Northern Fund Projects 2007/08

The following is a descriptive list of the projects that are being funded by the Northern Boundary Restoration and Enhancement Fund Committee in 2007.

ENHANCEMENT

SOCKEYE SALMON

Trapper Lake Sockeye Access Improvement. Year 4

Project Lead: Brian Mercer, Mercer and Associates, Whitehorse, YT.
Eric Prestegard, Douglas Island Pink and Chum Inc, Juneau, AK.
Project Cost: $100,000 US

Improving the access for returning sockeye to Trapper Lake could result in a sustained increase in production from the Taku River system conservatively estimated to be between 10,000 to 40,000 adult sockeye. The potential benefits to the Trapper Lake system that would be incurred by the establishment of a sustained anadromous sockeye run include increased biodiversity and trophic levels in the system, and increased productive capacity of the lake from marine derived energy and nutrients. In 2004 preliminary engineering work was initiated to examine the feasibility of improving access. Additional limnological and baseline biological assessments of Trapper Lake were also performed. In 2005 the Transboundary Panel recommended continuation of the baseline limnological work as well as additional engineering assessments. Another of the 2005 project activities included transplanting eggs and/or fry into the Trapper Lake system in order to assess the potential impacts of anadromous sockeye fry in the system. An application for the trial transplantation of eggs/fry to the B.C.Fish Transplant Committee was neither approved nor rejected for 2005. It was understood that since the transplant application would also include the potential modification of the barrier and therefore a "range extension" of anadromous sockeye additional factors had to be considered. In 2006, pending the outcome of the fish transplant application, ongoing limnological field work was conducted at Trapper Lake from June through October. This field work consisted of adding to the baseline limnological data that has been collected on the lake to date. In mid-August 2006 approval was granted by the FTC for transplanting 1 million hatchery incubated fry into Trapper Lake in June of 2007. The donor stock for the fertilized sockeye eggs was to be from the Little Trapper Lake sockeye. After approval from the FTC, sockeye broodstock was collected at little Trapper Lake. Fertilized eggs were delivered to Snettisham hatchery for incubation. It is proposed to outplant the resultant fry into Trapper Lake in early June 2007. The growth, survival, habitat utilization, diet, and niche overlap/competition with resident species of the outplanted fry will be monitored.

Trapper Lake Sockeye Enhancement Project: Evaluation Studies 2006-2007. *Final Report*
Trapper Lake Sockeye Access Improvement 2007 Program Year. *Final Report*

Purchase of a Biosonics DT-X Split Beam Hydro-acoustic Sonar Unit for Use in Trapper Lake

Project Lead: Brian Mercer, Mercer and Associates, Whitehorse, YT.
Project Cost: $44,000 CAN $39,300 US

The use of hydro-acoustic techniques has become an established and valuable tool used by researchers to evaluate components of the current Transboundary River sockeye enhancement program. Since the inception of the program assessment crews have used a Simrad EYM echo-sounder to obtain in-lake estimates of sockeye salmon fry. From 1989 to 2000 the Simrad sounders were provided by the Pacific Biological Station, in Nanaimo, BC. When those units were no longer available, two surplus sounders were obtained from ADF&G inventories. Over the past 4 years these units have been used to obtain sockeye fry estimates at Tatsamenie Lake and Trapper Lake.

Technical assistance and repairs of the EYM sounders is no longer provided by the manufacturer and the technology is antiquated by current standards. Parts and useable commodities (echogram paper and styluses) are no longer available. Only one of the two ADF&G units is functioning (the other having been cannibalized for parts) and the remaining unit does not have enough consumable products left for conducting the 2006 transboundary assessment work.

It is proposed to buy an up-to-date Biosonics DT-X split beam echo-sounder. In addition to the echo-sounder, applicable software, a laptop computer, and GPS are required. This machine will allow continued monitoring of the Transboundary sockeye enhancement programs. Specifically the state of the art technology of the DT-X unit will allow close monitoring and quantification of the sockeye, kokanee and zooplankton population abundance and composition in Trapper Lake; information pivotal in the ongoing assessment of the Trapper Lake sockeye enhancement project.

Summary of project. *Final Report*

Tuya River Harvest Study. Year 4

Project Lead: Pete Etherton, Senior Stock Assessment Technician, DFO Whitehorse, Yukon.
Project Cost: $100,800 CAN $90,014 US

The Tuya River system, specifically Tuya Lake, has long been recognized as a potential producer of Stikine sockeye salmon. Because of this potential, the Tuya River is key to the Canada / US joint enhancement agreement, which has the objective of increasing the adult production of Stikine River sockeye by 100,000 fish. Sockeye production originating from releases to Tuya Lake has resulted in a substantial increase in Stikine adult production, but has left in its wake problems associated with terminal harvest and the subsequent downstream straying of sockeye. Discussion within the Transboundary Technical Committee and with the Tahltan First Nation have resulted in the pursuit of funding from the Northern Fund to address the issue of terminal harvest (as well as straying). The Northern Fund granted funding commencing in 2004 based on a submission outlining an approach to addressing the problems. This application is for fourth year funding, extending the original three year proposal.

Tuya Lake is inaccessible to adult salmon which results in returning sockeye salmon, originating from Tuya lake fry plants, entering the mouth of the Tuya River and milling below fish obstructions located

there. Some fish are terminally harvested; most are not. Some fish exit the river and migrate into other Stikine River tributaries. This observed straying of sockeye salmon has generated concerns centered around the potential risk to wild sockeye stocks located downstream of the Tuya River. There is also a concern based on ethical grounds whereby returning fish are not afforded access to Tuya Lake resulting in self inflicted injury caused by their persistent attempts to negotiate an impassable fish barrier. These concerns could be mitigated by increased harvest of fish at the mouth of the Tuya River. Success of this endeavor is crucial for the large fish plants in Tuya Lake necessary to meet Pacific Salmon Treaty goals. The benefits to each country would be significant and would be sustained for the long term.

In early July 2006 a rock slide occurred adjacent to the fish trapping site that we have been attempting to develop over the past 3 years. The rock slide rendered this fishing site unusable due to a constriction of river flow and enlightenment to managers as to the instability of rock slopes there and the inherent dangers from rock falls to the fishing crew operating the fish trap. This leaves two primary options for harvest sites: either somewhere downstream of the barrier; or above the barrier with a concomitant requirement to provide passage past the barrier. This proposal requests funding to investigate, select the best approach, and reinitiate fish harvest at Tuya in 2007.

Tuya River Sockeye Harvest Research, Interim Report 2007-2008. *Final Report*
Tuya River Fish Passage Construction, March-November, 2008. *Final Report*

Sockeye Outplanting to Hanging Lakes. Year 2. Addressing Final Regulatory and Logistic Issues

Project Lead: Chris Picard, Gitga'at Development Corporation, Prince Rupert, BC.
Project Cost: $104,933 CAN $93,705 US

This project is a continuation of the iterative Hanging Lakes Sockeye Production program initiated in 2005 and is an integral step towards in the continuing development of a large-scale sockeye outplanting program in BC's North Coast. The economic benefits accrued from the established Alaskan outplanting program clearly demonstrate how similar dedication in BC could produce comparable benefits (Levy 2005; ENRI 2001). Levy (2005) outlined a strategy (in a project funded by the PSC) to develop a pilot hanging lakes outplanting program in BC, and the Transplant Permits acquired through the work described in this proposal is a fundamental regulatory step that must be addressed prior to pursuing large-scale outplanting. In addition, the project addresses many ecological and logisitic issues such as background data for ongoing monitoring, confirming the suitability of donor stocks and culture techniques required for successful outplanting.

The project has direct significance to the PST since the ultimate objective of the hanging lakes sockeye production project is to produce large quantities of additional sockeye to improve the fisheries of both countries. Further, it is anticipated that returning adults from this program will migrate through U.S. and Canadian waters and thus allocation will need to be addressed by the PST.

To date the program has included a general feasibility study of sockeye outplanting into Northern BC hanging lakes (Levy 2005) and the currently ongoing biological evaluation of three high priority hanging lakes (i.e., Batchellor, Red Bluff and Whalen lakes) and several potential donor stocks (i.e., Kitkiata, Tsimtack/Moore, Kooryet, Keecha, Devon, Curtis and Mikado) (Figure 2) . The next iteration involves 3 interrelated Phases that address the final questions leading to an outplanting program:

a. Acquire Transplant Permits
    i. 1 Permit for the Pilot Egg-Take program

ii. 2 Permits for initiating sockeye fry transplants into two hanging lakes (Batchellor and either Red Bluff or Whalen)
iii. Collect information that will be used as background for monitoring success and ecological impacts of sockeye introductions. Such monitoring will be a requirement of our Transplant Permits.

b. Pilot Egg-Take Program:
   i. work-out the logistics associated with a large-scale egg-take and hatchery program
   ii. growth and survival of selected donor stocks in a hatchery setting will be evaluated
   iii. determine hatchery conditions and husbandry methods required to optimize survival
   iv. Gitga'at and Gitxaala crews trained in proper egg-take, fertilization, and handling protocols

c. Donor Stock Assessment
   i. Confirm status of short-listed stocks as suitable donors
   ii. Area-under-the-curve estimates of sockeye escapement
   iii. Disease status of the populations

Sockeye Outplanting to Hanging Lakes. Year 2. Addressing Final Regulatory and Logistic Issues. *Final Report 1* *Final Report 2*

Conservation of Kitwanga Sockeye through Enhancement Activities. Year 2

Project Lead: Mark Cleveland, Head Biologist, Gitanyow Fisheries Authority, Kitwanga, BC.
Project Cost: $90,000 CAN $80,370 US

In 2005, the Pacific Salmon Commission's Northern Fund helped support a process to develop recovery options for Kitwanga sockeye. To date, one of the highest priority projects identified by the Kitwanga Sockeye Recovery Working Group is the out-planting of sockeye fry into Gitanyow Lake to boost egg to fry survival. The consensus of the working group was that enhancement of the stock should be initiated as soon as possible before too much genetic diversity is lost as the population continues to shrink.

Presently ~90,000 Kitwanga sockeye eggs have been collected and are currently being incubated at the Kispiox Hatchery. Broodstock for this initial egg take were collected from 28 adults that were held in lake net pens for 2 months (collected at the Kitwanga River permanent fence in August and moved to Gitanyow Lake - 90% holding survival rate) and from spawners that were netted on lakeshore spawning areas. It is expected that up to an additional 30,000 eggs will be acquired before the completion of the project from 20 adult sockeye (1:1 sex ratio) that are currently being held in a raceway at the Kispiox Hatchery (currently awaiting adults to ripen for egg collection).

2007/08 will mark the second consecutive year that Kitwanga sockeye are enhanced. Although the incubation of Kitwanga sockeye in 2006/07 is still ongoing, the initial results to date are encouraging. It is anticipated that the project will be successful in increasing production that could not otherwise be realized in the wild.

Kitwanga Sockeye Enhancement Program, 2007/08 – Year 2. *Final Report*

Lakelse Lake Sockeye Rehabilitation Program: Fry Outplant Project. Year 2

Project Lead: Lana Miller, Resource Restoration Biologist – North Coast, Prince Rupert, BC
Project Cost: $62,000 CAN $55,366 US

The Lakelse watershed has very high fisheries values and is a major producer of sockeye, coho and pink salmon as well as supporting chum, chinook and steelhead populations. The Lakelse system supports about 35% of the total Skeena River commercial fishery catch for all species. Skeena River sockeye are recognized as being a stock produced in Canadian waters that are subject to interception by American fisheries. As such, sockeye produced in tributaries of Lakelse Lake are part of a stock which is a high priority for conservation by the PST. However, sockeye stocks in Lakelse Lake have been declining at an alarming rate, due to physical changes and habitat impacts caused by logging, linear development and beaver activity. Sockeye escapements to Lakelse Lake have been depressed relative to historic levels, due to degraded or limited tributary spawning habitat which is believed to be restricting spawner access and spawning success in terms of fry recruitment. As an integral part of the Lakelse Lake Sockeye Salmon Recovery Plan, we propose to once again use Snootli Creek Hatchery to enhance and conserve sockeye populations in this watershed. Enhancement will be coupled with continued habitat restoration, protection and other assessment and monitoring in the overall plan while also building capacity in the Lakelse area.

