Chinook Sentinel Stock Projects 2009/10

The following is a descriptive list of the projects selected by the Sentinel Stock Committee and funded jointly by the Northern Boundary and Southern Boundary Restoration and Enhancement Funds in 2009.

CHINOOK SENTINEL STOCK PROGRAM YEAR 1

Burman River Chinook Salmon Total Escapement Estimation Project, Year 1

Project Lead: Roger Dunlop, Nuu-chah-nulth Tribal Council, Gold River, BC
Diana Dobson, DFO, Stock Assessment, Nanaimo, BC
Project Cost: $142,600 CAN $110,829 US

This project is intended to provide an accurate and precise estimate of escapement and sex/age/origin for Burman River Chinook. Previous efforts in the Burman River (Dunlop 2007, Taylor and Dunlop 2008, Dunlop 2009) attempted to validate the area-under-the-curve index (AUC index) method by comparison with mark re-sight estimates. Two problems were identified in those programs: 1) immediate removal of carcasses from the river by predators made it impossible to properly estimate tag loss, and more importantly; 2) without physically recapturing carcasses and live fish it is not possible to demonstrate the absence of sampling bias. SSC reviewers recommended changing the primary project method to a two event Petersen estimate. We intend to compare the results obtained from the Petersen estimate with the normative, DFO funded, area-under-the-curve index (AUC index).

The objectives of the project are to:
1. estimate the total escapement of age 3.0 and older Chinook salmon in the Burman River to the data standard (CV <15%, on average) using a two-event Petersen mark-recapture experiment.
2. estimate the proportions of age > 0.3 Chinook by age, sex, size and origin (hatchery & wild) with the a 95% probability of detecting a 5 % change in the largest component between years.
3. Compare the escapement estimate result to the DFO funded AUC index result.

Estimates of the 2009 Abundance and Composition of the Chinook Salmon (Oncorhynchus tschawytscha) Return to the Burman River on the West Coast of Vancouver Island. Final Report

Kaouk River Floating Weir to Enumerate Chinook Salmon Total Escapement, Year 1

Project Lead: Roger Dunlop, Nuu-chah-nulth Tribal Council, Gold River, BC
Diana Dobson, DFO, Stock Assessment, Nanaimo, BC
Project Cost: $321,800 CAN $250,103 US

This is a project to estimate Chinook salmon total escapement to the Kaouk River on the west coast of Vancouver Island (Area 26) using a weir modeled after the floating fence constructed on the Cowichan River. The weir count will be backed up with a Peterson mark-recapture estimate as a contingency in case the weir is topped by high flows.

The objectives of the project are:

1. to census the 2009 Chinook salmon escapement
2. to implement a mark-recapture estimate of the total escapement of age 3.0 and older Chinook salmon in the Kaouk River such that the precision of the annual total escapement estimate is consistent (defensibly accurate) and lies within the coefficient of variation of <15% data standard, on average (as a backup procedure, in the event that the weir fails to census the 2009 Chinook salmon escapement); and,
3. to estimate the age and sex composition of the escapement of Chinook salmon in the Kaouk River in 2009 such that all estimated fractions are within + 10 percentage points of the true value 95% of the time.

Tasks associated with the project are:

1. to conduct carcass surveys to document hatchery strays (if any in the escapement) and obtain otoliths required for origin determination,
2. to obtain additional fish length data,
3. to confirm visual sex identification at the weir and downstream tagging site ; and
4. to compare the census of the 2009 escapement of Chinook salmon in the Kaouk River with estimates as derived from the normative WCVI escapement methodology as applied to the Kaouk River.

