April 25, 2007

MEMORANDUM

TO: Oregon Watershed Enhancement Board

FROM: Greg Sieglitz, Monitoring and Reporting Program Manager

SUBJECT: **Agenda Item L: Oregon Plan Monitoring and Research Request**
May 15-16, 2007 OWEB Board Meeting

I. Introduction

This report seeks Board approval to provide funding for the Oregon Department of Fish and Wildlife (ODFW) John Day Chinook Salmon Productivity and Escapement Monitoring project in the John Day River Evolutionarily Significant Unit (ESU). This report also provides a summary and funding request for the Non-pareil Dam/Umpqua coho genetic pedigree work conducted by the Coastal Oregon Marine Experiment Station at Oregon State University (OSU).

II. John Day Monitoring

The John Day River Basin supports one of the last remaining intact wild populations of spring Chinook salmon in the Columbia River Basin. These populations, however, remain depressed relative to historic levels. Columbia Basin fish managers have identified the John Day Basin spring Chinook populations as an index population for assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin (Schaller et al. 1999). Significant monitoring is necessary to meet the data needs for John Day spring Chinook as index salmon stocks. The monitoring actions can help assess the long-term effectiveness of habitat projects and differentiate between freshwater and ocean survival. Sufficient annual estimates of salmon spawner escapement, age structure, smolt-to-adult survival, smolts/redd, recruits/spawner, and freshwater habitat use are essential to meet these monitoring needs.

From the 1960s to the 1980s, ODFW conducted adult census surveys in the John Day Basin. ODFW began more significant monitoring of spring Chinook salmon in the John Day Basin through Bonneville Power Administration (BPA) funded spawning ground surveys initiated in 1998, and smolt radio-tagging efforts initiated in 1999. However, during its evaluation and recommendations for funding of monitoring projects this year, BPA reduced and eliminated funding for projects that were not explicitly related to the recovery of Endangered Species Act listed species under the Columbia River Biological Opinion (BiOp). This resulted in a termination of BPA funding to support ODFW monitoring of John Day spring Chinook. BPA has indicated that ODFW will continue to receive funding for some of the monitoring parameters of listed steelhead in the basin.

Due to the BPA funding shortfall, ODFW is seeking OWEB support to continue spring Chinook spawner monitoring in the John Day River Basin. The total funding need for the program from June 1, 2007, to June 30, 2008, is $170,000. (Attachment A) ODFW currently seeks $65,882 to cover monitoring work through the end of September 2007. ODFW intends to approach the Board at its September meeting to request the remaining $105,000, if funding is available.

In the long term, ODFW will seek funding through the Federal Columbia River Power System BiOp remand process as well as from potential BPA funding through the Comparative Survival Study (CSS) to support ongoing Chinook smolt monitoring that provides estimates of smolt abundance and ocean survival or smolt-to-adult returns.

In addition, the future John Day monitoring program may be reshaped to provide important data and evaluation methods for determining the effectiveness of restoration projects in the Middle Fork John Day basin. Recent work between OWEB and the Middle Fork Working Group is designed to establish an Intensively Monitored Watersheds Study Plan to be implemented with existing National Oceanic and Atmospheric Administration funds held for the State of Oregon at the Pacific States Marine Fisheries Commission.

While long-term funding solutions are pursued, OWEB funding will allow ODFW to be able to continue to provide adult escapement, smolts/redd, and recruits/spawner estimates to aid in the recovery efforts for John Day and Columbia River spring Chinook populations.

III. Non-pareil Dam/Umpqua coho pedigree

A. Background

The OWEB Board began its investment in the Non-pareil Dam/Umpqua coho pedigree research project in September of 2002 following a solicitation of Conservation Hatchery Improvement Program (CHIP) concepts in 2001. The Independent Multidisciplinary Science Team reveiwed the CHIP proposals and developed findings that indicated Non-pareil Dam and three other proposals had merit for the purposes of aiding in salmon recovery. The project, as originally proposed to the Board, was structured to span a nine-year period from the 2001-2003 to 2011-2013 biennia. The request to the Board today is for funding of the sixth year of the study.

B. Intent of Study

The effective use of hatchery fish to increase the size of an existing wild population has not been demonstrated. The study concept is to take a portion of a small wild population into captivity and disproportionately increase the number of offspring produced by them, release those offspring into the wild, and then allow them to spawn naturally as adults, thereby, significantly increasing the total number of natural salmon spawners.   If this larger spawning population reproduces successfully in the stream, it should produce a much larger naturally-produced (“wild”) population in a small number of generations (shorter period of time). The detailed study plan and the multi-year proposal first presented to the Board in September of 2001 are found in Attachment B.

C. Proposed Work and Needed Funds

In 2007, OSU is planning to conduct pedigree analysis of the 2006 returning fish samples. That analysis would be conducted to determine:

- The relative success of unfed fry verses smolt releases as returning adult fish to the basin for 2004, 2005, and 2006 cohorts. This includes comparisons to the adult production by naturally spawning wild fish.
- The effective size of wild coho salmon inferred from demographic data.
- The influence of mate choice on fitness of wild coho

The budget to conduct this work in 2007 is $177,000.

In 2008, the study would conduct pedigree analysis of 2007 and 2008 returns to determine:

- The differences in reproductive success that occur by treatment, by age (males), by gender, by adult run time, and by adult body size (length).
- If the size of the naturally-produced population increases due to successful natural reproduction of hatchery fish, and whether contribution to this group varies by treatment.

The findings for both 2007 and 2008 would be prepared for the inclusion in peer reviewed literature. The budget for 2008 work is $181,795. The two year total is $359,112. (Attachment C)

OWEB does not have adequate non-capital funds available at this time to meet the total budget request of $359,112 to continue this work through the upcoming biennium. However, OSU has an immediate need to obtain funding to maintain its efforts into the new biennium, and has no available alternative funding sources. Given this situation, staff identified $177,000 of currently available non-capital funds that can support the continuation of OSU's research for the first year of the biennium. Staff and OSU will return to the Board at a later meeting to seek additional funding for the full biennium, if funding is available.

IV. Recommendation

Staff recommend:

1. The Board allocate $65,882 of non-capital funds to the John Day Chinook Salmon Productivity and Escapement Monitoring project for the period of June 1 to September 30, 2007.

2. The Board award $177,000 of non-capital funds to the Non-pareil Dam/Umpqua Coho Genetic Pedigree study.

Attachments

A. John Day Proposal and Budget
B. 2001 Non-pareil Study Plan
C. Non-pareil 2007 and 2008 Study Plan and Budget

Attachment A

PROJECT PROPOSAL

PROJECT TITLE: Chinook Salmon Productivity and Escapement Monitoring in the John Day River Basin.

