale test of domestication. Slight changes in predation vulnerability and competitive dominance, caused by domestication, were documented. 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. However, 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. 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 within containment objectives or impacts that were outside of containment objectives were not caused by supplementation activities. Some fish and bird piscivores have been estimated to consume large numbers of salmonids in the Yakima 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 if the Cle Elum Supplementation and Research Facility (CESRF) had not been constructed. Data are for return years 2001-2005, the first five years of age-4 returns from the CESRF.



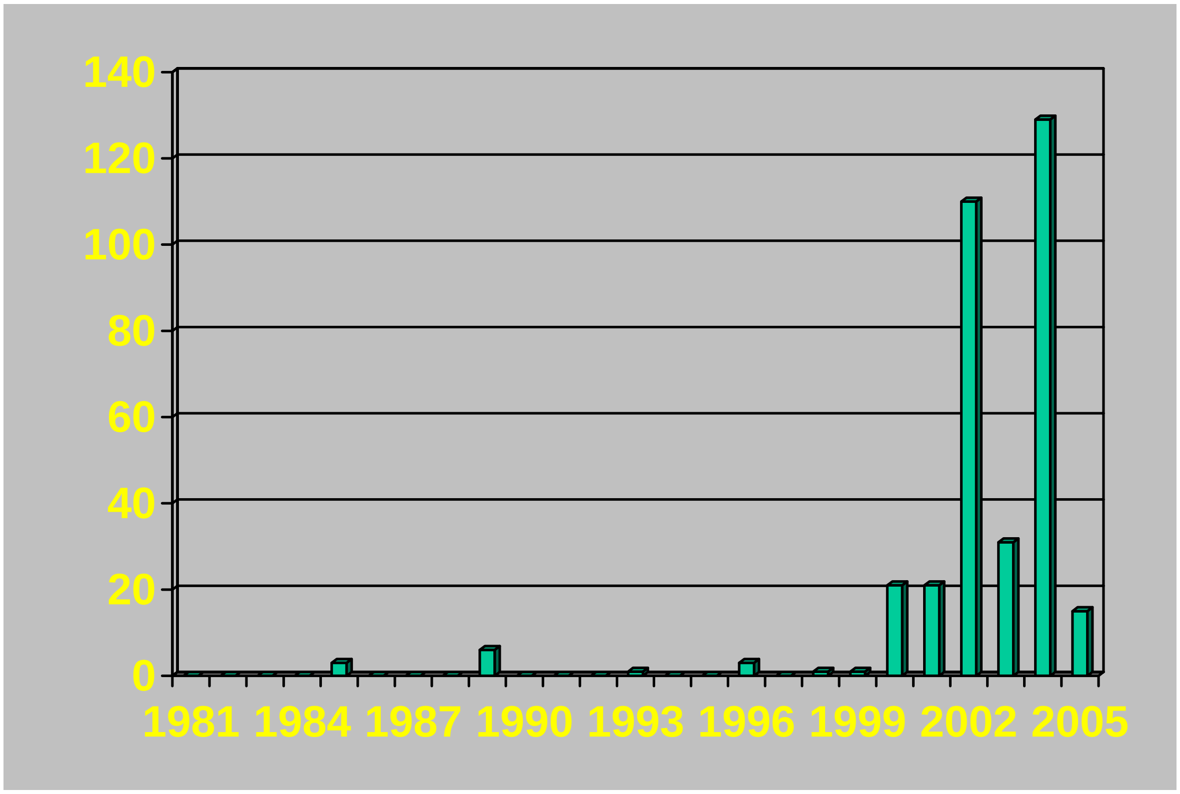
Methods and Discussion: For all years, actual returns with supplementation (green bars) are derived from actual counts of marked (CESRF) and unmarked (wild/natural) fish at Roza Dam backed through harvest to the Yakima River mouth. For F1 returns (returns from wild fish spawned in the hatchery) in 2001-2004, 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 13% in return year 2003 to 91% in return year 2001 and averaged 60% from 2001-2005.

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 1997-2001. Note: Age-5 returns are not yet included for brood year 2001.



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 – 2005.



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 71 redds per year increasing the spatial distribution of natural spawners on the spawning grounds. The natural productivity of these spawners is dependent on improving habitat conditions in the Teanaway, which are being addressed through a number of projects funded by a variety of organizations.

For detailed data and supporting information, see Appendix B of this report and the references to WDFW reports shown under tasks 1c, 1j, 1p, 1q, 1r, 3a-3c, and 4d-4f 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 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 Eagle Creek National Fish Hatchery 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 nearly 3,300 fish from 1997-2005 (an order of magnitude greater than the prior 10-year average) including estimated returns of wild/natural coho at or exceeding 1,500 fish in three of the five years 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 over 900 acres of prime floodplain habitat, reconnection and screening of over 15 miles of tributary habitat, substantial water savings through irrigation improvements, and restoration of over 60 acres of floodplain and side channels.

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. Over the past year, the YKFP has generated at least 10 technical manuscripts that are either in final internal review, in peer review, or have been accepted for publication and are in press.

Introduction

The monitoring and evaluation program for the YKFP was organized into four categories- Natural Production (tasks 1.a - 1.y), Harvest (task 2.b), Genetics (tasks 3.a – 3.c) and Ecological Interactions (tasks 4.a – 4.f). This annual report specifically discusses tasks directly conducted by the Yakama Nation during fiscal year 2005. 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.d, 1.e, 1.f, 1.g, and 1.h are included in full as appendices to this report.

Contributing authors from the Yakama Nation YKFP in alphabetical order are: Michael Berger, Bill Bosch, Melinda Davis, Chris Frederiksen, David Lind, Todd Newsome, and Jim Siegel. 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.

NATURAL PRODUCTION

Overall Objective: Develop methods of detecting indices of increasing natural production, as well as methods of detecting a realized increase 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:

Salmon Recovery Planning: In 2005, EDT model results were used in the salmon recovery planning process in both the Yakima and Klickitat subbasins by identifying environmental and biological factors limiting production of Summer Steelhead populations listed as threatened under the endangered species act. Modeling results were used to determine the relative impact of limiting factors to steelhead populations at various scales where attributes identified by the model were also supported by other sources. The EDT analysis was also used to prioritize geographic areas within a population's distribution for restoration and preservation related to the severity of the limiting factors identified. Incongruity between model results and other data sources were described as key uncertainties requiring additional research. For a complete review of the EDT analysis and methods used for the Yakima subbasin, a draft recovery plan is available for review at: http://www.co.yakima.wa.us/yaksubbasin. For a review of the analysis and methods used for the Klickitat Subbasin, a draft recovery plan will be available for public review on July 22, 2006 at: http://www.governor.wa.gov/gsro/regions.

YKFP Quantitative Objectives: Several models including EDT and the All-H-Analyzer (AHA) are currently being used to assist the YKFP in development of numerical objectives for the indigenous Spring Chinook stock. EDT outputs characterizing the natural production potential of a subbasin function as input variables into the All-H-Analyzer model. The All-H-analyzer is a life cycle model that integrates the interactions between the "four H" components of habitat, hatcheries, hydro operations and harvest. Outputs from the AHA model provide a simplistic understanding regarding the complex relationships between the state of habitat, magnitude and type of hatchery practices, differential smolt to adult return rates and exploitation rates on a given population. For our purposes, simultaneous use of the two models allowed us to quantify future habitat restoration scenarios, differential harvest rates for both the Columbia and terminal fisheries, and expected survival increases through the hydro system outlined in the 2004 Biological Opinion on the Federal Columbia River Power System. Because EDT is capable of describing the freshwater habitat's capacity and productivity for both the current and historic landscapes, scenarios restoring different proportions of the historic landscape were modeled for representative time frames related to short term, intermediate and long term goals for the program. These time frames include a ten year (2003-2013), 20 year (2003-2024) and long term goal extending well beyond 2024. The ten year goal expands upon recent trends in return numbers with the intent of maximizing natural production by fully seeding the current freshwater spawning and rearing capacity through the use of supplementation while maintaining harvest augmentation for treaty and sport fishermen. Intermediate and long term goals are driven by the assumption that habitat restoration activities prior to, or within the given time frames will grossly enhance freshwater productivity and capacity in concurrence with an increased rate of out of basin survival. Stock performance objectives within each time frame consist of several components linked to the desired success of the program, stock conservation, and cultural/economic benefits. These components include natural smolt production, escapement to the spawning grounds, Columbia River harvest, and Yakima Basin harvest. The analysis is a work in progress and has not been internally reviewed by tribal and state constituents of the YKFP. Results from this analysis will be available in the near future.

Klickitat Anadromous Fishery Master Plan: In response to the ISRP's step one review of the master plan, a spring Chinook stock assessment and investigation of integrated hatchery strategies were developed to analyze different alternatives for the future Klickitat Spring Chinook hatchery program. The AHA model was the primary tool in the analysis populated with results from the Spring Chinook stock assessment, EDT and other empirical data. Hatchery strategies modeled in the analysis consisted of integrated programs using different proportions of wild broodstock for multiple scaled hatchery programs. These scenarios included an 800,000 smolt release program using different proportions of wild broodstock and a 200,000 smolt release program using 100% wild broodstock. Critical parameters with a high level of uncertainty were varied to capture potential outcomes of the two different programs. These parameters include the mean hatchery recruitment rate for the hatchery population component and the expected terminal harvest rate within the Klickitat subbasin. Transition from an isolated to an integrated program is expected to increase the mean recruitment rate of the hatchery component but how much is unknown. A hatchery recruitment rate of 2.35 represents the lower bound in the analysis based on the current mean recruitment rate of the isolated program. A mean recruitment rate of 6.5 was used for the upper bound corresponding to a conservative, expected recruitment rate based on observed recruitment rates for Yakima River hatchery Spring Chinook. This value is considered a conservative estimate because survival of Klickitat River Spring Chinook which migrate past just one dam on the Columbia should be greater than that of Yakima River Spring Chinook which migrate past four Columbia hydrosystem dams plus four to five Yakima River irrigation diversion dams. Different harvest rates were applied to all scenarios attempting to capture the sport fishery changes recently transitioning to a selective fishery due to 100% clipping of hatchery fish. For a complete review of the analysis, refer to Appendix A.

2005 field work:

Habitat surveys were conducted to collect data and ground truth existing attribute rankings for a number of tributaries that previously had little to no empirical data to support the current rankings in the EDT model. In the past, extensive field work and literature review was used to populate the EDT model for the Yakima mainstem River but due to the size of the Yakima watershed, empirical data to support attribute rankings in the tributaries have been sparse. The field surveys in 2005 were primarily done in tributaries of the Upper Yakima watershed. These tributaries included Manastash Creek, South Fork Manastash, North Fork Manastash, Taneum Creek, Big Creek, and Little Creek. Surveys were conducted in twelve-hundred foot transects and depending on the size of the tributary, two to five transects were surveyed for a sampling percentage equivalent to twenty to twenty-five percent of the total length of tributary or stream reach. Although the EDT model has forty-six attributes, field data collection focused on the abiotic attributes that characterize the physical environment of the watershed. Among physical attributes included in the surveys were: habitat composition, natural confinement, hydro confinement, maximum and minimum channel widths, wood counts and the condition of the riparian corridor. Raw field data was then transferred into electronic format and converted into EDT attribute index values.

Task 1.b Yakima River Fall Chinook Fry Survival Study

Rationale: To determine the optimal locations within the lower Yakima basin where fall Chinook production is feasible, and to guide location of future acclimation and release sites.

Methods: The feasibility of beach seining for wild juvenile fall Chinook was initiated in 2001, with the long-term objective of initiating a Passive Integrated Transponder (PIT) tag study to evaluate smolt-smolt survival between different reaches of the Yakima River. In April of 2004, beach seine sites were established at Richland, Granger and Union Gap to target wild juvenile fall Chinook for growth profiling and marking via PIT tag or caudal clip.

Progress: Growth profiles of naturally rearing fall Chinook juveniles in the lower Yakima River were monitored via beach seining efforts from April 1st through June 4th, 2005. Beach seine locations are in four sections of the Yakima River; below Van Giessen Street Bridge (RM 8.4-7.9), Benton City (RM 29.8), above Granger (RM 83-100.3) and Union Gap (RM 107.1-111.6). Seining was conducted using a 30 ft beach seine. No fish in 2005 were caudal clipped due to lack of recovery in 2004. All PIT tagged fish were measured and a sub-sample of 100 fork lengths was taken per daily effort if enough fish were captured. PIT tag detections were monitored at CJMF, McNary and Bonneville Dam.

The number of fish captured and PIT tagged for Van Giessen, Granger and Union Gap were as follows: 3,182 with 108 PIT tagged, 2,389 with 293 PIT tagged and 262 with 33 PIT tagged, respectively.

The average fork length for April at Van Giessen and Granger were: 47.7mm and 45.8mm, respectively (Figure 4). There were no fish captured in April in the Union Gap reach. The average fork lengths in May at Granger and Union Gap were: 49.8mm and 48.5, respectively (Figure 5). No sampling for May was conducted in the Van Giessen reach due to hatchery releases from Prosser Hatchery. The larger sizes at Van Giessen are likely related to warmer temperatures as you move downstream.