Lakelse Lake Sockeye Rehabilitation Program: Satellite Sockeye Hatchery Site Fry Outplant Program - Year 2. *Final Report*

McDonald Lake Sockeye Sentinel Fish

Project Lead: John Burke, Southern Southeast Regional Aquaculture Association, Ketchikan, Alaska.
Project Cost: $201,900 US

The McDonald Lake stock is the largest "local" sockeye stock in southern SE Alaska. Since the early 1980's the current escapement goal has been generally met or exceeded with the exception of the past 5 years (6 years at this time) when the escapement goal has only been met two times. In three of the past 5 years escapement has fallen significantly below the goal. While the adult sockeye returning to McDonald Lake pass through several intensive traditional net fisheries, the current diminished stock productivity seems more likely the product of poor natural survival rather than the result of over harvest. Regardless, the most likely response of management – to restore this stock – will be constraints on the common property fisheries where these fish are caught. In order to effectively constrain fisheries so that the goal of rebuilding this stock is met with minimal restriction on common property harvest, it is important to know where and when these fish are harvested so that effective time and area closures can be used to protect this stock.

Perhaps even more importantly, this project will also add adults to the annual spawning population at McDonald Lake. After a number of experiences with sockeye and coho presmolt enhancement in southern SE Alaska, we are confident that returning the smolt-sized presmolt to McDonald Lake will significantly increase the number of adult sockeye returning to McDonald Lake. In addition, if the presmolts are released from pens immediately adjacent to the primary spawning tributary in McDonald Lake, we are confident that most of these fish will return to spawn in the desired location.

We will collect approximately 450,000 eggs from sockeye returning to McDonald Lake in each of the summers, 2007 through 2009. The eggs will be incubated in an "isolation module" at Burnett Inlet Hatchery. All embryos will be thermally tagged. Emergent fry will be reared for a year in sea bags, vertical raceways suspended in saltwater, at the hatchery site. In the springs of 2009 through 2011 the

yearling smolt will be returned to McDonald Lake by aircraft. They will be placed in a net pen near the primary spawning tributary in McDonald Lake for a short period to influence adult homing. After holding – about 10 days - they will be released and allowed to feed naturally for a short time (4 or 5 weeks) and leave the lake with the naturally occurring smolts.

Adults returning from this planting - estimated to annually be between 40,000 and 60,000 fish – will pass through several significant net fisheries in southern SE Alaska where they will be harvested in the normal conduct of those fisheries. SSRAA staff will collect otoliths from harvested sockeye and identify the thermally tagged fish, which in turn can be used to identify area of harvest and to some degree time of harvest. The fish escaping harvest will return to McDonald Lake and add to the spawning population in McDonald Lake. Post spawning collection of dead adults can be used to estimate the participation of the enhanced fish should that information be necessary.

McDonald Lake Sockeye Sentinel Fish Project. *Final Report*

CHINOOK SALMON

Snootli Hatchery Chinook Augmentation & Atnarko Tote Road Access Restoration

Project Lead: Russ Hilland, Snootli Hatchery Manager, Bella Coola, BC
Project Cost: $88,750 CAN $78,980 US

Chinook Augmentation
This proposal is to take 500,000 more Lower Atnarko Chinook eggs, and rear them to yearling smolts prior to release at the Atnarko rearing channels. Based on previous experiments (where a 3% survival rate was achieved) this increased enhancement would be expected to produce 15,000 returning adults. Potential broodstock would be randomly selected from the wild spawning population. Broodstock for this project will be captured and eggs taken in Sept 2007. Resultant eggs and milt would be transported to Snootli Hatchery for fertilization and planting. Snootli hatchery uses modified matrix spawning, which when combined with random broodstock collection protects natural stock genetic diversity. Resultant fry will be ponded in Feb 2008 and reared until either April 2008 or Oct 2008 at Snootli Hatchery, at which time they will be transported to the Atnarko channels for over winter rearing. The yearling smolts will be released in June 2009 at an average size of 20 -25 grams. In summary, the objectives are to:

- Increase the enhanced chinook production from Snootli hatchery by taking an additional 500,000 eggs and rearing to release as yearling smolts.
- Provide increased Snootli chinook harvests in Canadian and Alaskan fisheries.
- Increase production from a northerly migrating chinook stock contributing to Canadian and Alaskan PST chinook abundance indices.
- Evaluate the survival and harvest distribution of this enhanced release by applying cwt's.

Atnarko Tote Road Access Restoration
The project will require a excavator and two dump trucks capable of rock haul. There are 20 individual rock pieces that are too big or unsafe to lift into a truck. As blasting close to high value fish habitat is not an alternative the rock will have to be moved whole using a sling. This is the preferred method, however, a couple of the boulders may be too big for this method to be practical. Other alternatives will be to drill and split the rock using an expanding compound, or excavate and end haul enough material from the toe of the talus slope to construct an alcove large enough to move the larger boulders into. There are approximately 55 truck loads of rock to move, plus the individual boulders that are too large to load.

Snootli Hatchery Chinook Augmentation Brood Years 2007 and 2008. *Final Report*

COHO SALMON

Coho Pre-Smolt Enhancement Project. Bakewell Lake System

Project Lead: John Burke, Southern Southeast Regional Aquaculture Association, Ketchikan, Alaska.
Project Cost: $190,000 US

The primary objective of this project is to provide additional coho harvest opportunity to the region's salmon fisheries without adversely affecting its natural stocks. The initial startup of this project has an objective of providing a 35,000 coho harvest to the common property fisheries of the region. A secondary objective is to increase the productivity of the Bakewell Lake system to a point that allows it to be self sustaining. At that point the project will be complete and all enhancement of this system can be terminated if desired. This point is anticipated to occur anywhere from 3 to 10 years from the initiation of the project.

The project will establish a coho pre-smolt enhancement site in the Bakewell Lake system. Coho currently in the lake are from several stocking efforts in the 1950's and 1960's. These stocks are from various regions, including Washington and Oregon. These factors, plus the low nutrient levels in the lake, contribute to the inability of the Bakewell Lake system to have ever produced more than a very small return. We will use Whitman Lake Hatchery coho, a proven stock of fish that has a known history of successful rearing in local environments. The initial target is an egg-take of approximately 600,000 with a release of 500,000 pre-smolts. Fry will be reared to 0.75 grams at Whitman Lake Hatchery, CWT at a rate to be determined by ADF&G, and then transported to net pens in Bakewell Lake. In late fall the fish will be released into the lake at an average size of 20 to 25 grams.

Coho Pre-Smolt Enhancemen Project: Bakewell Lake System. *Final Report*

Coho Netpen Expansion at Pallant Creek Hatchery

Project Lead: Pat Fairweather, Program Manger, Haida Fisheries Program, Queen Charlotte Is, BC
Project Cost: $65,533 CAN $58,521 US

Pallant Creek Hatchery located on Haida Gwaii/Queen Charlotte Islands primarily produces chum and coho with current targets of 30M chum eggs, 550,000 coho smolts and up to 378,000 outplanted coho fry. The Haida Fisheries Program and Fisheries and Oceans Canada have co-managed the hatchery since 1997. This proposal is to complete an expansion of coho salmon production. The reasons for the project are to:

a. Increase the hatchery cost efficiency;
b. Add three netpens to an existing structure to provide additional hatchery off-site rearing space for a coho smolt program;
c. Increase the hatchery coho smolt production from 550,000 to 1.1 million; and
d. Increase benefits to northern fishermen and local communities

The three new netpens will be added to an existing structure located at Mosquito Lake about 5 km from the hatchery. Broodstock are taken at a fence in Pallant Creek and incubated at the main hatchery site. Coho fry are briefly reared in hatchery raceways and transferred to the lake netpens in about June of each year. Smolts are released in May of the following year by trucking them to the Pallant Creek estuary. The

first three netpens were installed in 1999 and all Federal and Provincial approvals are in place to add the three additional netpens.

The coho netpen expansion will increase hatchery coho production from a northern BC system and will benefit fishers and processors in the Northern Boundary area. Haida Gwaii coho contribute to troll, sport and net fisheries in Northern B.C. and Alaska, although incidence in Alaskan fisheries (generally <5% exploitation rate) is low compared to coho originating from the B.C. mainland. Pallant Creek coho also contribute to a hatchery terminal cost recovery fishery. Profits from the cost recovery fisheries for chum and coho are used to pay a portion of hatchery operating costs.

Coho Netpen Expansion at Pallant Creek Hatchery 2007. *Final Report*

CHUM SALMON

Determining the Trend of Chum Population Dynamics in Fisheries Statistical Area 5 and Measuring the Success of Small Hatcheries for Stock Assistance. Year 2

Project Lead: Janet Lemon, Oona River Resources Association, Oona River, BC.
Project Cost: $35,119 CAN $31,362 US

The coastal chum stocks in Area 5 appear to show a downward trend in their populations when compared with historical information, but there is some uncertainty over how current stock assessments relate to historical assessments. Three questions will be addressed by this project:

(1) Are chum stocks depressed in this area or are we dealing with an observational error between current assessment and historical assessments and can we improve the enumeration by having more frequent visits?
(2) What is the minimum viable population for long term persistence of these coastal chum stocks based on the amount of potential spawning habitat, using the Kumeleon River system in Area 5 as a model?
(3) What role will small hatcheries play in doing limited stock assistance to increase chum populations in these systems and how will you measure its success?

The design of this study will be to use the chum-bearing Kumeleon River (a major chum-bearing system within Area 5) for enumerating the in-migrating chums and mortalities. Chums will be tagged in the lower river/estuary using coloured elastic bands with zap straps on their peduncle for determination of resident time in the system. Spawning potential will be determined by identifying chum spawning areas from visual sightings of fish on redds and using criteria such as cobble size, depth of water and velocity of water (Groot & Margolis 1991). These areas will be annotated on maps noting the spatial and temporal movement of the chum spawners entering and moving up the system and whether there is an early and late run. DNA samples will be taken from new entrants and mortalities which will add to the established genetic database that is being managed by Brian Spilsted, DFO, Prince Rupert.

The hatchery component of this project will measure the success of using small hatcheries in these areas for increasing populations of chum and other indigenous salmon. Many small hatcheries take broodstock from impoverished systems and then release the fry back to their natal stream but do not follow up to see if this action has benefited the population recovery. All Kumeleon chum fry from the Oona River Hatchery will be marked before release back to the Kumeleon system for distinguishing the enhanced from the natural in migrating adults.

Determining the Trend of Chum Population Dynamics in Area 5 and Measuring the Success of Small Hatcheries for Stock Assistance Year 2. *Final Report*

MULTI-SPECIES

Salmon Enhancement Scoping in Northern and Central B.C.

