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TECHNICAL REPORT 13-12

Basinwide Supplementation Evaluation Project: 2012 Annual Progress Report

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I. Executive Project Summary

Work elements for contract year #4 (May 1, 2012 to April 30, 2013) of the multi-year Basinwide Supplementation Evaluation project (hereafter the Project; 2009-009-00, Contract #57275) were organized under seven Project Objectives, in addition to the requisite administrative activities. The primary focus of the Project involved Hatchery RM&E, specifically financing of molecular genetic analyses to assess critical uncertainties related to effects of hatchery supplementation on productivity of depressed natural salmon populations, as well as of stocks that have been reintroduced following extirpation of the native populations. A relative reproductive success (RRS) study of supplemented Johnson Creek spring/summer Chinook (Project Objective #1) is ongoing. Initial results indicate that the program is indeed providing a demographic boost to the depressed population with little or no apparent deleterious effect on population productivity (Hess et al. 2012). A RRS study of reintroduced spring Chinook in Hood River is being finalized (Project Objective #2). Results indicate that natural origin fish of the reintroduced stock generally demonstrate improved productivity, suggestive of adaptation to the reintroduced fish to the new environment. Additional RRS studies of reintroduced spring Chinook are ongoing in Lookingglass Creek and Newsome Creek (Project Objective #2). Genetics analyses are also being financed through the Project to assess relative spawning and rearing success of reintroduced sockeye salmon in the Cle Elum Lake/Yakima River system, and of a sockeye salmon run in the Cle Elum Lake and Suttle Lake/Deschutes and Metolius River system created through facilitated passage of kokanee out-migrants through the Pelton-Round Butte Dam complex (Project Objective #3). Two 2-day "Introduction to Molecular Genetics Analyses in Tribal Fisheries Management" training programs were sponsored through the Project, and were attended by 16 tribal fisheries biologists and technicians (Projective Objective #4). Columbia River Inter-Tribal Fish Commission (CRITFC) personnel involved with Project activities participated in a variety of inter-tribal and inter-agency meetings, workshops and symposia in which issues related to effects of hatchery management were discussed (Project Objective #5). Another study financed through the Project focused on Fish Population Status Monitoring RM&E, involving use of a DIDSON sonar to estimate spring Chinook salmon escapement through the Castile Falls fishway to the upper basin of the Klickitat River (Project Objective #6). The count for 2012 (n=30) was similar in magnitude to prior years, although video recordings available for the first time in 2012 revealed the fish to be a mix of approximately 2/3 steelhead and only 1/3 spring Chinook. As results from Project activities accumulate, they are summarized in study-specific technical reports, as well as in manuscripts submitted for publication in scientific journals (Project Objective #7). In addition to recent publication of the Johnson Creek RRS results (Hess et al. 2012), a manuscript on the tribal coho reintroduction programs is in review, and another involving reanalysis of mark-recapture data for Metolius River kokanee with a new likelihood model developed in prior years with Project support (Hyun et al. 2012) is being drafted.

II. 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 approach to obtain a basinwide understanding of the critical uncertainties associated with use of hatchery supplementation for rebuilding depressed populations. In response, the Ad Hoc Supplementation Workgroup (AHSWG) was formed – a group of volunteer scientists and managers working in 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) populations relative to un-supplemented (reference) populations, 2) conduct a series of relative reproductive success (RRS) studies to quantify short-term impacts through comparisons of productivity within broodyears of hatchery-origin (HO) and natural-origin (NO) fish observed in programs to supplement depressed natural populations, and in programs where an extirpated stock has been reintroduced and supplemented with hatchery-reared fish, and 3) develop a request for proposals to fund several intensive small-scale studies designed to elucidate various biological mechanisms by which introduction of hatchery-produced fish may influence natural population productivity (AHSWG 2008).

The Basinwide Supplementation Evaluation project, hereafter the Project, was submitted by CRITFC as part of the Columbia Basin Fish Accords (2008). The Project was designed to implement a variety of actions in support of the AHSWG recommendations. In contract year #4 of this Project, these activities included ones to: 1) improve abundance and productivity estimation procedures used in monitoring supplemented and reference populations, involving use of a DIDSON sonar to estimate spring Chinook escapement to the upper Klickitat River (Project Objective #6), 2) derive RRS information from supplemented populations, involving support of an ongoing RRS study of supplemented Johnson Creek spring/summer Chinook (Project Objective #1) and of supplemented reintroduced spring Chinook in the Hood River, Newsome Creek and Lookingglass Creek (Project Objective #2), and 3) to assess relative spawning success of reintroduced sockeye salmon in the Cle Elum Lake and Suttle Lake/Deschutes and Metolius River system and the Cle Elum Lake/Yakima River system (Project Objective #3). Additional project activities involved support for personnel training, for participation in regional forums involving review of hatchery management and supplementation effects, and for project reporting and (Project Objectives #4, #5 and #7, respectively).

III. Work Elements / Tasks

A. Project Administration

Activities involved in administration of the Project by CRITFC during contract year #4 included: production and posting in Pisces of the annual progress report for contract year #2, completion of quarterly and final status reports in Pisces that record progress associated with each work element within the statement of work, submission of monthly project expense summaries to BPA, and production and posting in Pisces of a statement of work, a line item budget proposal, and a capital and non-capital equipment inventory for contract year #5. Additional reports and presentation documents summarizing results from various work elements were also posted under Attachments within the project's PISCES web site.

B. **Project Objective #1:** Support an RRS study of Johnson Creek spring/summer Chinook

CRITFC has been collaborating with the Nez Perce Tribe (NPT) on a study to assess RRS of supplemented spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) as part of the Johnson Creek Artificial Propagation Enhancement Project (JCAPE; Project No. 199604300; Rabe and Nelson 2010). Beginning with the first year of supplementation (1998) of the spring/summer Chinook population in Johnson Creek (a tributary of the East Fork

South Fork Salmon River), NPT biologists have collected tissue samples and biodata on all returning adults intercepted at a weir (rkm 8), as well as tissues from a limited number of out-migrating NO juveniles collected at a rotary screw trap operated just downstream. The tissues have been sent to CRITFC geneticists at the Hagerman Fish Culture Experiment Station (HFCES), to be genotyped for parentage analyses. In the initial years, the NPT had a variable amount of funding to cover the associated laboratory and analytical expenses. Currently, the NPT is able to commit $60,000 annually from available monitoring and evaluation funds, which is sufficient for analysis of approximately 1,500 samples per year. However, the number of samples collected annually has often exceeded this number, especially in recent years when the NPT has seen substantially increased escapement. Additionally, CRITFC recommended to NPT biologists during contract year #1 that the number of juvenile samples collected annually be increased for several years, to boost power of RRS analyses based on juvenile recruits-per-spawner (R/S). To assure that adequate funds were available to perform the genetic analyses of back-logged samples and of new samples collected annually, the Project has provided supplemental funding to the JCAPE RRS study beginning in 2010. In contract year #4, funds from the Project were used to genotype approximately 3,532 adult and juvenile tissue samples.