Figure 4. Wild Fall Chinook fork lengths, April 2005.

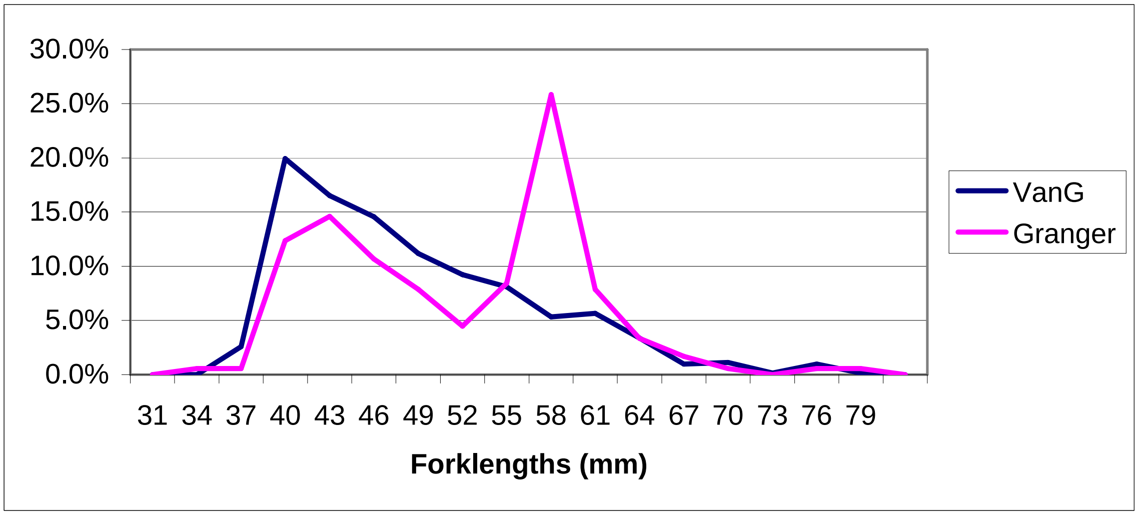
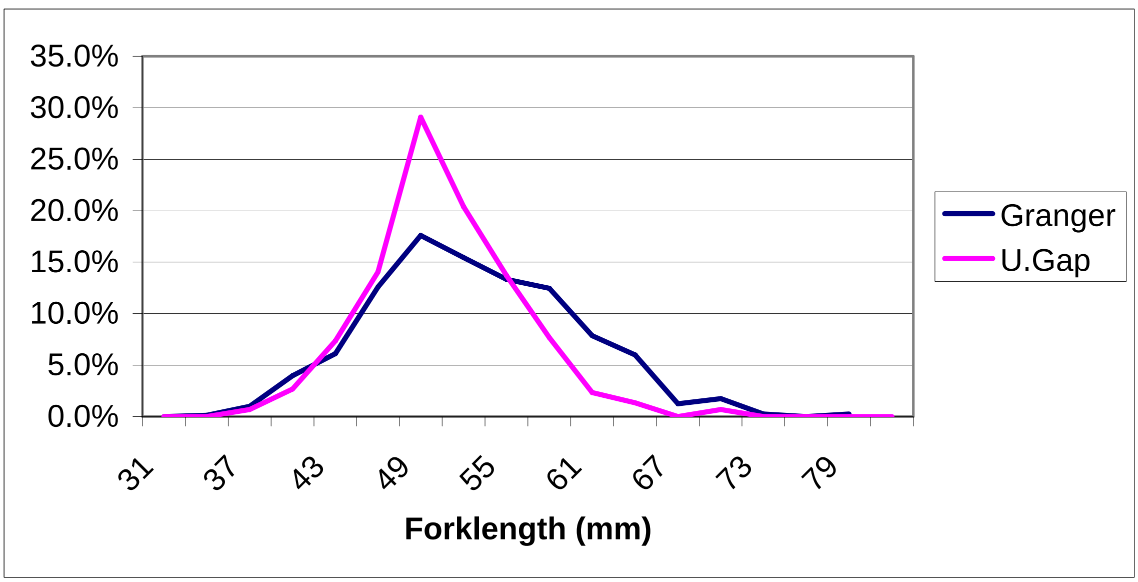


Figure 5. Wild Fall Chinook fork lengths, May 2005.



Survival indices were based on detections at McNary for all three sections. The Van Giessen reach was the only section to get detections at McNary with 22% survival. There were detections from the Granger reach at the CJMF but not from Union Gap. The detection efficiency at the monitoring stations are not 100% and our ability to get significant numbers of fall Chinook >=55 mm is not possible given the short amount of time from emergence to emigration. The limiting factor for survival estimates are the number and size of the fish during out-migration. To PIT tag, we need fish that are >= to 55 mm. The majority of fish captured during the sampling period are <55 mm. Taking fork lengths over weekly sampling continues to give us good insight of size differences from Union Gap down to Van Giessen, as well as, the duration and peak of the out-migration period for fall Chinook.

Personnel Acknowledgements: Melinda Davis is the project biologist for this task. Technicians Andrew Lewis, Delbert Nagle, Joe Jay Pinkham III, Conan Northwind and Quincy Wallahee conducted all field activities.

Task 1.c Yakima River Juvenile Spring Chinook Micro-habitat Utilization

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

Pearsons, T. N., C. L. Johnson, B. B. James, and G. M.Temple. 2006. Spring Chinook Salmon Interactions Indices and Residual/Precocious Male Monitoring in the Upper Yakima Basin; Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Annual Report 2005. DOE/BP-00022370.

Task 1.d 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 year of the OCT/SNT treatment cycle. Beginning with brood year 2002, 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) without a reduction in post-release survival. The two growth regimes to be 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. To estimate smolt-to-smolt survival by rearing treatment (HI/LO), 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 multiple body placement coded wire tags unique 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 groups for both smolt-to-smolt and smolt-to-adult survival and report on these data annually.

Progress: Tagging of brood year 2004 fish began at the Cle Elum hatchery on October 24, 2005 and was completed on December 15, 2005. Marking results are summarized in Table 2. Appendix B contains mark summary data for all brood years to date. As in prior years, all fish were adipose fin-clipped. Approximately 2,200 fish (4.6% to 5.0% of the fish) in each of 18 raceways were CWT tagged in the snout and then PIT tagged. The remaining progeny of natural brood parents (~703,000 fish) had a CWT placed in their snout, while the remaining progeny of hatchery brood parents (hatchery contol line; ~90,000 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, orange = Easton, and green = Jack Creek). Fish with the elastomer dye in the right eyelid corresponded to the HI treatment and the left eyelid to the LO treatment. A final quality control check by YN staff took place January 11-12, 2006. Estimated tag retention was again very high, ranging from 94-100% for both elastomer and CWT tags.

Smolt-to-smolt and smolt-to-adult survival data and analyses for brood years 1997-2001 OCT/SNT treatments are in the process of being peer-reviewed for publication. Appendix C contains an analysis of HI and LO smolt-to-smolt survival for release year 2005 (brood year 2003). Appendix D contains an analysis of OCT/SNT smolt-to-adult survival for brood years 1997-2001 (for all adults which returned in or prior to 2005). Additional survival data across years are given in Appendix B.

Table 1. Summary of 2004 brood year marking activities at the Cle Elum Supplementation and Research Facility.

CE RW ID	Treat-ment	Accl ID	Comment	Elastomer Eye Site	Elastomer Eye Color	CWT Body site	Number Tagged CWT	Number Tagged PIT	Number Tagged Total	Start Date	Finish Date
CLE01	HI	CFJ03	WW	Right	Red	Snout	44771	2222	46993	10/24/2005	10/27/2005
CLE02	LO	CFJ04	WW	Left	Red	Snout	43957	2222	46179	11/3/2005	11/8/2005
CLE03	HI	ESJ03	WW	Right	Orange	Snout	43991	2222	46213	10/27/2005	10/31/2005
CLE04	LO	ESJ04	WW	Left	Orange	Snout	43045	2222	45267	10/31/2005	11/3/2005
CLE05	HI	JCJ03	WW	Right	Green	Snout	45803	2222	48025	11/8/2005	11/14/2005
CLE06	LO	JCJ04	WW	Left	Green	Snout	43843	2222	46065	11/22/2005	11/30/2005
CLE07	HI	ESJ05	WW	Right	Orange	Snout	43913	2222	46135	11/14/2005	11/18/2005
CLE08	LO	ESJ06	WW	Left	Orange	Snout	42560	2222	44782	11/18/2005	11/22/2005
CLE09	LO	JCJ05	WW	Left	Green	Snout	42416	2222	44638	11/30/2005	12/5/2005
CLE10	HI	JCJ06	WW	Right	Green	Snout	43842	2222	46064	12/6/2005	12/9/2005
CLE11	HI	JCJ01	WW	Right	Green	Snout	45892	2222	48114	12/12/2005	12/15/2005
CLE12	LO	JCJ02	WW	Left	Green	Snout	42749	2222	44971	12/7/2005	12/10/2005
CLE13	HI	ESJ01	WW	Right	Orange	Snout	44887	2222	47109	12/6/2005	12/9/2005
CLE14	LO	ESJ02	WW	Left	Orange	Snout	42451	2222	44673	11/30/2005	12/6/2005
CLE15	HI	CFJ01	HH	Right	Red	Posterior Dorsal	45790	2222	48012	11/21/2005	11/30/2005
CLE16	LO	CFJ02	HH	Left	Red	Posterior Dorsal	44364	2222	46586	11/16/2005	11/21/2005
CLE17	HI	CFJ05	WW	Right	Red	Snout	46512	2222	48734	11/9/2005	11/15/2005
CLE18	LO	CFJ06	WW	Left	Red	Snout	42578	2222	44800	11/4/2005	11/9/2005

Task 1.e 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 January 28, 2005 through April 15, 2005. 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 3,151 (1,733 wild and 1,418 hatchery) juvenile spring Chinook were PIT tagged from fish collected at the Roza juvenile fish bypass trap. Wild fish were tagged from January 28, 2005 through April 15, 2005; and hatchery fish March 11 through April 28, 2005.

Appendix E contains a detailed analysis of wild/natural and CESRF (hatchery) smolt-to-smolt survival for Roza-tagged releases for brood year 2003 (migration year 2005) and summarizes these data for prior brood years 1997-2002 (migration years 1999-2004). Additional data on this task are provided in Appendix B.

Task 1.f 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 for additional 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 2005 smolt passage estimates were as follows: wild spring Chinook–157,057; LO spring Chinook– 106,253 (Easton: 37,248; Jack Creek: 38,045; Clark Flat: 30,960); HI spring Chinook– 124,412 (Easton: 43,922; Jack Creek: 43,697; Clark Flat: 36,793); unmarked fall Chinook– 174,812; Marion Drain hatchery fall Chinook– 7,466; wild coho– 31,631; hatchery coho– 214,694; and wild steelhead– 46,741. These estimates are provisional and subject to change as better entrainment estimates are developed. Appendix F contains a detailed analysis of data obtained from these studies. Additional data on this task are also provided in Appendix B.

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.

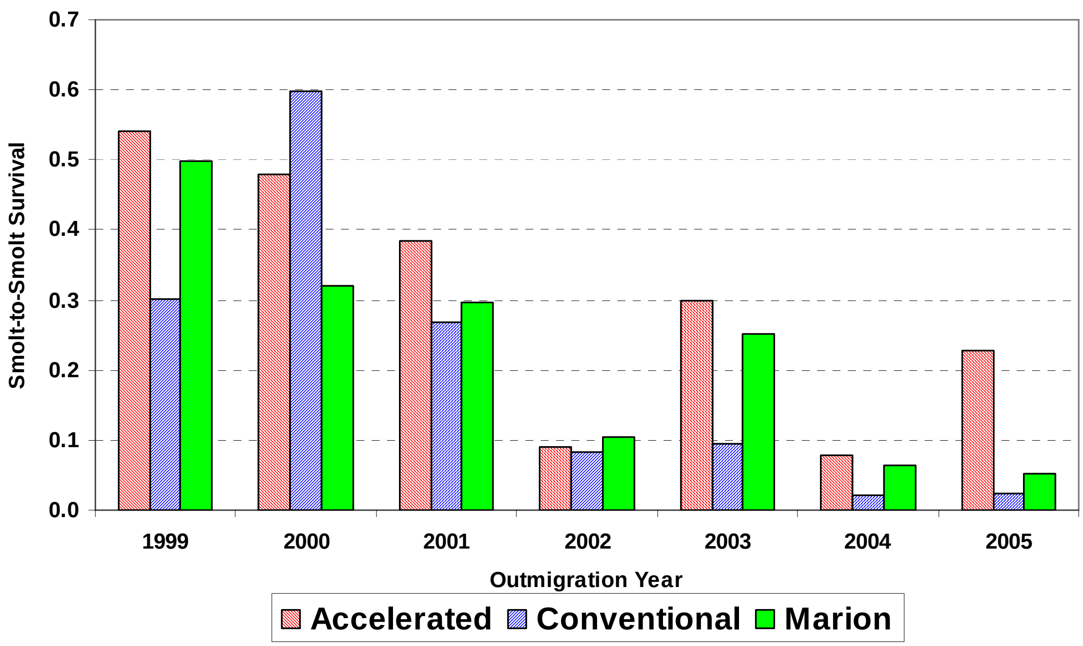
Task 1.g Yakima River Fall Chinook Monitoring & Evaluation

Rationale: To determine the optimal release timing (April vs. May) to increase overall smolt and smolt-to-adult survival.