PROJECT SPONSOR: Oregon Department of Fish & Wildlife
3406 Cherry Ave. NE
Salem, OR 97303

PROGRAM LEADER: Richard W. Carmichael
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PROJECT LEADER: James R. Ruzycki
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WORK PERIOD: JUNE 1, 2007-JUNE 30, 2008

INTRODUCTION

The John Day River subbasin supports one of the last remaining intact wild populations of spring Chinook salmon in the Columbia River Basin. These populations, however, remain depressed relative to historic levels. Between the completion of the life history and natural escapement study in 1984 and the start of the BPA-funded productivity and escapement project in 1998, spring Chinook spawning surveys did not provide adequate information to assess age structure, progeny-to-parent production values, smolt-to-adult survival (SAR), or natural spawning escapement. Numerous habitat protection and rehabilitation projects to improve salmonid freshwater production and survival have also been implemented in the basin and are in need of effectiveness monitoring. While our monitoring efforts outlined here will not specifically measure the effectiveness of any particular project, they will provide much needed background information for developing context for project-specific effectiveness monitoring efforts. To meet the data needs as index stocks, to assess the long-term effectiveness of habitat projects, and to differentiate freshwater and ocean survival, sufficient annual estimates of spawner escapement, age structure, SAR, smolts/redd, recruits/spawner, and freshwater habitat use are essential. We began to meet this need through BPA-funded spawning ground surveys initiated for spring Chinook salmon in 1998 and smolt PIT-tagging efforts initiated in 1999.

Due to recent BPA-funding shortfalls, we seek support to continue our Chinook spawner monitoring in the John Day River basin. BPA has indicated that we will likely continue to receive funding for our steelhead monitoring in the basin. We also are seeking BPA funding through the Comparitive Survival Study (CSS) to support our ongoing Chinook smolt monitoring that provides estimates of smolt abundance and ocean survival or smolt-to-adult returns (SAR). With additional funding for adult Chinook monitoring we will be able to continue to provide adult escapement, smolts/redd, and recruits/spawner estimates to aid in the recovery planning of John Day and Columbia River spring Chinook populations.

Because Columbia Basin managers have identified the John Day subbasin spring Chinook populations as an index population for assessing the effects of alternative future management actions on salmon stocks in the Columbia Basin (Schaller et al. 1999) there is a need to continue our ongoing studies. This project is high priority based on the high level of emphasis the NWPPC Fish and Wildlife Program, Subbasin Summaries, NOAA BiOp, ISRP, and the Oregon Plan for Salmon and Watersheds have placed on monitoring and evaluation to provide the real-time data to guide restoration and adaptive management in the region.

By implementing the proposed program we will be able to address many of the goals for population status monitoring, such as defining areas currently used by spring Chinook for holding and spawning habitats and determining range expansion or contraction of summer rearing and spawning populations of spring Chinook. The BiOp describes these goals as defining population growth rates (adult monitoring), detecting changes in those growth rates or relative abundance in a reasonable time (adult/juvenile monitoring), estimating juvenile abundance and survival rates (juvenile/smolt monitoring), and identifying stage-specific survival (adult-to-smolt, smolt-to-adult).

This project provides critical information for evaluating the Columbia Basin Fish and Wildlife Program including detailed stock status of key indicator naturally spawning populations and life history, distribution, and productivity of wild populations. This project was developed in direct response to the recommendations and needs of regional modeling efforts, the Independent Scientific Review Panel (ISRP), the Fish and Wildlife Program, and the Columbia Basin Fish and Wildlife Authority Multi-Year Implementation Plan.

PROJECT GOALS

1. Provide accurate and precise information on status and trends in adult Chinook throughout the John Day River subbasin.

2. Assess natural escapement, productivity (recruits per spawner), and freshwater productivity (smolts per spawner) of spring Chinook salmon in the John Day River subbasin.

PROJECT OBJECTIVES

1. Estimate number and distribution of Chinook salmon redds and spawners for the John Day River subbasin populations.

2. Estimate age composition and hatchery stray fraction of the John Day River subbasin spring Chinook salmon populations.

3. Estimate productivity metrics including recruits/spawner and smolts/spawner for the John Day River spring Chinook populations.

4. Complete reports of progress and communicate results.

5. Participate in planning activities associated with anadromous fish management and ESA permitting, consultation, and recovery.

ENDANGERED SPECIES ACT PERMIT REQUIREMENTS

John Day River Chinook Salmon are not listed under the Endangered Species Act (ESA). Therefore, no directed take permits or consultations are required to conduct the chinook salmon activities proposed in this statement of work. Steelhead juveniles, which are listed as threatened under the ESA will be captured, handled, and released during their directed take and during the collection of chinook smolts. The National Marine Fisheries Service (NMFS) authorizes take of steelhead under the provisions of the 4(d) ruling. The 4(d) rule includes an exemption from take prohibitions for research activities called "Limit on the take prohibitions for research activities". We submitted a 4(d) research application to NMFS for take of listed steelhead in the John Day

River subbasin. We received 4(d) take authorization from NMFS in early March 2002 and are expected to be renewed in 2003. Take will be reported annually in a comprehensive report provided to NMFS with copies to BPA.

ODFW has an ESA Section 6 agreement with the U.S. Fish and Wildlife Service (USFWS) for bull trout. This agreement authorizes all direct take associated with bull trout management and research activities conducted by ODFW. Because we are providing biological data for bull trout management, take of bull trout during Chinook sampling is covered under this agreement.

STUDY PLAN

OBJECTIVES 1-3: Estimate the number and distribution of spring Chinook salmon redds and spawners, and age and hatchery stray composition of the spawner stocks in the John Day River subbasin.

APPROACH: Spring Chinook salmon spawning ground surveys are conducted each year during the entire month of September and typically cover 137 km of stream habitat (Wilson et al. 2001). Surveys are conducted by walking while visual counts are made of spawning activity. Current survey sections range from 3.2 to 8 km in length, depending on accessibility and difficulty. Surveyors record number of occupied and unoccupied redds, the number of live fish observed (on redds and off redds), and the number, sex, and origin (hatchery or wild) of carcasses in each survey section. Surveys are conducted in known spawning areas (based on previous visual observations) with some additional exploratory surveys conducted each year when redds are reported or suspected outside traditional survey sections.

Surveyors will carry hand-held GPS receivers and topographic maps to reference survey sections and redd locations. Surveyors will record latitude and longitude of all encountered redds, or clusters of redds, depending on redd proximities. GPS reference points will be entered into a GIS database with coverage for the entire John Day River basin. Carcasses found during the survey are measured (fork length and middle of eye to posterior scale, MEPS, mm), confirmed for sex, and percent of eggs spawned are estimated to the nearest 25% for females. Any identifying marks or tags are noted. Scale samples are removed for age determination. If fin marks are observed, the snout of the fish is removed to determine the presence of a coded-wire tag.

To determine range expansion by spawners we will sample outside of traditional areas with sampling methods based on our current protocols and a random, sample-site selection method. Randomly drawn sample sites will be approximately 2 km in length. Downstream limits of the sampling universe will be defined as 20 km downstream of our current survey sections or 20 km downstream of the most downstream redd observed in each HUC (4th level HUC; North Fork, Middle Fork, Upper Mainstem) since 1959 when index surveys began. Upstream limits will be defined as 4 km upstream of our current survey sections or the most upstream redd observed since 1959. Each year, one site above and two sites below traditional sections will be selected in each HUC.

The EMAP sampling approach will not be used for Chinook spawner surveys in the John Day subbasin because managers require information at the 4^{th}-level HUC, geographic scale. This sampling universe is effectively too small for subsampling using the EMAP approach given the stream length of our survey units and the number of subsamples that can be drawn within each HUC.

Using counts of redds and adults, we will estimate recruits/spawner and smolts/spawner. Recruits per spawner estimates are determined from consecutive year spawner surveys and age composition analysis of spawning adults. Age composition is calculated from ageing of scales taken from spawner carcasses collected on spawning ground surveys. Smolts per spawner is estimated using annual spawner escapement counts and subsequent annual abundance estimates of their smolt progeny captured in rotary screw traps and seines.

