

# Docee Fence Co-Management and Capacity Building Initiative Docee Chinook Radio Tagging Study 2007



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For the Pacific Salmon Commission

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## **INTRODUCTION**

The Gwa'sala-'Nakwaxda'xw Nation traditionally occupied the land and waters of Smith and Seymour Inlets. These coastal inlets are home to several salmon stocks, including Long Lake sockeye, coho, and chinook. 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 they are assumed to be a northerly migrating stock similar to the Wannock chinook located in an adjacent inlet. With the recent commercial closures within the Rivers and Smith Inlet region, current data on exploitation is limited. The commercial fishery, however, prior to its complete closure in the mid 1990's, harvested as many as 2,850 adult chinook annually from Smith Inlet waters (DFO Catch Data, 2004). Furthermore, harvesting of the Docee River chinook for food, social and ceremonial purposes by the Gwa'sala-'Nakwaxda'xw Nation has occurred for thousands of years. Recreational anglers continue to take some fish from local stocks each year.

One of the most interesting aspects of the Long Lake chinook stock is their large size (over 80lbs) and the opinion, by some, that a portion the population were lake spawners (Gwa'sala-'Nakwaxda'xw Nation Fisheries Department 2004). Lakeshore spawning is not unheard of in chinook life history, but this behaviour is known primarily in landlocked populations (Scott and Crossman, 1973). Lakeshore spawning populations of chinook salmon appears to be extremely rare in Pacific, anadromous populations.

In an effort to gain a better understanding of the Long lake chinook (both numbers and distribution), an intensive mark-recapture/deadpitch program commenced in 2007. As opposed to a conventional mark recapture program, this study also relied on the use of esophageal radio tags to track the movement of tagged fish. This project was a coordinated effort which incorporated a number of user groups including: the Department of Fisheries and Oceans, the Rivers and Smith Inlets Salmonid Ecosystem Planning Society (RRSEPS) and the Gwa'sala-'Nakwaxda'xw Nation. The project sought to achieve four broad objectives, which form the outline of discussion within this report.