Project Lead: David Levy, Levy Research Services Ltd., North Vancouver, BC
Al Lill, A.F. Lill and Associates Ltd., North Vancouver, BC
Project Cost: $94,600 CAN $84,478 US

The project will involve a detailed review of salmon enhancement potential for Northern and Central BC (Canadian Statistical Areas 1 through 10). The focus will be on enhancement opportunities and potential fishing regimes that are fully manageable without impacting wild stocks. This will include review of traditional approaches e.g. hatcheries, lake fertilization and spawning channels, as well as innovative approaches e.g. ocean ranching and fry stocking to hanging lakes. The project will examine existing facilities in Northern/Central BC and in Alaska and carry out ex-post bioengineering analyses to determine the success rate of current approaches, measured in accordance with fisheries criteria (to be determined). The project will specifically include a focus on defining the successes (and failures) of Alaskan approaches to salmonid enhancement, including private non-profit corporation hatcheries, and will consider their applicability to Northern and Central BC. A series of workshops will be held with a view towards identifying relevant enhancement technologies and stream/river systems where they could be potentially applied. The review will involve key DFO staff in management and enhancement plus community representatives, First Nations and other fishing interests. Emphasis will be placed on evaluating both the productive potential and the manageability of enhancement proposals. Bioengineering analysis will evaluate, the practicality of applying alternate enhancement techniques at the most highly ranked candidate stream sites. This analysis will examine the potential for developing new and existing infrastructure for potential operations. We will request further guidance (DFO has agreed to provide if the project is successful) from the Canadian Northern Panel at the February 2007 meeting on the initial guidelines for the review. Shortly after project inception, a workshop will be carried out to provide experienced fishermen/stakeholders the chance to suggest opportunities that have not been previously identified by SEP staff

Purpose: to develop a strategy for renewed salmonid enhancement activities in Northern and Central B.C. that are based on:

- a clear definition of management objectives;
- integrated enhancement and management plans so potential production benefits can be realized with minimal impacts on wild stocks;
- optimized production from existing facilities; and
- new projects including habitat restoration, other low impact technology approaches or completely isolated non-government hatcheries with introduced stocks that can be fished discretely from wild populations.

Goals: To prepare an overview/scoping assessment of salmon enhancement opportunities in Northern and Central B.C. and identify some early projects for possible implementation in 2008/09.

Objectives: to provide a document which meets the needs of the Canadian Northern Panel of the Pacific Salmon Treaty for effectively guiding future investments in salmon enhancement.

Salmon Enhancement Scoping in Northern and Central B.C. *Final Report*

HABITAT RESTORATION

SOCKEYE SALMON

Kitwanga Sockeye Salmon Spawning Habitat Improvement Initiative. Year 2

Project Lead: Mark Cleveland, Head Biologist, Gitanyow Fisheries Authority, Kitwanga, BC.
Project Cost: $85,000 CAN $75,905 US

The Kitwanga River is biologically rich, supporting populations of all six species of Pacific salmon. A species of significant importance in the Kitwanga drainage is sockeye salmon. Historically, Kitwanga sockeye numbered in the 10's of thousands, but today only a fraction of those historical abundances persist. Studies on this genetically unique stock have been on going since 1999 and the reasons for the stock decline have been linked to over exploitation in the mixed stock fishery at the coast, and the deterioration of freshwater habitat within Gitanyow Lake. In 2005, the Pacific Salmon Commission's (PSC) Northern Boundary Fund helped fund a process to develop recovery options for Kitwanga sockeye. One of the highest priority projects identified by the Kitwanga Sockeye Recovery (KSR) Working Group has included the restoration of spawning sites along the shores of Gitanyow Lake. Kitwanga sockeye are exclusively lakeshore spawners, and it has been determined that spawning grounds along the lakeshore have been impacted by sediment input due to the cumulative effects of road building and clearcut logging that has taken place within the watershed over a period of more than 40 years. In 2006 the Northern Fund grant was used to implement small-scale gravel cleaning operations which involved the extraction of fine sediment using hydraulic wands and high pressure pumps, and the addition of superior gravels along lakeshore spawning sites. Based on observations of adult sockeye usage of spawning areas in 2006 it would appear that the highest sockeye spawner densities were on sites that were graveled compared to those just cleaned or left untreated.

There was no apparent difference between usage of sites that were cleaned and graveled over sites that were graveled only. Based on these observations GFA habitat restoration prescriptions in 2007 will concentrate strictly on gravelling operations. Gravelling of sites also proved to be the more cost effective method of treatment when compared to cleaning sites. Cleaning took the longest to complete and hence was the most expensive form of treatment. Therefore, in 2007 GFA is proposing to gravel an additional 600 m² of spawning habitat, which should potentially accommodate an additional 1,200 adult sockeye in 2007 and beyond.

Kitwanga Sockeye Salmon Spawning Habitat Improvement Initiative – 2007/2008. *Final Report*

Lakelse Lake Sockeye Salmon Recovery Program: Spawning Channel / Improved Spawning Habitat Feasibility Study

Project Lead: Lana Miller, Resource Restoration Biologist – North Coast, Prince Rupert, BC
Project Cost: $46,000 CAN $41,078 US

In recent years, sockeye recruitment in the Lakelse system has fallen dramatically due (we suspect) to reduced spawning habitat in the major spawning tributaries (DFO, 2004). A recent sedimentation study of Williams Creek (the main sockeye spawning tributary) suggests that the causes of reduced spawning habitat are a combination of ongoing flood scouring each fall and continued sedimentation/siltation of historic spawning grounds from combined geological and human activities (highway and road construction, land clearing, logging). The Lakelse Sockeye Recovery Team suspects that development of spawning channels to assist in fry production may be the most suitable option at this time, but a review of all (other) possibilities is required. Project objectives are to:

a) Determine the location of all historic and current sockeye spawning area about Lakelse Lake and obtain copies of all relevant historic works from all available sources.
b) Generate a Lakelse Sockeye spawning habitat evaluation form using FISS (Fisheries Information Summary System) card parameters, and/or other biological, physical and water quality parameters to develop two scoring systems. One to evaluate the current condition of these sockeye spawning habitats and the other, to evaluate its potential.
c) Conduct preliminary field surveys in order to complete the sockeye spawning habitat evaluation forms for all spawning areas.
d) Present habitat evaluation results to the Lakelse Sockeye Recovery Team.
e) Determine top ranked spawning sites for major habitat improvement consideration.
f) DFO and Project Engineers to compose sockeye spawning habitat augmentation designs for top ranked spawning sites.

Lakelse Sockeye Spawning Habitat Rehabilitation Feasibility Project 2007-8. *Final Report*

Assessment of Sockeye Spawning Distribution and Habitat in Tahltan Lake

Project Lead: Cheri Frocklage, Tahltan Fisheries Manger, Dease Lake, BC
Project Cost: $68,386 CAN $61,069 US

Tahltan Lake is vital contributor to the overall productivity of Stikine sockeye salmon and is an important stock to Tahltan First Nations as well as Canadian and Alaskan commercial harvesters. The Tahltan Lake proportion of average Stikine River total run size (from 1994-2003) is approximately 47%. Tahltan Lake has also been the source of brood stock for the Stikine sockeye enhancement program since it began in 1989, and the egg take is an identified project under the Appendix to Annex IV, Chapter 1 of the existing Treaty. Eggs taken on-site are incubated at the Snettisham hatchery in Alaska with subsequent fry planting into Tuya Lake and/or back into Tahltan Lake.

Observations made during annual enhancement field operations conducted at Tahltan Lake have revealed uncertainties about sockeye spawning distribution, behaviour and habitat condition. Within a period of approximately 10 - 15 years, brood capture has generally become more difficult, a new spawning location has been observed and site-specific alterations in ground-water flows have been noticed. While an extensive amount of data exists for Tahltan Lake sockeye, much of it associated with estimating the productivity of both enhanced and wild portions of the population, on-going studies have not had a specific focus on the spatial distribution of spawners or assessing factors that might influence spawning

habitat utilization and potential. This project will have such a focus and will entail both historical data examination and field surveys.

 *Tahltan Lake Assessment of Sockeye Spawning Distribution and Habitat.* Final Report

CHUM SALMON

Marx Creek Rehabilitation. Year 2

Project Lead: Todd Tisler, Fish & Wildlife Staff Officer, Ketchikan-Misty Fiords, AK.
Project Cost: $64,712 US

This project will improve and expand upon the existing Marx Creek chum salmon spawning channel in the Salmon River drainage at the head of Portland Canal. Portland Canal chum salmon stocks were specifically identified in the Pacific Salmon Treaty as having conservation concerns. Marx Creek and nearby Fish Creek are tributaries of the Salmon River, located near Hyder, Alaska. In 1985, a spawning channel (Marx Creek) was constructed by excavating into the ground water in the area between Fish Creek and the Salmon River in a protected area between dikes. This channel was 4,000 feet long and entered the Salmon River approximately one mile upstream from the Fish Creek confluence. In 1989 Marx Creek channel was extended upstream 1,600 feet. The extension was constructed directly in contact with the Salmon River dike, but, silty glacial water leaks through the dike and enters Marx Creek and, fish avoid this extended part of the channel. The severity of the leak depends on the proximity of the Salmon River to the constructed dike. The quality of the spawning gravel throughout Marx Creek is also deteriorating because of the deposition of silt. The purpose of this project is to prevent Marx Creek from further water quality deterioration and expand the channel by constructing an additional 1,500-2,000 feet of high quality, groundwater-fed spawning habitat. The new channel will connect to the existing channel 3500 feet from the confluence with the Salmon River.

 *Marx Creek Rehabilitation.* Final Report

MULTI-SPECIES

Assessment of Critical Salmon Habitat in Transboundary River Estuaries

Project Lead: Mitch Lorenz, Fisheries Research Biologist, NMFS, Auke Bay Lab, Juneau, Alaska.
Kercia Schroeder, Alaska Dept of Fish and Game, Sport Fish Division, Douglas, AK
Project Cost: $92,815 US

The Taku River is a large transboundary river that supports stocks of five species of Pacific salmon. Salmon produced from this watershed are critically important to commercial, sport, and subsistence fisheries in both Alaska and Canada. The estuarine environment at the mouth of the river provides critical habitat for migrant salmon while they make the physiologically challenging transition between marine and freshwater areas. The glacial conditions of transboundary river estuaries present migrant salmon with particularly significant environmental gradients in both temperature and salinity. Those estuarine environmental factors are consistently linked to salmon production from other large rivers (Beamish et al. 1994; Emmett and Schiewe 1997).

This project will map spatial and temporal patterns of salmon distribution in the Taku River estuary and assess the function of a range of environmental conditions specific to the estuary as salmon habitat. The

estuary will be sampled seasonally to assess the role of habitat in supporting physiological transitions that salmon must make to migrate between marine and freshwater areas. Estuary habitat is particularly important for chum salmon as well as zero-check sockeye and chinook salmon, all of which are stocks of concern in the Taku River. The results of this study could be applied to both fishery management and land-use strategies applied to transboundary river watersheds.

Assessment of Critical Pacific Salmon Habitat in a Transboundary River Estuary. *Final Report*

Critical Salmon Habitat Mapping for the Stikine Drainage

Project Lead: Cheri Frocklage, Tahltan Fisheries Manger, Dease Lake, BC
Project Cost: $46,352 CAN $41,392 US

In recent years, the Transboundary Panel (particularly the Alaskan side) has expressed an interest in facilitating the review and discussion of potential impacts of proposed industrial development within the Stikine River drainage. There are currently a substantial number of active industrial proponents (over 30, including exploration projects) mostly interested in mining but also including hydro and oil / gas developments. The complex nature of Transboundary River habitats leaves the potential for salmon utilization to be underestimated. Regulating fisheries agencies have the opportunity to be involved in environmental assessment processes, but often have limited time or resources in which to do so. Thus there is a need to provide fisheries agencies with an efficient tool for responding to proposed industries that may potentially impact salmon resources. The mapping product of this project not only provides a "quick reference" guide to documented critical salmon habitats but also a "time-saving" link to the more detailed data associated with specific sites.

Many sources of data relating to salmon distribution and spawning in the Stikine drainage already exist, having been collected over years through various stock assessment initiatives. Some examples of technical information include aerial surveys, radio telemetry and previous project reports. There is also an extensive amount of traditional and local knowledge which has not been effectively compiled. This baseline information regarding critical salmon habitat is currently not consolidated in a format that can readily be utilized for habitat management purposes.

