Chinook Salmon Escapement Estimation to the Skeena River Using Genetic Techniques 2010.

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ABSTRACT

The 2010 return of Chinook salmon (*Oncorhynchus tshawytscha*) to the Skeena River was estimated using genetic stock identification techniques. Genetic samples were analyzed from 839 Chinook salmon caught at the Tyee Test Fishery and the proportion of the catch identified as Kitsumkalum Chinook salmon using genetic techniques was 14.7% with a standard deviation of 2.0%. The escapement of large Chinook salmon to the Kitsumkalum River was estimated at 13,712 fish with a standard deviation of 2,033 fish from an independent mark-recapture estimate. The estimate of large Chinook salmon returning to the Skeena River as measured at Tyee was 93,121 fish with a standard deviation of 18,688 fish (coefficient of variation = 20%).

A number of additional populations were added to the genetic baseline from the Skeena River watershed in 2009 and 2010. Existing genetic data from the 2009 Tyee Test fishery were run against the improved baseline to revise the 2009 estimate of Skeena River Chinook escapement to 80,867 fish with a standard deviation of 13,799 fish (coefficient of variation = 17.1%).

Sex and age information from the fish sampled at the Tyee Test Fishery in 2010 were compared with the samples from the Kitsumkalum River. Sex and age structure was examined for the larger stock groups of Chinook salmon encountered at Tyee.

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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 2010. This report presents the second year of genetic analyses of samples collected at the Tyee Test fishery and preliminary estimates of the Chinook salmon return to the Skeena River for 2010 with revisions to the 2009 estimates. Various programs on the Skeena River have contributed to aspects important to this project including baseline collections, a radio telemetry program and catch monitoring programs in 2010. Most of the results from these independent projects were in preparation at the time of writing and only some of the baseline improvements have been incorporated here. As such, this report represents a second step in an iterative process to improve the escapement estimates to the Skeena River. Costs to the SSP consisted of the genetic analyses and a small portion of the sampling costs at the Tyee Test fishery. Other parts of the project were funded by Fisheries & Oceans Canada in existing programs.

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 escapement index for the Skeena River aggregate has averaged over 50,000 spawners since 1985. The index 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. Total escapements of Chinook salmon to the Skeena River are expected to be significantly larger than the indices.

Skeena Chinook salmon are encountered in the PST Aggregate Abundance Based Management (AABM) fisheries in Southeast Alaska (SEAK all gear) and Northern British Columbia (NBC Troll and Haida Gwaii (QCI) Sport). They also contribute to the Individual Stock Based Management (ISBM) fisheries in Northern British Columbia including gillnet, tidal sport, non-tidal sport, tidal First Nations' (FN) and non-tidal FN fisheries. Skeena Chinook are north migrating so they do not contribute to the West Coast Vancouver Island (WCVI) AABM fisheries nor do they contribute appreciably to ISBM fisheries south of the Skeena River.

The preliminary estimate of large Chinook salmon returning to the Skeena River in 2009 was 79,838 fish with a standard deviation of 13,601 fish (coefficient of variation = 17%). The 2009 escapement of large Chinook salmon to the Kitsumkalum River estimated by an independent mark-recapture program was 10,703 fish with a standard deviation of 1,424 fish. The proportion of Kitsumkalum fish in samples of 1,155 Chinook salmon caught at Tyee was 13.4% with a standard deviation of 1.4%. The proportion of Kitsumkalum Chinook in the 2009 samples was re-examined using the revised genetic baseline for Skeena River Chinook and the estimate for the Skeena Chinook aggregate has been revised as part of this report.

Genetic analyses completed for Chinook salmon samples collected at Tyee in 2000, 2001 and 2003 provided preliminary estimates for the Chinook return to the Skeena River with coefficients of variation between 15.2% and 17.2%. Improvements were expected in 2009 and 2010 estimations as the genetic baselines were improved, and an additional four genetic markers used by Genetic Analysis of Pacific Salmonids (GAPS) consortium (Seeb et al. 2007) were added. Also sample sizes were expected to increase at Tyee. However, sample size only increased marginally by starting the Tyee Test Fishery on 25 May rather than 10 June. The historic start date of 10 June proved to be sampling more of the front tail of the summer run than

initially thought. Much of the larger CV around the 2009 Skeena escapement estimate was attributed the broader variance around the mark-recapture estimate of Kitsumkalum River Chinook escapement.

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. We assume the Tyee Test fishery is an unbiased sampler of the Chinook salmon population entering the Skeena River.

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

A Skeena wide Chinook salmon escapement estimate and stock specific estimates of escapement were attempted using the genetic results from samples collected at Tyee. The component of the Tyee sample identified as Kitsumkalum was 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, in 2009 and 2010 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, Sclerochronology 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 281 Chinook salmon populations in the eastern Pacific from Alaska to California (Appendix 1). Then the mixed samples were compared with baselines collected from 32 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 15 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. The program CBAYES (Neaves et al 2005) can be downloaded from the Molecular Genetics Laboratory website. The model output included individual assignments to baseline populations where the posterior distribution gives probablities for the five most likely populations for each sample.

To examine possible changes in stock composition at Tyee over time the 847 samples collected in 2010 were separated temporally by week and genetic results were compared for fish caught at different times through the summer.

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

$$N_{sr} = \frac{(M_{sr}+1)(C_{sr}+1)}{(R_{sr}+1)}$$

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 by sex (subscript s) and river reach (subscript r) (Ricker, 1975). Separate estimates were calculated for males and females. Variance was computed using:

$$v(N_{sr}) = N_{sr}^2(C_{sr}-R_{sr})/(C_{sr}+1)(R_{sr}+2)$$

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 2010. Chinook salmon were caught from 25 May through 23 August (Figure 3.). A total of 1,043 Chinook salmon were encountered by the net; 959 large and 84 jacks. A total of 863 Chinook salmon were sampled for size, gender, scales and tissue. Depredation by seals accounted for most of the fish that could not be sampled. Often these consisted of only pieces of fish so badly mutilated that size and gender could not be determined.

Samples collected at Tyee in 2009 and 2010 were compared against a coast-wide genetic baseline of 281 stocks typically used to distinguish the composition of mixed stock marine samples collected off the north coast of British Columbia (Appendix 1). Genetic results were produced for 847 fish of the 863 Chinook salmon sampled at Tyee in 2010. In addition, genetic results were available from 1,155 Chinook salmon out of 1,163 fish sampled in 2009. Virtually all (99.7%) of the 2010 sample was assigned to the Skeena region with very small components (0.1% each) assigned to the adjacent Nass and Stikine regions. Re-analysis of the 2009 data assigned 98.7% of the samples collected at Tyee to the Skeena region and 1.3% to the Nass region (Table 1.).

The Skeena River baseline was revised prior to these genetic analyses to take advantage of additional collections made in the watershed during 2009 and 2010 (Erhardt and Rabnett, 2009; Gottesfeld, 2009). The baseline included genetic material from 32 populations (Appendix 3). When the 863 samples collected at Tyee in 2010 were compared against the 32 stock Skeena baseline results were produced for 839[1] fish. The proportion of the sample assigned to the Kitsumkalum River was 14.7% with a standard deviation of 2.0% (Table 2). The Kitsumkalum component in the sample was second to the Morice component which made up 30.6% of the sample. The Babine component of the sample was third largest at 8.8%. These rankings were near the expected values when compared with other estimates for 2010 Chinook escapements. The Babine component of the sample was much larger than identified in 2009 which resulted from replacing the baseline samples for this stock with new collections.

To test the assignment accuracy for the Kitsumkalum River, a sample of 100 Chinook salmon genotypes were removed without replacement from the baseline and estimated against the revised 32 stock Skeena baseline showing a 98.9% assignment accuracy to the Kitsumkalum River (Table 3). The next largest assignment of 0.8% was to the Suskwa River.

The 2010 escapement of Chinook salmon to the Kitsumkalum River was estimated at 13,712 large fish (jacks excluded) with a standard deviation of 2,032 fish. The total return to the Skeena River was estimated at 93,121 (standard deviation = 18,688) 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 20%.

When expansions of the stock components within the Skeena River from the Tyee samples were compared with independent estimates of escapement, estimates for the Babine River were higher than the independent estimates and genetic estimates to the Bear River were lower than the independent estimates. These two stocks appear very similar in the neighbor-joining tree (Saitou and Nei, 1987) of Skeena River stocks (Figure 5). The genetic samples overestimate the Kitwanga River component in the aggregate when compared to the fence count. The fence count of Kitwanga Chinook salmon was 824 fish in 2009 and the genetic ratio estimate was 3,526 fish. Similarly, the Kitwanga fence count was 852 fish in 2009 and the genetic ratio estimate was 3,444 fish. The Morice River formed the largest components in the Tyee samples at 30.5% and 33.9% in 2009 and 2010 respectively. These proportions were expanded to escapement estimates of 25,157 fish in 2009 and 28,514 fish in 2010 (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.). Stock groups in Figure 4 were based roughly on the genetic similarity as represented by the neighbor-joining tree for the 32 Skeena Chinook salmon stocks (Figure 5.)

Complete ages were derived for 712 fish and marine ages were derived for an additional 123 fish of the 863 Chinook salmon sampled at Tyee in 2010. The largest components in the age sample were age 4_2 males and age 5_2 females. These stream type fish were from the 2006 and 2005 brood years respectively. Age 4_2 fish made up 53% of the males and age 5_2 fish made up 53% of the females males sampled (Table 6.). Males made up 61% of the Chinook salmon catch at Tyee for a male:female ratio of 1.6:1. Ocean type fish (ages 3_1, 4_1, 5_1 & 6_1) made up 3.5% of the catch at Tyee while stream type fish with an extra freshwater annulus (ages 4_3, 5_3 & 6_3) made up only 1.3% of the catch.

