Retrospective Chinook Salmon Escapement Estimation to the Skeena River Using Genetic Techniques 2012.

Ivan Winther

Fisheries & Oceans Canada
Science Branch, Pacific Region
417-2nd Avenue West
Prince Rupert, British Columbia
V8J-1G8

January, 2013

A project funded by the Pacific Salmon Commission's Sentinel Stocks Program.
File SSP-2012-6.

ABSTRACT

Chinook salmon (*Oncorhynchus tshawytscha*) returns to the Skeena River were estimated for thirteen (13) years using genetic stock identification techniques on archived scale samples. Genetic analyses of 10,196 Chinook salmon were completed from 16,547 fish sampled at the Tyee Test Fishery over 13 years: 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. The proportions of Kitsumkalum River Chinook salmon identified in the annual samples were expanded to Skeena wide population estimates using the return of Kitsumkalum Chinook estimated from independent mark-recapture programs.

The preliminary estimates of large Chinook salmon returning to the Skeena River as measured at Tyee ranged from 59,248 in 1984 to 155,474 in 2001 across the 13 years. The coefficients of variation around the estimates were less than the data standard of 15% in 5 years and were greater than 15% in 8 years. These results combined with the retrospective work completed in 2011 and the annual estimates completed for 2009 to 2012 provide a continuous time series of escapement estimates for the Skeena River aggregate from 1984 to 2012. Over the full time series the coefficients of variation around the preliminary estimates were less than the data standard of 15% in 12 years and were greater than 15% in 17 years.

Genetic analyses were completed for 1,056 Chinook salmon caught at the Tyee Test Fishery from 1979 to 1984. Stock identification results are presented for these years completing the time series of stock mixtures from 1979 through 2012.

These results are preliminary as modifications are scheduled for the genetic baseline for Skeena River Chinook salmon populations. The ultimate objective for the retrospective and the annual Sentinel Stocks Programs on the Skeena River was to provide stock identification data and aggregate escapement estimates for the complete time series from 1979 to 2013.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

This document has been written to meet the reporting requirements defined in the cost sharing agreement between the Pacific Salmon Commission and Fisheries and Oceans Canada. A portion of the funding for this project was provided by the Pacific Salmon Commission's (PSC) Sentinel Stocks Program (SSP) to estimate Chinook salmon (*Oncorhynchus tshawytscha*) abundance in the Skeena River across selected years between 1979 and 2008. Costs to the SSP consisted of the genetic analyses of historic Chinook salmon samples. Other parts of the project were funded by Fisheries & Oceans Canada in existing programs.

A series of Sentinel Stocks projects were proposed to generate estimates of the Chinook salmon returning to the Skeena River (Figure 1). The projects consisted of current year programs and retrospective programs designed to complete a time series of estimates from 1979 to 2013. This retrospective project used archived samples collected from Chinook salmon caught in the Tyee Test fishery to produce stock compositions for 1979 to 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. Genetic analyses were used to determine the origin of the fish in the samples. This is the second proposal to the SSP to use archived Skeena River Chinook samples to generate historic Chinook escapement estimates and it completes the time series to 2008. Annual projects have produced estimates using the same method from 2009 to 2012 and a similar project is proposed for 2013.

The PSC is the body formed by the governments of Canada and the United States to implement the Pacific Salmon Treaty (PST) for the conservation, rational management and optimum production of Pacific salmon (www.psc.org). During recent negotiations within the Commission to amend Chapter 3, Annex IV of the PST, it became apparent that the accuracy and precision of spawning escapement estimates for important natural stocks of Chinook salmon should be improved in order to support implementation of the Chinook annex. Reliable estimates of spawning escapements for a large number of natural Chinook stocks over time are critical to assessing the status of the resource throughout the Treaty area and are necessary to assess the long term conservation and production goals of the Treaty. Recognizing the importance of better estimates of Chinook spawning escapements, the Commission conceived of the five year Sentinel Stock Program (SSP) and included it as a specific requirement in the revised Chinook regime (Paragraph 3(a) of Chapter 3, Annex IV). The SSP was intended to focus on improving spawning escapement estimates for a select subset of natural Chinook populations for which estimates of spawning escapement are critical to fishery management decisions required to implement the Chinook annex. Improving these estimates will strengthen the biological basis of the Chinook regime, increase confidence in management, and better inform the development of future regimes. The Skeena River Chinook salmon population was selected as one of the Sentinel Stocks.

The time series from 1984 to 2012 was selected as there were mark-recapture estimates available for the Kitsumkalum River Chinook salmon population. There was also interest in the period from 1979 to 1983 as it includes the base period considered in the analyses of Chinook abundance for the Treaty. This report presents the genetic analyses of samples collected at the Tyee Test fishery and preliminary estimates of the Chinook salmon return to the Skeena River for 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. Genetic analyses were also completed for 1979 through 1983 but estimates for the Skeena Chinook aggregate were not generated for these stock mixes.

The data standard established by the Sentinel Stocks Committee for estimates of Chinook salmon escapement was for estimates to have a coefficient of variation (CV) less than 15%. The objectives of the project were to estimate historic annual Chinook salmon escapements to the

Skeena River with an estimated CV of 15% or less and to examine Chinook salmon samples collected 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. Improvements were made to the genetic baseline for Skeena Chinook in 2012 and results from the revised baseline have been incorporated here. Additional improvements are scheduled for 2013.

The Skeena River has the second largest aggregate of Chinook salmon in British Columbia. The escapement index for the Skeena River has averaged over 50,000 spawners since 1985. However, current abundance indices consists of the sum of annual spawning population estimates derived using several different methods; mark-recapture estimates for the Kitsumkalum; visual observation estimates for the Bear, Morice and other systems; and fence counts for the Sustut, Kitwanga and part of the Babine populations. Further, the methods for developing estimates from visual observations appear to have changed over time (e.g. from peak count expansions to area-under-the-curve estimates). The Kitsumkalum River has been designated as an indicator stock for the Skeena River system and represents approximately 30% of the spawning populations in the escapement index. The Bear and Morice populations have comprised 20% and 26% of the escapement index respectively on average since 1985. Estimates of total Chinook salmon escapement to the Skeena River appear to be significantly larger than the indices in most years.

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.

Scale samples archived from the Tyee Test fishery are a reliable source of Chinook DNA such that stock composition can be identified for the historic time series of Skeena Chinook salmon. This was identified in feasibility studies of samples from 2000, 2001 and 2003 and was carried out for the 2011 SSP retrospective project and annual SSP projects from 2009 to 2012. Improvements to the genetic baseline have been incorporated and four additional genetic markers were included as recommended by the Genetic Analysis of Pacific Salmonids (GAPS) consortium (Seeb et al. 2007).

Prior to 2009 the Tyee Test Fishery typically started on or around 10 June each year. This start date appeared to miss a portion of the Chinook salmon migration as evident by the precipitous start to the average catch graph (Figure 2). Since 2009 the Tyee Test fishery has been initiated on or before 25 May. Catch and sample sizes were expected to increase significantly but these improvements were not realized: Starting the Tyee Test Fishery on 25 May rather than 10 June resulted in catch increases of less than 10% (average 6.6% from 2009 to 2012) (Winther, 2009; Winther and Candy, 2011; Winther, 2011). The historic start date of 10 June sampled more of the front tail of the summer run than expressed by the average run timing in Figure 2.

The estimates of Chinook salmon returning to the Kitsumkalum River form the cornerstone for the estimates of the Skeena aggregate escapements. The Kitsumkalum River Chinook program 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 PSC 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 returns tend to be a year older. 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 composed of predominantly age 4_2 and 5_2 males and 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 rare in other Skeena tributaries and more common in the Kitsumkalum River. The spawning migration occurs in the summer with peak passage through the estuary in early July. Spawning takes place in late August and early September. The non-Kitsumkalum life histories are consistent with those observed in most northern Chinook salmon populations.

The Kitsumkalum River Chinook population is of sufficient magnitude and the mark-recapture program provides escapement estimates with a reasonable level of accuracy such that the total return of Chinook to the Skeena River may be estimated from an unbiased sample of the Skeena return. 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. 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 with hatchery returns ranging 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 from early spring timed stocks that were not part of the summer timed stocks estimated by this project.

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. Genetic results from 2009 and 2010 (Winther, 2009; Winther and Candy, 2011) supported the assumption that all of the Chinook salmon caught at the Tyee Test fishery were from the Skeena watershed and that any straying was extremely limited (<1%) if they occurred at all.

In addition to providing escapement estimates within or near 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. If estimates for one or more of the component stocks within the Skeena aggregate can be calibrated then total estimates for the aggregate might be produced for the base period of 1979 to 1982 used by the PSC Chinook model.

METHODS

Chinook salmon escapement estimates and stock specific estimates of escapement were produced using the genetic results from samples collected at Tyee. The component of the Tyee sample identified as originating in the Kitsumkalum River was the basis for the expansions. Years were selected for analysis in the 2011 retrospective project considering the contrast in the annual escapement indices for the Skeena aggregate; the contrast in the annual escapement estimates for the large component stocks; the coefficient of variation around the annual Kitsumkalum estimate; and the number of samples collected at Tyee each year. This project completes the analyses for the remaining years (Table 1).

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 (described as *Alaska twist* by the manufacturer). 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 have been included to match 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. Prior to 1996 and in 1997 and 1998 a multifilament nylon net was used. This net was less efficient so fewer Chinook salmon were caught in these years. In 1996, 1999, 2000 and 2001 both types of net were used to calibrate the new net. Consequently additional catches were available for sampling in these years. A full description of the test fishery is provided by Jantz et. al. (1990).

Chinook salmon caught in the Tyee Test fishery were sampled for nose-fork length, eye orbit to hypural plate length, and were incised to determine sex. Data were entered to a database developed and maintained by the Management Biology Unit (the Salmon Stock Assessment Unit after 1994) of Fisheries and Oceans Canada in Prince Rupert. Scale samples were collected from each fish on to scale books as described by MacLellan (1999) and forwarded to the Fisheries & Oceans Canada, Sclerochronology Laboratory at the Pacific Biological Station for ageing. The process of deriving ages from the scales included making acetate impressions, maintaining a database and archiving the scales and the acetate impressions.

Chinook salmon collections were compared with baselines collected from 30 Skeena River populations (Appendix 1). 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 probabilities for the five most likely populations for each sample.

A mark-recapture program on the Kitsumkalum River provided estimates of the escapement of large Chinook salmon from 1984 to 2008. The mark re-capture estimates 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.

In addition to the development of escapement estimates for Kitsumkalum Chinook salmon, biological samples were collected from live fish during the tagging event and from dead fish during the recovery event. The samples included data on size and gender and scale samples to determine age.

RESULTS

Analyses were completed for 18 years of samples collected from 1979 to 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. These data complete the time series from 1979 to 2012 (Table 1).

The average Chinook migration pattern begins precipitously suggesting the migration was underway by the start of the test fishery around 10 June. Peak of the average migration past Tyee occurred at the end of June and early in July. In all years rear tail of the migration timing pattern was fully sampled with the last Chinook caught at Tyee around the middle of August (Figure 2.). Patterns of annual catch (Figure 3) reveal that the front tails of the migration patterns were not consistent from year to year. In 1996, 1998, 2000, 2001, and 2008 the front tail appears truncated by the start of the test fishery suggesting that the migration was under way when the test fishery began. This was evident to a lesser extent in 2004, 2005 and 1997. In other years the front tail of the run appears to be well represented.

