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

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ABSTRACT

The 2009 return of Chinook salmon (*Oncorhynchus tshawytscha*) to the Skeena River was estimated using genetic stock identification techniques. Genetic samples were analyzed from 1,155 Chinook salmon caught at the Tyee Test Fishery and the proportion of the catch identified as Kitsumkalum Chinook salmon using genetic techniques was 13.4% with a standard deviation of 1.4%. The escapement of large Chinook salmon to the Kitsumkalum River was estimated at 10,703 fish with a standard deviation of 1,424 fish from an independent mark-recapture estimate. The estimate of large Chinook salmon returning to the Skeena River as measured at Tyee was 79,838 fish with a standard deviation of 13,601 fish (coefficient of variation = 17%).

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INTRODUCTION

Funding for this project was provided by the Pacific Salmon Commission's Sentinel Stocks Program (SSP) to estimate Chinook salmon (*Oncorhynchus tshawytscha*) abundance in the Skeena River in 2009. This report presents the initial genetic information from samples collected at the Tyee Test fishery and a preliminary estimate of the Chinook salmon return to the Skeena River. Costs to the SSP consisted of the genetic analyses alone as other parts of the project were already funded by Fisheries & Oceans Canada.

The primary objective of this study was to generate a watershed-wide estimate of Chinook salmon return to the Skeena River. The Skeena River has the second largest aggregate of Chinook salmon in British Columbia. The aggregate has averaged over 50,000 spawners (indexed) since 1985. Chinook escapements for the Skeena aggregate are measured with an index that is comprised of the mark-recapture estimates for the Kitsumkalum, visual estimates for the Bear, Morice and other systems and fence counts for the Sustut, Kitwanga and part of the Babine populations. The Kitsumkalum indicator stock represents approximately 30% of the spawners in the escapement index. The Bear and Morice populations have comprised 20 and 26% of the escapement index respectively on average since 1985.

Skeena Chinook salmon are encountered in the northern Pacific Salmon Treaty (PST) Aggregate Abundance Based Management (AABM) fisheries of Southeast Alaska (SEAK) all gear in Alaska and Northern British Columbia (NBC) Troll & Haida Gwaii (QCI) Sport in northern British Columbia. They also contribute to the Northern BC Individual Stock Based Management (ISBM) fisheries of gillnet, tidal sport, non-tidal sport, tidal First Nations' (FN) and non-tidal FN.

The Kitsumkalum River Chinook project produces Chinook salmon marked with coded wire tags (cwt's) for annual release as fry and yearlings. A mark-recapture program is conducted annually to estimate the escapement of the marked and unmarked fractions of the Chinook returning to the Kitsumkalum River. The data generated by the program contribute internationally as one of the stocks in the Chinook model. Domestically the data contribute to Canada's Key Stream Program and provide the only exploitation rate indicator stock for Chinook salmon in the North Coast. These data are essential to the Chinook run reconstruction calculations.

The Kitsumkalum River hosts one of the largest spawning populations of Chinook salmon in the Skeena River watershed. The Kitsumkalum River indicator stock probably represents the ocean distribution of other spawning populations in the Skeena River however their age at maturity differs. Kitsumkalum River Chinook salmon have stream type life histories with the predominant portion of returns occurring at age 5_2 and 6_2 for males and at age 6_2 for females. Other Skeena Chinook salmon also have stream type life histories but age at return is usually less; composed of predominantly age 4_2 and 5_2 males and predominantly age 5_2 females. Other age components observed in Skeena Chinook salmon include males returning from 3 to 7 years from brood and females returning from 4 to 7 years from brood. Fish returning 7 years from brood are more common in the Kitsumkalum River. The spawning migration occurs in the summer with peak passage through river estuaries in early July. Spawning takes place in late August and early September. These life histories are consistent with those observed in most northern Chinook salmon populations other than the Kitsumkalum River returns tend to be a year older.

The Kitsumkalum River Chinook population is of sufficient magnitude and the mark-recapture program provides an escapement estimate with a reasonable level of accuracy such that if an unbiased sample could be collected then the total return of Chinook to the Skeena River could be estimated. Expansion of the Kitsumkalum component to a Skeena wide population estimate requires that Chinook salmon from Kitsumkalum be equally vulnerable to the sample collection procedure as other components. Differences in timing and/or size of the returning sub-populations within the Skeena watershed could confound these analyses

Hatchery production of Chinook salmon in the Skeena watershed has been limited to small scale assessment projects and small scale production projects for community development. The hatchery production for the purposes of the exploitation rate indicator contributes an average of 2.6% to returns of Chinook salmon to the Kitsumkalum River (range from near zero to 1000 fish annually). Community production projects have been carried out and tag groups have been released from Chinook stocks in the Babine, Kispiox, Morice, Bulkley, Cedar, and Erlandsen tributaries of the Skeena River. Most releases were smaller than those to the Kitsumkalum River and success rates are unknown. The Bulkley River releases were of an early spring timed stock, not part of this proposal.

There is no evidence of Chinook salmon straying from other rivers to the Skeena River to date. No stray coded wire tags have been recovered at the Tyee Test Fishery. The Kitsumkalum River is sampled extensively and no Chinook tagged in other systems have been recovered since the beginning of the program in 1984. However, the recovery of cwt's is a relatively weak measure of straying as few populations in northern British Columbia are tagged. The nearest populations to the Skeena that have been marked with cwt's are in the Kincolith River the north and the Kitimat River to the south.

In addition to providing escapement estimates within the data standard, the Skeena DNA project may be linked to visual surveys to calibrate historic visual escapement estimates in large Skeena systems like the Bear and Morice Rivers.

METHODS

The SSP portion of this project consisted of the analyses of genetic samples of Chinook salmon caught at the Tyee Test fishery. A Skeena wide escapement estimate and stock specific estimates of escapement were attempted using the genetic results with the Kitsumkalum component as the basis for the expansions.

Tyee is located on the tidal estuary of the Skeena River, on the north side, upstream of the confluence with the Ecstall River (Figure 1). The Tyee Test Fishery is a standardized fishery that has been conducted in the Skeena River estuary since 1955. Its' primary purpose has been to provide an in-season indication of sockeye salmon (Oncorhynchus nerka) abundance but is also used to monitor the relative abundance of other salmon species including Chinook (Cox-Rogers and Jantz, 1993). A gill net is deployed (set) in standard locations relative to tidal flow. Sets are made at high and low water slack tides during daylight hours. Usually three (3) sets are made per day except for some days late in the season when there are only two (2) tidal changes during daylight. An index consisting of standardized catch per effort is calculated daily. Typically more fish are caught during low water sets so the standardized catch consists of the mean of averaged high water and averaged low water catch measured per hour the net is fished.

The net used at the Tyee Test fishery is a multi-panel gill net 366 meters (200 fathoms) in length and 7.6 meters (25 feet) deep constructed of six strand monofilament nylon (Alaska twist). The net includes ten panels with web sizes ranging from 8.9 cm to 20.3 cm (3.5 inches to 8 inches) increasing in size by 1.3 cm (0.5 inch) increments. (Imperial units are included as this is the web size designation by the manufacturer.) The different mesh sizes are arranged at random across the length of the net. The web is hung in a 2:1 ratio of webbing to fishing net length. A full description of the test fishery is provided by Jantz et. al. (1990).

Prior to 2009 the test fishery usually began around June 10 and continued until September. The Chinook run is underway by June 10 and peak migration past Tyee occurs at the end of June and early in July. The last Chinook are caught at Tyee around the middle of August (Figure 2.). The test fishery began May 25, 2009 to capture more of the beginning of the Chinook salmon summer run.

Chinook salmon caught in the Tyee Test fishery were sampled for age (scales), nose-fork length, eye orbit to hypural plate length, and incised to determine sex. Scale samples were collected on to scale books as described by MacLellan (1999). Scales were forwarded to the Fisheries & Oceans Canada, Fish Ageing Laboratory at the Pacific Biological Station for ageing. Tissue samples were collected for genetic analyses.

Chinook salmon collections were first compared against genetic baselines from 268 Chinook salmon populations in the eastern Pacific from Alaska to California (Appendix 1). Then the mixed samples were compared with baselines collected from 21 Skeena River populations (Appendix 3). The criteria for selecting a spawning population or site as baseline were that they had to have genetic material from over 30 individuals. Samples were analyzed for 13 microsatellite loci using methods of DNA extraction, PCR reaction, electrophoresis, and allele scoring described by Candy et al. (2002) and Beacham et al. (2006). The Molecular Genetics Laboratory at the Pacific Biological Station provided the sample analysis. A new version of the computer program as described by Pella and Masuda (2001) was used for the analyses. This program called “c-BAYES” is available from http://www-sci.pac.dfo-mpo.gc.ca/mgl/data_e.htm. The model output included the Bayesian probability estimates for the five most probable populations for each sample.

To examine possible changes in stock composition at Tyee over time the 1,155 samples were separated temporally and genetic results were compared for fish caught at different times through the summer. The time blocks were May 25 to 31, June 1 to 10, June 11 to 20, June 21 to 30, July 1 to 10, July 11 to 20, July 21 to 30, July 31 to August 9, August 10 to 22. Essentially 10 day time blocks with some minor adjustments at the beginning and end periods.

A key stream program on the Kitsumkalum River estimates the escapement of large Chinook salmon to the system. In addition to the escapement estimate, biological samples are collected from live fish during the tagging event and from dead fish during the recovery event. The samples include data on size and gender and scale samples to determine age. The scale collections were also used as a sample of genetic material for comparison with the Skeena baseline. Scales from 200 live fish were collected and analyzed for the 13 microsatellite loci as described above as a test of the 21 stock Skeena baseline.

