

2011 Monitoring and Evaluation Work by WDFW - Lower Snake River Compensation Plan Hatchery Program

Category 1. Fish Culture and Production Activities

Project 1a – Production Monitoring

Objective 1a.1. Monitor and evaluate the quality and release of hatchery spring and fall Chinook salmon and summer steelhead produced at LFC.

Approach: Evaluation staff will analyze marking data and releases of juvenile salmon and steelhead to determine survival rates between life stages and examine potential variables that may influence observed survivals (fish quality as defined by hatchery production and IHOT criteria: for example size at release is close to program goal, CV, % precocious males, K-factor, incidence of disease, etc.). To document the percent precocious male fish in all release groups, visual sampling of spring and fall Chinook salmon and steelhead juveniles will occur.

Spring Chinook – Two different size groups of fish (30 g and 50 g) were marked and released from Curl Lake Acclimation Pond and quality of fish from both groups was evaluated (2010 Annual Spring Chinook Report - page 25).

Fall Chinook – Quality control checks and estimated numbers of fish released with each mark type were completed for all fish released by WDFW. We visually examined all groups for precocity at release. None of the fish examined exhibited signs of precocity in either the subyearling or yearlings released by WDFW. Size at release was calculated and releases were close to program goals of 10 fpp for yearlings and 50 fpp for subyearlings. For specific data, see the attached spreadsheet.

Steelhead – Quality control checks and estimated numbers of fish released for all summer steelhead released by WDFW in 2011 were completed. We visually examined all groups for precocity at release: precocity rates were about normal for all groups. Size at release was calculated for each release group and all groups were close to program goals of 4.5 fpp. For specific data, see the attached spreadsheet.

Objective 1a.2. Assist in the planning, spawning, record keeping, and summarizing of data for spawned spring and fall Chinook salmon and summer steelhead at LFC.

Approach: WDFW evaluation staff annually assists in the spawning operations of spring and fall Chinook salmon and summer steelhead at LFC. The role of the evaluation staff has been and will be to collect the biological data (date of spawning, sex, length, scales, marks/tags, extraction and decoding of CWTs, DNA and scale sampling, fecundity estimation, etc.) from all fish retained/spawned for broodstock from each of the species. In addition, evaluation staff has worked closely

with the hatchery staff to provide weekly/monthly/yearly summaries of the data for hatchery reports and ESA compliance.

Spring Chinook – Biological data were collected during spring Chinook spawning, summarized and the information was reported throughout the 2010 Annual Spring Chinook Report. Monthly reports were provided to the co-managers to maintain communication and inform management decisions.

Fall Chinook – Staff assisted with spawning activities, entered appropriate data, proofed the data and summarized the data for hatchery reporting purposes as well as co-manager needs.

Steelhead – Staff assisted with all steelhead spawning activities, entered appropriate data, proofed the data and summarized the data for hatchery reporting purposes as well as co-manager needs.

Objective 1a.3. Operate adult traps on the Touchet and Tucannon rivers for steelhead broodstocks.

Approach: WDFW evaluation staff will operate the adult fish trap on the Touchet River for endemic broodstock development for the LFC summer steelhead program. In the past, evaluation staff has taken the lead on operation and evaluation of adult trapping for the endemic broodstocks in the Tucannon and Touchet rivers. This remains the same in the Touchet River, but with the expansion of the Tucannon River endemic stock program, broodstock collection will take place at Tucannon FH and be overseen by hatchery staff. Evaluation staff will coordinate with TFH staff on broodstock collection protocols. Evaluation staff will be responsible for daily record keeping of all species captured, passed, or hauled for broodstock, along with any biological samples collected at the Touchet Adult trap in Dayton. Tucannon FH staff will do the same for the Tucannon FH. These adult traps are also used for estimating adult returns (Category 2).

Steelhead – Staff operated the Touchet Adult Trap nearly every day during the contract period, collected and transported Touchet River steelhead broodstock for the hatchery, entered and checked data on all species captured and supplied bi-weekly updates to fish management staff and other interested parties. Trap and fish ladder maintenance were dealt with accordingly. All biological samples collected were processed.

Project 1c – Optimum Production Strategies

Objective 1c.1. Maintain, and evaluate changes in, the phenotypic and genotypic characteristics of salmon and steelhead stocks used at LFC.

Approach: WDFW uses an assortment of endemic and non-endemic stocks of salmon and steelhead for production at LFC. WDFW, Tribal co-managers and NMFS desire to maintain the integrity of the salmon stocks for use in the program and to minimize the potential negative effects of hatchery operations on ESA listed populations. Likewise, recent efforts to develop endemic steelhead broodstocks on the Touchet and Tucannon rivers have similar goals of protecting the health of natural populations while using Lyons Ferry and Wallowa stocks for harvest mitigation production. To achieve these goals of production, broodstock genetic integrity and population genetic integrity and health, requires WDFW to manage their broodstocks carefully and monitor and evaluate the genetic health of hatchery and wild populations.

Broodstock Management

Sub-Objective 1c.1.1: Determine the origin and stock of fall Chinook salmon used as broodstock at LFC.

Result – CWTs were decoded and strays were not used in broodstock. Untagged fish had scales removed and examined to determine ages of fish used as broodstock. Broodstock was scanned for PIT tags and their origins documented.

Sub-Objective 1c.1.2: Document changes in the phenotypic characteristics of salmon and steelhead stocks used at LFC.

Spring Chinook – For spring Chinook we have documented some differences in phenotypic characteristics (e.g., fecundity, egg size, age at maturity) of hatchery and natural origin fish, however genetic traits and run and spawn timing have changed little over the program's history (2010 Annual Spring Chinook Report – pages 11-19).

Fall Chinook – Salmon were measured and fork lengths were documented, fecundity by age was determined, age structure from CWT and scale reading and sex ratio of fish trapped at Lower Granite Dam were documented.

Steelhead – All steelhead broodstocks were measured (fork length) and scales were collected from natural-origin broodstock from the Touchet and Tucannon stocks (scales were also collected from natural-origin steelhead captured in the adult traps on the Tucannon and Touchet rivers). Fecundity by age was determined for all groups, and age structure from CWT and scale reading and sex ratio of fish trapped/collected for broodstocks were documented.

Genetics Monitoring and Evaluation

Sub-Objective 1c.1.3: Determine the genotypic character of natural and hatchery spring and fall Chinook in the Tucannon River.

