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Review of 2001 chinook returns to the West Coast Vancouver Island, forecast of the 2002 Return to the Stamp River / Robertson Creek Hatchery indicator stock, and outlook for other WCVI chinook stocks

Remontes du saumon quinnat sur la côte ouest de l'île de Vancouver en 2001, prévision de la remonte de 2002 du stock indicateur de la rivière Stamp et de l'écloserie du ruisseau Robertson et perspectives pour les autres stocks de saumon quinnat de la côte ouest de l'île de Vancouver

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Abstract

The intensive assessments and resulting abundance forecasts of the Robertson Creek Hatchery (RCH) and Stamp River chinook are undertaken annually for management of ocean and terminal fisheries, and as an indicator of the expected returns to the naturally spawning chinook populations along the west coast of Vancouver Island (WCVI). Forecasts presented in this paper indicate a continued conservation concern for naturally spawning WCVI chinook in 2002.

Review of return of the WCVI chinook in 2001

The terminal return of chinook to the Stamp River/RCH indicator stock was estimated to be 40,574 adult (age 3 and older) chinook, plus 4,612 age 2 males (jacks). The adult return represented a 600% increase from the 2000 return level.

Returns were monitored in another 18 WCVI streams for natural chinook spawning escapement. Changes in numbers of spawners, relative to 2000 levels, were variable. Returns for the 7 PSC indicators stocks continued to decline while returns for the other 11 extensively surveyed systems increased relative to 2000. Over all these systems, total escapement to all natural stock indicators increased by 60% from 2000 to 2001.

Forecast for the 2002 terminal return of the WCVI chinook:

The forecasting methods applied have been reviewed and accepted previously by PSARC. For 2002, the forecasted total return of Stamp River/RCH chinook to the terminal area of Barkley Sound and Alberni Inlet is estimated to be 80,300 based on averaging the forecast models. The mean absolute percent error in the average forecast (returns) is 21%. The age structure of the 2002 return is projected to be: 25% Age 3, 73% Age 4, and 2% Age 5 chinook, with an expected sex ratio of 40% females. At this time, the forecast only assumes fishing mortality in Southeast Alaska (SEAK). Harvest rate factors in SEAK were based on the Pacific Salmon Treaty agreements and we initially used a harvest rate scalar of 0.755 in SEAK troll fishery. The remaining cohort is identified as the expected terminal run assuming no fishing mortality on this stock in Canada.

Overall, returns are expected to increase by more than 500% relative to 2001, due to the expected large age 4 component. The number of females predicted in the terminal run is 31,800, which would result in 127 million egg deposition for the Stamp River/RCH, double the base period level.

A slightly larger terminal run is predicted if the forecast is expressed as a cumulative probability distribution. Based on the annual deviations from forecasts observed between 1988 and 2001, the 50% value of the cumulative distribution is 82,500 chinook in the terminal run and the 50% confidence interval is 66,000 - 96,100 adult chinook (Appendix Figure 3). However, given that this distribution is based on only 14 years of observations, the authors recommend continuing with past methods and applying the average forecast model that predicts 80,300 adult chinook.

The more serious concern for conservation is the expected run size to the naturally spawning chinook populations along the WCVI. The 2002 outlook in the WCVI indicator streams assumes a 90% increase from 2001 levels and expected 40% female component in the total return. However, the results show some chinook populations along the WCVI with less than 100 females (Table 10).

Résumé

Chaque année, le saumon quinnat de l'écloserie du ruisseau Robertson et de la rivière Stamp fait l'objet d'évaluations intensives et de prévisions de l'abondance, utilisées dans la gestion des pêches en mer et en estuaire, mais aussi comme indices prévisionnels des remontes des populations sauvages le long de la côte ouest de l'île de Vancouver (COIV). Les prévisions présentées dans ce document indiquent que la conservation de ces dernières populations est encore une source de préoccupation en 2002.

<u>Remontes du saumon quinnat sur la COIV en 2001</u>

La remonte de saumon quinnat du stock indicateur de la rivière Stamp et de l'écloserie du ruisseau Robertson en 2001 a été estimée à 40 574 adultes (âgés de 3 ans ou plus) et à 4 612 mâles de deux ans (madeleineaux). La remonte des adultes était de 600 % plus élevée qu'en 2000.

Les remontes ont été surveillées dans 18 autres cours d'eau de la COIV pour évaluer l'échappée de saumons sauvages. Les différences dans le nombre de géniteurs, par rapport à 2000, étaient variables. Les remontes des sept stocks indicateurs de la CSP ont continué à baisser, tandis que les remontes des onze autres stocks étroitement surveillés ont augmenté en 2001. Pour l'ensemble de ces stocks indicateurs naturels, l'échappée totale a augmenté de 60 % de 2000 à 2001.

<u>Prévision de la remonte du saumon quinnat de la COIV en 2002</u>

Le Comité d'examen des évaluations scientifiques du Pacifique (CEESP) a déjà passé en revue et accepté les méthodes de prévision appliquées. En faisant la moyenne des résultats des modèles de prévision, on prévoit que la remonte de quinnats de la rivière Stamp et de l'écloserie du ruisseau Robertson au fond des baies Barkley et Alberni atteindra 80 300 poissons en 2002. L'erreur moyenne absolue en pourcentage de la prévision moyenne (de remontes) se chiffre à 21 %. Pour 2002, on prévoit une remonte composée de 25 %, 73 % et 2 % d'individus âgés respectivement de trois, quatre et cinq ans, avec 40 % de femelles. À ce moment, la prévision suppose qu'il n'y a mortalité par pêche que dans le sud-est de l'Alaska. Les taux de capture dans cette région sont fondés sur les ententes conclues dans le cadre du Traité sur le saumon du Pacifique. Nous avons utilisé au départ un taux de capture scalaire de 0,755 pour la pêche à la traîne dans le sud-est de l'Alaska. La cohorte restante est considérée comme la remonte attendue si le stock ne subit aucune mortalité par pêche au Canada.

Globalement, on s'attend à ce que les remontes de 2002 se chiffrent à plus de 500 % des valeurs de 2001, en raison de la forte abondance prévue de la classe d'âge de quatre ans. On prévoit que le nombre de femelles dans la remonte sera de 31 800, ce qui entraînerait une ponte de 127 millions d'œufs pour le stock de la rivière Stamp et de l'écloserie du ruisseau Robertson, soit le double du niveau de la période de base.

La remonte prévue est légèrement supérieure lorsque la prévision est exprimée sous forme d'une distribution de probabilité cumulative. D'après les écarts annuels observés de 1988 à 2001 par rapport aux prévisions, la remonte au niveau de distribution de 50 % se chiffre à 82 500 quinnats, tandis que l'intervalle de confiance à 50 % va de 66 000 à 96 100 quinnats adultes (Annexe – Figure 3). Cependant, comme cette distribution n'est fondée que sur 14 années d'observations, les auteurs recommandent que l'on continue d'utiliser les méthodes employées jusqu'ici et que l'on applique le modèle de la prévision moyenne, qui prévoit le retour de 80 300 quinnats adultes.

Au plan de la conservation, c'est la taille prévue de la remonte des populations sauvages du saumon quinnat de la COIV qui préoccupe le plus. Les perspectives pour les stocks des cours d'eau indicateurs de la COIV en 2002 supposent une hausse de 90 % par rapport aux niveaux de 2001 et que la remonte totale sera composée à 40 % de femelles. Selon les résultats, certaines populations de saumon quinnat sur la COIV comptent moins de 100 femelles (tableau 10).

TABLE OF CONTENTS

1 Introduction

The Stamp River chinook stock is a key indicator stock for exploitation rate and distribution pattern of WCVI chinook populations. This PSARC document uses methods previously reviewed in Riddell et al (PSARC X96-01) to forecast Stamp River chinook salmon returns to Barkley Sound. This working paper includes a summary of data collection and accounting procedures used in 2001 and a forecast of the 2002 return. Historic data are not repeated but were documented in PSARC X96-01.

Since the development of Robertson Creek Hatchery (RCH) in 1971, the Stamp River system has become one of Canada's major producers of chinook salmon, with large contributions to ocean troll and sport fisheries, and stimulating the development of substantial terminal sport, native, and commercial fisheries.

Analyses of coded-wire tag (CWT) data for this stock indicate that during an average year (prior to 1995) about 50% of the stock was harvested in ocean fisheries, and 50% returned to Barkley Sound. Over half of the ocean harvest occurred in southeast Alaska fisheries (SEAK). In one year of high productivity, production of tagged chinook salmon from RCH alone, including total terminal run plus ocean catch, exceeded 500,000 chinook (1991 return year). This catch is based on expanded CWT data but does not account for incidental mortality in ocean fisheries, or natural production from the Stamp River system. Since 1995, poor marine survival of WCVI chinook, associated with El Niño events, resulted in conservation concerns and restricted ocean exploitation in Canadian fisheries.

The Somass River system is located at the head of Alberni Inlet in Barkley Sound on the west coast Vancouver Island (WCVI). Within this system, the Stamp River, which drains Great Central Lake, and the Sproat River, which drains Sproat Lake, combines to form the Somass River. Roughly half way up the Stamp River are a set of impassable falls, Stamp Falls. A fishway constructed to circumvent the falls are the basis for counting escapement into the upper Stamp River. Historically, naturally spawning chinook were present in the lower Stamp below Stamp Falls, the Sproat River, and the Somass River mainstem. These areas were generally poorly enumerated. However, since the development of RCH on the upper Stamp River, the majority of the spawners are now located in the upper Stamp River.

An interim spawning escapement goal (to guide chinook rebuilding) was established in 1988 based on escapements immediately prior to the 1985 Pacific Salmon Treaty (PST), including:

- 70,000 naturally spawning chinook (or double the estimated 35,000 adult spawners),
- 15,000 chinook for 10 million eggs into RCH, plus a
- 20% increment to account for prespawn mortality.

However, this goal could not be achieved in recent years due to poor marine survival. Consequently, since 1995, the escapement after ocean fisheries was compared to escapement levels immediately prior to the PST, a period of over-exploitation for this stock. This spawner escapement level in this base period was estimated to be:

- 50 million eggs in natural inriver spawn, plus
- 9.3 million eggs for RCH,
- additional 20% increment lost through prespawn mortality

Fishing regimes in Canada have been designed with the goal of staying above this base level escapement.

2 Analytical Framework

The analytical framework for forecasting returns of Stamp River / Robertson Creek Hatchery chinook has been previously reviewed in Riddell et al (PSARC X96-01). The components of the review are described below.

2.1 Terminal Run Calculation

Assessment and forecasting for the WCVI stock group requires accurate information from the indicator stock at Stamp River / Robertson Creek Hatchery. Sampling of ocean fisheries provides CWT data to determine catch of this stock. Intensive assessment programs, including catch and escapement monitoring and sampling are conducted in the terminal area (DFO Statistical Area 23) of the indicator stock. Results of these monitoring and sampling programs are used to determine the terminal catch and escapement of the indicator stock. This is the "terminal run". This information becomes the basis for the overall assessment and forecast of WCVI chinook, and is presented in Chapter 3.

2.2 Cohort Analyses

Cohort analysis is conducted using 'estimated' CWT recoveries from the catch and escapement to determine survival rates and exploitation patterns for RCH chinook. The incorporation of in-river tag recoveries provides estimates of the true total exploitation rates not possible with most indicator stocks. The cohort model used is documented in Appendix 2 of Starr and Argue (1991) and as modified by the Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC, TCCHINOOK (99)-2). In determining incidental mortality, only the brood year method was used. The cohort model was modified by the CTC to account for the chinook non-retention fisheries implemented in Canada during 1996. Modifications are documented by the CTC in Appendix G of TCCHINOOK (99)-2.

For each brood year, information used from the cohort analyses include:

- annual distribution of catch and total fishing mortalities;
- survival of CWT groups to age 2 recruitment; and
- ocean (catch or total fishing mortality) and total exploitation rates by fishery and age.