The mark re-capture estimate of Chinook salmon to the Kitsumkalum River consisted of simple Petersen estimates of the form:

$$N = \frac{(M+1)(C+1)}{(R+1)}$$

Where N is the estimate of large Chinook salmon, M is the number of large Chinook salmon marked, C is the total number of large Chinook salmon carcasses encountered in the dead pitch and R is the number of marked large Chinook salmon carcasses recovered in the dead pitch (Ricker, 1975). Separate estimates were calculated for males and females. Variance was computed using:

$$v(N) = N^2(C-R)/(C+1)(R+2)$$

Variance (v) for the estimate of the Chinook salmon return to the Skeena River (z) was computed using Calculations from TCChinook (99)-3 where:

$$v(z) \sim= z^2((v(y)/y^2)+(v(x)/x^2))$$

or

$$v(z) \sim= z^2\ (cv^2\ (y)+cv^2\ (x))$$

Where y was the estimate of the Kitsumkalum escapement and x was the estimate of the Kitsumkalum component measured at Tyee. The abbreviation cv refers to the coefficient of variation.

RESULTS

The Tyee Test fishery was operated from 25 May to 24 September 2009. Chinook salmon were caught from 25 May through 24 August (Figure 3.). A total of 1,322 Chinook salmon were encountered by the net; 1,189 large and 133 jacks. A total of 1,163 Chinook salmon were sampled for size, gender, scales and tissue. Depredation by seals accounted for most of the losses of fish that were caught in the net but could not be sampled. Often these consisted of only pieces of fish so badly mutilated that size and gender could not be determined.

Of the 1,163 Chinook salmon sampled at Tyee, genetic results were produced for 1,155 fish. The samples were initially compared against genetic baselines from 268 stocks that form the regional baseline typically used to distinguish the composition of mixed stock marine samples collected off the north coast of British Columbia. 98.5% of the sample was assigned to the Skeena Region, 1.0% to the Nass Region and 0.4% to the Stikine Region (Table 1.).

The Skeena River baseline was revised prior to subsequent analyses to take advantage of collections made in the watershed during 2009 and to eliminate some redundancies in the Skeena stocks used in the 268 stock baseline (Appendix 3). The baseline improvements included: combining the Kitsumkalum samples collected above and below a mid-river canyon; combining samples from Magar Creek with Gitnadoix River samples (Magar is a tributary of the Gitnadoix); combining Thomas Creek and Zymoetz River samples and including them as Zymoetz; removing the Skeena at Terrace samples since this site no longer holds fish because the river moved in recent floods; including the 2009 Upper Skeena adult collections at Otsi Creek (90) , Kluayaz Creek (50) and Kluakaz Creek (17); and including some of the 2009 middle and lower Skeena juvenile and adult collections. Samples from six (6) populations sampled in 2009 could not be included in the baseline at the time of writing (Appendix 4).

When the 1,155 genetic samples collected at Tyee were compared against the 21 stock Skeena baseline the proportion of the sample assigned to the Kitsumkalum River was 13.4% with a standard deviation of 1.4% (Table 2). The Kitsumkalum component in the sample was second to the Morice component which made up 32.8% of the sample. The Bear component of the sample was third largest at 9.8%. These rankings are near the expected values when compared with other estimates of 2009 Chinook escapements; however the Babine component of the sample was identified as 0.1%, much lower than expected.

When the 190 Chinook salmon sampled in the Kitsumkalum River were compared against the 21 stock Skeena baseline 98% of the sample was assigned to the Kitsumkalum River (Table 3). The next largest assignment of 0.9% was to the Zymoetz River.

The escapement of Chinook salmon to the Kitsumkalum River was estimated at 10,703 large fish (jacks excluded) with a standard deviation of 1,424 fish. The total return to the Skeena River was estimated at 79,838 (standard deviation = 13,601) using the Kitsumkalum escapement estimate and the proportion of Kitsumkalum estimated at Tyee as the basis for expansion. The coefficient of variation for the estimated number of large Chinook returning to the Skeena River was 17%.

When expansions of the stock components within the Skeena River from the Tyee samples were compared with independent estimates of escapement, the Babine River component was underestimated by the genetic samples and the Kitwanga River component was overestimated. 1,485 Chinook salmon were counted through the Babine fence to 21 September and a large number were observed passing the fence sill after the barrier was removed on 22 September. Chinook salmon were observed holding below the Babine River Fence in 2009, hesitant to pass through the barrier. Following removal of the fence the visual estimate was 4,550 Chinook salmon compared with 66 estimated using the genetic proportion at Tyee. The fence count of Kitwanga Chinook salmon was 824 fish and the genetic ratio estimate was 3,432 fish. The largest component in the Tyee sample, 32.8%, was assigned to the Morice River which was expanded to an escapement estimate of 26,156 fish, more than twice the visual estimate of 12,365 fish (Table 4.).

The proportions of Kitsumkalum Chinook appear to increase relative to other stocks when compared across time periods (Table 5.). When the proportions are converted to numbers of fish caught at Tyee the timing of Kitsumkalum Chinook salmon appears slightly later than other stocks (Figure 4). The timing of fish from the highest parts of the watershed, Kluayaz, Kluakaz and Otsi mirrors that of fish assigned to the lowest part of the watershed, Gitnadoiks and Ecstall.

Complete ages were derived for 878 fish and marine ages were derived for an additional 237 fish of the Chinook salmon sampled at Tyee. The largest component in the age sample was made up of age 5_2, stream type fish from the 2004 brood year which made up 83% of the females and 65% of the males sampled (Table 6.). Age 4_2 males were the next largest component, making up 21% of the male return.

DISCUSSION

Timing of the Chinook salmon migration past Tyee appeared to be later in 2009 when compared with average run timing as measured by the Tyee Test fishery (Figures 2 & 3). It's not clear whether the fish were held up by the high water experienced in mid June or whether the high water levels made the fish passing Tyee less vulnerable to the fishery. The 2009 Skeena River water levels measured at Usk, just upstream of the Zymoetz River confluence, reached a maximum depth of 10.5 meters and maximum flow of 5550 m^3/s on 7 June (Figure 5.). Water input from the Zymoetz and Kitsumkalum watersheds and several minor systems enter the Skeena below Usk so the volumes experienced at Tyee probably exceeded 7000 m^3/s. The timing of Chinook passing through the fence on the Kitwanga River was also later than normal when compared to a smoothed average of returns from 2003 to 2008 (Figure 6.). The Kitwanga data support that the Chinook salmon migration was delayed in 2009.

The mixture model distinguished Skeena River Chinook salmon from other regions in the 268 stock baseline. Virtually all of the Chinook salmon caught at Tyee were assigned to the Skeena region aggregate. Only 1.0% of the Tyee catch was assigned to the Nass River, 0.4% was assigned to the Stikine River and less than 0.1% was assigned to all other regions. Similarity between stocks that are geographically close was expected, especially given that the Skeena, Nass and Stikine watersheds have adjacent headwaters. These results supported the assumption that all of the Chinook salmon caught at the Tyee Test fishery were from the Skeena watershed.

The mixture model recognized Kitsumkalum Chinook salmon using the revised 21 stock Skeena baseline. Essentially, Kitsumkalum Chinook salmon were not assigned to other populations with systematic regularity. The next largest assignment of 0.9% of the Kitsumkalum fish was to the Zymoetz River population. The Zymoetz River is geographically the nearest Chinook stock with a baseline collection to the Kitsumkalum River. The confluence of the Zymoetz and Skeena Rivers is only ~17 km upstream of the confluence of the Kitsumkalum and

Skeena Rivers (Figure 1). The alternative source of error, fish from other populations being assigned to the Kitsumkalum, has not been tested yet.

A problem with the identification of Babine Chinook salmon at Tyee appears to be the most serious error in the current genetic approach. A lack of assignments to the Babine population was evident in analyses using both the 268 and 21 stock baselines. The Babine River makes a significant contribution to the Skeena River Chinook salmon aggregate. It's unlikely that Babine River Chinook have such different migration timing that they were missed by the test fishery because spawning is synchronous with other Skeena populations. More probable is that they are similar to some other baseline stock and are being miss-assigned. The Babine River Chinook salmon baseline consists of 266 samples collected in 1994, 1995 and 1996. There are no further data regarding this collection but it's probable that adults were sampled at the Babine Fence. Since Chinook salmon are readily available at the fence the problem may be resolved by upgrading or replacing the baseline with samples collected in the future. Also, the existing Babine samples should be run against the baseline to see where they get assigned, similar to the procedure completed for Kitsumkalum Chinook salmon.

The error of assigning too many fish to stocks like Kitwanga can be expected in a situation like the Skeena watershed where populations are missing from the baseline. Fish from populations without baselines get assigned to the most similar population and as a consequence stocks may be overestimated. Since all of the Chinook salmon returning to the Kitwanga River were counted through the Kitwanga Fence in 2009 it's evident that some similar populations were assigned to the Kitwanga. Overestimation errors may be reduced as the baseline is improved to include more of the Chinook salmon populations in the Skeena watershed. Samples collected in 2009 represent six new populations in the Exstew, Zymagotitz, Gitsegukla, Shegunia, Kasiks, and Exchamsiks Rivers that have yet to be included in the Skeena River baseline (Appendix 4). (Allen Gottesfeld, Skeena Fisheries Commission, pers. comm.)

Size differences driven by differences in age at maturity could have influenced the vulnerability of Chinook salmon to the test fishery. The multi-panel test net has been designed to reduce size specific selection but the difference in age at maturity for Kitsumkalum Chinook salmon compared with fish in the rest of the Skeena watershed was a concern. Typically Kitsumkalum Chinook salmon mature at a year older than other Skeena River Chinook salmon (Figure 5.). However, poor performance of the 2003 brood year left the return to the Kitsumkalum in 2009 with an age structure similar to the rest of the Skeena (Figure 6.). Size selectivity was not an issue in 2009 because of little or no difference in age structure between Kitsumkalum River and other Skeena River Chinook salmon.

This project does not account for removals of Chinook salmon by fisheries upstream of Tyee, nor was any attempt made to measure whether removal rates differ among stocks. There are significant sport and First Nations' fisheries on the Skeena River. Estimates of First Nations' harvest exceed 6,000 Chinook salmon in 2009. This estimate was reported catch with no associated catch estimation procedures and no variance estimates. No creel surveys have been conducted on the Skeena River in recent years to estimate sport catch. A creel survey in 2003 estimated 6,280 Chinook salmon caught and 1,094 released below Terrace. Similar conditions in 2009 suggest a sport fishery of similar magnitude below Terrace. Sport fisheries for Chinook salmon above Terrace have not been surveyed.