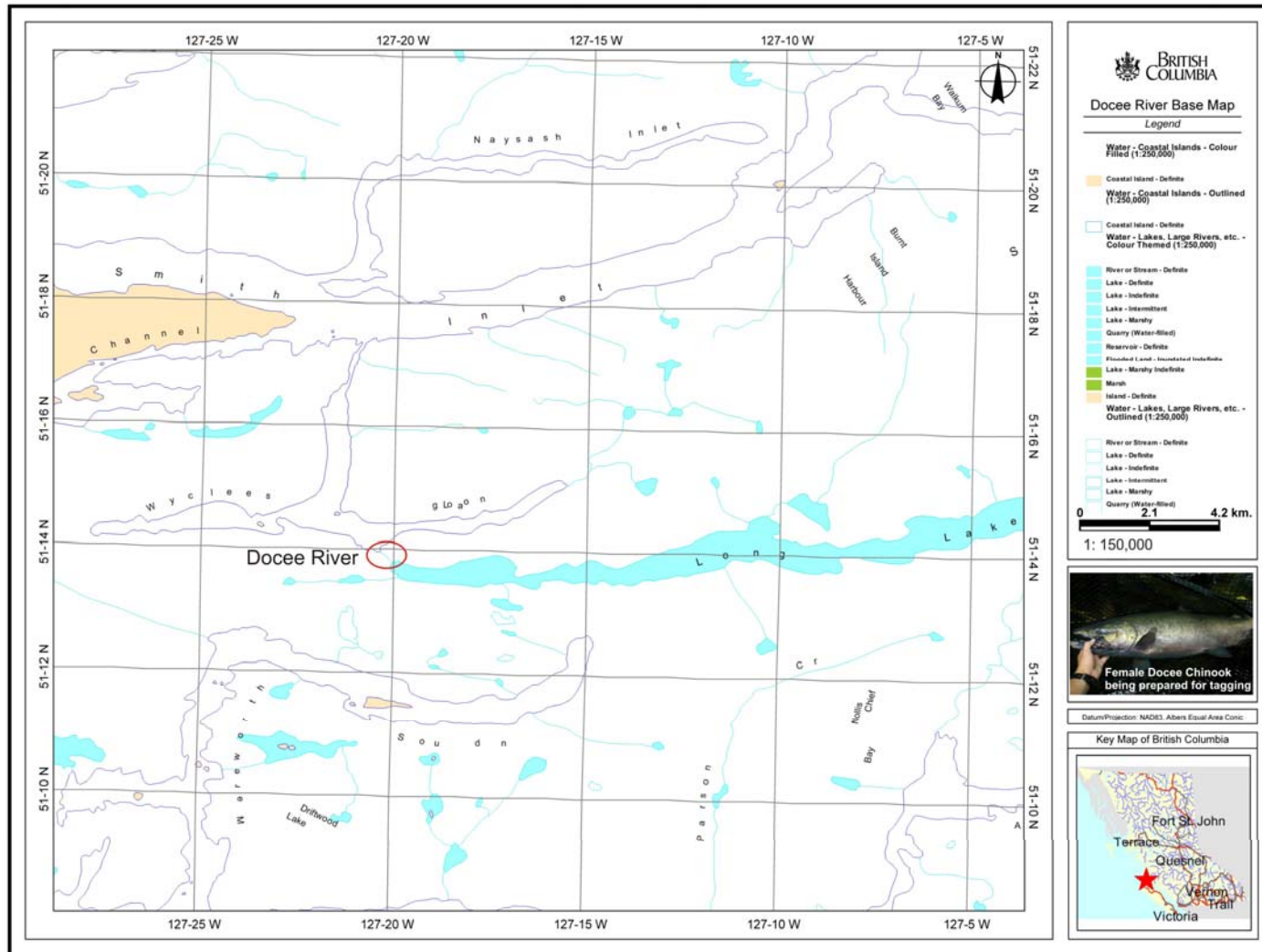


Figure 1. General location map of the project site within Smith Inlet. The Docee River drains into Wyclees Lagoon near the entrance to Smith Inlet.

## **DESCRIPTION OF PRINCIPAL ACTIVITIES**

### **Objective 1**

Enumeration of adult chinook escapement via the employment of a standard Peterson mark-recapture analysis was expected to provide a statistically defensible estimate of escapement. The fence, angling, and beach seining were to result in enough captured individuals to tag (either Floy and / or radio). Dead pitching, use of a carcass collection net, as well as scuba retrieval were expected to result in sufficient recaptures to produce reliable estimates using the Peterson formula.

### **Objective 2**

Comparison against fence counts (photo 1). With the recent video improvements made at the Docee River Counting Fence, the facility was to provide an accurate total estimate of those individual chinook which migrated into the lake (the fence does not provide any information on river spawners that do not reach the fence). It was hoped that this project would provide additional information on those individual fish dropping out of the lake to spawn in the Docee River.

### **Objective 3**

Radio tagging to determine distribution and habitat usage. The fence provided a true closed system. With the lake being a single body (i.e. few bays or arms) and only 3 tributaries, the system lent itself well to radio tracking.

### **Objective 4**

The collection of ancillary biological data (i.e. DNA) were to be collected and provided to the DFO for analysis and addition to existing databases.



Photo 1. Docee River counting fence 2007.

## **METHODOLOGIES**

### **Sampling**

Docee River chinook were captured using angling methodologies. Large single barbless hooks baited with coloured wool and fresh salmon roe were presented at or near the river bottom using a gear combination similar to that used when angling steelhead (i.e. a floating bobber attached to a weighted leader line which could be adjusted for depth). Sampling efforts took place throughout the river in a variety of habitats, however efforts were focused primarily on pool and run habitats. Fish were played for as little time as possible in an effort to limit stress to the fish.

Carcass recovery efforts employed the use long gaffs and small boats to look for and collect mortalities throughout the river, estuary and lake. In addition, a portable radio receiver was used in an attempt to located tagged fish.

## **Fence Enumeration**

Docee chinook were enumerated as they passed through the counting fence by trained Gwa'sala-'Nakwaxda'xw Nation crew members with several years of experience. In general, chinook were easy to differentiate from other species due to their large size. The number of fish observed passing through the fence was then compared to past data and those data collected from a radio receiving station located several metres upstream of the fence.

## **Tagging**

Captured fish were quickly moved into large recovery tubes which were specially designed to help to calm and control captured fish (i.e. large and dark with mesh to allow for water movement). Secured recovery tubes faced upstream in an area with gentle current to allow fish to 'breathe' with minimal effort. Once the fish was secured and positioned Floy and radio tags were inserted. Floy tags were inserted using a tagging gun into the dorsal portion of the fish immediately behind the dorsal fin (photo 2). The tag number was recorded and the tag was checked to ensure that it was properly inserted.

