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Basinwide Supplementation Evaluation Project: 2010 Annual Progress Report

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Annual Progress Report

Year #2 (May 1 2010 to April 30 2011)

Basinwide Supplementation Evaluation

Contract No. 47441
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in cooperation with:
Confederated Tribes of the Warm Springs Reservation of Oregon
Yakama Nation
Confederated Tribes of the Umatilla Reservation
Nez Perce Tribe

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ABSTRACT

This report reviews activities and results for Year #2 (May 1, 2010 to April 30, 2011) of the Basinwide Supplementation Evaluation project (hereafter, the Project), organized under four primary project objectives, summarized briefly for each objective as follows:

Project Objective #1: In collaboration with fisheries biologists with the Yakama Nation (YN), a Dual-Frequency Identification Sonar (DIDSON) was operated at the Castile Falls Fishway (rkm 103) on the Klickitat River from May to September 2010. Observation of fish passage events in the recorded video files provided an estimate of 26 to 27 fish for the 2010 escapement of spring Chinook to the upper basin. Activities and results were summarized in a final report, which included comparisons to escapement estimated from an expansion of the total redd count for the year, and to DIDSON and redd count escapement estimates for the previous year.

Project Objective #2: The mark-recapture likelihood model was designed to use data for single and double tagged fish for simultaneous inference of tag loss rate and population abundance, and their respective uncertainties. The model underwent additional refinements and validation analyses during Project Year #2. A manuscript describing the model was then finalized and submitted to the journal Transactions of the American Fisheries Society. Based on reviewer comments, the Editor requested resubmission following major revision. These revisions were made and the manuscript was resubmitted, following which confirmation of final acceptance was received from the Editor. Publication of the manuscript will occur within Project Year #3.

Project Objective #3: An agreement was reached with the Nez Perce Tribe (NPT) Fisheries Department for supplemental financing through the Project, of an ongoing relative reproductive success (RRS) study of Johnson Creek spring Chinook. The NPT manages a hatchery supplementation program for the Johnson Creek population, which includes an allocation of funds to the CRITFC co-managed molecular genetics laboratory at the Hagerman Fish Culture Experiment Station (HFCES), Hagerman ID. This allocation, recently increased to $60,000 annually, is sufficient to cover the costs of DNA-based parentage and RRS analyses of 1,500 samples. However, this allocation has been insufficient to cover analysis of all collected samples in prior years. Also, CRITFC has recommended an expansion of juvenile sampling to increase the power of recruits-per-spawner estimates, such that the increased allocation will remain insufficient. The Project financed genotyping of 700 unanalyzed archived samples in Project Year #2, and the Project will fund genotyping of an estimated 1500 samples annually, which in addition to the NPT allocation will be sufficient to provide analysis of all of the estimated 3,000 samples that will collected annually through this project over the coming years. A review of parentage results for broodyears 1998 to 2005 will be produced in the coming Project Year.

Project Objective #4: In Year #2, arrangements were finalized for the Project to take full or partial responsibility to finance genetics analyses associated with assessing RRS of hatchery-origin versus natural-origin fish in four spring Chinook salmon reintroduction/supplementation programs: Hood River (Confederated Tribes of the Warm Springs Reservation in Oregon, CTWSRO), Lookingglass Creek (Confederated Tribes of the Umatilla Reservation, CTUIR), Newsome Creek (NPT), and Crooked River (Idaho Fish and Game, IDFG). Archived and contemporary tissue samples from each of these populations were genotyped and parentage and other statistical analyses for assessing factors involved in reproductive success of the fish are on-going. A fifth RRS study of reintroduced Lolo Creek spring Chinook (NPT) will begin in 2012. Discussions continue regarding feasibility of a RRS study of reintroduced Wenatchee River coho (YN), and possibilities for studies in additional programs are being investigated. Additionally, an agreement has been reached to provides genetics analyses of steelhead and kokanee/sockeye *Oncorhynchus nerka* samples collected from the Deschutes River basin, as part of the CTWSRO, Oregon Department of Fish and Wildlife (ODFW) and Portland General Electric (PGE) collaborative project to reestablish anadromous salmonid populations upstream of the Round Butte Dam.

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1.0 Introduction

In their 2005 report submitted to the Northwest Power and Conservation Council (NPCC) entitled "Monitoring and Evaluation of Supplementation Projects" (ISRP and ISAB 2005), the Independent Scientific Review Panel (ISRP) and Independent Scientific Advisory Board (ISAB) recommended that an interagency workgroup be formed to design a monitoring and evaluation (M&E) program to obtain a basinwide understanding of the critical uncertainties associated with use of hatchery supplementation to rebuild depressed salmon and steelhead populations. In response, the *Ad Hoc* Supplementation Workgroup (AHSWG) was formed – a group of volunteer scientists and managers associated with tribal, state and federal fisheries agencies, power companies and other non-governmental agencies. Following a series of workshops and ancillary discussions, the AHSWG recommended a three-pronged approach: 1) conduct treatment/reference (T/R) comparisons of long-term trends in the abundance and productivity of multiple supplemented (treatment) and un-supplemented (reference) populations, 2) conduct a series of relative reproductive success (RRS) studies to quantify short-term impacts through comparisons of productivity within brood years of natural-origin (NO) versus hatchery-origin (HO) fish in supplemented populations, and 3) develop a request for proposals to fund several intensive small-scale studies designed to elucidate various biological mechanisms by which introduction of a hatchery stock may influence natural population productivity (AHSWG 2008).