During contract year #3, genotyping of the adult samples collected since initiation of the supplementation project through 2010 was completed (n=7,726), after which parentage (based on adult-to-adult recruits-per-spawner) analyses were performed. Results from these analyses were summarized in a manuscript published in November 2012 in Molecular Ecology (Hess et al. 2012). Briefly, the study indicated that the supplementation program did indeed provide a demographic boost to the depressed spring/summer Chinook population in Johnson Creek, and that natural productivity of successfully spawning HO and NO fish was generally similar. The proportion of fish identified to have produced one or more adult offspring was similar for NO and HO females (age 4 and 5) and for adult males (age 4 and 5); although HO "jack" (age 3) males were less successful than NO jacks. However, within all three sex/age categories, relative reproductive success (HO/NO) was not significantly different from 1.0.

These analyses will be augmented annually as data accumulates for each successive broodyear. Additionally, the enhanced juvenile sampling, initiated in 2010, will continue through at least 2013, and will permit an RRS analysis for these broodyears based on juvenile-recruits-per-spawner. The increased sample size will enhance power of the analyses (performed within sex/age category separately) to simultaneously test for effects of origin, broodfish size, and return time to the Johnson Creek weir.

C. **Project Objective #2**: Support RRS studies of reintroduced salmon populations

Freshwater habitat loss and degradation, and increased mortality during migration within the hydrosystem are the primary factors responsible for the current depressed state of natural salmon and steelhead populations in the Columbia basin. In some cases, however, the effects have been even more dramatic, and lead to the extinction of the affected populations. This obviously included extirpation of all populations whose natal streams were above the impassable mainstem Chief Joseph (Columbia River) and Hells Canyon (Snake River) dams. However, many populations downstream of these dams were also lost, e.g., spring Chinook in the Hood, Umatilla, Okanogan and Clearwater River basins, and 100% of the native coho salmon populations within the Columbia basin upstream of The Dalles Dam, etc. (Fulton 1968; Mullen 1983; Nehlson et al. 1991; O'Toole et al. 1991).

Tribal fisheries management agencies have engaged in efforts to re-establish naturally spawning populations in some of these Columbia basin rivers where the indigenous fish were extirpated. Reintroduction efforts involved stocking of juveniles produced from out-of-basin hatchery stocks, based on the presumption that these stocks retain the phenotypic and genotypic capacity to (re)adapt to the natural environment (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 reintroduction programs have been encouraging. Substantial numbers of the HO fish released as juveniles returned as mature adults, and increasing numbers of NO juveniles (fry, parr and smolts) have been observed, indicating successful natural spawning of the HO adults. Additionally, observation of NO adults in subsequent run years indicates that these fish have undergone a full generation or more of strictly natural

production (Phillips et al. 2000; Underwood et al. 2003; Lutch 2005; Murdoch et al. 2006; Bosch et al 2007; Narum et al. 2007).

Broodstock management protocols for these reintroduction programs involve progressively phasing out use of juveniles from the out-of-basin hatchery stock. Instead, broodfish are increasingly being collected from among adults returning in-basin, to produce the juveniles with which to continue supplementation. The initial generations of such "local origin" broodstock are comprised largely of mature HO adults. However, in subsequent generations, NO adults should make up an increasing proportion of the escapement, and they will be targeted for incorporation into the hatchery broodstock. With this broodstock management approach in combination with exposure of the fish to natural selective forces, it is expected that a new natural population will be created that is increasingly adapted to local conditions.

In a recent meta-analysis, Fraser (2008) reviewed published reports for 31 different salmonid reintroduction programs, including several within the Columbia basin. For many of these programs, particularly those for which effects of hydrosystem blockages and habitat degradation which contributed to the extirpation of the original populations have been sufficiently reversed, new naturally reproducing populations appear to be re-establishing themselves. However, hatchery supplementation is ongoing, and uncertainty therefore remains as to whether the observed production in each is supported by spawning of a progressively better adapted naturalized population, or simply by natural production of some number of returning adults from the continued annual stocking of supplementation juveniles.

If adaptation is occurring, we expect that productivity of the fish would increase. As such, NO fish (fish that have been exposed to a generation or more of natural selection), should on average, produce more recruits-per-spawner than HO fish (fish that lack this generation of selection), and relative reproductive success (NO/HO) should be greater than 1.0. To test this hypothesis, the Project has initiated RRS studies in three tribal reintroduction programs, each involving spring Chinook salmon – Hood River, Lookingglass Creek (Grande Ronde River) and Newsome Creek (South Fork Clearwater River). We also continue efforts to investigate possibilities for RRS studies in additional reintroduction programs.

C.1 Hood River spring Chinook

Many factors led to the extirpation of spring Chinook from the Hood River basin by the mid-1970s (O'Toole 1991). Within a decade, however, plans were being made to reintroduce spring Chinook as part of a program to be co-managed by the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) and the Oregon Department of Fish and Wildlife (ODFW). Initially (1986 through 1993), the program involved annual stocking of Carson National Fish Hatchery (NFH) juveniles. Managers then decided to switch to use of Deschutes River stock from Round Butte Hatchery, with occasional input from the nearby Warm Springs NFH as needed. Stocking of age 1+ smolts resumed in 1995 and has continued annually since. (Underwood et al. 2003, Reagan 2011). Beginning in 1992, scales and ancillary biodata (sex, size, date, etc.) were collected annually on (almost) all in-migrating adult Chinook salmon intercepted in Hood River at the Powerdale Dam fish trap (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. In 2009, an agreement was reached with CTWSRO and ODFW to engage in an RRS study financed through the Project, involving analysis of DNA extracted from the archived scales.