Chinook salmon harvests by fisheries on the Skeena River above Tyee were probably in excess of 12,000 Chinook salmon in 2009. The lack of a sport catch estimate and unknown variance around the First Nations' catch estimate makes the estimate of Chinook salmon spawning escapement to the Skeena watershed significantly more uncertain. A very rough estimate would place escapement near 68,000 Chinook salmon, using ~80,000 fish past Tyee less ~12,000 in-river fishery catch.

Kitsumkalum Chinook salmon may experience much higher rates of in-river harvest than other stocks because of a large terminal sport fishery near Terrace, at the confluence of the Kitsumkalum River and the Skeena River.

The genetic approach used in this study would benefit from additional work to improve the baseline for Skeena River Chinook salmon populations. Improvements identified in this work include:

1. Including the six (6) additional population from the 2009 collections in the baseline;
2. Running a simulation with the baseline to see where populations are miss-assigned; and
3. Re-sampling Babine River Chinook salmon population for genetic material.

Future work on Skeena River Chinook would benefit from a radio telemetry project to confirm that:

1. Large portions of the fish assigned to the Kitsumkalum stock using genetics do not spawn outside of the area measured by the mark-recapture program;
2. The migration of Kitsumkalum Chinook salmon and other Skeena Chinook populations past Tyee has similar timing; and
3. The genetic stock assignments to fish sampled at Tyee are correct (i.e. Fish from other stocks that spawn in other locations haven't been assigned to Kitsumkalum.).

Future work on Skeena River Chinook would benefit from improved catch estimation for in-river fisheries including:

1. A creel survey with age structure and genetic sampling to generate stock specific estimates of sport fishery removals.
2. Improved catch estimation for First Nations' fisheries to provide estimates of Chinook salmon harvest with known variance.
3. Biological sampling of First Nations' harvests, including genetic sampling.

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TABLES

Table 1. Results of the genetic mixture model analysis of 1,155 Chinook salmon caught at the Tyee Test fishery using the 268 stock baseline.

Data are presented as percent of the sample by region.

Region	Estimate (% of sample)	Standard Deviation
Alaska	0.03	(0.08)
Alsek	0.00	(0.02)
Taku	0.03	(0.13)
Stikine	0.38	(0.42)
Unuk_River	0.00	(0.05)
QCI	0.00	(0.01)
Nass	1.03	(0.57)
Skeena	**98.50**	**(0.16)**
NOMN	0.02	(0.08)
SOMN	0.00	(0.03)
ECVI	0.00	(0.04)
WCVI	0.00	(0.04)
LWFR-F	0.00	(0.02)
LWFR-Su	0.00	(0.01)
LWFR-Sp	0.00	(0.02)
MUFR	0.00	(0.05)
LWTH	0.00	(0.03)
SOTH	0.00	(0.04)
NOTH	0.00	(0.03)
UPFR	0.00	(0.05)
Puget_Sound	0.00	(0.04)
Juan_de_Fuca	0.00	(0.01)
Coastal_Wash	0.00	(0.02)
Low_Col	0.00	(0.02)
Mid_Col-Sp	0.00	(0.03)
Snake-F	0.00	(0.01)
Snake-Sp/Su	0.00	(0.04)
Up_Willamette	0.00	(0.02)
Klamath/Trinity	0.00	(0.02)
Up_Col-Sp	0.00	(0.03)
Up_Col-Su/F	0.00	(0.03)
North_&_Central_O	0.00	(0.03)
Cent_Val-Sp	0.00	(0.02)
South_Oregon_coas	0.00	(0.03)
Coastal_Californi	0.00	(0.01)
Cent_Val-F	0.00	(0.04)

Abbreviations are defined in Appendix 2.

Table 2. Results of the genetic mixture model analysis of 1,155 Chinook salmon caught at the Tyee Test fishery using the 21 stock Skeena baseline.

Data are presented as percent of the sample by stock.

Code	Stock	Estimate (% of sample)	Standard Deviation
21	Ecstall	2.9	(0.5)
271	Gitnadoiks	4.0	(0.7)
24	Kitsumkalum	13.4	(1.4)
86	Cedar	0.0	(0.1)
60	Zymoetz	4.2	(0.8)
16	Kitwanga	4.3	(1.4)
15	Bulkley	1.0	(0.3)
19	Morice	32.8	(1.9)
399	Suskwa	0.0	(0.1)
55	Kispiox	5.5	(1.8)
401	Sweetin	4.3	(1.3)
52	Babine	0.1	(0.2)
480	Kuldo	0.5	(0.7)
495	Sicintine	0.3	(0.5)
396	Slamgeesh	6.4	(1.9)
479	Squingula	6.1	(1.3)
51	Sustut	2.1	(0.5)
20	Bear	9.6	(1.9)
466	Kluayaz_Cr	0.5	(0.8)
490	Kluakaz_Cr	0.4	(0.6)
492	Otsi	1.7	(0.9)

Table 3. Results of the genetic mixture model analysis of 190 Kitsumkalum Chinook salmon samples collected in 2009 against the 21 stock Skeena baseline.

Code	Stock	Estimate (% of sample)	Standard Deviation
21	Ecstall	0.0%	(0.1)
271	Gitnadoix	0.0%	(0.2)
24	Kitsumkalum	98.0%	(1.9)
86	Cedar	0.0%	(0.1)
60	Zymoetz	0.9%	(1.3)
16	Kitwanga	0.1%	(0.4)
15	Bulkley	0.0%	(0.2)
19	Morice	0.0%	(0.2)
399	Suskwa	0.1%	(0.4)
55	Kispiox	0.2%	(0.5)
401	Sweetin	0.5%	(0.9)
52	Babine	0.0%	(0.1)
480	Kuldo	0.0%	(0.1)
495	Sicintine	0.0%	(0.1)
396	Slamgeesh	0.1%	(0.4)
479	Squingula	0.0%	(0.1)
51	Sustut	0.0%	(0.1)
20	Bear	0.0%	(0.2)
466	Kluayaz	0.0%	(0.3)
490	Kluakaz	0.0%	(0.1)
492	Otsi	0.0%	(0.2)

Table 4. Comparisons of stock specific Chinook salmon escapement estimates calculated from the ratio of Kitsumkalum Chinook in the Tyee sample against other estimates.

Stock	Proportion at Tyee	SD (%)	Escapement Estimate using genetics	Other Escapement Estimate	Other Escapement Estimation Method
Ecstall	2.9%	(0.5)	2,324		
Gitnadoix	4.0%	(0.7)	3,179	150	peak count
Kitsumkalum	13.4%	(1.4)	10,703	10,703	mark-recapture
Cedar	0.0%	(0.1)	20	350	peak count
Zymoetz	4.2%	(0.8)	3,345		
Kitwanga	4.3%	(1.4)	3,432	824	fence
Bulkley	1.0%	(0.3)	803	250	peak count
Morice	32.8%	(1.9)	26,156	12,365	AUC (includes 283 Nanika)
Suskwa	0.0%	(0.1)	22		
Kispiox	5.5%	(1.8)	4,400		
Sweetin	4.3%	(1.3)	3,432		
Babine	0.1%	(0.2)	66	4,550	AUC (1,485 fence)
Kuldo	0.5%	(0.7)	375		
Sicintine	0.3%	(0.5)	251		
Slamgeesh	6.4%	(1.9)	5,131		
Squingula	6.1%	(1.3)	4,839		
Sustut	2.1%	(0.5)	1,671	273	fence
Bear	9.6%	(1.9)	7,640	8,597	AUC
Kluayaz	0.5%	(0.8)	435		
Kluakaz	0.4%	(0.6)	291		
Otsi	1.7%	(0.9)	1,323		
Total			79,838	38,062	

AUC = area under the curve estimate from aerial surveys.
SD = standard deviation

Table 5. Mixture model analyses of the 1,155 Chinook salmon caught at the Tyee Test fishery using the 21 stock Skeena baseline separated by 10 day time period.

Data are presented as percent of the sample by stock.