The present Basinwide Supplementation Evaluation project, submitted by the Columbia River Inter-Tribal Fish Commission (CRITFC) as part of the Columbia Basin Fish Accords (2008), was designed to implement actions to support the AHSWG recommendations; specifically: 1) to improve abundance and productivity estimation procedures used in monitoring supplemented and reference populations (Project Objectives #1 and #2), and 2) to provide RRS information from supplemented populations and reintroduced/supplemented populations (Project Objectives #3 and #4, respectively) – see Project No. 2009-009-00 - Project Narrative, under Attachments within the Project PISCES web site, or http://www.nwcouncil.org/fw/projectselection/accord/Default.asp).

The following report summarizes activities and results obtained during the second year of the Project (Year #2, May 2010 through April 2011) for each of these four project objectives.

2.0 Project Objective #1: DIDSON Escapement Estimation

The Yakama Nation (YN) is actively involved in management of the anadromous fish populations in the Klickitat River (YN 2008), including estimating escapement of spring Chinook salmon as part of the M&E activities associated with their supplementation program. In a collaborative project between CRITFC and YN, a Dual-Frequency Identification Sonar (DIDSON) was deployed to observe spawning migration of spring Chinook adults through the Castile Falls Fishway (rkm 103) on the Klickitat River. The DIDSON was programmed to continuously record sequential 1-hour files from mid-May to September 2010, which encompassed the period anticipated for spring Chinook escapement into the upper basin. "Echograms" were processed from the original DIDSON video files, and upstream passage events observed in the echograms of large fish (deemed to be spring Chinook) were noted. Passage events were confirmed by a second reader, and the data were analyzed to account for occasional periods when operation of the DIDSON was interrupted due to technical problems. The analysis produced an estimate for total 2010 spring Chinook escapement to the upper basin of 26 to 27 fish (95% confidence interval). This estimate for 2010 escapement is higher than the estimate of 3 fish, based on an expansion of the single redd observed during 2010 spawning ground surveys (1 times an expansion factor of 3 fish per redd). The 2010 DIDSON estimate was similar to the estimate (24 ± 4 fish) calculated using the sonar in 2009 (Galbreath et al. 2010; http://maps.critfc.org/tech/10_01report.html, and in Attachments in the Project site within PISCES). The 2009 estimate was also much larger than the corresponding estimate based on expansion of the annual redd count (4 redds X 3 fish/redd = 12 fish). Reasons for the underestimation based on redd counts in both years are likely include: 1) occurrence of redds that were not observed during the surveys- either overlooked by the observers, or located in river sections not included within the areas surveyed, and/or 2) an expansion factor of 3 fish per redd which may inaccurately account for pre-spawn mortality resulting from natural causes or fishing/harvest mortality.

A full description of the 2010 DIDSON study, including background information and rationale, methods, results (raw data and data analysis) and evaluation, is provided in CRITFC Technical report 11-01 (Galbreath et al. 2011; http://maps.critfc.org/tech/11_01report.html); see also the Attachments section of the Project site within PISCES.

3.0 Project Objective #2: Development of a mark-recapture likelihood model

Another methodology fisheries biologists employ to estimate abundance is a mark-recapture design. When applied for estimation of spawning escapement of an anadromous population, the technique involves capture and tagging/marking a sample of adults at an initial point during their in-river migration, and the subsequent (re)capture/(re)sighting of fish at an upstream site or during spawning ground surveys. Data are collected on the number of fish tagged/marked, the number of fish captured/sighted upstream, and the number of tagged individuals among the latter. The data are entered into Petersen estimators to calculate population abundance at the time of tagging, and confidence limits for this estimate (Seber 1973, Everhart et al. 1975).

Portland General Electric (PGE), the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) and the Oregon Department of Fish and Wildlife (ODFW) have conducted a collaborative project each year over the past several years, using mark-recapture to estimate escapement of kokanee migrating to their spawning grounds in the Metolius River from Lake Billy Chinook, Jefferson County, Oregon (Lovtang et al. 2008). In these studies, a sample of adult kokanee was captured by seining in the lake just prior to their upstream migration, and the fish were marked with brightly colored plastic anchor tags. The fish were then “recaptured” via resighting during walking surveys of the spawning grounds, and the numbers of fish observed with tags (including information on tag color) and without tags were recorded. However, knowing that some portion of the fish would likely lose their tags during the period between tagging and the spawning surveys, it was expected that the resulting estimation of population abundance would be biased high. To correct for this bias in the initial years that the mark/recapture studies were conducted, a presumed tag loss rate of 25% (Smith et al. 1978, Smith and McPherson 1981) was used to apply a downward adjustment to the number of originally tagged adults. However, the 25% tag loss rate was estimated from studies of a coastal population of spring Chinook, and may not have been directly applicable to Metolius River kokanee. Since 2007, the study design was modified to provide an estimate of tag loss specific for Metolius kokanee. The alteration involved double-tagging a portion of the marked fish with tags of an alternative color. During the subsequent spawning surveys the number of double-tagged fish which had retained both, or only one of their tags was noted. The ratio of these two values was used to estimate the rate of tag loss, which in turn was used to correct the number of originally single-tagged fish prior to estimating population abundance (Lovtang et al. 2008).