The spring Chinook scales have been stored in individual envelopes at ODFW office in The Dalles, Oregon. From each envelope a few scales were sub-sampled and sent to HCFES for DNA extraction, genotyping for a suite of microsatellite DNA loci, parentage analysis, and estimation of RRS within sex and broodyear. Samples from a total of approximately 8,300 individuals, collected from 1992 until June 2010 when Powerdale Dam was decommissioned, were genotyped. Genotyping was completed during the current contract year, and parentage and statistical analyses are ongoing. Initial results indicate that the reintroduced stock of spring Chinook is establishing a natural population, and that the NO fish generally demonstrate improved productivity relative to HO fish of the same stock.

Interestingly, the data also indicates that a portion of the fish is of an alternative lower Columbia River genetic lineage which appears to have colonized the Hood River. The lower Columbia lineage comprises Chinook populations from tributaries to the Columbia downstream of Bonneville Dam and from the Willamette River basin, which are of both ocean-type or of stream type life history (Narum et al. 2010). The Carson and Deschutes stocks chosen for the reintroduction effort belong to a group of interior Columbia stream-type populations. NO and HO fish of the lower Columbia lineage were already present in the initial 1992 broodyear samples, and have been present in all subsequent run years. Genetic differentiation among lower Columbia populations is insufficient to determine the source population(s) of these Lower Columbia colonizers. There are also fish among the Hood River samples which appear intermediate in genotype, likely the result of interbreeding between stocks. Nonetheless, the genetic signature for most fish remains distinctly of one lineage or the other. Whether this is due to continued straying of lower Columbia fish into the Hood River, and/or to assortative mating between stocks is also unknown. The proportion of lower Columbia lineage fish in the escapement is low relative to the reintroduced stock, most likely due to continued supplementation of HO fish. However, the data indicates that they demonstrate significantly higher productivity than the NO fish of the reintroduced stock. The latest summary of information from this study was presented at the joint Western Division/Idaho Chapter of the American Fisheries Society meeting in Boise ID, April 16-18, 2013, "Reproductive success of reintroduced spring-run Chinook salmon in the Hood River, Oregon". During the coming contract year (#5), analyses will be completed, and information from the study will be summarized in a manuscript(s) to be submitted for publication in a scientific journal.

C.2 Lookingglass Creek (Grande Ronde River) spring Chinook

Spring Chinook populations within the Grande Ronde and Imnaha River subbasins had declined dramatically in abundance by the 1980s. As part of the Lower Snake River Compensation Plan (LSRCP), a hatchery was constructed at rkm 3 along Lookingglass Creek (a tributary to the Grande Ronde at rkm 136) for the purpose of rearing fish with which to supplement populations in Grande Ronde subbasins. However, spring Chinook in Lookingglass Creek itself had already been extirpated. Efforts to reintroduce spring Chinook into Lookingglass Creek were implemented over the following two decades, by annual stocking at upstream locations of juveniles produced in the hatchery. Different stocks were successively used at the hatchery during the initial years – Carson NFH, Wind River, and Imnaha River stocks – before switching to Rapid River Hatchery stock (located in the Little Salmon River subbasin in Idaho). However, a naturally spawning population never fully established itself in Lookinglass Creek during this period. Co-managers (CTUIR and ODFW) decided to cease use of an out-of-basin stock, and instead collect adults from Catherine Creek - a tributary within the Grande Ronde subbasin – for use as broodstock. From 1998 through 2003, no returning adults were passed upstream of the Lookingglass weir (½ km upstream of the hatchery) for natural spawning, so as to extirpate any remnant Rapid River origin fish. Beginning in 2001, spring Chinook was again reintroduced into Lookingglass Creek by annual stocking of juveniles produced with the Catherine Creek stock (Boe et al. 2010). The first adults from the new program returned in 2004, and since then tissue samples from all adults passed upstream of the weir were collected and archived, in anticipation of eventual genetics monitoring to assess return rates and productivity of the reintroduced fish. Additionally, samples from out-migrating juveniles (captured in a rotary screw trap located ¼ km downstream of the weir) have also been collected, albeit not on a systematic annual basis until 2008 (Boe et al. 2011).

In contract year #2, an agreement was reached with the Confederated Tribes of the Umatilla Reservation (CTUIR), which manages the monitoring program in Lookingglass Creek, for the Project to finance the laboratory analyses required for an RRS study of the newly reintroduced spring Chinook. In 2010, the archived samples were sent to HCFES for genotyping, as have all adult and juvenile samples collected each year since. By the end of the current Contract year (#4), approximately 5,700 samples had been genotyped. In the agreement, CRITFC requested the number of juvenile samples collected annually be increased, to as many as two to three times the number of adults passed above the weir in a given run year. By the end of the coming contract year (#5), samples for 5 consecutive broodyears (2007-2011) will be available for a HO versus NO RRS analysis based on juvenile recruits-per-spawner, results for which will be summarized in a manuscript to be submitted for publication in a scientific journal. In 2016, returns of the progeny as adults for these broodyears will be complete, and an RRS analysis will be performed, and compared to results based on juvenile recruits-per-spawner.

C.3 Newsome Creek (South Fork of the Clearwater River) spring Chinook

Spring Chinook were functionally extirpated from the entire Clearwater River subbasin following construction of Lewiston Dam (rkm 6) in 1927 (Fulton 1968). Renovation of the defective fish ladder in 1940 permitted limited upstream movement, but it was not until removal of the dam in 1973 that full access to the subbasin for anadromous fish was once again available. Spring Chinook were reintroduced to the basin, primarily through stocking of Rapid River (Salmon River) hatchery stock juveniles in various tributary streams beginning in the 1960s. However, this did not include Newsome Creek, a tributary to the South Fork of the Clearwater River (rkm 84), and surveys conducted from 1987 to 1992 indicated that no fish had volunteered into the stream. IDFG initiated a reintroduction/supplementation program shortly thereafter, involving stocking of variable numbers of pre-smolts, smolts or adults of spring/summer Chinook produced at the Clearwater Hatchery. In the early 2000s, management of the program was taken over by the NPT and juvenile production (75,000 pre-smolts per year) was shifted to the Nez Perce Tribal Hatchery, and has involved collection of some portion of the broodstock at the Newsome Creek weir (Hesse and Cramer 2000).

