LOWER SKEENA CHINOOK TAGGING FEASIBILITY STUDY 2008

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Pacific Salmon Commission
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Kitsumkalum Fisheries
3514 West Kalum Road, Terrace , BC
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[1] Plate, E.M. and K.K. English. 2008. Lower Skeena Chinook Tagging Feasibility Study, 2008. Prepared by LGL Limited, Sidney, BC, for the Pacific Salmon Commission, Vancouver, BC, and Kitsumkalum Fisheries, Kitsumkalum, BC.

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ABSTRACT

The primary purpose of this project was to determine if sufficient numbers of adult Chinook can be caught at sites along the lower Skeena River to provide the fish needed for a full-scale biotelemetry study. If funding will be provided, the full-scale biometry study will assess the distribution, abundance and migratory behavior of Skeena Chinook in 2009. During the 2008 field season, a total of 195 Chinook salmon were caught in 24 days of effort. Mesh size ranged from 8.9cm (3.5 in) to 20.3 cm (8.0 in) and the most common net dimensions were 30 m long and 5 m deep (150 m^2). The average catch per hour for 150 m2 of net in the water was 0.77 Chinook salmon over the entire sampling period.

INTRODUCTION

Skeena Chinook stocks are under increasing harvest pressure from Canadian sport and First Nation fisheries as well as commercial fisheries in Canada and Alaska and are therefore of trans-boundary importance. A better understanding of the distribution and relative abundance of the various Skeena Chinook stocks is important for the implementation of the Canada/US Pacific Salmon Treaty and Canada's Wild Salmon Policy.

The Skeena River supports over 75 separate spawning populations of Chinook salmon. Four river systems, the Kitsumkalum, Morice, Kispiox and Bear rivers account for approximately 70% of the total spawner abundance. An escapement index representing approximately 40 streams in the Skeena watershed is used by the CTC to provide a perspective on trends and stock status. Terminal runs (the escapement index plus terminal catch) of Chinook salmon have approached 100,000 in many years since 1985. There are no CTC accepted escapement goals for Skeena River Chinook salmon and future assessments are expected to partition this large aggregate into stocks separated by run timing, life history and geographic area. Fisheries managers and stock assessment biologists have identified radio-telemetry as a potential tool that could be used to fill some of the key information gaps for Skeena Chinook.

The 2008 feasibility study described in this report demonstrated that Skeena Chinook salmon can be caught and released in good condition in the lower Skeena river from May to late July, their main time of migration. The knowledge about reliable methods and locations for capturing and tagging the required number of Skeena Chinook salmon forms an essential component of a full-scale bio telemetry project on Skeena Chinook proposed for 2009.

The primary objectives for a bio-telemetry study of Skeena Chinook would be to:

1) Determine the distribution and relative abundance of adult Chinook spawners within the Skeena watershed;
2) Derive reliable estimates of the total Chinook escapement for the Skeena watershed;

3) Give an estimate of in-river harvest rates for the major Chinook stocks;
4) Quantify in-river migration rates and fishery residence times for each stock;
5) Make improvements to escapement monitoring procedures used for Skeena Chinook; and
6) Allow a better understanding of the absolute numbers relating to the Tyee test fishery index.

These objectives meet multiple goals of improved information for resource management and stock assessment specified by the Northern Fund Committee.

Given recent average escapement estimates of Chinook salmon to the Skeena River watershed (40,000-60,000), the number of Chinook salmon stocks within the Skeena drainage, and experience from previous telemetry studies on the Nass, Skeena, Fraser and Columbia rivers, we estimate that 500-700 radio-tags will have to be applied to adult Chinook salmon to meet the objectives stated above.

In 2008, we identified sites in the lower Skeena where tangle netting can be used throughout the run to capture upstream migrating adult Chinook salmon. We also demonstrated that increased effort to a maximum of three standard nets used simultaneously could capture more than three fish per hour during peak migration. All Chinook caught in 2008 were sampled for DNA, measured and externally tagged.

METHODS

FISHING LOCATIONS

The locations fished in this study were chosen based on traditional knowledge of First Nations harvesters from Kitsumkalum. Theses locations have been traditionally used by members of the Kitsumkalum and other First Nations for many years. All fishing locations were in the lower Skeena River in the vicinity of Kwinitsa East Creek (Figure 1). We have not provided the exact co-ordinates of our fishing locations because the best locations are likely to change each year with shifts in the river bed due to freshet. However, the basic attributes of a good Chinook site stay the same and are well known to the people that spent time and effort to seek them out.

All major Chinook stocks found in the Skeena, namely the Morice River, Babine River, Bear River, Kispiox River, Kitwanga River and Kitsumkalum River Chinnok stocks migrate through this area and therefore a realistic opportunity to apply tags to all of these stocks exists.

Figure 1: Map of the Skeena watershed, showing the location of major tributaries and communities and the area of fishing (tip of arrow) in this study (modified from: Walters at al. 2008).

TIMING OF CAPTURE PERIODS

Chinook salmon migrate through the lower Skeena River from May to August (Gottesfeld et al. 2002), with peak migration during the last week of June and the first week of July (Figure 2).

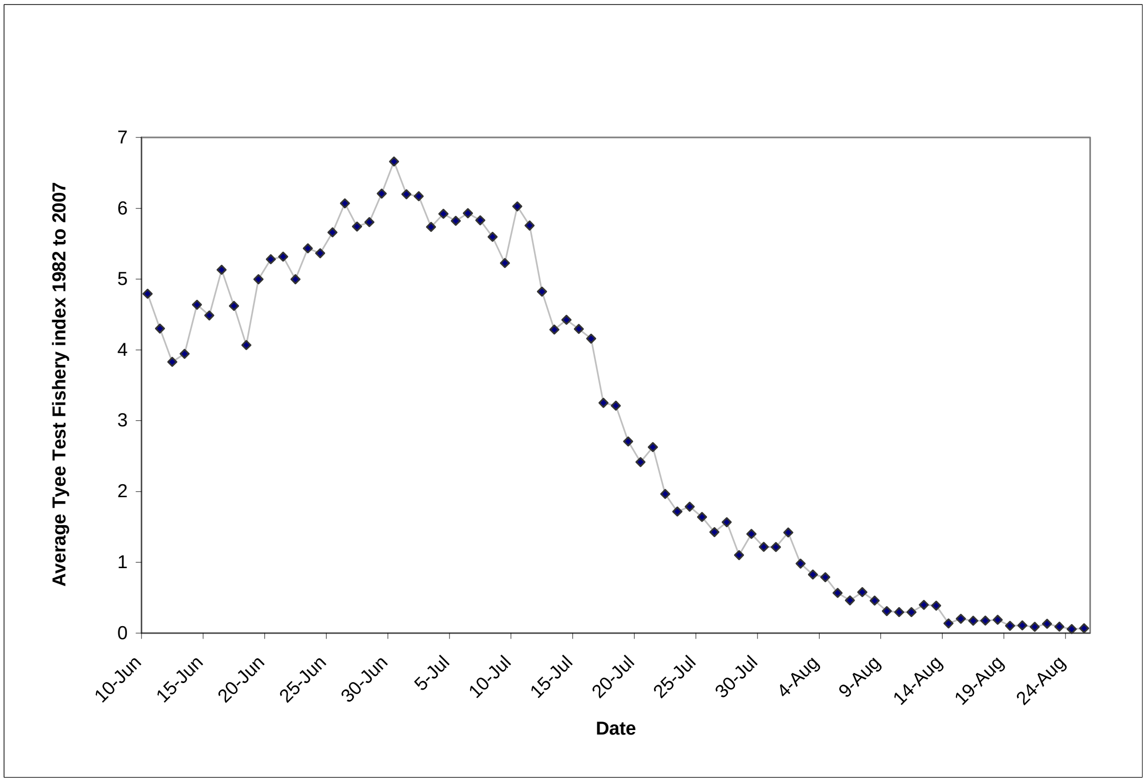

Figure 2: Chinook migration timing (average 1982-2007) through the Tyee Test Fishery conducted in the Skeena River approximately 20km downstream of the fishing locations in this study (DFO Prince Rupert).