In reviewing the double-tagging data for the 2007 study of kokanee escapement, we noted that a problem remains in the analytical procedure - the uncertainty in the estimate of tag loss rate is not incorporated into the calculation of population abundance. Ignoring this uncertainty results in confidence limits to the abundance estimate that are overly optimistic (narrow). As part of a Pacific Coast Salmon Recovery Fund project (CRITFC Project No. 2007-5-02), we developed a likelihood methodology (the biniomial-hypergeometric likelihood model) to estimate tag loss and its uncertainty based on double-tagging data. The model incorporates both values into the estimation of population abundance, providing a more realistic measure of the combined uncertainty (Galbreath and Hyun 2008).

While the original model was relatively robust, certain questions remained, particularly as concerns the model-required presumption that a double-tagged fish would not lose both of its tags. With input from an additional biometrician, (Dr. Joel Reynolds, US Fish & Wildlife Service, Anchorage AK) in Project Year #1, the original model was modified to accept incidence of loss of both tags in the data. In Year #2, the model was modified (now referred to as the full likelihood model) and tested in a series of validation exercises. Also, a manuscript describing the model was drafted then submitted for publication in

Transactions of the American Fisheries Society. Following peer review, the manuscript was revised according to reviewer comments, then resubmitted to the journal. Confirmation was recently received from the Editor that the manuscript has indeed been accepted, with publication anticipated during the coming Project Year.

4.0 Project Objective #3: Support for an Unfunded/Underfunded RRS Study

As indicated in the Introduction, the AHSWG recommended enacting additional RRS studies of NO versus HO fish within supplemented populations in the Columbia basin. Several tribal-managed supplementation programs were designed to include a RRS study, and tissue sampling of returning adults was performed, and in some cases natural origin juvenile progeny as well. However, budget limitations have often precluded performance of the genotyping and parentage analyses upon which the productivity information would be derived. The present Project was designed, therefore, to provide the needed financial support to enact the RRS studies within these tribal programs. One such study for which a need for additional funding is necessary is the Nez Perce Tribe managed supplementation project of spring/summer Chinook in Johnson Creek (a tributary of the East Fork to the South Fork of the Salmon River, Idaho) - BPA Project No. 19960430, Johnson Creek Artificial Propagation Enhancement Project (Rabe et al. 2006, Vogel et al. 2006).

4.1 Johnson Creek Artificial Propagation Enhancement Project (JCAPE)

In the original JCAPE project design, NPT managers anticipated performance of an RRS study. In consequence, tissue samples were collected from adults intercepted at the downstream weir in Johnson Creek each year since 1998, as well as a limited number of samples from juveniles intercepted with a rotary screw trap at a location adjacent to the weir. Available “year-end” funds have been opportunistically allocated to cover costs of molecular genetics analyses performed by CRITFC geneticists at the HFCES. However, the sum of money available was sufficient only to cover a portion of the adult samples, and none of the juvenile samples. Untested samples were archived while waiting additional funding. Results from preliminary analyses from those adult samples that were analyzed are summarized in a slide presentation provided at the 2009 Symposium on Salmon Supplementation: “Evaluation of the Johnson Creek summer Chinook supplementation program using genetic parentage analysis; Do hatchery fish reproduce in the wild?”.

Recently, the NPT was able to increase its commitment to $60,000 annually in support of laboratory analyses for this RRS study. This sum will be sufficient to cover genotyping expenses for approximately 1,500 samples. However, recent escapement to Johnson Creek has been encouragingly high, making the allocation for 1,500 samples still insufficient to cover the number of adult and juvenile fish sampled annually, and there remained a large number of the archived samples yet to be genotyped. Also, CRITFC has recommended that the NPT increase the rate at which juveniles are sampled, to provide greater power to the RRS analyses based on juvenile recruits per spawner. An agreement was therefore reached with the NPT to use Project funding to cover all costs in excess of the annual NPT allocation, so that a thorough assessment of productivity of the JCAPE Chinook may be made.

In Project Year #2, a total of approximately 1,000 JCAPE samples (archived and new) were genotyped by CRITFC geneticists at HFCES using Project funding, in addition to analyses funded by the NPT. Parentage and statistical analyses of these data are ongoing. A draft preliminary report for the first several years of the JCAPE project is anticipated later in Project Year #3. This report will be reviewed with NPT personnel, to be followed with a finalized Technical Report, and a manuscript to be submitted for publication in a scientific journal.