2.3 Forecast Methodology

Forecast Models

Using the results of the cohort analysis, sibling regression models are used to forecast total production from selected tag codes (including total ocean fishing mortality plus total terminal run for brood years used in the cohort analyses). Total production was calculated by multiplying the brood releases (for the selected tag codes) by the estimated total fishing mortality exploitation rates. Tag codes used are listed in Appendix Table 4.

Two combinations of terminal run and total production data have been used in the sibling regression models. Note that the first model developed in 1995 (i.e., Prod1), based on regressing total terminal return at one age class to total terminal return at a subsequent age class is not used since constant ocean fishing mortality rates must be assumed between years.

- Model 2 (Prod2). This regression model uses total terminal return at a younger age class (independent variable) to predict total production (the surviving cohort in the ocean) of a subsequent age or ages from the same brood year. The dependent variable is the total (total ocean fishing mortality plus terminal run) production at a subsequent age or ages.

- Model 3 (Prod3). This regression model uses estimated total production (total fishing mortality plus escapement) of an age class(es) to predict total production of subsequent ages (i.e., the surviving cohort) from the same brood year.

Relationships between all possible age class combinations were examined using these two models. The actual models used for the forecast were based on the highest r^2 values. In the case where more than one age class is used, such as the total terminal run of age 2+3, the total terminal runs at age 2 and age 3 were summed. Estimates of surviving cohort include natural mortality factors and are estimated as the pre-fishery abundance of the youngest age being predicted. All regressions were forced through the origin.

Spreadsheet Model of Fishery Impacts

The level of terminal return depends on the ocean exploitation. In order to predict terminal return and escapement levels, a spreadsheet model was developed to examine effects of changes in ocean harvest rates by fishery and age. Based on forecasted ocean abundance (Chapter 4) and exploitation patterns through the previous year, the model estimates terminal runs expected this year (i) and next year (i + 1), based on projected changes to harvest rates in ocean fisheries.

Due to the multiple age classes in chinook, the forecast can be refined based on observations in the previous year within the same cohort. A ratio is calculated of total terminal return of all hatchery and wild chinook (by age and brood year) divided by the terminal return of hatchery origin chinook (by age and brood year for specified CWT groups). This ratio (or expansion scalar) is used to expand the forecast age 3, 4, and 5 cohort abundance in Table 4 to "total" production of hatchery production not associated with the CWT used in the regression analyses and "natural" production from the Stamp River. This expansion assumes that natural production from the Stamp River exhibits similar behaviour and encounters similar fishing pressure as the hatchery stock.

Other components of the spreadsheet include average total mortality exploitation rates by age and fishery, maturity rates and natural mortality rates by age; and matrices of 'fishery management scalars'. These scalars are used to simulate management actions in the fisheries. Cohorts may be harvested in ocean and terminal fisheries, and/or allowed to become spawners. The surviving immature cohort is passed on to the next age in year i+1. Age 3 cohorts for year i+1 were estimated from average or recent average age 3 survival values (derived from the cohort analysis) times the smolts released in year i-2. These values were then expanded by average brood year scalars to account for natural production.

Forecast Error

A retrospective assessment of the forecasting methodology was presented in PSARC X96-01, for years 1988 through 1995. Including the information through 2001 in this assessment produces an updated estimate of the prediction error. The assessment uses a "leave-one-out" methodology. Each regression model is re-calculated while omitting each data point (one year) once. A terminal return is estimated for each predicted value by the same method as outlined in the spreadsheet. The predicted terminal return is compared to the terminal return actually observed for that year. The error is expressed as a mean absolute percent error (MAPE) for each model or the average of the two models.

In this assessment, the forecast errors (annual deviations) are used to estimate the probability distribution for the predicted terminal run in 2002. The distribution is only based on fourteen data points through 2001 but does present the 2002 forecast within a probabilistic framework. Only the average of the two forecast models is used in developing this distribution.

2.4 WCVI Stock Status based on Escapement Indicators

The Stamp River / Robertson Creek Hatchery stock is the main indicator for the WCVI stock group. Management actions taken to achieve goals for this stock are supposed to have a similar effect on other stocks along the WCVI. To monitor changes in spawning levels of other WCVI chinook populations, an extensive survey program assesses spawner levels each year in about 20 escapement indicator stocks. The results are the basis for the overall assessment of status of WCVI chinook stocks. This assessment and status report is presented in Chapter 6.

3 Terminal Run Calculation

The detailed accounting of the terminal return into Barkley Sound (DFO Statistical Area 23) can be found in Appendix Table 1 and is summarized in Table 1 below. The conduct of the monitoring programs and results are described here.

3.1 Sport Fishery Survey

Overview of WCVI creel surveys

A creel survey was conducted along most of the WCVI from June to the end of September. The goals of the survey included, in order of priority: 1) collect catch data, CWT mark incidence, biological sampling for use in the assessment of the chinook indicator stock, 2) determine coho encounters and biological sampling for stocks of concern, and 3) determine offshore catch as required by the Pacific Salmon Treaty.

In the terminal run area, 2362 interviews (17% of the fishing effort) were conducted in Alberni Inlet and approximately 1328 interviews (7 % of the fishing effort) were conducted in Barkley Sound. Fishing effort was surveyed in all sub-areas approximately twice per week or more.

Chinook catch data were collected by size category (less than 45cm, 45-77cm, and 77cm+) in accordance with size limits in the sport fishery. Inshore areas were under non-retention regulations to protect WCVI chinook returning to spawn. Chinook encounters in inshore areas of 23 and 24 were monitored by landing site surveys, charter patrol on-water interviews, and independent fisher reports.

Effort in Alberni Inlet in August and September was estimated at 4289 boat trips (2.76 times greater than 2000 effort). In Barkley Sound and offshore Area 23 the effort in August and September was 12120 boat trips (2.68 times greater than 2000 effort). In Area 25, where a portion of the inshore waters was open to chinook, the effort was 12107 (1.5 times greater than 2000 effort).

In Areas 20 to 27 every chinook and coho observed in the creel survey was visually and electronically sampled for the presence of a coded-wire tag. Due to the implementation of chinook non-retention from inshore areas of 23 and 24 during August and September no CWT or biological data were collected. Otoliths and CWTs were sampled from chinook caught in open inshore regions of Area 25 and in offshore Areas 123 to 126.

Mark incidence and otolith samples were not obtained in Alberni and Barkley Sound in August and September. The total chinook encounters in Alberni Inlet were estimated to be 639 chinook of all origins (96 mortalities at a 15% mortality rate) from approximately 14136 boat trips (Alberni Inlet includes waters seaward as far as Pocahontas Point). As a result, the total mortalities of Stamp River chinook in Alberni Inlet are estimated to be 93 fish (see Appendix Table 1).

The terminal run calculation includes all Stamp system chinook caught in the sport fishery in DFO Statistical Areas 123 and 23 (Barkley Sound and Alberni Inlet). Consequently, the mortalities of Stamp River chinook in Barkley Sound must also be determined. During June through September, the total catch of chinook was estimated to be 7576. During the migration period of Stamp River chinook (August - September) the total encounters of chinook in Barkley Sound were 2160 from approximately 5279 boat trips. The total mortalities of Stamp River chinook in Barkley Sound were estimated to be 36 chinook. The total mortalities of Stamp River chinook in Area 23 sport fisheries were estimated to be 129 fish.

3.2 Native Fishery Monitoring

Due to concerns over poor chinook returns, Tseshaht and Hupacasath First Nations agreed to forgo in-river fisheries targeting chinook salmon in 2001. There were no chinook reported as incidental catch to earlier sockeye fisheries or later chum fisheries. Coho fisheries were foregone to avoid incidental catch of chinook.

There was no reported catch of chinook during August and September by other First Nations in the Barkley Sound and outer Alberni Inlet area.

3.3 Stamp Falls Fishway Observations of Total Escapement

Monitoring of salmonid migration through the Stamp Falls fishway was conducted from September 6 until November 9, 2001. The number of chinook in the system above the counting facility prior to September 6 was estimated from a snorkel survey conducted above Stamp Falls on that day plus the number of chinook that had entered Robertson Creek Hatchery.

Observations at the Stamp Falls fishway counting facility were conducted for about 14 hours per day from September 6 to 23, from approximately 0.5 hour before sunrise to 0.5 hour after sunset. Observation periods were then reduced periodically until November 9, as the length of daylight hours diminished. Nighttime migration was videotaped from September 14 until October 24 except for September 26/27 and October 4/5 when technical difficulties prevented taping.

General Observations and Setup

The sockeye return to Great Central Lake in 2001 was stronger than anticipated and included a much larger return of late migrants than usual. Approximately 75,000 adults and 5,000 jacks migrated past Stamp Falls during counting operations. Coho escapement of approximately 130,000 was by far the highest on record. Moderate flows and water temperatures during most of the fall of 2001 had no noticeable impact upon the migration of any species through the fishway. The only exception to this were high flows and turbulence brought about by a storm event on October 26 which prevented observation after midday on October 26. The gate was closed during this period to prevent migration when counting could not be conducted. The overall effect of the high abundance of migrants passing through Stamp Falls was that the viewing box was congested at times. However, viewing conditions (clarity) were very good and resulted in high confidence of the estimates obtained.

The fishway monitoring set up was identical to that used in 2000. A video camera was mounted vertically above the counting tunnel and above the water. A mirror was placed beneath the camera and at a 45° angle behind a sheet of Plexiglas which divided the observation box lengthwise. This enabled the fish to be observed from above in half the image and a reflection of the side of the fish in the other half. Lines were marked on the side and bottom of the box to aid the observers in determining jacks and adults for each species. The viewing box and camera were covered with heavy black plastic to eliminate reflection of light from above. Underwater lights were placed inside the viewing box to provide light for the camera and observer. This resulted in consistent conditions from day to night as most of the light during daylight hours was artificial. Both day and nighttime estimates are therefore of equally high confidence. The images obtained in 2001 were of excellent quality.

Daytime Procedures

Daytime observations were conducted in real time through a 21 inch high-resolution colour monitor. A Super VHS time lapse VCR simultaneously recorded the migration. Observations were entered into a customized MSAccess program on a laptop PC. Time, date, observer, species, direction of migration and life stage (adult or jack) was recorded for each fish as they passed by, along with any comments. Any-chinook of 59cm or less 'total' length were considered to be jacks and were determined by using the reference markings on the base and back of the tunnel. The time lapse VCR provided excellent image quality and left a time/date stamp on the image. Synchronized times between the VCR and the Stamp Falls database enabled comparison of the 'real time' observations entered into the database with subsequent verifications.

Nighttime Procedures

Historically, the fishway had often been left open at night to allow free migration of chinook to avoid exerting unnecessary stresses on the fish. Migration during the night time period was thought to be minimal and of little significance to the overall escapement. In 1998 observations were conducted for 24 hours/day at Stamp Falls. These observations indicated that a significant proportion of the chinook run can migrate through Stamp Falls at night. Consequently, nighttime migration was videotaped in 2001 from September 14 to October 24, for subsequent review. The fishway was closed at night prior to the evening of September 14 and after October 24.

A video camera, Super VHS time lapse VCR and lighting operated at night off a bank of batteries and through an inverter. The batteries were re-charged during the day from the generator being used to operate the daytime equipment. Each night's entire migration was recorded by setting the VCR to record up to 12 hours on one videotape. Technical difficulties resulted in no recording on two nights.

The VCR was set for nighttime taping at the end of each daytime shift and stopped at the beginning of the following shift. Consequently each tape contained the end of each days migration plus the start of the following day's migration.

Components of Chinook Escapement Estimation

Daytime Component

The daytime component of escapement estimation was derived from a summation of each day's net upstream migration through Stamp Falls for each species, adults and jacks separately. These results were subsequently adjusted for observer error using a correction factor obtained through the following verification procedure.