Task 1.1: Conduct census surveys throughout the traditional 137 river kms to determine spawner distribution and abundance.

Task 1.2: Survey randomly drawn 2-km reaches outside traditional survey section areas.

Task 1.3: Geographically reference and develop GIS data base for redd distributions.

Task 2.1: Estimate sex ratio and age structure of returning spring Chinook salmon spawners.

Task 2.2: Calculate annual estimates of recruits/spawner and smolts/spawner.

Task 3.1: Estimate proportion of hatchery strays in spawner populations and origin of strays.

OBJECTIVES 4-5: Complete reports of progress and communicate results. Participate in planning activities associated with anadromous fish management and ESA permitting, consultation, and recovery.

APPROACH: Progress reports will be prepared and submitted as required in the contract agreement. Results will be communicated through reports and presentations at ODFW and professional society meetings. Products produced from this objective are specified in the tasks below. Regional coordination and oversight committees have been proposed to guide and coordinate monitoring and evaluation efforts in the Columbia Plateau and John Day subbasin. Program managers, project and assistant project leaders will participate in these committees. Permits and reports will be prepared to ensure consistency with ESA requirements.

Task 4.1: Write and submit progress and final reports.

Task 5.1: Provide data to Project biologists developing regional models and to StreamNet. Provide information as requested by subbasin planners, Technical Recovery Team (TRT), and basin-wide research activities.

Task 5.2: Comply with ESA permitting requirements including data summarization related to the 4(d) rule.

SCHEDULE

TASK	DATES OF COMPLETION
Task 1.1 (spawner census surveys)	October 20, 2007
Task 1.2 (random spawner surveys)	October 20, 2007
Task 1.3 (GIS redd distributions)	January 31, 2007
Task 2.1 (estimate sex ratio)	January 31, 2007
Task 2.2 (estimate recruits/ and smolts/spawner)	January 31, 2007
Task 3.1 (estimate hatchery stray rate)	January 31, 2007
Task 4.1 (submit l reports)	Draft-January 4, 2008; Final-March 1, 2008
Task 5.1 (provide data)	Complete by November 30, 2007
Task 5.2 (comply with ESA requirements)	As needed

LITERATURE CITED

Schaller, H.A., C.E. Petrosky, and O.P. Langess.1999. Contrasting patterns of productivity and survival rates for stream-type chinook salmon populations of the Snake and Columbia River. Canadian Journal of Fisheries and Aquatic Resources 56:1031-1045.

Wilson, W.A., J.R. Ruzycki, R.W. Carmichael, S. Onjukka, G. Claire, and J. Seals. 2001. John Day Spring Chinook Salmon Escapement and Productivity Monitoring. Annual Progress Report to Bonneville Power Administration. Project No. 98-016-00.

BUDGET

Chinook Productivity & Escapement Monitoring in the John Day River Basin

Personal Services - Salaries

1 Personnel		Person Months	Salary	Cost
Project Leader (SFWB, 0507097, Ruzycki)		2	4,308	8,616
Assist. Project Leader (NRS2, 0507070, Schultz)		12	3,208	38,496
Project Assistant (NRS1, 0507075, Schricker)		4	2,664	10,656
Experimental Biology Aide (2000.039, Walker)		3	1,863	5,589
Experimental Biology Aide (0507098, Willis)		2	1,863	3,726
Experimental Biology Aide (0507088, Lamb)		2	1,787	3,574
Office Coordinator (4400.168, Maley)		1	2,017	2,017
			Subtotal	72,674.00
	Fringe:	OPE 58% on Permanent	59,785	34,675.30
		OPE 68% on Seasonals	12,889	8,764.52
			Subtotal PS	**116,113.82**

Services and Supplies

2 Travel and Transportation	**Subtotal**	**6,540.00**
Ground Transportation		5,490
Per diem (30 days @ $31/day)		1,050.00
3 Supplies & Equipment	**Subtotal**	**1,600.00**
Program related supplies		1,100.00
Computer Supplies		200.00
Office Supplies		300.00
4 Rent/Utilities	**Subtotal**	**2,060.00**
Communication Service		240.00
Utilities		455.00
Other Services		165.00
Facilities Rent ($400/mo for 3 mo.)		1,200.00
5 Professional Meetings & Training		**250.00**
	Subtotal S&S	**10,450.00**
Overhead/Indirect 34.16% of Items 1-5		**42,234.20**
	Net ODFW Contract	**$169,798**

Attachment B

CHIP Project Proposal Narrative

I. Project Title: Nonpariel Dam Adult Trap and Coho Genetic Pedigree

II. Contact: Dave Loomis, Oregon Department of Fish and Wildlife
Dr. Michael Banks, Oregon State University

III. Project Abstract:

This proposal would investigate several areas of uncertainty about the use of hatcheries to increase the abundance of wild populations. There is a considerable interest in using hatcheries to speed the recovery of wild populations. However the value of such programs is untested. Substantial literature exists that indicates hatchery programs may pose high risks to wild populations, rather than aid them (see the following reviews: Hindar et al 1991, Waples 1991, Waples 1999, and Lichatowich 1999 and literature cited therein). If the risks are real, hatcheries may *interfere* with recovery, rather than speed it. Until recently, analytical methods to explore the critical questions and risks associated with hatchery programs were unavailable because we were not able to track lineages in streams once hatchery and wild fish were allowed to spawn together. New molecular genetics methods now allow us to use DNA fingerprints to pedigree entire populations under some circumstances and develop lineages that continue for multiple generations under natural spawning conditions. We can finally produce direct evidence of the success or failure of hatchery supplementation programs and provide direct measurements of some of the risks predicted by genetics theory. We propose to utilize these methods on an experimental supplementation program for coho salmon on the Calapooya River, a tributary of the Umpqua River on the Oregon Coast.

IV. Proposal:

A. Project Need:

1. Intent:

The effective use of hatchery fish to increase the size of an extant wild population has not been demonstrated. The concept is to take part of a small wild population into captivity, disproportionately increase the number of offspring produced by them, release those offspring into the wild, and then allow them to spawn naturally as adults thereby significantly increasing the total number of natural spawners. If this larger spawning population reproduces successfully in the stream it should produce a much larger naturally-produced ("wild") population in a small number of generations. The benefit of this larger population size may out-weigh the impact of genetic risks caused by the action (Figure 1).

However the success of this approach has not been evaluated or demonstrated. We know we are able to substantially increase the number of natural spawning fish by adding hatchery adults to a stream. But to date we have not been able to demonstrate that this action increases the number of naturally-produced ("wild") adults in the stream. We also expect, based on genetics theory, that substantial genetic risks to the wild population may occur as a result of this action, but we have not been able to directly measure the risks. Our biggest handicap to evaluating these efforts has been our inability to determine the parentage of naturally-produced offspring in a natural stream setting. New developments in molecular genetics now allow us to pedigree entire populations, provided we are able to handle the adults. These methods let us exactly match offspring to parents. The results are straightforward and unambiguous. We are able to follow lineages from parents to offspring to grand-offspring. We finally will have a clear answer as to whether hatchery fish breed as successfully in streams as wild fish do, which will measure the success of the hatchery program. We will also be able to directly measure several genetic risk factors.