As part of the monitoring component to the Newsome Creek reintroduction/supplementation program, the NPT has collected tissue samples of returning adults and out-migrating juveniles for the purpose of assessing productivity of the naturally spawning fish (Backman et al. 2009; Bradley et al. 2009). The adults are intercepted at a weir located approximately 100 m upstream of the creek's confluence with the South Fork. Samples from out-migrating juveniles are collected in a rotary screw trap located just downstream of the weir site, and operated in both the fall and spring. The samples have been sent to CRITFC geneticists at HCFES, and initially using "year-end" funds, NPT was able to partially finance genotyping of the samples and associated data analyses. As of 2009, all adult samples, and an initial adult-to-adult R/S assessment of productivity was performed for BY 2002, with results reported in "Genetic pedigree analysis to evaluate natural productivity between natural origin, and stray origin Chinook salmon in Newsome Creek, ID" by Matala et al., Appendix C in Bradley et al. 2009. However, funds were insufficient for genotyping and analysis of their corresponding juvenile progeny, and numbers of samples (both juvenile and adult) collected annually have generally been increasing. To assure full funding of the study, an agreement was reached with the NPT during contract year #2, for the Project to supplement financing of the genotyping, so as to complete analyses for all archived and currently collected samples. Then beginning in 2012, the Project took over full responsibility for supporting the laboratory work. As of the end of the current contract year (#4), a total of approximately 4,552 samples had been genotyped. A summary report of results from 2002 through 2010 was prepared by Matala and Narum (2012; see attachments in Pisces). A report with information from analyses of samples collected in 2011 and analyzed in the contract year #4 will be finalized early in the coming contract year, after which it will be posted within Attachments in the Project web site in PISCES.

C.4 RRS studies in other tribal reintroduction programs

Other tribal reintroduction programs have been examined to assess the feasibility of enacting similar RRS studies. Among them is the NPT coho reintroduction program, specifically in Lapwai Creek (rkm 28 Clearwater River). As for indigenous spring Chinook in the Clearwater River, coho salmon were also extirpated from the subbasin following construction of Lewiston Dam (Everett et al. 2006). The NPT initiated a reintroduction program in 1995, involving annual stocking of coho smolts obtained from a lower Columbia River hatchery (Eagle Creek NFH, Estacada OR). As of 1999, managers began collecting returning adults at in-basin locations (primarily hatcheries from which the juveniles had been acclimated and released) for use as broodfish to develop a local Clearwater stock. By 2009, they were able to meet 100% of the program's broodstock needs with in-basin returns. Since reintroduction, coho returns to the basin have grown steadily and escapement in 2011 was in excess of 5,000 fish.

An RRS study of the reintroduced coho in Lapwai Creek is of interest and would appear to be feasible. Natural spawning has already been observed upstream, and a weir is installed at rkm 1 each year at which all in-migrating coho are interrogated and could be tissue sampled. Additionally, annual tissue sampling of all broodfish for the Clearwater program was initiated in 2010, as part of a regional parental based tagging (PBT) project for anadromous salmonid hatchery programs in the Snake Basin, co-managed by IDFG, ODFW and CRITFC. The PBT database could therefore be used to identify the origin of all returning adults from the hatchery releases beginning

with BY 2010. Following discussions with project biologists, it was agreed that starting in 2013, they will record biodata and tissue sample all returning adults at the Lapwai weir, noting which are passed upstream for natural spawning. Beginning in 2017, with the return of the progeny from BY2013, RRS analyses based on adult recruits-per-spawner could be performed annually. An agreement on the details regarding sampling and laboratory analysis will be finalized early in the coming contract year (#5).

Another Clearwater River tributary that provides an opportunity for an RRS study is Lolo Creek (rkm 87), in which the NPT operates a spring Chinook reintroduction/ supplementation program. The NPT began reintroduction into Lolo Creek with out-plants of Dworshak NFH adults in 1997, followed by stocking of juveniles from the Clearwater Anadromous Fish Hatchery in 1999. Since 2004, the stream has been supplemented annually with progeny of adults collected in Lolo Creek that are produced and reared at the Nez Perce Tribal Fish Hatchery (Backman et al. 2009; Bradley et al. 2009). To present, escapement into Lolo Creek has been monitored at temporary weirs. However, high springtime flows typically preclude getting the weirs installed before a sometimes substantial portion of the spring Chinook run has already migrated past the site. Funds for construction of a permanent weir have been obtained, and construction was scheduled for 2013. However, needed permits have not been granted and the project is currently on hold. If and when the permanent weir is put in place, a full sampling of the spring Chinook run will be possible. Discussions with the NPT will continue over the coming year regarding the feasibility of initiating a collaborative project for an RRS study in Lolo Creek, and of study objectives.

D. **Project Objective #3:** Support genetics studies of reintroduced sockeye salmon

D.1 Cle Elum sockeye salmon

Cle Elum Lake in the upper Yakima River basin, once supported a thriving population of sockeye salmon. However, construction of a dam at the lake outlet in the early 1900s resulted in extirpation of the population. This dam was later enlarged by the Bureau of Reclamation (BOR) to provide increased water storage. As a first step toward investigating the feasibility of a Yakama Nation (YN) proposal to reintroduce sockeye to the lake, a flume was constructed by the BOR on the dam spillway and tested with coho salmon smolts to see if it would work effectively as a route for juvenile out-migration from the lake (Bureau of Reclamation 2007). Results of the tests were positive, and in 2009 the YN began an annual program of out-planting of adult sockeye salmon into the lake, using fish collected from among in-migrating sockeye captured in July at Priest Rapids Dam (PRD) on the Columbia mainstem. The fish are transported by truck and released in the upper portion of the lake near its confluence with the Cle Elum River. The adults at PRD represent a mix of fish originating from two populations in the Mid-Columbia: from Lake Wenatchee in the Wenatchee River basin, and from Osoyoos and Skaha Lakes in the Okanogan River basin. Waters in the two systems have very different thermal regimes, and the two stocks exhibit variation in life history characteristics, including differences in run timing and spawn timing.

In each year of adult out-planting into Cle Elum Lake, spawning activity has been observed during September and October. The spawning appears to be temporally and spatially bimodal. Spawning during the early pulse occurs to a greater extent in the tributary streams upstream of the lake (Cle Elum and Cooper rivers). Managers suspect the fish involved to be primarily from the Wenatchee stock, which has an earlier return time (in its natal river) than the Okanogan stock. A later pulse of spawning occurs lower in the tributary streams and in near-shore gravel in the upper reaches of the lake. These fish are suspected to be primarily of Okanogan stock. In the spring of 2011, a large number of age 1+ out-migrating *O. nerka* smolts (presumably progeny of the initial 2009 adults out-plants) were observed in the juvenile bypass facilities at Roza Dam (rkm 206 on the Yakima River) and at the Chandler smolt collection facility adjacent to Prosser Dam (rkm 76).