[1] Genetic analyses were conducted on 847 fish from the 2010 sample. The coast wide analyses examined 12 DFO loci and the Skeena analyses examined 16 loci (12 DFO and 4 GAPS). Both analyses used the criteria that excluded individual genotypes missing more than 5 loci. The number of fish that met the standard was less for the 2010 Skeena analyses than for the coast-wide analyses because more loci were tested.

The age and genetic data were combined to compare the age structure of the larger stock groups of Chinook salmon encountered at Tyee in 2010. The age composition of the Kitsumkalum and Morice stock groups appear similar (Figure 9.). The Bear & Babine stock group has fewer 4 year old males (4 years from brood) and more 6 year old females (6 years from brood). The Kispiox & Kitwanga stock group suffers from low sample sizes but 80% of females were aged at 5 years from brood and 57% of the males return was aged at 4 years from brood.

DISCUSSION

Timing of the Chinook salmon migration past Tyee appeared to be more normal in 2010 when compared with average run timing as measured by the Tyee Test fishery (Figures 2 & 3). The 2009 migration may have been delayed due to high water but it wasn't clear in 2009 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.

Virtually all of the Chinook salmon caught at Tyee were assigned to the Skeena region aggregate in 2009 and 2010. Only 1.3% of the Tyee catch was assigned to the Nass River in 2009 and 0.1% was assigned to each of the Nass and Stikine River regions in 2010 (Table 1.). Less than 0.1% was assigned to all other regions in both years. 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 essentially from the Skeena watershed and that any straying or nose-ins[2] were very limited.

The mixture model recognized Kitsumkalum Chinook salmon using the revised 32 stock Skeena baseline. Essentially, Kitsumkalum Chinook salmon were not assigned to other populations with systematic regularity. The next largest assignment of 0.8% of the Kitsumkalum fish was to the Suskwa River population. The alternative source of error, fish from other populations being assigned to the Kitsumkalum remains to be tested.

A lack of assignments to the Babine River Chinook population was evident in 2009 and earlier analyses of mixed stock samples. The problem appeared to be corrected in 2010 with the collection of new baseline material from adult Chinook salmon at the Babine River fence and in the Morice River. The genetic similarity between these large lake stocks in the Skeena watershed (Bear, Babine & Morice) suggests that it would be prudent to make new baseline collections from the Bear River as well (Figure 5.).

Size differences driven by differences in age at maturity could influence 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. Poor performance of the 2003 brood year left the return to the Kitsumkalum with an age structure similar to the rest of the Skeena in 2009. In 2010 the age structure of Skeena Chinook as measured at Tyee was again similar the age structure sampled in the Kitsumkalum River (Figure 6.). A large component of age 4_2 males was evident in both samples. Typically Kitsumkalum Chinook salmon mature at a year older than other Skeena River Chinook salmon (Figure 7.). Size selectivity was not an issue in 2009 (Figure 8.) or 2010 (Figure 6.) as there was little or no difference in age structure between the Kitsumkalum River population and the aggregate of Skeena River Chinook salmon in either year.

[2] Nose-ins refer to fish that enter a non-natal stream then leave.

This project does not account for removals of Chinook salmon by fisheries upstream of Tyee. Assessing whether removal rates differ among stocks encountered by in-river fisheries has yet to be measured. There were significant sport and First Nations' fisheries on the Skeena River in 2010 but final estimates were not available at the time of writing.

The genetic approach used in this study has benefitted from additional work to improve the baseline for Skeena River Chinook salmon populations. Further improvements identified in this work include:

1. Including the any remaining populations identified by the 2010 radio telemetry project in the baseline;
2. Running a simulation with the baseline to see where populations are miss-assigned; and
3. Re-sampling the Bear River Chinook salmon population for baseline genetic material.

Future work on Skeena River Chinook should benefit from the results of a radio telemetry project conducted in 2010 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.).

These results are currently part of the data being analyzed in a separate project funded by the Pacific Salmon Commission's Sentinel Stocks Program. Further, there are additional catch programs yet to be reported for 2010 which should benefit our understanding of the Skeena Chinook salmon aggregate.

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TABLES

Table 1. Results of the genetic mixture model analysis Chinook salmon caught at the Tyee Test fishery in 2009 and 2010 using the 281 stock baseline and 12 loci.

Data are presented as percent of the sample by region. N = 1,155 in 2009 and 847 in 2010.

Region	2009 Estimate (% of sample)	2009 Standard Deviation	2010 Estimate (% of sample)	2010 Standard Deviation
UPFR	0.0	(0.0)	0.0	(0.1)
MUFR	0.0	(0.0)	0.0	(0.1)
LWFR-F	0.0	(0.0)	0.0	(0.0)
NOTH	0.0	(0.0)	0.0	(0.0)
SOTH	0.0	(0.0)	0.0	(0.0)
LWTH	0.0	(0.0)	0.0	(0.0)
ECVI	0.0	(0.0)	0.0	(0.0)
WCVI	0.0	(0.0)	0.0	(0.1)
SOMN	0.0	(0.0)	0.0	(0.0)
NOMN	0.0	(0.1)	0.0	(0.1)
NASS	1.3	(0.5)	0.1	(0.3)
LWFR-Sp	0.0	(0.0)	0.0	(0.0)
LWFR-Su	0.0	(0.0)	0.0	(0.0)
QCI	0.0	(0.0)	0.0	(0.0)
Alaska	0.0	(0.0)	0.0	(0.0)
Taku	0.0	(0.1)	0.0	(0.2)
Stikine	0.0	(0.1)	0.1	(0.3)
Skeena	**98.7**	**(5.2)**	**99.7**	**(5.1)**
Alsek	0.0	(0.0)	0.0	(0.0)
Puget Sound	0.0	(0.0)	0.0	(0.0)
Juan de Fuca	0.0	(0.0)	0.0	(0.0)
Coastal Wash	0.0	(0.0)	0.0	(0.0)
Low Col	0.0	(0.0)	0.0	(0.0)
Up Col-Sp	0.0	(0.0)	0.0	(0.0)
Up Col-Su/F	0.0	(0.0)	0.0	(0.0)
Snake-Sp/Su	0.0	(0.0)	0.0	(0.0)
Snake-F	0.0	(0.0)	0.0	(0.0)
North & Central O	0.0	(0.0)	0.0	(0.0)
South Oregon coas	0.0	(0.0)	0.0	(0.0)
Klamath/Trinity	0.0	(0.0)	0.0	(0.0)
Mid Col-Sp	0.0	(0.0)	0.0	(0.0)
Up Willamette	0.0	(0.0)	0.0	(0.0)
Cent Val-F	0.0	(0.0)	0.0	(0.0)
Cent Val-Sp	0.0	(0.0)	0.0	(0.0)
Coastal Californi	0.0	(0.0)	0.0	(0.0)

Abbreviations are defined in Appendix 2.

Table 2. Results of the genetic mixture model analysis of Chinook salmon caught at the Tyee Test fishery in 2009 and 2010 using the 32 stock Skeena baseline and 15 loci.

Data are presented as percent of the sample by stock. N= 1,155 in 2009 and 839 in 2010.

Code	Stock	2009 Estimate (% of sample)	2009 Standard Deviation	2010 Estimate (% of sample)	2010 Standard Deviation
52	Babine	8.1	(1.8)	8.8	(1.6)
20	Bear	6.3	(1.4)	5.9	(1.5)
15	Bulkley_sp	0.9	(0.3)	0.9	(0.3)
86	Cedar_sp	0.3	(0.2)	0.1	(0.1)
21	Ecstall	2.9	(0.5)	2.0	(0.5)
54	Exchamsiks	1.3	(0.4)	0.9	(0.6)
496	Exstew	0.8	(0.4)	1.4	(0.6)
500	Fiddler_Cr	0.0	(0.0)	0.0	(0.1)
271	Gitnadoix	1.7	(0.5)	0.6	(0.6)
494	Gitsegukla	0.5	(0.3)	1.0	(0.5)
497	Kasiks	0.1	(0.2)	0.1	(0.3)
502	Khyex_R	0.0	(0.1)	0.8	(0.4)
55	Kispiox	6.1	(1.6)	2.1	(1.2)
24	**Kitsumkalum**	**13.2**	**(1.4)**	**14.7**	**(2.0)**
16	Kitwanga	4.4	(1.1)	3.7	(1.3)
490	Kluakaz_Cr	0.7	(0.5)	0.0	(0.2)
418	Kluatantan	0.0	(0.1)	0.1	(0.2)
466	Kluayaz_Cr	0.8	(0.8)	1.9	(0.7)
480	Kuldo	0.9	(0.6)	0.1	(0.3)
19	Morice	31.1	(1.6)	30.6	(1.8)
501	Nangeese_R	0.2	(0.3)	0.3	(0.5)
492	Otsi	1.5	(0.8)	2.6	(0.9)
493	Shequnia	0.0	(0.1)	0.5	(0.6)
495	Sicintine	1.1	(0.4)	0.1	(0.2)
396	Slamgeesh	3.9	(1.2)	5.3	(1.3)
479	Squingula	4.5	(0.9)	2.5	(0.9)
399	Suskwa	0.0	(0.1)	1.3	(0.5)
51	Sustut	1.9	(0.4)	1.0	(0.4)
401	Sweetin	3.2	(0.9)	4.8	(1.2)
402	Thomas_Cr	2.6	(0.8)	2.6	(0.7)
60	Zymoetz	0.8	(0.8)	2.7	(0.8)
498	Zymogotitz	0.0	(0.1)	0.6	(0.3)

Table 3. Results of the genetic mixture model analysis of 100 Kitsumkalum Chinook salmon samples against the 32 stock Skeena baseline.