Verification Procedure

Daytime observer error was estimated from verification of 100 randomly chosen hours of tape. An experienced observer from the Stamp Falls fishway crew conducted the verifications. Verifications were entered into the same MSAccess database as for the ‘real time’ events. Where there were any difficulties in determining either the species or the number of fish passing through the observation box the videotape was slowed, paused or replayed. Results of these verifications were considered to be a true count of the daytime migration.

Linear regression was used to compare verification counts with the ‘real time’ observations during identical time periods. The correlation between ‘real time’ values and ‘true’ (verification) values was 99.7% (*correction factor* =0.997) for chinook adults. This was probably due to the experience of the field crew although one new observer was employed in 2001. The chinook jack correlation was 87.2%, somewhat lower than for adults but very similar to 2000 and much better than in previous years. Jacks have often been poorly enumerated due to difficulty in determining their size (compared against reference lines marked on the tunnel) and difficulty in species identification – sometimes being confused with coho. In 2001 jacks comprised a much greater proportion of the chinook return than in 1998 and 1999. This and the crew's experience were probably the reasons for their improved recognition.

Nighttime Component

The nighttime component of the estimation was derived from a summation of each calendar day's net upstream migration through Stamp Falls at night. This was done for each species, adults and jacks separately, for all nighttime video tapes reviewed. For nights where the tape was not reviewed the values were interpolated using the following procedure.

Review Procedure

The same experienced observer who conducted the daytime verifications reviewed the nighttime videotapes (recording time approximately 19:30 to 06:30). Where there were difficulties in determining either the species or the number of fish passing through the observation box the videotape was slowed, paused or replayed. The review was therefore considered to be a true representation of the nighttime migration. Initially every fourth night's videotape was reviewed and data were entered into the same MSAccess database as the daytime observations. The review process was then extended to complete any calendar days (midnight to midnight) which had incomplete nighttime reviews. This permitted a comparison of adjusted (for observer error) daytime counts and nighttime counts within a calendar day. Values for nights that were not reviewed (including those nights where the video did not work) were interpolated from the adjacent night's value (in terms of a percentage of the adjusted daytime count). Interpolation using the absolute nighttime counts would have yielded a nighttime migration of 636 fewer adult chinook.

The observed nighttime migration may not be indicative of natural nighttime migration as it may be influenced by the lighting used in the observation box. However, the low wattage fluorescent bulbs were mounted inside the box so their field of influence was limited and it is unlikely they would have any impact below the first baffle in the fishway.

Nighttime migration accounted for 31% of the total chinook adult escapement and 14% of the jacks. It also accounted for 17% and 5% of the coho adult and jack escapements.

Early Escapement Component

In some years the number of chinook having migrated past Stamp Falls prior to the start of counting operations can be considerable. In 2001, escapement prior to September 6 was estimated as: i) counts of chinook through the brailer at Robertson Creek Hatchery plus an estimated number in the raceway, and ii) counts of chinook from snorkel surveys from Great Central Lake Dam to Ash River and Ash River to Stamp Falls. Standard snorkel techniques were used by experienced snorkel surveyors. Many of the chinook were observed in large schools (up to several thousand) of mixed species. The majority of fish in the schools were coho and sockeye but included significant numbers of chinook and steelhead. When apportioning large schools into different species components visual estimation was used by the observers to determine total numbers and proportions. An observer efficiency (OE) is assigned to snorkel surveys to account for inaccessible areas, poor visibility etc. An observer efficiency of 1.00 was applied in this survey.

The general calculations for estimating adult or jack chinook escapement to Stamp River are:

$$CN = \sum_{day} CNday + \sum_{day} CNnight + CNearly$$

$$CNday = \sum_{day} CNobs/cf$$

$$CNnight = \sum_{day} CNnight.obs + \sum_{day} CNnight.in$$

$$CNearly = CNswim.obs / OE + CNhatchery$$

Where:

CN = total escapement of chinook, adults and jacks determined separately

CNday = daytime counts of chinook adjusted for observer error (adjusted daytime counts)

CNnight = night time counts of chinook

CNearly = chinook in the system above Stamp Falls prior to commencing the Stamp Falls escapement enumeration program. Estimates are based on counts of fish observed during snorkel surveys and swim-ins to the hatchery or past Great Central Lake Dam.

CNobs = Daily counts of real time observed chinook from Stamp Falls monitor.

cf = correction factor for observer error. Determined by comparing real time counts to verification counts

For chinook adults cf = 0.997. r^2=0.997, d.f. = 99

For chinook jacks cf = 0.872. r^2=0.774, d.f. = 99

CNnight.obs = Daily counts of night observations of chinook from Stamp Falls video

CNnight.in = Interpolated counts for nights where there was no video review due to time and financial constraints.

Cnswim.obs = Counts of chinook observed during a snorkel survey above Stamp Falls prior to the start of counting operations.

OE = Observer error = 1.00. A subjective assessment of the percentage of each species missed during a snorkel survey based on survey conditions (size and speed of river, proportion of river observed, water clarity, etc). See section on '*Early Escapement Component'*.

CNhatchery = Count of chinook entering the hatchery prior to the start of counting operations at Stamp Falls fishway.

A minor component of the chinook return can not be accounted for as a result of bypass of the fishway via the falls. Bypass was difficult to quantify. Some coho and chinook were observed part way up Stamp Falls, well above the entrance to the fishway. Two fish were observed above the more difficult upper portion of the falls in 2001 but it was not known whether these had made it over the falls or had dropped down from upstream. It was assumed that the majority of fish that make it part way up the falls eventually drop back down and enter the fishway.

3.4 Sampling at Robertson Creek Hatchery

In 2001, 32,301 adult chinook (72% of total escapement) and 3,463 jack chinook (8% of total escapement) entered Robertson Creek Hatchery. This included 1728 females (5% of the adult population). All fish entering the hatchery were counted and recorded by sex. Jacks were distinguished from larger chinook based on a length of 50-cm post orbital hypural (POH) length. The hatchery was able to attain 7.4 million eggs towards its target of 9.3 million.

Ripe females were spawned immediately after brailing. Green females were released into a holding pond until mature enough for spawning. All spawned females and pre-spawn mortalities were checked for adipose fin clips (AFCs). All males were also sampled for AFCs after spawning or before sale of the carcasses. 169 males and 6 females released back into the Stamp River were not checked for AFCs. Two independent samples for each sex were used to determine the age composition of the total return to the hatchery:

i. ages from CWT chinook with AFC, and

ii. random scale samples from non-adipose clipped fish.

Sample data are summarized in Appendix Table 2. Age composition for each sex was estimated by pooling the number at age in the estimated CWT and scale samples.

Broodstock Collection from Great Central Lake Dam

The pre-season forecast for returns to Stamp River indicated that Robertson Creek Hatchery would have difficulty reaching its target of 9.3 million eggs. In an effort to reduce the broodstock shortfall, while at the same time permitting any 'early' wild run to escape into Great Central Lake, the hatchery used a trap at Great Central Lake Dam from October 15 to 26. All adult males and jacks were released back into the Stamp River above the dam. Ripe females were spawned immediately and green females were transported back to the hatchery for holding. These 62 females contributed about 253,000 eggs (3.4% of total egg collection) to RCH. Otoliths and adipose fin clip data were collected from spawned fish.

Broodstock Collection from Angling

Robertson Creek Hatchery came to an agreement with a number of local guides to angle for broodstock on a non-profit basis (no clients). 36 female chinook were caught from October 13 to October 29. These females contributed approximately 147,000 eggs (2.0% of total egg collection) to RCH. Biological data in the form of otoliths and adipose fin clip data were collected from spawned fish.

3.5 Sampling on Spawning Grounds

Moderate to moderately high water levels in the Stamp River during the carcass recovery program allowed sampling to take place throughout the primary spawning period with no 'down' time. Sampling took place from October 5 to November 5. A jet boat was used to search for and gaff carcasses along riverbanks and bars. A carcass net was fished above the inlet to the lagoon until higher water on October 25 made it inoperable. Carcasses were taken to a station on the bank where they were sampled for some or all of sex, fork lengths, POH lengths, scales, otoliths and egg retention level. All carcasses were sampled for AFCs. All fish with AFCs had their heads removed for subsequent dissection and coded wire tag removal and reading. Otoliths were sampled from 280 female, 250 adult male and 100 jacks to assess hatchery contribution rate. Tails were severed from all sampled fish before they were deposited back in the lagoon, to prevent subsequent re-sampling.

A total of 1514 chinook (17% of the adult river population and 9% of the jacks) were sampled for AFC, with 29 recoveries. Biological samples were taken from 999 adult males, 108 jacks, and 443 females. Sample data are summarized in Appendix Table 2.

Total in-river escapement was determined by subtraction of the hatchery count from the adjusted fishway count. Adjustments were made to account for releases from the hatchery back into the river and for broodstock collected from GCL Dam and by angling. Adult males and jacks are usually underrepresented in the deadpitch sample due to their post spawning behaviour but usually over represented in the hatchery. The in-river sex ratio was therefore estimated as the unweighted average of the hatchery and deadpitch sex ratios.

The in-river population was stratified into males, females, and jacks in the following way:

1. In-river count = total escapement - total hatchery count adjusted for hatchery releases and river broodstock collection
2. Total river males = in-river count (1) * unweighted average sex ratio
3. River females = in-river count (1) - total river males (2)
4. River jacks = total escapement - total hatchery count
5. Adult river males = total river males (2) - river jacks (4)

The same criteria were used to determine age composition by sex as for the hatchery samples.

3.6 Total Estimated Terminal Run

The terminal run was defined as catch in DFO Statistical Area 23, including catch of Stamp River/RCH chinook in native, sport, and commercial fisheries, plus spawning escapement to the RCH and Stamp River. Results from intensive catch monitoring and escapement monitoring programs were used to estimate the terminal run at 45,186 Stamp River/RCH chinook. Approximately 10% of this total run was comprised of age 2 jack chinook. The return by age and fishery is presented in Table 1a. The hatchery component of the terminal run, as estimated by CWT, is presented in Table 1b.

Table 1a. Summary of the 2001 terminal run of Stamp River chinook, including jacks (age2) and adults (age 3-6).

Fishery	# Age 2	# Age 3	# Age 4	# Age 5	# Age 6	Total Adult	Total
Alberni Inlet Sport[1]	0	64	19	10	0	93	93
Somass Native	0	0	0	0	0	0	0
Barkley Sound Sport1[1]	0	25	7	4	0	36	36
Hatchery Returns[2]	3,463	30,148	1,720	351	5	32,224	35,687
River Escapement[3]	1,149	5,638	1,642	902	39	8,221	9,370
Total Terminal Run	4,612	35,874	3,388	1,267	45	40,574	45,186

[1] Calculated at 15% of incidental catch.
[2] Includes captures from Great Central Lake Dam and Sport caught broodstock but excludes hatchery releases.
[3] Stamp River only, includes prespawn mortalities and hatchery releases.

Table 1b. Summary of total return from hatchery production only, based on expanded CWT.

Fishery	# Age 2	# Age 3	# Age 4	# Age 5	# Age 6	Total Adult	Total
Alberni Inlet Sport[1]	0	0	0	0	0	0	0
Somass Native	0	0	0	0	0	0	0
Barkley Sound Sport[1]	0	0	0	0	0	0	0
Hatchery Returns[2]	1,722	20,788	470	101	0	21,359	23,081
River Escapement[3]	1,075	3,954	372	348	0	4,675	5,750
Total Terminal Hatchery	2,797	24,742	842	449	0	26,034	28,831

[1] No sampling conducted – incidental mortalities only.
[2] Includes captures from Great Central Lake Dam and Sport caught broodstock but excludes hatchery releases.
[3] Stamp River only, includes prespawn mortalities and hatchery releases.

The female component of the 2001 return was extremely low and accounted for only 11% of the adults. Prespawn mortality was low with about 14% average mortality across all age classes. This return resulted in approximately 9.35 million eggs being deposited into the Stamp River. Based on average expanded CWT data (release/tag values calculated across all tagcodes from a given brood year from Robertson Creek Hatchery on Stamp River stock), the estimated proportion of hatchery origin chinook was very similar for both swim-in and river spawners at 68% and 70% respectively.