Scale samples were recovered from the archives for the 18 years selected. In a number of years the Chinook catch was sub-sampled which flattened the top of the sample by day distributions in periods of high catch (Figure 4). Samples were weighted to the catch by week to account for sub-sampling and for catch that couldn’t be sampled due to depredation by seals. Often these fish were so badly mutilated that size and gender could not be determined. The duration that the scale samples were archived did not appear to influence whether the genetic material could be extracted and amplified. The oldest scales tested were from 1979 and the most recent scales tested were from 2012.

The Skeena River baseline used for the analyses of the samples collected at Tyee included genetic material from 30 populations (Appendix 1) (Erhardt and Rabnett, 2009; Gottesfeld, 2009). Genetic analyses of 10,196 Chinook salmon were completed from 16,547 fish sampled at the Tyee Test Fishery over 13 years: 1984, 1990, 1992, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2006, 2007 and 2008. The proportions of Kitsumkalum River Chinook salmon identified in the annual samples were expanded to Skeena wide population estimates using the return of Kitsumkalum Chinook estimated from independent mark-recapture programs. Genetic analyses were also completed for 1,056 Chinook salmon caught at the Tyee Test Fishery from 1979 to 1984. Stock identification results are presented for these years completing the time series of stock mixtures from 1979 through 2012 (Table 2).

The preliminary estimates of large Chinook salmon returning to the Skeena River as measured at Tyee ranged from 59,248 in 1984 to 155,474 in 2001 across the 13 years. The coefficients of variation around the estimates were less than the data standard of 15% in 5 years and were greater than 15% in 8 years. These results combined with the retrospective work completed in 2011 and the annual estimates completed for 2009 to 2012 provide a continuous time series of escapement estimates for the Skeena River aggregate from 1984 to 2012. Over the full time series the coefficients of variation around the preliminary estimates were less than the data standard of 15% in 12 years and were greater than 15% in 17 years (Table 3).

In most years the Chinook salmon return to the Skeena estimated using the genetic technique was higher than the Skeena escapement index. Exceptions occurred in 1985 and 1986 when the indices were larger that the genetic estimates and in 1991 and 2012 when the genetic estimates were essentially the same as the indices (Figure 5).

DISCUSSION

Genetic analyses were proposed for samples collected from the Tyee Test Fishery from 1984 to 2008. This time series was selected as genetic analyses were complete for samples collected from 2009 to 2011 and mark-recapture estimates were not available for the Kitsumkalum stock prior to 1984. The Sentinel Stocks Committee expressed interest in expanding the Skeena retrospective program to include the period from 1979 to 1983 to include the base period identified for the PSC Chinook model.

The results represent significant progress toward understanding the Skeena River Chinook salmon aggregate. Success of the program relied on access to the historic sample data and the archived scale samples. The most significant results are that the data exist and the scale samples exist and could be recovered from the archives to do this work.

It appears that pressing the scales to produce acetate impressions may help to preserve the DNA in the scales (John Candy, personal communication).

The findings reported here represent preliminary estimates. Additional analyses are required to develop final estimates for the aggregate of Skeena River Chinook salmon as well as for the major component stocks. These analyses are proposed for 2013.

Problems were identified with the baseline genetic material collected for the Morice and Babine populations in 2009. No fish were assigned to the Babine population even though it was known to represent significant portions of the stock mixes tested. New baseline samples were collected in 2010 and 2011 from Morice and Babine which resulted in assignments to the Babine population (Winther, 2011). Baseline samples collected from 2010 to 2012 have been incorporated in the analyses presented here. Recent baseline changes included samples of Chinook populations from the Morice, Babine and Zymoetz (Thomas Creek) and Bear Rivers.

This project assumes that components of the Chinook salmon return to the Skeena River are equally vulnerable to the Tyee Test fishery. Starting the test fishery on 10 June appeared to truncate the front tail of the Chinook salmon migration pattern (Figure 2). Complete samples of the summer Chinook salmon migration have been attempted by starting the test fishery on 25 May in 2009 through 2012. The front tails of the migration pattern observed from 2009 to 2012 do not appear to be as substantial as might have been predicted when compared with the historic average. The proportion of the Chinook salmon runs sampled in the 25 May to 9 June period represented 6.6%, 9.5% and 3.2%of the 2009 to 2011 runs respectively (Winther, 2009; Winther and Candy, 2011; Winther, 2011; Winther 2012).

Water levels may influence fish migration and may also affect how vulnerable they are to the test net. The 2009 to 2012 samples represented recent extremes in the range of water levels on the Skeena River. Extreme high water and flooding was experienced in 2009. This was followed by small winter snow packs and a warm, dry summer which resulted in very low water conditions in 2010. Very high water and prolonged freshet conditions were evident in 2011 and 2012 as the result of heavy winter snow packs and a cool, wet spring and summer. The pattern of Chinook salmon catches at Tyee was not appreciably different between the four years (Winther, 2012).

The 2009 and 2010 Chinook salmon samples collected at Tyee were compared with the coast-wide stock baseline to test for closure in the system. The 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[1] were extremely limited (<1%) if they occurred at all. Other Tyee samples were not compared with the coast-wide stock mix since virtually all of the Chinook salmon caught at Tyee were assigned to the Skeena region aggregate in 2009 and 2010.

This project has not accounted 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. Significant sport and First Nations’ fisheries occur annually on the Skeena River and have not been incorporated in these results.

The estimate for 1996 is suspect because of very small sample sizes in the first two weeks of the fishery. Two test fishing vessels were used in 1996 and the samples used in these analyses were from the *Alaska twist* monofilament net. However the catch from this net was poorly sampled in the first two weeks of the fishery. We propose to rectify this in 2013 by analyzing additional samples from the nylon net to fill in the samples from early portion of the fishery.

The genetic approach used in this study has benefitted from additional work to improve the baseline for Skeena River Chinook salmon populations. Further work has been scheduled to improve the historic baseline samples.

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

ACKNOWLEDGEMENTS

Archived samples and historic data were the basis for this project. The author is indebted to the people that maintain the databases and archives and especially to those individuals that had the forethought to initiate them. This project was the result of a large number of people dedicated to assessments of Skeena River Chinook salmon: The Captains and crews of the test fishing boats caught the fish. The technical crews from the DFO Management Biology Unit (later Stock Assessment) sampled the fish, entered the data and maintained the database for the Tyee Test Fishery. The Sclerochronology Laboratory at PBS provided the age analyses of the scale collections, maintained the database and archived the scales. The Molecular Genetics Laboratory at the Pacific Biological Station (PBS), Nanaimo, provided the genetic analyses. Initial baseline samples were collected by staff from Fisheries and Oceans Canada. Additional collections were made by Richard Erhardt and the staff at Taltan Fisheries; by Barry Finnegan and the staff at the Babine Fence; by Mike O'Neil and the staff at the Toboggan Creek hatchery; by Dr. Allen Gottesfeld and the staff at the Skeena Fisheries Commission; by Chris Culp and the staff at the Deep Creek hatchery; by Ken Rabnett and by Thomas Patrick.

REFERENCES

Beacham, T.D., J.R. Candy, K.L. Jonsen, J. Supernault, M. Wetklo, L. Deng, K.M. Miller, R.E. Withler, and N.V. Varnavskaya. 2006. Estimation of stock composition and individual identification of Chinook salmon across the Pacific Rim using microsatellite variation. Transactions of the American Fisheries Society 135:861-888.

Candy, J.R., J.R. Irvine, C.K. Parken, S.L. Lemke, R.E. Bailey, M. Wetklo, and K. Jonsen. 2002. A discussion paper on possible new stock grouping (Conservation Units) for Fraser River Chinook salmon. Canadian Science Advisory Secretariat Res. Doc. 2002/085.

Cox-Rogers, S., and L. Jantz. 1993. Recent trends in the catchability of sockeye salmon in the Skeena River gillnet test fishery, and impacts on escapement estimation. Can. Manuscr. Rep. Fish. Aquat. Sci. 2219: 19 p.

Erhardt, R. and K.A. Rabnett. 2009. Unpublished data on the collection of Chinook baseline genetic samples from upper Skeena River tributaries. Tahltan Fisheries, Dease Lake, B.C., VOC 1LO.

Gottesfeld, A. S. 2009. Unpublished data on the collection of Chinook baseline genetic samples from Skeena River tributaries. Skeena Fisheries Commission, Box 18, Seymour Avenue, RR#1, South Hazelton, BC, V0J 2R0.

Jantz, L., R. Kadowaki and B. Spilsted. 1990. Skeena River Salmon Test fishery, 1987. Can. Data. Rep of Fish. And Aquatic. Sci. No. 804. 151 p.

Koch, K. 2009. Unpublished data on the passage of Chinook salmon through the Kitwanga River fence. Gitanyow Fisheries Authority, P.O. Box 148, Kitwanga, B.C. V0J 2A0.

MacLellan, S. E. 1999. Guide for sampling structures used in age determination of Pacific salmon. Fisheries & Oceans Canada, Stock Assessment Branch, Pacific Biological Station, Nanaimo, British Columbia.

Neaves, P. I., C. G. Wallace, J. R. Candy, and T. D. Beacham. 2005. CBayes: Computer program for mixed stock analysis of allelic data. Version v5.01. Free program distributed by the authors over the internet from http://www.pac.dfo-mpo.gc.ca/sci/mgl/Cbayes_e.htm

Pacific Salmon Commission. 2000. Pacific Salmon Treaty, 1999 Revised Annexes, Memorandum of Understanding (1985), Exchanges of Notes.

Parken, C.K. R.E. McNicol, J.R. Irvine. 2006. Habitat-based methods to estimate escapement goals for data limited Chinook salmon stocks in British Columbia, 2004. Canadian Stock Assessment Secretariat Research Document 2006/083. Ottawa, Ontario, Canada.

Pella, J., and M. Masuda. 2001. Bayesian methods for analysis of stock mixtures from genetic characters. Fishery Bulletin 99: 151-167.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Department of Environment Fisheries and Marine Service. Ottawa.

Saitou N., and M. Nei 1987. The neighbor-joining method: a new method for reconstructing phylogenetic trees. Molecular Biology and Evolution, 4, 406–425.

Seeb, L., A. Antonovich, M.A. Banks, T.D. Beacham, M.R. Bellinger, S.M. Blankenship, M.R. Campbell, N.A. Decovich, .. Garza, C.M. Guthrie, T.A. Lundrigan, P. Moran, S.R. Narum, J.J. Stephenson, K.J. Supernault, D.J. Teel, W.D. Templin, J.K. Wenburg, S.F. Young, and C. T. Smith. 2007 Development of a standardized DNA database for Chinook salmon. Fisheries 32:540-552.

Weir B.S., C.C. Cockerham 1984. Estimation F-statistics from the analysis of population structure. Evolution, 38, 1358–1370

Winther, I. 2009. Chinook salmon escapement estimation to the Skeena River using genetic techniques 2009. Unpublished report to the Pacific Salmon Commission's Sentinel Stocks Program. File SSP-4.

Winther, I and J. Candy. 2011. Chinook salmon escapement estimation to the Skeena River using genetic techniques 2010. Unpublished report to the Pacific Salmon Commission's Sentinel Stocks Program. File SSP-2010-1.

Winther, I. 2011. Chinook salmon escapement estimation to the Skeena River using genetic techniques 2011. Unpublished report to the Pacific Salmon Commission's Sentinel Stocks Program. File SSP-2011-1.

Winther, I. 2012. Chinook salmon escapement estimation to the Skeena River using genetic techniques 2012. Unpublished report to the Pacific Salmon Commission's Sentinel Stocks Program. File SSP-2012-5.

TABLES

Table 1. Skeena River Chinook escapement indices and sample size for Chinook salmon from the Tyee Test Fishery 1979 to 2012. Bold values indicate years funded by this study. Values in normal text were analyzed previously.