Code	Stock	Estimate (% of sample)	Standard Deviation
52	Babine	0.0	(0.3)
20	Bear	0.0	(0.3)
15	Bulkley_sp	0.0	(0.2)
86	Cedar_sp	0.0	(0.3)
21	Ecstall	0.0	(0.1)
54	Exchamsiks	0.0	(0.2)
496	Exstew	0.0	(0.2)
500	Fiddler_Cr	0.0	(0.2)
271	Gitnadoix	0.0	(0.2)
494	Gitsegukla	0.0	(0.2)
497	Kasiks	0.0	(0.2)
502	Khyex_R	0.0	(0.2)
55	Kispiox	0.0	(0.2)
24	**Kitsumkalum**	**98.9**	**(1.6)**
16	Kitwanga	0.0	(0.2)
490	Kluakaz_Cr	0.0	(0.4)
418	Kluatantan	0.0	(0.2)
466	Kluayaz_Cr	0.0	(0.2)
480	Kuldo	0.0	(0.1)
19	Morice	0.0	(0.1)
501	Nangeese_R	0.0	(0.3)
492	Otsi	0.0	(0.3)
493	Shequnia	0.0	(0.2)
495	Sicintine	0.0	(0.2)
396	Slamgeesh	0.1	(0.7)
479	Squingula	0.0	(0.2)
399	Suskwa	0.8	(1.0)
51	Sustut	0.0	(0.2)
401	Sweetin	0.0	(0.1)
402	Thomas_Cr	0.0	(0.3)
60	Zymoetz	0.0	(0.1)
498	Zymogotitz	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	2009 Escapement Estimate using genetics	2009 Other Escapement Estimate	2010 Escapement Estimate using genetics	2010 Other Escapement Estimate	Other Escapement Estimation Method
Babine	6,581	4,550	8,162	6,141	AUC flight visual
Bear	5,117	8,597	5,495	6,646	AUC flight visual
Bulkley_sp	707	250	835	269	peak count
Cedar_sp	267	350	56	118	peak count
Ecstall	2,323		1,905		
Exchamsiks	1,070		848		
Exstew	616		1,314		
Fiddler_Cr	2		4		
Gitnadoix	1,382	150	543	50	peak count
Gitsegukla	439		952		
Kasiks	73		119	85	
Khyex_R	6		753		
Kispiox	4,926		1,925	2,578	peak count
Kitsumkalum	**10,703**	**10,703**	**13,712**	**13,712**	**Mark Recapture**
Kitwanga	3,526	824	3,444	852	fence
Kluakaz_Cr	562		33		
Kluatantan	19		69		
Kluayaz_Cr	680		1,736		
Kuldo	764		88		
Morice	25,157	12,082	28,514	12,084	AUC flight visual
Nangeese_R	154		319		
Otsi	1,198		2,377		
Shequnia	21		454		
Sicintine	912		122		
Slamgeesh	3,158		4,980		
Squingula	3,600		2,296		
Suskwa	25		1,198		
Sustut	1,507	273	937	174	fence
Sweetin	2,610		4,497		
Thomas_Cr	2,120		2,383	160	peak count
Zymoetz	626		2,530		
Zymogotitz	15		521		
Total	80,867	37,779	93,121	42,869	

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

Table 5. Mixture model analyses of Chinook salmon caught at the 2010 Tyee Test fishery using the 32 stock Skeena baseline by week. Data are presented as percent of the sample by stock.

Time period	May 26		May 27-June 2		June 3-8		June 9-16		June 17-23		June 24-30		July 1-7		July 8-14		July 15-21	
Stat. week	53		54		61		62		63		64		71		72		73	
Sample size	5		15		29		68		136		113		162		126		96	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	0.2	(3.8)	0.3	(2.5)	2.5	(5.6)	6.4	(4.6)	6.1	(4.7)	0.1	(0.8)	6.1	(4.1)	17.7	(4.4)	14.8	(5.4)
Bear	0.0	(3.3)	0.3	(2.2)	3.1	(7.5)	0.2	(1.0)	1.7	(2.3)	5.8	(3.2)	15.2	(4.0)	7.5	(3.2)	1.3	(2.7)
Bulkley_sp	4.7	(10.0)	6.4	(6.1)	11.2	(5.9)	0.0	(0.3)	0.0	(0.1)	2.7	(1.5)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
Cedar_sp	0.0	(3.2)	12.6	(8.3)	0.2	(1.3)	0.9	(1.5)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Ecstall	0.0	(3.2)	0.0	(1.0)	0.0	(0.6)	0.0	(0.3)	0.0	(0.3)	0.7	(0.9)	2.5	(1.2)	2.4	(1.4)	4.2	(2.0)
Exchamsiks	0.0	(1.4)	0.5	(2.8)	0.2	(1.2)	1.9	(2.1)	0.1	(0.5)	4.1	(2.3)	1.4	(1.6)	0.1	(0.3)	0.1	(0.4)
Exstew	0.0	(2.6)	0.1	(1.0)	1.8	(3.4)	0.0	(0.3)	5.1	(2.4)	0.9	(1.4)	0.9	(1.2)	2.3	(1.6)	0.0	(0.1)
Fiddler_Cr	0.0	(3.3)	2.6	(6.8)	0.2	(1.2)	0.1	(0.6)	0.0	(0.2)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)
Gitnadoix	0.0	(2.3)	6.2	(6.0)	4.3	(4.8)	0.0	(0.3)	0.7	(1.4)	0.2	(0.9)	0.7	(1.4)	0.3	(0.9)	0.0	(0.2)
Gitsegukla	0.0	(2.6)	2.6	(5.0)	1.7	(3.5)	9.3	(4.2)	0.1	(0.4)	0.0	(0.4)	0.8	(0.8)	0.0	(0.2)	0.0	(0.2)
Kasiks	0.0	(2.8)	0.0	(0.8)	0.8	(2.3)	0.5	(1.4)	0.3	(0.9)	0.0	(0.3)	0.2	(0.7)	0.2	(0.7)	0.0	(0.1)
Khyex_R	0.2	(3.3)	0.0	(1.1)	0.0	(0.6)	0.0	(0.2)	0.2	(0.6)	1.4	(1.5)	1.7	(1.3)	0.0	(0.1)	2.2	(1.5)
Kispiox	2.1	(8.2)	3.9	(9.0)	8.1	(7.6)	5.6	(4.2)	3.8	(3.9)	2.5	(4.0)	0.5	(1.3)	0.1	(0.6)	0.7	(1.9)
Kitsumkalum	**1.1**	**(6.7)**	**0.1**	**(1.7)**	**9.3**	**(9.6)**	**0.2**	**(0.9)**	**0.5**	**(1.2)**	**0.8**	**(2.1)**	**10.9**	**(3.3)**	**18.9**	**(4.0)**	**30.0**	**(5.1)**
Kitwanga	0.0	(2.0)	2.2	(7.1)	0.3	(1.8)	0.5	(1.8)	11.4	(3.8)	10.7	(4.7)	0.5	(1.2)	5.7	(3.6)	0.0	(0.4)
Kluakaz_Cr	12.8	(16.0)	1.7	(5.6)	4.1	(6.5)	1.0	(2.7)	1.6	(2.6)	0.1	(0.4)	0.1	(0.7)	0.0	(0.2)	0.1	(0.5)
Kluatantan	2.1	(7.1)	6.4	(8.2)	0.0	(0.8)	0.0	(0.5)	0.1	(0.4)	0.1	(0.4)	1.8	(1.5)	0.3	(1.0)	0.2	(0.7)
Kluayaz_Cr	0.0	(2.1)	3.1	(6.3)	2.4	(4.6)	3.4	(3.8)	2.0	(2.4)	0.5	(1.4)	0.0	(0.3)	0.1	(0.6)	0.1	(0.5)
Kuldo	0.1	(2.9)	2.9	(7.6)	0.3	(1.7)	1.6	(2.6)	0.1	(0.4)	0.1	(0.6)	0.1	(0.3)	0.1	(0.3)	0.2	(0.6)
Morice	19.3	(15.9)	0.1	(1.4)	20.0	(7.7)	24.1	(5.6)	22.6	(4.2)	33.4	(4.9)	35.7	(4.4)	39.0	(4.8)	42.4	(5.7)
Nangeese_R	0.0	(2.6)	9.2	(9.3)	7.6	(5.5)	0.1	(0.5)	0.0	(0.2)	0.4	(1.4)	0.2	(0.6)	0.0	(0.2)	0.0	(0.2)
Otsi	3.1	(8.4)	25.6	(13.7)	0.4	(1.9)	6.2	(5.0)	5.3	(3.0)	0.0	(0.4)	5.1	(2.5)	0.1	(0.4)	0.4	(1.2)
Shequnia	0.0	(2.3)	0.7	(3.1)	0.2	(1.2)	1.0	(2.3)	2.6	(1.8)	0.2	(0.9)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
Sicintine-Sp	0.1	(2.8)	0.1	(1.2)	0.1	(1.1)	3.1	(2.4)	0.1	(0.5)	0.0	(0.2)	0.2	(0.5)	0.0	(0.2)	0.1	(0.3)
Slamgeesh	51.9	(21.2)	0.8	(4.0)	8.3	(11.8)	0.6	(1.9)	0.7	(1.9)	12.5	(5.0)	7.0	(3.1)	0.8	(2.2)	0.1	(0.4)
Squingula	1.8	(7.6)	0.1	(1.4)	0.5	(2.3)	0.5	(1.6)	8.9	(3.5)	3.5	(2.4)	0.7	(1.6)	0.0	(0.3)	0.7	(1.7)
Suskwa	0.0	(1.8)	6.4	(6.0)	3.8	(4.2)	7.7	(3.6)	0.1	(0.5)	1.5	(1.6)	0.0	(0.1)	0.0	(0.2)	0.9	(1.2)
Sustut	0.0	(2.6)	0.0	(1.3)	4.7	(4.3)	0.0	(0.2)	3.2	(1.7)	2.0	(1.6)	0.7	(0.7)	0.6	(0.8)	0.0	(0.2)
Sweetin	0.5	(4.5)	4.1	(8.2)	0.1	(1.1)	18.5	(6.2)	12.3	(4.4)	6.2	(3.3)	0.1	(0.4)	0.7	(2.0)	1.5	(2.4)
Thomas_Cr	0.0	(2.6)	0.4	(2.6)	1.9	(3.5)	0.1	(0.6)	9.4	(2.8)	4.6	(3.0)	0.8	(1.1)	2.7	(1.7)	0.0	(0.2)
Zymoetz	0.0	(2.2)	0.5	(2.9)	2.0	(4.2)	5.7	(3.0)	0.8	(1.9)	3.5	(3.2)	5.4	(2.3)	0.2	(0.8)	0.0	(0.4)
Zymogotitz	0.0	(2.1)	0.0	(1.0)	0.0	(0.8)	1.0	(1.4)	0.1	(0.5)	1.5	(1.4)	0.7	(0.7)	0.0	(0.3)	0.0	(0.2)