The main purpose the project is to consolidate existing information regarding adult salmon spawning and distribution within the Stikine drainage. It will include both technical data and traditional knowledge, which will be transferred into a GIS mapping format to display known spawning habitats and spatial distribution for all salmon species. Digitized information will be linked to a database which identifies the type of information and its source.

Critical Salmon Habitat Mapping for the Stikine Drainage. *Final Report*

Highway #16 and CN Rail Fish Passage Assessment in the Upper Skeena. Year 4

Project Lead: Allen Gottesfeld, Head Scientist, Gitksan Watersheds Authority, Hazelton, BC.
Project Cost: $109,090 CAN $97,416 US

The primary objective of this project will be to focus on increasing the abundance of fish stocks by re-opening freshwater salmon spawning and rearing habitat. The stream habitats to be examined include some of the most productive sockeye, coho and Chinook areas upstream of the Babine River. Fish access past the abandoned railroad grade has not been examined in the past 30 years, due principally to transportation and logistical costs relative to remote fieldwork.

This project will complete a series of Skeena watershed fish passage surveys of all fish passage problems beneath Highway #16, between Prince Rupert and Burns Lake, and between Terrace and Kitimat on Highway #37 South, as well as the stream crossings beneath the CN Rail lines, which parallels these highways. This series of surveys was supported by the PSC Northern Fund over the past three years.

Upper Skeena Fish Passage Culvert Inspection. *Final Report*
Please contact PSC for project maps.

IMPROVED INFORMATION

SOCKEYE SALMON

Canadian Northern Boundary Sockeye Stock ID Supplemental Sampling. Year 3

Project Lead: Steve Cox-rogers, Sockeye Stock Assessment Biologist, DFO Prince Rupert, BC.
Project Cost: $45,000 CAN $40,185 US

The Provisions of the 1999 Pacific Salmon Treaty (Chapter 2) specify harvest sharing arrangements of Nass and Skeena River sockeye salmon returns for the U.S. and Canada. The United States is allowed to harvest a fixed percentage of the annual allowable harvest (AAH) of Nass and Skeena sockeye stocks in Alaska's District 101 gillnet and District 104 purse seine fisheries. Accurate estimates of the stock-specific catch in commercial fisheries of each nation are required to estimate the total return of these stocks, and the percentage of each stock caught in treaty-limited fisheries.

Challenges in accurately estimating stock-specific catches and total returns in the early years of the agreement resulted in an extensive investigation by the bilateral Northern Boundary Technical Committee of the run reconstruction modeling process currently used. The Committee concluded that improved stock identification techniques are needed to accurately evaluate effectiveness and improve, if possible, existing run reconstruction methods. Further the panel recommended that direct sampling of a high proportion of the catch is preferred to the reconstruction model process.

This program is a follow up to the initial 2 year project funded in 2004. The initial funding intended for 2004 and 2005 was also carried over to cover 2006 DNA analysis. This project proposal provides funding for 2007 and 2008 on-water sampling (matched scale and DNA samples) of the seine and gillnet fleets for the times and areas not covered by the ongoing basic sampling program and for the subsequent analysis costs. The program will allow for complete sampling from all Area 3 and outside Area 4 fisheries for all weeks with significant catch as requested by the northern panel.

Project did not commence Final Report unavailable.

Northern Boundary Area Sockeye Genetic Stock Identification. Year 2

Project Lead: Richard Wilmot, Supervisory Research Geneticist, NOAA-NMFS-AFSC, Auke Bay Laboratory, Juneau, AK.
Project Cost: $218,200 US

Provisions of the 1999 Pacific Salmon Treaty (Chapter 2) specify harvest sharing arrangements of Nass and Skeena River sockeye salmon returns for the U.S. and Canada. The United States is allowed to harvest a fixed percentage of the annual allowable harvest (AAH) of Nass and Skeena sockeye stocks in Alaska's District 101 gillnet and District 104 purse seine fisheries. Accurate estimates of the stock-specific catch in commercial fisheries of each nation are required to estimate the total return of these stocks, and the percentage of each stock caught in treaty-limited fisheries. Annual catches over or under the agreed percentage are made up for in subsequent years.

The Alaska Department of Fish and Game has used scale pattern analysis (SPA) successfully for over two decades to estimate contributions of Nass, Skeena and Southeast Alaska sockeye stocks to fisheries in southern Southeast Alaska. Recently the Canadian Department of Fisheries and Oceans has applied genetic stock identification techniques (DNA analysis) to estimate sockeye stock compositions in selected

Canadian Boundary area fisheries. Additionally, the two agencies have compared SPA and DNA analyses in limited sample sets from Alaska's District 101 gillnet fishery. Results of these tests show that, although the two methods provide similar estimates on matched samples from mixed stock fisheries, DNA analysis is slightly more accurate and is able to discriminate stocks at a finer scale than SPA. Using the additional 15 SNP loci developed by ADF&G has the potential for greatly increasing the precision and accuracy of stock composition estimates in the Area 101 and 104 fisheries. Simulation results obtained by ADF&G on the Bristol Bay sockeye salmon baseline using the extended SNP markers showed greater than 90% accuracy by stock. New baseline samples of British Columbia and southeast Alaska sockeye salmon stocks are being obtained in the fall of 2006, and a 39 SNP marker baseline should be available by the summer of 2007. (Pers. Comm., Chris Habicht, ADF&G) An additional advantage of the DNA technique is that it is capable of providing results on an in-season basis for use by fishery managers because, unlike SPA, it does not require annual sampling to establish an annual 'escapement baseline'. In Alaska this project would provide funding for stock identification of weekly samples from commercial catches in the District 101 gillnet fishery and District 104 seine fishery using the 39 SNP baseline developed by ADF&G. Approximately 500 samples per week will be collected from the 2007 District 101 gillnet fishery and the District 104 seine fishery will be analyzed in 2007 and 2008 (Approximately 6,000 samples total). In addition, the 6,000 fishery samples collected in 2006 will be analyzed for 39 SNP markers rather than the 25 SNP markers originally proposed. In addition, 10 populations of approximately 100 fish per population from southeast Alaska and northern British Columbia will be added to the baseline for the 39 SNP markers.

Northern Boundary Area Sockeye Salmon Genetic Stock Identification For Year 2006 and 2007 District 101 Gillnet and District 104 Purse Seine Fisheries. *Final Report*

Population Estimate Using DNA Analysis for Alsek River Sockeye Salmon. Year 2

Project Lead: Bill Waugh, Senior Fisheries Technician, DFO Whitehorse, Yukon.
Project Cost: $21,200 CAN $18,932 US

Interest has been expressed in the feasibility of conducting a commercial fishery for sockeye salmon in the Canadian portion of the Alsek River drainage. In order to manage such a fishery, it is neccessary to determine the productive capacity of the drainage and establish an escapement goal. To achieve this, current run sizes and the production generated in subsequent returns must be determined. This project aims to provide managers the information necessary to execute a commercial fishery in Canada and refine the tools being used to manage the commercial fishery in the U.S. portion of the Alsek River. Through current DNA analysis, it is proposed that scale samples from the U.S. commercial fishery in Dry Bay be utilized to determine stock specific contribution rates for stocks which have a developed baseline. The results from the DNA analysis will be used to generate an abundance estimate for the drainage, as well as an estimate for stocks with a developed baseline. It is hoped that pending the results of the program (a similar project for 2005 was funded) that a low cost means of developing a drainage wide estimate for sockeye on the Alsek River can be achieved and will provide managers the results necessary to develop a reliable escapement goal for sockeye salmon. DNA analysis of ~500 Alsek River sockeye scale samples taken in the U.S. fishery will be conducted at DFO's molecular genetics lab in Nanaimo to develop weekly contributions for sockeye stocks with developed DNA baselines. The Klukshu sockeye weir count (potentially the count from Village Creek) will then be used to estimate the weekly Klukshu (Nesketaheen) contribution at Dry Bay and then expanded to generate a drainage-wide estimate by statistical week, which combined, will estimate the overall sockeye escapement.

Population Estimate for Alsek River Sockeye Salmon 2006. *Final Report*

Northern and Transboundary Sockeye Salmon Matched Scale-Tissue Sampling

Project Lead: Glen Oliver, Fisheries Biologist, Alaska Department of Fish and Game, Douglas, AK.
Project Cost: $107,075 US

Current Pacific Salmon Treaty agreements specify a percentage of the total return (catch plus escapement) of Nass, Skeena, and Stikine sockeye salmon stocks that may be harvested in selected Southeast Alaskan fisheries. To calculate the total return of each treaty stock it is necessary to estimate the number caught in all significant fisheries. These stock identification estimates have been provided for Alaskan fisheries since 1982 using scale pattern analysis. While scale analysis is accurate it requires months of repetitive work on the part of highly trained technicians, annual re-sampling of escapements, and can only identify a limited number of stock groups. In contrast, genetic analysis is relatively automated, can quickly process thousands of samples, can theoretically identify individual stocks with higher accuracy in less time, and does not require annual escapement baseline re-sampling. The genetic escapement baselines are nearly complete and appear to successfully identify important boundary area stocks of sockeye salmon. However, since all the Southeast Alaska estimates back to 1982 are based on scale pattern analysis the two analyses need to be run side by side on matched scale-tissue samples to identify any systematic bias. Obtaining matched samples from fisheries under treaty harvest sharing agreements, or where significant numbers of treaty stocks are harvested, will facilitate this transition.

Northern & Transboundary Sockeye Salmon Matched Scale-Tissue Sampling. *Final Report*

Kitwanga River Sockeye Salmon Enumeration. Year 4

Project Lead: Mark Cleveland, Head Biologist, Gitanyow Fisheries Authority, Kitwanga, BC.
Project Cost: $35,000 CAN $31,255 US

Kitwanga sockeye originate from Gitanyow Lake, one of the ten important wild Skeena River sockeye producing lakes. They are genetically unique and spatially separated from other Skeena River sockeye populations (no gene flow). Historically, sockeye escapement to Kitwancool numbered in the 10's of thousands per year. However, today only a fraction of these historical sockeye escapement numbers persist. Stock assessment patterns for Kitwanga sockeye over the last 50 years show extremely low but stable escapement trends, and presently the stock produces less than 5% of its potential. Reasons for the Kitwanga sockeye decline are believed to be linked to 100 years of over harvest in the commercial fishery at the coast and a 40-year legacy of poor forest harvesting techniques in the Kitwanga Watershed that has changed the ecology of the system. Some of the adverse effects to Gitanyow Lake and subsequently Kitwanga sockeye include changed drainage patterns, increased sediment input and increased macrophyte growth.

The specific objectives that will be achieved through the implementation of this project in 2007 include the accurate determination of Kitwanga sockeye salmon population health through the collection of escapement data and improve fisheries management through accurate inseason run timing for Kitwanga sockeye. A secondary objective includes the data collection of chinook, pink, chum and coho salmon escapement to the Kitwanga River for 2007. The data collected will not only provide indications of Kitwanga salmon health but the data will also give incite into the health of all middle Skeena salmon stocks with similar run timing. Another objective that will be achieved through the implementation of this project will be provided through the creation of employment opportunities in the Communities surrounding the Kitwanga River.

Kitwanga River Sockeye Salmon Enumeration, 2007. *Final Report*

Rivers Inlet Echo Sounding Program (Sockeye). Year 2

Project Lead: David Stevenson, Rivers and Smith Salmon Ecosystem Planning Society, Comox, BC.
Project Cost: $87,561 CAN $78,192 US

The primary purpose of the Rivers Inlet echo sounding project is to index the returning abundance (using acoustics) of Owikeno Lake sockeye in Rivers Inlet as a possible in-season management tool. Current escapement estimation procedures for Owikeno Lake sockeye are neither sufficiently reliable nor timely enough to assist in in-season fishery management decisions. A historic echo sounding program (1967-1991) provided managers with an early indication of stock abundance and assisted with in-season management of the commercial gillnet fishery (Goruk and Thomson 1988). Assessing adult escapements more accurately will improve our understanding of stock status and allow for improved in-season management of recovering Rivers Inlet sockeye when fisheries re-open. This project builds on the results obtained in a Northern Fund supported echo sounding study conducted in Rivers Inlet in 2006.