Time period	May 25-31		June 1- 10		June 11-20		June 21-30		July 1-10		July 11-20		July 21-30		July 31-Aug 9		Aug 10 - 22	
Sample size	17		40		102		289		248		256		140		46		17	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Ecstall	0.0	(1.2)	0.0	(0.6)	1.0	(1.0)	0.2	(0.3)	3.2	(1.1)	5.5	(1.4)	4.7	(1.9)	6.5	(3.6)	0.0	(1.5)
Gitnadoiks	8.7	(8.4)	0.8	(1.9)	4.8	(2.4)	6.5	(1.6)	3.0	(1.4)	1.2	(0.8)	2.7	(1.6)	3.0	(4.0)	3.6	(6.7)
Kitsumkalum	**3.1**	**(7.3)**	**0.1**	**(0.7)**	**11.6**	**(4.6)**	**1.8**	**(2.0)**	**16.7**	**(3.2)**	**20.8**	**(3.3)**	**22.1**	**(4.5)**	**27.6**	**(9.5)**	**41.0**	**(14.0)**
Cedar	6.2	(8.5)	7.0	(4.8)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(1.1)
Zymoetz	0.4	(2.3)	9.4	(5.5)	9.0	(3.3)	9.3	(2.1)	2.4	(1.5)	0.7	(0.7)	0.0	(0.3)	0.2	(1.2)	0.0	(1.4)
Kitwanga	8.6	(12.3)	1.8	(4.4)	0.5	(1.7)	8.8	(2.6)	0.4	(1.0)	0.3	(1.0)	3.0	(3.8)	8.7	(7.3)	0.5	(2.8)
Bulkley	11.6	(7.3)	5.5	(3.8)	3.0	(1.7)	0.4	(0.4)	0.0	(0.2)	0.5	(0.5)	0.0	(0.2)	0.0	(0.4)	0.0	(1.3)
Morice	0.2	(1.9)	3.0	(3.3)	13.7	(4.5)	31.1	(3.5)	31.9	(4.0)	36.0	(4.1)	23.8	(4.8)	20.9	(7.6)	2.8	(6.4)
Suskwa	2.7	(6.6)	1.0	(2.6)	0.0	(0.4)	0.1	(0.3)	0.1	(0.4)	0.0	(0.2)	0.0	(0.3)	0.1	(0.8)	0.3	(1.9)
Kispiox	23.3	(16.0)	2.9	(6.6)	16.4	(7.7)	16.2	(4.3)	11.3	(3.9)	0.3	(0.9)	0.4	(1.3)	0.6	(2.9)	2.3	(6.2)
Sweetin	7.6	(10.7)	37.0	(10.7)	3.6	(4.8)	0.6	(1.3)	5.4	(2.7)	4.1	(2.2)	0.2	(1.0)	2.9	(4.8)	1.1	(4.2)
Babine	0.4	(2.4)	0.2	(1.4)	0.1	(0.7)	0.0	(0.2)	0.0	(0.2)	1.3	(1.8)	0.5	(1.2)	1.2	(2.9)	2.0	(6.4)
Kuldo	1.0	(3.6)	1.1	(2.8)	0.2	(0.9)	2.7	(1.8)	0.2	(0.8)	0.1	(0.3)	1.5	(2.3)	0.2	(1.1)	0.1	(1.6)
Sicintine	0.1	(1.4)	8.8	(7.9)	3.7	(4.0)	0.2	(0.7)	0.3	(0.7)	0.0	(0.1)	0.1	(0.4)	0.2	(1.4)	0.5	(2.7)
Slamgeesh	14.6	(16.9)	1.6	(4.5)	15.4	(6.2)	3.4	(3.2)	16.8	(4.5)	2.9	(3.0)	11.8	(5.3)	19.4	(10.2)	0.1	(2.1)
Squingula	5.4	(8.1)	9.6	(6.9)	9.5	(4.9)	9.0	(2.7)	4.0	(2.7)	0.4	(1.0)	0.6	(1.6)	1.7	(3.9)	44.3	(14.7)
Sustut	0.0	(1.3)	5.5	(3.7)	6.1	(2.4)	4.1	(1.2)	1.1	(0.9)	0.0	(0.1)	0.0	(0.2)	0.0	(0.6)	0.1	(1.6)
Bear	2.3	(7.1)	1.5	(4.3)	0.2	(1.0)	2.0	(2.6)	0.2	(0.8)	22.8	(4.7)	27.2	(6.4)	4.0	(7.1)	0.5	(3.0)
Kluayaz_Cr	3.1	(5.9)	0.4	(1.7)	0.1	(0.6)	0.9	(1.5)	0.4	(1.2)	2.6	(2.3)	0.5	(1.4)	2.4	(4.6)	0.1	(1.4)
Kluakaz_Cr	0.4	(2.4)	0.6	(2.1)	0.2	(1.0)	0.1	(0.4)	2.0	(1.9)	0.3	(0.9)	0.3	(1.0)	0.2	(1.2)	0.2	(1.9)
Otsi	0.3	(1.9)	2.3	(4.9)	0.8	(1.8)	2.6	(1.7)	0.4	(1.1)	0.1	(0.3)	0.4	(1.2)	0.4	(1.9)	0.5	(2.8)

SD = standard deviation

Table 6. Chinook salmon age data from fish caught by the 2009 Tyee Test fishery.

Age	Males	Females	Total
3_1	2		2
4_1	6	9	15
3_2	27		27
4_2	100	10	110
5_2	303	344	647
6_2	22	48	70
7_2	1		1
5_3	2		2
6_3	1	3	4
1 marine year	2		2
2 marine years	19	1	20
3 marine years	100	97	197
4 marine years	9	9	18
Total	594	521	1115
Complete ages	464	414	878
Ocean type	1.7%	2.2%	1.9%
5_2	65.3%	83.1%	73.7%
3 marine years (includes 5_2's & 6_3's)	68.0%	85.2%	76.1%

FIGURES

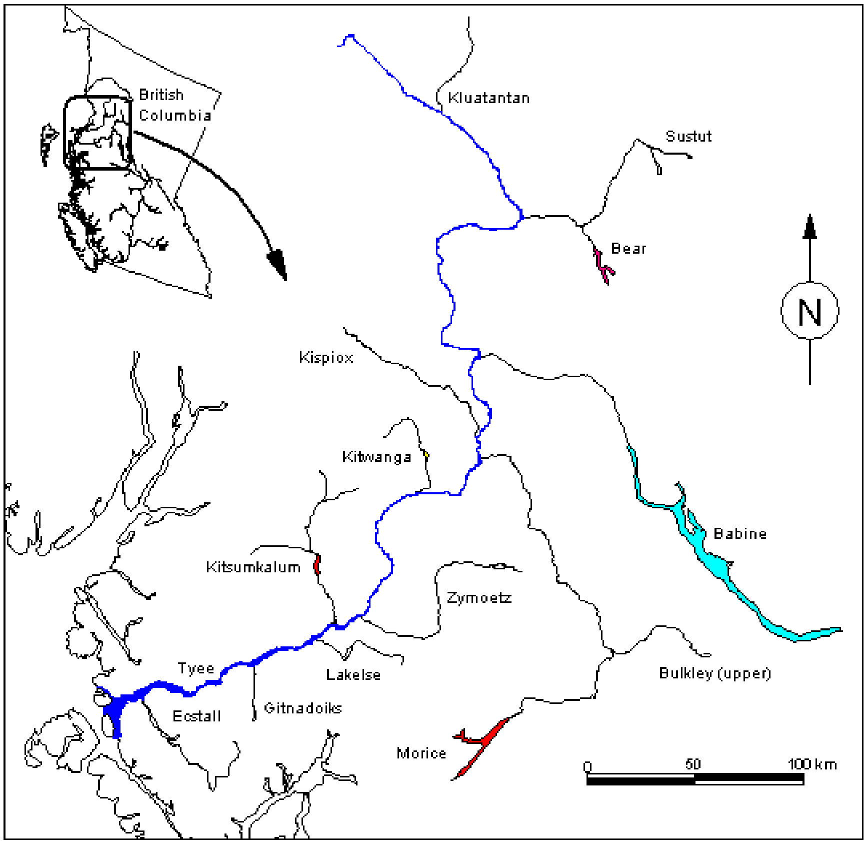


Figure 1. The Skeena River watershed in northern British Columbia showing the largest tributaries and the location of Tyee.

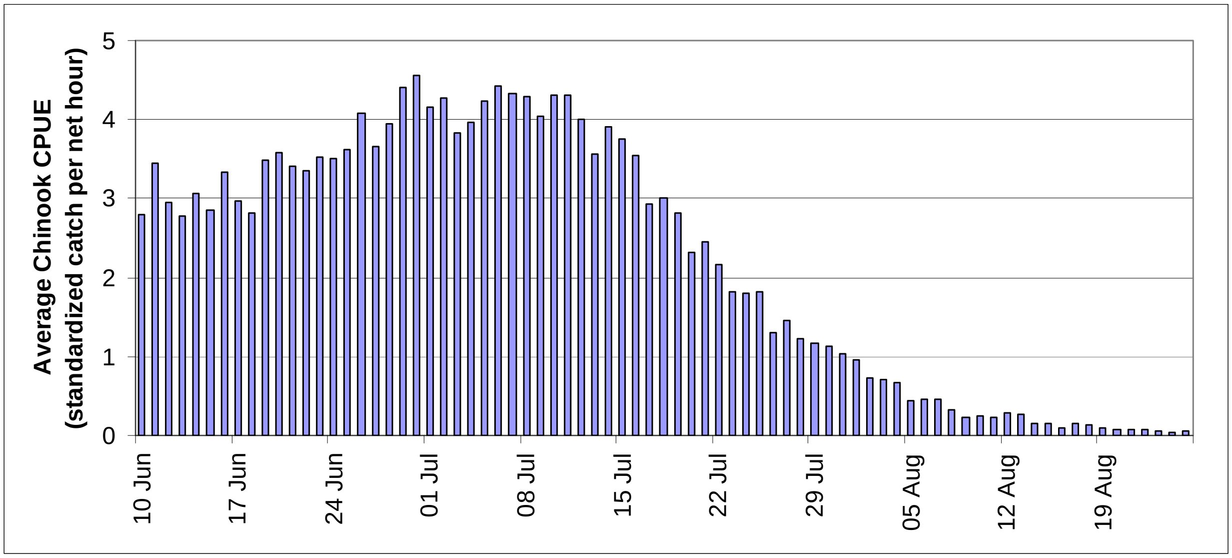


Figure 2. Skeena River Chinook salmon run timing past Tyee as measured by standardized catch per effort at the Tyee Test Fishery averaged from 1956 to 2008.

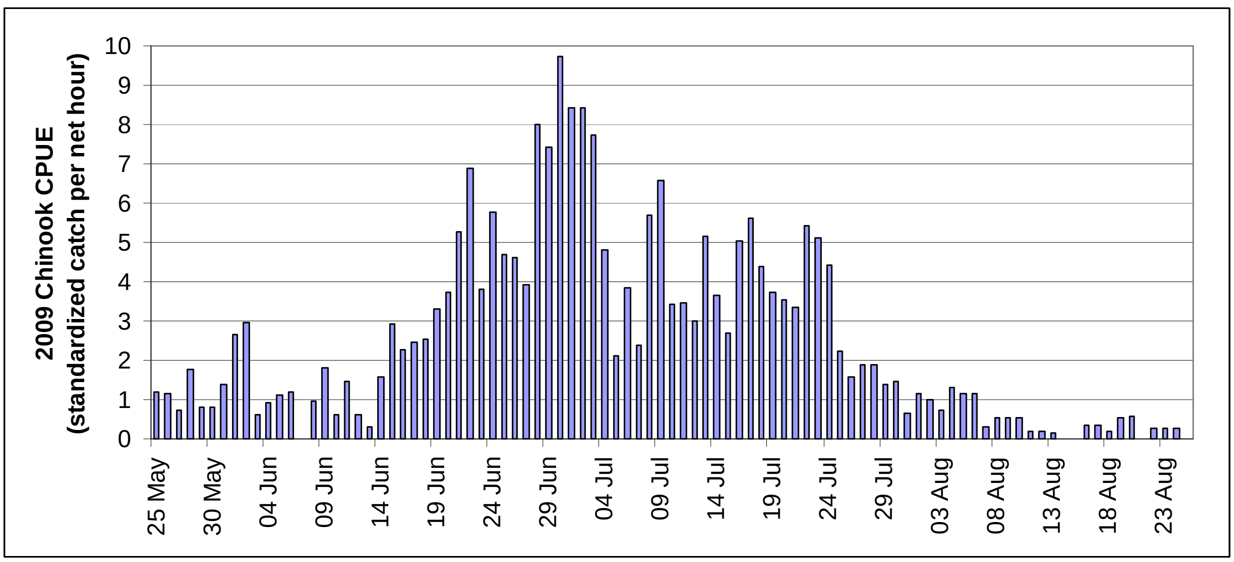


Figure 3. 2009 Skeena River Chinook standardized catch per effort by day at the Tyee Test fishery.