Method: Approximately 330,000 fall chinook smolts were produced from adult fall Chinook spawned during the fall of 2004 for use in an ongoing rearing treatment experiment begun in 1998. These fish were divided into two equal groups. One group was reared using conventional methods with ambient river temperature incubation and rearing profiles. The other group was incubated and reared using warmer well water to accelerate emergence and rearing and ultimately, smoltification. Both groups of fish were spawned, incubated and reared at the Prosser Hatchery. Fish from both groups were 100% marked using ventral fin clips. A portion of each group was PIT tagged (Accelerated 4,166 PIT tags and Conventional 4,300 PIT tags) to evaluate survival and migration timing to the lower Columbia River. Approximately, 4,254 PIT tagged Marion Drain hatchery fall chinook juveniles were released to estimate survival from Marion Drain Hatchery to CJMF and McNary Dam.

Progress: Since brood stock collection began in 1998, the accelerated rearing treatment has out-performed the conventional rearing treatment the majority of the time. Smolt survival for the Marion Drain conventional group was also higher than for the Prosser conventional groups the majority of the time. The survival indices for 2005 releases were as follows: Prosser Accelerated (0.23), Prosser Conventional (0.02) and Marion Drain (0.05). Seven years of combined survival indices to McNary Dam are given below in Figure 6 (Neeley, 2006 included as Appendix G). See Appendix G for a detailed report and analysis of fall Chinook smolt-to-smolt survival.

Figure 6. Weighted Tagging-to-McNary-Passage Smolt-to-Smolt Survival Indices for 1999-2005* Outmigrants of three Groups of Fall Chinook (weights are release numbers)**



* Brood-years 1998-2004, respectively.

** Groups are: 1) Main-Stem-Yakima Stock under Accelerated Rearing, 2) Main-Stem-Yakima Stock under Conventional Rearing, and 3) Marion Drain Stock.

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

Rationale: To determine the optimal location, date, and stock of release to maximize the feasibility of coho re-introduction into the Yakima Basin, and to determine the spawning distribution of returning adults.

Method: ***Phase I (1999-2003)*** The design of the phase I coho optimal stock consisted of a nested factorial experiment intended to test for survival differences between: out-of-basin and Prosser hatchery stocks; release location (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 being 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. 2006 (in press). Evaluating the Feasibility of Reestablishing a Coho Salmon Population in the Yakima River, Washington. American Fisheries Society, North American Journal of Fisheries Management.

Phase II (2004-2010) Implementation plans and guidance for phase II of the coho feasibility study are documented in the current coho master plan (Hubble and Woodward 2003). The design of the coho optimal stock has evolved toward testing survival from specific acclimation sites (including the current four), and trying to keep in-basin stock (Yakima Stock) acclimating in Lost Creek (Naches) and Boone Pond (Upper Yakima) in the upper portions of both watersheds. In this design, acclimation sites can only be compared geographically across sub-basins (Yakima and Naches). Out-of-basin coho will be acclimated at downstream acclimation sites in both sub-basins. Approximately 2,500 pit tags will represent each acclimation site during the normal acclimation period of February through May. Releases will continue to be volitional beginning the first Monday of April. An additional 3,000 PIT-tagged coho will be planted into each acclimation site during late summer to assess and monitor over-winter acclimation and survival. Acclimation sites will have PIT tag detectors to evaluate fish movement during the late winter and early spring.

Progress:

As the program awaits approval of the Coho Master Plan, the coho program maintains interim goals.

1. Increase juvenile smolt passage out of the Yakima sub-basin
2. Increase natural production and redd counts
3. Continue to increase and maintain a true in-basin coho brood stock
4. Increase smolt to adult survival rates for both wild and hatchery adults

Nearly all the goals are being met or surpassed. Hatchery and wild coho smolt passage increased again in 2005; redd counts increased slightly; our 100% in basin coho brood stock continues to be developed; and smolt-to-adult survival rates are remaining stable. Radio telemetry is showing 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 Acclimation Site 2004 and Easton Acclimation Site in 2003).

2005 Results:

Coho releases in 2003 marked the beginning of Phase II of the feasibility study. The 2004 releases replicated the 2003 releases, with one exception. All out of basin coho were acclimated in the two lower acclimation sites, Holmes and Stiles, while the in basin coho were acclimated in the furthermost upriver locations, Boone and Lost Creek. In addition, volitional releases were implemented in 2003 and will continue being used. Releases were to begin the first of each April, except in an extreme drought years. If an extreme drought was to occur, the coho would be brought in much earlier and forced out into the rivers in March, however, this will be determined on a yearly basis. We will monitor out-migration from the acclimation sites annually with PIT tag detectors.

Detection efficiency at the outlets to acclimation ponds was nonexistent in 2005. The variable water flows, vandalism, natural pond outlets and general lack of integrity at the release points (i.e. lacking concrete infrastructure and appropriate detection system) make high detection efficiency nearly impossible. However, with each year brings new ideas on how to increase our detection efficiencies. There has been considerable effort made for the 2006 spring releases. Detection efficiencies should be much higher.

Site comparisons were analyzed, and based on the Eagle Creek Stock survival indices to McNary, the Naches survival exceeded those of the Upper Yakima River (Table 2). Analysis was done within each sub-basin and showed that in the Upper Yakima, the Holmes (acclimation site) survival index was higher than that of Boone. While in the Naches, the Stiles survival index was higher than that of Lost Creek. Unfortunately, the furthest most upriver sites had the lowest smolt survival this project has ever estimated. The Lost Creek smolts were seined out after 3 weeks of acclimation. The looming drought and very low water encouraged this decision, however, after further analysis it showed most of the smolts died in the river or smolted and migrated too late for successful migration out of the Yakima River. The Boone acclimation site experienced extremely heavy bird predation. Upwards of 150 common mergansers were counted on the pond at any time. Fortunately, nearly 80% of the acclimating coho were in the two lower ponds, and both of these ponds had very high survival (Holmes 22% and Stiles 27%). See Appendix H for a detailed report and analysis of coho smolt-to-smolt survival indices for 2005 releases.

In basin coho PIT tag pond survival was poor in 2005. However, overall passage to Prosser was much higher than in previous years (i.e. 214,694 in 2005 and 164,000 in 2004 compared to 14,500 in 2003 and 30,000 in 2002). The Stiles and Holmes acclimation sites are located further down river and had excellent survival. This increase in survival ultimately increased the overall passage out of the Yakima Basin because of the large numbers of smolts being acclimated in the two ponds (250,000 smolts at each site).

Additionally, in preparation for phase II tributary studies, we have begun releasing late summer parr into acclimation sites to assess over winter survival and possible winter acclimation. Approximately, 2500 PIT tagged parr coho were released into three of the acclimation ponds, Holmes, Boone and Lost Creek. The first year's results were partly encouraging with Holmes over winter survival to smolt being 2%, followed by Lost Creek at .008% and Boone Pond at 0%. Preliminary results for 2006 show much higher survival for all of the acclimation sites.

It is hoped that upward trends in overall smolt passage should ultimately increase the returns of hatchery brood source adults from 2005 releases. With the estimated increase in adult returns, they will be used in Phase II of the Coho Feasibility Study, which calls for placing spawning adult coho into select tributaries to study stream seeding and interactions with resident fish.

Table 2. Summary of 2005 release-to-McNary survival index by stock, timing and location (see Appendix H for details).

Upper Yakima Subbasin				Naches Subbasin			
Acc. Site	Stock	Release Number	Survival	Acclimation Site	Stock	Release Number	Survival
Holmes	Eagle Cr	4958	.2157	Stiles	Eagle Cr	5005	.2722
Boone	Yakima	5052	.0050	Lost Creek	Yakima	5232	.0383
Pooled over sub-basins					Eagle Cr	9963	.2441
					Yakima	10284	.0220
Pooled over sub-basins and Stock						20247	.1313

Other highlights from 2005 include:

• We estimated that the smolt-to-adult survival rate for 18,787 wild/natural origin coho smolts (counted at CJMF in 2004) was 2.6%. This is considerably lower than the survival for natural-origin fish in previous years; however it was still higher than for hatchery-origin coho (next bullet).

• The estimated smolt-to-adult survival rate for 164,135 hatchery coho smolts (counted at CJMF in 2004) from releases in the Upper Yakima and Naches Rivers was 1.4%. This is a little below the 5 year average of 2%.

• The 2005 adult coho run was comprised of 485 wild/natural (17%) and 2,405 (83%) hatchery adult coho. This was the fifth year this distinction could be made. The entire hatchery release group was 100% fin clipped (out of basin adipose clipped, in basin left ventral clipped).

• During the 2005 upstream migration, approximately 76 radio tags were inserted into adult coho salmon passing the right bank Alaskan Steep Pass Denil. Radio tag locations represent areas of resting or spawning before the fish moved back down stream. Radio tags entering the Naches River have risen from a low of only 3% in 1999 to the high of nearly 27% in 2003 (Table 3). In 2005, the Naches River had 14.5% of the radio tagged adult coho, however, it had the vast majority of redds found in both sub basins at 79 (see Task 1.n).

Table 3. Results of 1999-2005 Radio Telemetry Studies for Yakima Basin Coho

	1999	2000	2001	2002	2003	2004	2005	Average
Number Radio Tagged	86	102	105	52	71	90	76	
Never Seen	3.5%	5.9%	5.7%	3.8%	11.3%	6.7%	47.4%	12.0%
Mortality/Regurgitated Tag	3.5%	2.0%	7.6%	5.8%	8.5%	2.2%	0.0%	4.2%
Fell back at Prosser	4.7%	7.8%	5.7%	7.7%	5.6%	12.2%	1.3%	6.4%
Prosser Dam to Naches conf.	79.1%	58.7%	49.5%	51.9%	36.6%	51.1%	26.3%	50.5%
Lower Naches	4.7%	2.0%	3.8%	1.9%	0.0%	0.0%	1.3%	2.0%
Naches above Cowiche Dam	3.5%	1.0%	13.3%	11.5%	26.8%	5.6%	13.2%	10.7%
Naches conf. To above Roza Dam		7.9%	9.5%	15.4%	2.8%	9.9%	7.9%	8.9%
Mid-Yakima Tributaries	1.2%	14.6%	4.8%	1.0%	8.5%	12.2%	2.6%	6.4%
Total above Naches Confluence	8.2%	10.9%	26.7%	28.8%	29.6%	15.5%	22.4%	21.6%

• 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. Despite this, the majority of spawning appears to occur in sections of the mainstem Yakima River and in the lower Naches River. In 2005 water conditions were excellent and redds were found in normal places. In the upper Yakima River (above Roza Dam), redd counts nearly doubled from the previous year and there were nearly 5 times more redds than 3 years ago (see Task 1.n). This is attributed to the high acclimation survival of the Holmes site.

- There continues to be evidence that the coho are establishing themselves in areas that were previously undiscovered. In 2005, two redds and a wild female carcass were found in Nile Creek. This creek is thought to have historically contributed large numbers of coho into the Naches system. The only plantings that have occurred were in 1994. The Nile system will be included in Phase II of the coho feasibility study, scheduled for implementation in the fall of 2006.

- In addition, there continues to be a significant number of coho not making it back to natal spawning areas (acclimation sites). There are varying beliefs of why this occurs, these include: 1) lack of stamina, primarily by females trying to reach their release locations, 2.) water temperatures, 3) unspecific acclimation (all four acclimation sites use main stem water for acclimation), 4) straying and delay due to false attraction from irrigation returns, and 5) natural production occurring above Granger to the confluence of the Naches River. Nevertheless, with the exception of 2004, the percentage of adult coho spawning above the Yakima River's confluence in the Naches River has generally increased from 8.2% in 1999 to 29.6% in 2003 with over 22% of the radio tagged fish migrating above this confluence in 2005.

- In 2003, it is estimated that approximately 4% of the entire coho run spent various amounts of time in Sulfur Drain, this percentage increased in 2004 to 6.6% percent. This is consistent with 2001, when approximately 7% of the coho run entered the drain. In 2005, the drought conditions pushed water users to conserve and cut back on total irrigation with drawls. Thus, only 1 coho was seen in the drain and only 2 fish were tracked into the mouth. Unlike 2004, when there were 4 successfully attempted salmon rescues with a total captured of 150 adult coho salmon, 6 fall Chinook and 4 steelhead (4.5% of the overall coho run) there were none in 2005.

- Snorkel surveys were conducted to look for residualized juvenile coho. Surveys were conducted on the Upper Yakima River (Cle Elum Reach) from the Cle Elum Hatchery (Rkm 299) to the confluence of the mouth 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 (Rkm53.9). 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 2005 residual surveys, indicating natural production occurring.

- Using the yearly snorkel surveys we try and establish areas of wild rearing coho parr. We will then use this data to pit tag some of the parr in the late summer. This will allow us to monitor smolt to smolt survival and possible SAR's in the following years.