Specifically, this project will lead to:
1. Improved in-season management of Rivers Inlet sockeye, and;
2. Increase the potential for harvest of Rivers Inlet sockeye.

Estimating Relative Abundance of Rivers Inlet Sockeye Salmon: 2007. *Final Report*

Skeena Sockeye Lakes Hydroacoustic Survey. Year 2

Project Lead: Allen Gottesfeld, Head Scientist, Skeena Fisheries Commission, Hazelton, BC.
Project Cost: $30,898 CAN $27,591 US

The prime objective of this project is to provide a juvenile sockeye population estimate for Lakelse, Kalum, Alastair and Sicintine Lakes. Lakelse, Kalum and Alastair Lakes have been surveyed in the past and our proposed surveys would follow the exact same survey design. The survey design for Sicintine Lake which has not been previously surveyed will be developed by DFO experts at the Cultus Lake Laboratory.

Sockeye juvenile samples will also be retained to provide information on growth rates, feeding behavior and total population biomass. These data will also be used to assess fry recruitment and spawning success for the lakes where adult spawner numbers are known. The hydroacoustic survey results may also be used in the future as a comparison when evaluating the success of potential sockeye recovery activities.

The hydroacoustic equipment consists of a Biosonics DT-X split beam echosounder with a 200kHz transducer producing a 6^{o} beam. Acoustic data are digitally recorded on a PC and analyzed using Echoview which is the industry's leading software. This portable equipment allows for helicopter or fixed wing delivery of the equipment which is critical to many Skeena sockeye lakes where there is no other method of access. Fish are captured by a 2x2 meter trawl and two variable mesh floating Swedish gillnets. Mapping will be produced by trained GIS technicians using ArcInfo.

Skeena & Nass Sockeye Lakes Hydroacoustic Surveys Report 2007. *Final Report*

McDonald Lake Sockeye Salmon Escapement Estimate

Project Lead: Todd Johnson, Alaska Department of Fish and Game, Division of Commercial Fisheries, Ketchican, AK.
Project Cost: $93,000 US

Historically, McDonald Lake near Ketchican has been the largest sockeye salmon producing system in southern Southeast Alaska. This stock represents the largest contributor of wild Alaskan sockeye salmon to the commercial net fisheries in southern Southeast Alaska, and tagging studies in the early 1980s showed that a small portion of this stock is also harvested in treaty-area fisheries. Because of its importance, McDonald Lake is the only wild Alaskan sockeye stock that is specifically identified in the Gazey and English sockeye salmon run-reconstruction model currently used by the Northern Boundary Technical Committee (NBTC) of the Pacific Salmon Commission to allocate harvests of sockeye salmon in the boundary area. Since 1984, we have estimated the sockeye salmon escapement at McDonald Lake through a standardized series of annual foot surveys of the spawning stream. The escapement estimates are calibrated to total weir counts from 1983 and 1984. We believe this method is sufficient to monitor this stock, and is better than "peak-count" methods; however, with only two years of comparisons to weir counts, we cannot be sure that this series is scaled to a value that even approximates the true escapement magnitude in any particular year.

We propose a study to estimate the escapement of sockeye salmon at McDonald Lake through a two-sample mark-recapture study in conjunction with radio telemetry, foot surveys, and observer counting-error studies. Our project will provide much needed information about the mortality rate of tagged fish, stream life, and the occurrence of lake spawning. We will develop an area-under-the-the curve estimator, calibrated to our mark-recapture estimate, which will provide much improved estimates of the sockeye salmon escapement at McDonald Lake.

Sockeye Salmon Mark-Recapture and Radio-Telemetry Studies at McDonald Lake in 2007. *Final Report*

CHINOOK SALMON

Chinook Salmon SNP Development

Project Lead: Terry Beacham, Research Scientist, MGL, Pacific Biological Station, Nanaimo, BC.
Project Cost: $35,000 CAN $31,255 US

Development of a standardized baseline for use in DNA stock composition estimation of chinook salmon has been an objective of the PSC's Chinook Technical Committee. Accordingly, the CTC funded through Letter of Agreement (LOA) funds the creation of a multi-agency consortium of genetics laboratories that became known as the Genetic Analysis of Pacific Salmon (GAPS) collaborative effort. Six US laboratories were initially in the GAPS consortium, along with the Molecular Genetics Laboratory (MGL) at DFO's Pacific Biological Station. The GAPS consortium agreed to survey 13 microsatellite markers, standardize observations among participating laboratories, and make the baseline available to the many agencies with interests in stock identification applications. The baseline included populations from southeast Alaska to California. This microsatellite baseline development is continuing. Concurrent with the development of the microsatellite baseline, the CTC funded development of single nucleotide polymorphism (SNP) markers for chinook salmon. In a project just finished, the CTC funded three US labs to develop some SNP markers, and five laboratories (4 US based plus the MGL) to survey SNPs in test populations in their respective geographic locations.

In phase 2 of the SNP project funded by the CTC and in this particular case the Northern Fund, the GAPS laboratories will continue development of additional SNP markers. The SNPs produced will likely be merged with SNPs from the GAPS development project earlier supported by the CTC and then likely with the existing GAPS microsatellite database for stock ID applications. Hence, this new combined marker database will offer increased transportability among cooperating research agencies. The main project benefit should be the production of a SNP baseline coordinated with US colleagues that will enable development, evaluation and possible application of SNPs to the estimation of stock composition of chinook salmon in mixed-stock fisheries, should SNP analyses prove to be feasible economically.

Chinook Salmon SNP Development. *Final Report.*

Queen Charlotte Islands Sport Chinook DNA Stock Composition. Year 3

Project Lead: Ivan Winther, Fisheries Biologist, DFO, Prince Rupert, BC.
Project Cost: $35,000 CAN $31,255 US

The QCI sport fishery is one of the fisheries defined within the Aggregate Abundance Based Management Regime by the PST. This fishery has grown to catches of ~70,000 chinook salmon annually. Chinook stock composition data is used in-season to manage fisheries with the ultimate objectives of defining stock specific fishery impacts and productivity estimates to ensure that chinook stocks are perpetuated and to avoid stocks of concern. For example, Canada currently has domestic concerns for weak stocks on the West Coast of Vancouver Island (WCVI). DNA data are used to estimate stock compositions and contributions to the fishery and may also be compared with the results from coded wire tag (CWT) data. CWT data support the chinook model currently used by the PST to set international chinook allocations.

Specifically, this project will collect DNA samples from chinook salmon caught in the Areas 1 and 2 sport fishery allowing an estimation of sport fishery impacts on chinook by stock. These data will be used in the assignment of chinook mortalities for the purposes of specific stock management (e.g. WCVI chinook or local concerns for Yakoun River or Kwinamass River chinook) and for accounting of Nisga'a Treaty entitlements. Funding only applies to the DNA analyses. Sample collection will be accomplished through existing creel survey programs and voluntary participation by the commercial sport industry. The results of DNA stock composition data are delivered annually back to the fishing community and the public during the post season review process. Stock composition data are also provided to the volunteers that have collected the data, to inform them of their contribution to the project.

Stock Composition of Chinook Salmon Caught in the Queen Charlotte Islands Sport Fishery in 2007. *Final Report*

Population Estimate Using DNA Analysis for Alsek River Chinook Salmon 2007

Project Lead: Bill Waugh, Senior Fisheries Technician, DFO Whitehorse, Yukon.
Project Cost: $20,000 CAN $17,800 US

Interest has been expressed in the feasibility of conducting a commercial fishery for Chinook salmon in the Canadian portion of the Alsek River drainage. The US has also expressed interest in increasing opportunities to fish Alsek Chinook salmon. In order to be able to manage such a fishery, it would be vital to determine the productive capacity of the drainage and would require the establishment of an escapement

goal. To achieve this, it would be necessary to determine the current run sizes and the production generated in subsequent returns

Prior to 1997, the Alsek River chinook salmon escapement was unknown because stock assessment projects to determine system-wide escapements had not yet been developed. Escapements were known for the Klukshu River, which has a salmon counting weir run by DFO in co-operation with the Champagne-Aishihik First Nation. An escapement goal was developed for the Klukshu River in 1998 but very little else was known about the magnitude of run sizes and system wide production capacity. In 1997, a pilot project was initiated to determine the feasibility of assessing the drainage wide escapement for Chinook salmon. After achieving the objectives of the 1997 study, the program was continued from 1998 through to 2004. Results provided sound estimates of the Chinook salmon escapement within the Alsek River drainage but the program was cancelled before the returns of Chinook from these estimates could be assessed. This created a large data gap and managers were unable to develop a defendable drainage-wide escapement goal.

In this project, DNA will be analyzed from ~600 Alsek River chinook tissues samples (up to 100/week) taken in the U.S. commercial/test fishery in 2007 at the Molecular Genetics Lab at the Pacific Biological Station in Nanaimo to develop weekly contributions for chinook stocks with developed DNA baselines. The Klukshu chinook weir count will then be used to estimate the weekly Klukshu contribution at Dry Bay and then expanded to generate a drainage wide estimate by statistical week, which combined, will estimate the overall chinook escapement.

Population Estimate for Alsek River Chinook Salmon. *Final Report*

Chinook Salmon Stock Composition of Southeast Alaska Fisheries. Year 2

Project Lead: William Templin, Fisheries Geneticist and Lisa Seeb, Fisheries Scientist**,** Gene Conservation Laboratory Alaska Department of Fish and Game – Commercial Fisheries Division, Anchorage, AK.

Project Cost: $313,434 US

The use of genetic stock identification to estimate mixture components of Chinook salmon harvests is well established in the scientific literature. Between 1999 and 2003, the State of Alaska used genetic stock identification based on a coastwide allozyme database (Teel et al. 1999) to estimate the composition of the commercial troll fishery harvest (Crane et al. 2000; Templin et al. *in revision*). At the same time, samples were collected from sublegal-sized Chinook salmon encountered in the summer troll fishery, providing important information for evaluating assumptions of stock-specific survival rates. Initial estimates demonstrated that the stock composition of the sublegal encounters was substantially different than assumptions used for management purposes (Bloomquist and Carlile 2002).

Recently the Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC) has explored the inclusion of genetic stock identification estimates as part of the decision-making process. To make this possible, the Genetic Analysis of Pacific Salmonids (GAPS), a cooperative project among ten laboratories to develop a standardized DNA database for stock identification of Chinook salmon, was funded by Letter of Agreement. This process began in 2002, and a standardized baseline became available during the summer of 2005. (Moran et al. 2006; Seeb et al. *in revision*). The first versions of the baseline contains allele frequencies at 13 microsatellite loci from 110 populations (Seeb et al. *in revision*; Appendix 1) contributing to PSC fisheries, ranging from the Situk River in Alaska to the Central Valley of California. Initial results indicate that 42 regional groups can be identified in mixtures with acceptable accuracy and precision (Moran et al. 2006; Seeb et al. *in revision*). More populations will be

added to the baseline over the next few years, extending and deepening its coverage. In addition, beginning in 2005 the CTC funded the expansion of the database to include single nucleotide polymorphisms (SNPs; Smith et al. 2005a, b).

Beginning in 2003 genetic stock identification was extended to cover the troll, seine, gillnet, and sport fishery harvests of Chinook salmon in Southeast Alaska waters with the intent to use the recently-developed baseline of DNA-markers. This included stock identification of sublegal-sized Chinook encountered in these fisheries. Funding for stock identification of these harvests will end September 2007. This project will extend genetic stock identification of Chinook salmon harvested or encountered in the commercial troll and sportfish fisheries in Southeast Alaska until the close of the summer fisheries in September 2008. Stock composition estimates will also be provided for the gillnet harvest in the District 108 and 111 directed fisheries in 2008. This project will provide estimates of the stock composition of Chinook salmon harvests in selected SEAK fisheries for each stock group present for an additional year.