A Post Season Assessment Report of the Sentinel Stock Program on the Kaouk River, 2009 for the Pacific Salmon Commission. *Final Report*

Achieving Acceptable Levels of Uncertainty in Mark Recapture Estimates of the Aggregate Population of Upper Nass River Chinook, Year 1

Project Lead: Cheryl Stephens, Nisgaa Fisheries Program Manager, New Aiyansh, BC
Project Cost: $63,200 CAN $49,119 US

Since 1994, mark recapture (MR) estimates of the Upper Nass River Chinook Aggregate have been derived by marking Chinook salmon with operculum tags at fishwheels on the mainstem Nass River at Gitwinksihlkw and recovering/examining live Chinook for marks at the Meziadin fishway and Chinook carcasses at other Upper Nass River tributary locations. Carcass recovery locations have varied over the years but have been predominantly Damdochax and Kwinageese rivers. Effort was focused on these two systems as they were found to be significant stocks to the aggregate population (~30%) based on stock composition results from radio-telemetry studies conducted in 1992 and 1993 (Koski et al. 1996a,b). Carcass recoveries have also been attempted on other systems such as Cranberry, Snowbank, Tiegen, and Oweegee; but these have not resulted in adequate recoveries (i.e., > 5 tags recovered) for generating reliable mark-recapture estimates, or to justify the survey effort expended. Upper Nass Aggregate Chinook MR estimates have achieved coefficients of variation (CV) less than or equal to 15% in 9 of 15 (60%) years since 1994 and the main factor determining CV has been the number of marked Chinook recovered or examined at terminal spawning areas in the Upper Nass. Over this period, the number of marked Chinook examined at the Meziadin fishway has averaged 54% of the total marks recovered in the Upper Nass and ranged from 16% to 100% in a given year. The sampling for marked fish at Meziadin is believed to be unbiased because all Chinook passing through the fishway are examined and few are believed to bypass the fishway by jumping the falls (this was evaluated in the telemetry study in 1993). Unfortunately recoveries of marked Chinook at Meziadin fishway alone are not sufficient to generate sufficiently reliable MR estimates for the Upper Nass Chinook Aggregate; hence, additional recovery efforts have been conducted by Nisga'a Fisheries in other tributaries.

Using carcass recoveries (dead pitch) of marked fish is known to impart biases in mark recapture estimates, primarily due to 1) temporal biases in tag recovery rates over the run, 2) sex biases in recovery rates, and 3) low recovery rates in some years when carcasses are hard to obtain. The mark occurrence at spawning grounds in the Upper Nass as evidenced at Kwinageese has been shown to increase over time (temporal bias) suggesting that marked fish migrate more slowly than un-marked fish; emphasizing the need to sample the entire run.

Mark recapture estimates for the Upper Nass Chinook aggregate have not been stratified by size in any years since 1994, other than 1997; this has been due to funding constraints to conduct enough surveys over the course of the entire run to obtain the necessary sample sizes at recovery to stratify estimates based on size or sex. The uncertainty in obtaining sufficient marks from carcass recoveries is evidenced by the fact that Damdochax has been the primary river of choice for mark sampling but in twelve sample years since 1994 less than 10 marks have been recovered in seven of those years; and less than 5 marks in three of those years. By comparison, in three years that the Kwinageese weir was operated for sampling of live fish, 21, 27, and 114 marked Chinook were examined throughout the majority of the Chinook run in 2005 (Alexander et al. 2006), 2006 (Alexander and Jessop 2007), and 2002 (Miller et al. 2005), respectively. Live sampling for mark rates across the entire run period will alleviate two of three potential sources of bias in recovery operations; namely temporal bias and low recoveries. Previous complete or almost complete sampling of the run of live Chinook was made at a weir operated on the Kwinageese River, in 2002, 2005 and 2006; and partial sampling of live Chinook occurred at a weir at Seaskinnish Creek in 2007 (Alexander et al. 2008) and 2008 (Alexander and Bussanich 2009 (draft)). These weir projects were funded by the Pacific Salmon Commission's Northern Fund for Middle and Upper Nass coho escapement assessments and depending on weir start up dates in the years described above provided partial or complete coverage of the Chinook run to those systems too. The Sentinel Stock Committee has

identified a potential fourth source of bias; namely spatial. If the recovery location samples do not represent the same population of Chinook passing the Gitwinksihlkw fishwheels, then spatial bias is occurring. This study will address this question by investigating other feasible locations for live recoveries or observations of marked Chinook as well as test for a statistical difference between mark rates between Meziadin and Kwinageese systems. The separation of distance between Meziadin (149 km) and Kwinageese (208 km) systems to the tagging platform do provide a large difference in spatial separation of stocks being assessed. In addition, scales are collected each year at the tagging platform of the aggregate Upper Nass Chinook population that could be analyzed for genetic stock composition if mark rates are found to be significantly different between the two systems. Although we have not tested for statistical difference in mark rates between the systems in past years due to incomplete sampling and low sample sizes, a general trend of similar mark rates between Meziadin and Kwinageese has been observed. Analyzing the stock composition data of the aggregate population would determine whether any statistical bias is related to capture, tagging, or timing biases.