A brief description of the genetic analyses involved in assessing parentage and RRS is as follows. DNA is extracted from each spring Chinook tissue sample then genotyped for a suite of 15 microsatellite loci: *μOts100* (Nelson and Beacham 1999), *μOts3M* (Greig and Banks 1999), *μSsa408* (Cairney et al. 2000), *μOMM*1080 (Rexroad et al., 2001), *μOts*211, *μOts*212, *μOts*213, *μOts*201b, *μOts*208b (Grieg et al., 2003), μ*Ots*G474, μ*Ots311* (Williamson et al., 2002), μ*Ogo*2, μ*Ogo*4 (Olsen et al., 1998), μ*Ots*9 (Banks et al., 1999), and μ*Oki100* (K. Miller, unpublished data). These loci were identified as being informative for spring Chinook salmon stock identification by the Genetic Analysis of Pacific Salmonids (GAPS) consortium - a collaborative interagency group of scientists and managers who have developed a centralized web accessible genetic database to support genetic stock identification of Chinook salmon across the full extent of its range (Moran et al. 2006, Narum et al. 2007b, Seeb et al. 2007). If and when RRS studies of coho or steelhead programs are included within the Project, a similar set of informative species-specific loci will be selected for analysis.

Following verification of the individual genotypes, the information is entered into CERVUS v3.0 (Marshall et al. 1998; Kalinowski et al. 2007) for parentage assignment using a maximum likelihood method based on population-wide LOD scores obtained from simulations. A LOD score, representing the likelihood ratio of the candidate being the true parent versus the candidate not being the true parent, is calculated for each possible parent-offspring pairing. The resulting number of recruits per spawner is then analyzed within a generalized linear model (GLM) to test the hypothesis of similarity of productivity among parental types (e.g., HO versus NO), with number of recruits as the response variable, and with origin, sex, size (length), and run timing (ordinal date of return) of the parents as explanatory variables. Under the expectation that the response variable will follow a Poisson random distribution, we will use a log-linear model within the GLM (e.g., Williamson et al. 2010). Additionally, a Chi square test of independence will be performed to examine the hypothesis of random mating among parental cross types (HOxHO, HOxNO, NOxHO and NOxNO) (Leth 2005, Lutch et al. 2005, Berejikian et al. 2008).

5.0 Project Objective #4: RRS in Reintroduced/Supplemented Populations

Factors such as overfishing, freshwater habitat loss and degradation, and increased mortality within the hydrosystem associated with effects of damming have been shown to be responsible for the generalized reduction in abundance of extant natural populations of salmon and steelhead within the Columbia basin. For many native populations, however, the effects were even more dramatic, resulting in their extirpation. These included all populations whose natal streams were upstream of the impassable Chief Joseph and Hells Canyon dams. Additionally, numerous populations in tributaries downstream of these dams were also extirpated, e.g., spring Chinook in the Hood, Umatilla, Okanogan and Clearwater rivers and their tributaries, all native coho salmon populations upstream of Bonneville Dam, sockeye salmon from the Deschutes, Yakima and Grande Ronde river systems, etc. (Fulton 1968, Mullen 1983; Nehlson et al. 1991, O'Toole et al. 1991).

The Columbia River treaty tribes (CTWSRO, YN, CTUIR and NPT) have been associated with efforts to create new naturally spawning populations in several of these tributaries where the cause of extirpation did not involve a still existent impassable dam. In each case, reintroduction of the species was performed via stocking of hatchery reared fish produced from out-of-basin hatchery stocks (e.g., Bowles and Leitzinger 1991, Phillips et al. 2000, Underwood et al. 2003, Lutch et al. 2005, Murdoch et al. 2006, Bosch et al 2007, Narum et al. 2007). Results from these tribal reintroduction programs have been very encouraging. Substantial numbers of the HO juveniles returning as mature adults have been recorded, as well as natural spawning of some portion of these HO fish. Further, NO juveniles at the fry, parr and out-migrating smolt stages have been observed, as have mature NO adults within the subsequent spawning escapement – indicative that a full generation or more of strictly natural production has occurred (Phillips et al. 2000, Underwood et al. 2003, Lutch 2005, Murdoch et al. 2006, Bosch et al 2007, Narum et al. 2007). However, can these programs lead to establishment of naturally self-sustaining populations? Concern has been expressed within the scientific community regarding the deleterious effects of artificial production on long term natural fitness of a hatchery stock (e.g., Ford 2002, ISRP 2005, Araki et al. 2008, RIST 2009), and that these effects may be genetic in nature and not readily reversible. In light of this concern, there is reason to question whether an out-of-basin stock which has been hatchery-reared over multiple generations, will retain sufficient levels and genetic diversity and adaptive potential needed for the stock to become self-sustaining in a new natural environment.