An esophageal radio tag was also inserted into the stomach of each captured fish. To accomplish this, each tag was lubricated and pushed into the fish's stomach using a narrow, rounded doweling that had been modified to ensure that it was smooth and free of protruding slivers or burrs (photo 3). A total of at least three crew members were utilized during this process to ensure that the fish was kept in a neutral position (i.e. immobile) and that the tagging was completed as quickly as possible. Once the tag was inserted the antenna was gently angled alongside the fish's body to prevent it from being chewed through or tangling in debris. Fish were then kept in their respective recovery tubes for at least 4 hours. This step was necessary to ensure that fish had recovered sufficiently to be released and also to ensure that the tag had not been regurgitated.



Photo 2. Floy tags were inserted near the anterior of the dorsal fin



Photo 3. Tags were inserted using a smooth, rounded doweling



### **Ancillary Biological Data Collection**

The collection of ancillary biological data was collected during the fish tagging process. Captured fish were gently placed in recovery tubes and allowed to rest. Scale samples were then taken at the appropriate location (generally at a 45° angle between the lateral portion of the dorsal fin and the lateral line). DNA was also gathered through the collection of an opercular punch (photo 4). Opercular samples were immediately placed in a preservative solution while in the field. This opercular punch also acted as a secondary mark (tag). Length, girth and other meristic information was collected and the general health of each individual fish was assessed.



Photo 4. A sample of the operculum was collected for DNA analysis and to act as a secondary mark.

## **PROJECT RESULTS AND DISCUSSION**

### **Sampling**

In the summer of 2007, the Docee River was assessed to determine the most appropriate sampling technique. Initially the counting fence itself was considered as a possible option as fish are funneled through a relatively small area as they pass upstream into the lake. However, due to the speed in which fish pass through this partial barrier and the number of chinook present when compared to other fish species, the capture of chinook for tagging at this location would have required significant effort and a great deal of luck. Furthermore, daily nearshore sampling to qualify species composition had not, historically, allowed for the capture of Chinook. As such sample collection at this site was deemed unfeasible and other methodologies were pursued.

Seining (beach and purse) were also considered as options to catch fish for sampling. The river, lagoon and lake were surveyed in an effort to assign appropriate beach seining sites. Due to its nature (fast and deep with significant LWD and SWD) the River itself was unsuitable. Similarly, acceptable beach seine sites did not exist in Long Lake due to extensive woody debris coverage or significant depths. Purse seining via small boat was also determined to be of little use due to the number of chinook salmon entering the Docee River. Although this methodology may have captured some chinook it was more likely to target other fish species (i.e. Coho).

Angling was deemed the most feasible methodology enabling samplers to focus their efforts on specific areas within the river itself (as opposed to the lake or lagoon) and target chinook through the use of appropriate fishing gear (i.e. large hook, large bait etc). Sampling efforts commenced in early August and, initially, the Docee chinook proved to be difficult to capture and no fish were sampled (during the month of August) despite significant effort. However, by the second week of September 2007 chinook were captured readily with the first fish sampled on September 14. A total of 46 Docee River chinook salmon were sampled over a period of 12 days (see appendix A). The last fish was sampled on September 24<sup>th</sup> at which time, despite significant effort, fish were no longer able to be captured due to unseasonably high water levels.

## **Fence Enumeration**

Chinook were enumerated by Gwa'sala-'Nakwaxda'xw crew members as they passed through the counting fence. Chinook counts were based on visual observation only and could not be truthed using the newly installed fence cameras due to technical difficulties. Unfortunately, the newly installed camera, designed to 'truth' visual observations was installed such that an air bubble was present in front of the lens which disallowed the speciation of fish passing through the counting fence. This problem is due to be corrected prior to the commencement of 2008 activities. Daily near shore netting of fish was also completed to supplement visual observations and allow for additional biological sampling to take place. However chinook salmon were not sampled during these efforts. A total of **95** Chinook salmon were observed passing through the fence in the summer of 2007 (photo 5). Due to their large size, chinook salmon are relatively easy to distinguish from other fish species, therefore the number of chinook salmon counted in 2007 is believed to be reasonably accurate.