Chinook salmon stock composition of Southeast Alaska fisheries, 2008. *Final Report*

Morice River Chinook CWT Group

Project Lead: Mike O'Neill, Manager, Toboggan Creek Salmon and Steelhead Enhancement Society, Smithers, BC.
Project Cost: $68,386 CAN $61,069 US

There is presently no CWT marked group of chinook representing the largest component of the Skeena run, these being the mid-timed (June 15th to July 15th) portion of the population in the upper Skeena watershed. Mid-timed stocks are the Morice, Kispiox and Sustut stocks, with the Morice stock historically having the highest escapements of the three. A CWT mark group representing these mid-timed upriver stocks would provide in-season abundance estimates and provide for better-informed management decisions. There also exists the possibility for an accurate estimate of catch, escapement and exploitation in future years.

Initially, the first year of the program would entail reconnaissance, broodstock collection, egg takes and over-winter incubation and monitoring. Subsequent years, up to a full 5-year cycle will involve annual rearing, marking and release. A tag group of Morice chinook should provide the same type of valuable information now available from the Toboggan Creek coho CWT group.

Final Report for Morice Chinook CWT Group Project (2007/2008). *Final Report*

Chickamin River Chinook Salmon Coded-Wire Tagging and Escapement Sampling. Year 2

Project Lead: Red Weller, Alaska Department of Fish and Game, Douglas, AK.
Project Cost: $84,904 US

This stock is included in the escapement indicator stocks used by the Chinook Technical Committee of the Pacific Salmon Commission to judge stock status of naturally spawning chinook salmon stocks coast-wide, and to judge performance in Chapter 3 of the June 1999 Agreement. Recoveries of CWT tagged fish will allow managers to estimate the tagging fraction and to estimate the harvest in all marine fisheries where coded-wire tagged fish are sampled and to expand them by the correct expansion factor. The data will be used to revise escapement goals and improve fishery management needed to achieve maximum

sustained yield from this stock. Providing high-quality escapement enumeration data for index stocks of chinook salmon and ensuring these data meet minimum USCTC standards is important to abundance-based management of PSC chinook fisheries for two reasons. First, the CTC uses the CTC chinook model to evaluate potential coast-wide fishery management options being considered or planned by the PSC and/or other fishery management agencies as well as to assist in evaluating fishery management decisions already made. Abundance indices in the CTC model are based, in part, upon escapement data. A second reason this work is important is for stock specific, rather than coast-wide, implementation of abundance-based management regimes. Existing commercial and sport fisheries in SEAK could be used to fine-tune management of Behm Canal chinook salmon. Surplus production could be harvested in terminal or near terminal fisheries if data limitations concerning stock status were adequately addressed and if accurate pre-season forecasts were developed for use in pre-season and in-season management. With the data gaps addressed, an abundance-based approach for specifically managing Behm Canal stocks of chinook can be developed. This project will also improve our understanding of chinook spawning and rearing habitat.

Chickamin River Chinook CWT Project July 1, 2006- June 30, 2009. Final Report

Chilkat River Chinook Salmon Coded Wire Tagging Project. Year 2

Project Lead: Rich Chapell, Assistant Area Management Biologist, ADF&G – Sport Fish Division, Haines, AK.
Project Cost: $89,330 US

The Chilkat River produces the third or fourth largest population of chinook salmon in Southeast Alaska. Chinook salmon escapement to the Chilkat River has been estimated annually since 1991 by on-going mark-recapture programs with escapements ranging from 2,035 to 8,100 large (3- to 5-ocean-age) fish and an average precision (CV) of 15%. A biological escapement goal of 1,750 to 3,500 large chinook salmon was adopted for the Chilkat River in 2003. The CTC uses a Chinook Model for various analyses. One important output from this model is estimation of an annual Abundance Index (AI) that is used to specify annual harvest limits in aggregate abundance-based management regimes (AABM). Southeast Alaska (SEAK) sport, net and troll fisheries are to be managed under an AABM approach. The stepped catches are based on the annual AI generated from the CTC Chinook Model. At present, the CTC Chinook Model includes one SEAK "model stock" in the annual AI. Inclusion of a single SEAK stock has limitations because: 1) the escapements of the five largest chinook salmon stocks in SEAK are not included and 2) differences in distribution and exploitation of the six stocks that are included warrant further separation. For that reason, ADFG has developed data for five separate model stocks that utilize escapement data for SEAK/TBR stocks and proposes to include them in the CTC modeling process when capabilities and agreement exist to include more stocks in the Chinook Model. Of interest in this project is the SEAK Northern Inside model stock, which would be weighted heavily toward the Chilkat River data because of its stock size in relation to that of the King Salmon River stock.

A mark-recapture experiment will be used to estimate the abundance of Chinook salmon fry rearing in the Chilkat River during the falls of 2006 and 2007. This funding will be used to capture, cwt and mark fry each fall as the first of two sampling events. Returning adults will be sampled for marks during ongoing inriver escapement programs (separate funding) between 2008 and 2013 as the second sampling event. In addition, recovery of Chinook salmon bearing Chilkat River cwt's in marine commercial and sport fisheries will allow us to estimate total harvest of this stock.

Project in progress Final Report to be submitted in June 2009.

Southeast Alaska Chinook Salmon Age, Sex, Length

Project Lead: Keith Pahlke, Fishery Biologist III, Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau, AK.
Project Cost: $98,972 US

This project will help improve abundance-based management of Southeast Alaska (SEAK) Chinook salmon through refinement of Chinook Technical Committee (CTC) Chinook model inputs, MSY escapement goals, and forecasting tools.

The King Salmon River is located on Admiralty Island southeast of Juneau and supports a small run of Chinook salmon. The Keta and Blossom rivers are located in Behm Canal near Ketchikan and also support small runs of Chinook salmon, numbering approximately 500 to 2,000 fish annually in escapement. Andrew Creek is a tributary of the lower Stikine River and supports a moderate run of Chinook salmon, averaging about 1,500 large Chinook spawners. These four stocks of Chinook are all harvested in SEAK fisheries and the Behm Canal stocks are also harvested to a minor extent in northern British Columbia fisheries. All four of these Chinook salmon populations are used as escapement indicator stocks by the CTC of the Pacific Salmon Commission (PSC). Escapement indicator stocks are used by the CTC to judge stock status of naturally spawning Chinook salmon stocks coast-wide, from SEAK through Oregon. The United States Section of the CTC (USCTC) developed data standards desirable for stock specific assessments of escapement, terminal runs, and forecasts of abundance against which existing stock assessment programs could be evaluated (USCTC 1997).

The USCTC (1997) report made specific findings relative to the current stock assessment program for all U. S. escapement indicator stocks relative to these data standards. The King Salmon River Chinook salmon stock assessment program failed to meet minimum data standards because age and sex composition of the annual escapements were not annually sampled. The Keta and Blossom Chinook salmon stock assessment programs failed to meet minimum data standards developed by the USCTC because of two reasons: (1) age and sex composition were not sampled on an annual basis, and (2) numerical index expansion factors specific to these rivers had not been verified. The USCTC (1997) recommendations for SEAK included:

> "*Develop permanent annual age and sex composition sampling of escapements for several river systems that are currently not sampled.*"

Since 1998, the Alaska Department of Fish and Game (ADF&G) has addressed these concerns with several programs, including mark-recapture studies on the Blossom and Keta rivers to estimate the escapement by age and the survey expansion factor, and age, sex and length (ASL) sampling programs to estimate the composition of the Chinook salmon escapement to all four systems. Funding has been provided by the CTC for implementation of the U.S. Chinook Letter of Agreement (LOA) and the Southeast Sustainable Salmon Fund.

This proposed project by ADF&G will continue annual sampling of escapements for age and sex composition. This project will maintain minimum USCTC standards relative to age and sex sampling for stock assessment programs on the Blossom, Keta and King Salmon rivers and Andrew Creek.

Bringing the stock assessment program for SEAK Chinook salmon up to minimum USCTC standards is important to abundance-based management of PSC Chinook fisheries for two reasons. First, the stock assessment data obtained through these programs is used by the CTC and in the CTC Chinook model, which in turn is used to evaluate potential coast-wide fishery management options being considered or planned by the PSC and/or other fishery management agencies, as well as to assist in evaluating fishery management decisions already made. Data quality has limited the CTC and PSC in the past and as the

PSC and coast-wide fishery management agencies shift to abundance-based management regimes, higher quality stock assessment data will be needed to ensure that both conservation and allocative fishery management objectives are realized.

 *Southeast Alaska Chinook Salmon Age, Sex, Length Project.* Final Report

The Long Lake Watershed Chinook Escapement Study

Project Lead: David Stevenson, Rivers and Smith Salmon Ecosystem Planning Society, Comox, BC.
Project Cost: $48,000 CAN $42,864 US

During the completion of the Rivers and Smith Inlets Recovery Plan in 2000, Long Lake chinook were identified as a high priority stock for recovery. Prior to initiating specific recovery efforts, additional information on stock status, habitat utilization, etc. was required. A report, *"Long Lake Chinook Salmon – an examination of their habitat, stock status, life history and future (McCorquodale, 2003),"* reviewed existing information on the stock, and revealed that historic escapement estimates may not be representative of true escapements, and that areas within the Long Lake watershed, other than the Docee River, were once the preferred spawning areas for these chinook.

The primary objectives of the study will include:

- The enumeration of adult chinook salmon using mark-recapture methodologies
- The comparison of mark-recapture enumeration results against the Docee Enumeration Fence results, in an attempt to determine if fence counts can be relied upon as an enumeration tool for chinook.
- The tagging of adult chinook with radio transmitters in an attempt to determine watershed distribution, habitat utilization, and run timing information.
- The collection of ancillary biological data, such as DNA baseline samples, age and sex data to improve stock identification.

The proposed study is relevant to the Pacific Salmon Treaty and the strategic objectives of the Northern Fund. Significant portions of Central Coast chinook populations are harvested in Southeast Alaska and Northern BC, as well as in the Central Coast (PFRCC, 2001). Although Docee Chinook have never been coded wire tagged (cwt'd) they are assumed to be a northerly migrating stock similar to the Wannock chinook located in an adjacent inlet. The Docee chinook population has been used in the past as a wild chinook indicator, however, due to the difficulty in obtaining reliable population estimates it has been dropped in recent years. Conducting a mark-recapture experiment in conjunction with the existing fence program may provide the data required to use future fence counts in determining more reliable escapement estimates for the Docee River.

 *Docee Fence Co-Management and Capacity Building Initiative Docee Chinook Radio Tagging Study 2007.* Final Report

Habitat-Based Chinook Escapement Goal Calibration: Clear Rivers in Northern BC. Year 3

Project Lead: Ivan Winther, Fisheries Biologist, DFO, Prince Rupert, BC.
Project Cost: $48,100 CAN $42,953 US

The Pacific Salmon Treaty outlines tasks for the Chinook Technical Committee (CTC), which include establishing MSY or other biologically-based escapement goals. Chinook escapement goals are used in

the management of ISBM fisheries (Appendix to Annex IV, Chapter 3, para. 4, p. 35), as well as triggers for additional management actions for both ISBM and AABM fisheries (para. 9, p. 39). Typically MSY escapement goals are calculated from stock-recruitment analyses of several years of spawner escapements and subsequent production. The approach can take several years (15-20) to acquire sufficient data and often requires considerable resources. For these and other reasons, many stocks do not have sufficient spawner and production data to estimate optimal spawning escapements. Consequently, habitat-based methods have been developed as low-cost, quick alternatives.