SD = standard deviation
Stat. week = Statistical week

Table 5 continued.

Data are presented as percent of the sample by stock.

Time period	July 22-28		July 29-Aug4		Aug 5-11		Aug 12-18		Aug 19-23		**TOTAL**	
Stat. week	74		75		81		82		83			
Sample size	41		25		11		7		5		839	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	18.2	(7.3)	34.7	(12.8)	48.8	(18.4)	21.9	(20.9)	58.2	(30.0)	8.8	(1.6)
Bear	0.3	(1.4)	2.7	(6.2)	1.6	(5.5)	15.0	(20.8)	15.4	(21.5)	5.9	(1.5)
Bulkley_sp	0.0	(0.4)	0.0	(0.6)	0.0	(1.2)	0.0	(1.8)	0.0	(2.5)	0.9	(0.3)
Cedar_sp	0.0	(0.6)	0.0	(0.6)	0.0	(0.7)	0.0	(1.9)	0.1	(3.9)	0.1	(0.1)
Ecstall	2.5	(2.4)	4.0	(3.9)	9.1	(7.7)	14.3	(11.5)	0.0	(2.7)	2.0	(0.5)
Exchamsiks	0.0	(0.6)	0.0	(0.8)	0.1	(1.8)	0.0	(1.7)	0.0	(2.2)	0.9	(0.6)
Exstew	0.0	(0.4)	0.1	(1.0)	0.0	(1.8)	0.0	(2.3)	0.0	(3.3)	1.4	(0.6)
Fiddler_Cr	0.2	(0.9)	0.0	(0.6)	0.0	(1.0)	0.0	(2.8)	0.2	(4.1)	0.0	(0.1)
Gitnadoix	0.0	(0.5)	0.0	(0.6)	0.1	(1.6)	0.0	(2.1)	0.0	(2.4)	0.6	(0.6)
Gitsegukla	0.0	(0.5)	0.0	(1.1)	0.0	(1.3)	0.0	(1.6)	0.0	(2.8)	1.0	(0.5)
Kasiks	0.0	(0.3)	0.6	(2.4)	0.0	(1.5)	0.1	(2.0)	0.0	(2.8)	0.1	(0.3)
Khyex_R	0.0	(0.5)	0.0	(0.5)	0.0	(1.4)	0.0	(2.0)	0.0	(2.7)	0.8	(0.4)
Kispiox	0.1	(0.8)	0.5	(2.5)	0.0	(1.7)	0.1	(3.2)	0.4	(4.1)	2.1	(1.2)
Kitsumkalum	**51.6**	**(9.4)**	**40.0**	**(14.3)**	**34.2**	**(16.6)**	**39.1**	**(28.4)**	**0.6**	**(5.2)**	**14.7**	**(2.0)**
Kitwanga	0.1	(0.6)	0.2	(1.3)	0.7	(3.5)	1.8	(7.1)	0.0	(2.4)	3.7	(1.3)
Kluakaz_Cr	0.0	(0.5)	0.6	(2.3)	0.2	(1.9)	0.4	(4.8)	0.1	(2.6)	0.0	(0.2)
Kluatantan	0.0	(0.5)	0.0	(0.9)	0.0	(1.3)	0.1	(1.9)	0.0	(2.6)	0.1	(0.2)
Kluayaz_Cr	0.1	(0.9)	0.2	(1.1)	0.6	(3.2)	0.5	(3.8)	0.1	(2.9)	1.9	(0.7)
Kuldo	0.2	(1.3)	0.4	(2.2)	0.1	(1.7)	4.6	(11.1)	0.9	(5.7)	0.1	(0.3)
Morice	24.5	(7.2)	6.0	(6.8)	0.0	(1.1)	0.1	(2.7)	22.0	(17.1)	30.6	(1.8)
Nangeese_R	0.0	(0.5)	0.0	(0.6)	0.0	(1.4)	0.0	(1.9)	0.0	(2.7)	0.3	(0.5)
Otsi	0.0	(0.2)	0.2	(1.8)	0.0	(1.2)	0.4	(3.6)	0.7	(4.2)	2.6	(0.9)
Shequnia	0.0	(0.5)	0.0	(0.9)	0.0	(1.1)	0.0	(1.4)	0.2	(5.2)	0.5	(0.6)
Sicintine-Sp	0.0	(0.5)	0.0	(0.8)	0.0	(1.6)	0.0	(2.4)	0.0	(3.4)	0.1	(0.2)
Slamgeesh	0.5	(2.4)	0.1	(1.1)	4.0	(8.9)	0.1	(1.9)	0.2	(3.8)	5.3	(1.3)
Squingula	0.1	(0.9)	5.0	(8.1)	0.1	(1.9)	1.1	(5.1)	0.6	(4.3)	2.5	(0.9)
Suskwa	0.0	(0.4)	0.0	(0.7)	0.0	(1.5)	0.0	(1.9)	0.0	(1.6)	1.3	(0.5)
Sustut	0.0	(0.4)	0.0	(0.5)	0.0	(0.9)	0.1	(2.7)	0.0	(2.4)	1.0	(0.4)
Sweetin	1.2	(2.8)	0.1	(0.9)	0.1	(1.4)	0.3	(2.8)	0.3	(4.5)	4.8	(1.2)
Thomas_Cr	0.1	(0.8)	4.3	(5.1)	0.0	(1.6)	0.0	(2.2)	0.0	(2.9)	2.6	(0.7)
Zymoetz	0.2	(1.3)	0.2	(1.3)	0.0	(1.7)	0.0	(2.4)	0.0	(2.1)	2.7	(0.8)
Zymogotitz	0.0	(0.6)	0.0	(0.6)	0.0	(1.0)	0.0	(2.1)	0.0	(2.6)	0.6	(0.3)

SD = standard deviation
Stat. week = Statistical week

Table 6. Chinook salmon age data from fish caught by the 2010 Tyee Test fishery.

Age	Males	Females	Total
3_1	8	0	8
4_1	2	3	5
5_1	5	6	11
6_1	0	1	1
3_2	10	0	10
4_2	235	10	245
5_2	117	145	262
6_2	56	104	160
7_2	0	1	1
4_3	1	0	1
5_3	5	0	5
6_3	0	3	3
2 marine years	40	2	42
3 marine years	17	20	37
4 marine years	16	28	44
Total	512	323	835
Complete ages	439	273	712
Ocean type	3.4%	3.7%	3.5%
4_2	53.5%	3.7%	34.4%
5_2	26.7%	53.1%	36.8%

FIGURES

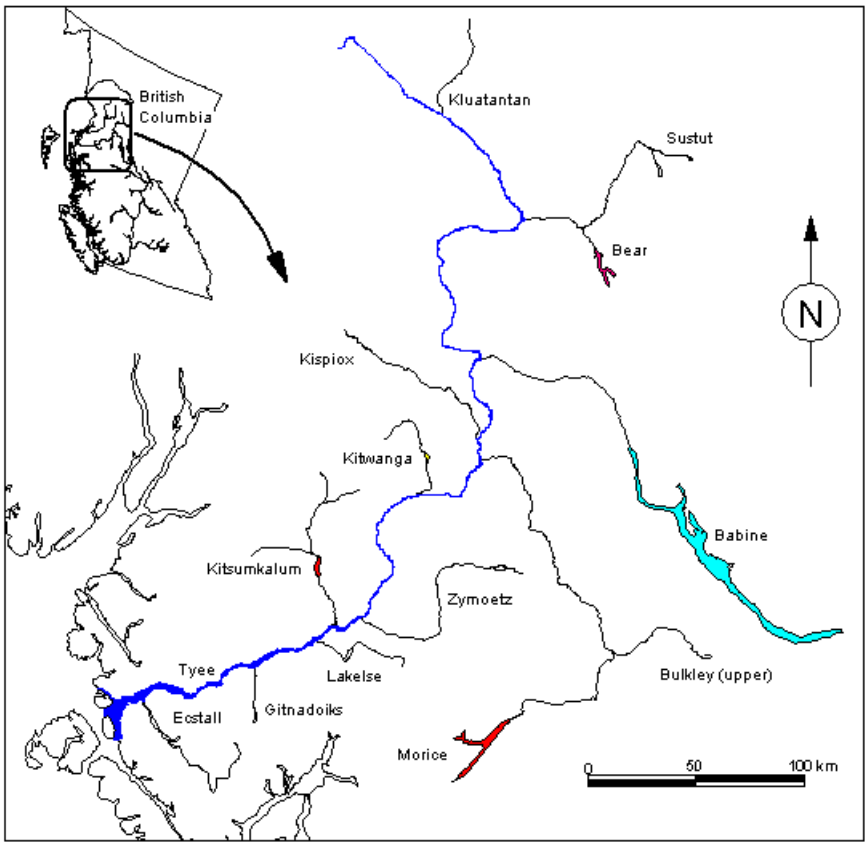


Figure 1. The Skeena River watershed in northern British Columbia showing the largest tributaries and the location of Tyee.