The more than 75 Chinook stocks described for the Skeena watershed (Gottesfeld et al. 2002), will migrate though the lower Skeena at discrete times. Holtby and Ciruna (2007) identified 8 Conservation Units (CUs) for Skeena Chinook using criteria developed for the implementation of DFO's Wild Salmon Policy. To apply radio-tags to fish from as many Chinook conservation units as possible it needs to be ensured that fish can be caught and released unharmed from May to August. To test the feasibility of this proposition throughout the highest flows, high numbers of co-migrating sockeye salmon and throughout Chinook migration timing, we chose the following sampling periods in 2008:

1. May 23 – May 31, 2008: peak of freshet and low Chinook numbers

2. June 20 - June 30, 2008: high water levels and peak of Chinook migration

3. July 20 – July 24, 2008: low water levels, medium Chinook numbers and high sockeye by-catch

NETS AND FISHING METHODS

Initially, it was planned to drift and set the different types of tangle nets that were available to this study. High water with a high debris load and dangerous water conditions during the first sampling period in May, did not allow for a safe attempt at drift fishing. At the end of June, during the second sampling period, the water levels decreased but the daily catches of Chinook was sufficiently high in set fishing that the more dangerous drift fishing did not need to be used. At the end of July, the by-catch of sockeye salmon that needed to be released unharmed increased to the point that they could only be handled properly when setting a net and not when drifting a net. Fish can be released from a set net by driving the boat along the net and pulling the net only in the location that the fish has been caught. This can usually be accomplished in less than two minutes. A drift net has to be retrieved completely into a boat to release fish. This usually takes 10-15 minutes depending on the number of fish caught and entangles the fish much more than a short section of a net.

Two types of netting materials, nylon and Alaska Twist and five mesh sizes (8.9cm, 14.3cm, 15.2cm, 17.8cm, 20.3cm) were used for a combination of seven different tangle nets deployed in the course of this study. All nets used in this study were designed to tangle rather than gill Chinook salmon and by-catch, therefore the nets were hung in a loose manner. Meaning the ratio of float line to netting was about 1:2.3 rather then the commonly used 1:2. Table 1, summarizes the seven net types, their use schedule and the anticipated advantages and disadvantage of each net.

During the deployment of all nets visual contact was maintained with the net floats to release fish within one minute of net encounter.

In May, small numbers of Steelhead entering and leaving the Skeena are the only species co-migrating with the Chinook salmon. Thus by-catch was anticipated to be of significant concern and it had to be ensured that steelhead could be released unharmed. We therefore opted to deploy the smaller mesh sizes (8.9cm and 14.3cm) and softer nylon Nets 1 and 2 described in Table 1. They were anticipated to tangle and bag Chinook salmon with little or no injury while allowing the quick release of steelhead by-catch. Only small pockets of water with slow flows and little debris influx could be found during the freshet and consequently shorter (30m-33m length) nets were used (Figure 17). In addition, we tested a short (30m) 15.2cm mesh size and stiffer Alaska Twist Net 3, that was anticipated to gill more fish but facilitate quicker release. All nets used in May were between 5m – 6.7m deep since they had to be fished close to shore in shallower water to avoid the high freshet flows in the main channel of the river.

At the end of June, during the second capture period, the Skeena's water levels were anticipated to slowly decrease while very few sockeye salmon would co-migrate with the peak in Chinook migration. Therefore, by-catch was expected to be of less concern and smaller mesh sizes could still be used. Either one (Net 3) or two panels attached end-to-end (Net 5) of 15.2cm mesh size Alaska Twist net were used (Table 1). To decrease potential injury through gilling of smaller Chinook, all fish were transferred in a net bag into a water-filled tub for detangling and all netting around the operculum plates was instantly cut instead of untangled.

At the end of July, during the third and last capture period, The Skeena's water levels were anticipated to be low and stable. At this point fishing could be conducted in locations with slow flow and deeper water.

Table 1: Net type, mesh size, panel configuration and anticipated advantages and disadvantages for Chinook salmon and by-catch of all nets used in the 2008 Chinook catch feasibility study.

Netting Material	# of Panels	Panel 1 closest to shore		Panel 2 added to end of Panel 1		Panel 3 added below Panel 2		Used When?	Anticipated Pros and Cons of Net for Chinook and By-Catch
		Panel 1: Length x Depth (m)	Mesh Size (cm)	Panel 2: Length x Depth (m)	Mesh Size (cm)	Panel 1: Length x Depth (m)	Mesh Size (cm)		
Net 1: Nylon	1	30 x 5	14.3 cm (5 5/8 inches)	N.A.	N.A.	N.A.	N.A.	May	Very good entangling? Little gilling? Quick release? Few injuries? High salmon by-catch?
Net 2: Nylon	1	33 x 6.7	8.9 cm (3.5 inches)	N.A.	N.A.	N.A.	N.A.	May	Very good entangling? No gilling? Quick release? Few injuries? High salmon and trout by-catch?
Net 3: Alaska Twist 12 strand	1	30 x 5	15.2 cm (6 inches)	N.A.	N.A.	N.A.	N.A.	May & June	Good entangling? Loss of Chinook? Gilling of smaller Chinook? Quick release? Gilling of by-catch?
Net 4: Alaska Twist 12 strand	1	30 x 5	17.8 cm (7 inches)	N.A.	N.A.	N.A.	N.A.	July	Entangling? Loss of Chinook? Gilling of smaller Chinook? Quick release? Little by-catch?
Net 5: Alaska Twist 12 strand	2	30 x 5	15.2 cm (6 inches)	30 x 5	15.2 cm (6 inches)	N.A.	N.A.	June	Entangling? Gilling of smaller Chinook? Quick release? Very little by-catch? More net - more Chinook?
Net 6: Alaska Twist 12 strand	2	N.A.	N.A.	30 x 5	20.3 cm (8 inches)	30 x 5	20.3 cm (8 inches)	July	Entangling? Gilling of most Chinook? Quick release? Very little by-catch? More net & fishing deeper - more Chinook?
Net 7: Alaska Twist 12 strand	3	30 x 5	17.8 cm (7 inches)	30 x 5	20.3 cm (8 inches)	30 x 5	20.3 cm (8 inches)	July	Entangling? Gilling of most Chinook? Quick release? Little by-catch? Most net & fishing deeper - more Chinook?

Accordingly, deeper (10m) and longer nets (60m) such as Nets 6 and 7 in Table 1 could be used. These longer nets could be set in the middle of the river where currents build natural back eddies such as in location shown in Figure 18. Sockeye salmon and the first steelhead were now co-migrating with decreasing numbers of Chinook salmon and unwanted by-catch was a major concern. Nets were therefore chosen in larger mesh sizes (17.8cm and 20.3cm) as found in Nets 4,6 and 7 (Table 1). Like in June, all fish were transferred in a net bag into a water-filled tub for detangling and all netting around the operculum plates was instantly cut instead of untangled to avoid injury and speed up the release process.

All fish were measured to the nearest centimetre in a foam line cradle, before they were marked on the left operculum with a yellow Kurl-Lock Tag (Kurl-Lock #3, coated steel, 29mm x 8mm, Ketchum Manufacturing Inc., 1245 California Avenue, Brockville, Ontario, Canada) labelled with the abbreviation SFC (for Skeena Fisheries Commission) followed by consecutive numbers from 0-1500.

RESULTS

MORTALITIES AND INJURIES

Of the total of 195 Chinook tagged in this study, 3 (1.5%) died as a consequence of their capture. All of these three fish were caught on June 26, June 27 and June 28, 2008, the days of highest catch throughout the program (Figure 3). An additional 8 Chinook (4.2%) died as a consequence of a predatory seal attack, 6 Chinook (3.1%) needed more than 1 minute of revival before they swam off and 11 fish (5.6%) needed less than 1 minute of revival while 167 fish (85.6%) were released in a vigorous state that did not require revival (Figure 3). Six of the 167 fish released in a vigorous state were bleeding from wounds inflicted by the net. None of theses fish needed revival and instantly swam out of the fisher’s hands.