The primary objective of this proposal is to rigorously assess and enhance the use of live recovery efforts for Chinook salmon from 2009 through 2013 using observations of live Chinook spawners at the Meziadin fishway and a video-counting weir at Kwinageese River. We believe that the annual operation of live sampling for marked Chinook at these two locations offers the best chance of achieving an unbiased MR estimate for Upper Nass Chinook with CVs less than or equal to 15%. In addition, we will assess the potential for size bias in the application of marks at the Gitwinksihlkw fishwheels. Specific objectives in 2009 are, therefore:

1. Continue to capture and mark, in proportion to the run, Chinook salmon at the fishwheels operated at Gitwinksihlkw;
2. Sample for sex, size and age, over the run period (early June to early-mid September), Chinook salmon captured at the Gitwinksihlkw fishwheels;
3. Operate recovery platforms for marked Chinook salmon at the Meziadin fishway (early July to mid-October) and the Kwinageese weir (early July to late September);
4. Determine mark rates for fishwheel marked Chinook salmon, over the run period, at Meziadin fishway and the Kwinageese weir;
5. Sample for sex and size, over the run period, Chinook salmon captured at the Meziadin fishway and the Kwinageese weir;
6. Sample Chinook salmon captured at the Meziadin fishway for age by collecting scales;
7. Assess the potential for marking or recovery biases among sex and size groupings;
8. Test for statistical bias in mark rates between Meziadin and Kwinageese; and
9. Assess other locations and methods for live Chinook mark recovery operations in tributaries above Gitwinksihlkw to mitigate for potential spatial recovery biases.

Estimating the Abundance of Adult Chinook Salmon Returning to the Nass River, BC, using Mark-recapture Techniques, 2009. *Final Report*

Chinook Salmon Escapement Estimation to the Skeena River Using Genetic techniques, Year 1

Project Lead: Ivan Winther, Fisheries Biologist, DFO, Prince Rupert, BC.
Project Cost: $29,300 CAN $22,772 US

Project Objectives
1. Estimate the 2009 Chinook salmon escapement to the Skeena River with an estimated coefficient of variation (CV) of 15% or less.
2. Sample all Chinook salmon captured at the Tyee Test Fishery for the biological attributes of length, sex and age and determine the age and sex composition for large components of the Chinook return to the Skeena River.
3. Meet the objectives above in subsequent years 2010 through 2013.

Tyee is located on the tidal estuary of the Skeena River, on the north side, upstream of the confluence with the Ecstall River. The Tyee Test Fishery is a standardized fishery that has been conducted in the Skeena River estuary since 1955. Its primary purpose has been to estimate sockeye salmon (Oncorhynchus nerka) abundance but is also used to monitor the relative abundance of other salmon species including Chinook (Cox-Rogers and Jantz, 1993). A gill net is deployed in standard locations relative to tidal flow. Sets are made at high and low water slack tides during daylight hours. Usually three sets are made per day except for some days late in the season when there are only two tidal changes during daylight.

The net is a multi-panel gill net 366 meters (200 fathoms) in length and 7.6 meters (25 feet) deep constructed of six strand monofilament nylon (Alaska twist). The net includes ten panels with web sizes ranging from 8.9 cm to 20.3 cm (3.5 inches to 8 inches) increasing in size by 1.3 cm (0.5 inch) increments. (Imperial units are included as this is the web size designation by the manufacturer.) The different mesh sizes are arranged at random across the length of the net. The web is hung in a 2:1 ratio of webbing to fishing net length. A full description of the test fishery is provided by Jantz et al (1990).
Typically the test fishery begins around June 10 and continues until September. The Chinook run is underway by June 10 and peak migration past Tyee occurs at the end of June and early in July. The last Chinook are caught at Tyee around the middle of August. The test fishery will begin May 25, 2009 to capture more of the beginning of the run.