4 Cohort Analyses

4.1 CWT based cohort analyses

Cohort analyses for the 1983 through 1999 brood releases from RCH were completed using the total escapement of coded-wire tags to the hatchery and the natural spawning grounds in the upper Stamp River. Note that the returns from the latter 3 broods are incomplete through 2001, so surviving cohorts are estimated using average maturation rates from the completed brood returns.

The cohort analysis provides insight into the annual exploitation and survival of the RCH chinook, including:

- Recoveries from the 1992 brood year are very limited (estimated number of recoveries = 10) and the cohort analysis is not reliable.

- Recoveries for the fourteen brood years (1983 through 1996) for which total escapement recoveries are available indicate the total exploitation rates (expressed as adult equivalents to account for changes in size limits over time) have averaged:

  ocean total mortality exploitation rates = 41.0% (CV = 24%)
  (ocean implies non-terminal fisheries, outside Barkley Sound), and
  brood total mortality exploitation rates = 61.8% (CV = 23%).

- Returns from the 1993-1996 brood years indicate significant reduction in exploitation rates (estimated average ocean exploitation rate = 30% and total exploitation rate = 46%) as expected due to the conservation actions taken during 1995 through 2001.
- Estimates of marine survival continue to demonstrate highly variable survival and very poor survival for the most recent brood years, 1995, 1996 and 1997 (Table 2). However, returns of Age-2 male chinook in 2000 and 2001 indicate some improvement in marine survival of the 1998 and 1999 brood years.
- Annual distribution of the total fishing mortality on the Robertson Creek stock has been up-dated through 2001 CWT recoveries. Conservation actions taken in recent years are again evident in distribution changes (Table 3) and the continued reduction in total fishing mortality. Fishing mortality was the lowest recorded in calendar year 2001.

`**Table 2.** Estimated survival rates (smolts released to Age 2 pre-fishing cohort) of coded-wire tagged (CWT) groups released from RCH by brood year. Survival to Age-2 cohort include all recoveries, estimated incidental fishing mortality, and annual rates of natural mortality for all ages (Ages 2 through 5). Note the last three broods have incomplete recoveries but are estimated based on observations to date and assuming average maturation rates from completed brood years.

Brood Year	Estimated % Survival Rate for Age-2 cohort CWT groups
1983	0.10%
1984	4.44%
1985	4.32%
1986	12.05%
1987	10.14%
1988	13.12%
1989	9.16%
1990	5.67%
1991	0.99%
1992	0.014%
1993	2.23%
1994	4.86%
1995	0.40%
1996	0.15%
1997	0.10% incomplete brood
1998	4.90% incomplete brood
1999	2.74% incomplete brood

4.2 Exploitation Pattern in Canada based on Otolith Thermal Marks

Significant management measures were implemented in 2001 in response to continued conservation concerns for WCVI chinook. The limited fishing in Canada, along with low numbers of WCVI chinook, resulted in very few CWT recoveries for WCVI stocks. Consequently the exploitation rate in Canada was also examined by analysis of otoliths.

Robertson Creek Hatchery was the first facility in BC to thermally mark salmonids. They have marked all chinook releases since the 1992 brood year. Since then all WCVI major hatcheries have mass marked chinook salmon with the thermal otolith mark. As well, other southern BC hatcheries such as Quinsam River, Chilliwack River, and many Washington State hatcheries apply thermal marks on the otoliths.

The coding system used to represent the thermal mark is called the RBr system. An example code is shown below. In this case the mark is pre-hatch with 3 rings in the first band and 4 rings in the second band.

Eg. 1: 1.3 + 2.4

R B r

where; R = region of the otolith that is marked (1 = pre-hatch, 2 = post-hatch, 3 = both)
B = Band No.
r = the no. of rings in the band

RCH uses a propane fired boiler to raise the temperature of the incubation water by approximately 2^{o}C for a 24 hour period and then drop it back to ambient for 24 hours. This process is repeated for each thermal ring required in the mark. A period of 72 hours of ambient water is required between bands.

Initially marks were varied from year to year to permit brood year identification. However, due to the limited number of marks available an identical mark has been used since the 1999 brood year. Scales will now be required to determine age and brood year of thermally marked releases. The marks relevant to the brood years available, and identified in reading include the following:

Brood Year	1994	1995	1996	1997	1998	1999
RBr Code	1 : 1.4	1 : 1.2 + 2.2	1 : 1.4	1 : 1.2 + 2.2	1 : 1.4 2 : 1.4 + 2.4	1 : 1.3 2 : 1.2 + 2.3

Catch sampling for otoliths was initiated in QCI sport, WCVI sport, northern troll, and WCVI troll fisheries. The resulting estimate of impact in the sport fisheries is presented in the Appendix Table 5. The cumulative impact of Canadian fisheries was estimated to be approximately 5% of the total Stamp River/RCH catch plus escapement. This impact was distributed about 3% in northern fisheries and 2% in southern fisheries. Impact from First Nations fisheries is not known but assumed to be negligible due to the timing and area of these fisheries relative to the known distribution of WCVI chinook.

5 Forecast

5.1 Regression Statistics for Two Forecast Models

Table 4 summarizes the regression statistics and results of Prod2 and Prod3 regression models. The upper portion of these tables identify each sibling model, the x-value used in the 2002 forecast, the predicted value and its upper and lower 90% confidence bounds, the co-efficient of the regression (intercept is zero), the R-squared value, and sigma (residual standard deviation of the regression). Regressions 3, 5, and 8 were used in each of the Prod2 and Prod3 regression models to determine the 2002 forecast. These Prod 2 and Prod 3 data points and regressions are plotted in Appendix Figure 1 and 2, respectively. Results of the retrospective assessment of each forecasting equation are also presented in the lower portion of tables.

Table 3. Distribution of total fishing mortality for RCH chinook stock; distributions based on CWT cohort analysis through 2001 and using the brood year method to estimate incidental fishing mortality. Some fisheries with very few recoveries have been combined, e.g. Southern nets and other sport include southern BC and Washington recoveries.

Fishing Mortalities by Major Fishery, as a proportion of Total Fishing Mortalities plus Escapement																	
Catch Year	Alaska Troll	North BC troll	Central BC troll	WCVI Troll	Alaska Net	NCBC Net	South BC Net	South US Net	Alaska Sport	NCBC Sport	WCVI Sport	Other Sport	Term Net	Term Sport	Total Ocean Fishing Mortality	Total Fishing Mortality	Escape
1985	15.3%	15.5%	0.5%	1.9%	15.3%	3.8%	1.7%	1.7%	0.0%	0.1%	0.0%	0.8%	1.3%	15.9%	56.6%	73.8%	26.2%
1986	19.0%	8.9%	1.5%	4.4%	11.5%	3.1%	0.9%	0.2%	0.6%	1.1%	1.5%	1.0%	0.5%	20.2%	53.7%	74.4%	25.6%
1987	11.9%	7.7%	2.9%	2.9%	3.5%	2.3%	1.0%	0.4%	0.8%	0.6%	0.5%	0.6%	0.3%	18.9%	35.0%	54.2%	45.8%
1988	12.8%	8.8%	1.6%	4.7%	4.3%	1.8%	0.2%	0.3%	1.3%	1.2%	4.5%	0.8%	7.0%	12.8%	42.2%	62.0%	38.0%
1989	14.1%	9.0%	1.4%	3.3%	5.6%	1.0%	1.0%	0.1%	1.4%	1.0%	1.6%	0.8%	15.7%	14.5%	40.5%	70.7%	29.3%
1990	19.1%	8.8%	2.5%	7.6%	4.4%	1.5%	0.6%	0.0%	1.6%	1.0%	1.9%	0.4%	8.2%	7.8%	49.3%	65.3%	34.7%
1991	19.5%	9.4%	2.8%	5.9%	2.6%	0.6%	0.6%	0.0%	3.0%	0.8%	1.1%	0.4%	12.7%	12.0%	46.7%	71.4%	28.6%
1992	16.8%	7.4%	2.8%	17.8%	7.9%	0.8%	0.3%	0.1%	1.8%	1.4%	2.0%	0.2%	0.4%	5.4%	59.2%	65.0%	35.0%
1993	15.9%	7.3%	2.0%	13.7%	2.3%	0.4%	0.8%	0.0%	2.6%	1.4%	2.5%	0.6%	6.9%	12.9%	49.6%	69.4%	30.6%
1994	17.8%	9.0%	1.0%	5.2%	4.7%	1.0%	0.2%	0.0%	3.6%	1.1%	4.2%	0.5%	11.6%	16.6%	48.4%	76.6%	23.4%
1995	17.0%	3.5%	0.4%	1.7%	0.1%	0.4%	0.1%	0.2%	5.0%	1.4%	4.3%	1.3%	6.5%	10.1%	35.7%	52.3%	47.8%
1996	14.8%	2.9%	0.7%	1.7%	1.5%	0.1%	0.0%	0.0%	5.7%	2.2%	1.3%	1.5%	0.1%	1.9%	32.6%	34.6%	65.4%
1997	13.1%	5.0%	1.8%	0.1%	6.7%	0.4%	0.1%	0.0%	4.5%	3.1%	2.0%	0.6%	5.7%	16.8%	37.9%	60.4%	39.6%
1998	16.9%	6.0%	0.1%	0.0%	4.1%	0.0%	0.0%	0.0%	5.0%	2.3%	3.3%	0.6%	3.9%	15.8%	38.2%	57.9%	42.1%
1999	12.9%	3.3%	0.2%	0.0%	0.7%	0.0%	0.0%	0.0%	7.4%	3.2%	3.4%	0.9%	6.9%	19.7%	32.3%	58.5%	41.5%
2000	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.1%	0.0%	2.9%	0.0%	0.0%	12.7%	12.7%	87.3%
2001	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	0.0%	1.6%	0.0%	0.0%	0.0%	8.3%	8.3%	91.7%
Average																	
1985-94	16.2%	9.2%	1.9%	6.7%	6.2%	1.6%	0.7%	0.3%	1.7%	1.0%	2.0%	0.6%	6.5%	13.7%	48.1%	68.3%	31.7%
1995-01	12.1%	3.0%	0.4%	0.5%	1.9%	0.1%	0.0%	0.0%	4.3%	2.4%	2.3%	1.1%	3.3%	9.2%	28.2%	40.7%	59.3%

Table 4. Regression equations and results for Robertson Creek forecast models.

Part A: Terminal run vs. Total production regressions (Prod2 model, 2002 RCH forecast)

Model # & Desc.	Predictor x-value	Prediction	90% confidence Lower	90% confidence Upper	Slope Para.	r-sq.	sigma
#1,Age 2 vs. Age 3	2739	19571	27	39116	7.145	0.910	16254
#3, Age 2 vs. Ages (3+4+5)	2739	74108	-11275	159491	27.057	0.898	70567
#5,Age (2+3) vs. Age (4+5)	27749	111239	79928	142551	4.008	0.963	25281
#6, Age (2+3+4) vs. Age 5	1484	672	-8730	10074	0.453	0.953	7808
#7,Age 3 vs. Age (4+5)	25643	127228	89480	164976	4.962	0.943	30134
#8,Age (3+4) vs. Age 5	1484	740	-8871	10350	0.498	0.951	7981

Mean absolute deviations by model:

	Sum of Square error
#1,Age 2 vs. Age 3	0.6810
#3, Age 2 vs. Ages (3+4+5)	0.6967
#5,Age (2+3) vs. Age (4+5)	0.4084
#6, Age (2+3+4) vs. Age 5	0.6104
#7,Age 3 vs. Age (4+5)	0.4479
#8,Age (3+4) vs. Age 5	0.5856

Leave-one-out Assessment (one forecast for each brood year by model type):

	MODEL #1		MODEL #3		MODEL #5		MODEL #6		MODEL #7		MODEL #8	
Brood	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.
1983	1018	4253	3330	16104	1850	3772	326	809	1814	1717	326	594
1984	46586	24636	145793	93772	79366	134785	18753	30966	77303	151868	18753	32412
1985	33358	35050	140433	132271	85660	95910	22257	28608	83212	94361	22257	29036
1986	98183	64976	402754	241710	243657	185973	80700	55034	234780	185700	80700	56396
1987	85760	109209	314988	417276	183383	172308	50660	48399	177810	139708	50660	45786
1988	125080	130828	461386	504217	269045	299257	65770	74694	261810	269483	65770	71985
1989	56980	75288	236411	281945	143545	121342	35860	36326	139600	99438	35860	34765
1990	45660	14157	189060	53519	114720	88044	32000	28891	111200	99663	32000	30903
1991	10460	12505	32038	47382	17262	17153	3200	5908	16910	12549	3200	5627
1992	125	0	446	0	256	501	195	74	235	620	195	82
1993	20740	13122	59553	49768	31050	75014	5000	14703	30500	84163	5000	15265
1994	34268	5232	143882	19800	87691	83807	18829	28382	85620	101023	18829	31054
1995	2962	536	13418	2029	8365	6438	1953	2725	8150	7596	1953	2961
1996	927	1694	4511	6413	2867	4053	582	1287	2803	3840	582	1298
1997	278	0	3330	16104	1850	3772	326	809	1814	1717	326	594
1998	28325	14972	145793	93770	79366	134789	18753	30966	77303	151868	18753	32412

Table 4 Continued.