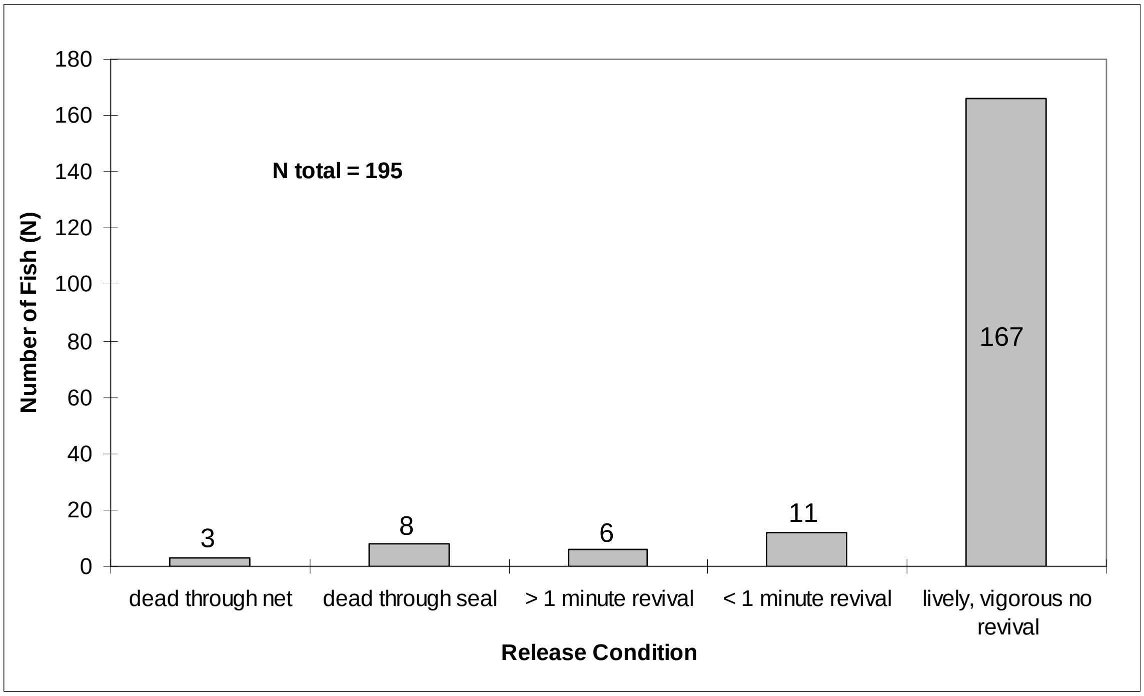

Figure 3: Condition of Chinook salmon at release from net, following length measurement, scale taking and application of operculum tag.

LENGTH AND AGE FREQUENCIES OF CHINOOK CATCH

The average fork length of the 195 Chinook salmon caught in 2008 was 80.2cm. Within the distribution of the lengthy frequencies, three groups, likely connected to three age classes, can be observed. The shortest group reached from 65cm-75cm, the middle group reached from 80cm-90cm and the group with the longest fork length reached from 95cm-110cm (Figure 4). Only three fish with a fork length of greater than 115cm were caught and the largest Chinook encountered in this study was 118cm long.

The average fork length for the May (77.1cm) and June (76.4cm) sampling periods were not significantly different from each other but were both significantly smaller than for the July (90cm) sampling period (Oneway Anova & Tuckey-Kramer post hoc test, $p=0.05$) (Figure 5).

For the May, June and July 2008 sampling periods 157 Chinook could be aged, 56% of them were 4-year olds, 30% were five year olds and 14% were six year olds (Figure 6).

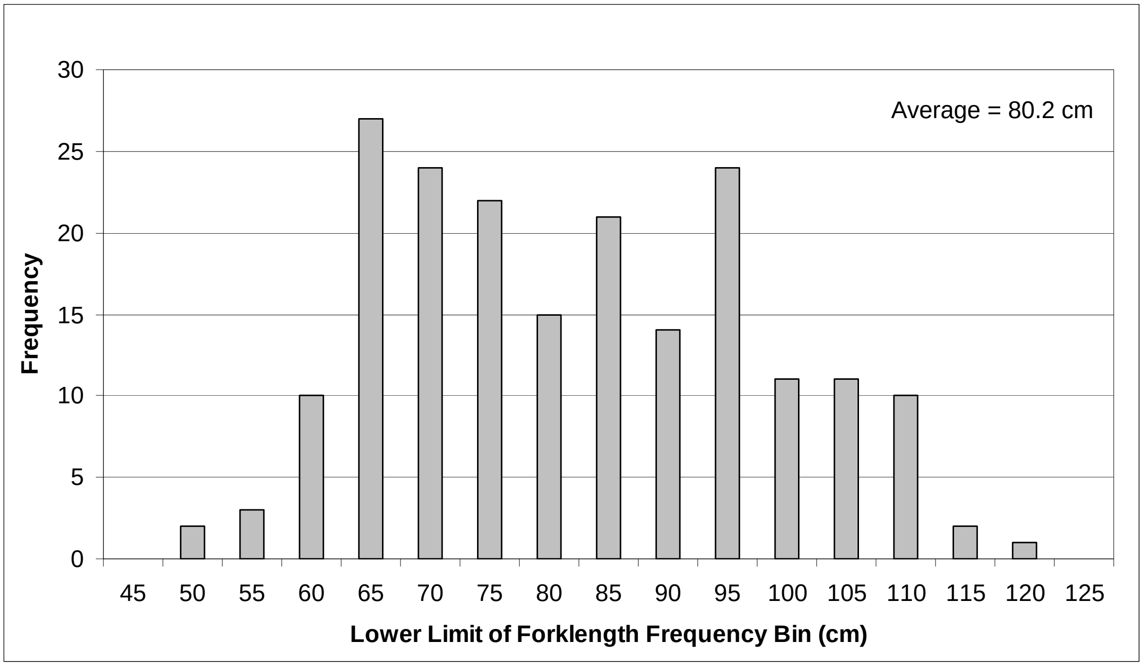

Figure 4: Length-frequencies of Chinook for the combined catch from the May, June and July 2008 sampling periods.

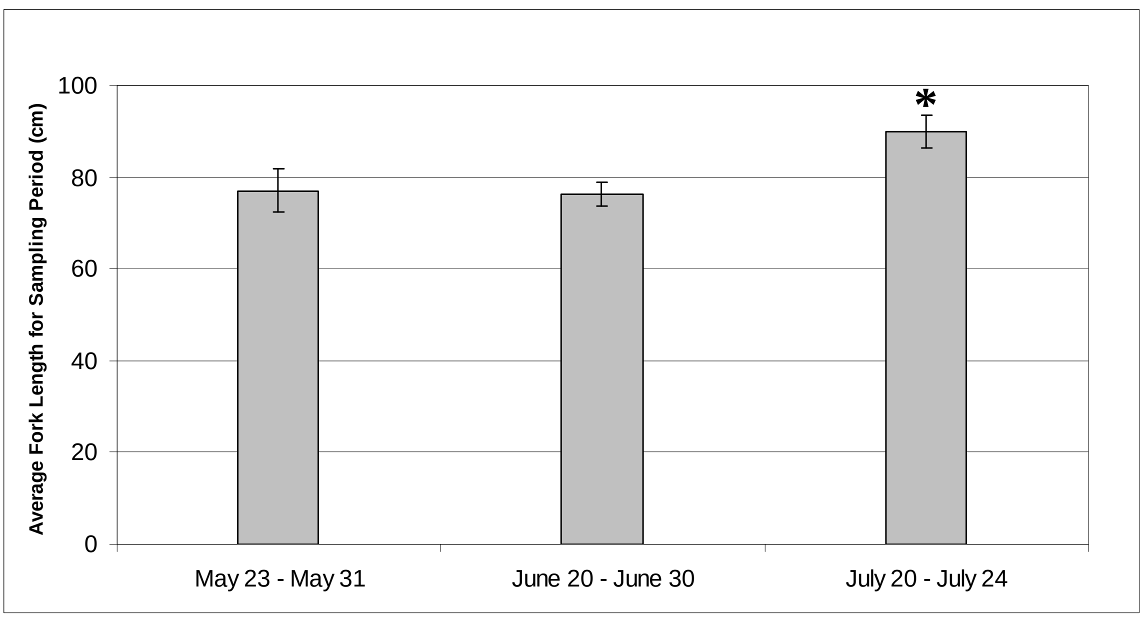

Figure 5: Average Chinook fork length for the May (mean=77.1cm), June (mean=76.4cm) and July (mean=90cm) 2008 sampling periods. Error bars shown stand for the 95% confidence intervals around the mean and asterisk stands for a significant difference in the marked values to other values in the graph.

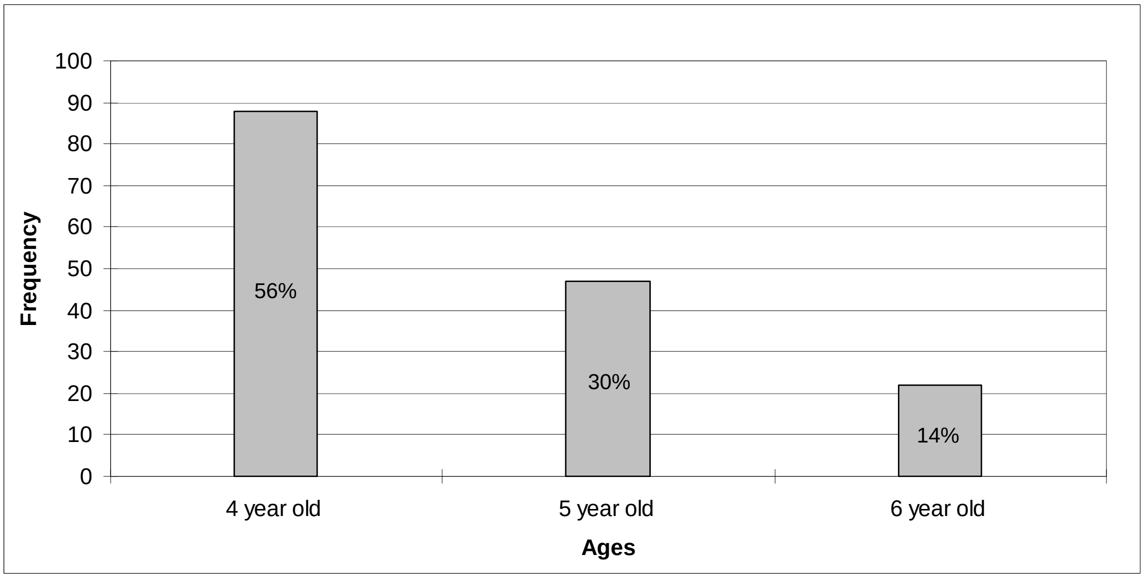

Figure 6: Age distribution of Chinook throughout all sampling periods in 2008 (N total = 157 fish).