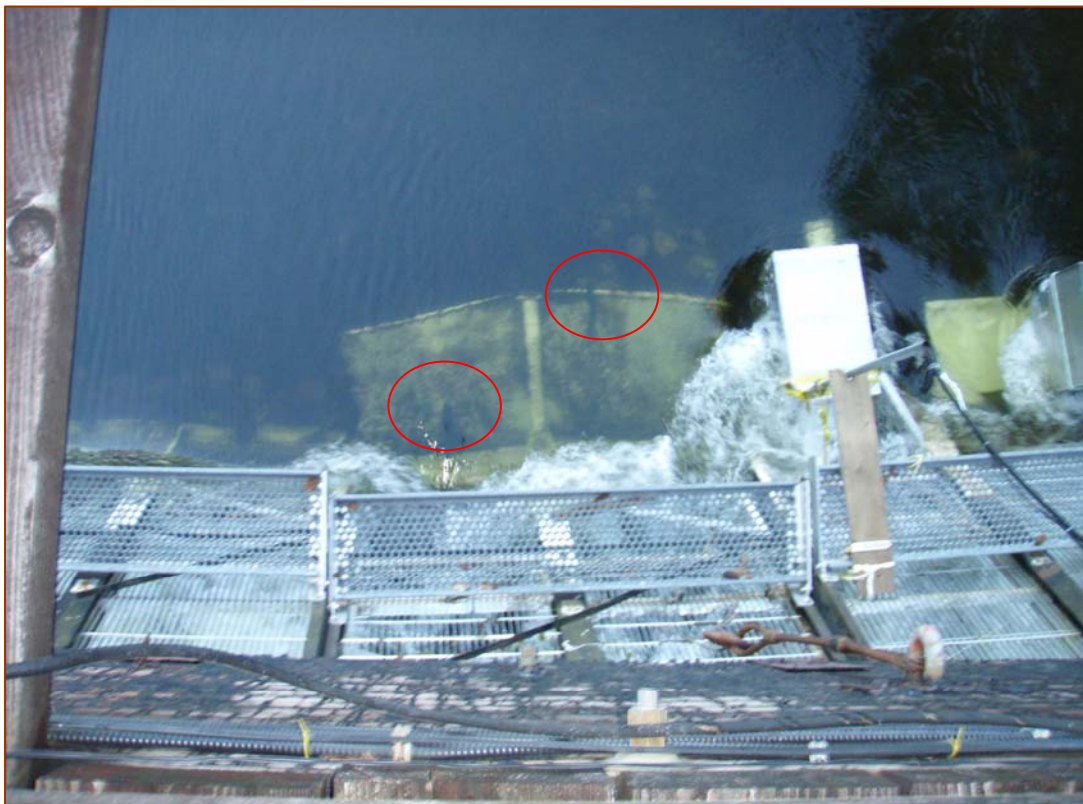


Photo 2. Salmon observed passing through the counting fence.

## **Radio Telemetry**

To track the movement of tagged fish, three radio telemetry receiver stations were set up prior to the tagging effort. Each of these stations was activated on August 20, 2007 (Figure 2):

1. At the mouth of the river
2. At lake outlet (cabin)
3. At a narrowing of the lake approximately 4km upstream from the Cabin.