Part B: Total production vs. Total production regressions (Prod3 model, 2002 RCH forecast)

Model # & Desc.	Predictor x-value	Prediction	90% confidence Lower	Upper	Slope Para	r-sq.	sigma
#1,Age 2 vs. Age 3	3163	7587	-5840	21014	2.399	0.957	11212
#3, Age 2 vs. Ages (3+4+5)	3163	28947	-21808	79703	9.152	0.964	42122
#5,Age (2+3) vs. Age (4+5)	30757	49358	31588	67128	1.605	0.987	14676
#6, Age (2+3+4) vs. Age 5	12150	442	-6306	11309	0.206	0.959	7313
#7,Age 3 vs. Age (4+5)	28235	62101	46764	77438	2.192	0.990	12619
#8,Age (3+4) vs. Age 5	11998	477	-5725	11448	0.238	0.961	7129

Mean absolute deviations by model:

	Sum of Square error
#1,Age 2 vs. Age 3	0.3963
#3, Age 2 vs. Ages (3+4+5)	0.4160
#5,Age (2+3) vs. Age (4+5)	0.2400
#6, Age (2+3+4) vs. Age 5	0.4018
#7,Age 3 vs. Age (4+5)	0.1990
#8,Age (3+4) vs. Age 5	0.3890

Leave-one-out Assessment (one forecast for each brood year by model type):

	MODEL #1		MODEL #3		MODEL #5		MODEL #6		MODEL #7		MODEL #8	
Brood	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.	OBS.	PRED.
1983	1018	2625	3330	10013	1850	3389	326	741	1814	2232	326	598
1984	46586	26154	145793	100329	79366	93019	18753	24109	77303	103458	18753	25328
1985	33358	28263	140433	107571	85660	72181	22257	21840	83212	72868	22257	22500
1986	98183	81410	402754	304838	243657	206071	80700	53261	234780	209616	80700	54298
1987	85760	96627	314988	371960	183383	204633	50660	52183	177810	190132	50660	50799
1988	125080	135387	461386	527596	269045	300367	65770	84130	261810	281340	65770	82666
1989	56980	72907	236411	275564	143545	138487	35860	39529	139600	123726	35860	38575
1990	45660	40019	189060	152084	114720	99494	32000	29004	111200	99541	32000	29650
1991	10460	9141	32038	34893	17262	22917	3200	5766	16910	22948	3200	5770
1992	125	38	446	146	256	226	195	37	235	274	195	39
1993	20740	12922	59553	49379	31050	42037	5000	10671	30500	45623	5000	11073
1994	34268	15331	143882	58415	87691	64876	18829	22234	85620	74836	18829	24297

1995	2962	1588	13418	6058	8365	5815	1953	2022	8150	6494	1953	2184
1996	927	864	4511	3295	2867	2065	582	722	2803	2032	582	751
1997	278	365	3330	10013	1850	3389	326	741	1814	2232	326	598
1998	28325	5816	145793	100329	79366	93019	18753	24109	77303	103458	18753	25328

5.2 Forecast Result

The forecast abundances shown in Table 4 are based on CWT groups listed in Appendix Table 4. These age-specific forecasts are expanded to account for hatchery production not associated with the CWT used in the regression analyses and "natural" production from the Stamp River. The expansion factors used in this forecast were 1.68 for Age 2 returns in 2001 (for the age 3+4+5 cohort), 1.40 for Age 3 returns in 2001 (for the age 4+5 cohort), and 3.07 for the Age 4 returns in 2001 (for the age 5+ cohort). The total cohort size available to ocean fisheries is presented in Table 5 as "Pre-fishery abundance".

Management scalars (i.e., proxy for management actions) may then be applied to average exploitation rates in fisheries to determine catches. In the case of the 2002 forecast, management scalars are only applied to Alaskan fisheries, based on expected catch as outlined in the Pacific Salmon Treaty agreement (harvest rate scalar of 0.755 in SEAK troll). The remaining cohort is identified as the expected terminal run assuming no fisheries in Canada (Table 5) based on recent average maturation rates (0.16 for Age 3, and 0.57 for Age 4), or remain at sea as the surviving cohort. At a later stage in the domestic fishery planning process, management scalars are derived for Canadian fisheries to reflect the conservation and allocation requirements for the Stamp River chinook.

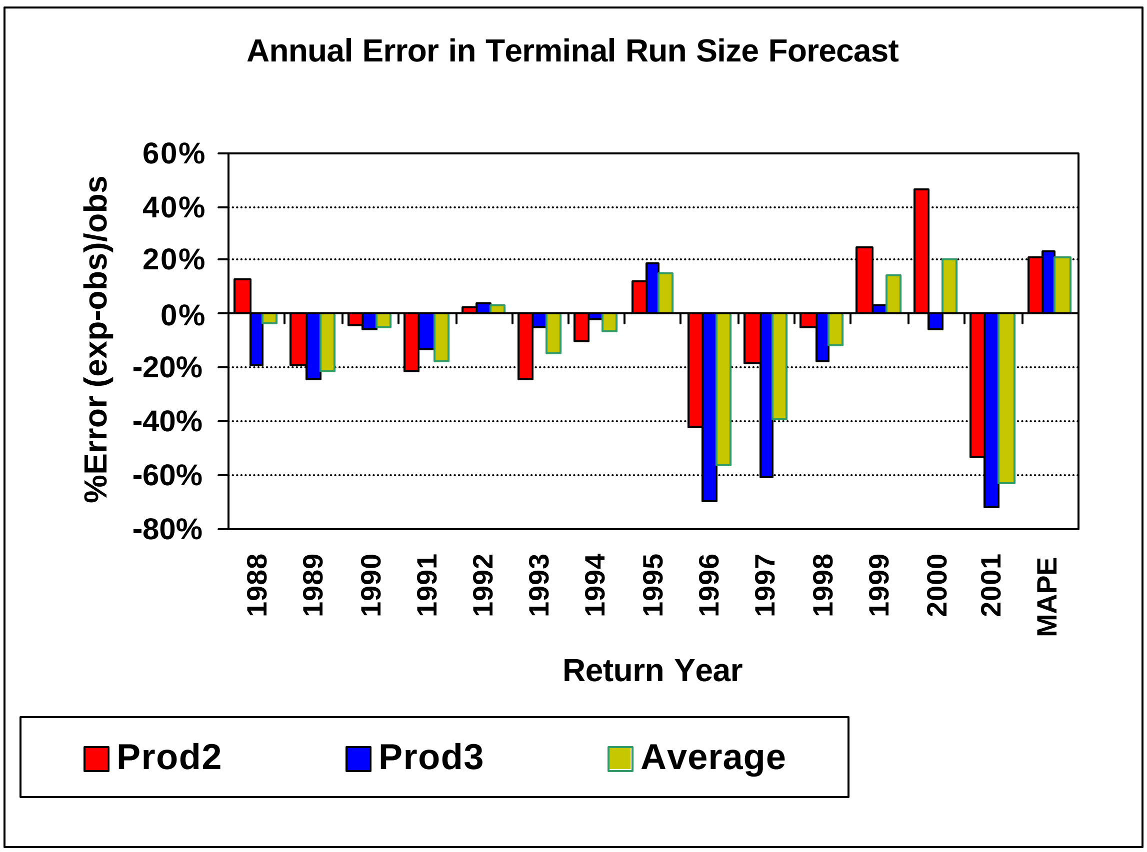
Table 5. Summary of forecasted abundance and terminal run size of Stamp River chinook salmon with no Canadian fisheries. Terminal run after Canadian fisheries to be determined by managers in consultation with stakeholders.

	Pre-Fishery Abundance	Terminal Run with no Canadian Fisheries	Age compositon
1. Model Prod 2 (Terminal vs Total Production)			
1999 brood	124,785	20,294	20%
1998 brood	155,720	80,993	79%
1997 brood	2,282	1,870	1%
Total	282,787	103,157	
2. Model Prod 3 (Total vs Total Production)			
1999 brood	48,742	7,927	18%
1998 brood	69,095	35,937	80%
1997 brood	1,471	1,206	3%
Total	119,307	45,070	
3. Average of Prod2, Prod3			
1999 brood	86,763	20,294	25%
1998 brood	112,407	58,465	73%
1997 brood	1,876	1,538	2%
Total	201,046	80,297	

When the age-specific forecasts are combined to predict the total terminal run to Barkley Sound (i.e, average of Prod2 and Prod3), the forecasting error is, on average, less than for the individual regression models. The mean absolute percent error (MAPE) for the average forecast value is 21% (Fig. 1). The high age-3 return in 2001 resulted in large absolute percent error in the 2001 forecast, including 53% in Prod2, 72% in Prod3, and 63% on the average model forecast. Over the period 1988 to 2001, the MAPE is 21% for Prod 2 and 23% for Prod 3. The error estimates were based on the deviations between forecast and observed returns, where:

- the terminal returns are calculated from the current regression models (i.e., leave one out assessment for the Prod2 and Prod3 models) and the actual preseason assumptions of exploitation rates used in past abundance forecasts.
- The observed total terminal return includes all catch plus escapement of Stamp River chinook in Area 23.

Figure 1. Average annual error for Prod2, Prod3, and average forecast models when applied to estimating the terminal run size of Stamp chinook into Barkley Sound, 1988 - 2001. Error is expressed as the percent deviation from the observed terminal run, 1988-2001. The mean absolute percent error (MAPE) is also shown.



In addition, a cumulative probability distribution for the "average" forecast is shown in Appendix Figure 3. Only 14 data points are available to formulate the cumulative distribution of the forecasts. The forecast at 50% probability of occurrence is approximately a 82,500 return to the Stamp River, and 50% confidence bound on that estimated is 66,000 to 96,100.

5.3 2002 Potential Escapement Level into Stamp River

As described in the Introduction, the forecast terminal run is compared relative to a base and the upper rebuilding target. The base reflects the escapement levels immediately prior to the PST implementation in 1985.

Because of changing age and sex compositions between years, the base level was expressed in terms of eggs, including a requirement for hatchery plus natural spawners in the Stamp River (i.e., 50 million eggs from natural spawners plus 9.3 million eggs required for Robertson Creek Hatchery). The escapement required to provide 59 million eggs is determined using Excel Solver, given the age composition, fecundity, proportion females, and prespawn mortality parameters outlined in Table 6. The escapement required in 2002 to exceed the base period level of river (plus hatchery) spawners, given the expected age composition, would be almost 36,000 (43,000) chinook. In 2002, the forecast terminal return (assuming no fishing in Canada) is approximately 80,300 adult chinook.

