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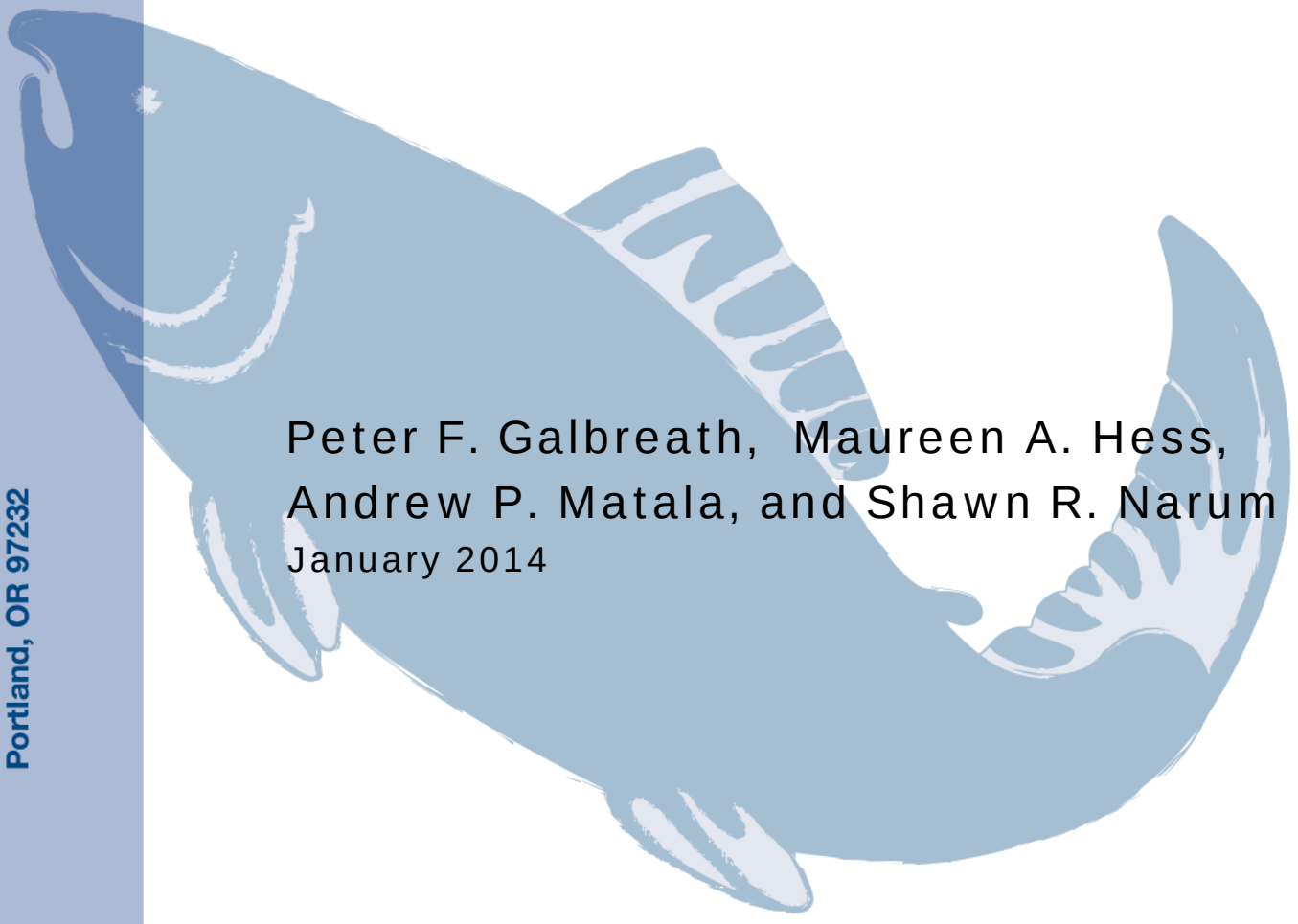
TECHNICAL REPORT 14-11

Basinwide Supplementation Evaluation Project: 2013 Annual Progress Report



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2013 Annual Progress Report

Basinwide Supplementation Evaluation

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I. Executive Project Summary