Approach: We will collect and archive tissue samples from broodstock and in-river spawners for future genetic analysis if warranted. Carcasses sampled during spring or fall spawning ground surveys provide the genetic (DNA) data to define stock characteristics, monitor possible introgression of hatchery stock genes into these populations, and evaluate our success at maintaining stock integrity.

Some tasks for 2010 include collection of appropriate samples for future analysis.

Spring Chinook – We compared genetic samples from before the hatchery supplementation program began with samples after the hatchery supplementation and captive brood program were in place. We found that the genetic diversity of spring Chinook in the Tucannon River has not significantly changed as a result of the supplementation or captive brood programs (Kassler and Dean 2010). We continue to collect and archive tissue samples for future analyses.

Fall Chinook – Tissue for DNA was collected and archived from carcasses sampled in the Tucannon River during fall Chinook spawning ground surveys.

Sub-Objective 1c.1.4: Collect tissue samples for future genotypic characterization of natural and hatchery fall Chinook salmon in the Snake River.

Approach: In 2010, we will collect and archive tissue samples by sub-sampling untagged fish to profile the origins of contributors to our broodstock. We will also continue to archive tissue samples randomly collected from LFH fall Chinook broodstock for future genetic comparisons.

Result – Tissue for DNA was collected and archived from a sample of hatchery and probable natural origin broodstock used at LFH.

Objective 1c.2. Evaluate hatchery release strategies (downstream survival rates).

Sub-objective 1c.2.1: Conduct a size at release experiment with Tucannon River Spring Chinook.

Approach: We will compare differences in survival and size and age at return between smolts reared to 9 fpp and the current release goal of 15 fpp for the 2006-2010 brood years. All fish in the two groups of approximately 65,000 fish will receive a CWT and a VIE tag, which will be used to analyze survival to adult returns (SARs), and size and age of returns between treatments. Each of the groups will also be tagged with equal size groups of PIT tags (utilizing 12,500 from LSRCP and 12,500 from BPA) before release to compare smolt-to-smolt survival within the system (Tucannon River PIT tag array), and detections of PIT tags for the groups will be analyzed using the SURPH model to calculate relative survival through the Federal Columbia River Power System (FCRPS).

Result – Evaluation of the release strategies is on-going. Fish in the two study groups were tagged and released as planned. The preliminary results to date are found in the 2010 annual report (pages 40-41). Adult returns are incomplete and one additional release year (the 2010 BY) will be released during the spring of 2012 to complete the study.

Sub-objective 1c.2.2: Evaluate fall Chinook release strategies, release sites, and smolt out-migration timing from LFH releases to downstream collection sites.

Approach: Acclimation facilities are located throughout the Snake River basin to promote homing of fall Chinook to their historical spawning grounds. Our evaluations will be performed on sub-yearling fish released directly from LFH, into the Snake River near Captain John Rapids, and into the Grande Ronde River (Table 1), and yearling fish released from LFH. Calculated SARs for the releases will be used to compare and contrast performance, and will be the primary metric for determining relative success of subyearling and yearling releases.

Table 1. Proposed marking/tagging of fall Chinook salmon released by WDFW in 2011.

Location	Life Stage	Total Number		Marks	PIT tags
		Released	Marked Release		
Lyons Ferry Hatchery	Yearling	225,000	225,000	AD/CWT	15,000
Lyons Ferry Hatchery	Yearling	225,000	225,000	CWT	15,000
Snake River near Couse Creek (direct release)	Sub-yearling	200,000	200,000	AD/CWT	

Grande Ronde River	Sub-yearling	400,000	200,000	AD/CWT	
				Total	30,000

a. Proposed tagging for 2009 subject to US v OR review and approval

Result – Completion of this task has been put on hold due to having to rework run reconstruction estimates which will change estimated numbers of returning wire tagged fish to the basin. Preliminary findings indicate that subyearlings released into the Grande Ronde River did not perform as well as subyearlings released at Couse Creek near Captain John Rapids or subyearlings released onstation at LFH. Releases of fish at LFH had the best performance and yearling releases out-performed the subyearling releases.

Sub-objective 1c.2.3: Evaluate and monitor summer steelhead (LFH, Wallowa, and Endemic stock) release strategies, release sites, smolt out-migration timing and relative survivals from LFC releases.

Approach: All LFH and Wallowa stock fish will be 100% AD-clip production marked for harvest purposes. In addition, a portion of the LFH and Wallowa stocks will be CWT and LV clipped for continued mitigation program contribution. Both endemic stocks will be coded wire tagged for identification upon adult return should they be recovered post-spawning at area traps (dead kelts) or from spawning ground surveys. Currently, endemic stocks are not marked for sport harvest. For both endemic stocks, PIT tags will be used to monitor relative out-migration timing and performance, but the primary purpose will be for determining smolt-to-adult returns rates. In addition, PIT tag groups have been added to all tributary release groups of Lyons Ferry or Wallowa stocks in the Snake, Walla Walla, Touchet, and Grande Ronde rivers. Many of these have been added since we will no longer conduct creel surveys on the Tucannon, Walla Walla or Touchet rivers and will rely on historical CWT data and catch record card estimates to determine contribution from LSRCP fish to these locations (See objective 2.3a). The listed PIT tagging rates are designed to return 25-60 adults for each brood year (over 1-2 years), and should provide reliable estimates of total survival that can be used with CWT harvest records and adult trap recoveries to estimate total contribution from each release location. Table 2 lists proposed marks/tags for the 2011 release year.

It has been a challenge each year to rear Touchet endemic stock fish to a 1-year smolt at 4.5 fish/lb, with many fish being release much smaller than the goal. Beginning in January 2009, a two-year study was initiated at Lyons Ferry to compare survival of 1-year and 2-year smolts from the Touchet River endemic stock program. Fish were hand sorted during coded-wire tagging, with approximately 6,000 fish removed from the population to begin their 2-year smolt-rearing program. An additional 5,000 PIT tags are requested to evaluate the post-releases survival of these 2-year smolts. Tagging in 2011 will be the 2nd year of the two-year smolt program.

In addition, the hatchery staff has recently proposed changes to the timing of when marking/tagging has typically occurred at Lyons Ferry. These proposed changes are the result of available automatic marking trailers, and hatchery staff trying to reduce fish handling. In the past groups were held in raceways for about four months. Tag groups may not adequately represent the fish that were reared in the lake full term. Estimated adult returns and calculated SAR rates will be used to compare group performance.