The historic time series of spawners in the Stamp River is presented in Appendix Table 3. The base level of 50 million eggs in the Stamp River was not achieved in 6 years since 1985. The minimum escapement in the time series occurred in 1996 when less than 9 million eggs were deposited in the Stamp River.

Table 6. Derivation of the number of spawners needed to meet the 50 million eggs for in-river spawning and the 9 million eggs for hatchery requirements, given forecast age composition, average fecundity, proportions of female by age, and average prespawn mortality.

	Age composition	**Fecundity**	**Proportion Female**	**Prespawn Mortality**	**Spawners**	**Eggs**
1999 brood	*25%*	*4000*	*0.07*	*.20*	*9,070*	*2 million*
1998 brood	*73%*	*4400*	*0.50*	*.20*	*26,130*	*46 million*
1997 brood	*2%*	*4800*	*0.75*	*.20*	*687*	*2 million*
In-river Requirement					*35,887*	*50 million*
Total Stamp/RCH Requirement					*42,562*	*59 million*

Table 7. Potential escapement into Stamp River, excluding potential losses to prespawn mortality.

	Prod2 Total Escapement	**Prod2 Eggs**	**Prod3 Total Escapement**	**Prod3 Eggs**	**Average Model Total Escapement**	**Average Model Eggs**
1999 brood	*20,294*	*5.68E+06*	*7,927*	*2.22E+06*	*20,294*	*5.68E+06*
1998 brood	*80,993*	*1.78E+08*	*35,937*	*7.91E+07*	*58,465*	*1.29E+08*
1997 brood	*1,870*	*6.73E+06*	*1,206*	*4.34E+07*	*1,538*	*5.54E+06*
Total return	*103,157*	*1.91E+08*	*45,070*	*85.62E+06*	*80,297*	*1.40E+08*

5.4 Summary and Recommendations for Stamp River chinook.

- Intensive monitoring of catch and escapement of Stamp River chinook was successfully completed in 2001.
- The 2001 terminal return of the Stamp River/RCH chinook was approximately 45,000. The age 2 jack chinook (10% of return at 4600) showed improved marine survival relative to the mid-1990 brood years. The total age 4 plus age 5 return was the lowest return for two consecutive year classes on record since 1985.
- The relative change in the Stamp River/RCH chinook is used as an indication of trends in other stocks along the WCVI. Overall, the 2001 return increased 500% from the 2000 return. The increase in adult return (not including age 2 jacks) was almost 600% relative to 2000.
- The 2002 forecast for the Stamp River/RCH chinook is based on the forecasting method used since 1995. The forecast total return of Stamp River/RCH chinook to the terminal area of Barkley Sound and Alberni Inlet is approximately 80,000 based on averaging the Prod2 and Prod3 models. The mean absolute percent error in the average forecast is 21%. The age structure of the return is projected to be: 25% Age-3, 73% Age-4, and 2% Age-5; with an expected sex ratio of 40% females. The forecast return of approximately 31,000 female chinook includes almost 29,003 age 4 females (93%).
- The forecast indicates the 2002 Stamp River/RCH terminal run will be almost double the 2001 return. Of this total about 40% will be females. The resulting number of females is predicted to increase 800% relative to the return of females in 2001. This is due to a strong return of age 4 chinook (1998 brood).
- The expected number of eggs to the river and hatchery is predicted to exceed the interim goal in 2002. With no fishing in Canada the expected escapement would provide a potential egg deposition of approximately 112 million eggs, if all fish were allowed to spawn in the river.

6 Extensive escapement indicators for WCVI chinook

6.1 Methods

The detailed assessments and forecasts of the Somass system (RCH/Stamp) chinook are undertaken annually for management plus as an indicator of the expected returns to the naturally spawning chinook populations along the WCVI. Seven populations on north-west Vancouver Island (NWVI), Areas 25 to 27, are in aggregate, used by the Pacific Salmon Commission (PSC) to indicate trends in escapement to naturally spawning chinook along the WCVI. These are termed “PSC extensive” escapement indicators based on the consistent effort and methodology used. Additionally, since 1995, at least 11 “other extensive” WCVI indicator streams have been surveyed annually (Table 8).

Since 1995, the snorkel method has been used to survey escapement to the PSC extensive indicators and the other extensive indicator streams. Surveys are scheduled for every 7-10 days during September and October, for a minimum of 6 surveys per system not including surveys for zero counts. Weather, water condition, and water flows may impact this schedule. Generally, surveyors started surveys from upstream migration barriers or observed upstream limit and snorkeled downstream, 1 to 3 observers per team. Observations were discussed at the end of each habitat type and river section, and recorded on waterproof paper Stream Inspection Logs. The counts from the snorkel surveys are used to estimate escapement by the Area-Under-the-Curve.

Table 8. Rivers extensively surveyed (consistent method and effort) to provide quantitative estimates of chinook escapement. Reliability is reported on a scale of 1-5 with 1 being low and five being high.

Stream	**Stat Area**	**Survey Method and Frequency in 2001**	**Reliability**
(PSC) Extensive			
Burman River	25	9 Snorkel	3
Gold River	25	6 Snorkel	1
Tahsis River	25	7 Snorkel	3
Kaouk River	26	5 Snorkel	2
Artlish River	26	2 Snorkel	2
Tahsish River	26	3 Snorkel	2
Marble River	27	1 Snorkel	1
Hatchery			
Conuma/Canton R	25	9/5 Snorkel	5
Nitinat River	22	7 Snorkel	4

Stream	**Stat Area**	**Survey Method and Frequency in 2001**	**Reliability**
Other Extensive			
San Juan River	20	Fence/2 Snorkel	4
Gordon River	20	5 Snorkel	2
Sarita River	23	6 Snorkel	3
Toquart River	23	11 Snorkel	3
Nahmint River	23	9 Snorkel	3
Bedwell R / Ursus	24	7 Snorkel	4
Moyeha River	24	4 Snorkel	3
Megin River	24	3 Snorkel	1
Sucwoa River	25	5 Snorkel	5
Deserted Creek	25	4 Snorkel	3
Tsowwin River	25	2 Snorkel	3
Leiner River	25	3 Snorkel	3
Zeballos River	25	4 Snorkel	2
Tlupana River	25	6 Snorkel	3
Colonial/Cayeghle	27	3 Snorkel	1

An Area-Under-Curve (AUC) method is used to calculate estimates of total escapement for these “extensive” escapement indicators, but only for those systems with a minimum of 4 surveys. Observer efficiencies are used to expand the raw survey counts. These efficiencies rely upon the surveyor’s estimate of their efficiency for a particular swim on a particular day and for a particular species. Surveys with efficiencies less than or equal to 50% were removed from the AUC calculation as they represented a low confidence count and the potential for a large inaccuracy in the number of fish as a result of the large expansion.

Low, middle, and high AUC estimates are derived based on a short and a long residence time with the mid-value calculated as the mean of the upper and lower values. In general, 15 and 25 days are used as the short and long residence times unless the percent new fish data suggest that the times should be longer or shorter than the base parameter.

Where the number of surveys did not support AUC calculations, escapement estimates are based on peak live plus dead survey observations. All parameter estimates and final escapement estimates were reviewed with individual surveyors.

Age composition of WCVI chinook escapement is estimated from a cross section of the "extensive" indicators based on random sampling of captures for broodstock in systems with small scale supplementation, recovery of carcasses in natural spawning populations, or test fishery sampling near the river mouth. Sampling was stratified by sex (male, female, and jack). Age composition by sex was weighted by sex ratios determined through broodstock collection, carcass recovery, and observation during snorkle surveys. The escapement estimates do not include jacks, only adults.

6.2 Operational Summary

The reliability of the AUC estimates in 2001 suffered from a reduced number of surveys and poor viewing conditions due to high water flows during much of October. Available observations indicate the peak spawner counts occurred in the first week of October. Surveys around and after the peak of spawning were impacted by high flows. Consequently, reliability of escapement estimates was low in several systems.

Through early September to early October 2001, river levels throughout the WCVI were generally stable and low. There was sufficient water in most systems that upstream migration was not impeded. Water temperatures were suitable for migration (i.e. less than 18°C). Survey conditions were generally favourable with good visibility, good access, etc. As a result of these low water conditions, crews had adequate coverage of the early stages of the chinook escapement (pre-spawn and spawn) in most systems. However starting in early October and carrying through to November intense rains created hazardous swimming conditions and reduced visibility preventing many surveys from taking place. These intense rains had an impact on the quality and coverage on some of the peak spawn and post spawn surveys, particularly in areas 24 through 27. Precipitation recordings from Port Hardy Airport and the Marble River (representing NWVI) showed significantly more rainfall for September, October and November than usual. For the Marble River, rainfall was 1.5 times greater in September, 2 times greater in October and 2.5 times greater in November than in the same months in 2000.

Survey coverage on each system is reported in Table 8. The reported survey coverage does not include zero counts either side of the chinook spawning period which are included in the AUC estimation. If a zero count was not observed at the beginning or end of the survey season the beginning of September was used as the starting point of chinook entry and the completion of spawning by the first week of November. The timing of these zero counts were identified through surveys of 4 systems prior to chinook arrival in the stream (Toquart, Bedwell, Burman and Tahsis Rivers).

The reliability of escapement estimates (Table 8) is based on the number of surveys, estimation method (AUC or Peak count), timing of surveys, and "countability" of spawners based on flow and visisbility in the river. The reliability of estimates in the NWVI area was generally lower than in the SWVI area.

Peak live plus dead was used as the basis for the escapement estimate in several systems due to the low number of surveys. Estimates from peak live plus dead occurred for the Colonial/Cayeghle and Marble rivers in Area 27; Tashish and Artlish rivers in Area 26; the Leiner and Tsowwin rivers in Area 25; and the Megin River in Area 24. Estimates on these systems should be considered minimum estimates of total escapement.

Age composition of WCVI chinook escapement was estimated from a cross section of the "extensive" indicators. The samples were collected by hatchery staff during broodstock collection, or by dedicated sampling crews using beach seines in the river, or through carcass recovery during snorkle surveys. As a result of the low chinook escapement and high flows, adult sampling was limited to those systems where hatchery broodstock was collected. Even with increased effort there was difficulty in capturing adequate numbers of adults for brood or age sampling. As an example, the combination of high river levels and low numbers of fish prevented any broodstock capture from the Gold, Tahsis and Marble rivers and very little broodstock from the Burman River (10 fish). One exception is the San Juan River (Area 20), 457 adults were captured for brood stock, twice as many as 2000, with 233 scale samples collected. Age data was calculated by determining age compositions individually for males and females from random samples taken during brood stock collection. Sex ratio information collected by hatchery staff and field staff was then applied to determine a total age composition.

6.3 Stock Status of Natural Spawning Chinook in 2001

Escapement trends

Total numbers of naturally spawning chinook increased by approximately 60% from 2000 levels. The reliability of this estimate is lower than in previous years due to uncertainty in the estimates from many of the NWVI escapement indicators. Generally, we believe this may be a minimum estimate of relative increase.

The trends in the natural stock indicators are presented in Figure 2. In 1998 and 1999 the aggregate PSC index exceeded the interim rebuilding goal of 11,500 chinook (double the base period 1979-1982 average escapement). In 2000, the aggregate PSC index declined to 4,722 adult chinook. The available data in 2001 indicate a continued decline to 2,975 naturally spawning chinook, which is below the base period average. Estimates for the “other” 11 escapement indicators show a slight increase relative to 2000.

The Stamp River indicator is used as the basis for predicting change in the natural stock indicators along the WCVI. Last year the 2001 forecast suggested an increase of 120%. The observed change in escapement relative to 2000 is presented in Figure 3. The PSC 7 stock aggregate index declined over 35% from 2000 escapements. Within the PSC indicator group of NWVI systems, the only systems that saw increases in escapement were the Kaouk and Artlish (Area 26), up 295% and 85% respectively from 2000 levels. Escapement to the Burman, Gold and Tahsis (Area 25) declined between 50% and 70% and the Tashish River (Area 26) declined by 58%. The Area 27 indicator (Marble River) as in 2000, again saw a 40% decrease in escapement from last year.