This report summarizes activities for the period May 1, 2013 to December 31, 2013, as part of the multi-year Basinwide Supplementation Evaluation project 2009-009-00 (hereafter the Project), Contract #61294. (Of note, activities for the first five months of 2013 are summarized in the annual report for the prior contract - #57275, contract year May 1, 2012 to April 30, 2013 - available in Attachments in PISCES for contract #61294.) The report is organized under the seven Project Objectives within the contract Statement of Work, in addition to a section regarding the requisite administrative activities. The primary focus of the Project involves Hatchery RM&E - specifically molecular genetic studies financed through the Project 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 financed jointly by the Nez Perce Tribe and the Project, 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 complete (Project Objective #2) and a manuscript summarizing results will be submitted for publication in early 2014 (Project Objective #7). Results indicate that natural origin fish of the reintroduced stock generally demonstrate improved productivity, suggestive of adaptation of 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 financed by the Project are also being conducted to assess relative spawning and rearing success of reintroduced sockeye salmon in the Cle Elum Lake/upper Yakima River system, and of a nascent sockeye population in the Lake Billy Chinook/Deschutes River and Suttle Lake/Metolius River system created through facilitated passage of kokanee out-migrants from the Pelton-Round Butte Dam complex (Project Objective #3). A 2-day "Introduction to Molecular Genetics Analyses in Tribal Fisheries Management" training program was sponsored through the Project, and attended by nine tribal fisheries biologists and technicians (Projective Objective #4). An Inter-Tribal Coho Reintroduction Workshop was sponsored through the Project. The meeting, attended by 25 tribal fisheries managers, biologists and technicians, reviewed progress made in coho reintroduction programs operated by YN, CTUIR and NPT. Columbia River Inter-Tribal Fish Commission (CRITFC) personnel associated 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 that focused on Fish Population Status Monitoring RM&E, involved 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). Reading of the 2013 sonar files is ongoing. When complete, date and time of fish passage will be compared to data obtained with the video recording system recently installed at the fishway, to assess concordance between systems. As results from the various studies supported by the Project accumulate, they are summarized in study-specific technical reports, and in manuscripts submitted for publication in scientific journals (Project Objective #7). A manuscript on the tribal coho reintroduction programs was accepted and scheduled for publication in February 2014. A manuscript presenting a reanalysis of mark-recapture data for Metolius River kokanee with a new likelihood model developed through the Project, and another summarizing results of the RRS study of reintroduced Hood River spring Chinook are being finalized, with submission for publication scheduled in early 2014.

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 2013, these activities included ones to: 1) use genetics analyses to derive productivity information and to assess RRS of supplemented Johnson Creek spring/summer Chinook (Project Objective #1), and of supplemented spring Chinook that were reintroduced in the Hood River, Newsome Creek and Lookingglass Creek (Project Objective #2); 2) to assess relative spawning success of reintroduced sockeye salmon in the Lake Billy Chinook and Suttle Lake/Deschutes and Metolius River system and the Cle Elum Lake/Yakima River system (Project Objective #3); and, 3) 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), Additional project activities involved support for personnel training, for participation in regional forums involving review of hatchery management and supplementation efforts, and for project reporting (Project Objectives #4, #5 and #7, respectively).

III. Work Elements / Tasks

A. Project Administration

Activities in 2013 involved with administration of the Project by CRITFC included: production and posting in PISCES of the annual progress report for contract year #4, completion of quarterly and final status reports in PISCES that record progress associated with each work element within the statement of work, and submission of monthly project expense summaries to BPA. Additional reports and associated documents summarizing results of activities described within the Project work elements were also posted under Attachments within 2009-009-00 Contract # 61294 in PISCES.

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

CRITFC collaborates 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) 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. The NPT commits $60,000 annually to cover costs for these analyses - sufficient for 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. To assure that adequate funds were available to meet these laboratory and data analysis expenses, the Project provided supplemental funding for the JCAPE RRS study beginning in 2010. As of the beginning of contract year #5 (May 1, 2013), funds from the Project were used to genotype approximately 3,900 adult and juvenile tissue samples.

Results from initial analyses, summarized in Hess et al. (2012) indicated that supplementation did indeed provide a demographic boost to the depressed spring/summer Chinook salmon 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.