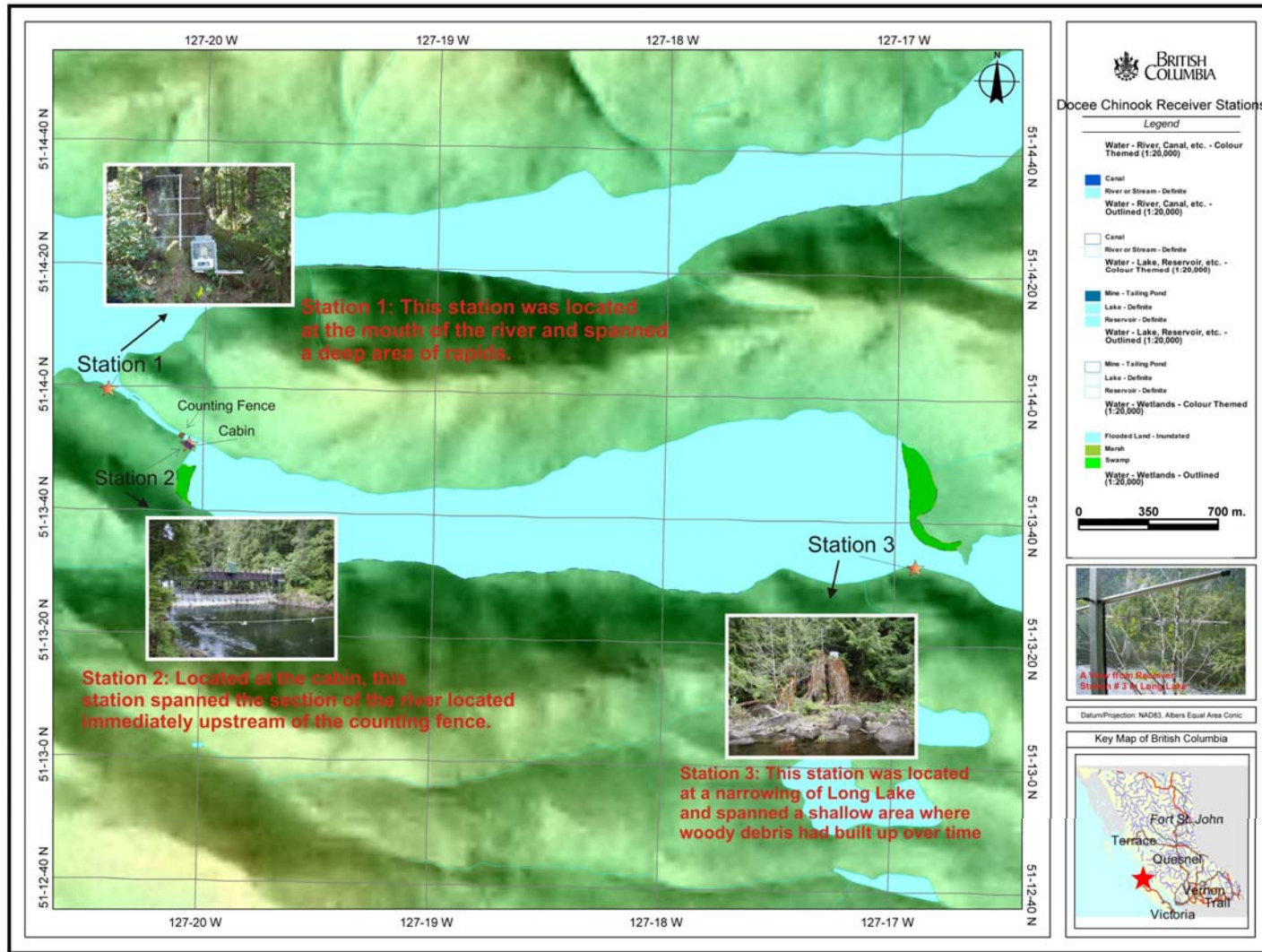


Figure 2. Radio telemetry receiving stations.

At each of these stations extensive testing designed to ensure that gain and other receiver settings were appropriate was undertaken. Receiver batteries were changed as required however; due to inclement weather, which included very cold temperatures, two of the stations (Station 1 and 3) were without power for varying periods over the course of the study. These issues were corrected as soon as weather allowed.

When radio receiver stations are powered down over the course of a study period it has significant connotations in terms of data reliability. The range over which the receiver station can record fish movement is limited, as such, if a fish or group of fish were to pass by an inactive station the overall data set becomes corrupted in terms of its ability to definitively establish fish distribution patterns.

### Fish Distribution

#### *Station 1*

At the mouth of the river 24 separate tagged fish were recorded. This number was lower than expected. The project staff had anticipated this station to record a number close to the total number of tagged fish as they passed downstream and into the ocean. As a result these data can be interpreted in a number of ways. First, it is possible that the significant increase in water and turbidity levels which occurred over the course of the study period allowed fish to pass by station 1 without being detected. This is due to the fact that the effective range of the receiver is dependent on water depth and water conductivity/turbidity. In particular, increases in water conductivity can drastically reduce the effective range of a radio transmission. Secondly, the remaining tagged fish may have stayed within the Docee River system (between stations 1 and 2). However during our dead pitching effort there was no evidence of this despite the use of a portable radio telemetry receiver. In fact, based on our deadpitch data it is possible that high water levels washed almost all of the spawned out fish downstream and into Wyclees Lagoon. It is therefore possible that some fish, which swam or drifted near the bottom of the river during high flows, were not recorded due to increased turbidity/conductivity and water depth. The lack of carcasses observed in the Docee River and Long Lake during the deadpitch effort, it would appear as though the majority of the chinook salmon within

the Docee River swim or are pushed down into Wyclees Lagoon post spawning. See Appendix A for raw data.