Reproductive success by hatchery fish spawning in a stream is expected to be lower than that of wild fish. The lower fitness of hatchery-born adults manifests itself in two ways: First, hatchery-born adults do not compete for mates or build nests as successfully as wild fish (Fleming and Petersson, 2001, Chebanov and Riddell 1998). Second, the survival of their offspring is reduced owing to relaxed natural selection and to domestication selection that occurs during the egg-to-smolt stage in the hatchery (Lynch and O'Hely 2001, Reisenbichler and McIntyre 1977, Reisenbichler and Rubin 1999).   Successful reproduction by the hatchery fish spawning in the stream – specifically production of adult offspring -- is required if the benefit of an increased wild population size is to occur. We will be able to directly measure the reproductive success of the hatchery fish relative to wild fish by knowing exactly how many adult offspring are produced by each natural spawning individual.

Hatchery programs, where substantial numbers of hatchery fish spawn naturally in a wild population, theoretically cause five major genetic risks to wild populations. The risks are demonstrated in Figure 1 and include the following:

Risk 1. Population Bottleneck (Ryman and Laikre 1991): This risk occurs when a small number of parents (those taken into the hatchery) contribute more offspring per parent to the supplemented population than the rest of the population (those left in the wild). This difference in family size causes a decrease in the effective population size of the total population.

Risk 2: Increased Inbreeding (Ryman et al 1995): This risk occurs when only a small number of parents (those taken into the hatchery) produce a substantial proportion of the fish in the supplemented population. Since they share so few parents, the hatchery fish in the supplemented population are more likely to be related to each other, thus increasing the incidence of inbreeding.

Risk 3: Increased Genetic Load (Lynch and O'Hely 2001): This risk results from the increased reproductive success and survival that occurs while fish are in the captive environment. Increased reproductive success and survival in captivity occurs because natural selection pressures are intensely relaxed which leads to an increase in the level of genetic load.

All of these risks are inevitable in any hatchery supplementation program. However, if the hatchery fish breed successfully, and the program succeeds in increasing the size of the wild population, and it stabilizes at the larger size, and the hatchery program stops removing further risk, a net benefit to the wild population may occur. If, on the other hand there is reproductive failure by the supplemented population, further genetic risks will occur:

Risk 4: Genetic Variation is Lost (Nei et al, 1975): When an offspring population is smaller than it's parent population genetic variation is lost. This is due to reproductive failure by some parents and the loss of the genetic material they carry. Additional random loss of genetic variation may occur when populations are very small.

And finally, if the hatchery program continues over multiple generations the impacts of these risks will accumulate in the wild population due to the nature of the genetic mechanisms involved **(Risk 5)**.

Direct measurements of effective population size, inbreeding coefficient, and reproductive success or failure can be made using pedigrees. Occurrence of increased genetic load and loss of genetic variation can be inferred from the measures of individual reproductive success.

Additional questions exist about the best protocols to use in implementing a supplementation program. For example, using single-generation hatchery broodstock (parents taken from the wild each generation) rather than old hatchery stocks should minimize the genetic effects, but there has never been a test of this hypothesis. Similarly, releasing unfed fry should reduce the extent to which selection is relaxed in the hatchery to only that experienced during the egg-to-fry stage, and to selection on any parental behaviors such as maternal nest building ability. Therefore, although survival from egg to adult of fish released as unfed fry is much lower than that of fish released as smolt, the hatchery adults that return from the unfed fry releases may be nearly as successful at natural reproduction as completely wild fish. This hypothesis has also never been tested. It is not possible to test all possible protocols in a single experiment. This study proposes to investigate the following strategies:

a. Is a first-generation wild-type broodstock a better choice than an older, multi-generation broodstock? Theoretically, the first-generation broodstock should have less genetic load and domestication build-up than an older one and should succeed better. The existing Rock Creek Hatchery coho broodstock is an older and also partly mixed-origin broodstock. The success of these will be compared to wild fish collected at Winchester Dam in 2001 and at Nonpareil Dam in 2002-03 to form a first generation broodstock.

b. Is a less invasive hatchery program better than a more invasive one? In a less invasive program, fish are held captive through a lesser portion of their life cycle, which should decrease genetic load build-up. The down-side of holding fish captive for a shorter period is that the survival benefits, and therefore the rapid increase in number of fish, are compromised. In our experiment we compare two options:

i. Captivity during reproduction and rearing through hatching (release of unfed fry); and

ii. Captivity during reproduction and rearing through smoltification (release of smolts).

c. The reproductive success of adults returning from all of the hatchery treatments will be compared to that of wild fish returning at the same time (in years 2004 through 2007, including both jacks and adults, with their offspring returning in 2007 through 2010, including both jacks and adults).

The potential benefits of a supplementation program also depend on the carrying capacity of the basin. The naturally-produced population can increase in size only if the basin is capable of producing more fish than are currently present. It is therefore important to evaluate the apparent carrying capacity of the supplemented basin at the beginning of the program.

2. **Basin, stock(s):** Umpqua River, coho
3. **Strategic goals:**

This project would be used to evaluate hatchery program effectiveness as required by the Oregon Plan for Coastal Salmonids and NMFS ESA Section 4(d) rulings, and by the ODFW Wild Fish Management Policy (OAR 635-07-525 through 529) and the ODFW Hatchery Fish Gene Resource Management Policy (OAR 635-07-540 through 541).

4. **Literature review:** Background material, theory, methodology and concepts are provided elsewhere in this document, based on the following references:

Blouin, M.S., M. Parsons, V. Lacaille, and S. Lotz. 1996. Use of microsatellite loci to classify individuals by relatedness. Molecular Ecology 5:393-401.

Chebanov, N.A. and B.E. Riddell. 1998. The spawning behavior, selection of mates and reproductive success of chinook salmon (*Oncorhynchus tschawytscha*) spawners of natural and hatchery origins under conditions of joint spawning. Journal of Ichthyology. 38: 517-526.

Fleming, I.A. and E. Petersson. 2001. The ability of released hatchery salmonids to breed and contribute to the natural productivity of wild populations. Nordic Journal of Freshwater Research.

Hindar, K., N. Ryman, and F. Utter. 1991. Genetic effects of cultured fish on natural fish populations. Can. J. Fish. Aquat. Sci. 48: 945-957.

Jackson, LS. and D. Loomis. 2001. Survival of unfed coho fry, Preliminary Report. Oregon Department of Fish and Wildlife, Roseburg, Oregon.

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Marshall, T.C., J. Slate, L.E.B. Kruuk and J.M. Pemberton. 1998. Statistical confidence for likelihood-based paternity inference in natural populations. Molecular Ecology 7:639-655.

Nei, M., T. Maruyama, and R. Chakraborty. 1975. The bottleneck effect and genetic variability in populations. Evolution. 29: 1-10.

Reisenbichler, R.R. and J.D. McIntyre. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmo gairdneri.* J. Fish. Res. Board Can. 34: 123-128.

Reisenbichler, R.R. and S.P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES Journal of Marine Science. 56: 459-466.

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SanCristobal, M. and C. Chevalet. 1997. Error tolerant parent identification from a finite set of individuals. Genetical Research 70:53-62.

Waples, R.S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Can. J. Fish. Aquat. Sci. 48: 124-133

Waples, R.S. 1999 Dispelling Some Myths about Hatcheries. Fisheries 24: 12-21

A. Objectives:

The objective of this study is to conduct an experimental supplementation project for coho salmon in the Calapooya, tributary of the Umpqua River, using the following hatchery scenarios:

- **a.** Rock Creek hatchery stock released as smolts (a "conventional hatchery program");
- **b.** Rock Creek hatchery stock released as unfed fry (a low- intervention hatchery program);
- **c.** First-generation wild-type hatchery stock released as smolts; and
- **d.** First-generation wild-type hatchery stock released as unfed fry.