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, Linda Lamebull, Conan Northwind, and Quincy Wallahee Andrew Lewis, and Denny Nagle. Also, thanks to the Prosser Fish Culturing facility, for their excellent fish culturing skills and year round cooperation, Ida Sohappy YKFP book keeper and David Byrnes and Patty Smith, who are the contracting officers and technical representative for BPA in this project.

Task 1.j Yakima Spring Chinook Juvenile Morphometric/Coloration

The WDFW annual report(s) for this task can be located on the BPA website: http://www.efw.bpa.gov/searchpublications/

Knudsen, C. M. (editor). 2006. Reproductive Ecology of Yakima River Hatchery and Wild Spring Chinook. Annual Report 2005, Project Number 1995-063-25. BPA Report DOE/BP-00022370.

And

Busack, C., A. Fritts, T. Kassler, J. Loxterman, T. Pearsons, S. Schroder, M. Small, S. Young, C. M. Knudsen, G. Hart, and P. Huffman. 2006. Yakima Fisheries Project Genetic Studies, Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2005. Project No. 1995-063-25; BPA Report DOE/BP-00022370.

Task 1.1 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: Monitoring is accomplished through use of time-lapse video recorders (VHS) and a video camera located at each of the three fishways. The videotapes are played back and various types of data are recorded for each fish that migrates upstream via the ladders. These data are recorded on paper, 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 (2005 run)

An estimated 8,724 spring chinook passed upstream of Prosser Dam in 2005. The total adult count was 7,897 (90.5%) fish, while the jack count was 827 (9.5%) fish. Of the adult count, 737 were identified as hatchery origin. Returning hatchery adults this year comprised 4 and 5 year olds (brood years 2000 and 2001). The ratios of wild to hatchery fish were 91:9 and 35:65, for adults and jacks respectively.

The 25%, 50% and 75% dates of cumulative passage were May 8, May 11 and May 20, respectively.

The estimated mean fork length for adults (wild and hatchery) and jacks (wild and hatchery) measured from video observations at Prosser Dam was 71.5 cm and 49.4 cm, respectively. These estimated video fork lengths for adults were 0.5 cm and 0.9 cm larger for adults and jacks respectively, than those measured "hands-on" at Roza during trapping and broodstock collection activities. Historical video data suggests that video based fork lengths at Prosser are not a reliable measurement to estimate true fork length. It is believed this is a result of a "mismatch" in the applied multiplier value (video length x multiplier value = true length) relative to the horizontal passage trajectory of the fish as it passes by the viewing window.

Fall Run (coho and fall chinook)

Coho (2005)

The estimated coho run was 3,115 fish. It should be mentioned that an undetermined number of fish "dropped out" below Prosser Dam and are not reflected in this count. Some fish were harvested while others were falsely attracted into tributaries such as Spring Creek. Adults comprised 92.7% and jacks 7.3% of the run. Of the estimated run, 34.3% were processed at the Denil and mark sampling there indicated the run was comprised of approximately 22.0% wild/natural and 78.0% hatchery coho.

The 25%, 50% and 75% dates of cumulative passage were October 4, October 11, and October 16, respectively.

The estimated mean adult and jack fork lengths as measured from video observations at Prosser Dam were 64.7 cm and 40.1 cm, respectively, compared to 67.6 cm and 39.3 cm for fish sampled at the Denil trap. This indicates a possible size bias of the true fork length for fish measured from the videotapes. This bias has been observed in past years for all salmonid species at Prosser Dam.

Fall Chinook (2005 run)

Estimated fall chinook passage at Prosser Dam was 1,942 fish. Adults comprised 98.9% of the run, and jacks 1.1%. Of the total number of fish, 109 were adipose clipped, 104 fish were adults and 5 fish were jacks. The median passage date was October 15, while the 25% and 75% dates of cumulative passage were October 1 and October 20, respectively. Of the total fish estimate, 442 (22.8%) were counted at the Denil.

The mean estimated adult and jack fork lengths as measured from video observations at Prosser Dam were 73.7 cm and 46.3 cm, respectively, compared to 77.6 cm and 47.9 cm for fish sampled at the Denil trap.

<u>Steelhead (2004-05 run)</u>

The estimated steelhead run was 3,451 fish. Of the total, 74 (2.1%) 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 October 21st, 2004, while the 25% and 75% cumulative dates of passage were September 28th, 2004 and December 4th, 2004 respectively.

The mean fork length from video observations was 64.6 cm, and fish ranged in size from 14.8 cm to 114.5 cm. For 993 steelhead sampled at the denil trap during the fall of 2004, mean fork length was 61.8 cm, and ranged from 48 to 81 cm.

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

Task 1.m Adult Salmonid Enumeration and Broodstock Collection at Roza/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 227 steelhead were counted past Roza Dam for the 2004-05 run. As shown in Figure 7, most steelhead migrated past Roza Dam from February through early May of 2005.

Spring Chinook

At Roza Dam 6,352 (88.2% adults and 11.8% jacks) spring Chinook were counted at the adult facility between May 2 and September 9, 2005. The adult return was comprised of natural- (87.0%) and CESRF-origin (13.0%) fish. The jack return was comprised of natural- (28.0%) and CESRF-origin (72.0%) fish. Figure 8 shows spring Chinook passage timing at Roza in 2005.

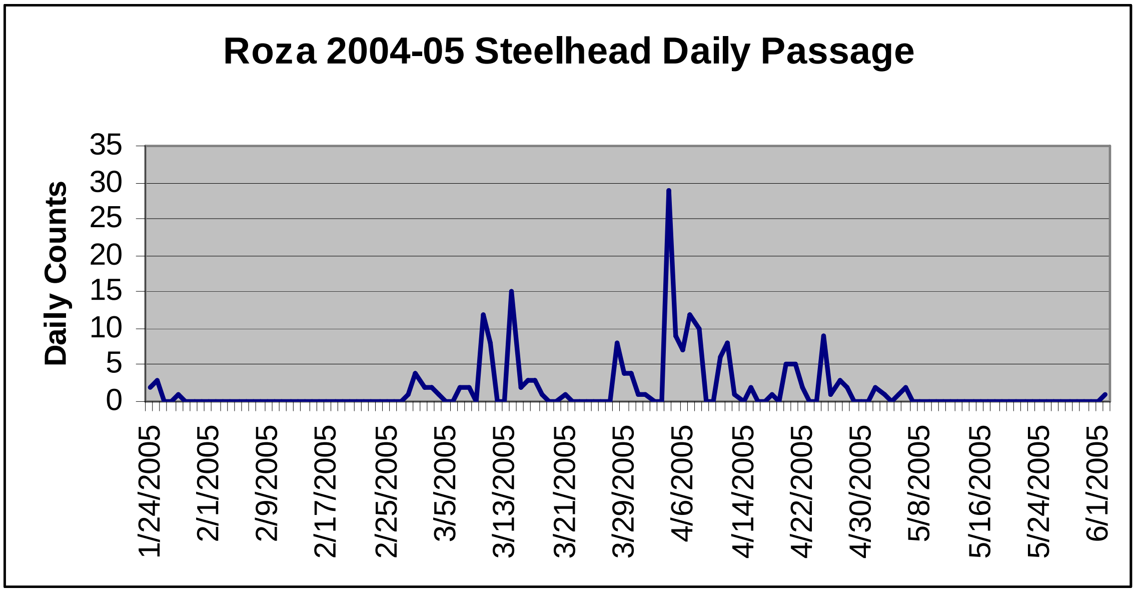


Figure 7. Daily steelhead passage at Roza Dam, 2004-05.

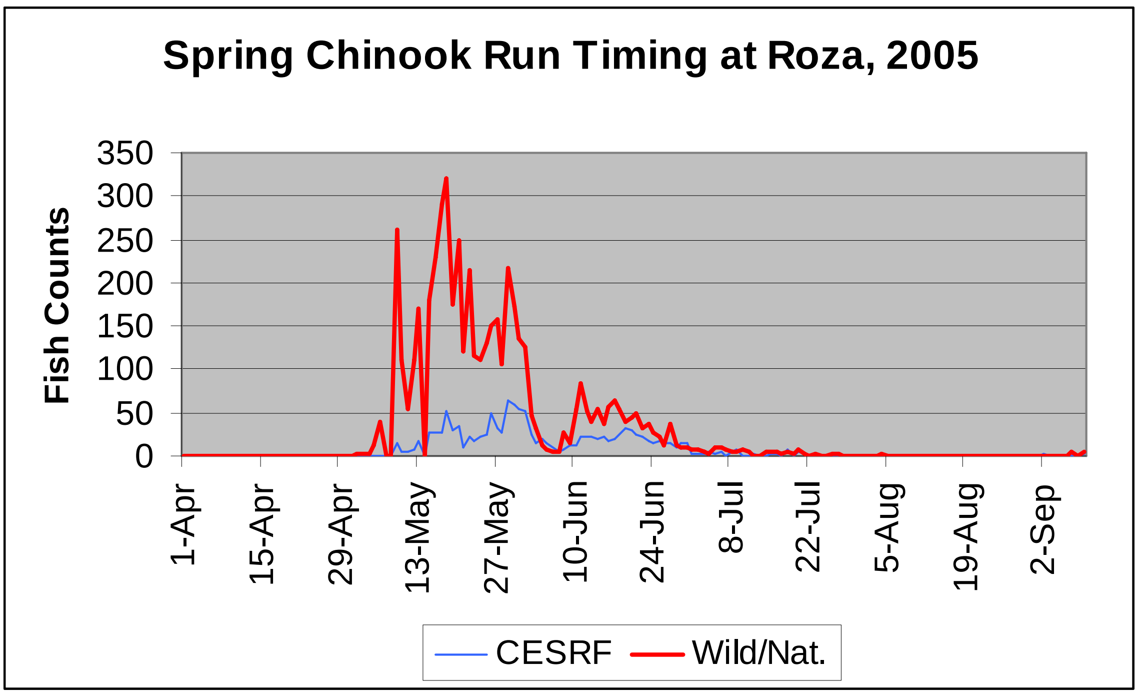


Figure 8. Daily passage counts for natural- and CESRF-origin spring Chinook at Roza Dam, 2005.

Coho

Based on video observations, a total of 30 adult and no jack coho were observed passing Roza Dam from September 30, 2005 through November 13, 2005. Of the total, three adults were observed to have an adipose fin clip (hatchery-origin). Video observations at Roza during the fall and winter months are known to be an incomplete accounting due to debris and lighting problems in the video counting area.

Cowiche Dam

Coho

A total of 179 adult and 0 jack coho were observed passing Cowiche Dam from October 14, 2005 through January 6, 2006. Of the total, one fish was observed to have an adipose fin clip (hatchery-origin). Video observations at Cowiche may also provide an incomplete accounting due to debris and lighting problems in the video counting area.

Task 1.n Spawning Ground Surveys (Redd Counts)

Rationale: To enumerate the temporal-spatial distribution of spring Chinook, fall Chinook, steelhead and coho redd deposition in the Klickitat and Yakima basins. To collect biological information from spawned out carcasses.

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 are 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: Steelhead surveys in Satus and Toppenish basins and Ahtanum Creek began in mid-March and ended in early June of 2006. Total redd counts by subbasin were as follows: Satus basin- 60, Toppenish basin- 20, and Ahtanum Creek- 1. For all three basins a total of 81 redds were counted. In addition, three redds were located in Harrah and Marion drains. Steelhead redd surveys in the Naches River system in the spring of 2006 were conducted jointly by the U.S. Forest Service and the Washington Dept. of Fish and Wildlife. These surveys counted 18 total redds in the Naches system (G. Torretta, USFS, personal communication). Sub-optimal conditions most probably resulted in an underestimation of steelhead redd counts throughout the Yakima Subbasin. Snow pack prevented access to many areas early in the season. High flows were generally prevalent later in the season, delaying access and resulting in poor visibility.

Spring Chinook: Redd counts began in late July, 2005 in the American River and ended in early October, 2005 in the upper Yakima River. Total counts for the American, Bumping, Little Naches, Naches, and Rattlesnake rivers were respectively: 139, 163, 68, 188, and 15 redds. Redd counts in the upper Yakima, Teanaway and the Cle Elum rivers were: 1,694, 15, and 287, respectively. The entire Yakima basin had a total of 2,569 redds (Naches- 573 redds, upper Yakima- 1,996). Historical spring Chinook redd count data are provided in Appendix B.