Year	Skeena Index	Babine	Bear	Kispiox	Morice	Kitsumkalum	CV of Kitsumkalum MR Esc. Est.	Tyee samples archived	Samples proposed for analyses	Samples analyzed
1979	**18,088**	**738**	**3,000**	**400**	**4,100**	**5,000**		**263**	**263**	**255**
1980	**23,000**	**880**	**9,000**	**300**	**4,500**	**4,200**		**155**	**155**	**145**
1981	**24,374**	**1,277**	**5,100**	**725**	**3,000**	**9,300**		**187**	**187**	**184**
1982	**16,934**	**598**	**3,000**		**3,000**	**5,500**		**150**	**150**	**148**
1983	**23,352**	**948**	**3,500**	**500**	**4,500**	**10,690**		**330**	**330**	**324**
1984	**35,639**	**1,780**	**12,300**	**1,362**	**4,500**	**11,825**	**16.7%**	**289**	**289**	**246**
1985	52,157	822	21,500	2,600	11,300	8,304	5.9%	348	348	318
1986	59,439	378	17,700	5,400	15,000	9,109	5.9%	291	291	293
1987	60,873	890	8,200	4,320	10,000	23,657	10.1%	386	386	386
1988	68,007	2,057	14,750	5,625	12,000	22,267	6.9%	651	651	422
1989	56,824	1,983	12,900	4,100	10,200	17,925	7.2%	380	380	378
1990	**55,441**	**1,604**	**10,010**	**5,050**	**12,000**	**17,406**	**6.4%**	**411**	**411**	**382**
1991	52,542	1,043	5,800	4,470	25,500	9,288	7.2%	403	403	396
1992	**66,868**	**1,685**	**11,370**	**15,071**	**16,000**	**12,437**	**8.1%**	**271**	**271**	**270**
1993	68,196	1,290	23,290	3,775	18,000	14,059	5.5%	379	379	370
1994	**22,461**	**485**	**1,111**	**4,500**		**12,629**	**9.5%**	**361**	**361**	**351**
1995	**34,190**	**493**	**10,672**	**2,326**	**10,500**	**7,221**	**10.1%**	**414**	**414**	**408**
1996	**73,684**	**2,893**	**19,000**	**4,365**	**30,000**	**12,776**	**16.7%**	**1,956**	**1,500**	**1,045**
1997	42,289	1,628	9,500	3,775	18,000	5,342	11.3%	664	664	617
1998	46,774	3,153	8,500	5,600	14,000	11,065	6.8%	333	333	323
1999	**43,775**	**1,500**	**6,000**	**6,000**	**17,000**	**9,763**	**8.9%**	**1,975**	**1,500**	**1,186**
2000	**51,804**	**4,372**	**10,084**		**17,000**	**14,722**	**8.2%**	**2,801**	**725**	**1,091**
2001	**81,504**	**5,971**	**12,081**	**8,600**	**18,000**	**23,839**	**9.5%**	**2,889**	**931**	**1,070**
2002	44,771	3,438	2,541	3,806	7,500	23,849	11.4%	1,303	1,303	1,285
2003	**56,758**	**5,023**	**6,014**	**6,400**	**10,000**	**23,608**	**11.0%**	**1,598**	**1,032**	**1,067**
2004	39,552	2,313	3,000		4,800	25,767	10.2%	1,007	1,007	999
2005	29,496	1,827	1,400		7,000	15,046	9.2%	1,238	1,238	1,221
2006	**36,232**	**3,538**	**1,713**		**13,000**	**12,368**	**14.5%**	**1,142**	**1,142**	**1,071**
2007	**36,754**	**2,094**	**825**		**11,000**	**15,736**	**18.0%**	**1,238**	**1,238**	**1,122**
2008	**34,415**	**6,842**	**8,209**		**6,000**	**10,374**	**14.2%**	**1,202**	**1,202**	**1,198**
2009	36,176	2,912	8,617		12,082	10,703	13.3%	1,155		1,155
2010	42,339	4,883	6,761	3,712	11,897	13,712	14.8%	839		847
2011	34,130	2,588	1,638		16,263	12,105	17.3%	917		907
2012	34,024	2,218	3,066		17,441	9,363	13.9%	499		497

MR Esc. Est. = Mark-Recapture Escapement Estimate.

Table 2. Mixture model analyses of Chinook salmon caught at the Tyee Test fishery using the 30 stock Skeena baseline by year. Data are presented as percent of the annual catch at Tyee by stock.

Year	1979		1980		1981		1982		1983		1984		1985		1986		1987	
Sample size	255		145		184		148		324		246		318		293		386	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	5.7	(2.6)	6.4	(2.9)	4.7	(2.0)	5.0	(3.4)	2.3	(1.5)	15.1	(3.0)	4.3	(1.6)	6.7	(2.1)	2.6	(1.7)
Bear	12.2	(3.0)	5.8	(2.8)	5.5	(2.7)	10.2	(3.8)	17.2	(2.8)	7.8	(2.9)	5.9	(1.9)	7.0	(3.0)	7.6	(2.5)
Bulkley_Early	2.3	(0.9)	2.5	(1.0)	0.6	(0.7)	2.1	(1.1)	1.6	(0.7)	0.8	(0.7)	2.4	(0.9)	0.8	(0.4)	2.5	(1.0)
Cedar_Early	0.0	(0.2)	0.0	(0.4)	0.0	(0.3)	0.0	(0.5)	0.0	(0.2)	0.0	(0.2)	0.3	(0.3)	0.2	(0.3)	0.8	(0.7)
Ecstall	2.7	(1.1)	0.7	(0.8)	2.7	(1.2)	3.2	(1.1)	2.5	(0.9)	4.0	(1.3)	1.7	(0.7)	2.9	(1.3)	0.8	(0.6)
Exchamsiks	0.7	(0.8)	0.6	(0.9)	0.3	(0.7)	0.6	(0.8)	0.1	(0.3)	1.6	(1.0)	0.0	(0.2)	0.8	(0.5)	0.6	(0.8)
Exstew_R	0.9	(0.8)	0.8	(1.1)	1.2	(0.9)	1.0	(1.0)	0.6	(0.6)	0.1	(0.4)	0.8	(0.6)	0.3	(0.5)	1.0	(0.9)
Fiddler_Cr	0.0	(0.3)	0.1	(0.5)	0.1	(0.3)	0.0	(0.4)	0.1	(0.3)	0.4	(0.7)	0.6	(0.6)	1.5	(0.9)	0.3	(0.7)
Gitnadoix	1.6	(1.0)	0.8	(0.9)	2.6	(1.2)	1.3	(1.0)	0.9	(0.6)	0.3	(0.5)	2.3	(1.2)	1.8	(1.2)	2.8	(1.3)
Kasiks_R	0.3	(0.4)	0.5	(0.9)	0.7	(0.9)	0.4	(0.8)	1.5	(0.8)	0.4	(0.6)	0.9	(0.8)	0.1	(0.4)	0.3	(0.7)
Khyex_R	0.3	(0.5)	1.0	(0.8)	1.3	(1.0)	0.6	(0.7)	0.0	(0.1)	0.2	(0.5)	1.8	(0.9)	0.0	(0.3)	1.6	(1.0)
Kispiox	4.1	(2.0)	2.3	(1.9)	0.6	(1.1)	0.7	(1.1)	3.0	(1.2)	1.4	(1.3)	5.1	(2.1)	3.6	(1.5)	5.1	(2.4)
Kitseguecla_R	0.1	(0.4)	0.1	(0.5)	0.1	(0.3)	0.0	(0.5)	0.1	(0.3)	0.5	(0.6)	0.5	(0.6)	0.6	(0.6)	7.3	(2.4)
Kitwanga	1.6	(1.7)	1.2	(1.4)	2.3	(2.2)	2.6	(2.0)	3.3	(1.3)	1.8	(0.9)	3.0	(1.6)	4.1	(2.0)	3.3	(1.6)
Kluatantan	1.1	(1.2)	0.5	(0.8)	0.2	(0.6)	0.6	(1.0)	0.6	(0.7)	0.2	(0.4)	1.0	(0.7)	0.6	(0.9)	0.1	(0.6)
Kluayaz_Cr	0.6	(0.9)	0.2	(0.7)	2.4	(1.4)	0.6	(1.0)	1.1	(1.2)	0.8	(1.0)	2.0	(1.2)	1.1	(0.9)	1.9	(1.1)
Kuldo_C	1.8	(1.2)	1.4	(1.2)	0.2	(0.6)	1.2	(1.5)	0.7	(0.6)	0.2	(0.6)	0.5	(0.7)	0.7	(0.7)	1.4	(1.0)
Kitsumkalum	**13.9**	**(2.7)**	**30.7**	**(4.1)**	**24.2**	**(3.5)**	**20.7**	**(3.8)**	**23.7**	**(2.6)**	**20.9**	**(3.2)**	**20.2**	**(2.5)**	**23.3**	**(3.4)**	**14.9**	**(2.1)**
Morice	36.3	(3.1)	32.2	(3.6)	37.6	(3.5)	38.8	(4.3)	32.6	(2.8)	35.9	(3.4)	36.7	(2.9)	32.6	(3.3)	26.6	(2.5)
Nangeese_R	0.6	(0.8)	2.8	(1.9)	1.8	(1.2)	0.4	(0.7)	0.5	(0.7)	0.1	(0.3)	0.2	(0.4)	1.0	(1.2)	0.6	(0.9)
Otsi_Cr	0.9	(1.0)	0.2	(0.6)	1.4	(1.2)	1.2	(1.3)	0.8	(0.9)	0.3	(0.7)	1.2	(0.7)	0.1	(0.3)	1.3	(1.2)
Shegunia_R	0.6	(0.7)	0.1	(0.5)	0.2	(0.5)	0.7	(0.5)	0.7	(0.6)	0.9	(0.9)	0.6	(0.6)	0.3	(0.5)	1.2	(1.1)
Sicintine_R	0.0	(0.3)	0.2	(0.6)	0.1	(0.4)	0.2	(0.7)	0.0	(0.2)	0.2	(0.4)	0.0	(0.2)	0.0	(0.2)	0.0	(0.6)
Slamgeesh	4.9	(1.7)	4.1	(2.7)	4.5	(2.4)	5.1	(2.5)	2.0	(1.1)	1.6	(1.5)	1.1	(1.1)	3.7	(2.2)	3.0	(1.6)
Squingula_R	2.5	(1.2)	2.3	(1.5)	0.8	(0.9)	0.6	(1.1)	3.1	(1.1)	2.5	(1.1)	0.6	(0.6)	1.5	(1.0)	2.1	(1.3)
Suskwa	0.3	(0.4)	0.1	(0.5)	0.1	(0.3)	0.0	(0.4)	0.0	(0.2)	0.2	(0.4)	0.3	(0.4)	0.0	(0.3)	0.1	(0.5)
Sustut	1.8	(0.8)	0.7	(0.8)	0.5	(0.6)	0.6	(0.8)	0.4	(0.4)	0.3	(0.4)	1.9	(0.8)	0.6	(0.5)	1.3	(0.8)
Sweetin	1.4	(1.3)	0.2	(0.6)	0.5	(0.9)	0.6	(1.1)	0.2	(0.4)	0.3	(0.6)	0.8	(0.8)	1.9	(1.1)	3.6	(1.7)
Thomas_Cr	0.5	(0.6)	1.0	(1.1)	3.0	(1.3)	0.5	(0.7)	0.4	(0.4)	1.1	(1.0)	3.0	(0.9)	2.1	(1.0)	5.0	(1.7)
Zymogotitz_R	0.3	(0.5)	0.8	(0.8)	0.0	(0.3)	0.2	(0.6)	0.0	(0.2)	0.0	(0.3)	0.2	(0.3)	0.1	(0.5)	0.3	(0.6)

SD = standard deviation

Table 2 continued.