Chinook salmon caught in the Tyee Test fishery will be sampled for age (scales), nose-fork length, eye orbit to hypural plate length, and incised to determine sex. Tissue samples will be collected for genetic analyses. Chinook salmon collections will be compared against genetic baselines from Skeena Chinook salmon populations. Samples will be analyzed for 13 microsatellite loci using methods of DNA extraction, PCR reaction, electrophoresis, and allele scoring described by Candy et al. (2002) and Beacham et al. (2006). The Molecular Genetics Laboratory at the Pacific Biological Station will provide the sample analysis. A new version of the computer program as described by Pella and Masuda (2001) will be used for the analyses. This program called "c-BAYES" is available from http://www-sci.pac.dfo-mpo.gc.ca/mgl/data_e.htm. The model output will include the Bayesian probability estimates for the five most probable populations for each sample.

Chinook Salmon Escapement Estimation to the Skeena River Using Genetic Techniques 2009. *Final Report*

Improving Abundance Estimates on the Fraser River's South Thompson Aged 0.3 Chinook Aggregate, Year 1

Project Lead: Michael Chamberlain, DFO, Chinook and Coho Stock Assessment, BC Interior, Kamloops, BC.
Project Cost: $101,500 CAN $78,886 US

The objective of this project is to improve the accuracy and precision of the system wide spawning escapement estimate to the Fraser River Chinook South Thompson aged 0.3 aggregate (ST0.3A).

The improvement of the spawning escapement estimates to the ST0.3A will provide better representation and potentially better management of the aggregate in PST fisheries. In 2005, the Fraser Early model stock represented about 5% and 3% of the CTC model catch in the SEAK all gear and NBC troll and sport fisheries (PSC 2007). However, genetic analysis of fishery samples from the NBC troll fisheries suggests the Fraser River Summer Age 0.3 natural and hatchery aggregate is a major contributor to SEAK and NCBC fisheries when they are abundant and healthy. For example, the Fraser Summer-run Age 0.3 aggregate has represented upwards of 30-40% of the NBC troll fishery catches since 2002 (Winther and Beacham 2006).

The poor representation of this stock group in fisheries during the 1979-1982 base period is not surprising given the data availability for this aggregate. During the base period, there were very few tagged stocks and very few CWTs recovered. Additionally, aggregate spawning escapements during the base period averaged approximately 20,000 fish compared to recent escapements which have increased substantially since 1995 to an average escapement of over a 100,000 fish between 2001 and 2008. Among the Fraser Early CTC model stock, the ST0.3A has represented a substantial amount, about 50% (range: 39%-75%), of the total model stock escapement since 1999.

As their contribution to PST fisheries has increased, good quality spawning ground estimates are required for this stock group to develop accurate forecasts of the NBC and SEAK AABM abundance indices. However, the current visual survey methods are thought to significantly underestimate spawner numbers because of poor counting conditions. This is due to a combination of factors including but not exclusive of the large abundance of returning fish, varying depths of the systems as well as natural wind-riffling and helicopter rotor wash of surface waters limiting visibility during surveys in the South and Lower Thompson rivers. Results from the Lower Shuswap escapement survey calibration program indicate escapements can be underestimated by 36%-79% in the ST0.3A (Chamberlain et al 2007).

Other methods have been explored such as DIDSON and, live (and carcass) mark-recapture. They are however, not feasible for South Thompson mainstem which forms the bulk of the run. Mark-recapture programs are not feasible as water temperatures run too high during tagging windows, and carcass mixing and recovery are not conducive to non-biased estimates. As well, DIDSON would prove ineffective due to co-migration of freshwater fish as well as other anadromous salmon. Navigation issues along this major waterway would also prohibit the necessary weiring.