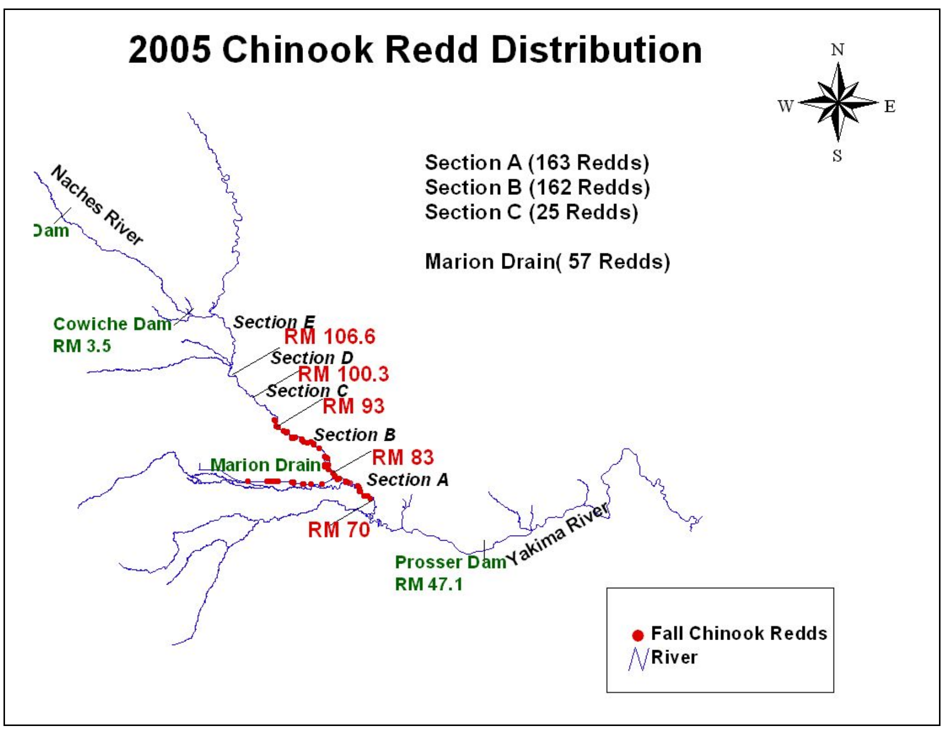
Fall Chinook: Redd counts in the Yakima River Basin above Prosser Dam began in mid-September and ended in late November. The river was divided into sections and surveyed every 7-10 days via raft or foot. Redd distribution for the Yakima, Naches, and Marion Drain was as follows:

Yakima R.: <u>350 redds</u>. 93% of the redds were located between RM 70 and RM 95. No redds were observed above RM 95.

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

Marion Drain: <u>57 redds</u>. 61% of the redds were located above HWY 97.

Figure 9. Distribution of fall chinook redds in the Yakima River Basin in 2005.

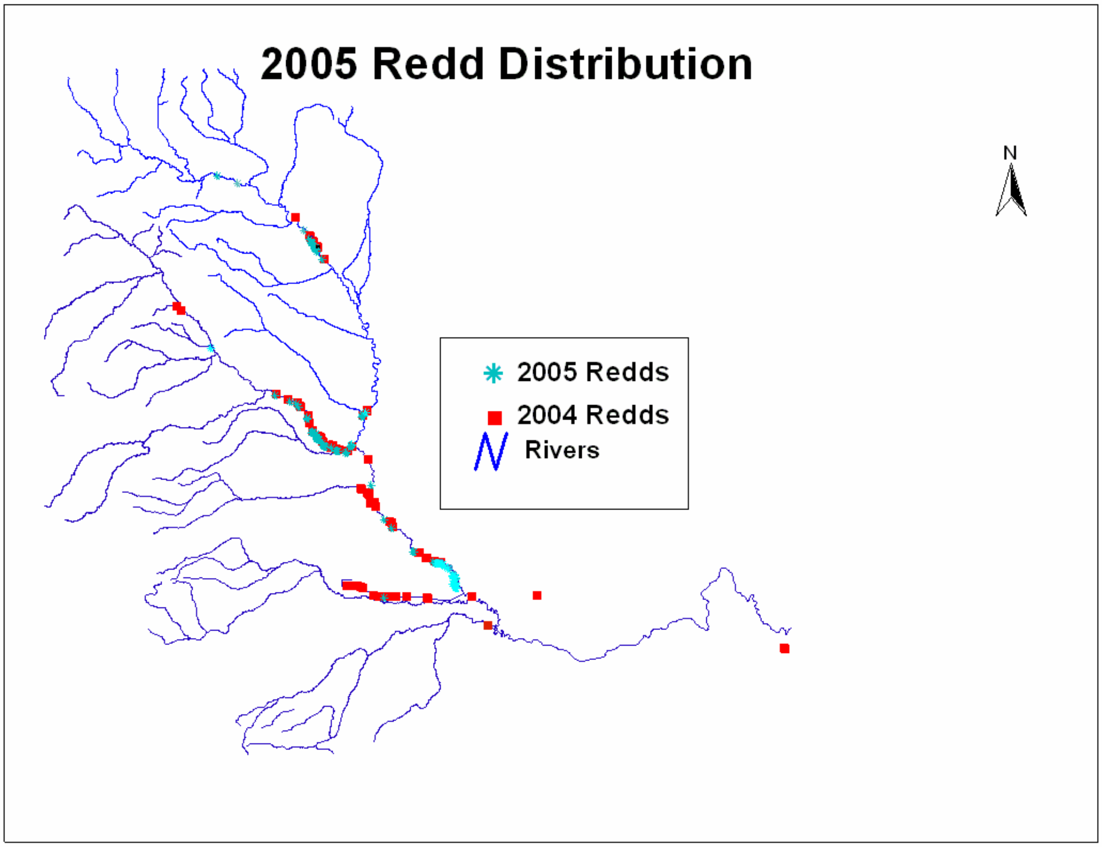


Coho: Surveys began the third week of October and ended in late December. Redd surveys were conducted daily in conjunction with fall Chinook surveys. The Yakima and Naches Rivers are broken into sections that are checked via boat or foot daily. Winter freshets and weather did not hinder the spawning surveys in 2005, thus the coho redd count was the second highest the YN has recorded. There was a slight decline in the overall numbers of redds in the Naches River. There was however, an upward trend in the total Yakima River redd counts including a large increase above Roza Dam, near the Holmes acclimation site. In 2003 only 3 redds were found, in 2004 (the first returning adults from the Holmes acclimation site) a total of 33 redds where found and in 2005 the number jumped to 57. 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 become much more accurate than in previous years. The redd counts should remain high in and possibly even go higher due to the consistency of surveyors and the discoveries of new spawning areas.

Table 4. Yakima Basin Coho Redd Counts, 1998-2005.

River	1998	1999	2000	2001	2002	2003	2004	2005
Yakima River	53	104	142	27	4	32	78	107
Naches River	6	NA	137	95	23	56	87	79
Tributaries	193	62	67	29	16	21	92	81
Total	252	166	346	154	43	109	257	272

Figure 10. Distribution of coho redds in the Yakima River Basin, 2004-2005.



Task 1.p 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/

Pearsons, T. N., C. L. Johnson, B. B. James, and G. M. Temple. 2006. Spring Chinook Salmon Interactions Indices and Residual/Precocious Male Monitoring in the Upper Yakima Basin; Yakima/Klickitat Fisheries Project Monitoring and Evaluation. Annual Report 2005. DOE/BP-00022370.

Task 1.q Yakima River Relative Hatchery/Wild Spring Chinook Reproductive Success

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

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. Annual Report 2005, Project Number 1995-063-25. BPA Report DOE/BP-00022370.

Task 1.r Yakima Spring Chinook Gamete Quality Monitoring

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

Knudsen, C.M. (editor). 2006. Reproductive Ecology of Yakima River hatchery and wild spring Chinook. Annual Report 2005, Project Number 1995-063-25. BPA Report DOE/BP-00022370.

Task 1.s Scale Analysis

Rationale: To determine age/length and stock (hatchery vs. wild) composition of adult salmonids 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: Adult scale sample results are summarized in Table 5 by species and sampling method. Historical data from age and length sampling activities of spring Chinook in the Yakima Basin are presented in Appendix B.

Table 5. The 2005 adult scale sample data summary for salmonids in the Yakima Basin.

	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	137	15.6	98	40.4	218	59.3	18	70.1
Upper Yakima Wild/Natural			35	43.2	441	60.9	11	71.0
Spawner Survey Samples								
Upper Yakima Supplementation			9	42.2	32	59.7	1	72.0
Upper Yakima Wild/Natural			14	49.1	318	59.9	4	69.3
American River Wild/Natural					33	62.1	10	78.0
Naches River Wild/Natural					41	61.0	8	73.3
Yakima R. Fall Chinook								
Hatchery	2	42.0	6	58.0	12	65.8	5	72.1
Wild/Natural	6	38.8	178	56.8	168	66.9	38	75.1
Yakima R. Coho								
Hatchery	60	32.0	712	54.4				
Wild/Natural	79	31.8	158	54.2				

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.u Habitat Monitoring Flights and Ground Truthing

Rationale: To record an aerial video record of a particular subbasin that can be used to aid in the EDT Level 2 data input to the model.

Methods and Progress: Ground survey work accomplished pursuant to this task in fiscal year 2005 was discussed under Task 1.a, Modeling.

Task 1.w 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 the upper Little Naches and South Fork Tieton Rivers in the fall of 2005. 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:

Little Naches Monitoring

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. The continued sampling efforts in the Little Naches extend our knowledge of trends and conditions in spawning habitat. With this year's monitoring work, the data set for the Little Naches drainage now covers a time period of 21 years for the two historical reaches, and 14 years for the expanded sampling area, which includes several tributary streams.

The average percent fine sediment less than 0.85mm for the entire Little Naches drainage is very similar to the previous year (cumulative average of 11.68% for 2005 compared to 11.77% for 2004). These results were not significantly different from each other (Figure 11). The comparable conditions between years may be due to fairly low flows (little bedload movement or flushing) and relatively stable watershed conditions. The lower levels of fine sediment are encouraging and should minimize mortality on eggs and alevins. This marks three years (2003-2005) that overall average fine sediment in the basin has been under 12%. However, conditions have not yet reached those found in the earliest years of monitoring (1985 and 1986).

The reason for the recently improved conditions is not fully understood. In the early 1990s, overall average fine sediment levels in the Little Naches were quite high and reached a peak in 1993 of 19.7% fines (Figure 11). Due to the high rate of fine sediment at that time, considerable road improvement, abandonment, and drainage work was completed by landowners in 1994 and 1995. In addition, more protective measures were enacted for logging practices near streams through the Northwest Forest Plan (1994) and the Plum Creek Habitat Conservation Plan (1996). From 1995 through 2001 fine sediment levels dropped and remained relatively constant at about 14-15.5% average overall fines in the spawning substrate (Figure 11). Since 2002, overall average fine sediment levels have further declined in the Little Naches to approximately 11.5-13%. Possible explanations for the latest conditions may be attributed to sediment abatement work on roads and trails, better logging practices, reduced precipitation and stream flows, and/or forest regrowth in previously harvested areas. These factors and others need to be compiled and analyzed to better understand factors affecting in-channel fine sediment levels.

An analysis of the monitoring results at individual reaches can sometimes help identify site-specific sediment conditions and factors. This past year, the highest average fine sediment was found at Bear Creek Reach 2 (14.8%). The reason for the elevated fine sediment level is not entirely clear. Within this reach there has been some tree fall and recruitment, along with lateral channel movement. A few recent timber sales have also been conducted in the headwaters above this reach. A dirt bike trail system also goes along the stream, but was relocated further away from the stream in some locations. These possible sediment sources need to be evaluated. The lowest reach average fine sediment this past sampling season was again at Little Naches Reach 2 (8.1%). For the past few years, beaver have been actively working immediately above this sampling reach. The beaver ponds above the dams have noticeable accumulation of fine sediment and could be moderating delivery to the sampling reach. In addition, the South Fork of the Little Naches enters immediately above this reach and had the second lowest level of reach average fines (10.4%).

A review of the results 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 subwatersheds. 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 two years the average percentage of fine sediment has declined. This year the average fine sediment levels in these two reaches were similar with 13.03% at Little Naches Reach 1 and 11.69% at North Fork Reach 1. The average fine sediment in these historical reaches has improved, but is still greater than was found in the earliest years of monitoring in 1985 (9.45% for LN Reach 1, 8.79% for NF Reach 1) and 1986 (8.45% for LN Reach 1, 9.33% for NF Reach 1).