Data are presented as percent of the annual catch at Tyee by stock.

Year	1988		1989		1990		1991		1992		1993		1994		1995		1996	
Sample size	422		378		382		396		270		370		351		408		1045	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	5.9	(1.8)	6.8	(2.0)	7.4	(2.3)	4.5	(2.1)	8.6	(2.4)	4.5	(2.1)	4.6	(2.2)	2.0	(1.3)	8.2	(1.8)
Bear	8.4	(2.4)	6.7	(1.8)	8.7	(3.0)	9.1	(2.0)	5.8	(1.9)	6.1	(2.3)	16.0	(2.6)	12.2	(2.7)	9.4	(2.1)
Bulkley_Early	1.7	(0.7)	0.9	(0.6)	0.7	(0.4)	2.4	(0.8)	2.3	(0.9)	0.8	(0.4)	0.4	(0.5)	0.4	(0.3)	0.1	(0.3)
Cedar_Early	0.5	(0.4)	0.0	(0.2)	0.0	(0.2)	0.2	(0.3)	1.1	(0.7)	0.1	(0.3)	0.0	(0.2)	0.0	(0.2)	0.0	(0.1)
Ecstall	0.8	(0.4)	1.9	(0.7)	2.0	(0.6)	1.7	(0.7)	0.9	(0.5)	0.0	(0.2)	1.0	(0.6)	0.9	(0.6)	0.3	(0.2)
Exchamsiks	0.5	(0.5)	0.3	(0.5)	0.1	(0.3)	0.4	(0.5)	0.1	(0.5)	0.9	(0.8)	0.3	(0.4)	0.3	(0.6)	1.5	(1.0)
Exstew_R	0.4	(0.6)	0.8	(0.7)	1.5	(0.8)	0.2	(0.4)	0.1	(0.3)	1.1	(0.8)	0.1	(0.4)	1.0	(0.6)	0.4	(0.3)
Fiddler_Cr	0.4	(0.4)	0.0	(0.2)	0.1	(0.3)	0.0	(0.2)	0.1	(0.5)	0.4	(0.4)	0.1	(0.4)	1.2	(1.2)	0.1	(0.4)
Gitnadoix	1.7	(0.8)	0.6	(0.6)	0.8	(0.8)	2.9	(1.0)	2.2	(1.1)	0.6	(0.6)	1.3	(0.8)	0.8	(0.7)	2.2	(1.3)
Kasiks_R	0.1	(0.3)	0.1	(0.3)	0.6	(0.6)	0.2	(0.3)	0.9	(0.7)	0.0	(0.3)	0.2	(0.4)	0.3	(0.5)	0.7	(0.5)
Khyex_R	0.4	(0.5)	1.5	(0.7)	0.6	(0.5)	1.6	(0.7)	1.1	(0.7)	0.5	(0.7)	0.0	(0.2)	1.6	(1.1)	0.4	(0.3)
Kispiox	5.5	(2.0)	5.8	(2.2)	2.6	(1.4)	5.7	(1.8)	1.4	(1.4)	0.8	(1.1)	3.8	(1.8)	1.5	(1.6)	1.7	(0.7)
Kitseguecla_R	0.2	(0.4)	0.3	(0.6)	0.3	(0.5)	0.6	(0.5)	0.3	(0.6)	0.7	(0.7)	1.0	(0.7)	0.2	(0.6)	0.1	(0.2)
Kitwanga	6.4	(1.7)	2.2	(2.0)	5.9	(1.5)	1.6	(1.2)	0.8	(1.1)	4.2	(1.9)	3.1	(1.4)	3.2	(2.7)	1.3	(0.6)
Kluatantan	1.7	(1.0)	0.1	(0.3)	0.4	(0.5)	0.4	(0.6)	0.4	(0.7)	1.2	(0.9)	0.8	(0.9)	1.2	(1.1)	0.3	(0.4)
Kluayaz_Cr	0.9	(0.8)	0.5	(0.7)	1.5	(0.9)	0.8	(0.8)	1.9	(1.4)	2.7	(1.3)	1.7	(1.0)	1.6	(1.3)	3.0	(1.6)
Kuldo_C	0.9	(0.7)	0.6	(0.5)	0.4	(0.6)	0.6	(0.5)	1.5	(1.3)	2.9	(1.5)	3.5	(1.3)	0.5	(1.0)	0.2	(0.3)
Kitsumkalum	**21.2**	**(2.2)**	**21.9**	**(2.3)**	**21.2**	**(2.4)**	**17.3**	**(2.0)**	**10.8**	**(2.2)**	**10.9**	**(1.8)**	**14.6**	**(2.0)**	**10.6**	**(2.4)**	**9.1**	**(1.0)**
Morice	28.3	(2.4)	37.6	(2.7)	28.4	(2.6)	34.7	(2.6)	37.3	(3.3)	40.3	(2.9)	29.9	(2.6)	36.9	(3.1)	44.2	(2.4)
Nangeese_R	1.1	(0.9)	0.1	(0.2)	0.0	(0.2)	0.2	(0.3)	1.8	(1.2)	0.8	(0.8)	0.2	(0.4)	0.7	(0.8)	0.1	(0.2)
Otsi_Cr	0.3	(0.5)	0.2	(0.4)	1.5	(1.3)	1.0	(0.7)	2.1	(1.4)	1.0	(0.9)	0.2	(0.4)	1.0	(1.6)	1.6	(0.7)
Shegunia_R	0.1	(0.3)	0.2	(0.5)	1.2	(0.7)	0.3	(0.5)	0.5	(0.7)	2.2	(1.3)	0.1	(0.3)	2.3	(1.3)	0.1	(0.2)
Sicintine_R	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.1	(0.3)	0.1	(0.2)	0.5	(0.5)	0.1	(0.4)	0.0	(0.2)
Slamgeesh	1.9	(1.1)	4.9	(1.9)	3.6	(1.4)	0.7	(0.8)	6.8	(2.8)	3.4	(1.3)	8.7	(2.2)	2.1	(1.3)	2.7	(1.0)
Squingula_R	2.3	(1.2)	2.1	(1.0)	3.7	(1.9)	2.7	(1.2)	1.9	(1.7)	0.8	(1.0)	2.9	(1.1)	4.8	(2.1)	4.8	(1.0)
Suskwa	0.0	(0.2)	0.4	(0.6)	0.1	(0.3)	0.6	(0.5)	0.1	(0.4)	0.4	(0.4)	0.0	(0.2)	0.2	(0.5)	0.3	(0.2)
Sustut	1.8	(0.7)	0.3	(0.4)	0.6	(0.5)	1.4	(0.7)	1.0	(0.8)	2.8	(1.3)	1.9	(0.8)	5.1	(1.7)	2.7	(0.9)
Sweetin	2.6	(1.0)	2.4	(1.1)	3.2	(1.4)	3.6	(1.4)	0.9	(1.2)	7.4	(2.3)	0.9	(0.8)	4.2	(3.0)	2.8	(1.2)
Thomas_Cr	3.5	(1.1)	0.2	(0.4)	2.7	(0.9)	4.2	(1.1)	6.5	(1.7)	2.4	(1.1)	2.0	(0.9)	2.7	(1.1)	1.8	(0.5)
Zymogotitz_R	0.3	(0.3)	0.5	(0.4)	0.0	(0.2)	0.3	(0.3)	1.0	(0.7)	0.0	(0.2)	0.1	(0.3)	0.1	(0.3)	0.2	(0.2)

SD = standard deviation

Table 2 continued.

Data are presented as percent of the annual catch at Tyee by stock.

Year	1997		1998		1999		2000		2001		2002		2003		2004		2005	
Sample size	617		323		1186		1091		1070		1285		1067		999		1221	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	5.1	(1.4)	6.9	(1.7)	8.4	(1.2)	5.6	(1.0)	6.7	(1.1)	7.6	(1.2)	7.2	(1.2)	10.2	(1.3)	8.1	(1.0)
Bear	7.5	(1.4)	8.9	(1.9)	8.6	(1.3)	7.0	(1.3)	4.8	(1.0)	3.3	(1.0)	4.6	(1.2)	4.3	(1.1)	5.7	(1.0)
Bulkley_Early	2.9	(0.7)	2.9	(1.0)	1.0	(0.3)	2.0	(0.5)	3.3	(0.6)	0.6	(0.2)	3.2	(0.6)	1.2	(0.4)	1.3	(0.4)
Cedar_Early	0.2	(0.2)	0.0	(0.2)	0.0	(0.1)	0.1	(0.1)	0.0	(0.1)	0.0	(0.1)	0.3	(0.3)	0.1	(0.1)	0.3	(0.3)
Ecstall	0.1	(0.2)	0.9	(0.5)	1.7	(0.4)	0.6	(0.2)	0.8	(0.3)	1.8	(0.4)	0.7	(0.3)	0.9	(0.3)	1.0	(0.3)
Exchamsiks	1.1	(0.7)	0.4	(0.6)	1.9	(0.5)	1.3	(0.5)	0.3	(0.4)	1.2	(0.5)	1.6	(0.5)	1.1	(0.5)	0.6	(0.4)
Exstew_R	0.1	(0.2)	2.4	(1.2)	1.9	(0.6)	1.3	(0.5)	1.2	(0.6)	2.1	(0.6)	1.3	(0.6)	1.0	(0.5)	0.9	(0.4)
Fiddler_Cr	0.6	(0.4)	0.4	(0.6)	0.2	(0.2)	0.1	(0.1)	0.2	(0.2)	0.1	(0.1)	0.2	(0.2)	0.6	(0.4)	0.4	(0.3)
Gitnadoix	0.7	(0.6)	0.8	(0.9)	0.8	(0.5)	3.9	(0.8)	3.8	(0.8)	1.8	(0.6)	1.8	(0.6)	1.9	(0.6)	0.3	(0.3)
Kasiks_R	0.9	(0.6)	0.2	(0.4)	0.3	(0.4)	0.2	(0.2)	0.1	(0.2)	0.3	(0.3)	0.6	(0.4)	0.4	(0.3)	0.7	(0.3)
Khyex_R	0.3	(0.3)	0.0	(0.2)	0.6	(0.3)	0.4	(0.3)	0.3	(0.2)	0.1	(0.1)	0.6	(0.3)	0.1	(0.1)	0.5	(0.2)
Kispiox	8.0	(1.7)	2.1	(1.9)	3.3	(1.4)	2.5	(1.3)	4.5	(1.3)	5.7	(1.1)	4.5	(1.3)	1.8	(0.8)	3.4	(1.0)
Kitseguecla_R	0.0	(0.2)	1.4	(1.0)	0.8	(0.4)	0.4	(0.4)	1.0	(0.4)	0.5	(0.3)	0.9	(0.4)	0.5	(0.3)	0.8	(0.5)
Kitwanga	3.4	(1.2)	4.9	(2.4)	4.2	(1.2)	7.5	(1.6)	2.6	(1.0)	3.9	(1.0)	4.2	(1.2)	6.3	(1.2)	5.4	(1.0)
Kluatantan	2.3	(1.1)	0.6	(0.7)	0.6	(0.4)	0.7	(0.5)	0.5	(0.4)	0.2	(0.2)	0.2	(0.3)	0.2	(0.3)	0.5	(0.4)
Kluayaz_Cr	4.4	(1.3)	3.7	(1.7)	0.7	(0.4)	1.5	(0.7)	1.6	(0.6)	2.1	(0.5)	1.4	(0.7)	2.0	(0.6)	0.9	(0.4)
Kuldo_C	4.0	(1.0)	2.2	(1.4)	2.3	(0.7)	1.8	(0.6)	3.7	(0.9)	1.6	(0.5)	0.7	(0.5)	0.6	(0.4)	0.7	(0.4)
Kitsumkalum	**8.4**	**(1.3)**	**12.2**	**(2.0)**	**14.2**	**(1.1)**	**13.6**	**(1.3)**	**15.3**	**(1.1)**	**25.0**	**(1.3)**	**18.9**	**(1.3)**	**16.8**	**(1.3)**	**17.8**	**(1.2)**
Morice	28.3	(2.0)	24.7	(2.6)	30.3	(1.4)	25.2	(1.4)	23.5	(1.4)	24.6	(1.3)	28.5	(1.5)	32.4	(1.5)	33.2	(1.5)
Nangeese_R	0.5	(0.6)	0.5	(0.7)	0.2	(0.2)	0.8	(0.6)	0.1	(0.2)	0.2	(0.3)	0.3	(0.4)	0.2	(0.2)	0.1	(0.2)
Otsi_Cr	2.6	(1.1)	2.5	(1.2)	1.1	(0.5)	1.0	(0.5)	1.7	(0.6)	0.5	(0.4)	1.9	(0.8)	1.0	(0.5)	0.2	(0.2)
Shegunia_R	1.5	(0.8)	1.0	(1.0)	0.0	(0.1)	0.4	(0.3)	0.2	(0.3)	0.7	(0.3)	0.3	(0.3)	0.4	(0.3)	0.3	(0.4)
Sicintine_R	0.1	(0.2)	0.1	(0.3)	0.2	(0.2)	0.2	(0.2)	0.1	(0.2)	0.3	(0.2)	0.3	(0.2)	0.2	(0.2)	0.1	(0.2)
Slamgeesh	4.8	(1.3)	6.8	(2.0)	2.7	(0.9)	5.8	(1.4)	6.8	(1.3)	2.7	(0.8)	2.7	(1.2)	3.6	(1.0)	1.5	(0.6)
Squingula_R	3.7	(1.0)	4.9	(1.7)	3.2	(0.8)	3.1	(0.8)	3.0	(0.8)	2.6	(0.7)	1.9	(0.8)	2.1	(0.7)	4.3	(0.8)
Suskwa	0.2	(0.3)	1.2	(0.8)	0.7	(0.3)	1.1	(0.4)	1.4	(0.5)	0.8	(0.3)	1.4	(0.5)	0.2	(0.2)	2.9	(0.6)
Sustut	3.5	(0.8)	2.6	(1.0)	1.6	(0.4)	2.7	(0.5)	3.8	(0.6)	1.7	(0.4)	2.2	(0.5)	1.9	(0.5)	2.0	(0.4)
Sweetin	0.9	(0.9)	1.3	(1.3)	5.0	(1.1)	4.9	(1.2)	2.3	(0.9)	2.5	(0.8)	3.2	(0.9)	4.1	(1.0)	1.8	(0.7)
Thomas_Cr	3.2	(0.8)	2.5	(1.0)	3.4	(0.6)	3.9	(0.7)	5.1	(0.7)	5.5	(0.7)	3.5	(0.6)	3.7	(0.7)	4.1	(0.6)
Zymogotitz_R	0.5	(0.4)	0.7	(0.6)	0.0	(0.1)	0.5	(0.2)	1.2	(0.4)	0.3	(0.2)	0.8	(0.3)	0.2	(0.2)	0.0	(0.1)