### *Station 2*

At the cabin receiver station, three tagged fish (Tag # 75, 107 and 65) were recorded. One fish (tag 75) was recorded a number of times over the course of the study indicating that it was holding in this area (see appendix A for raw data). This station was actively receiving throughout the majority of the radio-tagging project although there were short periods of time where this station was non-operational. Again, during these periods of non-operation fish may have been able to pass by the station and into the lake undetected. Although water depths did increase at this location, turbidity levels remained low as the lake outlet exhibits laminar flow as opposed to the rapids observed at station 1. As such, the project staff is confident that tagged chinook in the vicinity of this station would have been recorded as receiver and antenna gain was such that an increase in water depth would have been tolerable and turbidity levels were low. Thus, it would appear as though very few tagged chinook ventured into Long Lake during the spawning season in 2007. This may indicate that chinook observed passing through the fence are but a small portion of the total population. Furthermore these data may indicate that the fence itself effectively discouraged fish from moving upstream into the lake. Please see Appendix A for raw data.

### *Station 3*

No tagged fish were noted at the lake radio receiving station (Station 3) throughout the course of the study. These data indicate that tagged Docee River chinook did not utilize the upper portions of the lake to any significant degree in 2007. Conflicting data exist with regards to chinook distribution and usage within Long Lake. Anecdotal records indicate that chinook may have spawned along several small near shore gravel platforms within Long Lake ('Nakwaxda'xw Nation Fisheries Department 2005). One such region, and the most often referenced, is located near the lake outlet. Due to a number of factors including the installation of a sheer boom to protect the counting fence, this area is now inundated with woody debris. This woody debris may be

restricting or eliminating spawning within this region of the lake. Members of the DFO who have monitored the Docee River counting fence for over 30 years have indicated that chinook have never been observed to spawn in the lake (Personal Comm. Steve Backing DFO). Due to cold and inclement weather, the batteries at each of the stations (particularly station 3) were unable to be changed on a regular basis. As a result the receivers were not functioning for periods of time (up to 10 days throughout the study period). Thus, based on the data collected over the course of this study it is difficult to draw conclusions as to the degree of chinook lake utilization which occurred in 2007.

It should be noted as well that approximately 95 untagged fish, which were observed passing through the counting fence prior to tagging, seemed to remain holding above the fence at the lake outlet (visual observation), as opposed to moving up the lake. This may be further proof that the stock no longer utilized the lake for spawning.

#### *Mark Recapture*

This project planned to use a mark-recapture technique known as the Peterson mark-recapture, to estimate the total chinook population. This mark-recapture estimator required three processes: capture, marking and re-capture, all of which were to be completed over a reasonably short period of time.

Due to the high water levels which occurred in the Docee River this year only one capture methodology was feasible: angling. This methodology was utilized to capture and tag a total of 46 fish from September 14 2007 through September 26 2007. Each captured salmon was marked with a green Floy tag, and opercular punch for later identification. Each fish was also tagged with an esophageal radio tag in an effort to determine spawning distribution and habitat. Based on previous escapement estimates of chinook salmon in this system, a target of 50 fish was seen as an adequate number to allow for the mark/recapture to be statistically significant.

The original objective called for the random re-capture of tagged Chinook salmon prior to spawning (Nov 2007). However, due to unseasonably high flows, which occurred in the Docee River this year, fish were unable to be re-captured using angling or other methodologies (photo 6). A number of fish were captured during the dead pitch program however only one fish was tagged. As a result, the Peterson mark-recapture



formula could not be utilized to estimate the total population of Docee chinook in 2007.

However, throughout the sampling period not a single fish was re-captured via angling despite the fact that fish were readily sampled using this methodology. This would seem to indicate that there are more fish in the system than was previously estimated.