Table 2. Proposed marking/tagging of summer steelhead from LFH Complex in 2010/11. (All fish released of LFH or Wallowa stocks of origin receive adipose (AD) fin clips.)

Stock	Release Location	Total Number Released	Marks released (Number)	Tagged (PIT)
LFH	On Station	160,000	LV/CWT (20,000)	4,000
LFH	Touchet R. @ Dayton AP	85,000	LV/CWT (20,000)	4,000
LFH	Walla Walla R.	100,000	LV/CWT (20,000)	4,000
Wallowa 1	Grande Ronde R. @ Cottonwood AP	160,000	LV/CWT (20,000)	4,000 + 2000
Tucannon	Upper Tucannon R.	50,000	CWT (50,000)	10,000
Touchet	NF Touchet R. (1-year smolt)	40,000	CWT (40,000)	5,000
Touchet 2	NF Touchet R. (2-year smolt)	6,000	CWT (6,000)	5,000
			Total	36,000

¹ An additional 2,000 tags will be added the Cottonwood AP release. These PIT Tags will be provided by the Fish Passage Center as part of the Comparative Survival Study (CSS) for steelhead above Lower Granite Dam.

² These fish were CWT in January of 2010 when they were split out from the 1-year smolts that were released in 2010.

Result – Marking and tagging of all steelhead groups was completed as planned. CWT recovery efforts continue in fisheries and at hatchery traps which allows for estimating adult returns. The use of PIT tags to estimate adult returns has also been successful for several groups, and provides a way to account for fish that are not taken in fisheries or recovered at hatchery racks. Additional analysis needs to occur, but preliminary findings suggest 20-30% of the fish are not accounted for by CWT recoveries.

Completed rearing and releases of the Touchet 2-year smolt program. Two-year smolts were PIT tagged as needed prior to release. Adult returns in 2011 are only for 1-salt fish (incomplete) and will be monitored for future returns and analysis.

Category 2. Estimating Adult Returns

Project 2a – Catch Accounting

Sub-Project 2a.1: Marking and Tagging

Objective 2a.1.1: Coordinate marking/tagging needs with hatchery and fish management staff.

Approach: The LFC has three species programs (spring and fall Chinook salmon and summer steelhead) for mitigation within the Snake River Basin. Each has a specified mitigation goal under the LSRCP program. WDFW considers it essential that the programs evaluate success in meeting their goals, or take appropriate actions based on adult returns to modify programs so that they are successful. As such, evaluation, fish management, and hatchery staffs (along with US v. OR technical input) work closely in developing yearly marking programs that will satisfy most needs and be adequate in size to document 1) smolt-to-adult survivals, 2) harvest in ocean fisheries, and mainstem Columbia commercial, recreational and tribal fisheries, and 3) recreational fisheries in the project area.

Spring Chinook – A total of 231,437 spring Chinook were marked and released (2010 Annual Spring Chinook Report – page 25). We are currently examining size at release in an attempt to improve smolt to adult survival of hatchery fish.

Fall Chinook – Releases include 463,729 yearlings released on-station at LFH (49% were ADCWT and 51% were CWT only), 202,300 subyearlings released into the Snake River near Couse Creek (100% ADCWT), and 397,428 subyearlings released into the Grande Ronde River near Cougar Creek (51% were ADCWT and 49% were unmarked/untagged).

Steelhead – A total of 351,777 Lyons Ferry stock steelhead were released (Walla Walla River = 102,341, Touchet River @ Dayton AP = 84,623, and 164,813 into the Snake River @ Lyons Ferry) during April of 2011. A total of 197,839 Wallowa stock steelhead were released into the Grande Ronde River from Cottonwood Acclimation Pond during April 2011. A total of 77,683 Tucannon endemic hatchery stock steelhead were released into the Tucannon River in April and early May 2011. A total of 62,037 (1-year smolts) and 6,439 (2-year smolts) Touchet River endemic hatchery stock steelhead were released into the Touchet River above the city of Dayton during the spring of 2011.

Sub-project 2a.2: CWT Laboratory:

Objective 2a.2.1: Recover and process CWTs recovered from hatchery sampling, creel surveys, adult trap sampling, and spawning ground surveys.

Approach: The Snake River Lab (SRL) LSRCP evaluation office is remote from the main CWT extraction and processing lab in Olympia, where the vast majority of tag reading occurs for the State of Washington. Many of our spawning protocols require real-time extraction and processing of CWTs to remove any stray fish that might be in the broodstock (spring and fall Chinook programs). As such, over the years the SRL has become self-reliant and efficient in CWT extraction and processing (5,000-6,000 CWTs annually). All CWTs processed are eventually shipped to Olympia, re-read, and the data are submitted by Olympia staff to the regional CWT database.

Spring Chinook – We recovered and read 243 spring Chinook CWTs and sent tags to Olympia for a confirmation reading. Recovered CWTs are summarized in the 2010 Annual Spring Chinook Report (pg 15).

Fall Chinook – We extracted 2,062 CWTs, read and entered the tag codes into data files. After the CWTs were re-read by staff in Olympia, corrections were made to our databases. Recovery data were provided to co-managers for run reconstruction estimates and forecasting needs.

Steelhead – From broodstock spawning and trapping activities: we recovered and read 272 CWTs during Lyons Ferry stock spawning, 44 CWTs from the Wallowa stock spawning, and recovered just a few endemic stock (Touchet or Tucannon) CWTs. All CWTs from broodstocks/traps were sent to Olympia for a confirmation reading. Recovered CWTs from broodstock/trapping activities will be summarized by stock origin and release location in the Annual Summer Steelhead Report.

Staff also recovered and read 373 CWTs from steelhead fisheries within the Snake River Basin during the 2010/2011 season. The 2010/2011 Creel season data is still being double

checked, so recovered CWTs have not been sent to Olympia for confirmation reading. We expect this task to be completed by summer 2012.

Sub-project 2a.3: Fishery Catch Estimation and Sampling:

Objective 2a.3.1: Conduct summer steelhead fishery sampling to recover CWTs, determine impacts of fisheries to wild stocks, and estimate contribution of LSRCP fish to the sport fishery for mitigation evaluation.