Questions of interest to the tribe for management of the Cle Elum sockeye reintroduction program include: 1) Are the differences in spawning timing between Wenatchee and Okanogan stocks reflected in the bi-modal spawning activity of the out-planted adults in Cle Elum Lake? 2) What is the relative natural productivity of fish from the two stocks? 3) Do fish from the two stocks interbreed, and at what rate? 4) Do natural origin juveniles from matings within and between stocks demonstrate differences in age, size and timing at out-migration, and age and size at

return and in smolt-to-adult return rates? These are all questions that lend themselves to study using genetics-based stock identification analyses.

Prior genotyping of samples of Wenatchee and Okanogan stocks using a standardized panel of 96 single-nucleotide polymorphism (SNP) DNA markers was performed by CRITFC scientists at HFCES as part of a project to establish baseline genetic profiles for *O. nerka* populations across the Columbia basin. Results from standard genetic structure analyses indicate that the two stocks display very distinct genetic profiles (Matala, unpublished data). A high degree of accuracy is therefore expected for stock-of-origin assignment of adults out-planted into Cle Elum Lake, and of their progeny. An agreement with YN was finalized during contract year #3, to collaborate on a genetics study of the reintroduced Cle Elum sockeye salmon. Since that time, YN has been collecting tissue samples from a portion of the out-planted adults (temporally stratified) each year, from post-spawned carcasses observed during spawning ground surveys, from out-migrating juveniles sampled at the Chandler and Roza facilities, and from adults collected in the fish ladder at Roza Dam. In turn, the Project has covered the costs for genotyping, and subsequent analyses for stock identification and parentage.

As of the end of contract year #4, a total of approximately 2,100 samples had been genotyped. Genetic stock identification analyses are ongoing. We plan to continue analyses of samples collected through 2013, after which results will be summarized in an initial technical report to be presented to YN, and posted in the Attachments tab within the Project web site in PISCES.

D.2 Deschutes River sockeye salmon/kokanee

Suttle Lake, a nursery lake in the headwaters of the Metolius River, a tributary to the Deschutes River, was one of only two locations in Oregon where sockeye salmon were indigenous, Wallowa Lake draining the Wallowa River in the Grande Ronde River Basin being the other. Adult passage into Suttle Lake was blocked by construction of a dam at the lake's outlet, and another in Lake Creek (the stream which connects Suttle Lake to the Metolius River) in the early 1900s, and the sockeye population subsequently went extinct. A limited amount of spawning of sockeye persisted in the Metolius River below these obstructions, with the juveniles apparently rearing in the lower Deschutes or the Columbia. Then in 1964, Round Butte Dam was constructed downstream of the Metolius on the Deschutes River, and totally blocked upstream adult passage. The dam did, however, create a reservoir (Lake Billy Chinook, LBC) in which a large non-anadromous *O. nerka* (kokanee) population developed. Mature kokanee migrate from the lake into the Metolius River for spawning each year, with the newly emerged juveniles migrating back down to the lake for rearing. Similarly, in Suttle Lake, a kokanee population developed following loss of anadromy, with spawning occurring in Link Creek which flows into the upstream end of the lake. Of note, however, stocking of both LBC and Suttle Lake with kokanee juveniles from multiple out-of-basin hatchery stocks occurred repeatedly through the mid-1900s (Nehlson 1995, Gustafson et al. 1997).

In recent negotiations for relicensing of the Pelton-Round Butte hydroelectric complex, an agreement was reached to re-establish passage of anadromous fish through the complex, to and from the upper basin. It is presumed that some portion of juvenile *O. nerka* emanating from LBC and/or Suttle Lake will exhibit an anadromous sockeye salmon life history. In 2010, the new fish transfer facility (FTF) at Round Butte Dam, constructed as part of the relicensing agreement, became operational, and all out-migrating *O. nerka* smolts have been passed downstream annually. CTWSRO is leading the monitoring program of upper Deschutes *O. nerka* (kokanee and sockeye), and questions of interest to the co-managers (ODFW, PGE, CTWSRO) include: What is the relative proportion of juveniles from the LBC and Suttle Lake stocks that are passed downstream at the FTF? What are the relative proportions that return as mature adults? Do fish from the two stocks exhibit differences in age, size or timing at migration? Do genetic structure analyses indicate reproductive isolation between the two Deschutes locations, as opposed to one panmictic population? If differences are revealed, are they of local origin or indicative of stocking influences?

In contract year #2, an agreement was reached with CTWSRO for the Project to perform an initial genetic stock analysis of fish from the two lakes. Tissue samples collected in 2009 and 2010 from pre-spawning LBC kokanee and from juveniles captured at the outlet of Suttle Lake were sent to HFCES for analysis. Genetic structure results

using a standardized panel of 96 SNP markers provided evidence of multiple origins in both stocks, no doubt associated with past stocking with fish from out-of-basin hatchery sources. Nonetheless, there were also differences in the genetic profiles of possibly sufficient magnitude to be useful for stock differentiation (Matala, unpublished data).

The agreement with CTWSRO was therefore extended through at least 2015, to cover costs for genetics analysis of additional annual samples from the two stocks (up to 100 individuals per sample set), of a temporally representative sample of 200 fish of unknown origin from among the out-migrating juveniles collected at the FTF and passed downstream of Round Butte Dam, and of all (up to 600) in-migrating fish that eventually return to the Pelton trap as mature adults. Additionally, samples were obtained from kokanee populations in central Oregon lakes (Paulina and Wickiup) located within the upper Deschutes basin and that could be sources of migrants to LBC, but not to Suttle Lake. Samples were also collected from O'Dell Lake, which is not connected with the Deschutes, but may have experienced similar out-of-basin stocking events as the other lakes.

By the end of contract year #4 a total of approximately 4,200 samples had been genotyped. Genetic stock identification analyses are ongoing, and an initial technical report summarizing results from these analyses will be produced during the coming contract year.