In a recent review, Fraser (2008) examined published reports for 31 different salmonid reintroduction programs from Europe and North America, including several of the Columbia basin programs referred to above. For many of these programs, particularly those for which effects of hydrosystem blockages and habitat degradation that contributed to the extirpation of the original populations have been substantially reversed, a self-sustaining population appears to be re-establishing itself. However, hatchery supplementation continues to some degree in each of these programs, and uncertainty therefore remains as to whether the natural production observed is supported by spawning of a progressively better adapted naturalized population (the F2 and greater generations), as opposed simply to reproductive success of fish in any given year that were stocked as part of supplementation program.

Broodstock management protocols for the tribal reintroduction/supplementation programs involve the progressive phasing out of the original out-of-basin hatchery broodstock. In their place, returning adults are collected in-basin for use as broodfish to produce the juveniles with which to continue supplementation of the newly reintroduced population. The initial generations of this “local origin” broodstock are comprised of mature HO adults. In subsequent generations, as the number of NO adults in the return increases, NO fish can be incorporated into the hatchery broodstock in larger proportions. The rationale for this strategy is based on the presumption that the genetic characteristics that facilitate successful return and natural spawning of the original HO fish will be inherited by their progeny. Over generations, a population which is progressively better adapted to the local environment should become established.

It will not be possible to make a definitive determination as to whether or not a reintroduced population is self-sustainable prior to monitoring population abundance over several years following cessation of the supplementation project. In the meantime, however, RRS information could infer that the process of adaptation might, or might not, be occurring. An out-of-basin stock, particularly one which has been hatchery-reared over multiple generations, can be presumed to be less than ideally suited to a given natural environment. The mal-adapted nature of an introduced stock will be reflected by a low level of natural productivity (recruits per spawner, R/S). If natural selection, and artificial selection via broodstock management, are acting on these reintroduced fish, the stock should exhibit a trend for increasing productivity over successive generations as it becomes increasingly naturalized/adapted to the new environment. Unfortunately, because of year-to-year environmental variability, observation of a significant trend requires long term temporally stratified evaluations. However, improving population productivity can be inferred through comparisons of productivity within broodyears among parental types, i.e. measures of R/S that are generally higher for naturally spawning in-basin HO adults relative to out-of-basin HO fish, for in-basin NO fish relative to in-basin HO fish, and for second generation in-basin NO fish relative to first generation in-basin NO fish, etc.

Similar to the tribal programs to supplement depressed existent populations, funding to perform RRS studies of the reintroduced and supplemented fish has generally been insufficient or lacking. Therefore, the present Project was designed to provide the needed financial support to supplement or to initiate RRS studies in several of these reintroduction/ supplementation programs, so as to obtain empirical data with which to better assess their relative success.

In Year #1, a RRS study of reintroduced Hood River spring Chinook was initiated, and discussions were engaged with tribal fisheries personnel regarding feasibility of studies in other basins. Over Year #2, these discussions lead to agreements for initiation of RRS studies in the following four spring Chinook programs, and discussions continue regarding the potential for additional studies:

- Lookingglass Creek (Grande Ronde River)
- Lolo Creek (Clearwater River)
- Newsome Creek (South Fork of the Clearwater River)
- Crooked River (South Fork of the Clearwater River)

5.1 Hood River spring Chinook reintroduction program

The Hood River spring Chinook reintroduction/supplementation program is co-managed by CTWSRO and ODFW. Following extirpation of the native stock by the mid-1970s, spring Chinook were reintroduced into the Hood River via stocking of Carson NFH juveniles in 1986. Stocking of spring Chinook into the Hood River basin has continued annually, although in 1992 the co-managers switched to use of Deschutes River stock from Round Butte Hatchery, with occasional input from Warm Springs NFH (Underwood et al. 2003). Beginning in 1992, scales and ancillary information (date of capture, sex, size, etc.) were collected annually on every adult salmon intercepted at the Powerdale Dam fish trap (Hood River rkm 6), along with information as to whether the fish was passed upstream for natural spawning, collected for hatchery broodstock, or recycled downstream to the sport fishery. A subset of scales from each sample were read for aging and confirmation of origin (HO versus NO), and the remainder were archived at ODFW offices in The Dalles OR. Reports of the Hood River Monitoring and Evaluation Project which summarize information related to releases of hatchery-produced spring Chinook juveniles, of natural spawning and production of spring Chinook juveniles, and of adult escapement over the history of the project include: Underwood et al. 2003, Olsen 2003 and 2007, Vaivoda et al. 2005a and b, McCanna et al. 2006. An updated version of the monitoring and evaluation program associated with the Hood River Production Program, which includes a description of a proposed reproductive success study of the spring Chinook is available in ODFW and CTWSRO 2008.

During Year #1 of the Project, samples of archived scales (Run Years 1992 to 2008) were obtained for all adults passed upstream for natural spawning or used for supplementation broodstock, and sent to CRITFC geneticists at HFCES (n ≈ 6750). Genotyping and parentage analyses were performed following the protocols described above. In Year #2, another approximately 850 samples were analyzed, which included the final samples collected from adults returning to the trap at Powerdale Dam, prior to demolition and removal of the dam in July 2011.