Approach: WDFW personnel have annually surveyed steelhead sport anglers within the LSRCP area of Washington [Snake River (in cooperation with IDFG), Columbia River, Walla Walla River, Touchet River, Tucannon River and the Lower Grande Ronde River (in cooperation with ODFW)].

Results – Staff recovered 373 CWTs from steelhead fisheries within the Snake River Basin during the 2010/2001 season. The 2010/2011 Creel season data is still being double checked. However, determination of impacts to wild stocks was completed with NOAA Fisheries through an FMEP Report submitted from Fish Management Staff. Estimates of contribution of LSRCP to the sport fishery have not been completed at this time as we have been preparing for the February 2012 LSRCP Steelhead Symposium. We expect this task to be completed by summer 2012.

Project 2b - Estimating Project Area Escapement

Objective 2b.1. Monitor, evaluate and/or conduct adult trapping/collection of spring and fall Chinook and summer steelhead for broodstock and run reconstruction (fall Chinook).

Approach: SRL staff will continue to monitor, conduct, and/or evaluate broodstock collection of spring and fall Chinook salmon and summer steelhead at adult traps that are currently funded under the LSRCP. Duties shared between LFH hatchery staff and the evaluation staff differ at each trapping facility. Sampling protocols are designed for each location according to site, personnel and ESA limitations to provide the greatest accuracy and precision possible for estimating escapement.

Spring Chinook – Adult trapping protocols were provided to hatchery staff for collection of spring Chinook broodstock. Data collected by Hatchery staff were compiled and used with spawning ground survey data to estimate the returning population of hatchery and wild fish (see 2b.2.1 below). Results are summarized in the 2010 Annual Spring Chinook Report (pages 18-19).

Fall Chinook – Staff assisted with trapping and spawning activities. Data were collected, entered, proofed, and distributed for use in preliminary run reconstruction estimates.

Steelhead – Adult trapping protocols were provided to hatchery staff for collection of summer steelhead broodstocks. Staff assisted with trapping and spawning activities as needed. Data were collected, entered, proofed, and distributed for use as needed.

Sub-objective 2b.1.2: Monitor, evaluate, and/or conduct adult trapping/collection of summer steelhead at LFC adult traps or at temporary traps on the Tucannon and Touchet rivers.

Results – Staff operated the Touchet Adult Trap nearly every day during the contract period, collected and transported Touchet River steelhead broodstock for the hatchery, entered and checked data on all species captured, and supplied bi-weekly updates to fish management staff and other interested parties. Due to program changes, the Tucannon FH staff is responsible for adult trapping on steelhead on the Tucannon River.

Sub-objective 2b.1.3: Monitor and evaluate adult trapping/collection of fall Chinook at LFH and Lower Granite Dam Adult traps.

Results – Trapping protocols were developed for staff at LGR Dam and LFH to assure broodstock and run reconstruction needs were met. Preliminary escapement has been estimated although it will not be finalized until after the run reconstruction estimates are reworked sometime after the summer of 2012.

Objective 2b.2. Estimate adult returns, collect life history characteristics, and document distribution of adult spring and fall Chinook salmon, and summer steelhead to southeast Washington streams and facilities.

Approach: Adult return goals were used to define the LSRCP program; therefore measuring adult returns to the point of release and to other intermediate areas is necessary to determine program success. WDFW monitors the returns of spring and fall Chinook salmon and summer steelhead throughout southeast Washington through adult trapping (Lower Tucannon River adult trap, TFH adult trap, LFH adult trap, Lower Granite Dam adult trap, Touchet River adult trap, and Cottonwood Creek adult trap), PIT tag detection arrays, and spawning ground and creel surveys. Sport harvest, and CWT expansions from surveys can be used to estimate the number of adults that would have returned to the project area. Trapped and/or spawned broodstock fish and carcasses provide data concerning origin, stray rates, sex ratios, and composition of each year's run. Detections of PIT tagged returning adults of all species occur throughout the Columbia basin at the mainstem dams, hatchery (LFH and Tucannon) and in-river trapping locations, and increasingly at detection arrays deployed in tributary rivers and creeks by WDFW and other management agencies.

Species-specific approaches to document straying.

Spring Chinook: WDFW adult trapping and broodstock collection activities are used to gather return data for representative CWT releases. These actions also will result in substantial data annually on stray fish from other watersheds entering the Tucannon River. Because Tucannon River Chinook and steelhead have been documented in Asotin Creek, limited carcass recovery surveys will be conducted there.

Fall Chinook: We will trap fall Chinook at LFH as well as LGR Dam to determine the return fidelity of fish to the hatchery, and to above LGR Dam where the majority of in-basin spawning occurs. We will also document straying of LFH origin fall Chinook to out-of-basin areas and interception in fisheries. Although not considered straying, recoveries of tagged fish from fisheries affects the overall return of fish to the spawning grounds, and potentially the success of our program. Straying of out-of-basin fish to points within our study area must also be addressed. Members from the US v OR Technical Advisory Committee (TAC) and our staff will cooperate to develop the run reconstruction at LGR Dam. The run reconstruction of fall Chinook at LGR Dam will be used to estimate LSRCP returns for evaluation and to monitor wild returns to meet ESA goals.

Steelhead: The assessment of summer steelhead straying is difficult due to the extended time that they spend in freshwater migrating to their final destination. While sport/commercial fisheries are useful in the overall assessment of returns, they may give a skewed view of straying depending on the time of year and location in which the harvest occurred. Steelhead are also periodically recovered in adult traps or from spawning ground surveys. In recent years, the number of PIT tagged steelhead of both hatchery and wild origin has increased dramatically. We will use recoveries of hatchery steelhead CWTs as reported to RMIS from fisheries (depending on time and location of recovery), adult fish traps, PIT tag antennas and spawning ground surveys to assess straying in summer steelhead (both within-program and out-of-program).

Sub-objective 2b.2.1: Estimate adult returns, collect life history characteristics, and document distribution of adult spring Chinook to the Tucannon River and Asotin Creek.

Results – An estimated 2,525 spring Chinook (1,444 natural origin, 1,081 hatchery origin) returned to the Tucannon River during 2010. On Asotin Creek we counted five spring Chinook redds and collected one carcass during spawning ground surveys (pages 22-23 in 2010 Annual Report).

Sub-objective 2b.2.2: Estimate adult returns, collect life history characteristics, and document distribution of adult fall Chinook to southeast Washington streams and facilities.