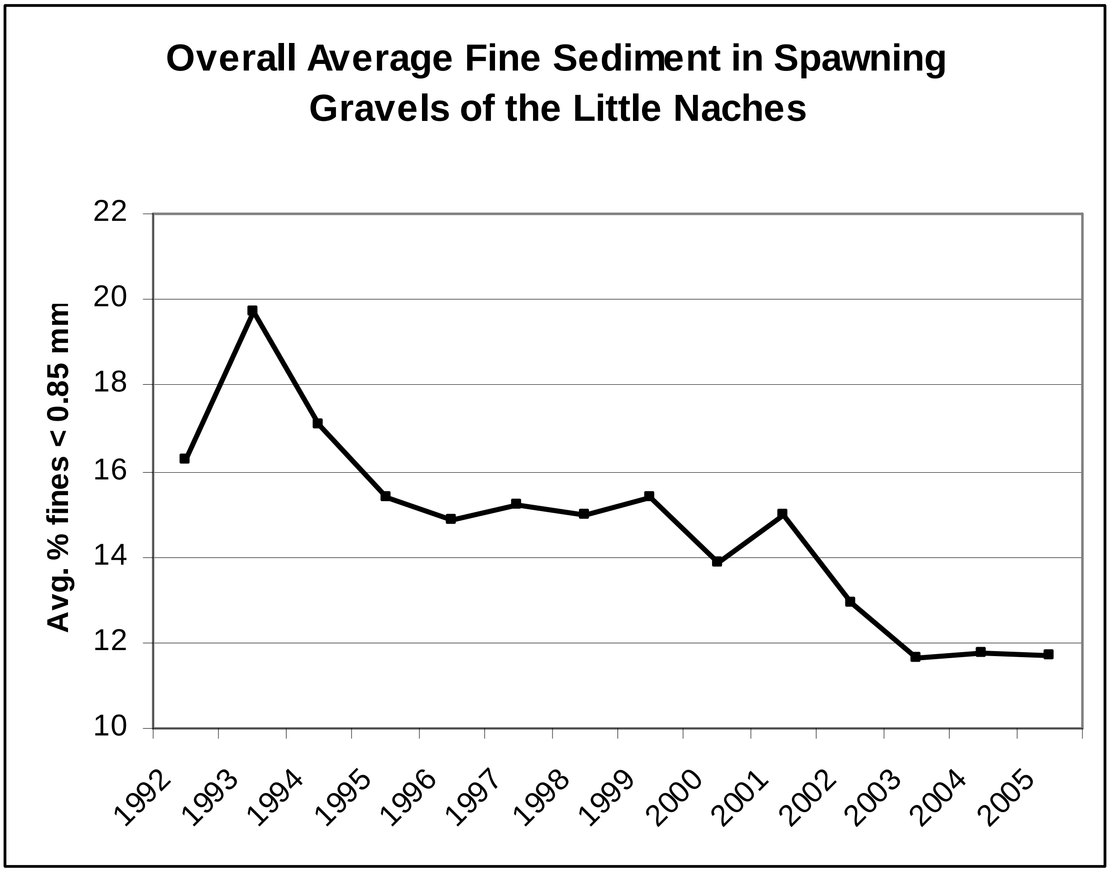


Figure 11. Overall Fine Sediment (<0.85mm) Trends in the Little Naches River Drainage, 1992-2005.

<u>South Fork Tieton Monitoring</u>

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 area typically receives considerable bull trout spawning activity and the sampling provides additional information on spawning conditions. This reach has now been sampled for seven consecutive years (see Figure 12). This past year the reach average fine sediment, less than 0.85mm in size, is similar to 2003 and 2004, and lower than the peak found in 2002 (Figure 12). The latest conditions should reduce impacts on incubating eggs, but fine sediment levels are still higher than observed in 1999. Upstream sediment sources should be identified and corrected to ensure that favorable bull trout spawning conditions are achieved.

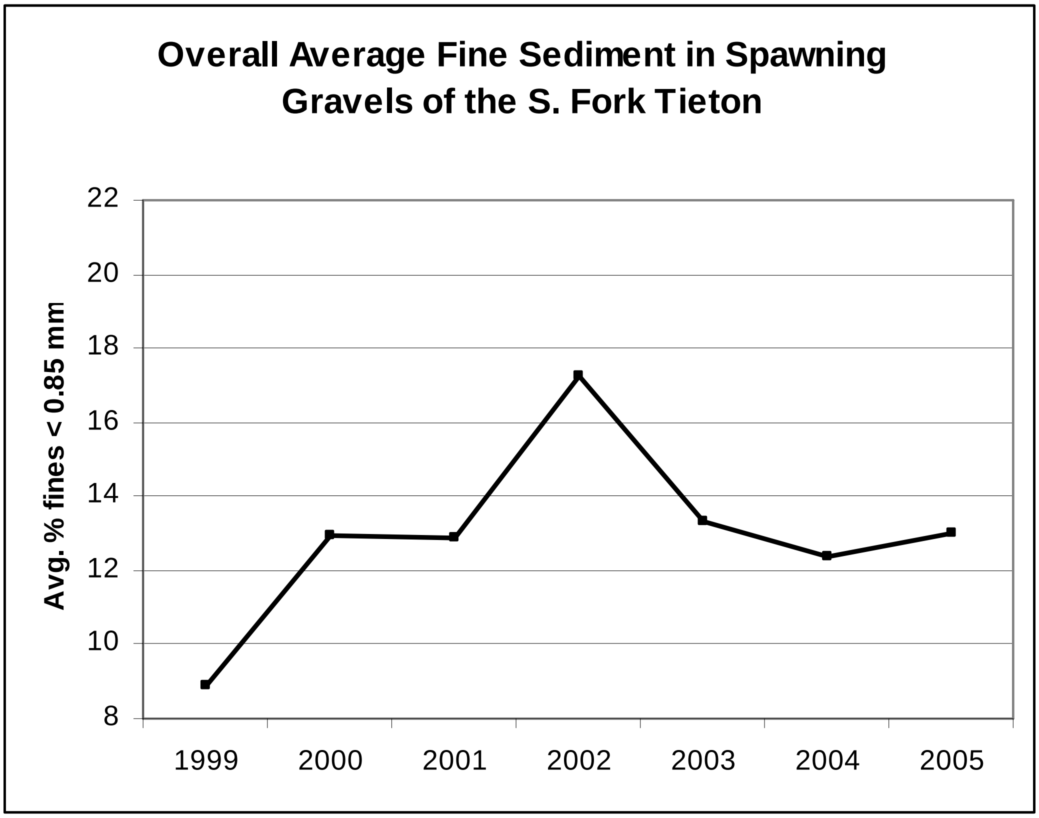


Figure 12. Fine Sediment Trends in the South Fork Tieton River, 1999-2005.

Summary

The overall average fine sediment levels in the Little Naches this past season were similar to 2004 and 2003. This marks four years of improving spawning conditions as measured by overall average fine sediment levels. The downward movement in fine sediment should help reduce impacts on egg and alevin survival. However, the latest improvement in conditions only covers a short time frame. The current fine sediment conditions are also still higher than those found in the earliest years of monitoring. Further monitoring is needed to see if the latest conditions are a continuing trend or just a short term change. Additional investigations of sediment sources and their contribution to the stream system is also very much needed. Without information on fine sediment delivery sources in the drainage it will be difficult to manage and correct problem conditions. In particular, dispersed camping and off road vehicle activities near streams, stream-adjacent roads, eroding banks, isolated unstable areas, and timber harvest should be evaluated for their delivery capability and effect on spawning conditions.

Sampling in the South Fork Tieton River by the USFS showed a similar level of fine sediment as found in the previous two years. Overall average fine sediment in 2005 for this reach was 13.0%. These conditions would be expected to have relatively minor effects on bull trout egg incubation and fry emergence. However, fine sediment levels have not dropped down to levels observed in 1999, which are considered more favorable for egg and fry survival. Similar to the Little Naches, fine sediment sources and their causes should be investigated, identified and addressed.

For all of the monitoring project watersheds (Little Naches, American, Tieton, Rattlesnake), a better understanding of fine sediment delivery sources and their relative contribution to the stream system is needed. The monitoring work has been extremely valuable for assessing conditions and trends directly in the spawning habitat. However, the sources of the fine sediment, scale of contribution, and factors that cause the delivery have not been quantified to any great degree. The past watershed analyses provided some insight into sediment delivery sources, but this information is becoming dated and only provided a coarse picture. Further investigations into sediment sources and contributions could greatly enhance the understanding of spawning habitat conditions in the watershed.

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.x Predator Avoidance Training

Details on this work were presented in the 2003 annual report:
(http://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=00013769-1).
No additional work was done pursuant to this task in fiscal year 2005.

Task 1.y Biometrical Support

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

- 2005 Annual Report HI-LO smolt-to-smolt Survival (See Appendix C)

- 2005 Annual Report OCT-SNT smolt-to-adult Survival (See Appendix D)

- 2005 Annual Report, Wild and Hatchery Smolt Survival of Roza Spring Chinook Releases (See Appendix E)

- Chandler entrainment and canal survival rate estimates (See Appendix F)

- Annual Report: Smolt Survival to McNary of Year-2005 Fall Chinook (Appendix G) and Coho (Appendix H) Releases into the Yakima Basin

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 Yakima Subbasin Harvest Monitoring

Rationale: To develop a database to track the contribution of target stocks to in-basin fisheries.

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 6.

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

Table 6. A summary of Yakama Nation tributary estimated harvest in the Yakima Subbasin, 2005.

River	Dates	Weekly Schedule	Notes	Chinook	Jacks	Steelhead	Coho
Yakima River	4/12-7/2	Noon Tues to 6 PM Saturday		470	4	0	0
Yakima River	9/20-11/26	Noon Tues to 6 PM Saturday		0	0	0	0

GENETICS

Overall Objective: Develop methods of detecting significant PAPS genetic changes in extinction risk, within-stock genetic variability, between-stock variability and domestication selection.

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 Allozyme/DNA data collection and analysis.
- Task 3.b Stray recovery on Naches and American river spawning grounds.
- Task 3.c Yakima spring Chinook domestication.

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

Busack, C., A. Fritts, T. Kassler, J. Loxterman, T. Pearsons, S. Schroder, M. Small, S. Young, C. M. Knudsen, G. Hart, and P. Huffman. 2006. Yakima Fisheries Project Genetic Studies, Yakima/Klickitat Fisheries Project Monitoring and Evaluation, Annual Report 2005. Project No. 1995-063-25; BPA Report DOE/BP-00022370.

ECOLOGICAL INTERACTIONS

Overall Objective: To develop monitoring methods to determine if supplementation and enhancement efforts keep ecological interactions on non-target taxa of concern within prescribed limits and to determine if ecological interactions limit supplementation or enhancement success.

Task 4.a Avian Predation Index

Rationale: To assess the annual impact of avian predation upon juvenile salmonid populations on the Yakima River.

Methods: The methods used to monitor avian predation on the Yakima River in 2005 were consistent with the techniques used in 2001-2004. 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 six aerial surveys for pelicans were conducted on the lower Yakima River from Union Gap to the mouth of the Columbia River. Details of survey, analytical methods and results can be found in Appendix I of this annual report.

Progress (see Appendix I for additional detail, tables and figures):

River Reach Surveys

In 2005, 15 different piscivorous bird species were observed on the Yakima River. These are the same species observed in previous years. The middle river reach, Canyon, exhibited the lowest diversity of bird species (4) and the Zillah drift in the lower river had the highest (13). Great Blue Heron, Belted Kingfisher and Osprey were the only species found on all six reaches in the spring. Common Mergansers were seen on all reaches except the Vangie reach in the lower river. Common Mergansers were most abundant in the upper reaches of the river as has been the case in all previous years surveyed, followed by Belted Kingfishers. In the middle reach, Common Mergansers were the most common species in spring and second to the Belted Kingfisher in summer. The lower reaches were more variable with pelicans the most abundant bird at Zillah, followed by Common Mergansers, and gulls the most abundant birds at Vangie and Benton, followed by pelicans and Double-crested Cormorants, respectively. Great Blue Herons were the third most common species at Zillah and Vangie, and pelicans were the third most common species at Benton. Double-crested Cormorants, a major fish predator on the Lower

Columbia River, were found in low to moderate numbers in the lower river, particularly at Benton and Vangie with a few at Zillah. Caspian Terns, another major fish predator on the Lower Columbia River, were only found at Vangie and Benton in low numbers.

Common Mergansers are of particular importance because of their known utilization of salmon smolts in Europe and North America., and their relatively high abundance within the upper and middle reaches of the Yakima River. They were also fairly abundant at Zillah in the lower river in spring. As in the previous seven years, Common Mergansers remained the primary avian predator of the upper and middle river in both the spring and summer periods. Belted Kingfisher and Great Blue Heron, although common in the upper and middle river, are far less important consumers of fish biomass in the Yakima Basin for different reasons. The Belted Kingfisher is too small in size and the Great Blue Heron too thinly distributed to be major factors in the consumption of salmon smolts. Great Blue Herons also prey on a wide variety of aquatic and terrestrial species ranging from frogs to rodents. Pelicans in the lower river are important because of their growing numbers and high daily dietary requirements.

Common Merganser Abundance along River Reaches

In the upper river in spring, Common Mergansers averaged 2.3 birds/km, while on the middle river they averaged 1.1 birds/km. At Zillah in the lower river, they averaged 1.0 birds/km in the spring. In summer, Mergansers averaged 1.3 birds/km on the upper river, and 0.5 birds/km on the middle river. This is fairly similar to counts in 2004, when Mergansers averaged 2.2 birds/km on the upper river in spring and 1.6 in the summer. In 2004, the middle river averaged 0.7 birds/km in spring and summer. At Zillah they averaged 1.3 birds/km in the spring.

The 2005 estimated consumption of fish biomass by Common Mergansers was 134.3 kg/km in the Upper River and 62.6 kg/km in middle river. This represented 93.3% of the fish biomass consumed by birds in the upper river in spring and 86.6% of the fish consumed by birds in the upper river in summer. In the middle river, Common Mergansers consumed 84.3% of the fish biomass taken by birds in the spring and 55.8% of the fish biomass taken during the summer period.

These consumption estimates are similar to those in 2004, when Mergansers consumed an estimated 133.4 kg/km in the Upper River and 43.3 kg/km in the middle river. In spring 2004, Common Mergansers accounted for 67% of the consumption in the upper river and 69% in the middle river. In the summer 2004, they accounted for 90% of the total consumption in the upper river and 69% in the middle river.