A RRS study, based on juvenile-recruits-per-spawner, for four consecutive broodyears (2009 to 2012) will be possible following sampling of the BY 2012 age 1+ out-migrants in spring 2014. The enhanced rate of juvenile sampling requested by CRITFC will provide sufficient statistical power to perform RRS analyses for origin within sex/age category separately, and to simultaneously test for effects of 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; Mullan 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. Reintroduction efforts involved stocking of juveniles produced from out-of-basin hatchery stocks, based on the presumption that the stocks retained 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 engaged in natural spawning, and increasing numbers of NO juveniles (fry, parr and smolts) have been observed. 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; Yakama Nation 2011; Yakama Nation Fisheries Resource Management 2012).

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, some of which would be incorporated into the hatchery broodstock. With this broodstock management approach and 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 is being 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 natural 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, 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 switched 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 indication for each fish that is 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 HFCES 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, and parentage and statistical analyses were completed in 2013. Results indicate that the reintroduced stock of spring Chinook is establishing a natural population, and that as hypothesized, 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 derived from 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 may be either of 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 populations within the lower Columbia lineage 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, undoubtedly the result of interbreeding between stocks. Nonetheless, the genetic signature for most fish remains strongly of one lineage or the other. The extent to which this is due to continued straying of lower Columbia fish into the Hood River, and/or

to assortative mating between stocks is unknown. The proportion of lower Columbia lineage fish in the escapement is low relative to the reintroduced stock, most likely due to the magnitude of supplementation with the HO Deschutes fish. However, the data indicates that they demonstrate significantly higher productivity than the NO fish of the reintroduced stock. These results are currently being summarized in a manuscript that will be submitted for publication in early 2014.

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. In response, a hatchery was constructed at rkm 3 along Lookingglass Creek (a tributary to the Grande Ronde at rkm 136) as part of the Lower Snake River Compensation Plan (LSRCP), to produce fish with which to supplement tributary populations within the 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 for this purpose - Carson NFH, Wind River, and Imnaha River stocks – before settling on 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. 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 were 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 HFCES for genotyping, as have all adult and juvenile samples collected each year since. As of the end of 2013, 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. In spring 2014, samples from BY 2012 age 1+ NO out-migrants will have been collected, completing sampling for 6 consecutive broodyears (2007-2012). Genotypes for these samples will be subjected to a RRS analysis based on juvenile recruits-per-spawner in 2014. Results will be summarized in a manuscript to be submitted for publication in a scientific journal.

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 established. 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 Anadromous Fish Hatchery. In the early 2000s, management of the program was taken over by the NPT and juvenile production was shifted to the Nez Perce Tribal Hatchery, from which 75,000 age 1+ smolts were planned for stocking into Newsome Creek each year (Bradley et al. 2009). The program also involved collection of returning adults at a weir in Newsome Creek for use

as broodstock. However, returns have been low, and as of 2011 broodstock collected ceased – from that time 100% of returning adults were passed upstream for natural spawning (Sherman Sprague, personal communication).

As part of the monitoring component to the Newsome Creek reintroduction/supplementation program, the NPT collected tissue samples from all returning adults and from a sample of 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 were sent to CRITFC geneticists at HFCES, and the NPT was able to provide a limited amount of funding to cover costs for genotyping and data analyses. However, these funds were insufficient for analysis of all samples, and in addition, CRITFC advised that a higher sampling rate of juveniles would be desirable. To assure full funding of the study, an agreement was reached with the NPT during contract year #2 (2011), for the Project to take over responsibility for supporting the laboratory work.

Returns to the Newsome Creek weir have remained low, especially for natural origin adults, and too low to affect a reliable RRS analysis based on adult recruits-per-spawner. On the other hand, the increased sampling of juveniles requested by CRITFC permitted conducting a RRS analysis based on juvenile recruits-per-spawner for broodyears 2010 and 2011. As hypothesized, the natural origin adults produced on average a greater number of juvenile out-migrants - RRS (NO/HO) > 1.0 (Matala and Narum 2012). However, the hatchery origin adults were not strictly of Newsome Creek stock; they were progeny of a generalized Clearwater River stock maintained at the Nez Tribal Hatchery well downstream on the Clearwater River. The suggestion from the RRS results that the natural origin fish are demonstrating improving productivity and readaptating to the local environment is therefore somewhat confounded by the hatchery fish not having been derived from Newsome Creek adults.