Results – Preliminary estimates of the numbers of fish returning from WDFW releases as well as the ages of the fish at return have been completed and provided to the co-managers. Final estimates will be made after the run reconstructions are revised once new protocols are agreed to by the co-managers.

Sub-objective 2b.2.3: Estimate adult returns, collect life history characteristics, and document distribution of adult summer steelhead to southeast Washington streams and to LSRCP facilities.

Results – Estimation of adult returns (by PIT Tags) for the 2010/2011 run year was completed and provided to managers as needed. Estimation of adult returns by CWTs for the 2010/2011 is incomplete at this time and will be completed once all CWT data have been submitted to the RMIS CWT database from all agencies. This may take up to two years to get complete data. Prior run year estimates for summer steelhead are currently being summarized for the LSRCP Steelhead Symposium. We expect returns through the 2009/2010 run year will be complete by the symposium.

Life history characteristics (from CWTs or scales) were collected where appropriate for hatchery or natural origin fish at traps and other recovery locations. Nearly all CWTs and scales collected from the 2010/2011 run have been processed.

Describing the return distribution of summer steelhead through PIT tag detections or CWT recoveries have not been completed for the 2010/2011 run year. Distribution of our different releases of steelhead will be partially described in the LSRCP tables that will be provided. However, a more in-depth analysis of distributions should occur in the future.

Sub-objective 2b.2.4. Assess the nature and extent of straying of LFC spring and fall Chinook salmon and summer steelhead.

Spring Chinook – Tucannon origin spring Chinook bypassing the Tucannon River and going above Lower Granite Dam has been a problem in past years but has declined in recent years going from 80% of PIT tagged fish from 1995-1999 down to 11% from 2005-2009 (2010 Annual report).

Fall Chinook – Fall Chinook have been documented at hatcheries and racks outside of the Snake River basin at a low rate (<1%). Straying of LFH released fall Chinook to LGR Dam and the Tucannon likely occurs at a greater rate because of trapping protocols in place. The trap at LFH is only used to divert fish to the hatchery that are need for broodstock and is only open intermittently. Since the trap at LFH is closed during most of the season fall Chinook are returning, they must go to alternative locations to spawn.

Steelhead – The assessment of summer steelhead straying is difficult due to the extended time that they spend in freshwater migrating to their final destination. While recoveries from sport/commercial fisheries are useful in the overall assessment of returns, they may give a skewed view of straying depending on the time of year and location in which the harvest occurred. Summer steelhead have been documented at hatcheries and racks outside of the Snake River basin at relatively low rates (<2%), but straying within the Snake River basin is more extensive. For example, we have documented about 50% of the steelhead that should return to the Tucannon River (hatchery or natural origin), stray past Lower Granite Dam and do not successfully return downstream. This behavior is likely driven by environmental factors (temperature) but is, we believe, being largely influenced by the Snake River Dams. As part of the LSRCF steelhead symposium, an initial look of this and other straying issues will be examined.

Project 2c- Smolt Production and Adult Survival

Objective 2c.1. Assess and quantify the juvenile out-migration of natural and hatchery-origin spring Chinook salmon, naturally reared fall Chinook salmon and coho, and naturally and hatchery-origin (endemic broodstock only) summer steelhead from the Tucannon River.

Approach: WDFW operates a juvenile migrant trap in the lower Tucannon River. Information about naturally produced spring and fall Chinook salmon, coho, and summer steelhead migrants obtained from this trap includes: 1) smolt out-migration timing, 2) duration, 3) magnitude, and 4) smolt age.

Spring Chinook – We estimate that 14,778 (95% C.I. 12,767-17,978) natural origin spring Chinook emigrated from the Tucannon River during the 2009/2010 smolt trapping period (2010 Annual Spring Chinook Report (pages 26-28)).

Fall Chinook – Smolts per redd were estimated based on smolt trapping estimates and numbers of redds above the trap. We expanded the estimate to include redds occurring below the trap and estimate a total of 24,627 natural origin fall Chinook emigrated from the Tucannon River during 2011 from the 2010 spawn.

Steelhead – We estimate that 15,348 (95% C.I. 13,428-17,891) natural origin summer steelhead emigrated from the Tucannon River during the 2009/2010 smolt trapping period. We estimate that 10,267 (95% C.I. 8,295-13,299) natural origin summer steelhead emigrated from the Tucannon River during the 2009/2010 smolt trapping period. Peak out-migration timing for natural and hatchery steelhead was 19 May. Age composition of natural origin smolts was 75% age 1, 22% age 2, 2.5% age 3, and 0.5% age 4 for the 2009/2010 migration.

Objective 2c.2. Estimate the nature, degree and variance of juvenile population sampling methodology bias; and calculate corrections for Tucannon River smolt trap estimates.

Approach: We reviewed releases of PIT tagged steelhead from the Tucannon River, and compared survival estimates from point of release to our smolt trap (based on smolt trap efficiency tests) and to Lower Monumental Dam on the Snake River (using the SURPH survival model). Results estimated on average a 30% survival to the smolt trap based on fin clip capture efficiency, but 70% survival to Lower Monumental Dam based on PIT tags. It has been suggested that the marked fish release location for efficiency tests may be too close to our trap, thereby overestimating efficiency, and underestimating smolt out-migration. Other factors (e.g. - trap avoidance by large size smolts, positive or negative bias in recapture probability from previously captured fish used for mark efficiency tests) could also be involved and may contribute to the differences observed.

Results – We had planned to use in-river PIT tag arrays to evaluate bias in our smolt trap estimates - however the arrays failed to detect known PIT tagged fish passing the array site. We are currently looking for a new method to evaluate bias in our smolt trap estimates.

Objective 2c.3. Estimate and compare smolt-to-adult and parent-to-progeny survival rates for LFC hatchery origin (WDFW released) and natural origin spring and fall Chinook salmon, and summer steelhead.

Approach: WDFW will use data from the smolt trap to determine natural smolt yield, and to determine smolt-to-adult (SAR) survival rates for naturally produced spring and fall Chinook salmon, and summer steelhead in the Tucannon River (see Objective 2c.1 above).

Spring Chinook – Smolt to adult survival rates averaged 1.62 (geometric mean = 0.82) for natural origin fish and 0.22 (geometric mean = 0.15) for hatchery origin fish (2010 Annual Spring Chinook Report - pages 30-37).