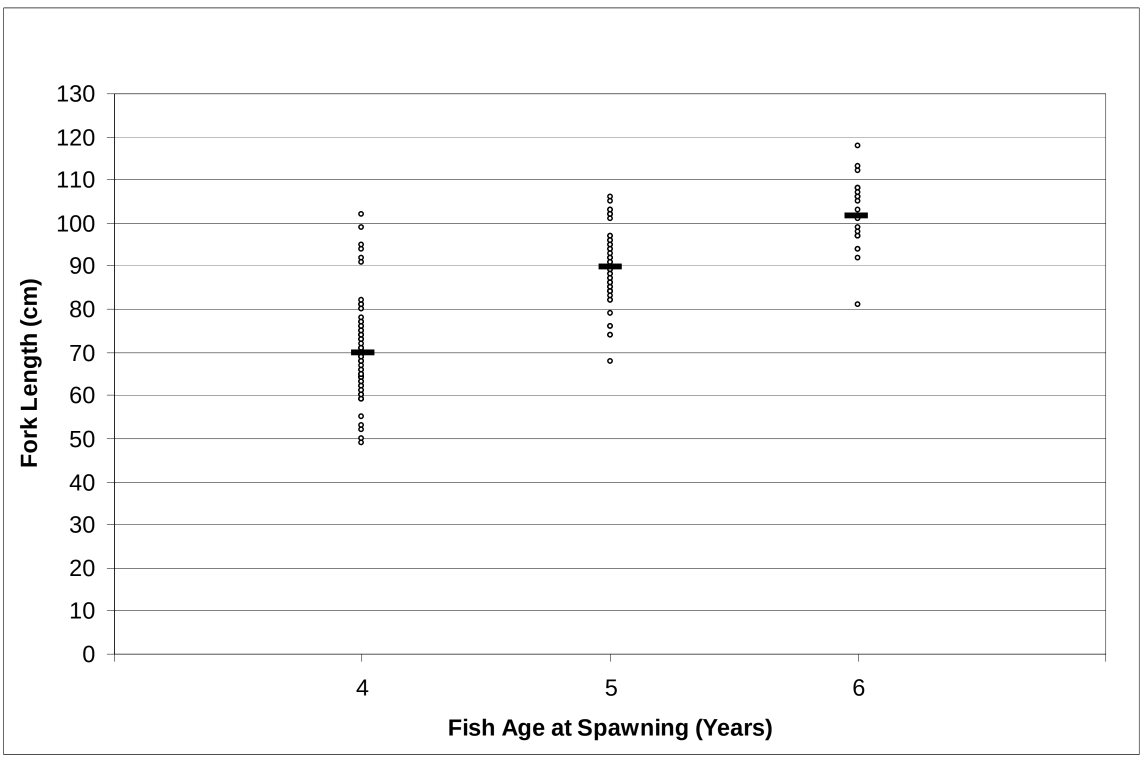

Figure 7: Length at age plot for Chinook caught throughout the May, June and July 2008 sampling periods (black bars stand for mean length at respective age).

The mean Chinook lengths at ages four, five and six of a total of 157 Chinook that could be aged throughout this study were 70cm, 90cm and 102cm respectively. Age 4 fish ranged from 49cm - 102cm, age five fish ranged from 68cm – 106cm and the age 6 fish ranged from 81cm – 118cm (Figure 7). Therefore considerable length overlap exists between all age groups.

TOTAL DAILY CATCH AND CATCH PER UNIT EFFORT THROUGHOUT THE STUDY PERIOD

The daily catch throughout our 24 days ranged from a minimum of 2 to a maximum of 33 Chinook per day, for an average of 8.25 fish per day and a total of 195 Chinook (Figure 8). The total catch and the catch per unit effort (catch per hour per 150m^2 of net deployed) rose and fell parallel with each other for most dates (Figure 8). Only on July 21, 2008 did the CPUE decrease from July 20, while the total daily catch increased from 2 to 8 fish. July 21, 2008 initially a shallow net was fished in a deep location with no success. Later in the day we changed the net to be longer and deeper and increased the net surface fished by three times (and therefore decreased the CPUE) to catch 8 Chinook within 6 hours.

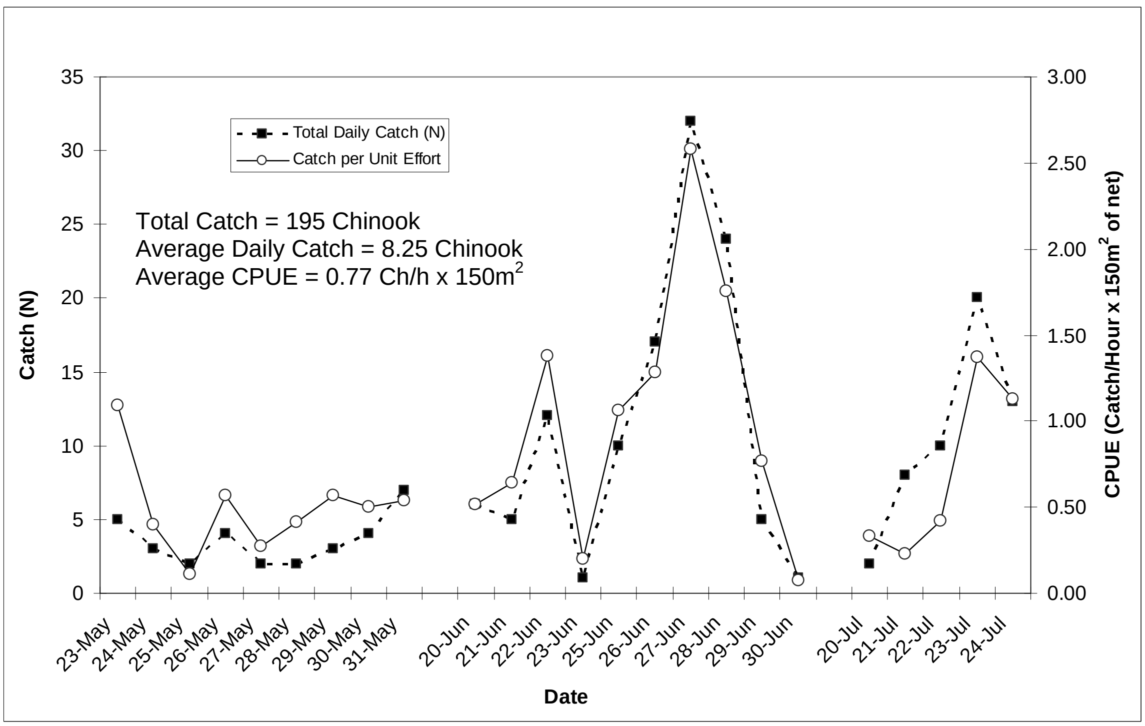

Figure 8: Total daily catch and Catch per Unit Effort (CPUE) for Chinook salmon during the fishing periods in 2008.