In contrast to the upper and middle sections of the river, Common Mergansers consumption of fish biomass in the lower river during spring 2005 was only 27.9 kg/km, representing only 4.8% of the fish biomass consumed by birds in the lower river during spring. In 2004, merganser spring biomass consumption of 23.4 kg/km represented only 6% of the total fish biomass consumed in the lower river.

Based on our estimates, a minimum of 212.5 kg/km of juvenile wild and hatchery spring chinook and hatchery coho biomass were present in the upper and middle Yakima River in spring and summer 2005. If Common Merganser fed entirely on hatchery and wild spring chinook and hatchery coho smolts in spring and summer, their consumption of an average of 98.5 kg/km in the upper and middle Yakima River, would represent removal of 46.4% of the salmonid smolt biomass present. This worse case scenario represents a likely upper limit for merganser predation on salmon smolts in the Upper and Middle Yakima River. It does not include merganser consumption of salmon at smolt acclimation sites.

The diet analysis of 20 Common Mergansers collected along the 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 our river reach model, Common Mergansers consumed an estimated 11.3% of the fish biomass consumed by birds in the entire Yakima River during the spring period. Based on 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 underestimated. These two statistics suggest that mergansers consume salmonids and other fish taxa of the appropriate prey size at a proportion that is about half of their availability in the

Yakima River, indicating some degree of prey selection, either by species or size.

A conclusion that could be drawn from these varied data sources is that Common 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 Common 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.

American White Pelican Abundance along River Reaches

Pelicans were the major avian fish consumer in the lower river in spring 2005, as in 2003-2004, because they were both relatively abundant and have high daily dietary requirements. Pelicans were largely absent from the middle and upper river during both spring and summer. Pelicans averaged 6.9 birds/km in Zillah and 0.5 birds/km at both Benton and Vangie. These are similar figures to those in 2004, when Pelicans averaged 5.9 birds/km at Zillah and 1.2 birds/km and 0.3 birds/km at Benton and Vangie, respectively.

Aerial survey counts of pelicans between Union Gap and the Yakima River mouth ranged from a low of about 60 birds on February 22 to a high of about 660 birds on May 17, averaging 247.5 birds. The great majority of the pelicans were observed between Mabton Bridge and Union Gap. Pelicans were often observed in backwater sloughs and oxbows off the mainstem of the river, presumably feeding on carp and sucker.

Based on the river reach predation model, the total estimated fish consumption by pelicans during the spring 2005 was 482.7 kg/km representing 82.7% of the total estimated fish biomass consumed by birds in the lower river in the spring period, and 72.8% of the total estimated fish biomass consumed by birds in the entire river in the spring. This was a significant increase from 2004, when estimated fish consumption by pelicans was 320.4 kg/km, accounting for 78% of the total consumption in the lower river in the spring and 70.5 % of the total fish biomass consumed in the entire river in spring.

If pelicans inhabiting the lower river reaches consumed the entire 2005 hatchery production of fall chinook and coho salmon smolts released in the lower river, representing over 2.2 million chinook and 52,000 coho (a total biomass of 104.7 kg/km), that would equate to less than 22% of the estimated fish biomass consumed by pelicans in the lower river. However, the small size of fall chinook smolts (4-7 g) appears to preclude them from being a major component of the pelican diet. From pelicans observed foraging at hotspots and from the handful of pelican carcasses collected along the lower Yakima River during this study over the last 3 years, it is known that Yakima River pelicans frequently consume other fish species of size classes larger than salmon smolts, including chiselmouth, pikeminnow and sucker. Estimates of salmon and other fish taken by pelicans at Chandler, which serves a vulnerable bottleneck for smolts, would appear to be a better indicator of smolt consumption by this species than the river reach model, which may be too broad scale to serve as an accurate consumption index.

Hotspot Surveys

Chandler

Over the last 3 years, pelicans have displaced gulls as the dominant predatory bird at Chandler, changing the potential hotspot consumption equation significantly. Estimated consumption of smolts by gulls at Chandler continued to decrease from previous years, declining by 94% from 2004. Bird abundance at the Chandler Juvenile Fish Facility in 2005 was similar to the pattern observed in 2004, with high numbers of pelicans and low numbers of gulls encountered. Pelican numbers dropped to an average of 56.5 bird/day (high of 256) from 72.7 bird/day (high of 291) in 2004. Gull numbers remained relatively stable averaging 1.4 bird/day (high of 6) as compared to 1.3 bird/day (high of 7.5) in 2004. Other piscivorous bird species observed at Chandler included Great Blue Heron, Caspian Tern, Black-crown Night-Heron, Double-crested Cormorant, and Common Merganser. These 7 species as well as Great Egret and Osprey were observed at Horn Rapids.

Pelicans at Chandler

Pelicans appeared to remain for long periods during daylight hours at Chandler in 2005, a pattern similar to that in 2004. Pelicans both rest and forage among the exposed rocks at low water at Chandler. A common observation is that although numerous pelicans attempt to forage for fish discharged out of the Chandler fish bypass pipe, many attempts are unsuccessful. Because pelicans typically feed by grabbing and engulfing fish in their pouch, it is usually difficult to identify prey items before they disappear into their gullet. Pelicans have been observed foraging on both salmon molts and non-salmonid fish at Chandler bypass pipe. Non-salmonids observed taken include sucker, chiselmouth, and northern pikeminnow, typically of size classes larger than that of any smolts. Pelicans are capable of consuming their entire food requirements by eating a few large fish in a fairly short time (~1/2 hr) and then remaining inactive for very long periods (up to 14 hrs).

If it is assumed pelicans at Chandler are obtaining their entire daily dietary requirements at the site, an estimate of their consumption of fish can be derived from their average daily abundances and dietary requirements extrapolated over the entire survey period. It is important to reiterate that pelican consumption estimates at Chandler are not based on direct foraging observations as the gull consumption estimates have been calculated.

However, based on the above assumptions, pelicans are estimated to have consumed a total of 6,582 kg of fish biomass at Chandler in 2005 down from an estimated 9,637 kg in 2004.   If it is further assumed that all fish biomass consumed by pelicans at Chandler consists of salmon smolts predated there, that sets the upper limit of pelican predation on smolts, a worse case scenario. The smolt biomass consumption estimate of 6,582 kg would represent 18.5% of the smolt passage biomass at Chandler between April 1 and July 1, 2005. This passage includes both an estimated 860,000 bypassed smolts and nearly 2.2 million hatchery smolts released at Chandler from the Prosser Acclimation Ponds. If pelicans actually consume salmon smolts of all species in the proportion to their availability the 18.5% would represent consumption of 826,178 smolts, including 29,794 spring chinook, nearly 800,000 fall chinook (35.4% of the hatchery production), 16,015 coho and 1,339 steelhead.

In 2004, based on the same worst case assumptions as above, pelicans at Chandler would have consumed 29.5% of the total smolt passage biomass. That passage includes both over 900,000 bypassed fish and 2.3 million hatchery fish released at Chandler from Prosser Acclimation Ponds. If pelicans consumed salmon in proportion to their availability, the 29.5% of fish biomass consumed would represent nearly 1.4 million smolts consumed, including 63,082 spring chinook, 1.3 million fall chinook (56.8% of the hatchery production), 16,696 coho and 1,721 steelhead.

However correlation analysis brings into question these huge fall chinook consumption estimates for 2004-2005. Fall chinook smolts weighing 4-7 grams in size may be too small for pelicans to efficiently consume them and sustain themselves. Examining the degree of correlation between the various smolt runs and pelican numbers may indicate which runs, if any, are being targeted by pelicans.

The arrival of pelicans at Chandler in spring suggests a relationship between smolt passage and predation by pelicans. The 2005 graph of total smolt passage, smolt passage by run and pelican numbers appears to indicate a significant relationship between the two.

However a correlation analysis of fish passage and pelican numbers indicates the relative weakness of the relationship. Only the correlations between coho smolt passage and total salmon passage (all smolt species combined) show a moderate correlation, suggesting that less than 25% of the pelican count variability can be explained by coho passage. Hatchery spring chinook, total spring chinook and total fall chinook only show weak correlations. Wild spring chinook and steelhead passages show the lowest correlations. Other non-salmonid species, such as chiselmouth also show low, even negative correlations.

The correlation analysis for 2004 fish passage and pelican data shows a roughly similar pattern. The highest, yet only moderate, correlation of pelican numbers is with the coho run, particularly the total coho run and hatchery coho run. There is a moderate correlation with the total salmonid run, the fall chinook run and steelhead run. There is no correlation with the total spring chinook run, with a weak correlation with the hatchery spring chinook run and a negative correlation with the wild spring chinook run. Again it is important to state that the best 2004 correlations are only moderate, with less than 33% of the pelican count variability being explained by differences in hatchery coho and total coho passage.

The correlation analysis gives credence to rejecting any assumption that pelicans are responding directly to smolt runs of spring chinook, fall chinook and steelhead and presumably consuming large numbers of them. The correlations do suggest that pelicans may be responding to the relatively large run of coho smolts that are of sufficient size (> 30 g.) with the run in large enough volume to serve as an energy efficient food source.

Gulls at Chandler and Horn Rapids

Unlike pelicans, gulls do not spend all day at hotspots. The number of gulls at Chandler and Horn Rapids peaks at just before mid-day and declines in the afternoon. Based on observed successful foraging by gulls, the birds are estimated to have consumed only 672 smolts at Chandler in 2005, representing less than 0.08% of the smolts counted at Chandler. At Chandler in 2004, gulls were estimated to have consumed 11,977 smolts, representing an estimated 1.3% of the bypassed smolts.

Gulls remained the primary fish predator at Horn Rapids Dam as in 2004, with an average of 5.6 birds/day (high of 36.5) down from an average of 10.7 birds/day (high of 43) in 2004. This site had little pelican activity. Consumption by gulls at Horn Rapids accounted for over 96% of the total gull consumption of smolts at both hotspots. Consumption of smolts by gulls at Horn Rapids decreased 82% from totals in 2004. Estimated consumption of juvenile salmonids by gulls at both hotspots combined in the spring was 19,108 fish, continuing the declining trend in total gull consumption since 2002 (112,850 fish in 2004, 141,349 in 2003 and 279,482 in 2002). The total observed gull consumption in 2005 represents 0.62% of the more than 3 million smolts that may have passed Chandler and Horn Rapids in 2005, which includes smolts counted at Chandler Bypass and nearly 2.2 million fall chinook smolts released from Prosser Acclimation Ponds. Those 2.2 million fall chinook smolts (average weight 4 g) represented 9,026.6 kg of fish biomass passing Horn Rapids Dam, with the 18,436 smolts consumed at Horn Rapids represented an estimated 0.84 % of salmonid biomass consumed.

The 2005 gull consumption totals are more than 5 times lower than those in 2004. In 2004, Prosser Acclimation Ponds alone contributed over 2.3 million fall chinook smolts (average weight 5 g) representing 11,181.5 kg of fish biomass passing over Horn Rapids Dam. The total estimated gull consumption of 112,850 smolts at both hotspots in 2004 represented 3.5% of the over 3.2 million smolts that passed Chandler and Horn Rapids.

The 2005 graphs of fish passage (counted at Chandler including Prosser hatchery fish) and gull numbers at Horn Rapids appear to indicate a significant relationship. The highest, moderate, correlation between fish passage and gull numbers is for the wild coho run and total salmonid run. The lowest is for the wild spring chinook, fall chinook and steelhead runs. Except for the low correlations for wild spring chinook, all the runs show moderate correlations. The highest correlations between gull numbers and the coho and total salmonid runs indicate that 44% of the variability in gull numbers can be explained by differences in the wild coho run or 42% of the variability can be explained by differences in the total salmonid run.

The 2004 correlation analysis of fish passage (counted at Chandler including Prosser hatchery fish) and gull numbers at Horn Rapids, showed the highest correlation between coho passage and bird numbers. This correlation was strong, indicating a greater level of significance. The strong correlations between coho passage and gull numbers indicate that nearly 63% of the variability in gull numbers could be explained by differences in the hatchery or total coho run. Fall chinook correlations were moderate as were those of the total salmonid passage. About one fourth of the variability in gull numbers could be explained by differences in the total salmon run. Correlations for spring chinook were weak and insignificant as were correlations with steelhead passage.

If the observed gull predatory behavior on smolts and correlation analysis above is accurate, it might be expected that birds feeding at Horn Rapids would be more likely to be feeding on coho smolts than any other salmonid species. Twenty-nine gulls (Ring-billed and California) were collected for stomach content analysis on May 27 at Horn Rapids. However, this was a poor test of whether gulls were tracking coho, because during late May only large numbers of fall chinook smolts were being released from Prosser Acclimation Ponds with few other salmonids moving through Chandler Bypass. Despite the large number of fall chinook smolts presumably present, none of the gulls appeared to have eaten fish and only two birds had eaten aquatic life of any kind (crustaceans or insects). The rest had consumed terrestrial organisms – insects, isopods, and rodents. Fat, meat, and plant material were also found. By far the most common food item (contained in 34% of the stomachs) was Hemipterans (*Acrosternum hilare*, commonly known as green stinkbugs). Four of the gulls had eaten a rodent. These findings suggest that the on May 27 at least, gulls had been feeding either in agricultural fields or at waste disposal sites and only roosting at Horn Rapids Dam, despite the presence of large numbers of fall chinook smolts in the river released upstream at Prosser.