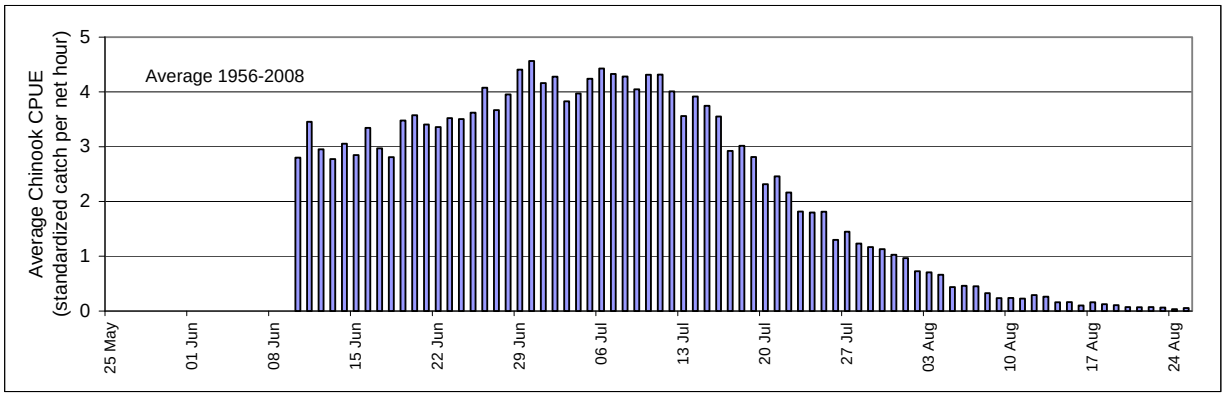


Figure 2. Skeena River Chinook salmon run timing past Tyee as measured by standardized catch per effort at the Tyee Test Fishery averaged from 1956 to 2008.

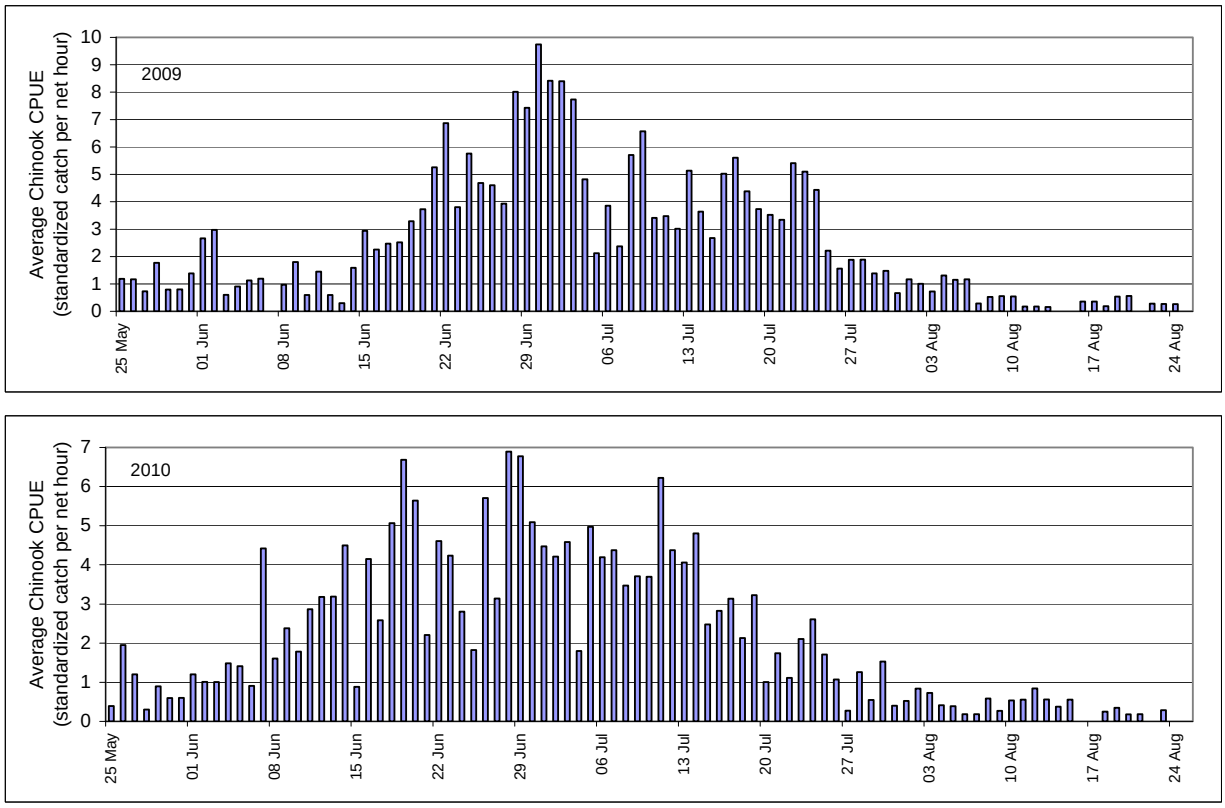


Figure 3. 2009 and 2010 Skeena River Chinook standardized catch per effort by day at the Tyee Test fishery.

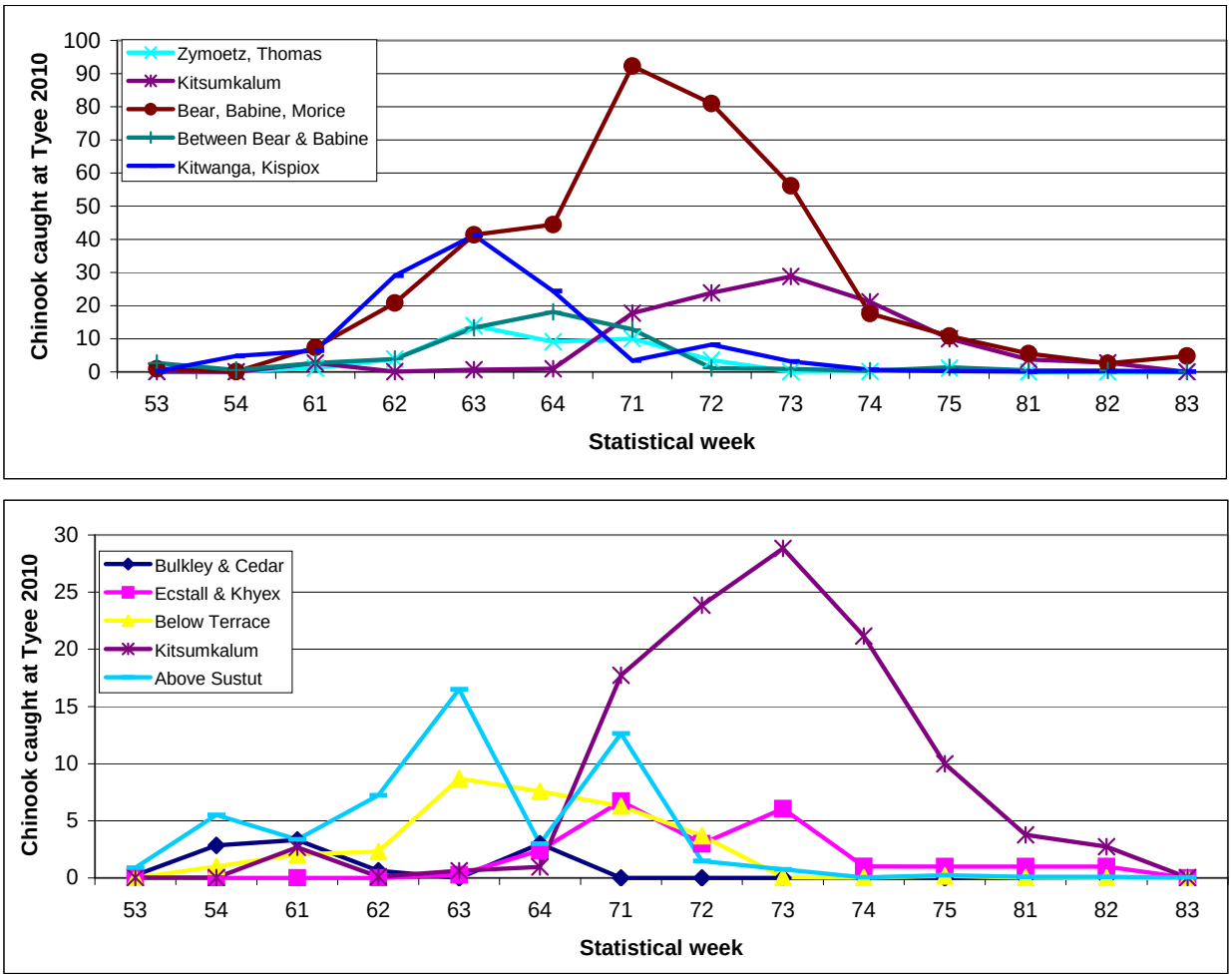


Figure 4. Catch of Chinook salmon at Tyee presented by stock group and time period to depict run timing.