The majority of declines took place in the NWVI while SWVI saw some large increases. On SWVI, eight streams were extensively surveyed for chinook. These systems all had increased escapements relative to 2000 except for the Megin River, which showed a decline, likely a result of poor survey coverage due to poor visibility caused by intense rains. The 2001 escapement to the San Juan River (Area 20) was up 120% from 2000 but still considerably lower than 1998-99 levels. The Nahmint River (Area 23) also had an increased escapement, 230% higher than 2000 but again substantially lower than 1998-99 levels. Two of the primary indicator stocks in Area 24 (Bedwell and Moyeha) were above 2000 escapements (with the exception of the Megin), increasing by 84% and 22% for the Bedwell and the Moyeha, respectively.

Most crews surveying WCVI systems during 2001 noted lower numbers of jack chinook relative to 2000 with the exception of the Nahmint (Area 23), Artlish, and Kaouk Rivers (Area 26), which had levels similar to 2000 (45%, 18% and 13% respectively). On the Sarita (Area 23), the jack number was estimated at 3.4% of the total chinook escapement. On the Tahsish Rivers (Area 26) the jack number was estimated at 7.8% of the total escapement. Jacks contributed 2% to the San Juan escapement and 3% to the Bedwell/Ursus Rivers.

Terminal harvests were not calculated for the “other” extensive indicators, however, terminal harvests would be negligible except in Nootka Sound (Area 25) where terminal sports fisheries may have significantly impacted local stocks other than Conuma Hatchery returns. These impacts will be assessed using otolith mark incidence in the fishery (not yet completed). Where it was not possible to determine the terminal harvest in a system the escapement reported is a “gross escapement” which includes the natural escapement to a river, plus any broodstock collection that may have taken place.

Figure 2. Trend in adult chinook escapement of PSC escapement indicator stocks, 1975 to 2001. The solid line indicates the base period (1979-1982) average escapement. The broken line indicates the PSC rebuilding goal (double the base period average).

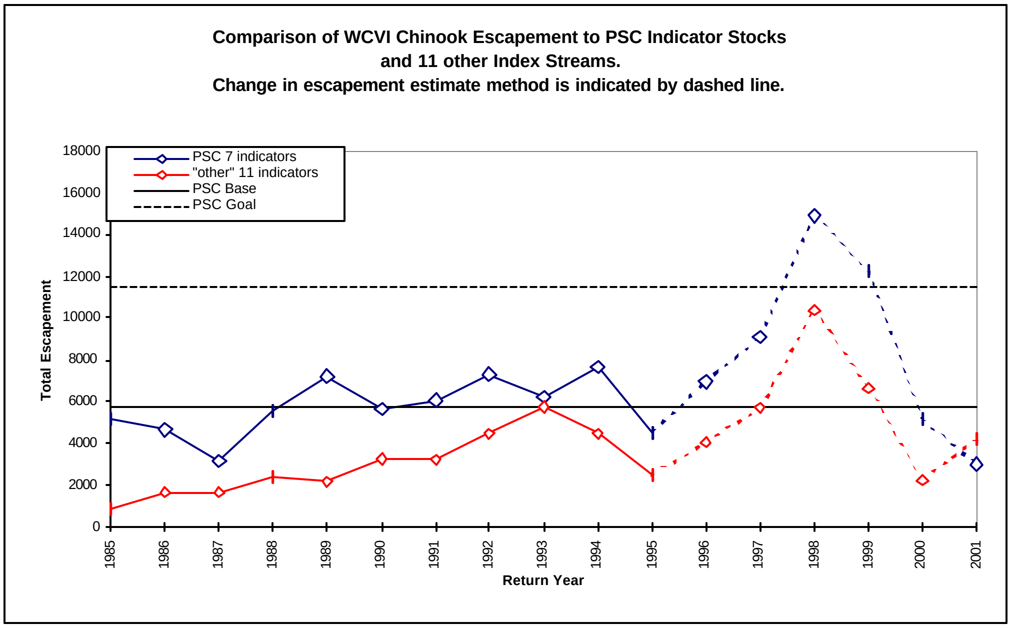
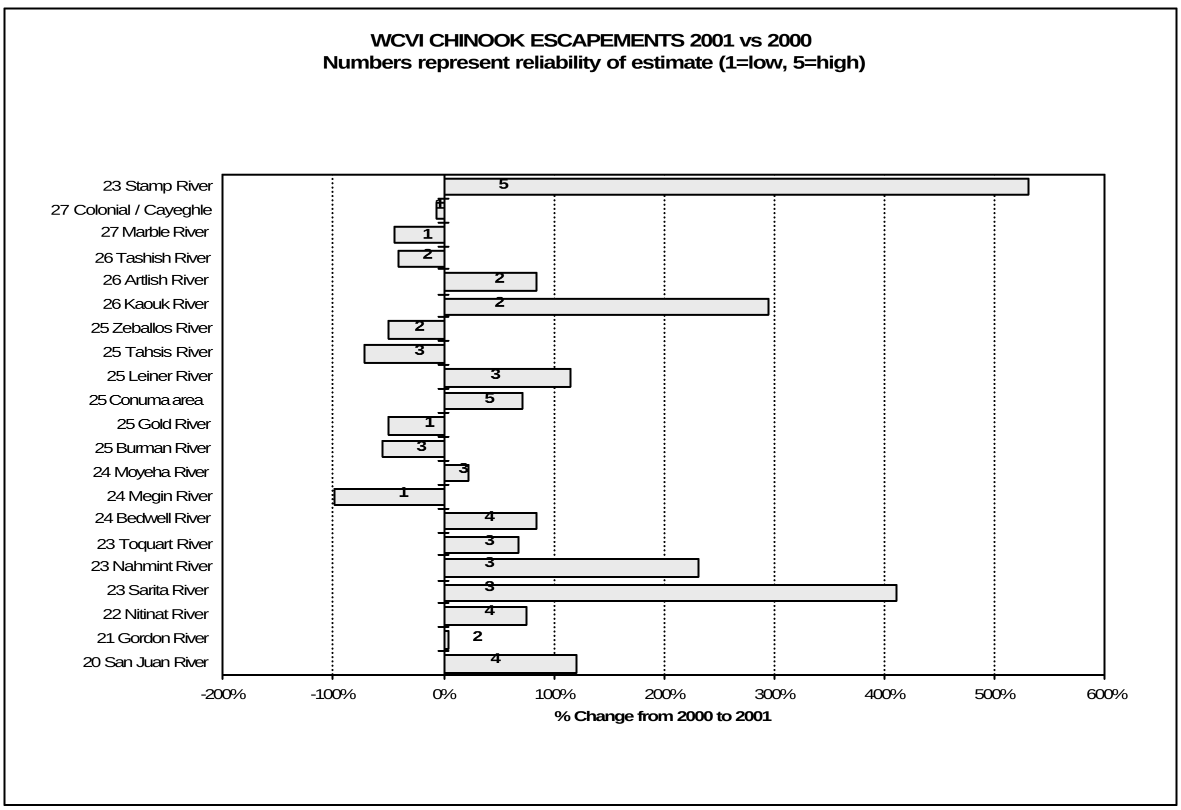


Figure 3. Relative change in escapement from 2000 to 2001 for WCVI indicator stocks with multiple surveys and quantitative estimates of escapement.



Age composition of 2001 escapements

Data on age composition of the escapement to natural stock indicators are available for some WCVI systems (Table 9). Uncertainty in the data was higher in 2001 due to inability to obtain samples. The available data suggest high variability between systems and that three year-olds dominated the returns in most systems. Visual size observations of spawners corroborate this assessment.

Table 9. Age Composition from scale analysis for extensively surveyed systems along the WCVI. Note: Due to low chinook escapement, capture of chinook was limited.

System	Age 3	Age 4	Age 5	Age 6	Sample Size
San Juan R (A20)	12.4%	37.6%	49.5%	0.5%	218
Sarita R (A23)	51.2%	32.5%	16.3%	0.0%	232
Thornton Creek (A23)	65.1%	29.9%	3.0%	0.0%	101
Unweighted mean	42.9%	33.3%	22.9%	0.2%	546
Standard error about the mean	27.3%	3.9%	23.9%	0.3%	
Nitinat R	37.3%	50.1%	12.0%	0.6%	457
Conuma R	59.0%	17.7%	23.2%	0.1%	696

6.4 Stock Status of WCVI Hatchery Chinook in 2001

Escapement levels in 2001

As indicated in the previous chapter, relative change in the Stamp River/RCH indicator stock is used as an indicator of change in chinook escapement to other WCVI systems. The total Stamp River escapement in 2001 increased by over 500% from the 2000 return.

The other major hatchery systems along the WCVI all showed substantial increases similar to the Stamp. In the Conuma area (including Conuma, Canton, Sucwoa, and Tlupana rivers) the overall increase was approximately 70% relative to 2000. The area was compared as a whole due to potential straying of Conuma hatchery stock into surrounding rivers. For the Nitinat River the increase was 76% relative to 2000 levels.

Terminal returns were calculated for Conuma River and Nitinat River using CWT and otolith marks to apportion the terminal catch to these systems. Age and sex composition of the returns, were derived from biological sampling in the river, hatchery, and fisheries.

The total terminal return of Conuma River chinook was 23,046 including 15,206 natural spawners, 1,981 broodstock for the hatchery, and 5,859 removed in the Area 25 sport fishery. Catch in the sport fishery was based on the presence of thermal marked otoliths. The estimated proportion of hatchery origin chinook in the terminal sport fishery was approximately 65%. The return by age and area is shown in the following table. Female spawners in the river totaled 4,016 which produced an egg deposition in the river of 18.7 million (assuming fecundities of 4,000 at Age 3, 4400 at Age 4, 4800 at Age 5 and 5200 at Age 6).

The sex ratio in the Conuma was 72.6% male and 27.4% female. The scale samples used to generate the age compositions were only from unbiased, first sets or random sets done during broodstock collection. No test seine in the estuary was done. In response to concerns that the sample size in 2000 was inadequate over three times as many samples were collected in 2001 (830 random adults, 42% of the total removals and 5% of the total adult escapement).

Summary of 2001 terminal run of Conuma River chinook based on expanded scale ages.

Fishery	# Age 2	# Age 3	# Age 4	# Age 5	# Age 6	Total (Jacks incl.)
Nootka Sport	139	2,790	1,256	1,116	558	5,859
Hatchery Removals	170	1,068	321	420	2	1,981
Natural Escapement	549	8,641	2,594	3,405	17	15,206
Total Terminal Run	858	12,499	4,171	4,941	577	23,046

In the Nitinat River the terminal run into Area 21/22 totaled 17,725 chinook, including 11,958 natural spawners, 3,827 broodstock removals, 1,211 First Nations food fishery, and 729 sport catch. Female spawners in the river totaled 6,317 which produced an egg deposition in the river of 28 million (assuming fecundities of 4000 at Age 3, 4400 at Age 4, 4800 at Age 5 and 5200 at Age 6).

Nitinat River sex ratio was estimated at 45% male and 55% female. The Nitinat sample only includes the escapement scales. The native food scales were classified as low priority and have not been completed to-date.

Summary of 2001 terminal run of Nitinat River chinook based on expanded scale ages.

Fishery	# Age 2	# Age 3	# Age 4	# Age 5	# Age 6	Total (Jacks incl.)
Sport (A21 & 22)	0	272	365	88	4	729
Native Food	0	452	607	145	7	1,211
Hatchery Removals	18	1420	1908	458	23	3,827
Natural Escapement	472	4284	5754	1378	70	11,958
Total Terminal Run	490	6428	8634	2069	104	17,725

6.5 Forecast Returns for extensively surveyed systems along the WCVI

As indicated in the previous chapter, relative change in the Stamp River/RCH indicator stock is used as an indicator of change in chinook escapement to other WCVI systems. For 2002 an increase in terminal return of approximately 90% is forecast. Females would comprise approximately 40% of the total, reflecting the significant age 4 contribution. Using this information, the outlook for each system is presented in Table 10.

