NONPAREIL DAM ADULT TRAP AND COHO GENETIC PEDIGREE PROJECT

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Final

~~PROGRESS~~ REPORT
FOR
NONPAREIL TRAP
SEPTEMBER 2006 – NOVEMBER 2007

OREGON WATERSHED ENHANCEMENT BOARD
CONTRACT
OWEB 206-835

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Summer

The last progress report was submitted to the Oregon Watershed Enhancement Board (OWEB) in the spring of 2007, at that time the contract (206-835) date was extended to Nov. 30, 2007. This progress report is an update to the spring 2007 grant report and summarizes the activities that occurred from September 2006 – November 2007.

I. Project Background

Summer

The Nonpareil dam, adult fish trap and Umpqua Coho Pedigree Study were undertaken as a Conservation Hatchery Incentive Project (CHIP project) to study experimental supplementation of coho. The ongoing study is being conducted at Calapooya Creek within the Umpqua watershed near the town of Sutherlin, OR. Overall this project is composed of three phases to evaluate the effectiveness and impacts of utilizing hatchery coho to speed the recovery of wild coho populations. The basic hatchery scenarios being tested are the survival of: 1) hatchery progeny released as smolts; and 2) hatchery progeny released as unfed fry. The broodstock utilized for these hatchery scenarios included wild type (W x W) crosses and hatchery type (H x H) crosses. The project therefore tests the following: W x W progeny released as smolts, H x H progeny released as smolts, W x W progeny released as unfed fry, and H x H progeny released as unfed fry. This project was initiated in 2001 and will continue into 2010 to follow two complete generations of coho salmon replicated within three cohorts. In partnership with Oregon State University (OSU), DNA fingerprinting is being used to form a genetic pedigree of the Upper Calapooya Basin coho population for multiple generations. This will provide direct evidence of the success or failure of hatchery supplementation to recover the coho population. The multi-generational genetic pedigree study will also provide information regarding the risks to wild coho as predicted by genetic theory.

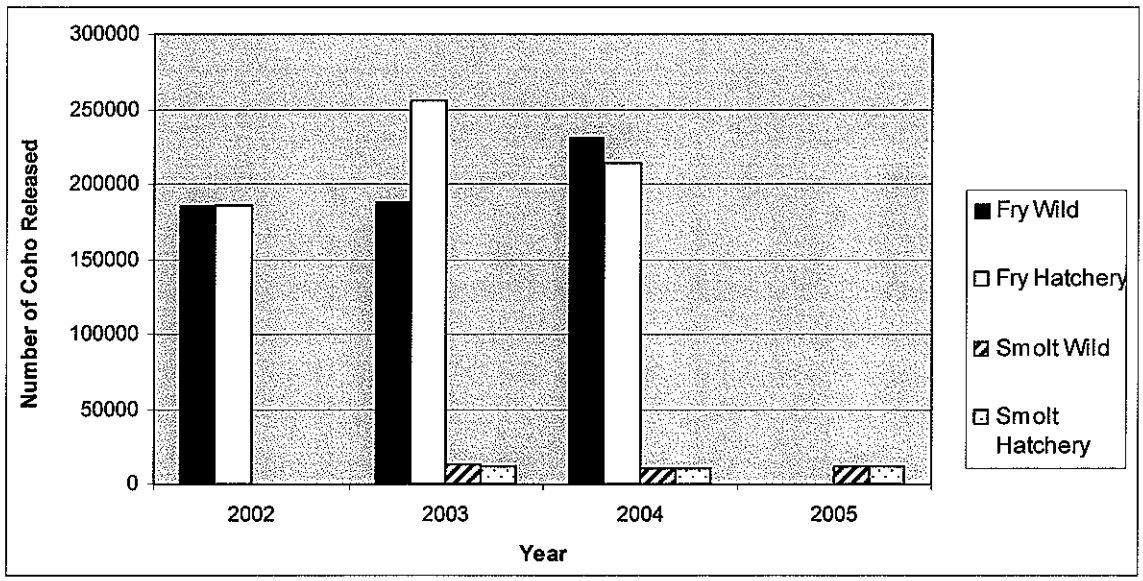
II. Project Activities

Phase I

Phase I of the study involved annually capturing an adequate number of hatchery and wild coho to use for the parent generation. The offspring of these fish were used for the initial supplemental releases (the F1 generation). The project used 100 pair each of W x W and H x H coho during three consecutive brood years (2001 – 2003). Genetic samples were taken from each pair of fish so that their subsequent progeny could be both genetically identified and linked back to the parent generation. Progeny from brood years 2001, 2002, and 2003 were released as unfed fry in 2002, 2003, and 2004. Smolts require one-year for rearing, thus they were released in 2003, 2004, and 2005.