We will evaluate the success and genetic implications of these alternative hatchery scenarios using DNA pedigree reconstruction. We will establish the pedigree of fish from the hatchery and subsequently above Nonpareil Dam that is illustrated in Figure 2. Three generation-lines will be developed to provide a replication of the study. The total sampling and release design is presented in Table 1. One limitation for this project is that the trap in Nonpareil Dam is not yet installed (as of October 2001). Installation of the trap is expected to occur in the summer of 2002. Although we will begin the pedigrees for the hatchery fish in 2001 we will not be able to begin sampling wild fish in the Calapooya until 2002. Also the first year of wild-type broodstock collection will occur (in 2001) at Winchester Dam, rather than at Nonpareil Dam. The subsequent two wild-type broods will be collected from the Calapooya. This limitation provides us with a unique opportunity to compare two generations of a true "local" wild-type brood to one that came from an adjacent basin. Theory predicts that the true local wild-type brood should be the superior one.

This project will specifically address the following tasks:

Task 1. What is the relative success of using a first generation, wild-type broodstock in a supplementation program compared to a broodstock that has been captive for multiple generations?
Task 2. What is the relative success of unfed fry releases compared to smolt releases in producing returning adults?
Task 3. What is the reproductive success in the wild of adult fish from the following treatments:

- ***a.*** First-generation hatchery fish from unfed fry releases;
- ***b.*** First-generation hatchery fish from smolt releases;
- ***c.*** Multi-generation hatchery fish from unfed fry releases;
- ***d.*** Multi-generation hatchery fish from smolt relases; and
- ***e.*** Wild fish.

Task 4: How does the supplementation program modify the effective population size of the population in the Calapooya (termed the "Ryman-Laikre Effect" (Ryman and Laikre 1991, Ryman et al 1995)
Task 5: What is the level of inbreeding that results from the supplementation

program?
Task 6: What is the incidence of natural crossing between adults from the different treatment groups while on the natural spawning grounds and the consequences of mate choice to the relative production of offspring by individuals;
Task 7: What differences in reproductive success occur by treatment by age (males), by gender, by adult run time, and by adult body size (length)?
Task 8: Does the size of the naturally-produced population increase due to successful natural reproduction by hatchery fish? Does the contribution to this increase vary by treatment group?

This study will use highly variable DNA markers to pedigree coho salmon in the Calapooya, tributary of the Umpqua. The study design will require the installation of a trap in Nonpareil Dam on the Calapooya so that the sampling and data collection can occur. The laboratory analysis will be done under contract to Dr. Michael Banks, OSU, Marine Fisheries Genetics Laboratory.

The results of the evaluation of unfed fry in this project will also be compared to results from other work currently underway in the Umpqua. This other work uses otolith marks to mark unfed fry. Marked fish are recaptured as adults, providing a measure of unfed fry to adult survival rates (Jackson and Loomis 2001). It was not possible to measure the reproductive success of the adults resulting from these releases of marked unfed fry. Final results from the otolith work will be reported in the 2002 annual report for this project.

The district will be initiating an evaluation of the productivity and carrying capacity of the upper Calapooya subbasin in 2002. This evaluation will address natural juvenile production in the subbasin. Existing information on habitat capacity will be compiled in 2002 and provided in the 2002 annual report for this project.

B. Methodology:

Spawning of coho adults will occur at Rock Creek Hatchery and rearing of smolts will occur at Rock Creek Hatchery or Butte Falls Hatchery. Unfed fry will be released under the jurisdiction of the ODFW STEP program with assistance from ODFW volunteers. The Nonpareil trap will be staffed by ODFW district staff out of the Roseburg Fish District office.

In summer of 2002 an adult trap will be installed in the existing fishway in the Nonpareil Dam. The trap would be operated during the adult coho migration period. Fin clips and scales would be taken from each returning adult. Fish will be wanded for coded wire tag collection. Identity of hatchery and wild fish will be based on marks, with a back-up of scale pattern identification. The following information will also be collected at both Nonpareil Dam and at Winchester Dam during the initial broodstock collection:

a. Run time at the respective dam;
b. Gender;

- **c.** Adult size (body length);
- **d.** Age (applies to males only in coho: "Jacks" (age 2) and "Adults" (age 3));
- **e.** Total number of adult fish arriving at and passing Nonpareil Dam each year.
- **f.** Origin of all adult fish arriving at and passing Nonpareil Dam each year.
- **g.** Fecundity of individual females in the hatchery broodstocks (possibility of measuring this will be explored in 2001; if successful it will continue)

Microsatellite DNA markers that are sufficient to identify individuals in the population, and to match offspring to parents, will be used to trace genetic pedigrees. Microsatellite DNA markers are already available for coho salmon (M. Ford NMFS, personal communication; M. Blouin OSU, personal communication, Smith 2001) and the laboratory techniques are routinely used in Dr. Banks's lab. The statistical methods of parentage analysis that are to be used are well established (Blouin et al 1996, SanCristobal and Chevalet 1997, Marshall et al 1998, and Lynch and Ritland 1999). Laboratory staff will initially determine the heterozygosity and number of alleles per locus at each marker locus in the Umpqua population, and will choose the most informative subset of the available markers for use with this population. This screening and optimization of markers will occur in the first year of the contract (2002). The total sampling design for this project, including estimated fish sampled and run through the lab each year, is provided in Table 1. Laboratory work on the sampled fish in a year will begin following final collection of the samples.

Progress reports will be provided annually and major project reports will be developed as results become available. Since this study ultimately addresses the reproductive success of hatchery fish in the wild it is necessary to trace the lineages over three generations (parents, supplemented population, naturally-produced offspring) before the most interesting results become available. The first major project report will be completed in 2006 addressing the relative success of unfed fry releases, and smolt releases at returning adults to the dam. A second major report addressing the return of all hatchery adults and comparisons with returns from wild parents will be completed in 2008. A third major report will occur in 2009 to address the first results comparing reproductive success of hatchery and wild fish in the wild, with a final series of reports in 2011 that will include all results. A schedule of these papers is provided in Table 2. The laboratory will be expected to publish the results in peer-reviewed journals.

C. Research/Management Implications:

This project will evaluate major areas of uncertainty about the use of hatchery programs to increase the abundance of wild populations. The project will be able to uniquely address important questions, listed in the objectives above, that currently limit the usefulness of hatchery supplementation in conservation and recovery. Although this project is specific to one hatchery program for coho in the Umpqua, the results will be of immense value in the design and application of supplementation programs throughout Oregon.

D. Evaluation

1. Define success:

Success in this project is clear information about the relative reproductive success of our various hatchery fish treatments and wild fish. This project can be uniquely implemented in the Calapooya/Umpqua for the following reasons:

1. The study can only be conducted on populations (including hatchery and wild parents) of a particular size. Populations that are too small introduce random errors, while populations that are too large (in the thousands) exceed the abilities of the methods. Populations between 100 and 1,000 adults are appropriate.
2. The study requires that the *entire* population can be sampled without error. We must be able to capture 100% of the fish passing into the population, handle them, sample and measure them and release them unharmed. All individuals must receive the same treatment. The trap must be effective over multiple years for the duration of the project.
3. Coho are particularly attractive as a study species because of their 3-year life history.
4. We must be able to collect other kinds of information on the fish, including abundance, origin, gender, and life history data. This information can also be collected using an effective adult trap.