Fall Chinook – Estimates of natural smolt yield occurred yearly and adult progeny-to-parent survival estimates have been estimated for broodyears 1992-2005 and averaged 0.4 adult progeny/parent for naturally produced fall Chinook salmon in the Tucannon River. The 1993 broodyear was the only production group that replaced themselves (1.17 adult progeny to parent) during the time span evaluated (2009 Annual Fall Chinook Report-pages 31 and 93).

Steelhead – Through the use of PIT tags in both natural and hatchery smolt releases in the Tucannon River, we've determined the average smolt-to-adult survival from three different groups of summer steelhead (LFH hatchery stock, Endemic hatchery stock, Natural Stock) from comparable release years (2006-2010 migration years). Smolt-to-adult survivals

(average and geometric mean) to Bonneville Dam from the three groups were 1) LFH stock = 4.2%, 4.1%, 2) Endemic stock = 2.4%, 2.0%, and 3) Natural stock = 3.1%, 2.8%. Smolt-to-adult survivals (average and geometric) to Ice Harbor Dam from the three groups were 1) LFH stock = 3.1%, 3.0%, 2) Endemic stock = 1.6%, 1.4%, and 3) Natural stock = 2.2%, 1.8%.

Category 3. Legal Obligations

Project 3a – ESA compliance

Objective 3a.1. Assess LSRCP hatchery evaluation actions to determine potential effects on species listed under the Endangered Species Act; represent WDFW during formal ESA consultation between NMFS and the USFWS; coordinate and integrate Washington's anadromous fish management and research with the Section 7 LSRCP Biological Assessment, subsequent Biological Opinions and Management Plans, NMFS' Recovery Plan, and develop and submit Hatchery and Genetic Management Plans (HGMPs) for stocks produced at LFC.

Sub-objective 3a.1.1: Assess LSRCP hatchery evaluation actions to determine potential effects on species listed under the Endangered Species Act.

Actions or Results – Numbers of fish takes (indirect and direct) are within the limits listed in our HGMP (2010 Annual Spring Chinook Report). We assessed potential effects of the hatchery program on ESA listed spring Chinook and other listed species (both plant and animal) in the Tucannon River and provide a full description within the HGMP document.

Sub-objective 3a.1.2: Represent WDFW during formal ESA consultation between NMFS and the USFWS.

Actions or Results – The Tucannon River spring Chinook and Snake River Fall Chinook HGMPs were edited and submitted for consultation under Section 10 of the Endangered Species Act. HGMP's for summer steelhead programs in the Tucannon River (endemic stock program), Cottonwood Acclimation Pond on the Grande Ronde, and the on-station release of steelhead at Lyons Ferry were edited and submitted for consultation under either Section 10 or Section 7 of the Endangered Species Act. The HGMP for the Touchet endemic stock program was updated and submitted to NOAA Fisheries in the summer of 2010 – there was no status change in the program so it was not being formally consulted on. Per NOAA Fisheries request, WDFW provided a status update on the Lyons Ferry stock steelhead releases into the Walla Walla Basin (Walla Walla River and Dayton Acclimation Pond). This was in place of a formal HGMP submission, but was used for consultation of Section 7 programs in the mid-Columbia ESU.

Sub-objective 3a.1.3: Coordinate and integrate Washington's anadromous fish research with the Section 7 LSRCP Biological Assessment, subsequent Biological Opinions and Management Plans, HGMPs, and NMFS' Recovery Plans.

Actions or Results – Numbers of fish takes (indirect and direct) were within the limits listed in our steelhead HGMP's. We assessed potential effects of the hatchery program on ESA

listed summer steelhead and other listed species (both plant and animal) in the Touchet, Walla Walla, Grande Ronde, Snake and Tucannon rivers and provide a full description within each HGMP document.

Project 3b – Hatchery/Wild interactions

Objective 3b.1. Estimate relative reproductive success for hatchery and natural origin spring Chinook salmon.

Approach: Natural and hatchery origin adult spring Chinook salmon from Washington's LSRCF program are known to utilize overlapping spawning areas. It is currently unknown to what extent natural and hatchery origin fish interbreed, and what effects interbreeding of hatchery and wild fish, and natural production from hatchery x hatchery spawning (whether intended or defacto supplementation) may have on natural production.

Results – A cursory examination was made and the results were presented at the 2011 Annual American Fisheries Society Meeting in Seattle, WA. It did not appear that hatchery origin fish on the spawning grounds limited production. However, we did find that large numbers of fish on the spawning grounds (regardless of origin) did limit natural production suggesting density dependent effects had a greater influence than hatchery origin effects.

Objective 3b.2. Investigate effects of the LSRCF hatchery production program on non-target taxa of concern.

Approach: Beginning in 2007, evaluation staff began a retrospective review and analysis of existing data sets to examine possible negative effects of the hatchery spring Chinook and steelhead programs on the abundance and growth of the native bull trout, spring Chinook and Tucannon summer-run steelhead populations. Those analyses were completed in 2007 but no strong correlations were found. However, data limitations likely limited the sensitivity of those analyses to detect correlations. We will continue collection of data on species of concern that are encountered at our traps and during field sampling (species, relative abundance, presence/absence over time, and where applicable, lengths and weights of a sample of fish)

Results – We continue to collect information (length, scales, PIT tag information) on non-target taxa captured in rotary screw traps and at adult traps. These data are provided to managers through monthly reports and our annual report for them to assess the effects of our actions and the hatchery program on other species.

Objective 3b.3. Utilize reference streams within the Snake and Columbia basins to evaluate the effects of LSRCF hatchery production supplementation on ESA listed target mitigation populations.

Approach: We will use data sets from the Tucannon River, Touchet River, and Asotin Creek steelhead to compare and contrast metrics defined as part of the supplementation M&E program

developed through the CSMEP. Some of these metrics are: adult age structure, adult sex ratio, spawn timing, % hatchery fish in the spawning population, genetic indices (heterozygosity, hatchery genetic introgression, etc.), fecundity and change in fecundity over time, and smolt age structure. We expect to collaborate with other managers and utilize the data for the CSMEP effort to describe and evaluate the impacts of hatchery supplementation as developed in the study protocol. We intend to complete an analysis of potential reference streams for Tucannon spring Chinook and present the results.