SD = standard deviation

Table 2 continued.

Data are presented as percent of the annual catch at Tyee by stock.

Year	2006		2007		2008		2009		2010		2011		2012	
Sample size	1071		1122		1198		1155		847		907		497	
Stock	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Babine	8.9	(1.3)	10.8	(1.4)	8.9	(1.2)	7.1	(1.2)	7.6	(1.4)	3.7	(1.1)	9.2	(1.5)
Bear	2.9	(1.1)	2.4	(1.0)	5.3	(1.1)	9.7	(1.4)	7.1	(1.4)	5.4	(1.1)	5.5	(1.4)
Bulkley_Early	2.3	(0.5)	1.0	(0.3)	0.9	(0.3)	1.1	(0.3)	1.3	(0.5)	2.5	(0.5)	2.8	(0.8)
Cedar_Early	0.1	(0.2)	0.0	(0.1)	0.4	(0.2)	1.1	(0.3)	0.4	(0.3)	0.2	(0.2)	0.6	(0.6)
Ecstall	1.7	(0.4)	2.4	(0.5)	1.8	(0.4)	2.7	(0.5)	1.8	(0.4)	1.5	(0.4)	0.6	(0.4)
Exchamsiks	1.9	(0.6)	0.5	(0.5)	0.7	(0.4)	1.4	(0.5)	0.9	(0.5)	0.4	(0.4)	0.3	(0.5)
Exstew_R	2.5	(0.8)	2.0	(0.5)	1.7	(0.7)	1.2	(0.4)	1.6	(0.6)	1.5	(0.6)	1.7	(0.9)
Fiddler_Cr	0.2	(0.2)	0.4	(0.3)	0.3	(0.3)	0.1	(0.2)	0.1	(0.2)	0.0	(0.1)	0.9	(0.7)
Gitnadoix	0.6	(0.7)	2.0	(0.6)	2.9	(0.7)	1.2	(0.5)	0.8	(0.5)	0.8	(0.5)	1.6	(0.9)
Kasiks_R	0.9	(0.6)	0.2	(0.2)	0.3	(0.3)	0.4	(0.4)	0.2	(0.3)	0.1	(0.2)	1.1	(0.8)
Khyex_R	0.8	(0.3)	1.5	(0.4)	0.3	(0.2)	0.1	(0.1)	0.8	(0.3)	0.5	(0.3)	0.6	(0.4)
Kispiox	4.2	(1.4)	4.9	(1.4)	3.9	(1.2)	6.7	(1.4)	2.8	(1.2)	1.9	(1.1)	0.9	(1.0)
Kitseguecla_R	0.1	(0.2)	1.9	(0.5)	0.8	(0.4)	0.6	(0.4)	1.1	(0.5)	0.2	(0.2)	0.1	(0.4)
Kitwanga	7.4	(1.4)	4.5	(1.1)	7.8	(1.3)	3.1	(1.0)	4.1	(1.1)	5.6	(1.3)	6.8	(1.9)
Kluatantan	0.2	(0.3)	1.6	(0.6)	0.9	(0.6)	0.1	(0.2)	0.7	(0.4)	0.3	(0.4)	1.7	(1.0)
Kluayaz_Cr	1.8	(0.7)	0.7	(0.4)	0.7	(0.5)	0.7	(0.5)	1.0	(0.7)	1.4	(0.6)	1.4	(0.8)
Kuldo_C	0.8	(0.5)	2.7	(0.7)	2.1	(0.7)	0.8	(0.4)	0.5	(0.4)	0.5	(0.5)	0.4	(0.5)
Kitsumkalum	**13.7**	**(1.3)**	**17.5**	**(1.3)**	**13.1**	**(1.1)**	**12.4**	**(1.1)**	**12.7**	**(1.3)**	**21.0**	**(1.4)**	**26.0**	**(2.0)**
Morice	27.7	(1.5)	23.5	(1.4)	21.9	(1.3)	30.3	(1.4)	29.7	(1.7)	39.6	(1.7)	18.1	(1.8)
Nangeese_R	0.1	(0.2)	0.2	(0.3)	0.1	(0.2)	0.2	(0.2)	0.7	(0.5)	0.1	(0.1)	0.2	(0.4)
Otsi_Cr	0.2	(0.3)	0.3	(0.4)	2.4	(0.7)	1.7	(0.6)	3.0	(1.0)	1.0	(0.5)	0.3	(0.4)
Shegunia_R	0.7	(0.4)	0.6	(0.4)	0.5	(0.4)	0.2	(0.2)	0.7	(0.5)	0.1	(0.2)	1.8	(0.8)
Sicintine_R	0.1	(0.1)	0.1	(0.2)	0.6	(0.4)	1.3	(0.4)	0.3	(0.3)	0.0	(0.1)	0.3	(0.3)
Slamgeesh	4.6	(1.1)	4.3	(1.2)	5.2	(1.2)	3.0	(0.9)	4.8	(1.3)	1.7	(0.8)	5.0	(1.5)
Squingula_R	2.4	(0.8)	1.9	(0.7)	5.6	(0.9)	3.7	(0.8)	2.7	(0.9)	0.3	(0.4)	2.9	(1.1)
Suskwa	1.6	(0.5)	1.2	(0.4)	0.7	(0.3)	0.2	(0.2)	1.4	(0.5)	2.0	(0.6)	1.9	(0.9)
Sustut	2.1	(0.5)	2.3	(0.5)	1.7	(0.4)	1.9	(0.4)	1.3	(0.5)	0.9	(0.4)	1.0	(0.5)
Sweetin	3.6	(1.0)	3.7	(1.3)	4.4	(1.0)	3.9	(1.1)	4.7	(1.1)	0.7	(0.6)	1.8	(1.0)
Thomas_Cr	4.9	(0.8)	4.6	(0.7)	3.6	(0.6)	3.0	(0.6)	4.7	(0.8)	5.6	(0.8)	4.3	(1.0)
Zymogotitz_R	0.8	(0.4)	0.2	(0.2)	0.7	(0.3)	0.1	(0.1)	0.5	(0.3)	0.6	(0.4)	0.2	(0.3)

SD = standard deviation

Table 3. Preliminary escapement estimates for the aggregate of Skeena River Chinook salmon populations caught at Tyee 1984 to 2012.

Year	Kitsumkalum mark-recapture Estimate	CV of Kitsumkalum mark-recapture estimate	Weighted Proportion of Kitsumkalum at Tyee from DNA	CV of Kitsumkalum proportion	Total Skeena Chinook Estimate	CV of Skeena Estimate
1984	12,408	19.9%	20.9%	15.1%	59,248	25.0%
1985	8,304	5.9%	20.2%	12.4%	41,175	13.7%
1986	9,109	5.9%	23.3%	14.7%	39,051	15.9%
1987	23,657	10.1%	14.9%	14.3%	158,774	17.5%
1988	22,267	6.9%	21.2%	10.5%	105,196	12.6%
1989	17,925	7.2%	21.9%	10.5%	81,822	12.8%
1990	17,406	6.4%	21.2%	11.3%	82,043	13.0%
1991	9,288	7.2%	17.3%	11.7%	53,640	13.7%
1992	12,437	8.1%	10.8%	20.7%	114,726	22.3%
1993	14,059	5.5%	10.9%	16.1%	129,349	17.1%
1994	12,629	9.5%	14.6%	13.4%	86,368	16.4%
1995	7,221	10.1%	10.6%	22.3%	67,996	24.5%
1996	12,776	16.7%	9.1%	11.1%	141,135	20.0%
1997	5,342	11.3%	8.4%	15.9%	63,657	19.5%
1998	11,065	6.8%	12.2%	16.6%	90,460	17.9%
1999	9,763	8.9%	14.2%	7.9%	68,763	11.9%
2000	14,722	8.2%	13.6%	9.5%	107,859	12.5%
2001	23,839	9.5%	15.3%	7.4%	155,474	12.1%
2002	23,849	11.4%	25.0%	5.3%	95,442	12.6%
2003	23,608	11.0%	18.9%	6.9%	124,818	13.0%
2004	25,767	10.2%	16.8%	7.8%	153,065	12.8%
2005	15,046	9.2%	17.8%	7.0%	84,470	11.6%
2006	12,368	14.5%	13.7%	9.3%	90,434	17.2%
2007	15,736	18.0%	17.5%	7.5%	89,995	19.5%
2008	10,374	14.2%	13.1%	8.2%	79,333	16.4%
2009	10,703	13.3%	12.4%	13.3%	86,476	18.8%
2010	13,712	14.8%	12.7%	10.2%	107,601	18.0%
2011	12,059	20.2%	21.0%	6.8%	57,446	21.3%
2012	9,363	13.9%	26.0%	7.8%	36,006	16.0%

CV = coefficient of variation.