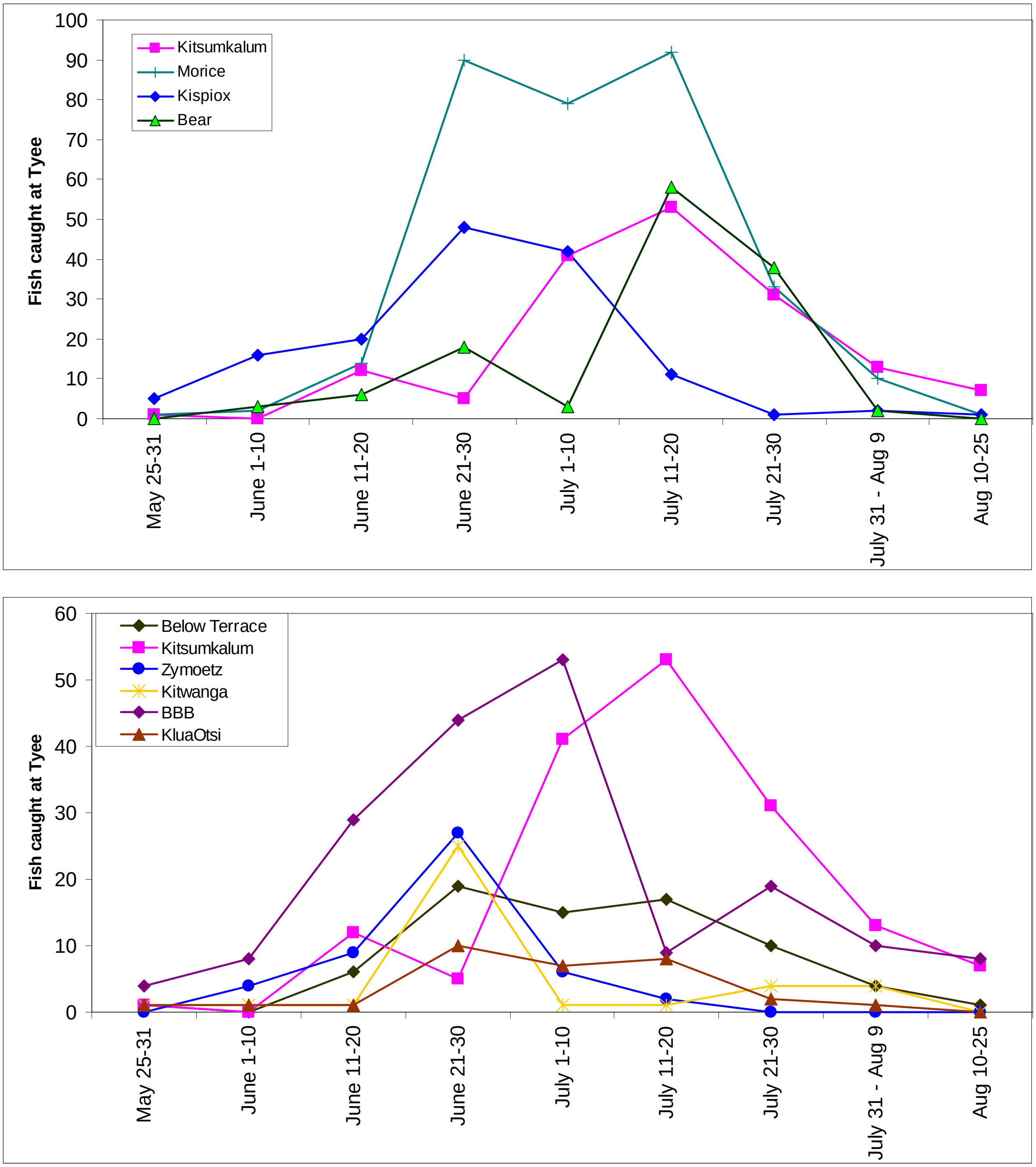


Figure 4. Catch of Chinook salmon at Tyee presented by stock group and time period to depict run timing.

Data are presented in two graphs to reduce clutter. The catch of Kitsumkalum Chinook salmon is presented in both graphs. Babine, Cedar and upper Bulkley stocks are not presented. Proportions are presented with standard deviations in Table 5. Results from some stocks were combined:
Below Terrace = assignments to the Ecstall and Gitnadoiks Rivers combined.
BBB = stocks between Babine River and Bear River, assignments to the Kuldo, Sicintine, Slamgeesh, and Squingula Rivers combined.
KluaOtsi = stocks above the Bear River, assignments to the Kluayaz, Kluakaz and Otsi Creeks combined.

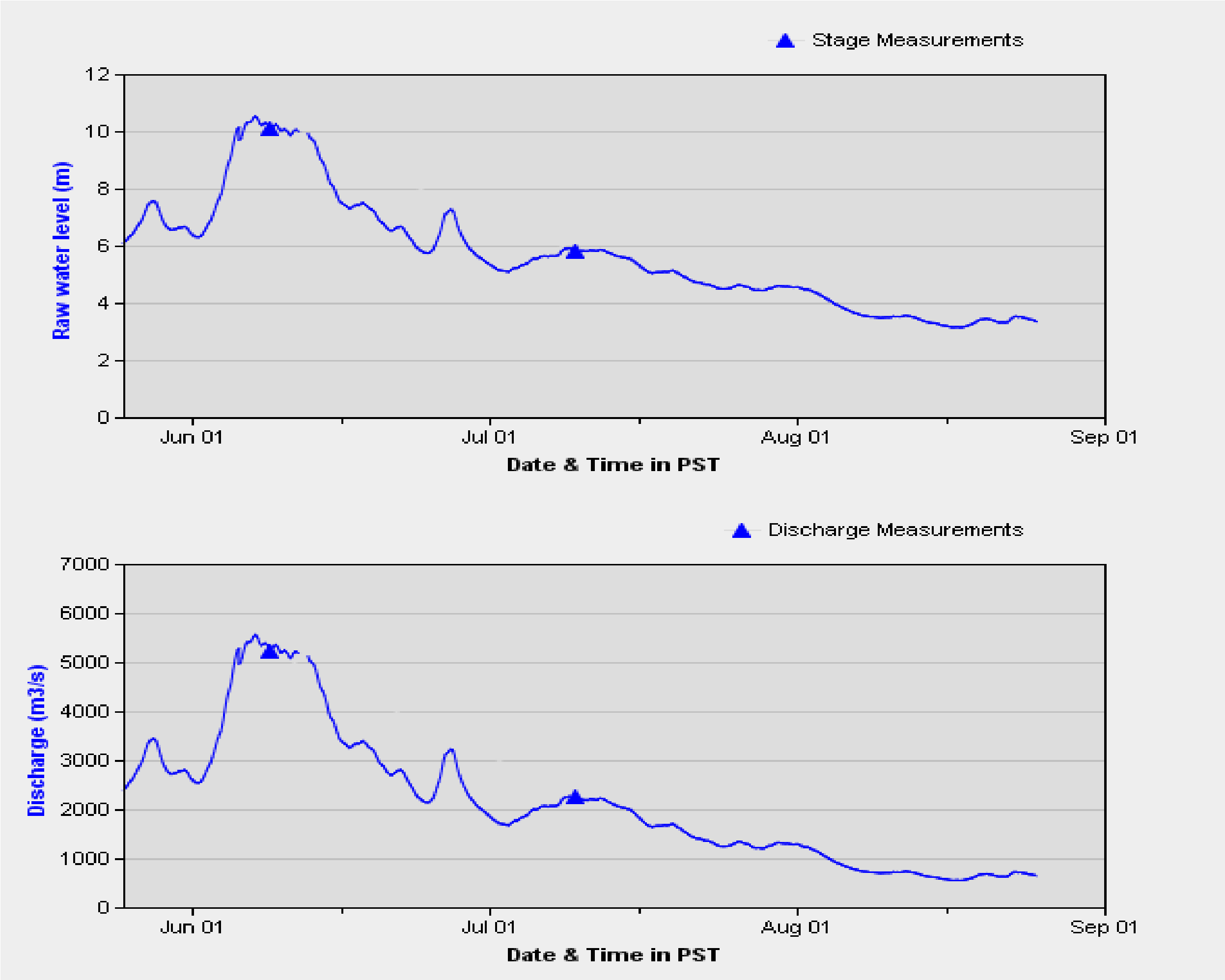


Figure 5. Raw water level and discharge rate of the Skeena River measured at Usk, 25 May to 1 September 2009. (**Environment Canada, http://scitech.pyr.ec.gc.ca/waterweb/fullgraph.asp)**