The habitat-based approach will be used to estimate the optimal spawning escapements based on the size of the watershed used by the stock. The model was developed from stock-recruitment estimates of optimal spawning escapements for stocks ranging from coastal Oregon to the Yukon drainage in Alaska. The model has been verified with independent estimates of optimal spawner escapements and was used to establish escapement goals for data limited stocks in Alaska.

In Northern BC, abundance indices for chinook salmon are chiefly generated from visual surveys during the peak of spawning activity. Little information exists from this area to convert spawner indices to total escapement estimates. Since rivers can be grouped by common visual counting conditions that influence the accuracy of counts (e.g. river size and water clarity), we propose several studies on rivers with similar counting conditions to calculate stream-specific expansion factors and average-stream expansion factors. With this information, we will assess the expected bias from applying an average-stream expansion factor with respect to data standard guidelines being developed by the CTC.

This project is a continuation of a project funded by the Northern Endowment Fund in 2005 & 2006. We will generate expansion factors for visual escapement indices at two sites, a coastal stream and a tributary of the Skeena River. On the Kateen River, a mark-recapture program will provide an escapement estimate with a reasonable level of accuracy (within CTC guidelines) to allow for the development of an expansion factor relative to the visual index of escapement. On the Kitwanga River the project is the inverse; we will generate visual indices of chinook salmon escapement for a system where a true estimate of escapement is derived from a counting fence.

Calibration of 2007 Chinook Salmon Escapements to Two Clear Rivers in Northern B.C.
Final Report

COHO SALMON

Taku River Coho Salmon Escapement and Smolt Tagging Augmentation. Year 2

Project Lead: Ian Boyce, Stock Assessment Biologist, DFO, Whitehorse, YT.
Project Cost: $49,272 CAN $44,000 US

The stock assessment program for coho salmon originating from the Taku River is a cooperative effort between the Alaska Department of Fish and Game (ADF&G), Fisheries and Oceans Canada (DFO), and the Taku River Tlingit First Nation (TRTFN). Each spring since 1991, coho salmon smolts have been tagged with coded wire tags as they emigrate from the Taku River. Then in the following year, returning adults are sampled for these tags using fishwheels and set gillnets operated near Canyon Island in the lower Taku River. At the same time, adults are tagged as part of a two-event mark-recapture study to estimate in-river abundance and sampled for age, sex, and length composition data. A short distance upriver, in Canada, adults are inspected in the commercial gillnet fishery. Typically the commercial fishery ceases in late August and it is necessary to obtain tag ratio information by contract. Data gathered from these efforts has provided estimates of in-river abundance and escapement since 1987, estimates of

harvest, exploitation, survival, smolt abundance, and total run since 1992, and run forecasts since 1996. These combined efforts in-river along with adult sampling programs in the various marine fisheries allow detailed stock assessment analyses. Because of the many fisheries that utilize the Taku River stock of coho salmon and the need for a biological escapement goal on adult coho salmon and newly implemented directed chinook salmon fisheries, the researchers propose that the Northern Fund augment the existing budget to: (1) allow the addition of another smolt trapline in order to boost chinook and coho smolt tagging numbers and the associated coded wire tag marked fractions, (2) allow the operation of the coho adult tagging project through the first week of October to encompass the majority of the adult run, and (3) run the coho recapture effort through the duration of the tagging project. Coho salmon returning to the Taku River pass through an offshore troll fishery before entering inside waters where they encounter seine, drift gillnet, and recreational fisheries. After entering the river, the remaining coho salmon are exposed to a drift/set gillnet fishery in Canada. Such a resource is worthy of a stock assessment program that directly estimates production parameters such as harvest, escapement, exploitation rate, smolt production, survival rates and brood year production. This project will provide annual estimates of escapement necessary to refine escapement goals and forecast runs. Improved escapement goals and run forecasts along with in-season abundance estimates allow for the implementation of abundance-based management.

Taku River Coho Salmon Escapement and Smolt Tagging Augmentation 2007. *Final Report*

In-Season Forecasting of Regional-Scale Abundance of Northern BC Coho Salmon

Project Lead: Sean Cox, Assistant Professor, School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC.
Project Cost: $36,805 CAN $32,867 US

Several northern BC coho salmon populations, including populations from the Upper Skeena River, are considered a conservation concern because abundances are well below historical escapement levels. In-season forecasting for northern BC coho salmon currently relies on the assumption that returns to a few indicator stocks are representative of hundreds of other stocks (Cox et al. 2003). The risk involved with this approach is that selected indicators over-react or under-react to productivity changes compared to larger-scale stock aggregates. Such deviations may ultimately lead to overexploitation on one hand, or lost fishing opportunities on the other. Furthermore, because the current forecasting framework predicts marine survival as opposed to total coho abundance, the procedure will likely fail to meet harvest and conservation objectives for years in which marine survival is high but total abundance is actually low due to low brood-year escapement and freshwater production. When this is the case, there would be a high risk of overexploitation. To address these two concerns, we propose to calibrate current forecasting models to large-scale, regional escapement indices based on visual surveys that are performed on hundreds of northern BC streams each year. Because coho populations from northern BC and southeast Alaska tend to have co-varying escapement, we would additionally like to include coho populations from southeast Alaska in our analysis, which may provide additional information on regional escapement trends. The end-product of our research will be a forecasting tool that provides in-season measures of run-strength reflecting large-scale changes in northern BC coho salmon abundances.

In-season Forecasting of Regional Scale Abundance of Northern BC Coho Salmon. *Final Report*

Babine River Remote Video Enumeration of Coho

Project Lead: Barry Finnegan, Biologist, DFO, Smithers, BC.
Project Cost: $34,150 CAN $30,496 US

Babine coho are a key stock and the focus of PST discussions prior to the 1999 PST arrangement. This project will form part of the North Coast coho assessment program and will improve the data available for managing North Coast coho stocks. Specifically the project addresses the long-standing problem of accurately assessing the escapement of coho into Babine Lake and its tributaries. The timing of coho migration is variable from year to year due to temperature and water levels. In some years it appears that a significant portion of the coho escapement is counted at the Babine weir before October 1. However, there are indications that migration of coho can continue past this site well into December. The cost of running a manned operation for this period of time is prohibitive. Further, migration patterns suggest that coho may only actually migrate during short periods of time. Therefore there are very long periods of time where no fish migrate. This makes a manned operation virtually impossible. We propose to modify two of the counting bays on the Babine River fence and install 12 volt digital cameras and recorders to count coho and other species migrating upstream. The cameras will operate on an event basis, only recording periods when fish are migrating. Power will be supplied by batteries which will be constantly charged using submersible micro-hydro generators. The system will be unmanned which will reduce staffing and camp operating costs. Digital images will be downloaded weekly for the first year to a CD. These images will be reviewed and fish numbers by day will be generated. This will provide a permanent record of species and time of migration.

Results of the Babine River Remote Video Enumeration Project. *Final Report*
Please contact PSC for accompanying report pictures.

Middle-Nass Mark-Rate Sampling Program for Adult Coho Salmon: Seaskinnish Weir Program

Project Lead: Cheryl Stephens, Nisgaa Fisheries Program Manager, New Aiyansh, BC.
Project Cost: $67,000 CAN $59,831 US

The uncertainty in mark-recapture rates for Middle and Upper Nass coho salmon reduces the reliability of the annual escapement estimates generated each year especially if Meziadin River is used as the only mark-recapture site (i.e., estimates may be severely under-estimating the Middle/Upper Nass coho population). Accurate adult escapement and mark rate information at systems other than Meziadin River, would allow managers to estimate more precisely the system-wide coho salmon escapement and harvest rates for Middle and Upper Nass coho stocks. These estimates are critical for the abundance-based management of Nass coho stocks and treaty implementation (i.e., US - Canada and Nisga'a - Canada Treaties).

The proposed study has four objectives: 1) install and operate an adult weir at Seaskinnish Creek using materials from Kwinageese River, 2) enumerate coho salmon (and any other salmon species entering the system) using underwater video, 3) collect mark-rate data for Nass coho and 4) improve our understanding and methodologies for generating escapement estimates and pre-season/in-season forecasting for Upper Nass coho stocks.

The techniques and methods to be employed would be similar to past fence studies conducted on the Kwinageese River since 2002. A floating style weir and digital video fish-counting system would be installed in Seaskinnish Creek prior to mid-August and run into November (final date to depend on daily counts of coho and environmental factors). Results from the 2005 telemetry study found that coho did not

arrive in the Seaskinnish before late August. The use of this proven video detection system allows for the installation of a weir capable of withstanding infrequent pulses of high water on the Seaskinnish. All data from the weir would be reviewed and published in a technical report (DFO manuscript series).
The tagging and mark-recapture estimate procedures would be similar as performed for the past 15 years and documented in the annual Nisga'a Fisheries fishwheel technical reports (DFO manuscript series; e.g., Alexander and Bocking 2004). Any changes to the final escapement estimates for Middle/Upper Nass coho based on results from this study (i.e., if the combined mark-rate of Meziadin and Seaskinnish would be used in the final estimates) would be documented in the 2007 Nass fishwheel Report.

The Seaskinnish Creek Weir Project 2007: Mark-Recapture Sampling Program for Middle & Upper Nass River Adult Coho Salmon Stocks Caught & Tagged at the Gitwinksihlkw Fishwheels. *Final Report*

MULTI-SPECIES

Stikine, Taku, and Alsek River Sockeye and Chinook Salmon Baseline DNA Profiles. Year 2

Project Lead: Sandy Johnston, DFO, Whitehorse, on behalf of Transboundary Technical Committee.
Project Cost: $183,000 CAN $163,400 US

Improved in-season stock specific management of Transboundary River (Stikine, Taku and Alsek rivers) salmonids is required to meet stock specific spawning goals and harvest shares. In-season catch estimates based on historical stock compositions from scale pattern analysis (SPA) are often unreliable and tend to differ significantly from post season estimates. There is also a need to truth the present stock identification techniques used in the management of some transboundary sockeye salmon. The techniques presently used include SPA, egg diameter measurement, and brain parasite prevalence. Presently there are only limited tools to assist managers in stock specific management of Chinook and coho salmon, primarily mark-recapture experiments and tag recoveries on the spawning grounds.

Once baselines are established/refined, they will be used in the analyses of mixed stock fisheries located in Canada and the U.S. to determine run timing and catches of specific transboundary river salmon stocks and eventually provide managers with the reliable in-season stock specific catch numbers where required to improve management regimes. They will also be used to monitor the relative abundance of specific spawning stocks.

Stikine, Taku, and Alsek River Sockeye and Chinook Salmon Baseline DNA Profiles 2007 - 2008 *Final Report* *Appendix 2* *Appendix 3* *Appendix 4*

Remote-sensed Approach to Mapping and Quantifying Important Salmon Habitat Indicators in the Lower Taku River, and Assessing Potential Enhancement Opportunities for Sockeye and Fall Chum Salmon

Project Lead: Brian Frenette, Alaska Dept of Fish and Game, Sport Fish Division, Douglas, AK and Mitch Lorenz, National Marine Fisheries Service, Auke Bay Lab, Juneau, AK.
Project Cost: $143,300 US

The Taku River watershed is a large 4.5 million acre, glacial transboundary river system producing some of the largest escapements of salmon in Southeast Alaska that provides many social and economic

opportunities to a variety of users. The Taku River basin is predominately pristine, with very little development posing threats to important habitats necessary for ensuring the sustainability of these important salmon stocks. However, very little is known about how these important habitats are distributed within the basin, and less is know about how these habitats have changed naturally over time due to ecological succession and changes in climatic/hydrologic regimes.

This project will enable managers and researchers of both countries to: gain a better understanding of important spawning and rearing habitats through identification and delineation of habitat extents in the Lower Taku River; assess and integrate historical information acquired in the 1980's to begin evaluating large-scale habitat changes and habitat use by salmon; utilize the resulting products to begin to better understand factors that affect overall salmon production (e.g., the amount of spawning and rearing habitats necessary to sustain salmon populations to meet established escapement goals); and by providing information necessary for evaluating and directing restoration and enhancement efforts for stocks of interest (i.e., sockeye and chum salmon).