FIGURES

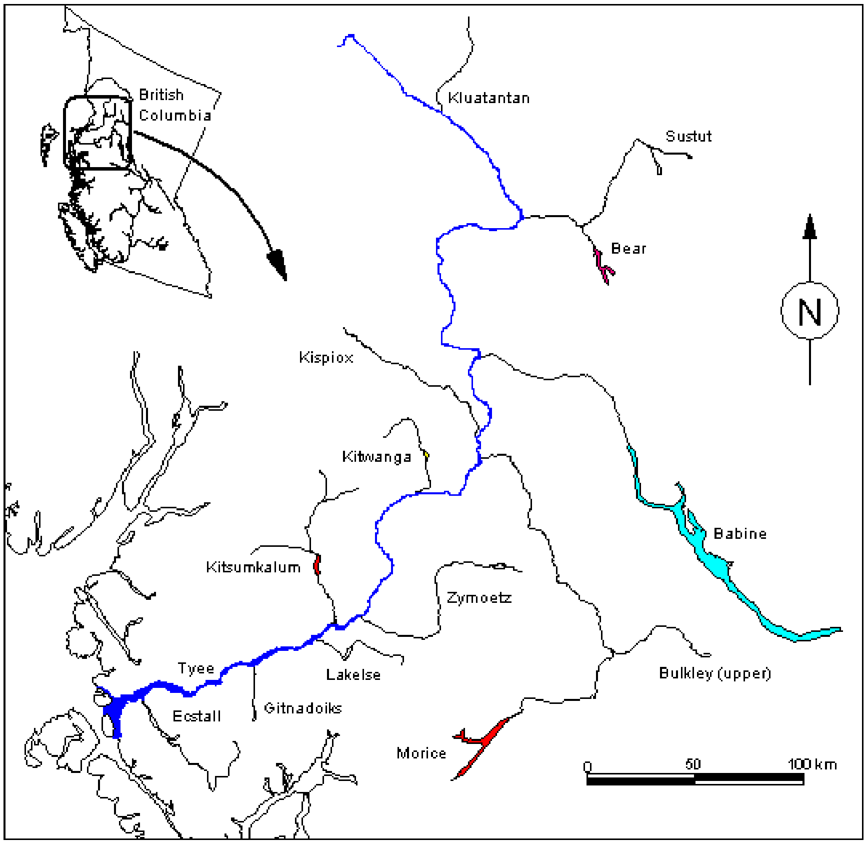

Figure 1. The Skeena River watershed in northern British Columbia showing the largest tributaries and the location of Tyee.

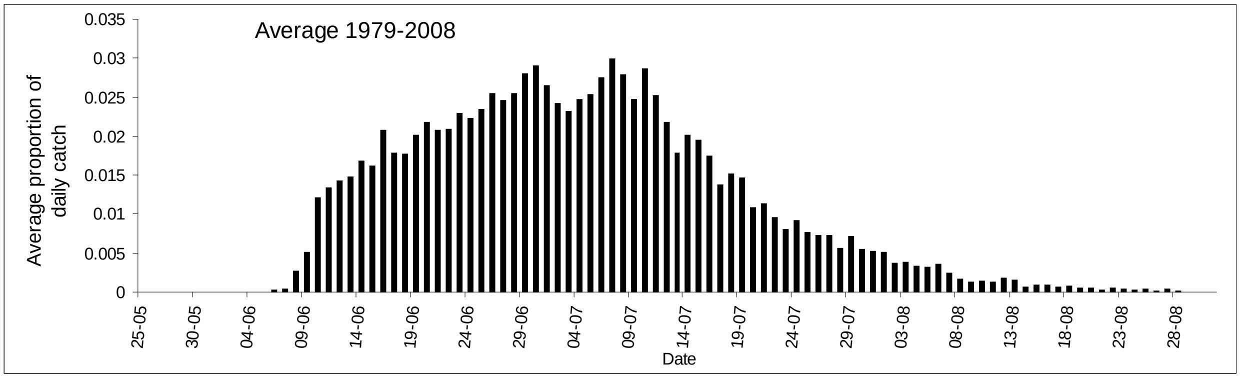

Figure 2. Skeena River Chinook salmon run timing past Tyee as measured by the average proportion of daily catch at the Tyee Test Fishery from 1979 to 2008.

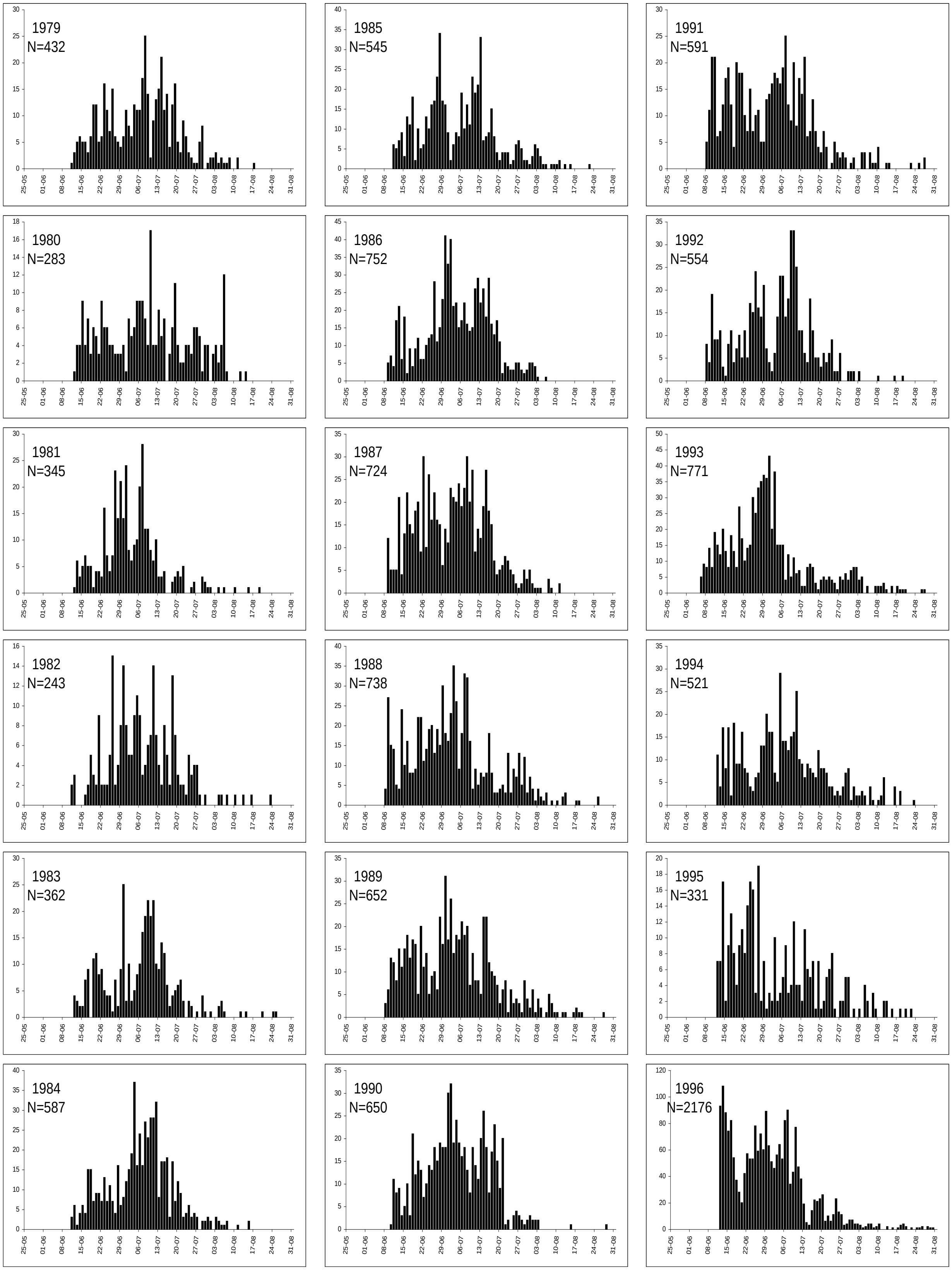

Figure 3. Skeena River Chinook salmon daily catch at the Tyee Test fishery for 1979 to 2012. (1979 to 1996)

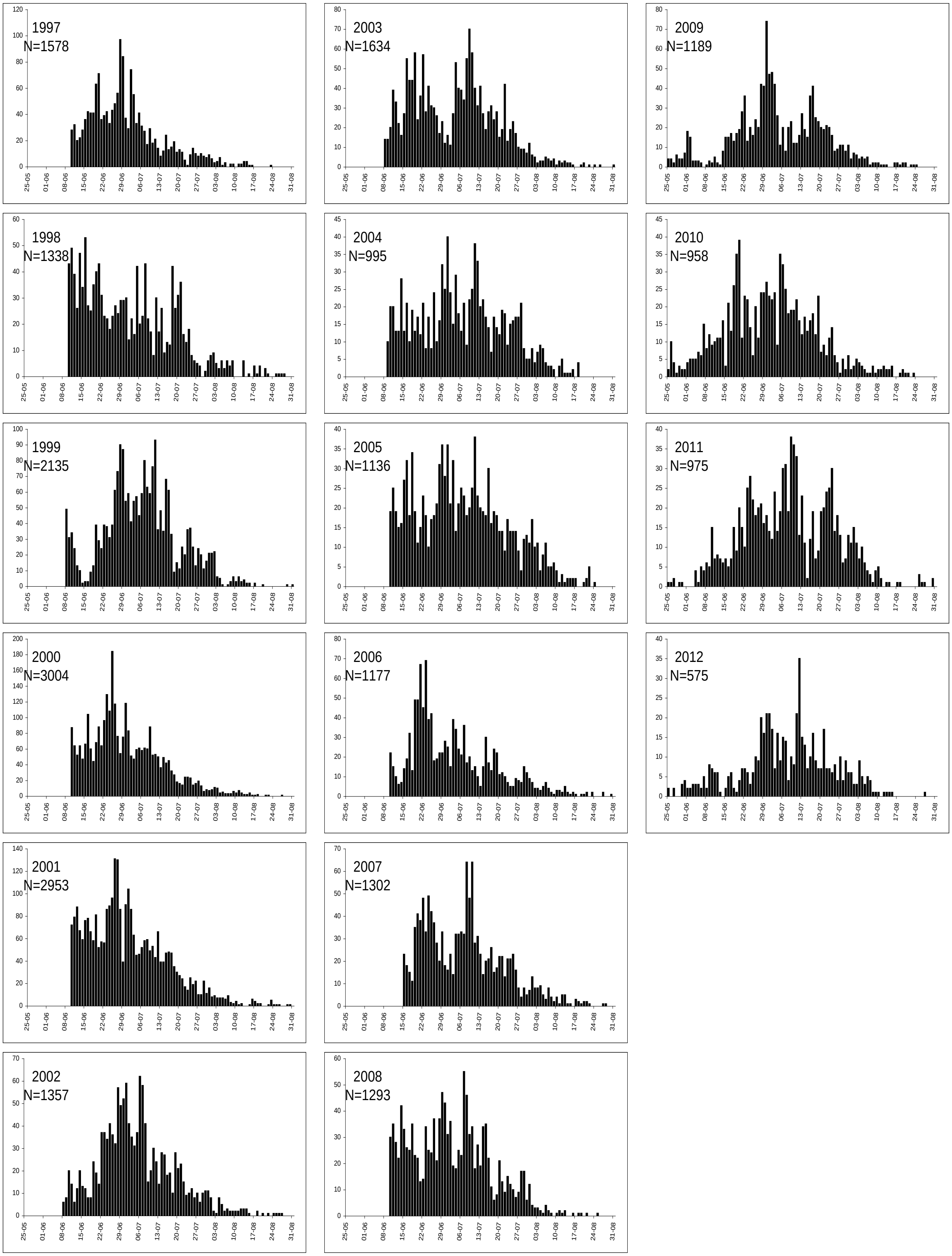

Figure 3. Continued (1997 to 2012).