2. Describe monitoring programs:

The following samples and information must be collected:

i) Monitoring of the hatchery broodstock:

(1) The experimental broodstocks will consist of exactly 200 wild fish and exactly 200 hatchery fish, Rock Creek stock. Each experimental fish should be marked upon capture and assigned a number so that subsequent individual information can be tracked. All data must be kept in a spread sheet or data base.

(2) Age, size (fork length), date of capture (aka run time at Winchester Dam), and date of spawning of each parent in the hatchery.

(3) Tissue clip from each parent, stored in ethanol. Scale sample from each parent.

(4) Gender of each hatchery parent; the sex ratio must be exactly 50% females and 50% males.

(5) Each parent will be paired with only one mate.

(6) Crosses will consist of W x W and H x H only.

(7) Identification of mates for each parent fish (which male is paired with which female).

(8) Individual family survivals (or small groups of families) must be tracked as long as possible. Generally this is through hatch or early fry stage.

(9) Any catastrophic loss or other incident that affects any family or groups of families.

ii) Monitoring of the wild fish and supplemented population at Nonpareil Dam:

(1) Exact number of hatchery and wild fish passed above the dam each year of the study. Each adult should be given a number so that subsequent individual information can be tracked. All data must be kept in a spread sheet or data base.

(2) A fin clip from each fish passed above the dam, stored in ethanol. A scale sample from each fish.

(3) Age, size (fork length), date of passage, origin (marked or unmarked), and gender of each fish passed above the dam.

(4) Wild population size (number of naturally produced fish) returning to Nonpareil Dam should be monitored indefinitely into the future, but at least for 10 years after the supplementation program and this study are concluded.

(5) Average production of offspring per adult and wild fish survival should be monitored indefinitely into the future, but at least for 10 years after the supplementation program and this study are concluded. This information can be obtained from the adult data at the dam using number of fish passed, sex ratio, average fecundity, and number of naturally-produced fish returning to the dam in the next generation. It would also be useful to use smolt traps to estimate smolt production from the basin.

Overall Context

1. Relationship to other projects

This evaluation program can be implemented without interfering with natural production or any element of the hatchery program under evaluation or any other program. It will provide very important information that will be useful in our consideration of all supplementation programs implemented in Oregon. This study is being repeated in other locations and for other species in Oregon and elsewhere in the Northwest, however it will not be possible to do it in every location where hatchery programs occur. Therefore, it will be necessary to extrapolate the results of this project, and of several other similar projects that are underway elsewhere, to other supplementation programs. In the Calapooya, this hatchery project will be coordinated with a study of the habitat and productivity of the upper Calapooya subbasin.

2. Adaptive management components

This program will provide information useful for evaluating the Calapooya unfed fry program and comparing it to smolt programs. But equally important, this study will address critical questions that are hindering the effective use of supplementation in recovery throughout Oregon and elsewhere in the Northwest. The results of this study should confirm those elements of supplementation projects that are effective, provide factual data about risks, and pin-point some effective and ineffective actions and strategies.

V. Annual and Total Project Budget

Capital Construction

Adult Trap (2002 only)		$ 10,000
	Annual costs (2002):	**$ 10,000**
	Total costs (2002):	$ 10,000

***Hatchery Operations (**2002-04)*

Rearing 20,000 smolts @10/lb or 2,000 pounds		$ 6,920
Adult holding facilities (2002 only):		$ 1,000
Incubation tray partitions (2002 only):		$ 2,500
	2002 Annual cost:	**$ 10,420**
	Future annual costs (2002-3):	$ 6,920
	Total costs (2002-04):	$ 24,260

***District Costs for field work** (2002-2010)*

Salaries and benefits			
EBA Seasonal	0.33 FTE		$ 24,130
EBA Seasonal	0.33 FTE		$ 24,130
NRS 4 Permanent	0.25 FTE		$ 38,830
EBA (0.5 month) scale reading			$ 2,500
Field Supplies and equipment			
Glassware, Nets, AnestheticTanks, waders, CWT wand, etc.			$ 10,000
Travel & per diem			
100 miles/day; 4 months/year; $.325/mile			$ 5,200
	Total annual costs:	**$ 151,590**	
	Total costs (2002-10)(estimated*)		$1,364,310

Contract Services for DNA analysis

(Contracted to Dr. Michael Banks, OSU)		$130,000
	Annual costs:	**$130,000**
	Total costs (2002-11)(estimated*):	$1,300,000

Total cost for 2002:	**$302,010**
Estimated annual costs through 2004:	**$288,510**
Estimated annual costs 2005 through 2010	**$281,590**
Estimated cost in 2011	**$130,000**

* Actual laboratory costs may vary depending on inflation levels, cost-of-living increases, and actual numbers of coho returning to the Nonpareil Dam. District costs will vary based on cost of living and inflation increases.

Sampling and release design for the total study at Nonpareil Dam.

Year	Broodstock captured at Winchester		Broodstock captured at Nonpareil	Unfed fry releases	Smolt releases	Adults sampled and passed at Nonpariel Dam*		
	Hatchery (Rock Cr stock)	Wild	(All wild)	(unmarked)	(2 mark groups)	Unmarked		Hatchery fish
						wild	hatchery	
2001	200	200						
2002	200		200	400,000		400		
2003	200		200	400,000	20,000	400		
2004				400,000	20,000	400	5	30
2005					20,000	400	75	350
2006						400	75	350
2007						450	70	320
2008						500		
2009						500		
2010						500		

Parent Generation

Supplemented Generation

Offspring Generation

*Estimated numbers (6375). We do not have historic counts at Nonpariel Dam. The estimated number of adult hatchery fish is based on anticipated average survivals.

Table 2. Schedule of delivery of major products.

Year	Product
2002	Annual progress report. Report on the final results of the otolith marking. Report on the compilation of existing information on the habitat condition in the Calapooya subbasin.
2003	Annual progress report
2004	Annual progress report
2005	Annual progress report
2006	First report on the relative success of unfed fry verses smolt releases at returning adult fish to the basin;
2007	Annual progress report
2008	Final report on the relative success of unfed fry verses smolt releases at returning adult fish to the basin, including comparisons to the adult production by wild fish naturally spawning. Measurements of effective population sizes as influenced by the hatchery program (*RISK 1*, Bottleneck Risk); measurements of the degree of relatedness in the supplemented population (initial part of *RISK 3,* Inbreeding Risk).
2009	First report on the relative reproductive success in the natural environment of hatchery adults from the various treatment groups, as compared to wild fish.
2010	Second report on the same.
2011	Final reports on the following topics: Relative reproductive success of hatchery fish from the various treatment groups and wild fish on the natural spawning grounds (*RISK 2,* potential for *BENEFITS*); Inbreeding coefficient (*RISK 3*); Level (if any) of reproductive failure (*RISK 4*); Relative reproductive success by the following phenotypes (jack vers adult males, run time, body size) and variations in these (if any) in hatchery verses wild fish; Mate selection on natural spawning grounds (potential of mixing of hatchery and wild fish) and implications for reproductive success. Abundance of naturally-produced fish in three offspring years, and contribution of hatchery fish to any increases in abundance (*BENEFIT*). Abundance would need to continue to be monitored for at least ten years after the conclusion of this study to determine whether any abundance increases are maintained. We anticipate additional analyses and products from this data.