Data are presented in two graphs to reduce clutter. The catch of Kitsumkalum Chinook salmon is presented in both graphs. Proportions are presented with standard deviations in Table 5. Dates for statistical weeks are also in Table 5.
Results from stock groups not named were combined as follows:
Below Terrace = the Exchamsiks, Exstew, Gitnadoiks, and Kasiks Rivers combined.
Between Bear & Babine = the Kuldo, Sicintine, Slamgeesh, and Squingula Rivers combined.
Above Sustut = the Kluakaz, Kluatantan, Kluayaz, Otsi and Sustut Rivers combined.

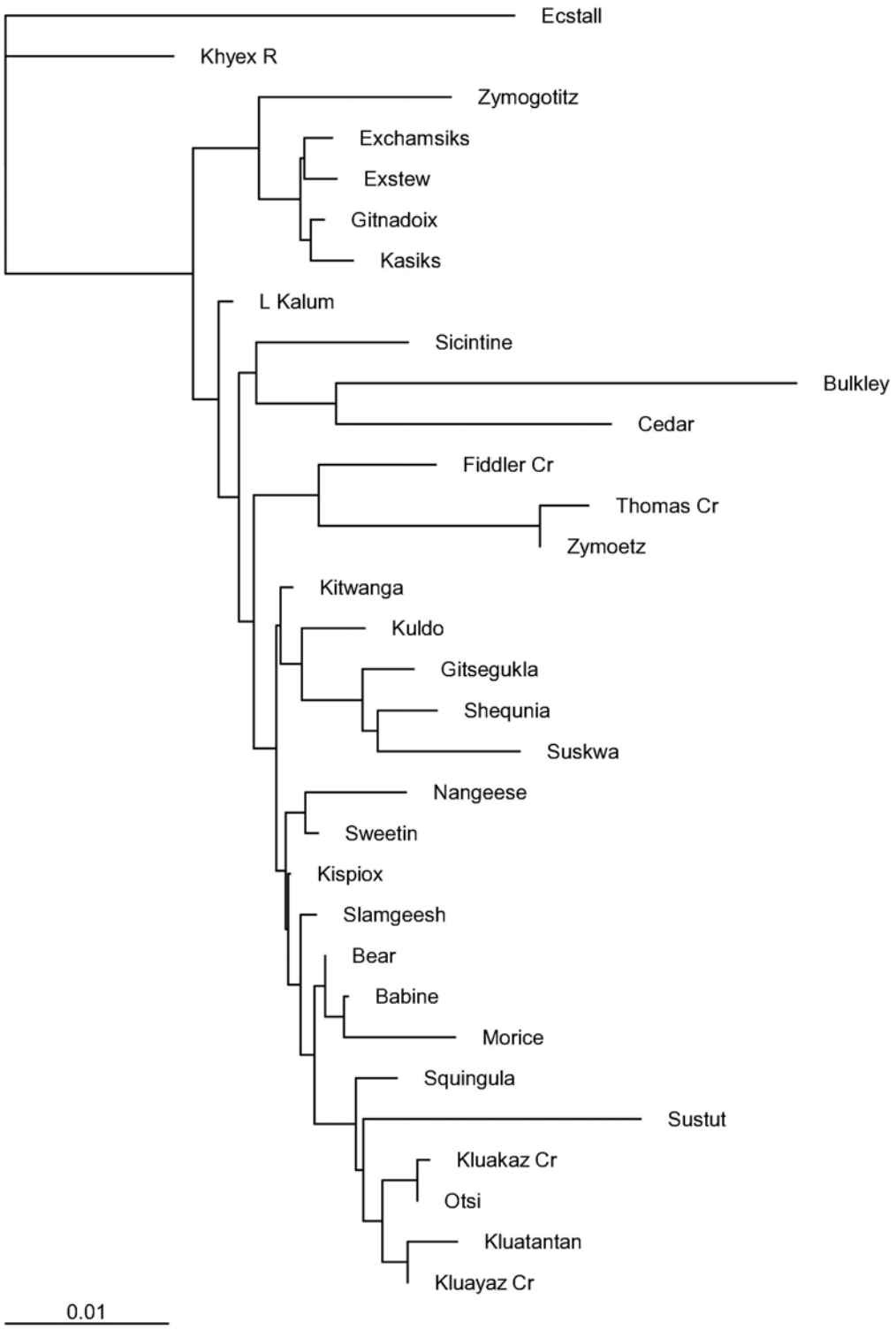


Figure 5. Neighbor-joining tree (Saitou and Nei, 1987) for 32 Skeena Chinook salmon populations using Weir & Cockerham's (1984) F_{ST} genetic distance measure.

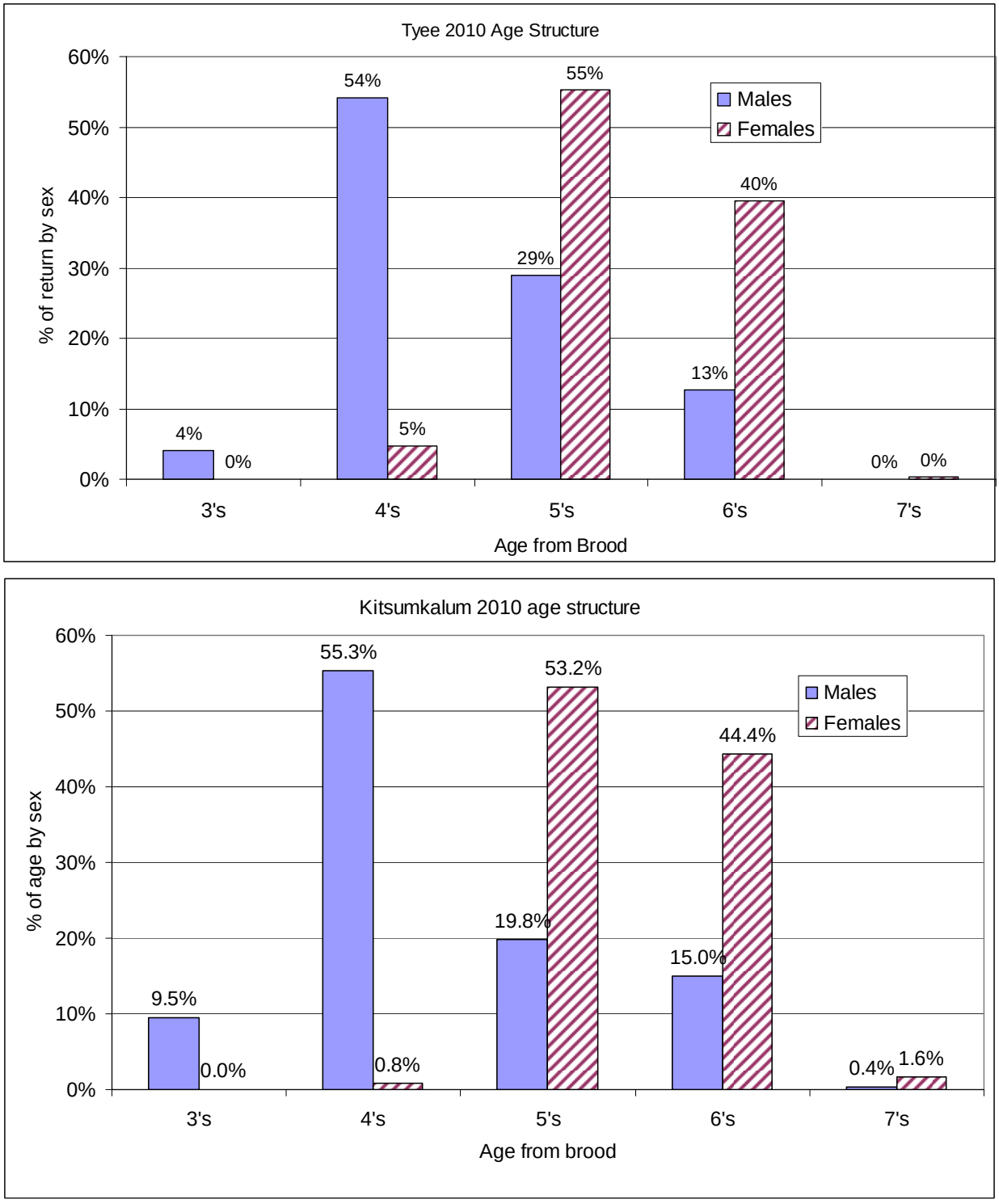
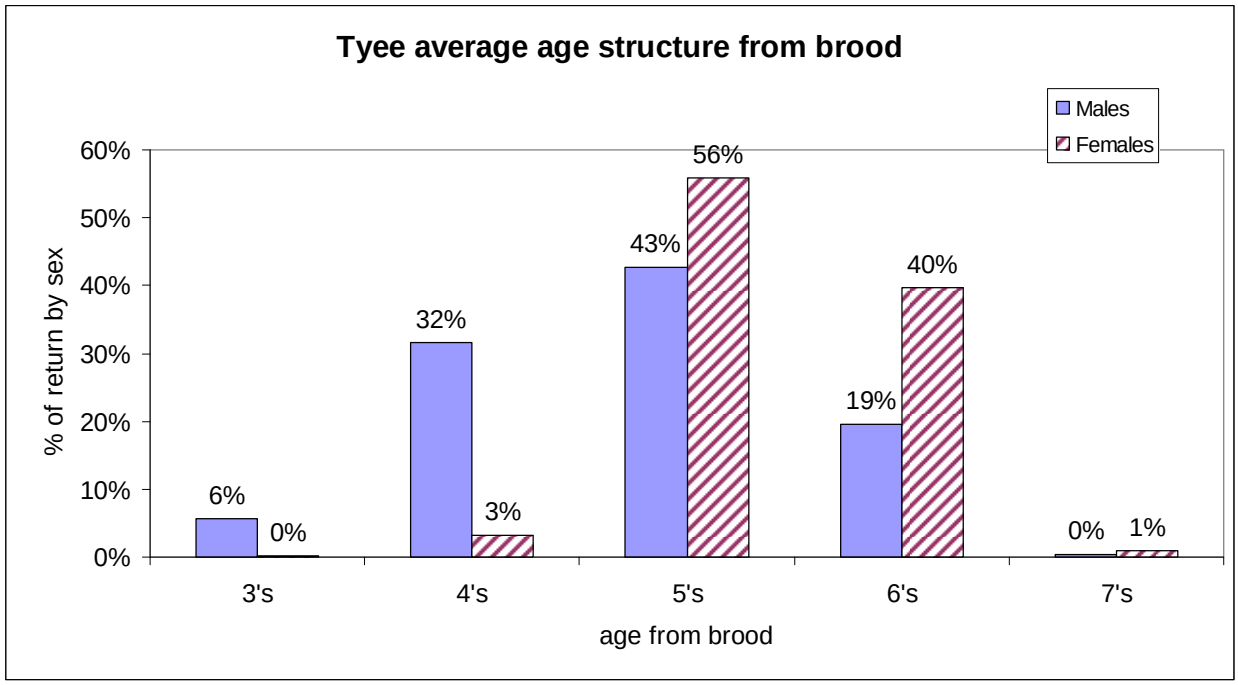