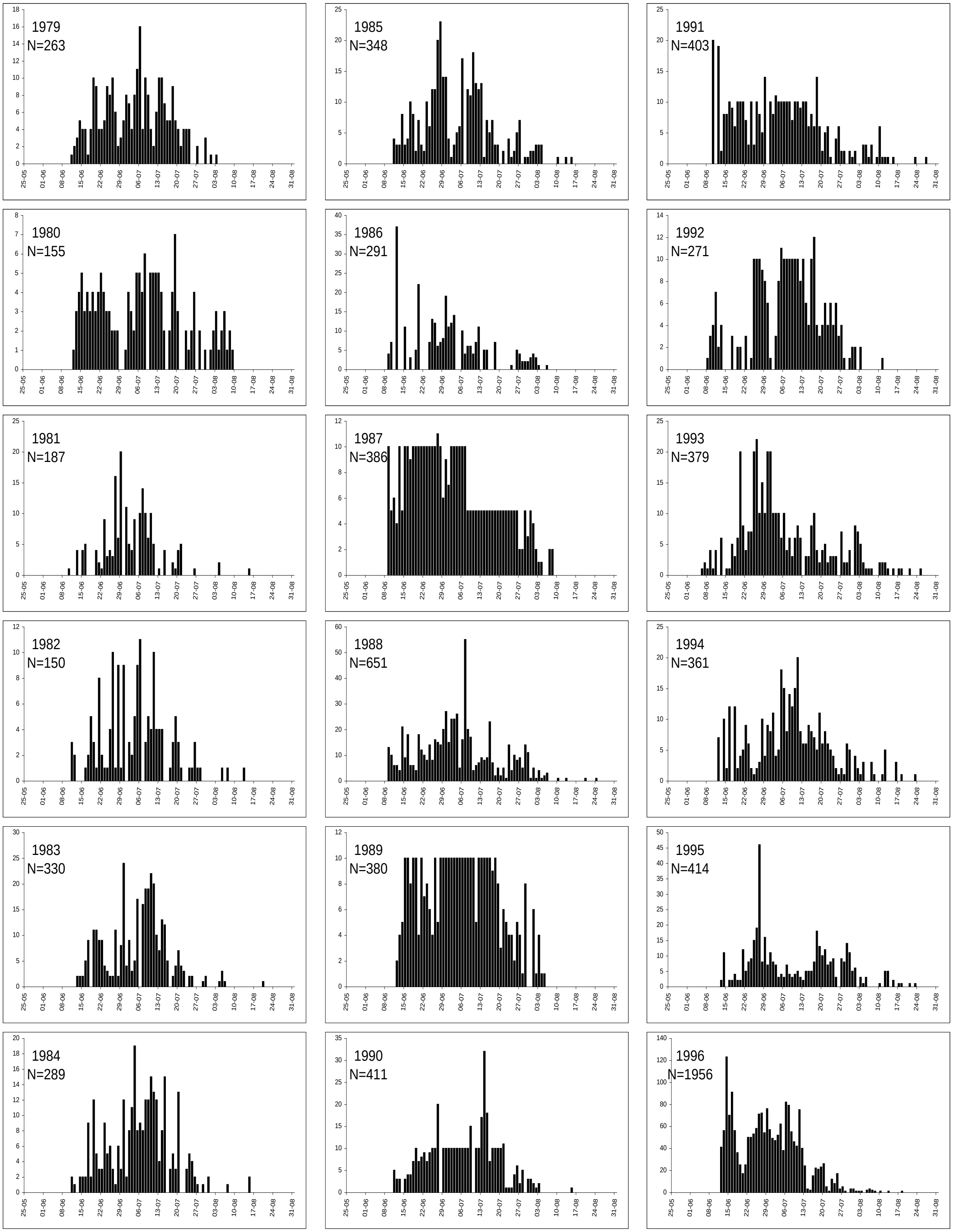

Figure 4. Daily samples of Skeena River Chinook salmon catch at the Tyee Test fishery from 1979 to 2012.

(1979 to 1996)

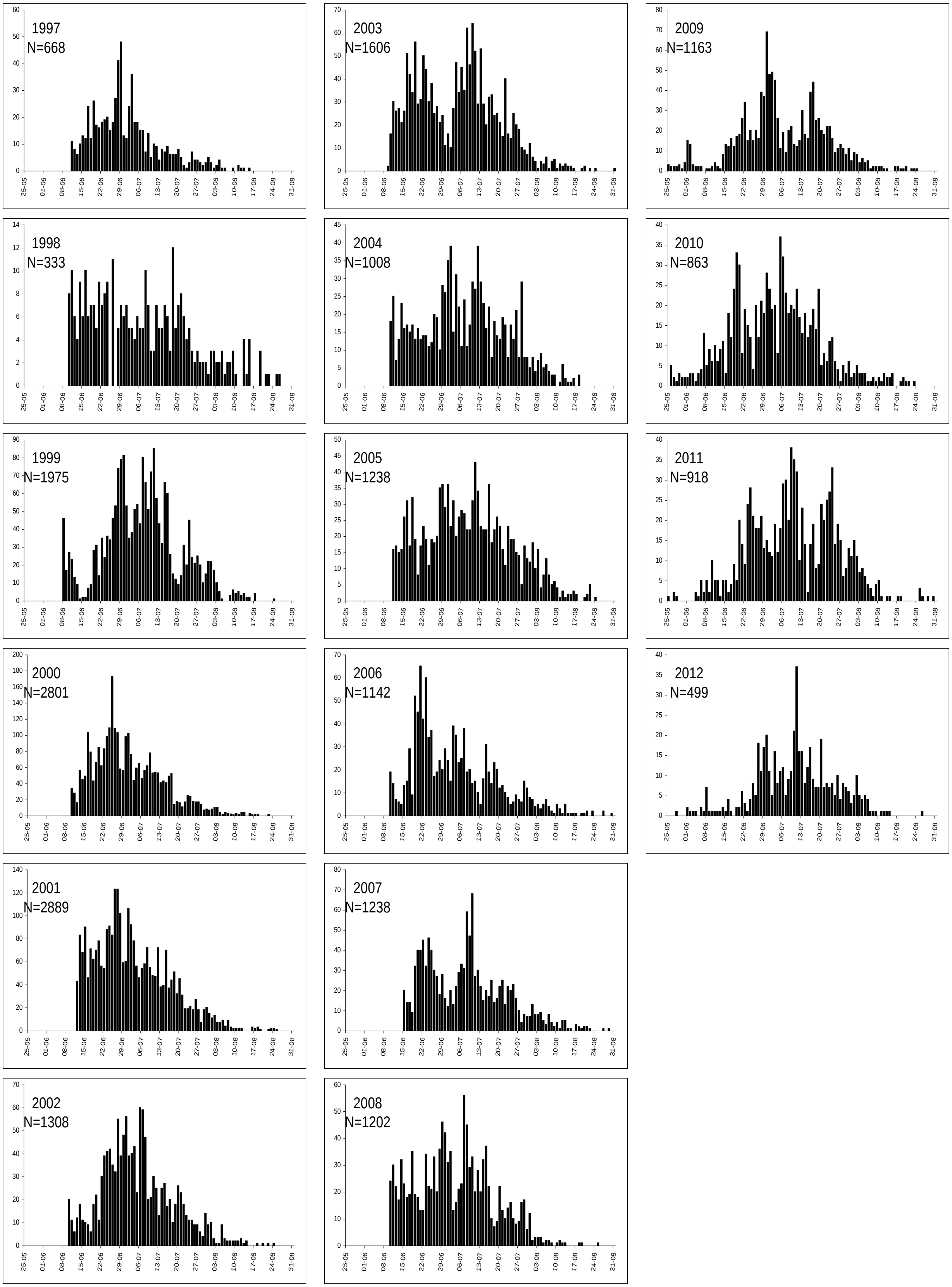

Figure 4. Continued (1997 to 2012).

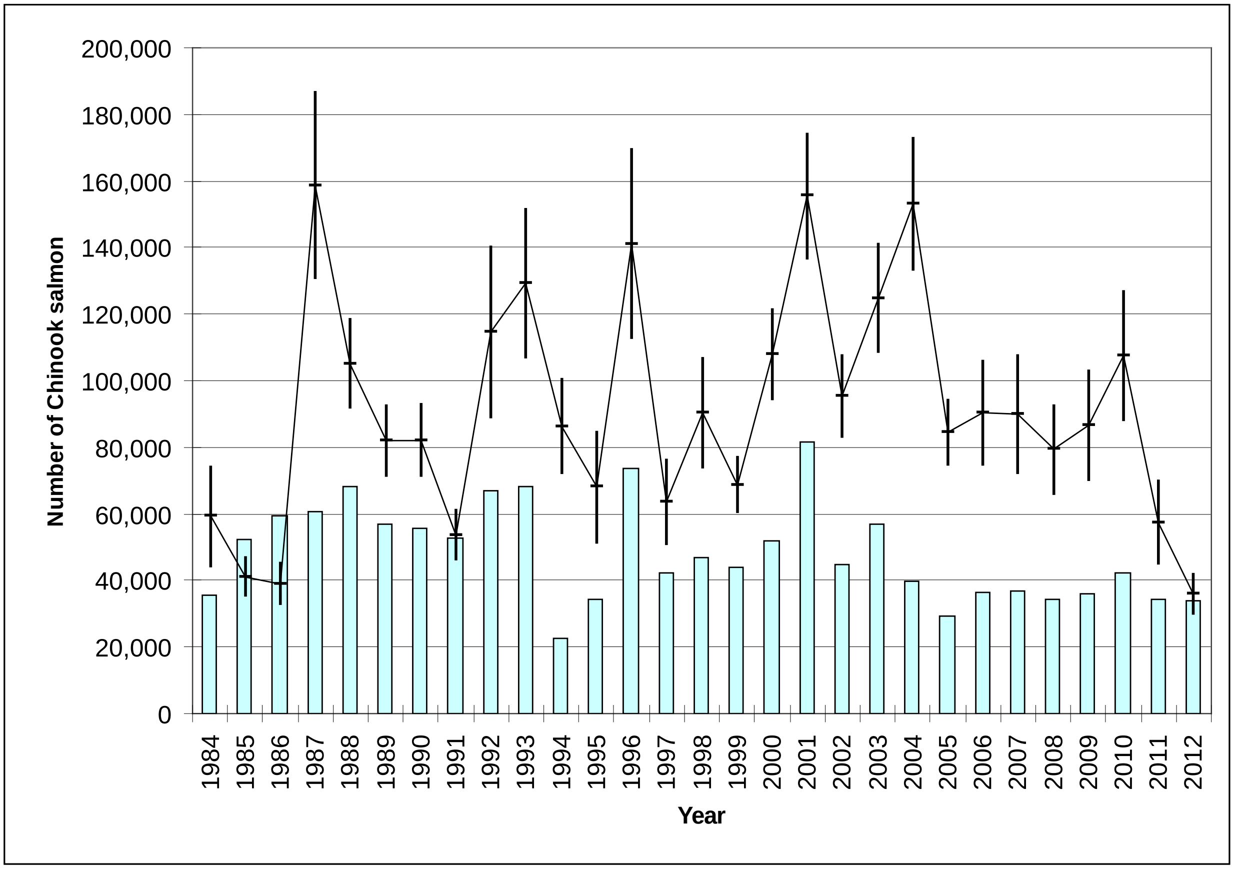

Figure 5. Comparison of the number of Chinook salmon estimated past Tyee using the genetic approach with the Skeena Chinook escapement index.