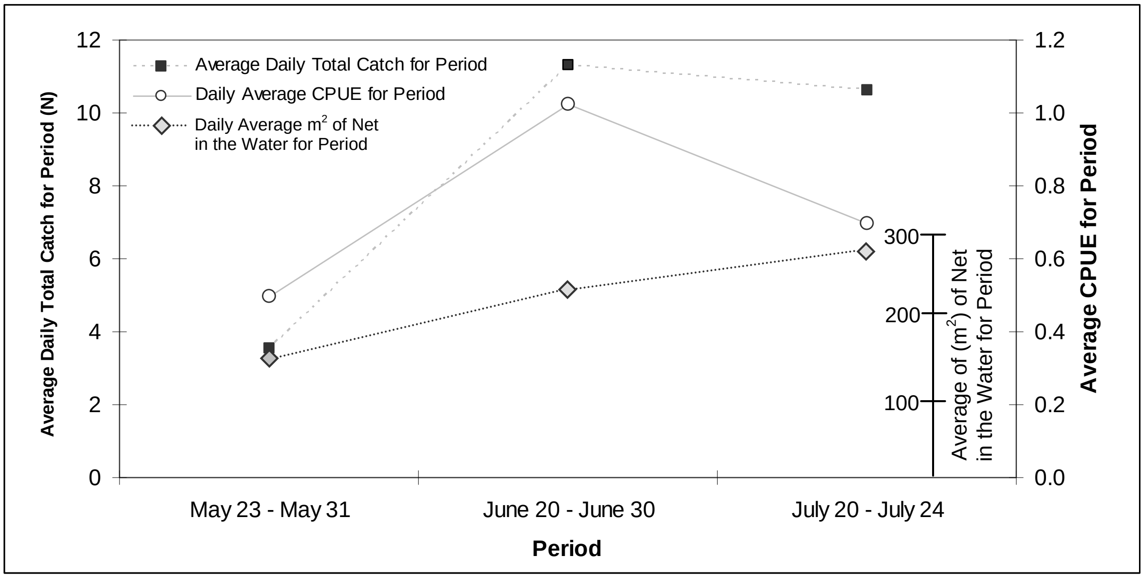

Figure 9: Average of the daily catches and average CPUE for Chinook salmon for the three fishing periods in May, June and July. The additional third data series shows average of area of net fished for the respective period.

The average total daily catch was higher for the June and July periods when compared to the May period (Figure 9). The average CPUE for the June period was significantly higher than for the May and July periods but the total average catch for the July period was kept on par with the June period by deploying more net into the water. The average area of net in the water was increased from May (156m^2) to June (225m^2) and again from June to July (285m^2) to keep the numbers of total daily catches high (Figure 9).

CPUE AND SIZE SLECTIVITY VERSUS NETTING MATERIAL AND MESH SIZE

CPUE versus Net Type and Mesh Size

The CPUE was neither significantly different for the two different netting materials (12-Strand Alaska Twist or Nylon), nor was it significantly different (Wilcoxon Test, Chi sq=3.7, df=3, p=0.29) for the four different mesh sizes (14.3cm, 15.25cm, 17.8cm and 20.3cm) that were predominantly fished (Figure 10). The smallest mesh size of 9.2cm (Nylon mesh) was only fished for a total of 2.1 hours and was therefore not considered in this comparison.

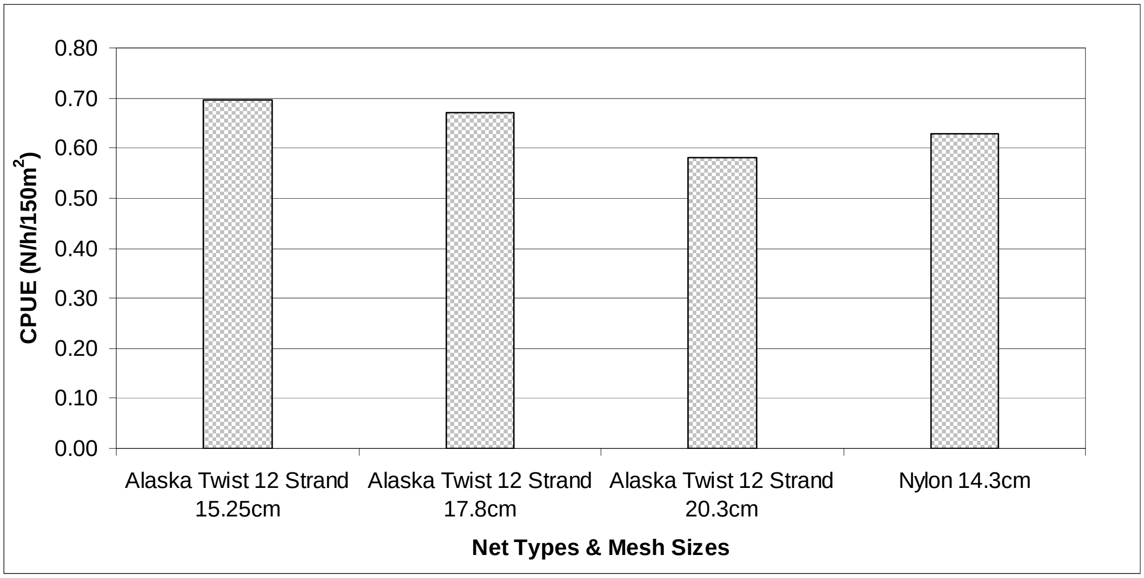

Figure 10: CPUE for different netting materials and mesh sizes.

Average Fish Length versus Mesh Size

To determine the average length of Chinook caught in different mesh sizes, only three mesh sizes are compared (14.74cm, 15.25cm and 20.3cm). Other mesh sizes tested for short period of time are not considered in this comparison. The average fish length per mesh size was calculated over the whole period of the study but it needs to be mentioned that the bigger mesh size of 20.3cm was only fished in July.

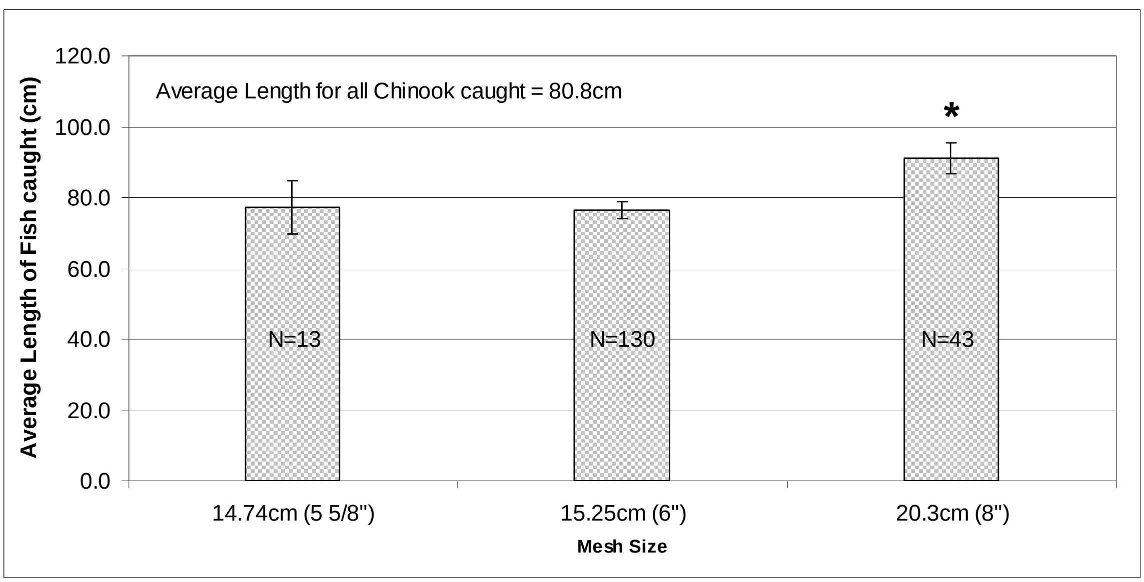

Figure 11: Average length of fish caught in different mesh sizes. Asterisk shows significant difference between fork length value for 20.3cm mesh when compared with 14.74cm and 15.25cm mesh size.

Chinook caught in the biggest mesh size of 20.3cm (mean fork length=91.1cm) were significantly longer (One Way Anova, F2,182 = 18.2; $p < 0.001$) than fish caught in the 14.74cm (mean fork length=77.4cm) and the 15.25cm (mean fork length=76.4cm) mesh sizes, while the fish caught in the two smaller mesh sizes were not significantly different in their fork length (Figure 11). The 20.3cm mesh size was only fished in July and we therefore tested for a date bias and determined no linear temporal trends within any of the mesh types ($p > 0.05$) could be found, and an ANCOVA (mesh and date versus fork length) showed a significant mesh effect ($F_{2,182} = 7.45$; $p = 0.008$), and no significant date effect ($F_{1,182} = 2.17$; $p = 0.92$). A date effect should at least have been visible for the 15.25cm (6”) mesh size since it was fished throughout all sampling periods in May, June and July.

CPUE AND RIVER DISCHARGE

Skeena River Discharge and Sampling Periods:

In 2008, Chinook were caught in a variety of river level or discharge conditions. During the first capture period from May 23 to May 31, the peak of the 2008 freshet occurred and water levels rose from 7.7m to 9.8m at the Usk Hydrometic Station between May 23 and May 28, 2008 and stayed between 9-10m after that (Figure 12). During the second capture period from June 20 to June 30, 2008 another run-off peak was encountered and the water rose from 5.5m to 6.8m between June 20 and June 23, 2008 to fall back to 5.5m after that (Figure 12). During the third and last capture period (July 20- July 24) the water rose only slightly from 4.7m to 5.1m on July 22 and then fell and stabilized (Figure 12).