Results – An analysis was completed for Tucannon spring Chinook in comparison to 12 other spring Chinook populations around the Columbia River Basin. The Wenaha River in Oregon and Camas and Loon Creeks in Idaho appeared to have the most potential to be reference streams for the Tucannon River spring Chinook population. Fall Chinook reference streams are still being researched. To date the Deschutes River, Oregon appears to be one of the indicator streams of fall Chinook that we can compare and contrast metrics with Snake River fall Chinook. Staff continues to search for additional fall Chinook reference streams. The Asotin Creek summer steelhead population has been identified as a reference stream for summer steelhead within the lower Snake River Basin, as it currently receives no hatchery supplementation. The Touchet River may also be another partial reference stream as limited supplementation (both from an endemic stock and non-endemic stock) is currently present.

Category 4. Electronic Database Systems

Upload PIT tag data to PTAGIS after PIT tagging, and tag recovery data from fish spawned at LFH or recovered at traps. Estimates of returns of hatchery and wild fish sampled on the project are provided to Washington's Salmonid Stock Inventory (SaSI) database, which functions to assess stock status. Coded wire tag recoveries and expansion estimates are provided to the Regional Mark Information System (RMIS) by WDFW Olympia staff, after SRL evaluation personnel finalize the data. No databases are directly funded by LSRCP, only the data are provided.

Results – Spring and fall Chinook salmon and summer steelhead PIT tag data were uploaded to the PIT tag regional data base and coded wire tags were submitted to RMIS.

Category 5. Peer Review, Biometric Review, Analysis and Reporting

Project 5a – Annual progress reports

Objective 5a.1. Complete annual reports to summarize results of all LSRCP funded work conducted during the FFY07-10 contract periods.

Spring Chinook – The 2010 spring Chinook annual report was completed and submitted to Lower Snake River Compensation Plan staff on time.

Fall Chinook – Have completed FFY07-08 annual reports, have the FFY09 report reviewed and nearly completed, and work is proceeding on populating the FFY10 data, which is currently on schedule for completion in March 2012.

Steelhead – Have completed a combined 2008/2009 and 2009/2010 run year annual report. Began work on the 2010/2011 run year report, but this has not been completed due to data preparation for the LSRCP Summer Steelhead Symposium in February 2012. Completion of the 2010/2011 and 2011/2012 run years (combined report) is expected to be complete by December 2012.

Project 5b – Peer reviewed publications

Results – no peer review articles were accepted or published during the contract period.

Category 6. Participation in External Forums

Not Anticipated for FFY2010.

Category 7. Regionally Significant Research

Objective 7a: Conduct and Evaluate the Tucannon River Spring Chinook Captive Broodstock Program.

Approach: WDFW utilized a captive broodstock program to provide a quick “boost” to the Tucannon River spring Chinook population due to low returns in the mid-90s. The final release of smolts occurred in 2008, but returns will continue to be assessed through the LSRCP M&E program until the last captive brood progeny return in 2011. The program was primarily funded by BPA but the LSRCP program provides additional support through its ongoing M&E and hatchery O&M programs. Captive broodstock programs are experimental and the information gathered from this program will be shared with other interested parties in the Snake River Basin that conduct, or are considering conducting, captive broodstock programs for recovery of ESA-listed populations.

Results – The final progeny returned in 2011. A final analysis will be completed and submitted for publication as time permits.

Category 8. Data Gaps

Ongoing monitoring and evaluations conducted within the LSRCP generate questions that may not be answered as part of the work through which they were identified. These questions, or data gaps, can have both a direct and indirect relevancy to LSRCP programs. Some of these are identified and studied as part of regionally significant research (Category 7) where their applicability to LSRCP programs is inferential rather than directly applicable to its success. The remainder represents

studies that can and should be addressed as part of the LSRCP monitoring and evaluation program. Following are data gaps identified for future studies within Washington. A brief description of each unknown and its relevancy to the program is provided. Data gaps are not listed in priority order.

1. Unaccounted steelhead – steelhead are particularly difficult to enumerate because of their protracted pre-spawning migration period, the extensive nature of their distribution, their predilection to wander into far reaching streams where they may or may not eventually spawn, their long spawning season and difficult environmental and river conditions during spawning which makes surveys very difficult and accuracy questionable, and the difficulties associated with trying to effectively trap steelhead. A combination of expanded PIT tagging and adult trapping may be required to accurately account for hatchery origin fish returning to the Snake basin and then subsequently to their intended river.

Action or Result – WDFW has recently added PIT tags to all summer steelhead release groups, along with all groups being CWT'd. Preliminary data suggests that 20-30% of the summer steelhead accounted for by PIT tags, are not accounted for by CWT recoveries. WDFW will continue to mark/tag fish with both tag types and continue this evaluation into the future.

2. Stray steelhead – stray steelhead are really a subset of unaccounted fish. However their potential impact to ESA listed populations has been identified as a jeopardy issue for the LSRCP program. A LSRCP collaborative study to further define the problem fish will depend on ESA consultation with NMFS.

Action or Result – No specific action was taken during the contract year. Over the last year, WDFW has been compiling data for the LSRCP Summer Steelhead Symposium. A portion of this data set will can be used for examining the extent and magnitude of stray rates on hatchery steelhead from the LSRCP program. Further analysis will be required to fully understand the problem.

3. Relative reproductive success of LSRCP salmon and steelhead stocks – hatchery stocks used for direct supplementation (developed from endemic populations), and the affects of defacto supplementation of other hatchery stocks on ESA listed populations is not completely understood. LSRCP cooperators should engage where possible with regional actions to assess the productivity of hatchery and wild populations. Data mining from long term data sets, and/or changes to data collection protocols within the LSRCP program may be necessary.

Action or Result – We completed a cursory examination of hatchery effects on productivity for Tucannon River spring Chinook. We found that hatchery fish on the spawning grounds did not appear to lower productivity. However, large numbers of spawning fish (regardless of origin) did affect productivity, suggesting density dependent effects.

4. Hooking mortality – significant fisheries are currently in place for LSRCP spring Chinook salmon and steelhead in the Snake Basin. Harsh environmental conditions may negatively affect a fishes' recovery after being hooked and released. The delayed hooking mortality rates associated with fisheries in the Columbia basin east of the Cascades is currently not well understood. A study similar to one conducted by ODFW in the Willamette River

(Lindsay et al. 2004) should be conducted within the Snake River for steelhead, and the applicability Oregon's study results for Chinook examined.

Action or Result – No specific action was taken during the contract year. This has been identified as a priority for many years but lack of dedicated funding has not allowed any evaluation.