Figure 6. 2010 Chinook salmon age at return as measured at the Tyee Test fishery compared with the Kitsumkalum River.



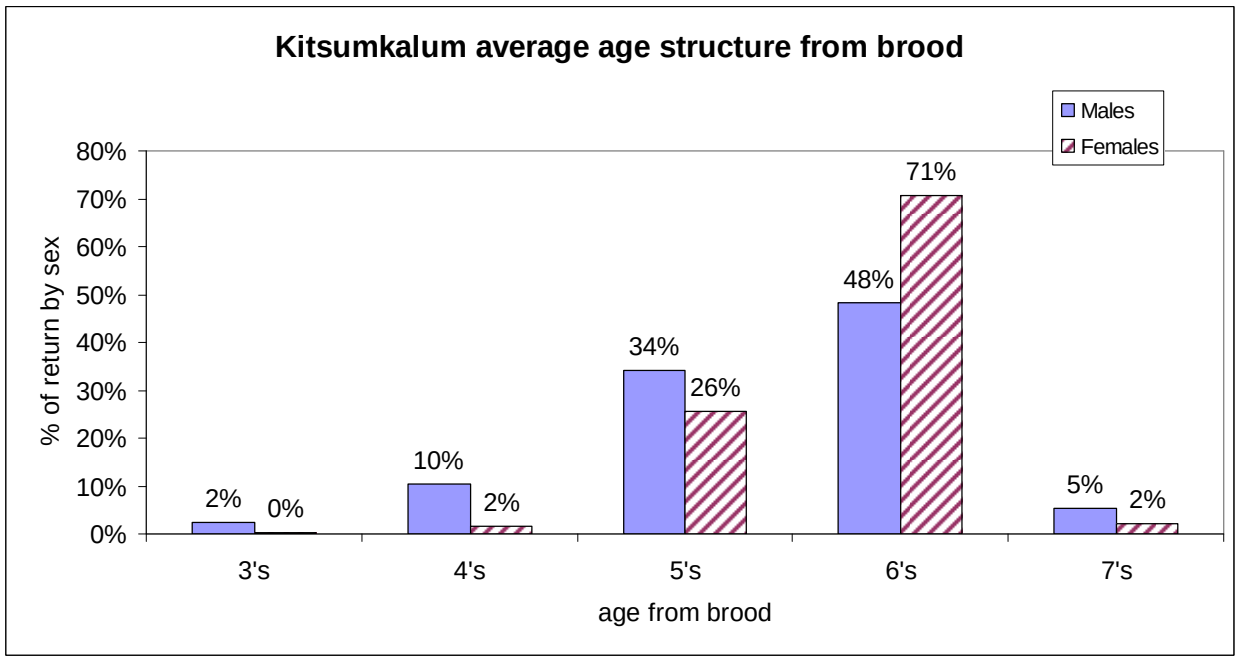


Figure 7. Average Chinook salmon age at return from brood as measured at the Tyee Test fishery compared with the Kitsumkalum River.

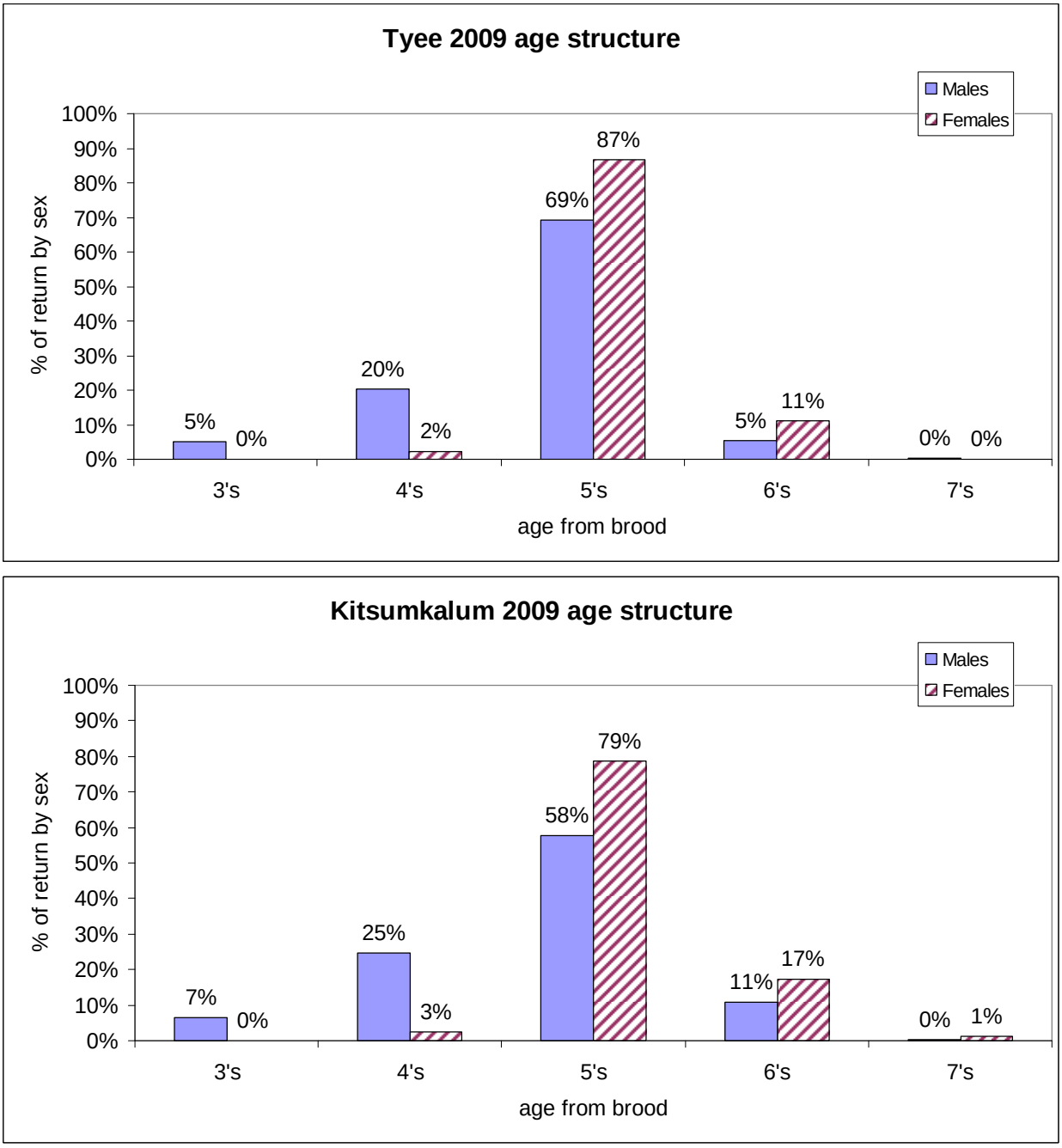


Figure 8. 2009 Chinook salmon age composition measured at the Tyee Test fishery compared with the Kitsumkalum River.