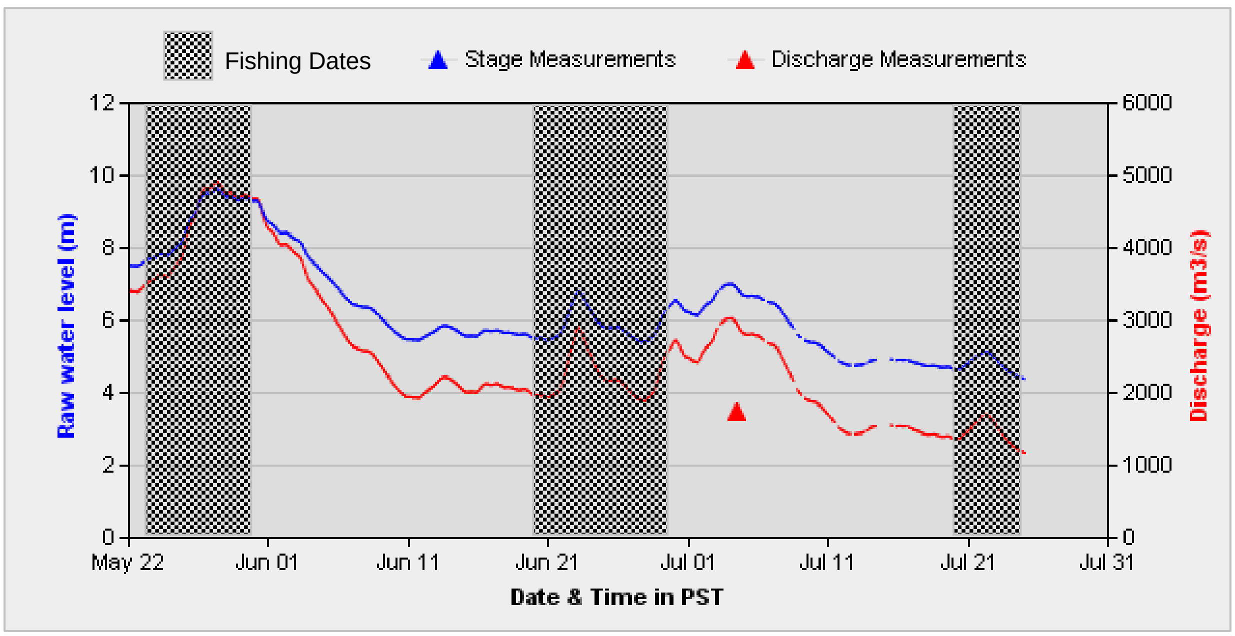

Figure 12: Raw water level (blue line) and river discharge (red line) of Skeena River at Usk Station (Latitude: 54° 37’ 50” N, Longitude: 128° 25’ 55” W, ~115 km from main fishing sites) between May 22 and July 25, 2008. Grey striped areas represent the fishing dates of the 2008 Chinook catch feasibility study (Data and Graph modified from: Environment Canada, Water Web[2]).

[2] http://scitech.pyr.ec.gc.ca/waterweb/fullgraph.asp

Changes in Skeena River Level Versus Changes in CPUE:

During our sampling periods, the water level of the Skeena River several times rose significantly. These water level increases are accompanied by an increase in debris load and water turbidity. River level increases observed between May 23 and May 28, 2008 and June 22 and June 23, 2008 were clearly related to an increase in air temperatures and the resulting increase in snow melt (Figure 13). The third slight increase in river level observed on July 22, 2008 resulted from increased precipitation at stable temperatures. The CPUE in all instances decreased with an increase in river level and the CPUE increased when the river level started to decrease (Figure 13).

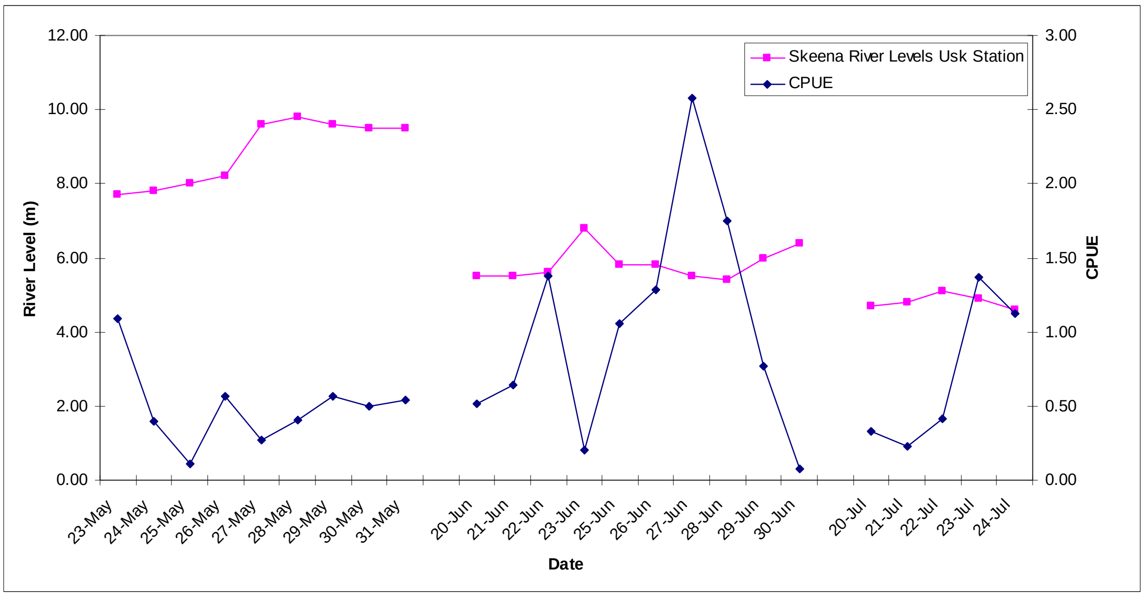

Figure 13: Skeena river level at Usk versus CPUE for Chinook capture periods in 2008.

CATCH AND TIDAL PHASE

Many in-river harvesters connect the period of time following the low slack tide as measured in Prince Rupert plus 3 hours to adjust for the area around Kwinitsa Creek with an increase in catch. The time lag between the Prince Rupert tidal station and Kwinitsa is generally around 3 hours but can be longer if the river levels is high and tides are small and can be shorter if the river level is low and the tides are large. We therefore compared the total Chinook catch from 2 hours before to 2 hours following low tide plus 3 hours in Prince Rupert with the catch outside of this time period. The catch for the low tide period was then adjusted for the hours that we actually fished inside the ± 2h low tide window when compared with the time that we did not fish inside the tidal window. In this comparison we used the total catch rather than CPUE since we generally did not change the amount of net area within a day, so the catch inside and outside of the temporal low tide window was never influenced by net area.

Chinook catch was not significantly different (Paired T-Test, p=0,32) between the adjusted time ± 2h of the low tide (mean=4.4 fish) and the catch outside this temporal window (mean=3.9) (Figure 14). The overall catch during the study fluctuated between 2 and 33 fish per day and the hypothesis was postulated that the catch difference between the low tide phase and the rest of the day may be the most pronounced on days when the catch is high and many fish migrate. To test for this hypothesis again the adjusted catch during the low tide phase was compared with the catch for the rest of the daily fishing period for the eight days that we caught ≥ 10 fish per day (June 22, June 25, June 26, June 27, June 28, July 22, July 23 and July 24). Again Chinook catch was not significantly higher (Paired T-Test, p=0,08) during the adjusted low tide (mean=10.5) phase than during the remainder of the daily fishing period (mean=6.3) (Figure 15). A trend is visible in this data and more sampling would be needed to confirm this trend. The high variability in the catch between days makes it difficult to detect these types of within day differences.