Phase I was completed in April of 2005. The project successfully collected 100 pairs of both hatchery and wild-type coho to use for the H x H and W x W crosses each brood year. This provided adequate brood to produce a sufficient number of eggs each year to fulfill the smolt and unfed fry requirements of the study. The project released approximately 1.3 million unfed fry from 2002 - 2004 (~200,000 per year for both the hatchery-type and wild-type releases). Additionally the project released approximately 66,000 smolts from 2003 – 2005 (~10,000 each per year for both H x H and W x W-types) (Figure 1). Oregon State University was able to genotype the genetic samples collected from the initial brood fish to discern hatchery versus wild backgrounds. Thus OSU can identify the parentage (H x H or W x W) of the progeny with 95 – 99% confidence.

Figure 1. Released juvenile coho into Calapooya Creek for the Umpqua Coho Pedigree Study.



Phase II

Phase II was completed in January 2007. This involved capturing the F1 generation adult and jack coho salmon which were released as smolts and fry during Phase I as they returned to the Calapooya Nonpareil trap. Data was collected on age, sex, and fin/maxillary markings for all coho passing through the trap during this period. External marks were used to indicate the origin (hatchery or wild type) of coho released as smolts. All smolts released as part of the supplementation portion of this study had their adipose fin (AD) removed and were maxillary clipped to allow visual identification of H x H or W x W crosses. The left maxillary (ADLM) was clipped for the hatchery-type stock, while the right maxillary (ADRM) was clipped for the wild-type stock smolts. No clips were administered to coho released as fry and therefore the only indication of origin for these fish was through the use of molecular genetics. In addition to using external marks, pedigree analysis was used to trace all F1 fish back to its parent generation as progeny from H x H, W x W, or native coho. As part of phase II, the Nonpareil trap has been operated since 2003. Genetic samples were collected from coho returning from brood years 2001 (jacks in 2003 and adults in 2004), 2002 (jacks in 2004 and adults in 2005), and 2003 (jacks in 2005 and adults in 2006). (Table 1). In spring 2006, OSU successfully identified the parentage of the coho returning to the Nonpareil trap from the samples collected in brood years 2004 and 2005. (Table 2).

Table 1. Coho captured at the Nonpareil Trap, Calapooya Creek. (Preliminary Figures)

Mark/Age	2002 No F1	2003 Only BY01 jacks return marked	2004 BY01 adult BY02 jack	2005 BY02 adult BY03 jack	2006 BY03 adult BY04 jack
Total Jacks*	62 (5.7%)	161 (19.5%)	131 (10%)	165 (9.7%)	81 (5.2%)
ADLM (HXH)		39 (24.2%)	213 (16.2%)	408 (24.2%)	336 (21.6%)
ADRM (WXW)		22 (13.7)	178 (13.6%)	343 (20.3%)	237 (15.24%)
AD		4 (2.5%)	9 (0.69%)	7 (0.4%)	63 (4.0%)
Poor fin clip			None	4 (0.2%)	11 (.7%)
Unmarked		96 (59.6)	911 (69.5%)	924 (54.8%)	827 (53.2%)
Total Coho	1,093	824	1,311	1,686	1,555

*Jacks are included within mark categories to represent the total number of coho.
*Percent values are of the total run.

Table 2. Parentage analysis of coho captured in 2004 and 2005. (Preliminary data)

Year	Unmarked Fry		Marked Smolts		Native
	WXW	HXH	WXW	HXH	
2004	24	27	163	235	775
2005	72	133	347	408	482

As part of Phase II, from September 2006 to December 12, 2006, the study accomplished the following tasks:

Task 1. Trapping for brood year 2006 began at the Nonpareil trap in October and continued through January. The first coho was captured on 23 October. A total of 1,555 coho were captured during 2006. The number of jacks captured was approximately half the amount from 2005 (Table 2).

Task 2. To have adequate field staff to operate the trap, the ODFW hired four seasonal Experimental Biological Aides (EBAs). Additionally, an ODFW Natural Resource Specialist (NRS) 2 Biologist helped oversee the field work and data entry of the project and was available to help at the trap during peak run times. Two vehicles were used by the ODFW staff during the 2006-2007 season. Annual field supplies such as vials, preservatives, labels, data sheets, fish nets, waders, and rain gear were also purchased.

Task 3. Fall activities included annual maintenance for the Nonpareil adult trap. Annual repairs included new dam boards for the ladder, repairing trap hinges, rocking the access road, and renting a porta-potty.

Additionally, an informational guide to operating and managing the Nonpareil trap was compiled. This guide outlines the basic maintenance and technical aspects involved in running the trap.

Phase III

After data was collected on the F1 generation coho, which returned from 2003-2006, the coho were allowed to pass upstream and reproduce naturally. Given the HxH fry/smolt and the WxW fry/smolt components of the study, there are 15 different mating possibilities (Table 3). The F2 coho represent the returning adults of these various possibilities. Thus, as the F2 coho return from 2006 – 2009 the genetic pedigree of the fish can be tested to determine the success of the potential crosses. This will provide valuable management information for the ODFW regarding supplementation programs to aid coho recovery.