The bars represent the Skeena Chinook escapement index. The crosses represent the estimates generated using the genetic approach. The vertical lines represent the genetic estimates plus and minus one standard deviation.

APPENDICES

Appendix 1. Skeena Chinook baseline used in the 2012 genetic analyses.

Stock name	Year	Locus specific N															Maximum
		1b	i1	3g	a1	go2	go4	oke	oki	omy	ots2	ots 201b	ots 211	ots 213	ots9	sa	
Babine	2010	179	179	179	178	178	178	178	177	179	179	178	178	179	179	178	179
Babine	2011	19	19	19	19	19	19	19	18	19	18	19	18	19		18	19
Bear	1991	88	91	86	92	90	99	99	96	90	90	22	28	15	94	95	99
Bear	1995	13	17	10	11	15	19	18	20	15	19	22	20	23	21	23	23
Bear	1996	50	50	47	50	51	53	52	52	45	51	50	49	50	51	52	53
Bear	2005	5	5	5	4	5	5	5	5	5	5	5	5	4	5	5	5
Bear	2012	91	91	91	89	91	91	91	91	91	89	91	91	92	90	92	92
Bulkley_Early	1991	92	93	87	92	91	109	110	111	81	91	93	91	93	94	111	111
Bulkley_Early	1996	11	20	28	11	68	1	23	28		65				88	4	88
Bulkley_Early	1998	197	197	181	189	208	206	206	204	204	198	6	6	6	204	208	208
Bulkley_Early	1999	135	136	121	141	142	131	131	129	139	121	269	271	250	139	124	271
Cedar_Early	1996	114	111	110	109	112	114	116	116	106	114	108	115	111	115	116	116
Ecstall	1995	10	11	10	9	13	7	15	14	9	11				10	16	16
Ecstall	2000	39	41	36	34	40	35	23	36	35	39	63	58	62	42	29	63
Ecstall	2001	64	66	66	65	64	62	63	61	62	64	60	61	60	66	64	66
Ecstall	2002	60	58	59	60	58	60	59	58	59	57	74	79	68	57	56	79
Ecstall	2003	103	104	102	98	101	104	102	99	105	103				104	106	106
Exchamsiks	1995	4		6	7		8	9	9	9	4	8	7	7	9	11	11
Exchamsiks	2009	105	103	105	105	103	103	103	105	102	101	102	103	101	99	104	105
Exstew_R	2009	138	138	138	134	138	138	135	137	136	136	138	138	139	136	138	139
Fiddler_Cr	2010	109	109	109	109	109	109	108	106	109	109	111	110	113	109	109	113
Gitnadoix	1995	13		12	14		12	19	17	18	15	11	8	11	24	22	24
Gitnadoix	2002	22	22	22	22	22	22	18	22	22	22	9	13	13	22	21	22
Gitnadoix	2003	19	19	19	19	18	18	19	20	19	19				19	20	20
Gitnadoix	2009	168	170	171	171	172	166	170	173	163	170	163	168	172	170	172	173
Kasiks_R	2009	62	61	62	61	59	59	62	61	61	61	62	62	62	63	62	63
Khyex_R	2010	35	37	35	37	37	37	37	37	37	37	36	36	37	36	37	37
Kispiox	1979	1	3			3	3	2	3	3	3				3	3	3
Kispiox	1985	21	24	9	19	23	24	24	19	12	26				26	20	26
Kispiox	1989	15	21	6	18	16	19	20	20	9	21				21	17	21
Kispiox	1991	13	17	3	9	16	17	19	11	15	17				17	17	19
Kispiox	1995	18		17	18		24	21	22	22	18	15	16	14	14	25	25
Kispiox	2004	61	60	61	59	61	57	61	59	61	61	61	62	62	61	62	62
Kispiox	2006	28	28	28	28	27	28	25	26	28	28	28	26	28	28	28	28
Kispiox	2008	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Kispiox	2010	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8
Kitseguecla_R	2009	258	255	258	253	256	258	254	246	257	260	259	255	258	259	258	260

Appendix 1. continued.

Stock name	Year	Locus specific N															Maximum
		1b	i1	3g	a1	go2	go4	oke	oki	omy	ots2	ots 201b	ots 211	ots 213	ots9	sa	
Kitsumkalum_R	1991	153	152	139	143	142	177	176	177	143	153				151	180	180
Kitsumkalum_R	1995	17	18	13	19	16	13	22	21	21	19				18	22	22
Kitsumkalum_R	1996	41	42	41	41	41	41	41	42	39	42	42	42	42	40	42	42
Kitsumkalum_R	1998	172	171	86	170	166	167	167	151	169	165	84	49	85	172	173	173
Kitsumkalum_R	2001	219	219	217	217	218	213	215	192	214	211	282	318	283	218	214	318
Kitsumkalum_R	2009	200	195	199	198	194	197	197	197	198	197	193	199	198	199	200	200
Kitwanga	1991	88	91	85	87	93	92	95	95	78	87				88	93	95
Kitwanga	1996	14	18	13	18	18	19	19	19	16	17	17	19	17	17	19	19
Kitwanga	2002	68	51	64	62	49	69	68	67	68	56	69	70	66	58	68	70
Kitwanga	2003	88	84	78	78	84	80	88	64	64	69	100	97	96	85	83	100
Kluatantan	2006	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7
Kluatantan	2008	8	9	6	9	9	9	9	9	4	9	2	6		9	9	9
Kluatantan	2009	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	14
Kluatantan	2010	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Kluayaz_Cr	2007	85	86	85	86	86	85	85	86	86	84	86	85	86	83	86	86
Kluayaz_Cr	2008	19	18	18	21	21	20	18	22	19	20	19	21	20	20	19	22
Kluayaz_Cr	2009	50	50	50	50	49	50	50	50	49	50	49	48	50	50	49	50
Kluayaz_Cr	2010	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Kuldo_C	2008	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Kuldo_C	2009	166	162	165	166	164	167	168	168	168	167	168	158	168	166	168	168
Kuldo_C	2010	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1
Morice_R	2010	82	82	82	82	82	81	82	81	82	81	82	82	82	81	82	82
Morice_R	2011	158	156	160	155	157	160	154	156	157	154	160	160	155	152	155	160
Nangeese_R	2010	29	31	30	32	32	32	32	32	29	30	28	30	29	30	31	32
Otsi_Cr	2007	30	30	30	30	30	30	30	30	30	29	30	30	30	29	28	30
Otsi_Cr	2008	48	56	50	53	58	52	53	53	52	52	55	54	53	56	54	58
Otsi_Cr	2009	107	106	107	106	106	105	107	105	107	107	107	107	107	107	103	107
Otsi_Cr	2010	69	69	69	69	69	69	68	69	69	68	49	69	69	68	69	69
Otsi_Cr	2011	6	5	6	5	5	6	6	6	6	5	5	5	6		6	6
Shegunia_R	2009	79	79	79	78	79	77	78	79	79	79	78	77	79	78	75	79
Shegunia_R	2010	51	52	51	53	53	51	53	53	51	52	50	52	50	53	52	53
Sicintine_R	2009	110	110	111	108	110	109	109	106	107	111	109	108	108	111	111	111
Sicintine_R	2010	202	202	204	205	203	202	203	203	202	206	206	203	204	205	205	206
Slamgeesh	2004	34	32	34	34	34	32	34	31	34	34	33	33	34	34	34	34
Slamgeesh	2005	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
Slamgeesh	2006	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Slamgeesh	2007	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Slamgeesh	2008	18	18	18	18	18	18	18	18	17	18	17	18	18	18	18	18
Slamgeesh	2009	49	49	49	49	49	49	49	47	49	49	48	49	48	49	49	49
Squingula_R	2008	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Squingula_R	2009	266	264	267	262	263	263	268	263	265	259	261	256	263	261	260	268

Appendix 1. continued.

Stock name	Year	Locus specific N															Maximum
		1b	i1	3g	a1	go2	go4	oke	oki	omy	ots2	ots 201b	ots 211	ots 213	ots9	sa	
Suskwa	2004	20	20	19	20	19	16	21	21	20	20	13	19	14	20	20	21
Suskwa	2005	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
Suskwa	2009	81	79	79	83	76	77	77	76	74	78	74	77	76	75	77	83
Suskwa	2010	1	2	1	2	2	2	2	2	1	2	1	2	2	2	2	2
Sustut	1995	28		28	28		28	34	36	25	28	26	28	26	30	37	37
Sustut	1996	36	36	20	32	35	35	37	23	36	35	18	18	18	33	34	37
Sustut	1999	78	85	73	85	83	84	83	83	88	83	87	63	87	90	87	90
Sustut	2001	177	175	181	183	181	190	182	174	187	168	152	148	149	177	197	197
Sustut	2002	42	44	43	43	43	46	36	43	42	39	46	45	47	38	40	47
Sustut	2003					3					4				5		5
Sustut	2005	47	47	47	46	47	46	44	46	47	46	47	40	44	46	46	47
Sustut	2006	48	48	48	48	48	47	44	46	48	48	48	42	45	48	48	48
Sweetin	2004	43	42	42	41	41	40	41	38	43	43	42	44	42	44	43	44
Sweetin	2005	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sweetin	2008	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sweetin	2010	180	181	180	181	181	181	181	180	179	180	180	180	180	179	180	181
Thomas_Cr	2003	2	2	2	2	2	2	2	2	2	2				2	2	2
Thomas_Cr	2004	19	19	21	20	21	19	21	20	16	20	21	21	21	19	21	21
Thomas_Cr	2009	32	32	31	31	32	30	32	31	32	32	31	31	31	32	31	32
Thomas_Cr	2010	62	62	61	62	62	60	62	61	62	62	60	61	61	61	61	62
Zymogotitz_R	2006	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Zymogotitz_R	2009	116	119	116	116	119	118	117	116	118	117	115	116	115	116	119	119

Appendix 2. Comparison of 2012 retrospective project results with the objectives identified in the proposal to the Pacific Salmon Commission's Sentinel Stocks Program.

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

   The coefficients of variation around the estimates were less than the data standard of 15% in 5 years and were greater than the data standard in 8 years of the 13 years with estimates produced by the 2012 Skeena retrospective project. Over the full time series 1984 to 2012 the coefficients of variation around the estimates were less than the data standard of 15% in 12 years and were greater than 15% in 17 years.

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 have been sampled in recent years. Component populations will be identified when baselines are finalized.

3. Meet the objectives above in 2013.

   This project has been proposed to the SSC for 2013 and further improvements to the genetic baseline for Skeena River Chinook are under way.