From initiation of the project through 2011, samples have been genotyped for a standardized set of microsatellite DNA markers. In recent years, however, SNP DNA markers have replaced microsatellite markers as "the marker of choice" at HFCES for these types of studies. Analysis with SNPs is generally less expensive, can provide genotypes from DNA of poorer quality, and genotypes are more consistently reproducible between laboratories. Therefore, the decision was made to switch the Newsome Creek analyses to SNP markers. This will necessitate reanalysis of the samples of adults passed upstream of the weir from 2008 to 2011 (n=366) – potential parents for natural origin adults returning to the Newsome Creek weir beginning in 2012. In 2012, a total of 1,476 samples from adults and juveniles were collected. These samples and the 2008-2011 adult samples are scheduled for SNP genotyping in early 2014, after which a summary report will be provided to the NPT. We await delivery of the adult and juvenile samples collected in 2013, which will be processed and analyzed later in 2014.

C.4 RRS studies in other tribal reintroduction programs

Other tribal reintroduction programs have been examined to assess 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, coho salmon were also extirpated from the Clearwater basin following construction of Lewiston Dam (Everett et al. 2006). In 1995 the NPT initiated a reintroduction program in the Clearwater River, with annual stocking of coho smolts obtained from a lower Columbia River hatchery (Eagle Creek NFH, Estacada OR). While annual coho returns to Lower Granite Dam in the mid-1990s were (near) zero, average escapement over the past five years is now in excess of 3,400 fish (Fish Passage Center 2014; http://www.fpc.org, query: Adult Data - Annual Totals - Lower Granite Dam + Coho).

Among these adult returns there is now a growing proportion of NO fish. A RRS study of the reintroduced NO and HO coho would therefore be of interest, and such a study would be logistically feasible in Lapwai Creek. Natural spawning has already been observed in Lapwai Creek, and the NPT operate a weir at rkm 1 each year, at which all in-migrating adults could be interrogated and tissue sampled. Tissue sampling has already begun for adults captured at the weir for use as broodstock. These samples are collected as part of a regional parentage based tagging (PBT) project for anadromous salmonid hatchery programs in the Snake Basin, co-managed by IDFG, ODFW

and CRITFC. An agreement has been reached with the NPT to begin recording biodata and tissue sampling adults passed upstream of the Lapwai weir for natural spawning in 2014. The samples will then be sent to HFCES for use in a RRS study.

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, the funding allocation was subsequently put on an indefinite hold.

An additional RRS study of the upper Yakima River spring Chinook supplementation program (not a reintroduced population) has been proposed. Since 2001, the first year 4 year-old adults from the initial broodyear of supplementation releases, tissue samples have been collected and archived for all adults intercepted at Roza Dam on the upper Yakima River. Some preliminary analyses have been conducted by WDFW, using a suite of microsatellite DNA markers. However, adult returns to the upper Yakima have grown substantially, and funding has been inadequate for a full multi-broodyear RRS study. Additionally, a consensus has been reached that for financial and logistical reasons, it would be advisable to switch DNA marker type to SNP markers. The large number of samples that have been collected since 2001 will make a complete RRS analysis extremely expensive. At the same time, however, the large sample size would also provide high power to the analyses. Discussions are underway regarding a study design that initially would be limited to three consecutive broodyears (e.g., BY 2007-2009), and would be jointly financed by YKFP and CRITFC (Basinwide Supplementation Project). It is possible that an agreement will be reached such that the study could be included within the budget and statement of work for the next (2014-2015) Project contract year.

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 to see if it would work effectively as a route for juvenile out-migration of coho salmon smolts that had been released into 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, 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 Mid-Columbia stocks - Lake Wenatchee/Wenatchee River stock, and Osoyoos Lake/Okanogan River stock. Waters in the two lake/river systems have very different thermal regimes, and the two stocks exhibit variation in run and spawn timing and other life history characteristics. These differences could make fish from one stock more or less well adapted relative to the other stock, for reproduction and rearing within the Cle Elum system.

In each year of adult out-planting, spawning activity has been observed in the Cle Elum River during September and October. The spawning appears to be temporally and spatially bimodal. Spawning during the early pulse occurs to a greater extent in upstream areas in Cle Elum River and in the tributary Cooper River. A later pulse of spawning appears to occur predominantly in the downstream portion of the Cle Elum River and in near-shore

gravel in the upper reaches of the lake. 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) Does the bi-modal spawning activity of the out-planted adults in Cle Elum Lake correspond to the differences in spawn timing observed between Wenatchee and Okanogan stocks? 2) What is the relative natural productivity of the two stocks - measured as stock proportions among first generation smolts, and returning adults? 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?