Initial results from these analyses are summarized in a slide presentation (HoodR CHS_Provisional Summary_May2010.pdf) that was presented and discussed with CTWSRO and ODFW co-managers, and in the poster" Reproductive Success of Reintroduced spring-run Chinook salmon in the Hood River, Oregon" presented at the Coastwide Salmonid Genetics meeting, Boise ID June 2-4, 2010, and the 2011 meeting of the Idaho Chapter of the American Fisheries Society (Boise ID, Mar 2-4, 2011). Copies of these presentations are available within the Attachments section of the Project's site in PISCES.

One initial finding of note was that adults returning to the Hood River were mixtures of fish of two different genetic lineages. One is an upriver Columbia River stream-type lineage, to which belong the Carson and Deschutes stocks with which the river was supplemented. Unexpectedly however, there are also fish which are similar in genotype to a distinctly different Lower Columbia genetic lineage, containing both stream-type and ocean-type stocks (Narum et al. 2010). Presence of natural origin Chinook salmon characterized by the Lower Columbia genetic lineage persisted across run years in the Hood River samples (1992 to 2009; average ≈ 16%). Additionally, capture date at Powerdale Dam for these fish was on average 37 days later than fish of the reintroduced stream-type lineage. These fish of Lower Columbia lineage likely represent strays, or progeny of strays, which recolonized the Hood River in the years following extirpation of the indigenous stock, and were thus present when the initial samples for the current study were collected in 1992.

Analysis of the parentage information will continue through Project Year #3, to assess effects origin, age and size, run-timing, etc., with results to be summarized in oral presentations and posters, technical reports, and manuscripts for submission for publication in scientific journals.

5.2 <u>Lookingglass Creek (Grande Ronde River) spring Chinook</u>

Spring Chinook populations within the Snake River basin declined dramatically in abundance by the 1980s. As part of the Lower Snake River Compensation Plan (LSRCP), a hatchery was constructed at rkm 3 on Lookingglass Creek (a tributary to the Grande Ronde at rkm 136) for the purpose of rearing fish with which to supplement populations in both the Grande Ronde and Imnaha basins. However, for the population in Lookingglass Creek itself, it was too late – this population had already become extinct. Using juveniles reared at the hatchery, spring Chinook were stocked into Lookingglass Creek over the following 20 years. During this period, the hatchery used a succession of different source stocks – initially Wind River, followed by Carson, then Rapid River stock. These reintroductions into Lookingglass, however, had very limited success in terms of establishing a new naturally spawning population. Managers later decided to cease use of an out-of-basin stock, and re-reintroduction was attempted again, this time using natural origin adults from nearby Catherine Creek, also a tributary to the Grande Ronde (river km 222), as broodstock. In 1999 and 2000, no returning adults from previous stockings were passed upstream of the weir, and reintroduction of spring Chinook using juveniles from the Catherine Creek stock was initiated in 2001. Annual project reports (1989 to present) which summarize juvenile stocking and population monitoring information for Lookingglass Creek spring Chinook are available within the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) - Reports and Publications section of the LSRCP/US Fish and Wildlife web site: http://www.fws.gov/lsnakecomplan/Reports/CTUIRreports.html.

Since 2004, in anticipation of eventual genetics studies to help assess the relative success of the reintroduction using Catherine Creek stock, tissue samples from all returning adults passed upstream of the Lookingglass weir (½ km upstream of the hatchery), as well as samples from juveniles captured in a screw trap (¼ km downstream of the weir), have been collected and archived (n ≈ 2,800). These samples were sent to CRITFC/Hagerman, and in Project Year #2, genotyping was performed with Project funding. Parentage and statistical analyses of these data are ongoing. A draft report summarizing results from these analyses is anticipated later in Project Year #3. This report will be reviewed with CTUIR personnel, and will be followed with a finalized Technical Report, and a manuscript to be submitted for publication in a scientific journal.

5.3 Lolo Creek (Clearwater River) spring Chinook

Reintroduction of spring Chinook in the Clearwater basin began with the removal of the Lewiston Dam and the annual stocking of hatchery juveniles in the early 1970s. In Lolo Creek - a tributary to the Clearwater River at rkm 87 - the NPT began reintroduction with outplants of Dworshak NFH adults in 1997. Beginning in 1999, spring Chinook juveniles from the adjacent Clearwater Anadromous Fish Hatchery were released annually into Lolo Creek. Since 2004, annual stocking switched to use of juveniles produced from returning adults collected in Lolo Creek, and reared at the Nez Perce Tribal Fish Hatchery. Recent information on spring Chinook juvenile stocking, on natural spawning and juvenile production, and on adult escapement is available in annual reports for the Nez Perce Tribal Hatchery Monitoring and Evaluation Project – Spring Chinook Supplementation in the Clearwater Subbasin (e.g., Backman et al. 2009 and Bradley et al. 2009).