Given the limitations stated above we propose to investigate how ST0.3A spawner estimates can be improved by using two approaches:

The first approach will extract the following information from the NBC troll fishery both:

- the exploitation rate indicator stock (Lower Shuswap) CWT information, and
- ST0.3A catches estimated by microsatellite (GSI) analysis.

This will be used to develop a ratio that can be applied to Lower Shuswap spawning ground estimates of CWTs therefore estimating the entire ST0.3A spawner numbers. Estimates will be by both age and by the total aggregate escapement.

The second approach will combine spawner abundances from the first approach with spawner estimates developed by aerial surveys on the spawning grounds using Bayesian methods.

Performing initial estimates with current CWT levels and using only fisheries data (GSI and CWTs) from the NBC troll (i.e., method 1 only), the coefficient of variation (CV) has been very close to or at the standards adopted by the Chinook Technical Committee (CTC) standards. Activities proposed here to increase precision of these estimates and therefore better inform fisheries planning include:

- increased CWT tagging and marking of smolts released to the Lower Shuswap from 200,000 to 500,000 to increase the amount and precision of CWT data collected from the northern troll fishery and spawning grounds, especially during periods of adverse marine survival,
- extra spawning ground survey effort on the Lower Shuswap to increase sampling rate and amount of CWT data to increase precision of the total CWTs at the spawning grounds,
- marking and clipping of 200K hatchery smolts released into the Middle Shuswap River to improve the quality of the methods and evaluate if cohorts with different origins have the same dynamic rates, and
- mark-recapture estimation of the Middle Shuswap River spawners to support stock-recruit analysis of 4 stock aggregations to describe population dynamics parameters and develop MSY escapement goals.

Final Report report due September, 2011.

Nehalem River Escapement Indicator Stock Chinook Enumeration and Spawner Survey Calibration, Year 1

Project Lead: Mark Lewis, Oregon Adult Salmonid Inventory and Sampling Project Leader, Oregon Department of Fish and Wildlife, Corvallis, OR
Project Cost: $269,400 US

The goal of the Nehalem River Escapement Indicator Project is to precisely estimate the annual escapement at age of adult Chinook salmon to the Nehalem River basin. Additionally, successful completion of this study will enable managers to calibrate escapement estimates in the Nehalem and other North Oregon Coast (NOC) basins to cost effective survey methods. In keeping with this goal, the specific objectives of the project are:

1. Estimate the total annual escapement of adult Chinook from ocean fisheries into the Nehalem River within +/- 15% of the true value 95% of the time and to estimate the age specific proportions of the escapement within +/- 5% of the true value 95% of the time. Specific tasks that must be completed to achieve the overall objective are:

a) Estimate the annual sport harvest of Chinook salmon in Nehalem Bay such that the estimate is within +/- 15% of the true value 95% of the time, and estimate age/sex specific proportions of that harvest such that the estimates are within +/- 5% of the true value 95% of the time.

b) Estimate the annual spawning escapement of Chinook salmon in Nehalem River such that the estimate is within +/- 15% of the true value 95% of the time, and estimate age/sex specific proportions of that spawning escapement such that the estimate is within +/- 5% of the true value 95% of the time.

2) Determine the appropriate visual index from spawning ground surveys that best correlates with true spawner escapement as determined from mark and recapture investigations.

Oregon's NOC Escapement Indicator Stock Chinook Enumeration and Spawner Survey Calibration – Nehalem and Siletz River Basins. *Final Report*

Siletz River Escapement Indicator Stock Enumeration and Survey Calibration Study, Year 1

Project Lead: Mark Lewis, Oregon Adult Salmonid Inventory and Sampling Project Leader, Oregon Department of Fish and Wildlife, Corvallis, OR
Project Cost: $251,988 US