Genetics analysis from prior genetics studies, and from SNP analyses conducted at HFCES, from indicate that the Wenatchee and Okanogan sockeye stocks display distinctly different genetic profiles (Winans et al. 1996; Campbell and Narum 2011; Waples et al. 2011; Matala, unpublished data). A high degree of stock-of-origin assignment accuracy can therefore expected in analyses of samples of adults out-planted into Cle Elum Lake, and in their progeny. An agreement with YN was finalized during contract year #3 (2011), to collaborate on a genetics study of the reintroduced Cle Elum sockeye salmon. Since that time, YN has collected tissue samples from a temporally stratified portion of the out-planted adults each year, from a sample of 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 the genetics analyses.

As of the end of 2013, a total of approximately 3,100 samples had been collected. Approximately half of these have already been genotyped, and the remaining half will be genotyped in early 2014. Genetics analyses performed to present indicate that the ratio of Okanogan to Wenatchee stock among the adults translocated to Cle Elum Lake was approximately 3:1. In contrast, preliminary analyses of out-migrating juveniles indicate them to be predominantly of the Wenatchee genotype. In 2014, additional analyses will includes samples of the adults that returned to Roza Dam in 2013 - the first 4 year old adult progeny of the initial group of adults out-planted in 2009. A report on these analyses will be available later in 2014.

D.2 Deschutes River sockeye salmon/kokanee

Suttle Lake is a nursery lake in the headwaters of the Metolius River, a tributary to the Deschutes River, and 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 River. Then in 1964, Round Butte Dam was constructed downstream of the Metolius on the Deschutes River at rkm 177, 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, these lakes were also both stocked repeatedly through the mid-1900s, with kokanee juveniles from multiple out-of-basin hatchery sources (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. It is presumed that some portion of juvenile *O. nerka* emanating from LBC and/or Suttle Lake retain the capacity to 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 out-migrating *O. nerka* smolts captured at the FTF have been passed

downstream annually. CTWSRO is leading the monitoring program of upper Deschutes *O. nerka* (kokanee and sockeye). 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? If differences are revealed, are they of local origin or indicative of alternative stocking histories?

In 2011, an agreement was reached with CTWSRO for the Project to perform an initial genetic stock analysis of fish from the two lakes. Tissue samples that had already been collected in 2009 and 2010 from pre-spawning LBC kokanee and from juveniles captured at the outlet of Suttle Lake. These samples were sent to HFCES for genotyping using a standardized panel of 96 SNP markers. Analyses 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, including temporally representative samples of: out-migrating juveniles collected at the FTF and passed downstream, in-migrating adults captured at the Pelton trap, adult kokanee sampled in Lake Billy Chinook just prior to their spawning run, spawning adults in Link Creek upstream of Suttle Lake, and out-migrating juveniles from Suttle Lake.

By the end of contract year #4 (April 30 2013), a total of approximately 2,700 samples have been genotyped. Since then an additional 333 samples were sent to HFCES, and are scheduled for processing in early 2014. Initial adult sockeye salmon returns have been very few in number. Among those that have been genotyped, most appear to be LBC stock, a couple might be Suttle Lake stock, and a couple more were no doubt Okanogan River strays.

A desired product of the genetics study would be an assessment of the relative propensity for anadromy between Lake Billy Chinook and Suttle Lake kokanee. However, significant passage constraints for Suttle Lake kokanee persist in the creek linking the lake to the Metolius River, such that the likelihood of juvenile out-migrants reaching the FTF is very low. Until higher out-migration success of Suttle Lake juveniles is achieved, and/or until a translocation program for juveniles from Suttle Lake to the Deschutes River below the Pelton-Round Butte complex is initiated, this assessment will not be possible.

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 1970s, a harvest augmentation program for coho was initiated in the Yakima River. In the 1990s, the YN took over control of the program and modified it to be a supplementation program with the objective of reestablishing a natural population within the river. During the same period, the YN initiated a similar reintroduction in the Mid-Columbia Wenatchee and Methow rivers, as did the Nez Perce Tribe in the Clearwater River. A harvest augmentation program was initiated in the 1970s in the Umatilla River, but has only recently been able to shift its focus towards reestablishing a naturally spawning population.