E **Project Objective #4:** Coordinate inter-tribal workshops and genetics training programs

E.1 Inter-Tribal Coho Reintroduction Workshop

Natural populations of coho salmon were functionally extirpated from the Columbia basin upstream of The Dalles Dam by the mid to late 1900s. Beginning in the 1990s, the YN initiated two programs to reintroduce coho, one into the Yakima River and the other into the Mid-Columbia Wenatchee and Methow rivers. Similarly, the Nez Perce Tribe initiated a reintroduction program in the Clearwater River. In 2005, CRITFC sponsored an inter-tribal meeting to facilitate exchange of information on methodologies and initial results from their programs. Seven years have elapsed since this meeting, and each program has evolved substantially. We therefore proposed in Contract Year #4 to hold a second workshop, to provide an opportunity for program managers to update each other on progress and "lessons learned" relative to different management approaches. While initially planned for January-February 2013, in discussions with program managers the decision was made to postpone this meeting until the following contract year (#5), and the task was duly included in the contract statement of work. The meeting is currently scheduled to be held in Lewiston ID, July 8-10, 2013.

E.2 Molecular Genetics in Tribal Fisheries Management training programs

Tribal fisheries personnel are involved in monitoring and evaluation programs of essentially all salmon and steelhead populations within their reservations and ceded territories. Tissue sampling of fish (at weirs and ladders, in smolt traps and during carcass surveys) is often included as part of standard monitoring activities. These samples are sent to genetics laboratories, such as the HFCES, for molecular genetics analyses and the resulting data are analyzed to inform a variety of management questions. However, the field personnel involved have little formal training in the principles of molecular and quantitative genetics, and limited knowledge of how the information can be used to guide management. An additional disconnect exists between the tribal field personnel and the CRITFC laboratory personnel, such that respective groups have limited understanding of the logistical and working constraints within which the other group operates. To provide the field personnel the opportunity to obtain a better understanding of basic genetic principles and of the practicalities of how the tissue samples are processed and the genotypic data analyzed, and to improve the understanding and communication between the tribal field personnel and the CRITFC geneticists at the HFCES, in contract year #3 we initiated a series of 2-day training programs, entitled "Introduction to Molecular Genetics Analyses in Tribal Fisheries Management" (curriculum is posted within Attachments in the Project's site in Pisces). Participants were solicited from among the technicians and biologists within the fisheries agencies of the four treaty tribes – YN, CTWSRO, CTUIR and NPT, with lodging and per diem for each financed through the Project.

The training program consists of a series of presentations ("lectures", videos, demonstrations and discussions) made by CRITFC staff on basic principles of genetics and inheritance, types of molecular markers, and analyses using these markers applicable to fisheries management. Emphasis is placed on use of microsatellite and SNP DNA markers for genetic stock identification and for parentage analysis. CRITFC staff also provide summary presentations of previous and ongoing studies conducted on tribal programs. These presentations are interspersed with "hands-on" exercises to provide familiarity with the actual laboratory techniques. Additionally, the entire HCFES staff is invited to attend a noontime presentation made each day by one of the participants, who provides a review of a tribal project on which he/she works. The schedule and presentation files from the latest program are available at: http://www.critfc.org/fish-and-watersheds/fishery-science/hagerman-genetics-laboratory/genetics-training/. Participants also receive a hard copy of "Genetic Guidelines for Fisheries Management" by Kapuscinski and Miller (Sea Grant MN) for use as a reference document.

Three training programs were held in contract years #3, for a total of 22 participants. During contract year #4, two more training programs were conducted. Participating in the first (November 6-7, 2012) were five YN technicians and biologists, and another 3 from CTWSRO. The second training (December 4-5, 2012) was attended by four participants each from CTUIR and NPT.

F. **Project Objective #5:** Participate in regional forums for review of hatchery effects on natural populations

The Project coordinator (Galbreath) and collaborating CRITFC geneticists at HFCES (Hess, Matala and Narum) participated in a variety of inter-tribal and inter-agency meetings, workshops and symposia, in which were discussed Project-related issues concerning hatchery management and the nature and magnitude of effects that HO salmon and steelhead may have on the natural populations with which they interact or interbreed. The purpose was to exchange information acquired during studies conducted by CRITFC and by other participating agencies, as well as to develop and articulate the tribal perspective on how hatcheries can be appropriately managed to minimize possible negative effects on productivity and to benefit from the potential positive effects on the other three viable salmonid population (VSPs) parameters - abundance, spatial structure and diversity (McElhany et al. 2000). The following is a list of the primary meetings, workshops and symposia, and the nature of CRITFC's participation at each:

- Attendance at various of the monthly Northwest Power and Planning Council meetings, including presentation ("Supportive breeding boosts natural population abundance with minimal negative impacts on fitness of wild Chinook salmon in Johnson Creek") at the August 2012 meeting
- Attendance at various meetings of Hells Canyon Complex Fishery Resource Committee (examining alternative scenarios for reintroduction of anadromous salmoninds above the complex)
- Attendance at the Fisheries & Hatcheries – Legal and Regulatory Frameworks seminar (May 25, 2011, Seattle WA)
- Attendance at the annual Yakima Basin Science and Management Conference (June 13-14, 2012, Ellensburg WA)
- Participation in the annual Spawning Ground Survey Workshop, co-sponsored by IDFG and NPT (August 6-8, 2012; McCall ID)
- Attendance at the Future of Our Salmon 2012 Conference (October 17-18, 2012, Portland OR)
- Participation in a CRITFC delegation with to representatives of the Dept. of the Interior, Dept. of Commerce/NOAA Fisheries, and to congressional committees, and presentation of "Supportive breeding boosts natural population abundance with minimal negative impacts on fitness of wild Chinook salmon in Johnson Creek" (Dec 3-5, 2012; Washington D.C.)
- Attendance at the Northwest Fish Culture Conference (December 11-13, 2012, Portland OR)
- Attendance at the NW Fish Culture Conference (December 6-8, 2011, Victoria BC)
- Attendance and oral presentation ("Are hatchery effects forever? Use of hatchery stocks to reintroduce extirpated coho salmon to the interior Columbia River basin") at the Aquaculture 2013 conference (Feb 21-25, 2013, Nashville TN)

- Attendance at the Pelton-Round Butte Project Fisheries Workshop (March 11-12, 2013, Madras OR)
- Attendance at the Klickitat and White Salmon Rivers Fisheries and Watershed Conference (March 19, 2013, The Dalles OR)
- Attendance and oral presentation ("Reproductive success of reintroduced spring-run Chinook salmon in the Hood River, Oregon") at the joint Western Division-Idaho Chapter of the American Fisheries Society meeting (April 15-18, 2013; Boise ID)