1) Estimate the total annual escapement of adult fall Chinook into the Siletz River within +/- 15% of the true value 95% of the time and to estimate the age and gender specific proportions of the escapement within +/- 5% of the true value 95% of the time. Specific tasks that must be completed to achieve the overall objective are:
a) Estimate the annual sport harvest of fall Chinook salmon in the Siletz River such that the estimate is within +/- 15% of the true value 95% of the time, and estimate age/sex specific proportions of that harvest such that the estimate is within +/- 5% of the true value 95% of the time.
b) Estimate the annual spawning escapement of Chinook salmon in the Siletz River such that the estimate is within +/- 15% of the true value 95% of the time, and estimate age and sex specific proportions of the spawning escapement such that estimates are within +/- 5% of the true value 95% of the time.
2) Determine the appropriate spawner survey methodology that can be implemented at the aggregate level to estimate Chinook spawner abundance in other Chinook production river systems in the North Oregon Coast (NOC) by measuring several indexes of spawner abundance using the Oregon Department of Fish and Wildlife (ODFW) spawning survey methods and network of Chinook standard index sites.
3) Identify streams and stream reaches not included in the standard Chinook surveys that could be incorporated into the overall sampling design to produce accurate and precise estimates of spawning escapement. These may include mainstem reaches which are currently sampled at low frequency relative to their potential contribution to total escapement. We will determine if inclusion of these surveys results in improved estimates of Chinook escapement based on habitat expansion methods applied to the entire basin.

Oregon's NOC Escapement Indicator Stock Chinook Enumeration and Spawner Survey Calibration – Nehalem and Siletz River Basins. *Final Report*

The Feasibility of Capturing Sufficient Skagit Chinook To Do a Mark-Recovery Population Estimate, Year 1 of 1

Project Lead: Jake Musslewhite, Field Operations Manager, Skagit River System Cooperative, La Conner, WA
Project Cost: $45,971 US

The objective is to determine whether it is logistically feasible to capture and release, in the lower Skagit River, sufficient Chinook salmon to generate a mark-recapture estimate of total run size entering the river that meets CTC data standards for accuracy and precision (i.e. provides an unbiased estimate with coefficient of variation < 15%).

Depending on the run size and spawning grounds sampling numbers, this project would need to demonstrate that it is feasible to capture and tag approximately 400 to 600 Skagit Chinook, in order to meet CTC data standards.

If this project indicates that it would be feasible to capture that number of Chinook, then the next objective will be to develop a proposal for conducting the full-blown mark-recapture study. If this project indicates that it is not feasible to capture that many Chinook, then we will not proceed any further with mark-recapture abundance estimates for Skagit Chinook.

The Feasibility of Capturing Sufficient Skagit Chinook to Do a Mark Recovery Population Estimate. *Final Report*

Abundance Estimation of Snohomish System Chinook Salmon Via Mark-Recapture, Year 1

Project Lead: Peter Hahn & Dayv Lowry, Stock Assessment Scientists, WDFW, Olympia, WA.
Project Cost: $220,600 US

We propose to capture and mark live Chinook salmon in the Snohomish River Basin by the use of beach seines, and possibly tangle nets ("eddy sets") and hook-and-line, followed by recaptures as carcasses on all of the known spawning grounds. Each fish will be marked with two uniquely coded tags. Additionally, all salmon returning to the Wallace Hatchery, to the Sunset Falls fish ladder trap, and to the Tokul Creek Trout Hatchery will undergo a census. The harvest of marked (adipose clipped) salmon in the in-river selective sport fishery will be estimated by a creel survey and also by subsequent catch record card CRC analysis. We intend to estimate and evaluate predictive relationships (expansion ratio) between mark-recapture run size and (a) peak, cumulative & AUC redd counts, (b) peak, cumulative & AUC live/dead fish counts, and (c) the Sunset Falls passage count. This proposal also sets goals for scale samples needed to estimate the age-gender components and length, and assists in the collection of coded wire tags. Historical Perspective Spawner abundance of certain spring, summer and fall Chinook stocks in Puget Sound, including those in the Snohomish River system, have historically been estimated from counts of redds in conjunction with four key assumptions (which have been evaluated in previous research: Hahn et al. 2001, Hahn et al. 2003B&C, Hahn et al. 2004 and others).

Abundance Estimation of Snohomish System Chinook Salmon Via Mark-Recapture, 2009-10 Sentinel Stock Monitoring. *Final Report*