The proposed project also addresses three provisions under Chapter 1 (*Transboundary Rivers*) of the 1999 Annex (Annex IV) by beginning to: 1) identify the spatial distribution of habitats (spawning and rearing) necessary to evaluate spawning escapement requirements; and 2) assess information necessary for developing habitat-based tools that may be better suited for achieving preliminary escapement goals in absence of full stock assessment programs; and 3) provide information necessary to evaluate the feasibility of enhancement potential on transboundary rivers.

Project terminated in 2008.

Skeena River Juvenile Chinook and Coho Habitat

Project Lead: Allen Gottesfeld, Head Scientist, Skeena Fisheries Commission, Hazelton, BC.
Project Cost: $115,864 CAN $103,467 US

The juvenile habitat and behaviour patterns of Skeena chinook & coho are poorly known. The purpose of this project is to sample juvenile salmon, and their distribution and downstream migration timing in the Skeena River freshwater habitat.

There are four large chinook populations in the Skeena: Kitsumkalum River, Morice River, Babine River, and Bear River. Juvenile chinook leave these natal streams within a month or two of emerging from the gravel. When they return as adults, their scales show that they spent a year in fresh water. We do not know where they spend their first year. Defining the rearing habitat of Skeena chinook would help with predicting chinook productivity and aid in protecting habitat.

Coho salmon habitat in small streams has been extensively sampled. It is generally realized that some coho are displaced downriver from initial stream habitat. In Skeena and Nass River coho smolt marking programs, unmarked adults often return in numbers larger than predicted by the marking program. Where these coho rear is largely unknown. Therefore, we would expect mainstem coho to have diverse origins. In this proposal sampling of coho would be opportunistic.

Understanding the spatial and temporal linkages to habitat distribution and utilization patterns will support decision-making tools for stock assessment and habitat managers in regard to potential juvenile production and limiting factors, especially for stocks of harvest or conservation interest.

Stock-Specific Distribution of Juvenile Chinook Salmon in the Skeena River, BC 2007-2008. *Final Report*

Coastal Area 3 Escapement and Enhancement Monitoring: Kincolith Weir Upgrade

Project Lead: Cheryl Stephens, Nisgaa Fisheries Program Manager, New Aiyansh, BC.
Project Cost: $76,000 CAN $67,868 US

Annual estimates of Nass area coastal returns of Chinook, pink and chum are derived from visual surveys (aerial and ground) conducted by DFO on one to six Area 3 coastal indicator systems (Nass JTC 2004). Fence studies conducted on two of the indicator systems in 2001 and 2002 [Kwinamass (Bussanich et al. 2003) and Kincolith rivers in 2001 (Sviatko and Baxter 2002) and 2002 (Baxter et al. 2005)] found that aerial surveys were under-estimating the true abundance of either Chinook or pink salmon by up to sixfold (Bussanich et al. 2003). In addition, chum returns to Area 3 have been declining but the method of determining escapement has not been reliable to properly assess the status of the returns. Thus the proposed study would benefit fishery managers in collecting more reliable data for improving stock assessment escapement estimates for Chinook, pink and chum salmon stocks in Area 3.

This project is for replacement of the old weir panels and video system from the past Kincolith fence studies with new equipment and the collection of accurate escapement estimates on the Kincolith River for Chinook, pink and chum (from May to October) to assist in calibrating visual counts and estimating total aggregate escapements to Area 3 for these species in the future. In addition to improving the accuracy of generating estimates of Area 3 coastal returns for Chinook, pink and chum, the weir program would provide an opportunity for the Kincolith Hatchery to collect Chinook and chum for enhancement purposes. Chum are unable to be captured for broodstock without the use of fence program due to relatively low numbers returning and protracted timing of the return of the run (i.e., no areas to collect broodstock). Adult coho salmon would also be enumerated and assessment information (e.g., run timing, abundance trends over time, etc.) collected during the study but the duration of the weir operation would not cover the entire run of coho salmon.

The Kincolith River Weir Program 2007: Coastal Area 3 Escapement and Enhancement Monitoring. *Final Report*

Slamgeesh Weir Upgrade

Project Lead: Peter Hall, Fisheries Biologist, Gitksan Watersheds Authority, Hazelton, BC.
Project Cost: $92,874 CAN $82,937 US

A well known problem of managing the Skeena sockeye fishery is the large run of enhanced and highly productive Babine sockeye that co-migrate with other less productive and smaller distinct wild salmon stocks. These less productive stocks limit the exploitation on the Babine stocks which can support high exploitation rates. Better understanding of the health of smaller wild sockeye stocks, which includes Slamgeesh, would help to fine tune the management of the Skeena mixed stock fishery.

A second rationale for the project involves coho management. Drastic declines in coho returns to the upper Skeena in the late 1990's precipitated severe curtailment of Canadian commercial fisheries directed on these stocks or their co-migrants. The Pacific Salmon Commission Northern Boundary Technical Committee recommended the development of coho indicator stock projects in the upper Skeena which would entail estimation of smolt production, provide coded-wire tags for determination of exploitation rates and enumeration of adult returns over a variety of escapement levels and in general "resolve questions about the adequacy of spawning escapements in the upper Skeena and the carrying capacity of interior coho habitats relative to coastal streams".

The Slamgeesh Lake field station was set up in 2000 with the goal of becoming a long-term sockeye and coho full index site for the upper Skeena Watershed. It is a small salmon producing system with simple hydrology enabling fairly simple technology to be used for stock assessment. Sockeye and coho adults have been enumerated by the GWA annually since inception using a temporary weir on Damshilgwet Creek downstream of Slamgeesh Lake. All salmon are marked with tags and re-sighted above Slamgeesh Lake on the primary spawning grounds to correct for potential weir leakage or failure. The temporary weir was expected to last two years but has served for seven years, with frequent repair. A civil or mechanical engineer will be contracted to develop the design of the weir in consultation with the GWA Head Scientist. The target for the new weir will be 100% capture efficiency for all salmon species including sockeye jacks.

Slamgeesh Fence Rebuild 2007. *Final Report*

Stikine River Coded Wire Tagging Augmentation. Year 2

Project Lead: Pete Etherton, Senior Stock Assessment Technician, DFO Whitehorse, Yukon.
Project Cost: $67,200 CAN $60,009 US

This project is directly linked to the requirement in Annex IV, Chapter 1, paragraph 3(a)(2&3) of the PST to develop and implement abundance-based management regimes for Stikine chinook and coho salmon. In addition, the chinook component will help refine the management regime of the new 'directed chinook salmon fisheries' which were agreed to by the Transboundary Panel, commencing 2005. The data derived from this project will be used to determine the distribution, run timing and magnitude of marine catches of adult Stikine chinook and coho salmon. In addition, the project provides the means to estimate chinook salmon smolt abundance (which then can be used to monitor marine survival and refine escapement goals).

Since 2000 Canada and the US have been conducting coded wire tagging (CWT) projects on Stikine River chinook and coho. Since its inception, the CWT tagging goals of 25,000 chinook and 25,000 coho smolts have not been achieved consistently. Through funding provided by the Northern Fund for this project in 2006, additional staff and support resources were provided which resulted in a record catch of 48,000 chinook smolts and 32,000 coho smolts. This proposal requests funding to continue with the required augmentation to the existing CWT project and further requests a multi-year agreement through to June 2009.

By again increasing field staff and the requisite equipment and supplies, it is anticipated that the annual tagging goals of 40,000 chinook and 25-30,000 coho will be met. Further, it is anticipated that a renewed interest in the in-river commercial harvest of coho salmon will occur due to the increase in coho prices in 2005 and 2006. It is also anticipated that the annual coho test fishery will be funded by DFO in 2007 which will provide a rough measure of run size and a relatively precise picture of run timing. Returning CWT-marked coho will be collected from both fisheries.

Stikine River Chinook and Coho Salmon Coded Wire Tagging Augmentation, 2007. *Final Report*

A Feasibility Study to Determine the Potential to Develop a Stock Assessment Tool on the Cranberry River

Project Lead: Mark Cleveland, Head Biologist, Gitanyow Fisheries Authority, Kitwanga, BC.
Project Cost: $15,000 CAN $13,350 US

The Nass River is the third largest in BC providing a multitude of fishing opportunities for Aboriginal, commercial and sport fishermen in both salt and freshwater in Alaska and Canada. The Cranberry River is a major tributary to the Nass and it produces a good portion of the overall salmon returns in Area 3 on a yearly basis. Presently, the management of Nass River salmon is conducted through a mark-recapture program implemented by the Nisga'a Government Fishwheel Program. Overall this type of management ensures the sustainable use of the aggregate salmon returning to the Nass River in any given year. However, the strength of any mark-recapture program relies on the ability to recapture tagged fish in individual streams. Presently there are reliable recapture locations for sockeye and to some extent chinook salmon. Re-capturing marked coho and steelhead in the Nass Watershed has proven problematic because these stocks usually enter the rivers when waters are higher and more turbid.

Therefore, in an attempt to complement the Nisga'a Fishwheel mark-recapture program the Gitanyow Fisheries Authority (GFA) are proposing to conduct a feasibility study on the Cranberry River to attempt to find suitable locations for the establishment of a long-term stock assessment tool, which could efficiently enumerate coho, steelhead and possibly chinook in the Cranberry River system. If a stock assessment tool could logistically and economically be established and operated on the Cranberry River on an annual basis, information such as recapture rates from fishwheel tagged salmon could compliment the Nisga'a Fisheries Program. This information will allow for better management of salmon stocks in the Nass as a whole. In 2006 the Gitanyow Fisheries Authority partnered with the Nisga'a Government to jointly collect salmon mark recapture rates in the Upper Nass through Gitanyow Food fishery and escapement walks. To date the partnership has been deemed a huge success. The Gitanyow would like to expand this partnership in the future to provide better population size data for Cranberry River salmon, which will benefit both Nations, Canada and Alaska through improve fisheries management.

Project in progress Final Report to be submitted in December 2008.

Taku River Fish Wheels

Project Lead: Ed Jones, Fisheries Biologist, Alaska Department of Fish and Game, Douglas, AK.
Project Cost: $56,750 US

The Pacific Salmon Treaty directs the U.S. and Canada to manage chinook, sockeye, and coho salmon fisheries using abundance-based management regimes. Information gathered from fish wheel catches of chinook, sockeye, and coho salmon is necessary for estimating in-river run sizes, escapement, and age, sex, and length composition. The fish wheels are used annually as part of "event one" of a "two-event" mark-recapture project for each species. Index catch information is also gathered on pink and chum salmon along with steelhead. Escapement estimates coupled with harvest estimates are used to calculate total run and exploitation rates and to track harvest sharing. The Taku River produces large annual runs of these three species: 50,000 to 100,000 adult chinook, 150,000 to 350,000 adult sockeye and 150,000 to 400,000 adult coho salmon. Chinook and coho salmon smolt abundance and marine survival are also estimated from information gathered in fish wheel catches.

The two fish wheels operated at Canyon Island were built in 1990 and 1995, respectively, and funds will be used to replace the oldest fish wheel with a new one and for maintenance. The design of the present

baskets and axles, which are modifications from the existing structures, and the design of the 1995 frame and floatation system will be used as they have a proven track record since implementation. The floatation system is aluminum floats with multiple compartments and reinforcing channels. The axle and basket brackets are steel. The basket ribs are aluminum based structures, with some wooden components. The catch material on the baskets is seine webbing, which is secured with cable ties. A new fish wheel is necessary and long overdue as the loss of any fish wheel at Canyon Island seriously jeopardizes our ability to estimate run strength and all party's ability to manage for abundance.

Taku River Fish Wheels. *Final Report*