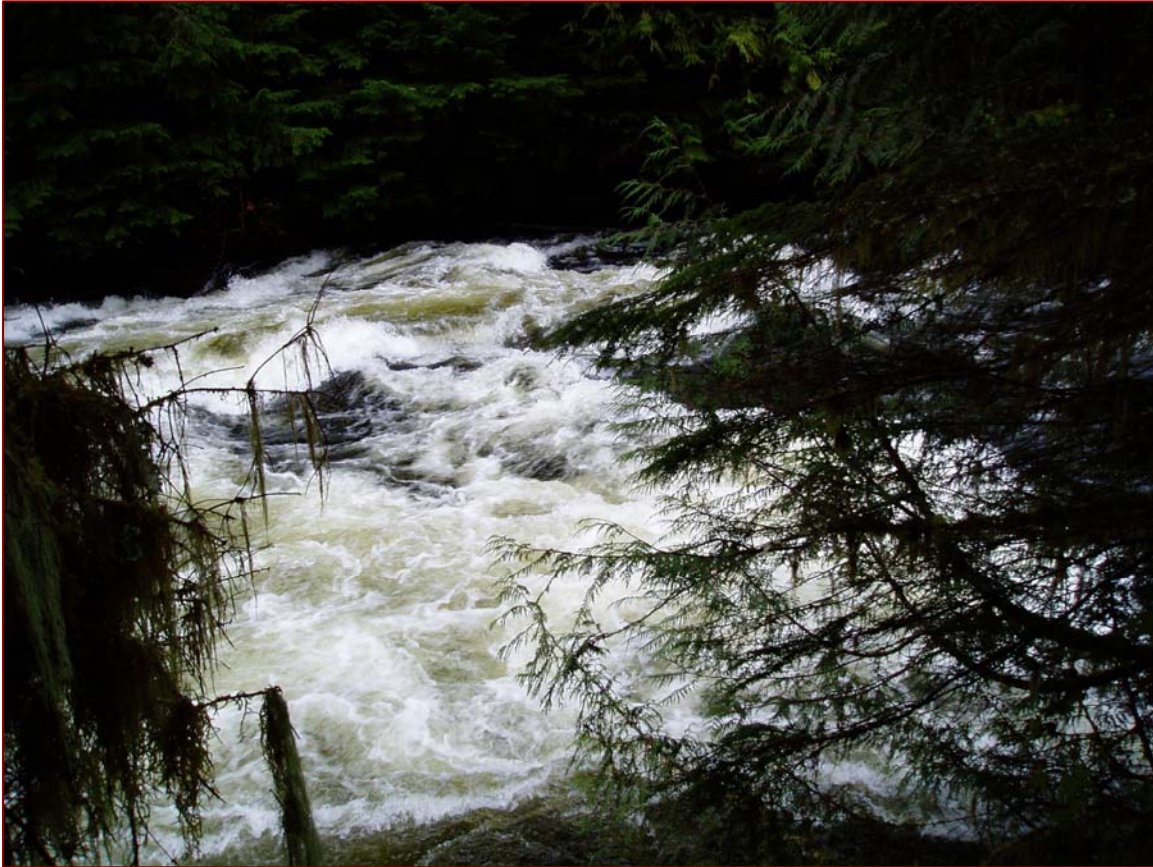


Photo 6. Unseasonably high waters in late September through November 2007 hampered recapture efforts.



Photo 7. An example of high water conditions October 19, 2007. The area shoreward of the red outline is usually dry or partially wetted.

### *Dead Pitch*

A dead pitch effort was put forth near the end of October and into the first week of November. As the fence and camp were no longer occupied by either DFO or Gwa'sala-'Nakwaxda'xw crew members the radio tagging crew completed a SIL approximately once a week (7-10 days) during scheduled battery changes at the radio telemetry receiving stations to determine when a dead pitching effort would be necessary. The first Chinook mortality was noted on October 30 2007. Fortunately, DFO staff members arrived at the fence on October 31 2007 and completed fish recovery activities until a Gwa'sala-'Nakwaxda'xw crew was dispatched on Nov 5 2007. A total of 28 chinook carcasses in various states of decomposition were recovered from October 31 through to November 7 2007. Of these a single tagged fish was recovered (Appendix A). The lack of tagged fish recovered during the deadpitch is more evidence that the population of chinook within the Docee River system is larger than current estimations.

As with all aspects of the 2007 program, the dead pitch was hampered by high water levels and bad weather. Plans to install a 'catch net' at the mouth of the river to collect carcasses were cancelled due to safety concerns for divers. Furthermore, a dive survey of the river and river mouth was not possible due to high flow levels. It would appear as though spawned out fish were quickly pushed out of the system or moved downstream into the lagoon of their own accord. Four days of extensive surveying within the river, lake and most of Wyclees lagoon using a portable radio telemetry receiver did not yield any positive results (i.e. no tagged fish were noted). This portion of the program was discontinued on November 9 2007 due to a lack of carcasses.