In 2005, CRITFC sponsored an inter-tribal meeting to facilitate exchange of information among tribal managers biologists and technicians, on methodologies and initial results from these reintroduction programs. Seven years have elapsed since this meeting, and each program has evolved substantially. In 2013 a second workshop was sponsored through the Project (July 8-10, Lewistion ID), to provide an opportunity for associated tribal personnel to update each other on progress and “lessons learned” relative to different management approaches. The workshop was attended by 25 biologists, technicians, and managers from CRITFC, NPT, CTUIR, CTWSRO, YN and BPA. Primary conclusions from the Workshop included:

1. Transition to production of juveniles using only in-basin broodstock is complete in the Yakima, Mid-Columbia and Clearwater programs – import of lower Columbia juveniles has ceased. Transition to use of in-basin broodstock in the Umatilla program is in progress.
2. Redds are being observed at increasing numbers and with increasing distribution, and a growing proportion of the escapement is of natural origin fish – suggestive of adaptation and establishment of nascent natural populations.
3. Alternative release strategies (adult out-planting, parr stocking, smolts stocking from small temporary facilities) are being investigated.
4. Terminal fisheries for coho were recently begun in the Yakima, Wenatchee and Clearwater rivers, though available fish are underexploited.
5. There is increasing abundance of coho available for harvest in Zone 6, however, fish are underexploited due to restrictions on steelhead harvest.

The workshop agenda and list of participants, copies of the presentations, and a workshop summary document are available at: http://www.critfc.org/fish-and-watersheds/fishery-science/critfc-science-workshops/inter-tribal-workshop-on-coho-reintroduction-and-production-programs-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 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.

With the objective of providing the field personnel a better understanding of basic genetic principles and of the practicalities of how the tissue samples are processed and the genotypic data analyzed at the HFCES, and improving understanding and communication between the tribal field personnel and the CRITFC geneticists, we developed a curriculum for a 2-day "Introduction to Molecular Genetics Analyses in Tribal Fisheries Management" training workshop. The program consists of a series of presentations ("lectures", videos, demonstrations) 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. Summary presentations of previous and ongoing studies conducted on tribal programs at HFCES are also included. These presentations are interspersed with "hands-on" exercises to provide familiarity with the actual laboratory techniques. Additionally, the entire HFCES staff is invited to attend a noontime presentation made each of the two days by one of the participants, that reviews a tribal project on which he/she works.

In 2013 (December 10-11) we conducted another of these workshops, the 6th since 2011. The workshop was attended by 9 tribal fisheries biologists and technicians - CTWSRO (2), CTUIR (4) and NPT (3). Lodging and per diem for each of the participant was financed through the Project. Copies of the program schedule and presentations are available at: http://www.critfc.org/fish-and-watersheds/fishery-science/hagerman-genetics-laboratory/genetics-training/, as well as a copy of "Genetic Guidelines for Fisheries Management" by Kapuscinski and Miller (Sea Grant MN), a paper copy of which was provided to each attendee for use as a reference document.

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

Project coordinator (Galbreath) and associated CRITFC geneticists at HFCES (Hess, Matala and Narum) participated in various inter-tribal and inter-agency meetings, workshops and symposia, in which Project-related issues were discussed – issues related to 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 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 the Inter-Tribal Fisheries Program Hatchery Strategy Meeting (Pendleton OR May7-8, 2013)
- Attendance at the annual Yakima Basin Science and Management Conference (June 12-13, 2013, Ellensburg WA), and presentation of "Genetic monitoring of sockeye salmon reintroduction in Lake Cle Elum: evaluating relative productivity among two donor stocks"
- Attendance at the public Research Meeting of the Oregon Hatchery Research Center (July 17, 2013, Alsea OR)
- Attendance at a tour of the Hells Canyon Complex sponsored by the Idaho Power Company, and discussion of relicensing issues including salmon reintroduction upstream of the complex (October 1-2, Boise ID)
- Attendance at the Upper Columbia Science Conference (November 13-14, 2013, Wenatchee WA)
- Attendance at the Northwest Fish Culture Conference (December 3-5, 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 2013 a Dual-Frequency Identification Sonar (DIDSON) was operated for a fifth consecutive summer (June 29 to October 3), to obtain an estimate of spring Chinook escapement following a similar methodology used in prior years (Galbreath et al. 2009, 2010, 2011, and 2012). 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 reading of these files for occurrence of upstream passage events should finish in early 2014. The number of upstream passage events will be summed to provide an estimate of total spring Chinook escapement. The data will then be compared to passage events past the viewing window in the fishway as observed in video recordings, for concordance of number of events and time of passage. The DIDSON count will then be multiplied by the ratio of spring Chinook among total counts (spring Chinook + steelhead) in the video recordings, to obtain a DIDSON-based estimate of spring Chinook passage. The DIDSON and video spring Chinook escapement estimates will then be compared to an estimate based on the annual redd count (the sum of redds observed during three successive spawning ground surveys in August-September 2013, then multiplied by a 3 fish per redd expansion factor). Of note, however, in 2013 no redds were observed (Joseph Zendt, personal communication).