G. **Project Objective #6:** DIDSON Estimation of Klickitat River spring Chinook escapement

The YN is actively involved in management and rebuilding of anadromous fish populations in the Klickitat River (YN 2008). Among these actions was the recent renovation of the Castile Falls fishway (rkm 103), which reopened passage for steelhead and spring Chinook to a substantial amount of unutilized habitat in the upper basin. In lieu of actively reintroducing fish to the upper basin, the YN made the management decision to wait and see if the fish would find the fishway and repopulate the newly accessible upper basin on their own. It was therefore critical to obtain information to quantify annual escapement. In 2012 (contract year #4) a Dual-Frequency Identification Sonar (DIDSON) was operated for a fourth consecutive summer (July 2 until September 21), to obtain an estimate of spring Chinook escapement. The DIDSON was positioned in the water at the upstream outlet of the fishway to record passage of large fish (presumed to be adult Chinook) migrating out of the fishway into the upper basin. Five of the six sections of trash rack in the upstream opening of the fishway, were blocked with weir frames to preclude passage of fish. The sonar was installed adjacent to the remaining unblocked section so that all fish migrating out of the fishway would swim through the sonar's field of view. The sonar was powered from recently installed diesel generators, and programmed to record sequential hour-long files. At the end of the field season, these files were processed and read, and the time of each upstream passage event was noted. The number of upstream passage events were summed to provide an estimate of total spring Chinook escapement. The data was then compared to counts of passage through the window in the fishway that was recently installed along with a video recording system.

The total counts of fish passage events recorded by the DIDSON was 30, presumed to be of spring Chinook. This estimate is similar in magnitude to the escapement estimates of 24 ± 4, 26 to 27, and 38 derived with the DIDSON in 2009, 2010 and 2011, respectively (Galbreath et al 2010, 2011 and 2012). Also similar to prior years, the 2012 estimate was substantially higher than the estimate of 15 based on spawning ground surveys (5 redds observed X 3 fish/redd).

Unlike prior years, however, a similar set of observations were recorded for the first time with a video camera recently installed in a newly constructed monitoring facility. The video recordings, showed 45 fish passage events in the corresponding July-September period – 50% more than observed with the DIDSON. Also, the video images indicated that the majority of fish were steelhead (34 of 45; 76%), as opposed to spring Chinook (11 of 45; 24%). A video count of 11 spring Chinook is not dissimilar to the estimate of 15 based on expanded redd counts. Assuming that the species mix was similar across years, we readjusted our prior DIDSON estimates of spring Chinook escapement for the years 2009 through 2011, by increasing the DIDSON counts by 50% to estimate total salmon/steelhead escapement, then multiplying by 24% to estimate only spring Chinook. These calculations provided new estimates for spring Chinook escapement in 2009, 2010 and 2011, of 9, 9 and 14, respectively. These lower estimates bring them generally closer in line with escapement estimates based on expanded redd counts for these years of 12, 3, and 0, respectively. However, the 2012 video counts and these new estimates also indicate that spring Chinook are recolonizing the upper basin at a much lower rate than previously thought, although steelhead escapement in these years was estimated as 27, 30 and 43, respectively, and 34 for 2012 based on the video recordings.

H. **Project Objective #7:** Prepare manuscripts for publication in scientific journals

Results from the RRS study of spring Chinook in the JCAPE project (see Project Objective #1), based on adult R/S for the initial broodyears, were summarized in a manuscript, "Supportive breeding boosts natural population

abundance with minimal negative impacts on fitness of a wild population of Chinook salmon". The manuscript was submitted for publication in Molecular Ecology, and was published during contract year #4 (Hess et al. 2012).

A manuscript entitled "Tribal reintroduction of extirpated coho salmon to the interior Columbia River basin" was drafted during contract year #4. This manuscript provides an overview methodologies and results for tribal programs to reintroduce coho into the Yakima, Wenatchee and Methow rivers (tributaries to the mid-Columbia), and into the Clearwater River (tributary to the Snake River). The manuscript was submitted for publication in Fisheries, was peer-reviewed, and is currently undergoing revision.

As indicated in section 4.1, genotyping is complete for the RRS study of reintroduced Hood River spring Chinook. Final analyses of the data are underway, and drafting of a manuscript describing results of this study has already begun. We expect to finalize this manuscript and submit it for publication in the coming contract year (#5).

A likelihood model (MRmix) that uses mark-recapture data to provide robust estimates of both population abundance and tag loss rate (and associated uncertainty of each estimate) was developed by CRITFC scientists. The need for the model was prompted by discussions with co-managers regarding analysis of data from a CTWSRO/ODFW/PGE mark-recapture study to estimate abundance of Metolius River kokanee. A manuscript describing the model, "Accounting for tag loss and its uncertainty in a mark–recapture study with a mixture of single and double tags", was published during contract year #3 (Hyun et al. 2012). During the current contract year, the model was adapted to a web-based interface, and this "user-friendly" version was made available to the public at: http://www.critfc.org/mrmix. A reanalysis of mark-recapture data for Metolius River kokanee studies for the years 2006-2012 is currently being conducted, and the web-based model will be used to recalculate abundance estimates for these years. A manuscript summarizing results will be written in collaboration with project co-managers, and will be submitted for publication in the North American Journal of Fisheries Management in Contract year #5.

IV. Synthesis of Findings: Discussion/Conclusions

A. Fish Population Status Monitoring (RM&E)

Among Project tasks, the DIDSON study to estimate spring Chinook escapement to the upper Klickitat River basin (Project Objective #6) falls within the category for Fish Population Status Monitoring (RM&E). Prior to construction of the new fish monitoring facility at the Castile Falls fishway, the YN had only an indirect means to estimate spawning escapement – annual redd counts. To address this problem, the DIDSON sonar has been deployed each summer since 2009. While resolution of the images in the DIDSON files provide no more than a rough estimate of fish size, on the assumption that all images of medium to large "salmon-sized" fish migrating upstream out of the fishway involved spring Chinook, a direct count of escapement could be obtained. Of particular concern over these years is that the DIDSON counts have consistently exceeded those obtained by redd counting by 2-3 fold. The discrepancy between the two methodologies could have been due to a high rate of pre-spawn mortality, although the more likely explanation seemed to lie with incompleteness in the spawning ground surveys and an underestimation of the number of existing redds.