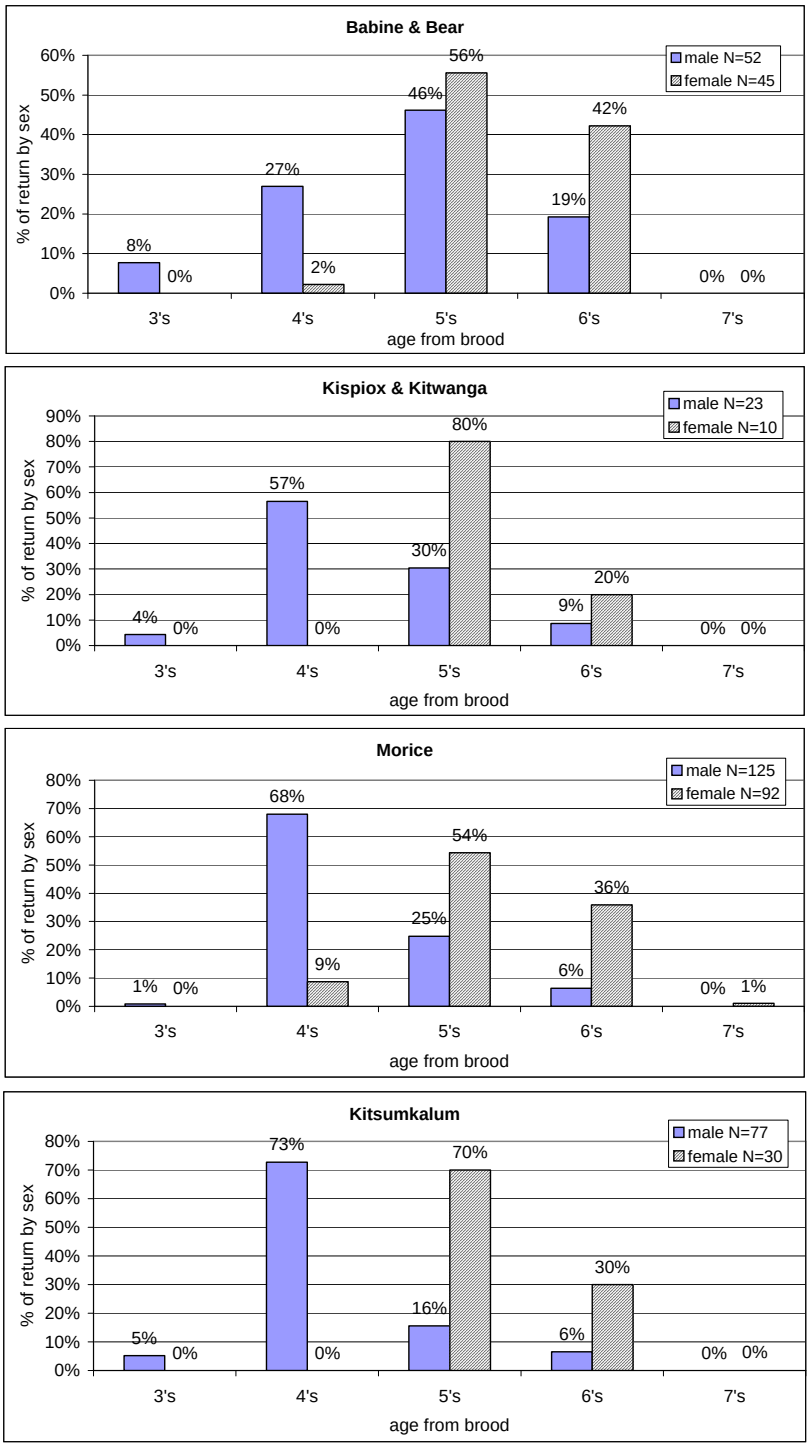


Figure 9. Age composition of the larger stock components measured at the 2010 Tyee Test Fishery.

APPENDICES

Appendix 1. Baseline samples used in the 281 mixture analyses (Abbreviations in Appendix 2.).

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

#	Region	Population	N
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	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	Hackett_r	na
17	Taku	Kowatua	301
17	Taku	Little_Tatsam	603
17	Taku	Nahlin	290
17	Taku	Nakina	435
17	Taku	Tatsamenie	na
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	Tahltan_R	na
18	Stikine	Verrett	561
19	Skeena Upper	Bear	176
19	Skeena Upper	Kluakaz_Cr	124
19	Skeena Upper	Kluatantan	38
19	Skeena Upper	Kluayaz_Cr	162
19	Skeena Upper	Kuldo	170
19	Skeena Upper	Otsi	139
19	Skeena Upper	Sicintine	317
19	Skeena Upper	Slamgeesh	129
19	Skeena Upper	Squingula	271
19	Skeena Upper	Sustut	476
20	Skeena Babine	Babine	407
21	Skeena Bulkley	Bulkley_sp	525
21	Skeena Bulkley	Morice	287
21	Skeena Bulkley	Suskwa	108
22	Skeena Mid	Gitsegukla	260
22	Skeena Mid	Kispiox	176
22	Skeena Mid	Kitwanga	270
22	Skeena Mid	Nangeese_R	na
22	Skeena Mid	Shequnia	132
22	Skeena Mid	Sweetin	243
23	Skeena Lower	Cedar_sp	116
23	Skeena Lower	Ecstall	280
23	Skeena Lower	Exchamsiks	114
23	Skeena Lower	Exstew	139
23	Skeena Lower	Fiddler_Cr	na
23	Skeena Lower	Gitnadoix	235
23	Skeena Lower	Kasiks	na
23	Skeena Lower	Khyex_R	na
23	Skeena Lower	L_Kalum	801
23	Skeena Lower	Thomas_Cr	62
23	Skeena Lower	Zymoetz	59
23	Skeena Lower	Zymogotitz	120
24	Alsek	Blanchard	381
24	Alsek	Goat_Cr	na
24	Alsek	Klukshu	432
24	Alsek	Takhanne	187
50	Puget Sound	Green@Kendal_F	50
50	Puget Sound	Green_F@Soos	100
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
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. Skeena Chinook baseline used in the 2010 genetic analyses.

Stock #	Stock name	Locus specific N															Maximum
		1b	i1	3g	a1	go2	go4	oke	oki	omy	ots2	ots 201b	ots 211	ots 213	ots9	sa	
52	Babine	361	385	407	388	371	382	348	365	378	393	309	296	290	400	417	407
20	Bear	155	176	174	173	156	163	148	157	161	165	99	102	92	171	175	176
15	Bulkley_sp	424	475	470	472	435	446	417	433	509	475	368	362	349	525	447	525
86	Cedar_sp	106	114	116	116	114	111	110	109	112	114	108	115	111	115	116	116
21	Ecstall	270	268	262	268	276	280	273	266	276	274	182	175	177	279	271	280
54	Exchamsiks	111	111	112	114	109	103	111	112	103	105	110	110	108	108	115	114
496	Exstew	136	138	135	137	138	138	138	134	138	136	138	138	139	136	138	139
500	Fiddler_Cr	109	109	108	106	109	109	109	109	109	109	111	110	113	109	109	113
271	Gitnadoix	204	206	207	215	222	211	224	226	212	226	174	174	183	235	213	235
494	Gitsegukla	257	258	254	246	258	255	258	253	256	260	259	255	258	259	258	260
497	Kasiks	61	59	62	61	62	61	62	61	59	61	62	62	62	63	62	63
502	Khyex_R	37	37	37	37	35	37	35	37	37	37	36	36	37	36	37	37
55	Kispiox	152	174	174	162	159	155	126	153	148	176	106	105	106	172	174	176
24	Kitsumkalum	690	722	729	709	801	797	695	788	777	787	587	566	586	706	739	801
16	Kitwanga	226	260	270	245	258	244	240	245	244	229	186	186	179	248	263	270
490	Kluakaz_Cr	119	117	120	89	115	122	117	120	124	118	122	119	120	122	118	124
418	Kluatantan	33	38	38	38	37	38	35	38	37	38	31	35	29	38	37	38
466	Kluayaz_Cr	158	159	157	162	158	158	157	161	160	158	158	158	160	157	158	162
480	Kuldo	170	169	170	170	168	164	167	168	166	169	170	160	170	168	170	170
19	Morice	241	256	287	285	244	259	228	233	253	261	208	218	195	263	306	287
501	Nangeese_R	29	32	32	32	29	31	30	32	32	30	28	30	29	30	31	32
492	Otsi	139	139	138	138	139	139	139	138	139	138	139	138	139	138	136	139
493	Shequnia	130	128	131	132	130	131	130	131	132	131	128	129	129	131	127	132
495	Sicintine	309	311	312	309	312	312	315	313	313	317	315	311	312	316	316	317
396	Slamgeesh	128	127	129	124	129	127	129	129	129	129	126	127	128	129	129	129
479	Squingula	268	266	271	266	269	267	270	265	266	262	264	258	266	264	263	271
399	Suskwa	98	98	103	102	105	104	102	108	100	102	91	100	95	99	102	108
51	Sustut	473	476	460	451	456	435	440	465	440	451	337	321	329	467	489	476
401	Sweetin	242	241	242	238	243	243	242	242	242	243	242	243	242	243	243	243
402	Thomas_Cr	62	60	62	61	62	62	61	62	62	62	60	61	61	61	61	62
60	Zymoetz	56	56	59	59	58	53	58	57	55	59	58	55	57	58	60	59
498	Zymogotitz	119	119	118	117	117	120	117	117	120	118	116	116	116	117	120	120

Appendix 4. Comparison of 2010 project results with the objectives identified in the proposal to the Pacific Salmon Commission's Sentinel Stocks Program.

1. Estimate the 2010 Chinook salmon escapement to the Skeena River with an estimated coefficient of variation (CV) of 15% or less.

   The 2010 escapement of Chinook salmon to the Skeena River was estimated but the program failed to meet the data standard of a CV of 15%. The CV for the 2010 estimate was 20%.

2. Sample all Chinook salmon captured at the Tyee Test Fishery for the biological attributes of length, sex and age and determine the age and sex composition for large components of the Chinook return to the Skeena River.

   All of the Chinook salmon captured at the Tyee Test Fishery were sampled. Age and sex compositions of the catch were reported for the aggregate and for the large component populations.

3. Meet the objectives above in subsequent years 2011 through 2013.

   This project has been proposed to the SSC for 2011 and further improvements to the genetic baseline for Skeena River Chinook have been suggested.