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

A manuscript entitled "Tribal reintroduction of extirpated coho salmon to the interior Columbia River basin" was submitted and approved for publication in Fisheries (American Fisheries Society). Publication is anticipated February 2014. The manuscript provides an overview of methodologies and results for tribal programs to reintroduce coho salmon into the Yakima, Wenatchee, Methow and Clearwater rivers.

As indicated in section 4.1, genotyping and analyses are complete for the RRS study of reintroduced Hood River spring Chinook. Finalization of the manuscript is underway, with submission for publication in the journal Evolutionary Applications anticipated in early 2014.

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 as part of the Project by CRITFC scientists in earlier contract years. The model was described in a publication by Hyun et al. (2012), and in 2013 was adapted to a web-based interface, to make a "user-friendly" version available to the public (http://www.critfc.org/fish-and-watersheds/fishery-science/data-resources-for-scientists/mrmix-2/). Development of the model was initially prompted by questions regarding analysis of the data from the 2007 mark-recapture study conducted to estimate abundance of Metolius River kokanee. These studies have been conducted annually since 2005. With the availability of the updated web-based model, data from past years' studies was reanalyzed, so as to obtain consistently derived estimates across years. The results are being summarized in a manuscript in collaboration with project co-managers (CTWSRO, ODFW and PGE), that will be submitted for publication in the North American Journal of Fisheries Management in Contract year in 2014.

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 method to estimate spawning escapement - annual redd counts. To provide a direct estimate of escapement, a DIDSON sonar has been deployed each summer since 2009. Resolution of the images in the DIDSON files provide no more than a rough estimate of fish size, however, assuming that all images of medium to large "salmon-sized" fish migrating upstream out of the fishway involved spring Chinook, a direct count could be obtained. Results from the initial DIDSON studies consistently provided counts that exceeded by 2-3 fold, estimates based on redd counting. It was thought that the discrepancy between the two methodologies could have been due to a high rate of pre-spawn mortality, or with incompleteness in the spawning ground surveys and an underestimation of the number of existing redds.

In 2012, a new fish monitoring facility became functional at the Castile Falls fishway, that includes a viewing window and a video recording system. In this year, the video system and the DIDSON sonar were operated concurrently. The video images demonstrated that our DIDSON estimates suffer from two significant sources of error. First, the 2012 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 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. Presuming that this ratio is similar across years, the prior years' estimates for spring Chinook escapement were readjusted downward accordingly. This brought the estimates much closer in line with those based on expanded redd counts.

The DIDSON was deployed and operated one last time over the summer of 2013. Once file reading is complete, a similar comparison between passage events observed in the DIDSON and the video files will be conducted.

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 conducted in conjunction 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 indicate both primary JCAPE objectives are being achieved – supplementation has affected a demographic boost to the population, and it has done so with no apparent deleterious effect on natural productivity – productivity of successfully spawning HO and NO fish was generally similar.

Tissues collected in 2014 for this program will complete the four broodyears of enhanced juvenile sampling that was requested by CRITFC. RRS analyses for these broodyears will be conducted based on juvenile recruits-per-spawner estimates from the parentage analyses. The large sample size for juvenile progeny will substantially increase the power of the RRS analyses to assess differences between origin, relative to analyses based on adult recruits-per-spawner. Later, when analyses for adults returns for these brood years are complete they will be tested for concordance with the juvenile recruits-per-spawner results.