In 2012, the new fish monitoring facility became functional, with a video recording system that was operated concurrently with the DIDSON sonar. The video images demonstrated that our prior DISON estimates suffered from two significant sources of error. First, the video counts exceeded the DIDSON counts by about half, with the most likely explanation being that the lower resolution of the DIDSON images resulted in a tendency to miss/undercount fish passage events. Also, the video images also showed that our assumption of escapement during the summer months to be strictly of spring Chinook was erroneous. In fact, only about ¼ of the fish observed in the 2012 video recordings were spring Chinook, the remaining ¾ being summer steelhead.

To correct our previous DIDSON-based escapement estimates for these two sources of error, we increased each year's count by half, then multiplied by ¼ to provide estimates of escapement for spring Chinook only. The process

provided new estimates of 9, 10 and 14 for 2009, 2010 and 2011, respectively. These counts are closer to those obtained with redd counts for these years (12, 3 and 0, respectively), as were the 2012 video and redd count estimates of 11 and 15 – resolving to a large extent our questions regarding reliability of redd counting for estimating escapement. However, these new estimates also suggest that spring Chinook are recolonizing the upper basin at a much lower rate than previously thought. On the other hand, it is now apparent that summer steelhead escapement to the upper basin, for which no prior data existed, is relatively greater. Increasing the 2009 to 2011 DIDSON counts by half then multiplying by ¾ provides estimates for steelhead escapement of 27, 29 and 43, respectively, plus the 2012 video estimate of 34.

B. Hatchery RM&E

The majority of Project activities concern Hatchery RM&E, with a particular focus on assessing relative productivity of hatchery-origin and natural origin fish associated with supplementation programs – of both depressed natural populations, and of new populations created following reintroduction of fish to streams from which the native populations had been extirpated. The RRS study associated with the JCAPE Project (Project Objective #1), which receives supplemental funding through the Project, addresses the former situation. The recently published manuscript (Hess et al. 2012) provides an initial summary of study results, which indicates that both primary JCAPE objectives are being achieved - a demographic boost to the population via the supplementation program, and no apparent deleterious effect on natural productivity – productivity of successfully spawning HO and NO fish was generally similar.

The Project is supporting RRS studies of three reintroduced populations, each of spring(/summer) Chinook salmon - in the Hood River, Newsome Creek and Lookingglass Creek (Project Objective #2). Additionally, a study has been proposed for reintroduced coho salmon in Lapwai Creek, which should begin in 2013. RRS analyses in these studies are calculated in an inverse manner to that for studies of supplemented native populations. Reintroduction programs are typically initiated with out-of-basin hatchery stocks which it is presumed will exhibit (greatly) reduced productivity, but are also presumed to have the potential to respond to hatchery management strategies and to natural selective forces such that over generations a natural population will be created that progressively adapts to the new environment. Adaptation would be suggested by RRS ratios for NO/HO (the inverse for RRS evaluations of supplemented native populations), greater than 1.0 – indicative of increased productivity of fish which have spent a generation of more within the natural environment relative to fish that are the direct product of hatchery rearing.

Results for the Hood River study, which involves analysis of archived tissues from broodyears 1992 to 2010, are currently being summarized in a manuscript to be submitted for journal publication. RRS results indicate that fish of the reintroduced stock (an interior Columbia River lineage) were generally > 1.0, as predicted. Interestingly, the genetic analyses also indicated the unexpected presence of fish from a second stock of spring Chinook, that are of a lower Columbia River lineage. These fish apparently colonized the Hood River on their own, and have persisted over the years since introduction of the interior Columbia stock. In addition, the lower Columbia stock appears to demonstrated even greater productivity than natural origin fish of the interior stock.

Results for genetics study of the reintroduced Newsome Creek Chinook have been summarized in annual technical reports. This population is small, and interpretation of study results is somewhat confounded by various management and sampling issues. To present, therefore, we have been unable to suggest with any certainty that the analyses indicate differences in productivity. Analyses for the Lookingglass Chinook are ongoing, although we anticipate that within a year, we will be able to summarize results, based on juvenile recruits-per-spawner, for the initial broodyears when natural origin fish derived from the reintroduced Catherine Creek stock were present.

The Project is also supporting genetics studies associated with two other reintroduction projects, both involving sockeye salmon (Project Objective #3). Information obtained should be useful both for guiding management of these programs, and for potential sockeye reintroduction efforts into other lakes from which the species has been eliminated. The first study is being conducted as part of a YN project to reintroduce sockeye salmon into Cle Elum

Lake, initiated in 2009, through annual out-planting of mature adults to the lake. These fish are captured at Priest Rapids Dam and consist of a combination of two stocks - Wenatchee River and Okanogan River – which demonstrate differences in life history within their natal rivers/lakes, and are distinctly differentiable genetically. Beginning in 2011, tissue samples have been collected from a sample of the out-planted adults, as well as from out-migrating juveniles, and from a limited number of carcasses. The objective of the genetics study is to determine whether the two stocks demonstrate differential reproductive success and productivity. An initial report of study results will be provided in 2014, following analyses of samples collected through 2013 (which will include returning adult progeny from the first broodyear of out-planted spawners).

The second sockeye study involves a CTWSRO/ODFW/PGE project to reestablish downstream passage of kokanee juveniles from Lake Billy Chinook on the Deschutes River, which is anticipated to result in subsequent return of anadromous sockeye salmon. Two stocks of kokanee exist in this system, one from Lake Billy Chinook and the other from Suttle Lake, which is the lake in which sockeye salmon were originally indigenous. Initial analyses of samples of fish from the two stocks indicates that each is a composite of multiple genetic stocks – the result of stocking with out-of-basin fish in years past. However, the stocks also bear some level of genetic differentiability. In 2014, we anticipate production of a report that compares the genotypes of juveniles passed downstream of the new fish passage facility at Round Butte Dam, which began operation in 2010, to that of returning adults. The objective is to assess relative return rate, and to assess any differences in genotypic signature of the returning adults relative to their source stock.

The remaining Project Objectives (#4 - Coordinate inter-tribal workshops and genetics training programs, #5 - Participate in regional forums for review of hatchery effects on natural populations , and #7 - Prepare manuscripts for publication in scientific journals) provide additional direct and indirect support to the overriding Project goal of advancing our understanding of how hatchery rearing may affect productivity characteristics of the salmon, and to assess how supplementation - of native populations and of reintroduced populations – may affect VSP parameters of a natural population, in particular abundance and productivity.

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