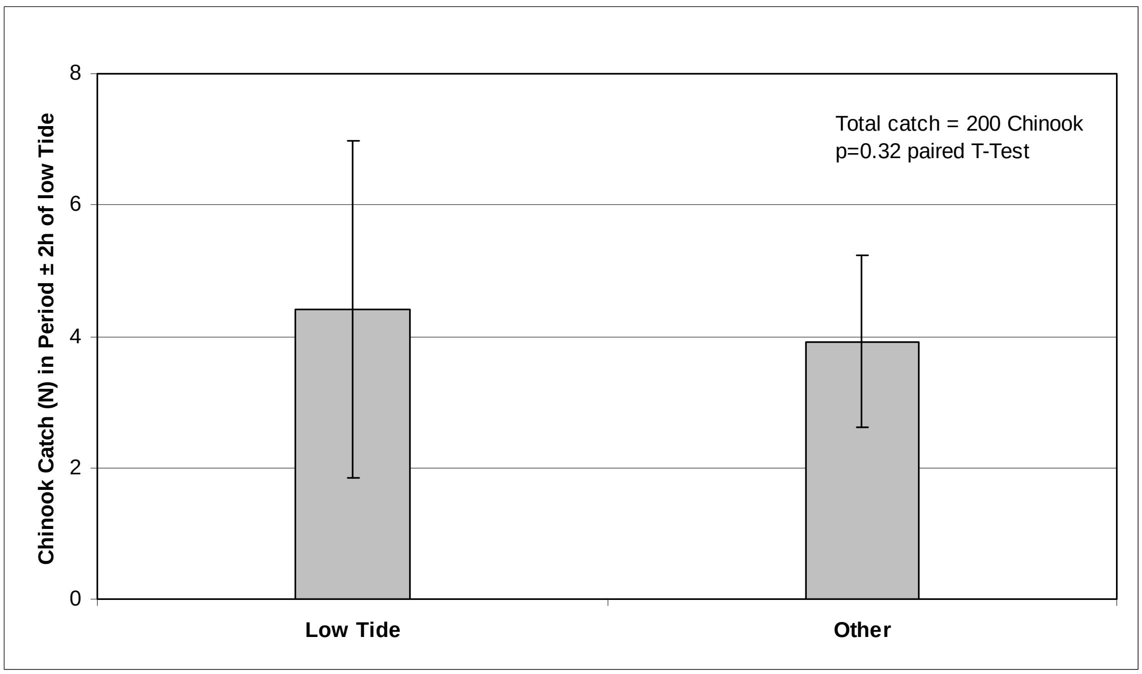

Figure 14: Catch of Chinook salmon inside a ±2hour adjusted time window around the low tide at our fishing location compared with the catch outside of this temporal window for all days fished in 2008.

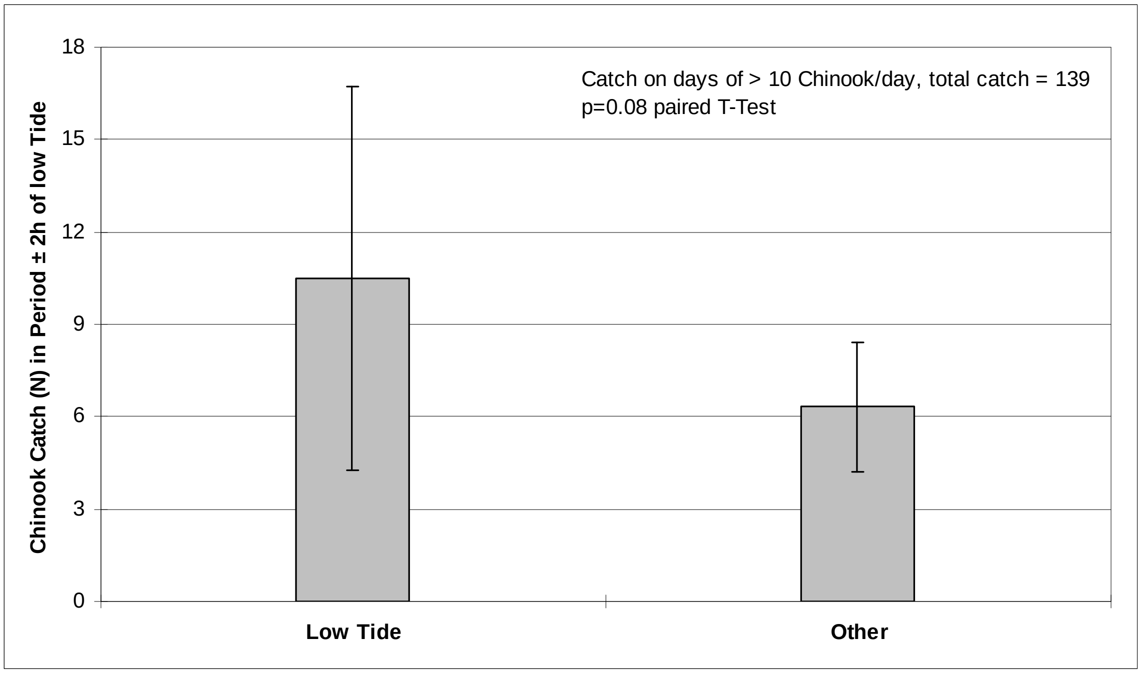

Figure 15: Catch of Chinook salmon inside a ±2hour adjusted time window around the low tide at our fishing location compared with the catch outside of this temporal window only for the days when more than 10 Chinook were caught.

BY-CATCH AND MORTALITY RATE IN SPECIES OTHER THAN CHINOOK

This study aimed at targeting Chinook salmon with lowest possible by-catch of all other salmon species. During the three sampling periods in May, June and July we caught 219 sockeye salmon, seven upstream migrating steelhead (rather then spent kelts) and one coho (Figure 16). All of these fish were released within minutes of being tangled into the net, since every fish in the net was assumed to be a Chinook salmon that needed to be released without harm in the least possible amount of time. The mortality of the sockeye by-catch was low, at 15%. One of the seven steelhead caught was released bleeding while the other fish were released unharmed and the one coho caught was also released unharmed. The incidence of sockeye being gilled and therefore bleeding from the gills was slightly higher than for Chinook salmon. Since the average size of sockeye is much smaller than that of Chinook, sockeye get gilled rather than tangled.

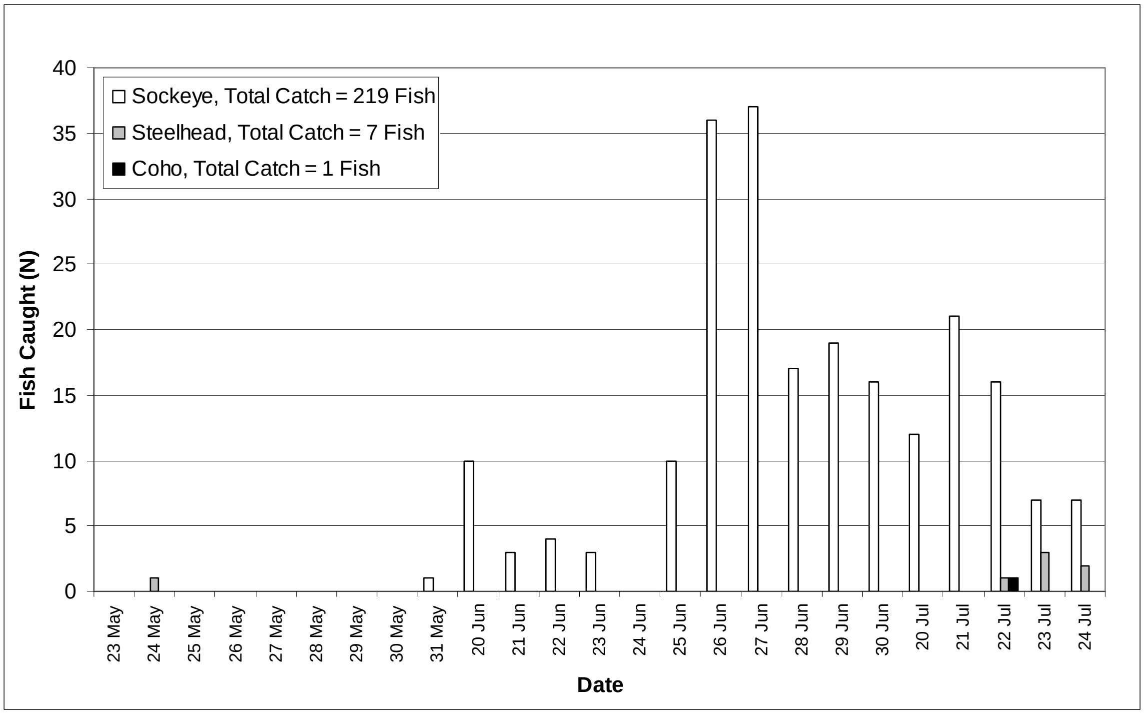

Figure 16: Catch of sockeye, steelhead and coho for all three sampling periods in May, June and July of 2008.