Escapement into Lolo Creek is monitored at 2 seasonal weirs: a lower weir at rkm 21 and an upper weir at rkm 51. The upper weir can generally be installed 1-2 weeks before the lower weir, and generally captures the near totality of spring Chinook accessing the upper basin, although this comprises only a minority of the known spawning area for spring Chinook in the basin. The lower weir is downstream of essentially 100% of the spawning area, however, it typically cannot be installed until a substantial portion of the adult migration has already passed this location.

A project to construct a permanent weir at the lower site was recently submitted and approved (see FY2010 Fast Track BiOp Review proposal submitted to the Northwest Power and Conservation Council “Lolo Creek Permanent Weir Construction”, http://www.nwcouncil.org/fw/budget/2010/rme/proposal.asp?id=1653). Construction of the weir is foreseen in 2012, and it should be operational for the 2013 run year. Beginning that year, all in-migrating adults will be intercepted and tissue-sampled, and agreement has been reached with the NPT for the Project to finance a RRS study. The study will also include analysis of juvenile samples for estimation of RRS based on both juvenile and adult R/S.

While awaiting installation of the permanent weir, an agreement with NPT was reached to perform preliminary RRS studies limited to the upper basin of Lolo Creek. In 2010, adults were sampled at the upper weir. Unfortunately, several late spring rain storms caused flow in Lolo Creek to remain too high for installation of the upper weir, until the majority of in-migrating adults had already passed the weir location. It was therefore necessary to forego a study of the 2010 broodyear, and re-attempt interception and sampling of adults in 2011 (Project Year #3), and of their progeny the following summer.

5.4 Newsome Creek (South Fork of the Clearwater River) spring Chinook

Supplementation of reintroduced spring Chinook has also been performed by the NPT in Newsome Creek, a tributary to the South Fork of the Clearwater River (rkm 84). Similar to Lolo Creek, recent information on juvenile stocking and on juvenile and adult monitoring is available in the annual reports by Backman et al. (2009) and Bradley et al. (2009). Unlike Lolo Creek, however, the NPT is able to install a weir below all known spawning area (within 100 m of its confluence with the South Fork of the Clearwater River) prior to arrival of in-migrating adults. Beginning in run year 2005, they have tissue sampled returning adults each year. Also, beginning in fall 2007, samples from out-migrating juveniles have been collected in both the fall (as 0+ parr) and spring (as 1+ smolts), using a rotary screw-trap located just downstream of the weir site. The NPT sent all samples to HFCES, and has used “year-end” monies to finance the genotyping and parentage analyses by CRITFC geneticists. Available funds have been sufficient for analyses of the adult samples (both those released upstream for natural spawning, and those collected for use as hatchery broodstock), but only for a portion of natural origin juvenile progeny. Results for these initial analyses are summarized in the report “Genetic pedigree analysis to evaluate natural productivity between natural-, and stray-origin Chinook salmon (*Oncorhynchus tshawytscha*) in Newsome Creek, ID by Matala et al., which is included as Appendix C in Bradley et al. 2009.

To assure systematic analysis of all samples, including an increased number of juvenile samples as recommended by CRITFC, an agreement was reached with NPT for the Project to take over financial responsibility for continued genetics analyses. In Year #2, the Project supplemented a final allocation from the NPT of $15,000, to cover costs of analysis of all backlogged juvenile samples, as well as adult and juvenile samples collected in 2010. These data are being merged with previous information. A draft report summarizing results from the broodyears 2005 through 2010 is anticipated later in Project Year #3. This report will be reviewed with NPT personnel, and will be followed with a finalized Technical Report. Summarization of these data in a manuscript to be submitted for publication in a scientific journal will also be considered.

5.5 Crooked River (South Fork of the Clearwater River) spring Chinook

Only 2 km upstream of Newsome Creek is Crooked River, whose spring Chinook population underwent a similar extirpation and reintroduction. Since the early 1990s, Crooked River was annually supplemented by Idaho Fish & Game (IDFG) with Clearwater stock spring Chinook juveniles as part of the Idaho Supplementation Study (ISS; Bowles and Leitzinger 1991). The ISS design prescribed cessation of supplementation in many of the treatment streams which had undergone supplementation over several years, including Crooked River. As such, 2004 was the last year of supplementation in Crooked River, and since then only natural origin adults have been passed upstream of the weir (located within 1 km of the confluence with the South Fork of the Clearwater River) for natural spawning. Performance of RRS studies in several of the supplementation treatment streams, including the Crooked River, was proposed as an addition to the ISS design (Lutch et al. 2005), and tissue samples from all adults and from a limited number of natural origin juveniles have been collected annually and archived. However, funding to perform the RRS studies was not forthcoming.

Given the proximity and similarity of the Crooked River and Newsome Creek watersheds, it was felt that assessment of Crooked River spring Chinook productivity would be enhance information obtained from the Newsome Creek RRS study. CRITFC and NPT engaged in discussions with IDFG, and an agreement was reached to have the Project provide the funds to perform the genotyping and data analyses for a RRS study in Crook River. Towards the end of Project Year #2, the archived Crooked River samples were sent to HFCES. Genotyping of these samples and parentage analyses will be performed by CRITFC geneticists in Project Year #3. Results will be summarized and reviewed with IDFG and NPT personnel, to be followed afterwards with a finalized Technical Report.