Figure 1. Genetic risks and benefits caused by supplementation programs.

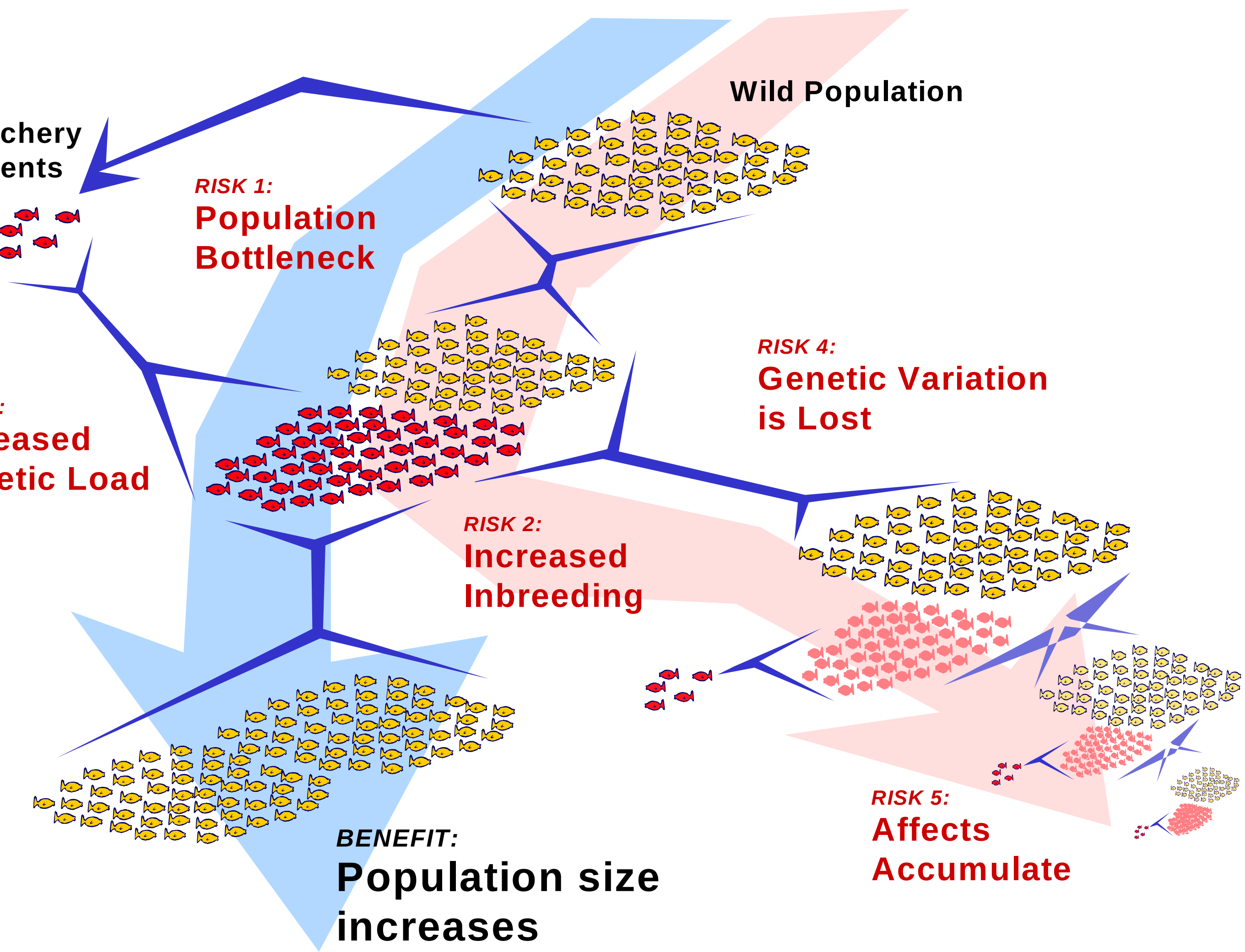
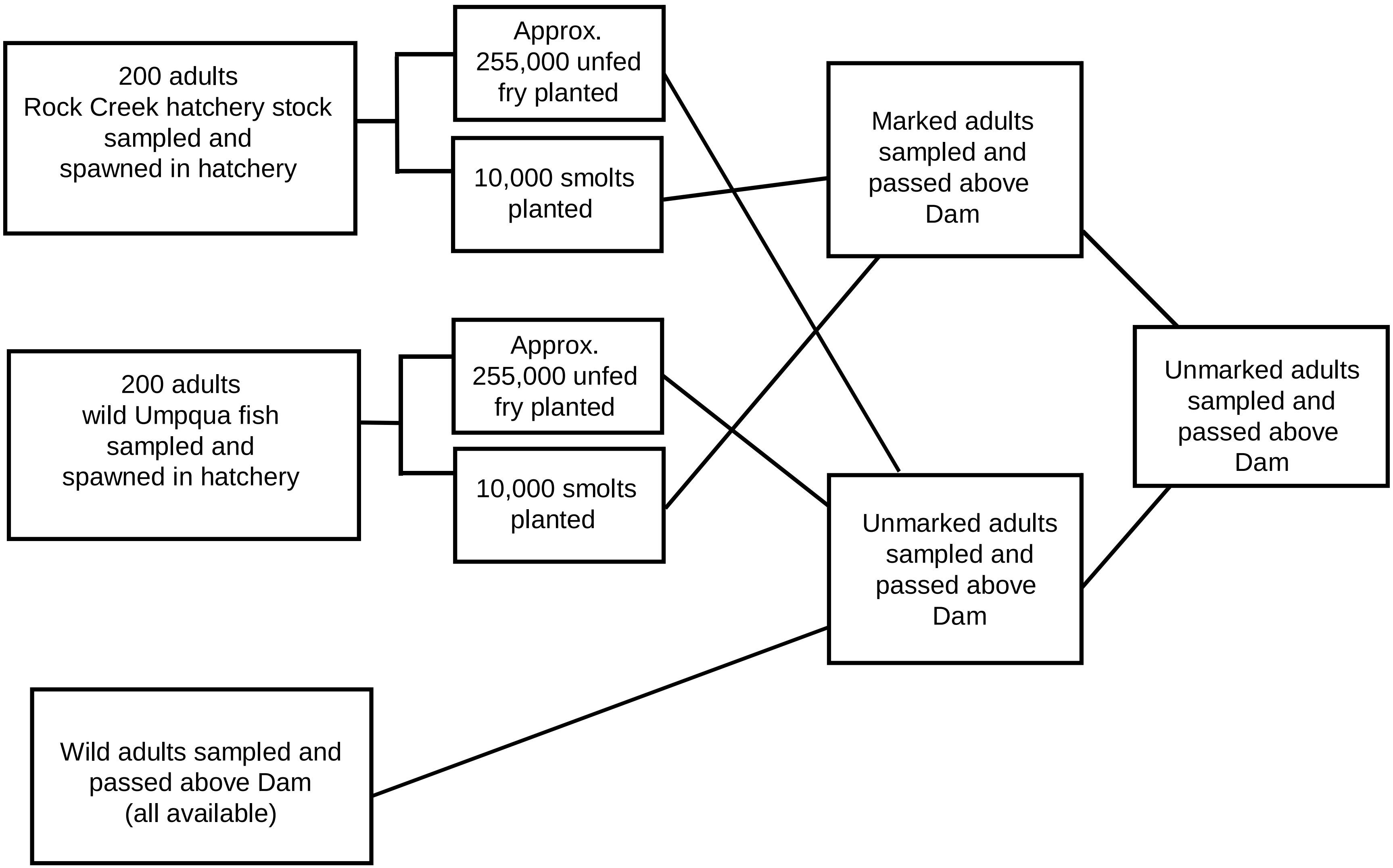


Figure 1. Pedigree reconstruction of coho salmon in the Calapooya subbasin of the Umpqua.River, including hatchery fish used in supplementation.