DISCUSSION

INJURIES, MORTALITIES, BY-CATCH AND FISH HANDLING

The handling of Chinook was improved over the course of the study. Fish were initially grabbed in the water and were tried to untangle before they were transferred into the measuring bin inside the boat. This method resulted in a few fish bleeding from their gills because the pressure of the hanging net was tightening the entanglement of the fish. This release method was quickly replaced by the transfer of fish in a net bag into a water filled trough inside the boat. Here fish could be entangled without the added pressure of the hanging net. In addition, all net strands that were entangling the fish around its gill plates were immediately cut, rather than detangled. The result of these combined measures led to very low mortality and injury of Chinook salmon throughout this study. Only 1.5% of the 195 Chinook were killed through the net and 94.3% were released alive. The highest mortality rate of 4.2% was inflicted by seals. To keep the seal attacks to a minimum, reaction time to a fish hitting the net was initially decreased to mere seconds when seals were present. The close proximity of the boat engine generally discouraged seals from preying on entangled fish. When seal presence became permanent fishing locations were changed.

It was one of the goals of this Chinook study to keep the by-catch mainly of sockeye salmon as low as possible. By using a bigger mesh size when the number of sockeye salmon co-migrating with Chinook was high, at the end of July, we caught a favourable ratio of almost 1:1 between Chinook and sockeye salmon, although the number of sockeye migrating was approximately 32 times higher (according to the daily Tyee Test Fishery Indices for both species from July 20 - July 24, 2008[3]). Based on this year's results we are confident that the Chinook radio telemetry study proposed for 2009 will not be plagued by unmanageable numbers of sockeye by-catch if a large mesh size (20.3cm or 8") is used in July.

CPUE AND SIZE SELECTIVITY BY NETTING TYPE AND MESH SIZE

The CPUE was neither significantly affected by mesh size (14.3cm or 5 5/8", 15.2cm or 6" and 20.3 or 8") nor by the netting material (nylon or 12-strand Alaska Twist). This will allow for the use of a wide selection of mesh sizes and material to avoid fish injury or unwanted by-catch without concerns for a decrease in CPUE in future Chinook studies.

In contrast, mesh size had a significant effect on the size of Chinook that were caught. While the average size of Chinook caught in 20.3cm (or 8") mesh was 91.1cm, the average size of Chinook caught in 15.2cm (or 6") and 14.3cm (or 5 5/8") mesh was 76.4cm and 77.4cm respectively. The 20.3cm or largest mesh size was only fished at the end of July when the majority of migrating Chinook salmon will be of Kitsumkalum River origin (Alexander & English 1996), the stock with largest average Chinook salmon in the Skeena River (DFO 1985). Therefore, a date bias towards larger fish in July when compared with May and June is expected. When we tested for a date bias versus a mesh size bias, the mesh size bias was significant while the date bias was not, although the 15.2cm net was fished throughout all sampling periods in May, June and July and caught the majority (67%) of Chinook in this study. Therefore, the selectivity of the 20.3cm mesh size towards larger fish appears to be real and may pose a problem when the desired outcome of the catch is a representative distribution of all Chinook age classes since four year old Chinook with an average fork length of 66cm (Figure 7) or Chinook jacks (fork length less then 55cm) will be underrepresented. Five (average fork length = 86cm) or six year old (average fork length = 96cm) Chinook should be represented according to their presence in the fishery.

CPUE AND RIVER DISCHARGE

River discharge has a pronounced effect on CPUE. An increase in river levels leads to a decrease in CPUE while a decreasing or stable river level produces relatively higher CPUE (Figure 13). Similar responses of fish to the higher flows and increase in debris load during increasing river levels have been found in the Nass River where fishwheels have been used to assess the daily escapement for all salmon species since 1992 (Nisga'a Lisims Government, Fish and Wildlife Department, 2008 Nass Stock Assessment Updates). If the primary goal was to capture large numbers of fish rather than represent the whole run, periods of rapidly increasing river levels should be avoided. Chinook for

[3] http://www.pac.dfo-mpo.gc.ca/northcoast/webdocs/Tyee%20Test/di.pdf

the radio-telemetry study planned for 2009, need to be sampled from as broad a range of time periods as possible, therefore, it is advisable to fish through all river level changes.

CATCH AND TIDAL PHASE

Kitsumkalum crew members familiar with the Kwinitsa fishing area indicated that their catch rates typically increase from the time immediately before the low tide to about two hours after low tide. The tidal change is clearly visible in the Kwinitsa Creek area of the Skeena River and occurs approximately three hours after the low tide is measured at the station in Prince Rupert. But the tidal time lag between the Prince Rupert tidal station and Kwinitsa area is influenced by tidal amplitude and river level. During high river flows and small amplitude tides, the lag is larger and during low flows and large amplitude tides the lag is smaller. Therefore, we chose a 4 hour window around the anticipated low tide time at Kwinitsa to test whether more fish can be caught during the low tide period when compared to other times of the day.

No significant difference in catch between the low tide period and the rest of the daily fishing period could be found when all fishing days during the May, June and July sampling periods were considered. When we restricted the analysis to days when more than ten Chinook were caught, the low tide period still did not produce a significantly higher catch than the rest of the day but the difference was more pronounced. Significance may have been prevented by the high variability in the total catch numbers (Figure 15). In summary, it does not appear plausible to concentrate fishing effort on the low tide phase but rather cover as much time as possible with fishing effort and draw conclusions from one day to the next. Often the catch pattern from one day holds true for the next few days as along as the river level stays constant or is slightly falling.

CHANGES DURING THE CHINOOK MIGRATION PERIOD

The early part of the Skeena Chinook run can be characterized by low numbers of fish that can be caught in the high flows and debris load of the spring and early summer freshet. Fishing locations are very limited, catch is low and constant net cleaning during increases in river level require long days to catch adequate numbers of fish for a biotelemetry study. However, contrary to some predictions prior to this study, Chinook can be caught on a consistent basis and released without harm throughout the peak of the freshet period. In late June and July, Chinook catch rates were high enough to easily satisfy the daily minimum catch target of five fish (as a benchmark for the application of radio-tags). In July, when the river levels are dropping, daily catches can also be increased by fishing longer and deeper nets in more locations. Larger mesh sizes are required in July to minimize the sockeye by-catch.

BY-CATCH AND MORTALITY RATES OF SPECIES OTHER THAN CHINOOK

This study clearly shows that larger mesh sizes, increased from 15.25cm (6”) in June, to 20.3cm (8”) in July allow most sockeye salmon to swim through the net while Chinook are still caught at sufficient numbers and with little or no injury. The run of Skeena coho and steelhead start at the tail end of the Skeena Chinook run and therefore coho and steelhead by-catch should be low. Coho, steelhead and to a larger extent pink salmon are also selected against through the large mesh size used when they are starting to migrate into the Skeena in late July. Six out of seven steelhead caught in this study were released unharmed and without the need for revival. No chum salmon were caught during this study. Chum size and pronounced teeth make them vulnerable to capture in the nets used, however, Skeena chum stocks are currently at historic record lows and mainly enter the river in August and September. Therefore, chum salmon are not anticipated to be encountered in high numbers during a future Chinook biotelemetry study. If encountered, chum salmon will be released with the utmost care.

CONCLUSIONS AND RECOMMENDATIONS

This study represents the first and crucial step to determine the feasibility of a Chinook study when radio-tags are applied to adult Chinook throughout their migration period as they enter the Skeena River. Therefore, the optimization of fishing techniques and sensitive fish handling were as much a part of this study as the catch of sufficient Chinook numbers. Summarizing our data and personal experience from the 2008 field season, the following conclusions can be drawn and recommendations can be made:

1. Quick and careful fish handling is crucial for good fish health.
2. All fish should be entangled submerged in a water filled tub and with as little pressure on the net as possible. The pressure of a net can only be effectively reduced with a crew of three people fishing, where one person untangles and the other two pull the net towards the release tub from both directions.
3. Whenever possible, deep water locations (5m-15) in the middle of the river should be fished, they produce more Chinook on a consistent basis.
4. A smaller mesh size (15.25cm or 6”) does not injure less Chinook than a larger mesh size (20.3cm or 8”) if fish are cut out the net and net pressure is properly reduced to facilitate fish removal from the net (see point 2.).
5. An average of 0.77 fish caught per hour in the typical 30m x 5m net can be caught throughout the season and higher catch rates can be achieved using larger mesh size and deeper nets after the freshet period.
6. The catch rates from this study indicated that the 500 fish required for the proposed 2009 bio telemetry study could be caught in about 50 days (12 hours per day) assuming that Chinook abundance and fishing conditions were similar to those encountered in 2008. This level of effort would also ensure good temporal coverage of the Chinook run.

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PHOTO PLATES

Figure 17: Typical high water conditions in the Skeena River encountered from May 23-May 31, 2008. Only small pockets of slow currents and minimal debris flow could be found to set a net close to shore.

Figure 18: Typical low water conditions in the Skeena River encountered from July 20-July 24, 2008. Slow currents and little debris flow allow the net to be set far out in the middle of the river.