Smolt Consumption at Acclimation Sites

At the three spring chinook salmon acclimation pond sites in the upper Yakima River and its tributaries surveyed in winter 2005 (Clark Flat, Easton and Jack Creek), the most common birds preying on smolts were the Belted Kingfisher, Common Merganser and Great Blue Heron. If it is assumed that birds feeding in acclimation ponds are consuming smolts, based on an average number of counts at each site conducted over a 4 month period, daily energy requirements of birds, and the average size of smolts, it was estimated that these three bird species together consumed an estimated 703-832 smolts per site (average 757.3). Common Mergansers and Great Blue Herons consumed between 84-94% of the spring chinook smolts eaten by birds. At Clark Flat and Jack Creek in 2004, Belted Kingfishers were the most common avian predator with fewer numbers of Great Blue Herons and Common Mergansers. The three species consumed approximately 511 smolts total at both sites in 2004 (average 335.5), with a few pelicans consuming an estimated 160 more smolts at Clark Flat.

Surveys of a sample stretch of the Teanaway River, where the Jack Creek acclimation pond is located, indicated low levels of avian predation on fish. In spring and summer, a few Common Mergansers and Belted Kingfishers consumed an estimated total of 8.6 kilograms of fish biomass, representing 286 salmon smolts. This is a similar level of predation as in 2004, when an estimated total of 8.1 kilograms were consumed. The Jack Creek chinook acclimation site has not become a major attractant for piscivorous birds.

Belted Kingfishers and Common Mergansers were also the most common birds seen at the four coho acclimation sites in 2005 (Boone, Holmes, Stiles and Lost Creek). Great Blue Herons were only found at Stiles, where their consumption was minimal. If it is assumed that birds were consuming coho smolts alone, they consumed an estimated 24,784 smolts, with the Common Merganser alone consumed between 85-99.98% of the smolts eaten per site. However, 98% of the coho smolts (24,315) were consumed at one site, Boone, which averaged nearly 31 Mergansers per day. Common Merganser consumption represents 64% of the 38,000 coho smolts released at Boone. Holmes and Lost Creek lost an estimated average of 50 smolts per pond, with 369 smolts consumed at Stiles.

This pattern was fairly similar to that in 2004, when Belted Kingfishers, Common Mergansers and Great Blue Herons predominated, with the Common Merganser and Great Blue Heron being the most important predators, consuming between 90-99.98% of smolts eaten by birds. Lost Creek and Holmes lost an average of 1,771 smolts per site, with Stiles losing 380 smolts. Coho consumption was dominated by Common Mergansers at Boone, consuming an estimated 8.8 % of 233,750 coho smolts, equaling to 20,616 fish. In supporting high numbers of Common Mergansers in both the winter and early spring 2004-2005, Boone Pond has become a hotspot for coho smolts.

Personnel Acknowledgements: Jim Siegel is the project biologist for this task. Biologist Ann Stephenson and Biological Technicians Sara Sohappy and Frank Canapo conducted all field work.

Task 4.b Fish Predation Index (Yakama Nation Portion Only)

Rationale: Develop an index of the mortality rate of upper Yakima spring Chinook attributable to non-salmonid piscivorous fish in the lower Yakima.

This index will be used to estimate the contribution of in-basin predation to fluctuations in hatchery and wild smolt-to-adult survival rate.

Methods: Monthly mark-recapture Northern pikeminnow (NPM, *Ptychocheilus oregonensis*) population estimates are attempted from March through June at Selah Gap to Union Gap (Section 1-3), Parker Dam to Toppenish (Sections 4-6), and Toppenish to Granger (Sections 7-9). In the past, valid estimates had not been successful for Granger and Sunnyside, thus population estimates were on hold until sufficient PIT tags were deployed, allowing for valid estimates to be obtained. In addition to work associated with population estimates, stomach samples were collected from every fifth NPM that is 200+ cm in fork length, and these are collected within the population estimate sites. Northern pikeminnow stomachs with fish present were further analyzed to determine the number and type(s) of species consumed. This analysis is performed using diagnostic bones which allows determination of species (though for salmonids this is more difficult) and approximate body length. All new NPM over 200+ cm are tagged with a PIT tag and subsequently all fish are scanned for the presence of a PIT tag. If a PIT tag is found the tag code and fork length are recorded along with the fish's location (GPS). In addition to GPS tracking of recaptured NPM, radio tags have also been attached to 20 fish in order to determine site fidelity of PIT tagged NPM. This information will be used to determine if PIT tagged fish are remaining in the sample areas that will be used to estimate NPM populations.

Progress:
The predation crew has marked out the major pool complexes within the river reach from Yakima to Granger (Table 7). These sites and other associated habitats are the places where PIT tags are placed in fish and movement patterns are being established for NPM. In addition to PIT tags, radio tagging and tracking are also being conducted for further study of NPM movement. This season will see a slight change in methodology. Population estimates for the one mile transects laid earlier in the project will be aggressively marked and recaptured on the following day. During the population estimate phase, no stomach samples will be taken, thus no reduction in the population and maximization of the marking base can be attained.

A closer examination of radio tagged fish has shown that Northern pikeminnow tend to remain in the section they were tagged in. This information means the population estimation by mark / recapture should provide valid estimates this spring.

Table 7. Current location of Northern pikeminnow sample sites.

Site[a]	Start & End of Site	Number of Pools	Way Point #	North GPS #	West GPS #	Approx. Length of Pool
Gap - Gap 1	Start 1			N46-37.862	W120-30.884	
Gap - Gap 1		1	S1P1	N46-37.844	W120-30.703	400 Meters
Gap - Gap 1		2	S1P2	N46-37.822	W120-30.648	200 Meters
Gap - Gap 1		3	S1P3	N46-37.576	W120-30.126	100 Meters
Gap - Gap 1	End 1			N46-37.498	W120-29.729	
Gap - Gap 2	Start 2			N46-36.185	W120-28.239	
Gap - Gap 2		4	S2P1	N46-36.168	W120-28.227	300 meters
Gap - Gap 2	End 2			N46-35.292	W120-28.003	
Gap - Gap 3	Start 3			N46-33.543	W120-28.012	
Gap - Gap 3		5	S3P1	N46-33.541	W120-27.973	150 Meters
Gap - Gap 3		6	S3P2	N46-33.142	W120-28.152	300 Meters
Gap - Gap 3	End 3			N46-32.678	W120-28.177	
Toppenish 1	Start 4			N46-29.425	W120-25.389	
Toppenish 1		7	S4P1	N46-29.354	W120-25.768	100 Meters
Toppenish 1		8	S4P2	N46-29.104	W120-25.871	250 Meters
Toppenish 1		9	S4P3	N46-28.876	W120-25.306	100 Meters
Toppenish 1		10	S4P4	N46-28.780	W120-25.172	200 Meters
Toppenish 1	End 4			N46-28.942	W120-24.754	
Toppenish 2	Start 5			N46-27.551	W120-23.155	
Toppenish 2		11	S5P1	N46-27.548	W120-23.159	200 Meters
Toppenish 2		12	S5P2	N46-27.343	W120-22.588	400 Meters
Toppenish 2		13	S5P3	N46-27.263	W120-21.973	200 Meters
Toppenish 2	End 5			N46-27.283	W120-21.998	
Toppenish 3	Start 6			N46-25.611	W120-21.167	
Toppenish 3		14	S6P1	N46-25.514	W120-21.117	500 Meters
Toppenish 3		15	S6P2	N46-25.267	W120-21.836	200 Meters
Toppenish 3		16	S6P3	N46-25.196	W120-20.451	100 Meters
Toppenish 3	End 6			N46-25.205	W120-20.052	
Toppenish 4	Start 7			N46-24.167	W120-18.001	
Toppenish 4		17	S7P1	N46-24.354	W120-17.752	300 Meters
Toppenish 4		18	S7P2	N46-24.178	W120-17.208	250 Meters
Toppenish 4	End 7			N46-23.926	W120-16.786	
Toppenish 5	Start 8			N46-23.019	W120-14.631	
Toppenish 5		19	S8P1	N46-23.011	W120-14.203	100 Meters
Toppenish 5		20	S8P2	N46-22.893	W120-13.718	400 Meters
Toppenish 5	End 8			N46-22.616	W120-13.507	
Granger 1	Start 9			N46-20.934	W120-12.882	
Granger 1		21	S9P1	N46-20.851	W120-12.780	400 Meters
Granger 1		22	S9P2	N46-20.820	W120-12.445	1/2 Mile both sides
Granger 1	End 9			N46-20.242	W120-11.889	
2 miles below Granger 1 end point				N46-19.461	W120-10.090	
Toppenish Cr.				N46-	W120-	

[a] Each site is 1 mile long and 2 miles separate them.

A summary of NPM stomach contents collected at Sections 1-9 is presented in Table 8. A total of 41 stomachs were collected during the spring 2005 field season. Of these, 11 stomachs were empty. All stomachs with fish present were further analyzed to determine the species using diagnostic bones to identify them.

Table 8. Summary of species found in Northern pikeminnow stomachs sampled in the Yakima Basin in 2005.

Species	**Count found in NPM stomachs**
Sculpin	4
Red Side Shiner	6
Stickel Back	1
Sucker	1
Lamprey	1
Salmon (unknown species)	4
Steelhead	1
Pumpkin Seed	1
Total All Species	**19**

Task 4.c Indirect Predation (and environmental analysis)

Rationale: The release of hatchery salmonids may enhance or decrease the survival of randomly commingled wild salmonid smolts by altering the functional or numerical response of predators. For example, predators may increase consumption of wild fish by switching prey preferences from invertebrates to fish, or may be attracted to areas where hatchery fish are released. Conversely, large numbers of hatchery fish may confuse or satiate predators, resulting in enhanced survival of wild fish.

Methods:

Progress: No work was budgeted for this task in fiscal year 2005.

See Appendix F in 2002 Annual Report (http://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=00013769-2) for the latest information on this study.

Task 4.d Yakima River Spring Chinook Competition/Prey Index

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

Pearsons, T. N., A. L. Fritts, and J. L. Scott. 2006. Effects of Domestication on Predation Mortality and Competitive Dominance; Yakima/Klickitat Fisheries Project Monitoring and Evaluation 2005-2006 Annual Report. Project No. 199506325, 76 electronic pages. DOE/BP-00022370-2.

Task 4.e 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

Pearsons, T. N., G. M. Temple, A. L. Fritts, C. L. Johnson, and T. D. Webster. 2006. Ecological Interactions between Non-target Taxa of Concern and Hatchery Supplemented Salmon. Yakima/Klickitat Fisheries Project Monitoring and Evaluation Report. 2005-2006 Annual Report, Project No. 199506325, 192 electronic pages, Bonneville Power Administration, Portland, Oregon. DOE/BP-00022370-1.

Task 4.f Pathogen Sampling

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

Thomas, J. B. 2006. Pathogen Screening of Naturally Produced Yakima River Spring Chinook Smolts; Yakima/Klickitat Fisheries Project Monitoring and Evaluation Report. Annual Report 2005. DOE/BP-00022370.

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://pisces.bpa.gov/release/documents/documentviewer.aspx?doc=64878-1

Hubble J. and J. Woodward, (editors). 2003. Yakima Coho Master Plan. Prepared by Yakama Nation in cooperation with Washington State Department of Fish and Wildlife. September 2003. 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.

APPENDICES A through I
[Click on links below to access Appendices]

Appendix	Task		file size	# of pages
A.	1.a.	**Klickitat River Spring Chinook Stock Assessment and Investigation of Integrated Hatchery Strategies**	687Kb	58
B		**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**	340Kb	66
C.	1.d.	IntStats, Inc. Draft Annual Report: **Survival of Upper Yakima Spring Chinook from 2005 Release to McNary Dam Smolt Passage for Releases Subjected to Low and High Early-Rearing Nutritional Regimes**	223Kb	33
D.	1.d.	IntStats, Inc. Annual Report: **Brood Years 1997-2001 OCT-SNTSmolt-to-Adult Survival from Release to Roza Dam Recovery**	82Kb	6
E.	1.e.	IntStats, Inc. Annual Report: **Smolt Survival to McNary Dam of Year-2005 Spring Chinook Releases at Roza Dam**	106Kb	9
F.	1.f.	IntStats, Inc. Annual Report: **Chandler Certification for Yearling Outmigrating Spring Chinook Smolt**	283Kb	27
G.	1.g.	IntStats, Inc. Annual Report: **Smolt-to-Smolt Survival to McNary Dam of Main-Stem-Yakima Fall Chinook reared under Accelerated- and Conventional-Rearing Conditions (and Smolt-to-Smolt Survival of Marion Drain Fall Chinook)**	137Kb	12
H.	1.h.	IntStats, Inc. Annual Report: **Smolt Survival to McNary of Year-2005 Coho Releases into the Yakima Basin**	75Kb	5
I.	4.a.	**Monitoring and Evaluation of Avian Predation on Juvenile Salmonids on the Yakima River, Washington**	1.1MB	42