Table 3. Timeline of releases, returns, and future returns of coho to the upper Calapooya.

Phase I (2001-2005) F1 Generation		
1. Collect parent brood stock for the study		
2. Wild brood offspring as fry and smolt released		
3. Hatchery brood offspring as fry and smolt released		
Phase II (2004-2006) F1 Generation		
1. Adults from wild brood fry and smolt releases return		
2. Adults from hatchery brood fry and smolt releases return		
3. Native Calapooya basin coho return		
4. Returning adults have 15 possible spawning combinations		
Phase III Returns (2007-2009) F2 Generation		
The F2 adults/jacks returning to the trap represent the 15 spawning combinations of the F1 generation:		
1. Wild Fry x Wild Fry	6. Wild Smolt x Wild Smolt	11. Hatchery Fry x Hatchery Smolt
2. Wild Fry x Wild Smolt	7. Wild Smolt x Native	12. Hatchery Fry x Native
3. Wild Fry x Native	8. Wild Smolt x Hatchery Fry	13. Hatchery Smolt x Hatchery Smolt
4. Wild Fry x Hatchery Fry	9. Wild Smolt x Hatchery Smolt	14. Hatchery Smolt x Native
5. Wild Fry x Hatchery Smolt	10. Hatchery Fry x Hatchery Fry	15. Native x Native

The ODFW and OSU can also examine the following genetic risks that could occur if a substantial number of hatchery-based coho spawn.

- Risk 1) Population Bottleneck: This risk occurs when a small number of parents (those taken into a 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: 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: This risk results from the increased reproductive success and survival that occurs while fish are in the captive environment. Increase 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.
- Risk 4) Genetic Variation is Lost: When the offspring population size is less than its parent population size, 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.
- Risk 5) Accumulative Genetic Variation: If the hatchery program continues over multiple generations the impacts of the risks will accumulate in the wild populations due to the nature of the genetic mechanisms involved.

In preparation for Phase III, the program accomplished the following tasks during the grant extension.

Task 1. Several measures were taken to address safety concerns and to ease daily operations at the trap. First, 90 feet of handrail at 42 inches tall was installed around the facility where foot traffic is common. Cable (.25 inch) was strung at 21 inches tall underneath all handrails to ensure OSHA standards for safety were met. A removable chain was installed in areas where handrail was not appropriate due to the need for access for leaf removal or bin board adjustment. These modifications provided a barrier for potential fall hazards and served as a reminder to all those working at the trap to maintain a safe working environment. Secondly, a 7 foot tall and 10 foot wide archway and pulley system was erected to assist in the raising of the aluminum front trap panel (Figure 2). This will eliminate the need for manual labor of three or more workers to lift the 200 pound panel. Thus, there will be decrease in the safety hazard of injuring someone while lifting the panel. The final trap modification to be completed was the bracing of the aluminum floor on the trap roof. This area was experiencing serious fatigue from years of foot traffic and was a safety concern because it could have failed while someone was standing on it, causing a fall of approximately 10 feet. Additionally, steel beams were installed under the roof to provide stability and prevent future sagging.

Task 2. A seeding level study was developed to complement the overall goals of the project by determining whether or not Calapooya Creek was fully seeded with coho juveniles during the summer of 2007. The juveniles occupying the areas surveyed would be part of the second generation (F2) of the study. Thus the seeding study would provide some insight to the reproductive success of the first generation (F1) of returning adults and the carrying capacity of the Calapooya. Over 30 miles of coho habitat was surveyed upstream of the Nonpareil fish trap. The surveys estimated the density and population size of juvenile coho in rearing habitats throughout the upper Calapooya.

Task 3. The trap was installed on September 1, 2007 in preparation for the collection of the brood year 2007 (F2) generation coho. Theoretically these fish should all be naturally produced (native) and therefore none should be fin clipped. However, personnel are still checking for marks in addition to collecting data on sex, age, length, and taking a genetic sample. Through mid-November 303 coho have been sampled and passed above the trap.

. The NRS 2 Biologist funded by the grant extension was responsible for the trap modifications, summer seeding level surveys, hiring personnel to operate the trap, and getting the equipment ready for the 2007 trapping season.

Figure 2. Archway and pulley system used to lift front trap grate.

III. Conclusions

This project will provide valuable information on the use of hatchery supplementation programs for salmon. This project will evaluate the survival of supplementation fish released as smolts versus unfed fry, plus look at differences in the survival of F1 fish produced from hatchery-type and wild-type parent brood. Due to the fact that these fish can be genetically followed through the F2 generation, survival rates can be tested to determine if supplementation programs contribute to the long-term survival of a local population. This project will also provide valuable information on the potential risks of using hatchery fish to recovery native populations. In addition, information on population bottlenecks, inbreeding, genetic load, and loss of genetic variation can be tested.

The ongoing project has successfully completed Phase I and Phase II of the study. The long-term impacts of supplementation and genetic risks will be studied during Phase III of the project which is planned to continue through 2010.