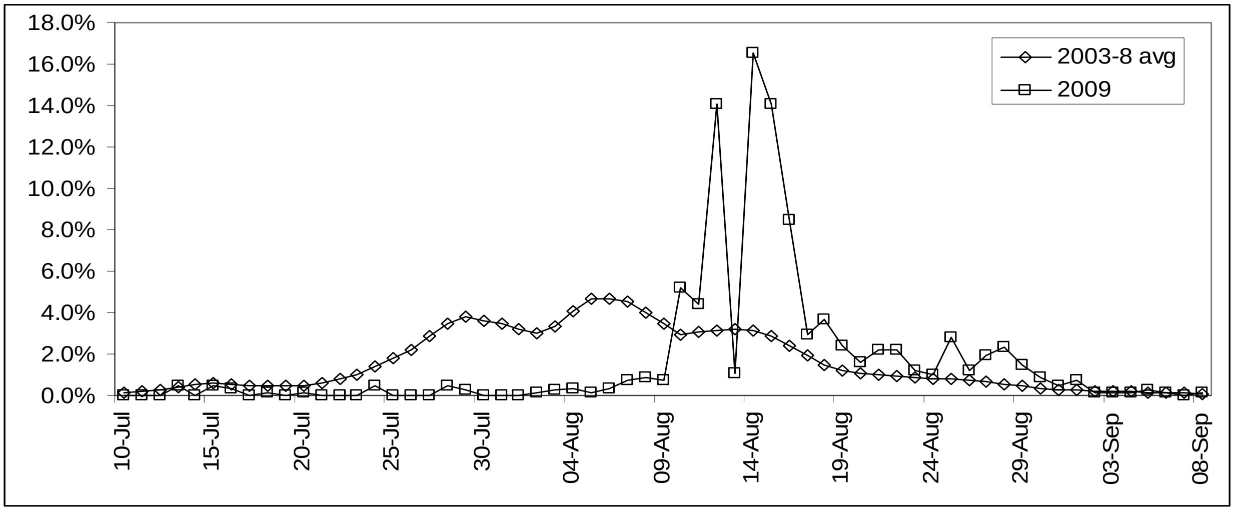
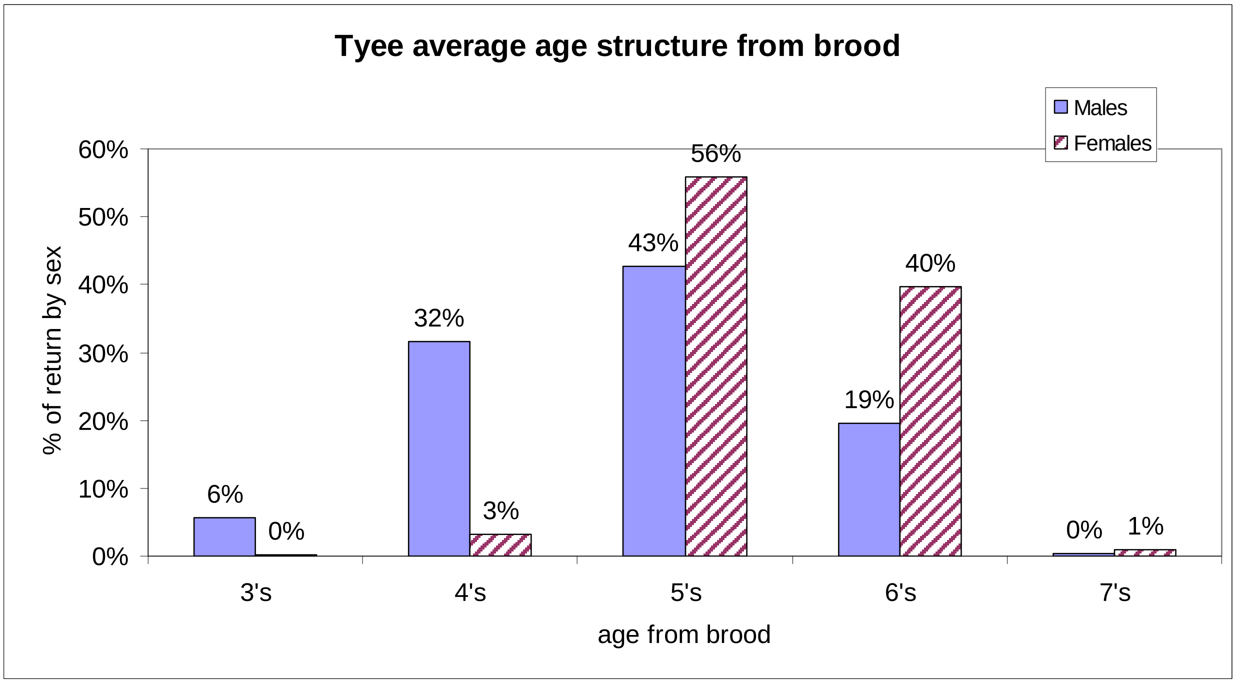


Figure 6. Chinook salmon migration through the Kitwanga Fence in 2009 compared with the 2003 to 2008 smoothed 5 day average timing.

Data courtesy Kevin Koch, Gitanyow Fisheries Authority.



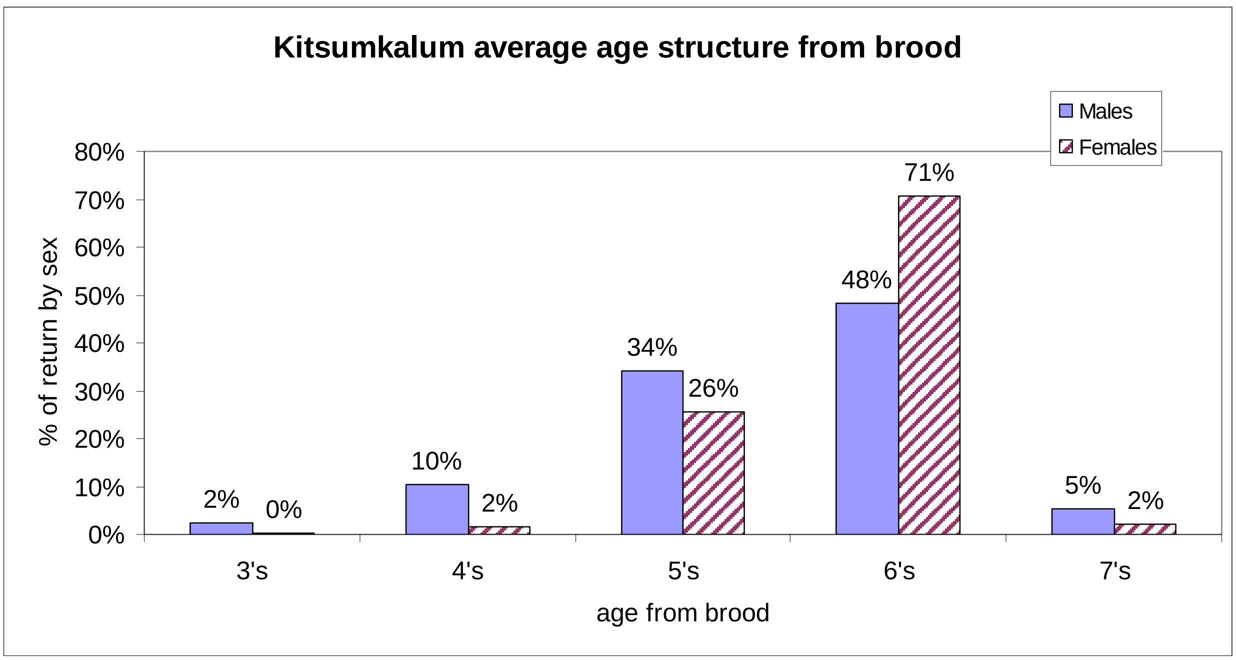
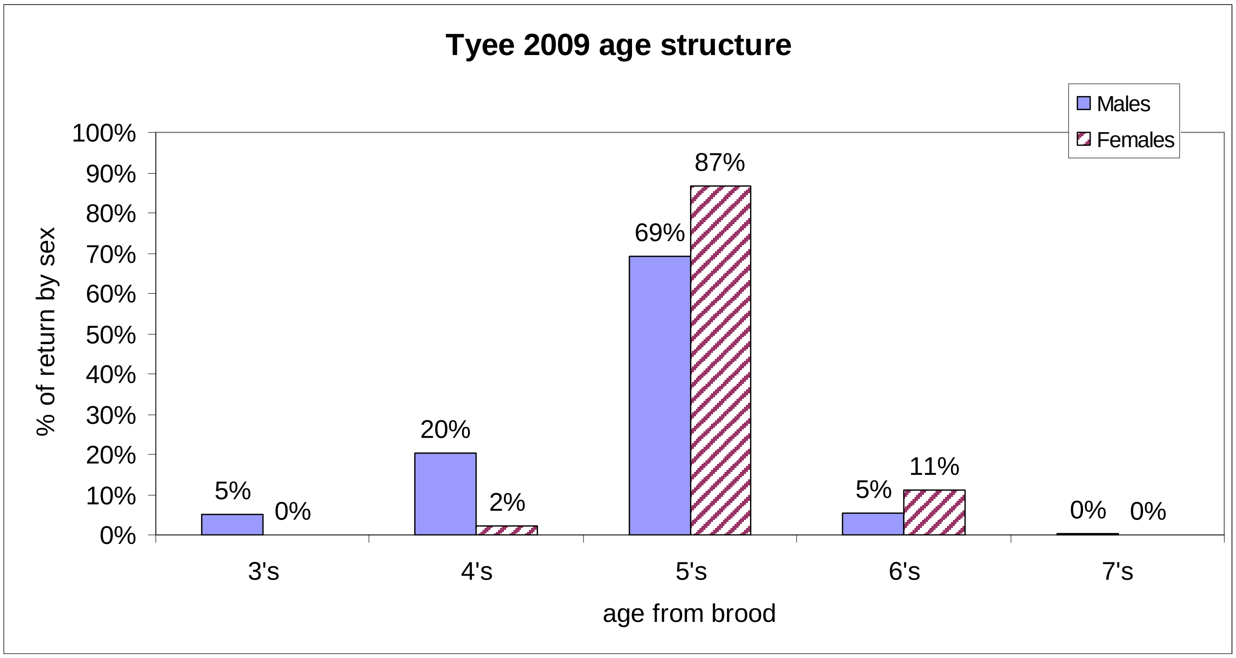


Figure 7. Average Chinook salmon age at return from brood as measured at the Tyee Test fishery compared with the Kitsumkalum River.