Attachment B



Attachment C

Interim report to: Oregon Watershed Enhancement Board
775 Summer Street NE, Ste 366
Salem OR 97301-1290

Submitting by: Michael A. Banks,
Assistant Professor, Marine Fisheries Genetics
Coastal Oregon Marine Experiment Station
Hatfield Marine Science Center
2030 Marine Science Drive
Newport, OREGON 97365

:

OSU Component for Nonpareil Dam Adult Trap and Genetic Pedigree

Progress Report and Scope of Work for 2007-2009

Total amount requested:	Proposed duration:	Starting date:
$359,112	Two years	July 1, 2007

Principal Investigator:

Dr. Michael A. Banks Fax: (541) 867 0345
Office: (541) 867 0420
Michael.Banks@hmsc.orst.edu

OSU Component for Nonpareil Dam Adult Trap and Genetic Pedigree
2007 – 2009 Scope of Work

The CHIP Project Proposal Narrative (see below) detailed the following 8 primary tasks:

Task 1. What is the relative success of using a first generation, wild-type broodstock in a supplementation program compared to a broodstock that has been captive for multiple generations?
Task 2. What is the relative success of unfed fry releases compared to smolt releases in producing returning adults?
Task 3. What is the reproductive success in the wild of adult fish from the following treatments:

- ***a.*** First-generation hatchery fish from unfed fry releases;
- ***b.*** First-generation hatchery fish from smolt releases;
- ***c.*** Multi-generation hatchery fish from unfed fry releases;
- ***d.*** Multi-generation hatchery fish from smolt relases; and
- ***e.*** Wild fish.

Task 4: How does the supplementation program modify the effective population size of the population in the Calapooya (termed the "Ryman-Laikre Effect" (Ryman and Laikre 1991, Ryman et al 1995)
Task 5: What is the level of inbreeding that results from the supplementation program?
Task 6: What is the incidence of natural crossing between adults from the different treatment groups while on the natural spawning grounds and the consequences of mate choice to the relative production of offspring by individuals;
Task 7: What differences in reproductive success occur by treatment by age (males), by gender, by adult run time, and by adult body size (length)?
Task 8: Does the size of the naturally-produced population increase due to successful natural reproduction by hatchery fish? Does the contribution to this increase vary by treatment group?

Initial data from 2004/5 and 2005/6 returns have enabled us to make a primary assessment of tasks 1 through 5. See attached manuscript currently in second review for publication in the *Canadian Journal of Fisheries and Aquatic Sciences* which focuses primarily on task 1,4 and 5. Publication of findings for task 2 and 3 has been deferred until we have data for at least one more cohorts.

Ongoing funding is hereby requested for the following scope of work to provide additional data for tasks 2, 3 and 6 through 8.

Scope of Work

2007/2008

Pedigree analysis of 2006 returns.

Perform analysis to determine:

1. The relative success of unfed fry verses smolt releases at returning adult fish to the basin for 2004,2005 and 2006 cohorts, including comparisons to the adult production by wild fish naturally spawning **(tasks 2&3)**

2. Effective size for wild coho salmon inferred form demographic data: an evaluation of Ne estimators **(task 4 continued)**

3. The influence of mate choice on fitness of wild coho **(task 6)**

Prepare peer review scientific papers on these findings.

2008/2009

Pedigree analysis of 2007 and 2008 returns.

Perform analysis to determine:

4. What differences in reproductive success occur by treatment by age (males), by gender, by adult run time, and by adult body size (length)? **(task 7)**

5. Does the size of the naturally-produced population increase due to successful natural reproduction of hatchery fish? Does contribution to this group vary by treatment? **(task 8)**

Prepare peer review scientific papers on these findings.

Nonpariel Dam coho pedigree	Genetics 2007-2008					
'SALARIES & WAGES **Name, Position, Title**		**Monthly Salary**	**OPE %**	**FTE**	**MM**	**Totals**
Assistant Prof (Greg Moyer – Veronique Theriault)		3,900	52%	1	12	$ 46,800
Graduate Research Assistant (Marc Johnson)		$1,800	0.03	0.49	9	$ 16,200
Res. Asst:(Summer salaries for Marc)		$3,600	0.05	1	3	$ 10,800
A. TOTAL SALARIES & WAGES						$ 73,800
B. FRINGE BENEFITS						$ 25,362
student medical benefit		$ 523			3	$ 1,569
C. EXPENDABLE SUPPLIES & EQUIPMENT - under $5,000 per unit						$ 48,000
D. TRAVEL			Instate:	2,000		
Domestic			Outstate:	2,000		$ 4,000
E. PUBLICATION COSTS						
OTHER COSTS (subcontracts, consultants, computer time, etc.)						
1. Communications						$ 180
2. Publications						$ 600
F. TOTAL OTHER COSTS						$ 780
G. GRADUATE STUDENT TUITION (1 students for 3 terms)			$3,085	3		$ 9,255
H. PERMANENT EQUIPMENT						
I. TOTAL PERMANENT EQUIPMENT - $5000 or more per unit						
J. GRAND TOTAL REQUESTED (sum items G to J)						$ 161,197
K. INDIRECT COSTS	Indirect Cost Rate					
ON-campus Cost at	0.1	% (multiply G x rate)				$ 16,120
L. **2007-8 TOTAL**						**$ 177,317**

Nonpariel Dam coho pedigree Genetics 2008-2009

'SALARIES & WAGES Name, Position, Title		Monthly Salary	OPE %	FTE	MM	Totals
Assistant Prof (Greg Moyer-Veronique Theriault)		4,056	52%	1	12	$ 48,672
Graduate Research Assistant (Marc Johnson)		$1,872	0.03	0.49	9	$ 16,848
Res. Asst:(Summer salaries for Marc)		$3,744	0.05	1	3	$ 11,232
A. TOTAL SALARIES & WAGES						$ 76,752
B. FRINGE BENEFITS						$ 26,376
student medical benefit		$ 550			3	$ 1,650
C. EXPENDABLE SUPPLIES & EQUIPMENT - under $5,000 per unit						$ 48,000
D. TRAVEL			Instate:	2,000		
Domestic			Outstate:	2,000		$ 4,000
E. PUBLICATION COSTS						
OTHER COSTS (subcontracts, consultants, computer time, etc.)						
1. Communications						$ 180
2. Publications						$ 600
F. TOTAL OTHER COSTS						$ 780
G. GRADUATE STUDENT TUITION (1 students for 3 terms)			$3,120	3		$ 9,360
H. PERMANENT EQUIPMENT						
I. TOTAL PERMANENT EQUIPMENT - $5000 or more per unit						
J. GRAND TOTAL REQUESTED (sum items G to J)						$ 165,268
K. INDIRECT COSTS	Indirect Cost Rate					
ON-campus Cost at	0.1	% (multiply G x rate)				$ 16,527
L. 2008-9 TOTAL						$ 181,795

GRAND TOTAL (2007-9)	Total	$359,112