5.6 Wenatchee coho

Coho salmon were extirpated from the entire Mid-Columbia basin by the mid-1990s. The YN initiated a coho reintroduction program in the Wenatchee River in 1999, involving annual stocking of out-of-basin hatchery origin juveniles (a stock created from multiple lower Columbia sources, which had undergone at a minimum 15 generations of hatchery rearing). Adult returns from the initial years of reintroduction were sufficiently abundant that by 2003 100% of the broodfish for the supplementation program were collected in-basin. Additionally, an increasing proportion of the broodfish collected each year are of natural origin – progeny of hatchery origin fish which returned and spawned naturally. This program is described in detail in Murdoch et al. 2006.

A large portion of the juvenile release sites were in Icicle Creek, a tributary to the lower Wenatchee, and to present the majority of the adults have returned to spawning areas in the lower river. Dryden Dam is located at rkm 26, below almost 100% of the coho spawning, however, the fish trap at Dryden Dam can intercept only a portion of returning adults, compromising its use as the sampling site for a RRS study. Currently, the YN is shifting more of the juvenile releases to acclimation sites in the upper basin, and they operate a fish trap at Tumwater Dam (rkm 52) where it would be feasible to interrogate upwards of 100% of the adults returning to the upper basin of the Wenatchee. A provisional agreement with the YN has also been reached to institute a RRS study of reintroduced coho salmon in the upper basin (above Tumwater Dam) of the Wenatchee River. For logistical reasons, however, initiation of 100% adult interception and sampling at Tumwater Dam was not possible in Project Year #2. It is hoped that systematic sampling may be performed in 2011 (Project Year #3), although there also remain numerous logistical questions to be resolved regarding the feasibility of juvenile sampling.

5.7 Additional RRS studies of reintroduction programs

Opportunities for additional RRS studies of reintroduced populations continue to be investigated. Where deemed logistically feasible, estimation will be made of annual sample analysis needs in relation to budget constraints to determine whether or not to make a commitment to finance the laboratory and data analyses costs. Two programs, both managed by the NPT, currently being studied include the coho supplementation program in Lapwai Creek (Clearwater River) and the steelhead program in Lolo Creek. In 2010, the NPT initiated operation of a weir in Lapwai Creek, for the purpose of collecting coho broodstock. Discussions are underway to examine the efficiency of the weir, and to determine the feasibility of intercepting and sampling “all” adults passed above the weir for natural spawning, and of acquiring a representative sample of natural origin juveniles. As for spring Chinook in Lolo Creek, steelhead will also be intercepted at the planned permanent weir. The NPT has already envisioned collection of adult tissue samples for a RRS study. Whether or not funds will be sufficient to augment the study with RRS analyses based on juveniles recruits is yet to be determined. Should additional funds be needed for this purpose, we will consider whether the Project can provide these funds.

Also during Project Year #2, discussions were initiated with the CTWSRO and ODFW regarding the need to associate genetics studies with their efforts to reestablish anadromous populations of spring Chinook, steelhead and sockeye salmon in the upper Deschutes River basin. The possibility came about with the installation of a new selective water withdrawal (SWW) structure at Round Butte Dam (rkm 177), which was equipped to capture and sort out-migrating juveniles, and to transport them downstream below the dam complex so that they may continue their outmigration to the ocean. Previously, no out-migration was possible for these fish, eliminating the anadromous life history of these stocks upstream of the dam complex. Beginning 2 to 3 years prior to completion of the SWW, Chinook and steelhead juveniles have been released in upstream tributaries, and there are resident populations of redband rainbow trout and kokanee – some or all of which could produce out-migrating smolts. For both the steelhead and the sockeye/kokanee (*Oncorhynchus nerka*), however, there are questions as to the number and identity of different stocks within the basin, and to the identity of the out-migrating juveniles and of the returning adults. Several sets of tissue samples for both species have been collected in recent years and archived, with additional collections anticipated during the coming year. An agreement has been reached for the Project to finance genotyping of the *O. nerka* samples during Project Year #3, and the archived samples have been sent to HFCES. Discussions continue regarding feasibility and objectives for stock identification of the steelhead collections.

5.8 Summary tissue sample numbers for genetics analyses

The Project is currently budgeted to cover the costs for analysis of up to 8,000 tissue samples per year for the RRS studies under Project Objectives #3 and #4. The table below provides numbers of samples analyzed in Project Year #2 and estimates for Project Year #3.

Population	Species	Year #2	Estimated Year #3
Johnson Creek	spring Chinook	700	1,500
Hood River	spring Chinook	1,000	500
Lookingglass Creek	spring Chinook	2,800	1,200
Lolo Creek	spring Chinook	0	150
Newsome Creek	spring Chinook	1,025	400
Crooked River	spring Chinook	0	900
Wenatchee River	coho	0	2,000
Deschutes River	*O. nerka*	515	400
Total		6,040	8,550

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