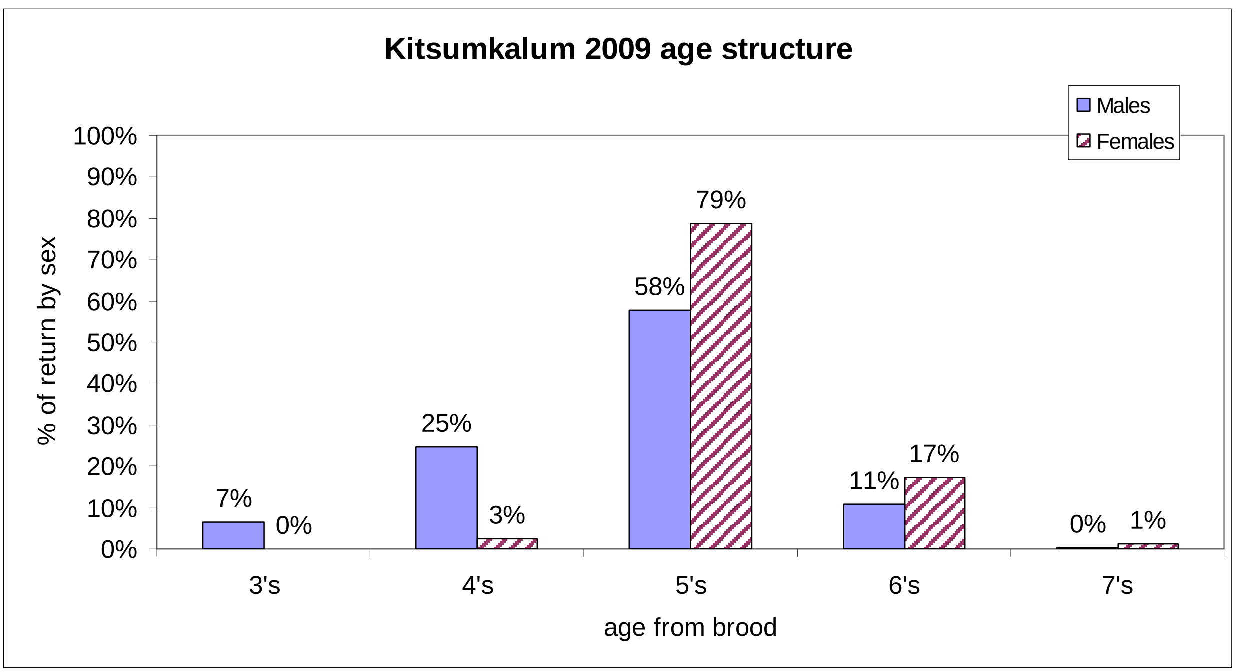


Figure 8. 2009 Chinook salmon age composition measured at the Tyee Test fishery compared with the Kitsumkalum River.

APPENDICES

Appendix 1. Baseline samples used in the 268 mixture analyses. Abbreviations in Appendix 2.

#	Region	Population	N	#	Region	Population	N
1	UPFR	Bowron	216	6	LWTH	Louis	577
1	UPFR	Dome	385	6	LWTH	Nicola	465
1	UPFR	Fontoniko	63	6	LWTH	Spius	136
1	UPFR	Goat	77	6	LWTH	U_Coldwat_SP	212
1	UPFR	Holmes	216	6	LWTH	U_Spius_SP	135
1	UPFR	Horsey	46	7	ECVI	Big_Qualicum	374
1	UPFR	Indianpoint	47	7	ECVI	BigQul@Lang	293
1	UPFR	James	57	7	ECVI	Chemainus	261
1	UPFR	Kenneth_Cr	86	7	ECVI	Cowichan	684
1	UPFR	McGregor	126	7	ECVI	L_Qualicum	209
1	UPFR	Morkill	208	7	ECVI	Nanaimo_F	546
1	UPFR	Nevin_Cr	46	7	ECVI	Nanaimo_SP	99
1	UPFR	R_Chehalis	127	7	ECVI	Nanaimo_SU	281
1	UPFR	R_Chilliwack	163	7	ECVI	NanaimoUpper	118
1	UPFR	Salmon@PG	263	7	ECVI	Nimpkish	127
1	UPFR	Slim	204	7	ECVI	Puntled_SU	1350
1	UPFR	Swift	411	7	ECVI	Puntledge_F	715
1	UPFR	Tete_Jaune	488	7	ECVI	Quatse	38
1	UPFR	Torpy	170	7	ECVI	Quinsam	457
1	UPFR	Walker	42	7	ECVI	Woss_Lake	31
1	UPFR	Willow	116	8	WCVI	Burman	273
2	MUFR	Baezaeko	82	8	WCVI	Colonial_Cay	58
2	MUFR	Bridge	425	8	WCVI	Conuma	456
2	MUFR	Chilako	45	8	WCVI	Gold (87-02)	225
2	MUFR	Chilcotin_mix	47	8	WCVI	Kennedy	338
2	MUFR	Chilko	270	8	WCVI	Marble@NVI	507
2	MUFR	Cottonwood	131	8	WCVI	Nahmint	411
2	MUFR	Elkin	235	8	WCVI	Nitinat	346
2	MUFR	Endako	87	8	WCVI	Robertson	386
2	MUFR	Horsefly	59	8	WCVI	San_Juan	196
2	MUFR	L_Cariboo	71	8	WCVI	Sarita	415
2	MUFR	L_Chilcoti	232	8	WCVI	Sooke	58
2	MUFR	Nazko	194	8	WCVI	Stamp	303
2	MUFR	Nechako	577	8	WCVI	Tahsis	309
2	MUFR	Portage	234	8	WCVI	Thornton	517
2	MUFR	Quesnel	564	8	WCVI	Tlupana	66
2	MUFR	Stuart	555	8	WCVI	Toquart	87
2	MUFR	Taseko	200	8	WCVI	Tranquil	394
2	MUFR	U_Cariboo	171	8	WCVI	Zeballos	140
2	MUFR	U_Chilcotin	277	9	SOMN	Bute	72
2	MUFR	Westroad	39	9	SOMN	Capilano	126
3	LWFR-F	Chilliwac@Stav	376	9	SOMN	Devereux	325
3	LWFR-F	Harrison	602	9	SOMN	Homathko	52
3	LWFR-F	W_Chilliwack	481	9	SOMN	Klinaklini	447
4	NOTH	Barriere	55	9	SOMN	Phillips	284
4	NOTH	Blue	64	9	SOMN	Porteau_Cove	357
4	NOTH	Clearwater	258	9	SOMN	Squamish	157
4	NOTH	Finn	171	10	NOMN	Ashlulm	65
4	NOTH	Lemieux_Cr	133	10	NOMN	Atnarko	275
4	NOTH	N_Thom@Main	115	10	NOMN	Chuckwalla	312
4	NOTH	Raft	248	10	NOMN	Dean	210
5	SOTH	Bessette	109	10	NOMN	Dean@Main	20
5	SOTH	Duteau_Cr	49	10	NOMN	Docee	123
5	SOTH	Eagle	144	10	NOMN	Hirsch	474
5	SOTH	L_Adams	208	10	NOMN	Kateen	134
5	SOTH	L_Shus@U_Adams	45	10	NOMN	Kilbella	196
5	SOTH	L_Shuswap	356	10	NOMN	Kildala	440
5	SOTH	L_Thompson	172	10	NOMN	Kitimat	482
5	SOTH	Little	157	10	NOMN	Kitlope	201
5	SOTH	M_Shuswap	376	10	NOMN	Kwinamass	362
5	SOTH	Salmon@SA	214	10	NOMN	Neechanze	57
5	SOTH	South_Thom	267	10	NOMN	Nusatsum	62
6	LWTH	Bonaparte	308	10	NOMN	Saloompt	139
6	LWTH	Coldwater	278	10	NOMN	Takia	62
6	LWTH	Deadman	299	10	NOMN	U_Atnarko	155

#	Region	Population	N
10	NOMN	Wannock	510
11	NASS	Cranberry	164
11	NASS	Damdochax	255
11	NASS	Ishkheenickh	199
11	NASS	Kincolith	287
11	NASS	Kiteen	59
11	NASS	Kwinageese	299
11	NASS	Meziadin	195
11	NASS	Owegee	220
11	NASS	Seaskinnish	99
11	NASS	Snowbank	54
11	NASS	Teigen	30
11	NASS	Tseax	191
12	LWFR-Sp	Big_Silver	173
12	LWFR-Sp	Birkenhead	347
12	LWFR-Sp	Sloquet_Cr	35
12	LWFR-Sp	Upper_Pitt	146
13	LWFR-Su	Maria_Slough	318
14	QCI	Yakoun	201
15	Alaska	Big_Boulder_C	144
15	Alaska	Chickamin	116
15	Alaska	King_Salmon	202
15	Alaska	Situk	114
15	Alaska	Tahini	142
15	Alaska	Unuk	193
17	Taku	Dudidontu	240
17	Taku	Kowatua	301
17	Taku	Little_Tatsam	603
17	Taku	Nahlin	290
17	Taku	Nakina	435
18	Stikine	Andrew_Cr	144
18	Stikine	Christina	217
18	Stikine	Craig	113
18	Stikine	Little_Tahltan	615
18	Stikine	Shakes_Cr	224
18	Stikine	Verrett	561
19	Skeena Upper	Bear	182
19	Skeena Upper	Slamgeesh	62
19	Skeena Upper	Sustut	519
20	Skeena Babine	Babine	266
21	Skeena Bulkley	Bulkley	585
21	Skeena Bulkley	Morice	228
22	Skeena Mid	Kispiox	195
22	Skeena Mid	Kitwanga	288
22	Skeena Mid	Skeena@Terrace	37
22	Skeena Mid	Sweetin	54
23	Skeena Lower	Cedar	116
23	Skeena Lower	Ecstall	293
23	Skeena Lower	Gitnadoiks	42
23	Skeena Lower	L_Kalum	456
23	Skeena Lower	L_Kalum@AC	190
24	Alsek	Blanchard	381
24	Alsek	Klukshu	432
24	Alsek	Takhanne	187
25	Unuk River	Cripple_Cr	140
50	Puget Sound	Green@Kendal_F	50
50	Puget Sound	Green_F@Soos	100
50	Puget Sound	LittleCampbell	90
50	Puget Sound	Nooksack_SP@Ke	100
50	Puget Sound	Serpentine	46
50	Puget Sound	Skagit_Su	282
50	Puget Sound	Skykomish_Su	75
50	Puget Sound	Soos_Cr_H	94
50	Puget Sound	StillaguamishS	87
50	Puget Sound	White_F	96
51	Juan de Fuca	Elwha_F	99
52	Coastal Wash	Hoh_River_SP_S	59
52	Coastal Wash	Queets	57
52	Coastal Wash	Quinault_F	64
52	Coastal Wash	Solduc_F	98
53	Low Col	Abernathy_F	100
53	Low Col	Coweeman	77