#### *Ancillary biological data*

One of the objective of this project was to collect ancillary biological data from sampled fish. This biological data collection took place during the capture efforts in September 2007. Length, sex, DNA, condition and scale sample data were collected from each of the 46 marked fish and each of the 28 fish recovered during deadpitch efforts (DNA and scale samples could not be collected from severely decomposed carcasses). All DNA and scale sample sets were delivered to the Pacific Biological Station for analysis. These data are presented in Appendix A

#### SUMMARY

The 2007 Docee radio tagging effort helped to build capacity within the Gwa'sala-'Nakwaxda'xw Nation in all activities. Four band members were involved with the project, and gained a wide variety of experience in the capture and handling of large fish, the tagging of fish (radio and floy), the recording of data, safety, angling methodologies, as well as the use of a radio-telemetry receiver, and handheld GPS unit. The angling of fish proved to be an effective methodology, which allow for the capture and tagging of 46 individual fish. Ancillary data were also collected from each fish, which will ultimately aid investigations in stock management.

The movements of tagged chinook salmon were tracked throughout the study area. An analysis of the data indicate that the majority of the Docee River chinook tend to remain within the short stretch (~350m) of the Docee River itself during their

migration and spawning cycle (between telemetry stations 1 and 2). A portion of the population, however, do enter the lake although it is believed that they stay close to the lake outlet as evidenced by the lack of recorded movement at station 3 and visual observations at the outlet of the lake. Unfortunately, this year's data are not robust enough to confidently determine the extent of spawning and habitat utilization of chinook salmon within Long Lake. However, habitat deterioration and the counting fence itself may be discouraging or elimination spawning within the lake. No tagged fish were observed or tracked via portable radio receiver within the lake in 2007.

In terms of physically quantified chinook within the Docee River system: 46 fish were tagged, 95 fish were counted moving through the fence and 28 fish were sampled during the dead pitch (with one re-capture). This suggests that, at the very least, several hundred chinook utilized the system in 2007. This indicates that previous estimates regarding the total population of chinook utilizing the system may have underestimated the total abundance of fish.

Unfortunately, due to unseasonably high water levels many of the objects set out at the beginning of this project were unable to be completed. In particular the re-capture effort, including the dead pitch, was hampered by this high water. Trap nets, diving and mortality fencing were unable to be utilized due to safety concerns. Also, the dramatic increase water depth and the resulting turbidity levels may have reduced the effective range of the receiver station at the mouth of the river (Station 1). Finally, inclement weather prevented the project crew from accessing the Long Lake receiving station (Station 3) on a regular basis. As a result this station was not operational for portions of the project which may have allowed tagged fish to move farther up the lake undetected.

Although several important objectives were not achieved over the course of this project there were many successes. Weather was a deciding factor this year which limited accomplishments in several areas. However, the project design was sound. Fish were captured in a timely manner and the receiving stations were appropriately positioned and functioned as intended. Should similar projects occur in the future it is recommended that allowances be made for the possibility of increased rainfall and river discharge. Furthermore, an additional (fourth) portable receiver should be utilized during SIL's. During the dead pitch a portable receiver was used and would have proven an

effective tool to track the habits of tagged fish as it would appear as though the majority of the Docee River chinook remained within the river (between Stations 1 and 2) throughout their spawning cycle.

The Docee River chinook are an important species to monitor. They are a unique sub-species that continue to be of great interest to the Gwa'sala-'Nakwaxda'xw Nation and we believe that future studies are warranted.

REFERENCES

- Gwa'sala-'Nakwaxda'xw Nation Fisheries Department 2005. Long Lake Chinook Salmon - An Examination of their Habitat, Life History, Stock Status, and Future.
- Gwa'sala-'Nakwaxda'xw Fisheries. 2003. Aboriginal Fisheries Strategy Document. Prepared for Fisheries and Oceans Canada.
- Harvey, B. and M. MacDuffee – editors. 2002. Ghost runs – The future of wild salmon on the north and central coasts of British Columbia. Raincoast Conservation Society. Victoria, B.C.
- Riddell, B. 2004. Pacific Salmon Resources in Central and North Coast British Columbia. Prepared for the Pacific Fisheries Resource Conservation Council.
- RSSEPS. 2003. Rivers and Smith Inlets Salmon Ecosystem Recovery Plan. Prepared for the Pacific Salmon Endowment Fund Society.
- Scott, W.B., and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184.

**Appendix A**