5. Evaluate the ecological status of LSRCP rivers in relation to the Mitigation goals – mitigation goals were established within the context of historical productivity and capacity. Those capacities may now be substantially more limiting than in the past because of a lack of marine derived nutrients and other ecological changes. These changes may prevent the LSRCP program from succeeding (e.g. high within tributary mortalities of smolts) if systems are not ecologically capable of supporting mitigation numbers of fish. An evaluation of this unknown and the potential actions to increase productivity (e.g. carcass analogs) and capacity, or to reduce the LSRCP goal, may be appropriate.

Action or Result – We have conducted stock-recruitment analysis (Ricker and Beverton-Holt models) of Tucannon River spring Chinook to examine carrying capacity of the Tucannon River. Recent large returns will prove beneficial in estimating the current carrying capacity.

6. Review current fishery sampling coverage and protocols and advocate for uniform electronic sampling protocols in the Columbia basin and NW coastal fisheries– a substantial proportion of the original LSRCP mitigation goal was designated to downriver and ocean fisheries. Certain fisheries downriver or in the ocean are known to not electronically sample fish that are not externally marked (i.e. fin clips). This lack of consistent sampling protocols among the agencies makes using the CWT database suspect, and greatly limits our ability to adequately monitor/assess the LSRCP salmon and steelhead program.

Action or Result – Inquiries made of other organizations regarding this topic seem to indicate that most downriver fisheries are currently 100% electronically sampled, however, some ocean fisheries are not. As a result of this find, WDFW continues to externally mark some groups of the fish so CWT tagged fish can be externally identified at recovery locations in the Columbia River system and elsewhere.

Recovery estimates for fall Chinook released by WDFW have been adjusted according to harvest sampling protocols [electronic vs. visual (2009 Annual Report- page 46)] resulting in 2,267 additional tagged and untagged fish being harvested in 2009 than could be estimated solely using unadjusted RMIS data. Double index tagging of yearling fall Chinook has allowed us to identify fisheries that are reporting sampling methods incorrectly as electronic when they are actually sampling visually.

7. Identifying untagged stray fall Chinook in the Snake River is becoming more complex. Development of a benign mark that would accurately identify Snake River hatchery fish has been a high priority within the LSRCP program. Thermal manipulation of salmon eggs at the eyed stage provides a distinctive otolith mark that is being used on Pacific salmon in the Northwest. If all of the Snake River basin hatchery fish were otolith marked, any untagged fish that did not have the same identifier would either be stray or wild. Wilds could be subtracted out based on scale data and the remaining numbers of fish could be assigned to

strays. The benefits of using this mark would be nearly 100% identification of in-basin fish resulting in a more accurate estimate of stock compensation of the run as well as broodstock. Pursuing a discussion of this marking technique should be a high priority for fall Chinook.

Action or Result – Thermal marking of hatchery fall Chinook released in the Snake River basin has been tabled. Profiling of broodstock (parental based tagging) used at NPTH occurred in 2010 and in 2011 broodstock used at LFH will occur.

8. Fall Chinook run reconstruction estimates the composition of returning adults and jacks primarily based on CWTs. Occasionally, large groups of juvenile hatchery fish are released as unassociated (not represented by a CWT). To estimate returns of these groups, SARs of fish released at similar times and from similar locations are used. However, run reconstruction is not able to assign all returning hatchery fish to a release location (In 2007 approximately 13.7% of the in-basin hatchery fish were unassignable to release locations). Possible reasons include incorrect SAR estimates used to estimate unassociated component, inaccurate pre-release quality control checks that do not sufficiently cover tag loss, or unaccounted post-release tag loss. To address pre-release tag loss, increased sample sizes and/or standardized waiting periods before quality control checks are needed to reduce error in tag loss estimates. To address post-release tag loss, an examination of CWT retention in PIT tagged release groups when they return as adults may provide accurate estimates of this loss.

Action or Result – Co-managers have agreed to begin DNA profiling parental broodstock (PBT) of fall Chinook released in the Snake River basin to allow identification of their untagged progeny upon return. The NPT has been profiling their broodstock for a couple of years and LFH will begin profiling broodstock collected in 2011. Quality control sampling of wire tagged juveniles released by WDFW occurs at LFH as well as Irrigon Hatchery by WDFW staff.

9. The use of PIT tags to expand our knowledge of fish behavior and survival within the Snake and Columbia Rivers has increased dramatically in recent years. There is sufficient information within the basin and in published literature to caution researchers about the potential decrease in survival (SAR) for PIT tagged fish. We believe PIT tagging will continue to play a significant role in hatchery and wild fish research. As such we also believe that a comprehensive study to assess the effect of a PIT tag on fish survival is needed. There exists within the LSRCP program sufficient facilities and use of multiple species for mitigation that would support the development and conduction of a comprehensive PIT tag survival study, and strongly suggest that the LSRCP cooperators work toward such a study.

Action or Result – No specific action was taken during the contract year. Limited raceway rearing space for unique groups of fish to test the effect of PIT tags on survival is available at Lyons Ferry Hatchery at this time. Discussions are ongoing with co-managers regarding this issue.

10. PIT tag loss from release locations where we don't have a release channel in which to deploy a detection array, or directly release tagged juveniles is not presently well estimated. We need to investigate methodologies using portable detectors, or ways to more completely account for PIT tags being released, to most accurately document juvenile survival and produce accurate estimates of adult returns for represented groups.

Action or Result – Discussions occurred about adding an array to the outlet pipe for subyearling fall Chinook released on-station at LFH. The decision was to not pursue an array because the masses of fish pumped through the pipe would not allow for individual detections of PIT tags.

11. Trapping at LFH shunts fall Chinook not needed back to the river. The yearling releases have been PIT tagged at a level that will allow us to estimate the numbers of yearlings trapped multiple times and returned to the river. Detection arrays in the Tucannon and upstream allow for more detections of those fish. The subyearlings are not PIT tagged so we cannot determine how many recaptures there are of that group of fish. Although the subyearlings return at a much lower rate than the yearlings, this is a piece of the return that cannot be accurately estimated.

Action or Result – The trap at LFH was not used systematically to estimate recapture events of PIT tagged fish. The trap was closed when broodstock were not being collected so estimates of recapture events could not occur. Subyearlings were not PIT tagged for the 2011 release but they are slated to be tagged for the 2012 release to address this data gap.