#	Region	Population	N
53	Low Col	Cowlitz_H_Sp	134
54	Up Col-Sp	Chewuch_SP	100
54	Up Col-Sp	Chiwawa_SP	100
54	Up Col-Sp	Entiat_Sp	64
54	Up Col-Sp	Twisp_SP	100
55	Up Col-Su/F	Deschutes-F	100
55	Up Col-Su/F	Hanford_Reach	270
55	Up Col-Su/F	Okanagan	90
55	Up Col-Su/F	Silmilkameen_S	369
55	Up Col-Su/F	Wenatchee_Su	100
56	Snake-Sp/Su	Frenchman-SP	61
56	Snake-Sp/Su	Imnaha	239
56	Snake-Sp/Su	Johnson_Cr	96
56	Snake-Sp/Su	Marsh_Cr	220
56	Snake-Sp/Su	McCall	32
56	Snake-Sp/Su	McCall_Hat	41
56	Snake-Sp/Su	Minam_Cr	143
56	Snake-Sp/Su	Rapid_Sp	220
56	Snake-Sp/Su	Salmon_E_Fork	53
56	Snake-Sp/Su	Secech	138
56	Snake-Sp/Su	Snake_S	62
56	Snake-Sp/Su	Tucannon_SP	100
56	Snake-Sp/Su	Up_Salmon-SP	165
56	Snake-Sp/Su	Upper_Valley	77
56	Snake-Sp/Su	Valley_Cr	43
56	Snake-Sp/Su	Wenaha	43
57	Snake-F	Lyon's_Ferry_F	207
58	North & Central O	Elk	70
58	North & Central O	Euchre_Cr	57
58	North & Central O	Nehalem	53
58	North & Central O	Siuslaw	37
58	North & Central O	Trask_hat_F	98
58	North & Central O	Trask_hat_SP	48
58	North & Central O	Umpqua_Smith	93
59	South Oregon coas	Cole	49
59	South Oregon coas	Hunter_Cr	96
59	South Oregon coas	Lobster_Cr	49
59	South Oregon coas	Nestucca_F	91
59	South Oregon coas	Pistol	94
59	South Oregon coas	Umpqua_Sp	136
59	South Oregon coas	Winchuk	80
61	Klamath/Trinity	Blue_Cr	94
61	Klamath/Trinity	Trinity_F	100
61	Klamath/Trinity	Trinity_SP	100
62	Mid Col-Sp	John_Day_main	36
62	Mid Col-Sp	John_Day_Mid	40
62	Mid Col-Sp	John_Day_N	40
62	Mid Col-Sp	Naches_Sp	30
62	Mid Col-Sp	Spring_Cr_H	135
63	Up Willamette	Clackamas_N	79
63	Up Willamette	North_Santiam	97
63	Up Willamette	Sandy	89
64	Cent Val-F	American	69
64	Cent Val-F	Battle_Cr	40
64	Cent Val-F	Butte_F	49
64	Cent Val-F	Feather_F	128
64	Cent Val-F	Merced	200
64	Cent Val-F	Mokelumne	94
64	Cent Val-F	Sacr_F	136
64	Cent Val-F	Sacr_LF	96
64	Cent Val-F	Toulumne	34
64	Cent Val-F	Yuba	50
65	Cent Val-Sp	Butte_Sp	166
65	Cent Val-Sp	Feather_Sp	82
65	Cent Val-Sp	Yuba_Sp	32
66	Coastal Californi	Eel_F	143

Appendix 2. Abbreviations used to describe regions.

#	Abbreviation	Region
1	UPFR	Upper Fraser River
2	MUFR	Middle Fraser River
3	LWFR-F	Lower Fraser River Fall
4	NOTH	North Thompson River
5	SOTH	South Thompson River
6	LWTH	Lower Thompson River
7	ECVI	East Coast of Vancouver Island
8	WCVI	West Coast of Vancouver Island
9	SOMN	Southern Mainland BC
10	NOMN	Northern Mainland BC
11	NASS	Nass River
12	LWFR-Sp	Lower Fraser River Spring
13	LWFR-Su	Lower Fraser River Summer
14	QCI	Yakoun River
15	Alaska	Alaska
17	Taku	Taku River
18	Stikine	Stikine River
19	Skeena Upper	Skeena Upper
20	Skeena Babine	Skeena Babine
21	Skeena Bulkley	Skeena Bulkley
22	Skeena Mid	Skeena Mid
23	Skeena Lower	Skeena Lower
24	Alsek	Alsek
50	Puget Sound	Puget Sound
51	Juan de Fuca	Juan de Fuca Strait
52	Coastal Wash	Coastal Washington
53	Low Col	Lower Columbia
54	Up Col-Sp	Upper Columbia spring timed
55	Up Col-Su/F	Upper Columbia summer & fall timed
56	Snake-Sp/Su	Snake River spring & summer timed
57	Snake-F	Snake River fall timed
58	Oregon coastal	Oregon coastal
59	S.Oregon/Cal coast	Southern Oregon Coastal and California Coastal
61	Up Klam/Trinity	Upper Klamath & Trinity
62	Mid Col-Sp	Middle Columbia Spring timed
63	Up Willamette	Upper Willamette
64	Cent Val-F	Central Valley fall timed
65	Cent Val-Sp	Central Valley spring timed
66	Coastal Californi	Coastal California
1-6, 12 & 13	Fraser	Fraser River and tributaries
19-23	Skeena	Skeena River and tributaries
17, 18 & 24	TRANS	Transboundary Rivers originating in Canada flowing through Southeast Alaska
53-57, 61-63	Columbia	Columbia River and tributaries
58 & 59	Oregon	Oregon coastal
64 to 66	California	California
50-52	Washington	Washington

Appendix 3. Revised Chinook baseline used in Skeena analyses.

Stocks are arranged roughly as encountered travelling upstream.

Code	STOCK	REGION	Locus specific N												Max
			1b	3g	a1	go2	go4	i1	oke	oki	omy	ots2	ots9	sa	
21	Ecstall	Skeena Lower	270	262	268	276	280	268	273	266	276	274	279	271	280
271	Gitnadoiks	Skeena Lower	204	207	215	222	211	206	224	226	212	226	235	213	235
24	Kitsumkalum	Skeena Lower	690	729	709	801	797	722	695	788	777	787	706	739	801
86	Cedar	Skeena Lower	106	116	116	114	111	114	110	109	112	114	115	116	116
60	Zymoetz	Skeena Lower	56	59	59	58	53	56	58	57	55	59	58	60	60
16	Kitwanga	Skeena Mid	226	270	245	258	244	260	240	245	244	229	248	263	270
15	Bulkley	Skeena Bulkley	424	470	472	435	446	475	417	433	509	475	525	447	525
19	Morice	Skeena Bulkley	159	205	204	162	177	175	146	151	171	180	182	224	224
399	Suskwa	Skeena Bulkley	74	78	77	81	79	76	78	83	75	78	76	77	83
55	Kispiox	Skeena Mid	152	174	162	159	155	174	126	153	148	176	172	174	176
401	Sweetin	Skeena Mid	63	61	58	63	62	60	62	61	61	63	64	63	64
52	Babine	Skeena Babine	182	229	211	192	203	207	169	187	200	214	221	239	239
480	Kuldo	Skeena Upper	170	170	170	168	164	169	167	168	166	169	168	170	170
495	Sicintine	Skeena Upper	107	109	106	110	110	109	111	108	110	111	111	111	111
396	Slamgeesh	Skeena Upper	128	129	124	129	127	127	129	129	129	129	129	129	129
479	Squingula	Skeena Upper	268	271	266	269	267	266	270	265	266	262	264	263	271
51	Sustut	Skeena Upper	473	460	451	456	435	476	440	465	440	451	467	489	489
20	Bear	Skeena Upper	155	174	173	156	163	176	148	157	161	165	171	175	176
466	Kluayaz Cr	Skeena Upper	144	143	148	144	145	145	143	147	147	144	143	144	148
490	Kluakaz Cr	Skeena Upper	69	70	69	65	72	67	67	70	74	69	73	70	74
492	Otsi	Skeena Upper	90	90	89	90	90	90	90	89	90	90	90	87	90

Appendix 4. Comparison of Chinook baselines used in this report with additional baseline collections made in 2009.

Skeena populations in 268 stock baseline	268 baseline N	Change	Skeena populations in 21 stock baseline	Max # loci in 21 Stock baseline	Potential new Skeena baseline stocks	2009 collections available but not included to date
Ecstall	293		Ecstall	280		
					Kasiks	76 juveniles
					Exchamsiks	105 juveniles
Gitnadoiks	42	add 185 juveniles	Gitnadoix	235		
					Exstew	142 juveniles
					Zymagotitz	119 juveniles
L_Kalum	456	combine with AC and add 190 adults from 2009	Kitsumkalum	801		
L_Kalum@AC	190	combine with L_Kalum				
Skeena@Terrace	37	removed				
Cedar	116		Cedar	116		
Zymoetz	<30	combine with Thomas Creek & add 18 juveniles & 15 adults	Zymoetz	60		
Kitwanga	288		Kitwanga	270		
					Gitsegukla	262 juveniles
Bulkley	585		Bulkley	525		
Morice	228		Morice	224		
Suskwa	<30	add 91 juv. & 6 adults	Suskwa	83		
					Shegunia	65 juv. & 14 adults
Kispiox	195		Kispiox	176		
Sweetin	54		Sweetin	64		
Babine	266		Babine	239		
		add 168 juveniles	Kuldo	170		
		add 112 juveniles	Sicintine	111		
Slamgeesh	62	add 49 adults	Slamgeesh	129		
		add 214 juv. & 56 adults	Squingula	271		
Sustut	519		Sustut	489		
Bear	182		Bear	176		
Kluayaz new in 2008		add 50 adults	Kluayaz Cr	148		
		add 17 adults	Kluakaz Cr	74		
		add 90 adults	Otsi	90		
	<30	add 15 adults	Kluatantan	<30		