Discussion is underway to initiate a similar RRS study of the supplemented upper Yakima River spring Chinook salmon. Adult returns to the upper Yakima River are several fold greater than for Johnson Creek, and costs for the analyses will be proportionately greater. However, the high sample number should also substantially increase the relative power of the analyses to detect differences in productivity, and associated effects of sex, size/age and run-timing within origins.

The Project also supports RRS studies of three reintroduced populations, involving spring(/summer) Chinook salmon in the Hood River, Newsome Creek and Lookingglass Creek (Project Objective #2). Additionally, a study reintroduced coho salmon in Lapwai Creek (Clearwater River) has been proposed, and should begin in 2014. Reintroduction programs are typically initiated with out-of-basin hatchery stocks which are anticipated to initially exhibit relatively low natural productivity. However, it is hypothesized that these stocks retain 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. Therefore, RRS analyses in these studies are calculated in an inverse manner to that for studies of supplemented native populations. Adaptation would be suggested by RRS ratios for NO/HO 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 complete and results are currently being summarized in a manuscript, with submission to Ecological Applications planned in early 2014. Results indicate that, as hypothesized, natural origin fish of the reintroduced stock (an interior Columbia River lineage) exhibited greater productivity than first generation hatchery origin fish. Interestingly, the genetic analyses also indicated the unexpected presence of fish from a second stock of spring Chinook, that are from 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 demonstrated greater productivity than natural origin fish of the interior stock.

Results for the genetics study of the reintroduced Newsome Creek Chinook have been summarized in interim technical reports. This population is small, and the numbers insufficient to assess differences in adult-to-adult

productivity of hatchery and natural origin fish with any certainty. However, analyses for the initial two years since sampling of juvenile out-migrants was increased (2009 and 2010) did show the hypothesized greater productivity of natural origin fish - RRS (NO/HO) > 1.0. Analyses for spring Chinook in Lookingglass Creek are ongoing. A RRS analysis based on juvenile recruits-per-spawner for the broodyears 2008 to 2012 is planned in 2014.

The Project is supporting genetics studies associated with two other reintroduction projects, both involving sockeye salmon (Project Objective #3). One study is of sockeye salmon that are being reintroduced to Cle Elum Lake, through out-planting of adults collected at Preist Rapids Dam. These adults are a mix of approximately ¾ Okanogan River and ¼ Wenatchee River stock. However, initial analyses of out-migrating juveniles indicates them to be predominantly the progeny of the less numerous Wenatchee River stock adults. Of interest, analyses to be conducted in 2014 will include adult progeny from the initial 2009 out-planting. Sampling and analysis will continue for at least 3 additional years thereafter.

The second study involves a CTWSRO/ODFW/PGE project to create a sockeye run in the Deschutes River, facilitated by reestablishment of downstream passage of kokanee juveniles from Lake Billy Chinook, plus other juveniles that may have migrated downstream from Suttle Lake in the Metolius River basin. Initial genetics analyses indicates that the Lake Billy Chinook and the Suttle Lake stocks are each a composite of multiple source populations. However, the two stocks do exhibit retain some level of differentiability. Initial sockeye salmon returns from the kokanee juvenile out-migrants have been very few in number. Additionally, significant passage constraints persist in the creek linking Suttle Lake to the Metolius River. Sampling will continue over the coming years, although a comparison of the relative propensity for anadromy between the stocks in the two lakes will not be possible until higher out-migration success of Suttle Lake juveniles is established, and/or until a translocation program for juveniles from Suttle Lake to the Deschutes River below the Pelton-Round Butte complex is initiated.

In 2013, an Inter-Tribal Coho Salmon Reintroduction Workshop was sponsored by the Project, as was an additional Introduction to Molecular Genetics in Tribal Fisheries Management workshop (Project Objectives). The Project supported participation by CRITFC personnel at various regional forums for review of hatchery effects on natural populations (Project Objective #5). Three manuscripts are at different stages of preparation in anticipation of submission for publication in peer-reviewed scientific journals (Project Objective #7). Together these efforts are helping to advance our understanding of how hatchery rearing may affect productivity characteristics of salmon, and to assess how supplementation and reintroduction/supplementation programs may affect VSP parameters of associated natural populations.

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