The outlook for natural spawning populations is less clear due to uncertainty in the 2001 spawner estimates. Conditions for counting wild chinook in 2001 were very poor and the projected escapement of 5,500 fish for PSC indicator streams in 2002, which is based on these estimates, is probably biased low. An alternative method of forecasting 2002 returns is based on output from the coastwide chinook model (calibration #0204)[1]. This method estimates that even if the Alaskans harvest their full entitlement, approximately 8000 mature WCVI wild-index chinook will escape to Canadian waters.

This alternate forecast is above the base-period average escapement level of 5,700 chinook for the seven PSC escapement indicator stocks. This level of 5,700 chinook is also the average escapement observed during the 1995 - 1996 period of low returns and extensive management closures (however, note that in 1996 the limiting factor was the extremely low proportion of female spawners in the total escapement). Projecting the expected 40% female contribution in the Stamp River / RCH return to the natural stocks would result in significantly greater numbers of females in the 2002 return compared to 1996.

Table 10. 2002 outlook of total escapement and female spawners in selected WCVI indicator streams assuming a 90% increase from 2001 levels and expected 40% female component in the total return (based on Stamp River / Robertson Creek Hatchery forecast).

AREA	RIVER	2001 adults	2002 adults	2002 females
20	San Juan River	814	1,547	619
21	Gordon River	20	38	15
22	Nitinat River	15295	29,060	11,624
23	Sarita River	1536	2,918	1,167
23	Nahmint River	225	428	171
23	Toquart River	168	319	128
24	Bedwell River	263	500	200
24	Megin River	2	4	2
24	Moyeha River	115	219	88
25	Burman River	96	182	73
25	Gold River	250	475	190
25	Conuma River	16468	31,289	12,516
25	Leiner River	394	749	300
25	Tahsis River	389	739	296
25	Zeballos River	100	190	76
26	Kaouk River	415	789	316
26	Artlish River	139	264	106
26	Tashish River	165	314	126
27	Marble River	1,450	2,755	1,102
27	Colonial / Cayeghle	571	1,085	434

[1] The coastwide CTC chinook model estimates cohort size at age for each stock, including the “all” WCVI natural production. Using the chinook model estimates for this stock (or “model fish”), plus estimated stock composition of the catches of each fishery, we can estimate how many mature model fish will reach the terminal area. To do so, first requires converting model fish to “actual fish” for the PSC seven stock index. Due to changes in counting methodology in 1995, two recent years including 1995 and 1996 were selected for use in the conversion. These two years also represent the lowest “effective” spawning levels recorded prior to 2001. By dividing the mean “model escapement” for 1995 and 1996 (20,000) into the mean PSC index for the same period (5,700) 1 model fish $\cong$ 0.28 actual fish. However, the accuracy of this relationship is unclear, and this conversion should be used with caution.

6.6 Summary and Recommendations for WCVI Systems Outside the Stamp River

- Confidence in the estimates of escapement to natural stock indicators is relatively low in 2001 due to weather related problems. In many systems, the estimates should be considered minimum estimates. In addition, the lack of quantitative parameter estimates such as stream residence times require attention. Current parameters are based on experience from visual clues on the fish. A marking program should be undertaken to more accurately determine what is an acceptable residence time for chinook adults.

- Estimates based on the available data indicated that the total 2001 escapement to the PSC seven indicator stocks was below the established goal and the base period average. Total escapement to all natural stock indicators increased about 60% from 2000 to 2001.

- The 2002 outlook in selected WCVI indicator streams assumes a 90% increase from 2001 levels and expected 40% female component in the total return. The results show most chinook populations along the WCVI with more than 100 females.

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8 Appendices

Appendix Table 1. 2001 Stamp River (Somass) Chinook Terminal Run, Catch and Escapement

			AGE COMPOSITION					
FISHERY	DATE	CATCH	Aged	Age 2	3	4	5	6
ALBERNI INLET FISHERIES								
Alberni Inlet Sport Encounters	(released)	639	releases only, apply 15% mortality rate					
			assume 97% Stamp origin based on 1999 info					
Total Alberni Inlet mortalities		**96**						
Total morts of Stamp R chinook in Alberni		**93**		**0**	**64**	**19**	**10**	**0**
Age composition Stamp chinook only				**0.0%**	**68.6%**	**20.0%**	**11.0%**	**0.5%**
ESCAPEMENT ABOVE STAMP FALLS								
Hatchery broodstock, morts, surplus		35.687		3.463	30.148	1.720	351	5
Inriver escapement, potential spawners		9,370		1,149	5,638	1,642	902	39
ESCAPEMENT TOTAL		**45,057**		**4,612**	**35,786**	**3,362**	**1,253**	**44**
Age composition				**10.2%**	**79.4%**	**7.5%**	**2.8%**	**0.1%**
Escapement of adults only		40,445						
Escapement hatchery component based on expCWT		27.109						
Total inriver female spawners ni pre-spawn morts		2.454						
prespawn mortality adults		351	1%					
Effective natural spawning females		2,103						
Total inriver eggs		9.3M						
BARKLEY SOUND FISHERIES								
A23B Creel Survey Estimated Total Catch CN		0	= catch during RBT migration only, Aug-Sep only					
23B Release		2,160						
A123 Creel Survey Estimated Total Catch CN		9,786						
123 Release		416	does not include releases from CP - not available.					
Barkley Sound Mortalities		**324**						
Total morts of Stamp R chinook in Barkley		**36**		**-**	**25**	**7**	**4**	**0**
TOTAL TERMINAL RUN STAMP CHINOOK		**45,186**		**4,612**	**35,874**	**3,388**	**1,267**	**45**
TOTAL TERMINAL RUN w/o jacks		40,574		**10.2%**	**79.4%**	**7.5%**	**2.8%**	**0.1%**

Appendix Table 2. Total escapement into Stamp River, hatchery and natural spawning.

A. TOTAL COUNT THROUGH STAMP FALLS FISHWAY

	Adults	Jacks	Total Count
Unadjusted Daytime Observations at Stamp Falls:	26538	3348	29886
Adjusted daytime count from tape verification:	26626	3838	30464
Adjusted swim survey count (incl. Hatchery swim-ins):	1272	113	1385
Night time count from tape verification:	12547	661	13208
Adjusted jack count after removal of 'jimmies':		4612	
Final adjusted counts **(above Stamp Falls)**:	**40445**	**4612**	**45057**

B. HATCHERY COMPONENT

	Total Swim-in Populatior	Total Swim-in Sampled	Released	Adipose Clipped	Effective Heads Taken	Sex	C/S	%MI
Males (incl jacks):	34,036							
Adjustment factor (M to J):	-64							
Females:	1,728	1,722	6	33	32	F	1.00	1.92%
Jacks:	3,463	3,463		54	54	J	1.00	1.56%
Adult males:	30,573	30,404	169	589	588	M	1.01	1.94%
Totals:	**35,764**	**35,589**	**175**	**676**	**674**			

CWT composition by sex:

Expansion	Unadjusted Jack	Adjusted Jack	Unadjusted Adult Male	Adjusted Adult Male	Unadjusted Female	Adjusted Female
no data	0		1		1	
lost pins	0	0	4	4.006803	0	0
no pin	2	2	18	18.03061	6	6.1875

		Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males	Observed CWT	52	558	7	1		618	566
	Adjusted observed	52	562.899	7.061	1.009	0.000	623	571
	Estimated	52	566	7	1	0	626	574
	Expanded	1722	19922	172	1			
	Adjusted expanded	1722	20097	173	1		21994	20272
	Average Rel/Tag Value	32	38	34	23	25	152	119
	Average Expanded	1677	21249	240	24	0	23190	21513
	AverageAdjusted Expanded	1677	21436	242	24		23379	21702
Female	Observed CWT		17	4	5		26	26
	Adjusted observed	0.000	17.531	4.125	5.156	0.000		
	Estimated	0	18	4	5	0	27	27
	Expanded		670	287	97		1054	1054
	Adjusted expanded		691	296	100		1087	1087
	Average Rel/Tag Value	32	38	34	23	25	152	119
	Average Expanded	0	660	140	121	0	922	922
	AverageAdjusted Expanded		681	144	125		950	950
TOTAL (swim-in)	Adjusted Expanded	1722	20788	470	101	0	23081	21359
	AverageAdjusted Expanded	1677	22117	386	149	0	24329	22652
TOTAL (incl GCL)	Adjusted Expanded	1722	20788	470	101	0	23081	21359

Scale Age composition (from biosample fish only, excluding cwt samples):

	Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males	97	348	23			468	371
Females		166	176	68	1	411	411
Female/ dam						0	0

Pooled Age composition (est cwt + scale by age)/(total sample adults only) excluding GCL:

	Age 2	Age 3	Age 4	Age 5	Age 6	Total	ttl sample
Males		96.7%	3.2%	0.1%	0.0%	100%	945
Females		41.9%	41.1%	16.7%	0.2%	100%	438

Age composition based on Expanded CWT % (including jacks):

	Age 2	Age 3	Age 4	Age 5	Age 6	Total
Males	7.8%	91.4%	0.8%	0.0%	0.0%	100.0%
Females	0.0%	63.5%	27.3%	9.2%	0.0%	100.0%
Female/ dam						

TOTAL SWIM-INS TO HATCHERY BY AGE - including releases (based on pooled samples):

	Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males (swim-in)	3463	29567	974	33	0	34036	30573
Females (swim-in)	0	724	711	289	4	1728	1728
Total (swim-in)	3463	30291	1685	322	4	35764	32301
% hatchery (exp cwt) - swim-ins only	*50%*	*69%*	*28%*	*31%*	*0%*	*65%*	*66%*
% hatchery (exp cwt) - using avg rel/tag	*48%*	*73%*	*23%*	*46%*	*0%*	*68%*	*70%*
% hatchery (otolith)- swim-ins only							
Otolith sample size							

NET RETURN TO HATCHERY BY AGE - excluding releases (based on pooled samples):

	Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males (swim-in)	3463	29403	968	33	0	33867	30404
Females (swim-in)	0	722	708	288	4	1722	1722
Total (swim-in)	3463	30125	1677	320	4	35589	32126
Females from GCL	0	8	16	11	1	36	36
Females from Sport	0	15	27	19	1	62	62
Total	3463	30148	1720	351	5	35687	32224

0.946 Sex Ratio (Adult Males/Total Adult):

0.102 Ratio of Jacks to Total Males:

C. INRIVER POPULATION (excludes hatchery releases)

INRIVER:	Total spawners:	9,293	=Escapement estimate-hatchery, includes jacks
	River Adults:	8,144	=Escapement estimate-hatchery
	In-river Jack estimate (a):	1,149	=Escapement estimate-hatchery
	Number of males(excl jacks):	6,747	=total inriver * unweighted pooled sex ratio
	Alternate in-river jack est (b):	690	=based on jack/male ratio in hatchery

0.711 =Sex ratio in sample(Adult males / Total Adult)

0.828 = Unweighted males (pooled Hatchery & River)

	River Sample Popn.	Total River Sampled	Adipose Clipped	Effective Heads Taken	Sex	C/S Rate	%MI
Females:	2,546	407	4	4	F	6.26	0.98%
Chosen jack est (a):	1,149	108	3	3	J	10.64	2.78%
Adult males:	5,598	999	22	22	M	5.60	2.20%

CWT composition by sex:

Expansion	Unadjusted Jack	Adjusted Jack	Unadjusted Adult Male	Adjusted Adult Male	Unadjusted Female	Adjusted Female
no data	0		0		0	
lost pins	0	0	1	1	0	0
no pin	0	0	0	0	0	0

		Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males	Observed CWT	3	19	1	1		24	21
	Adjusted observed	3	19.905	1.048	1.048	0.000	25	22
	Estimated	32	112	6	6	0	155	123
	Expanded	1075	3775	158	161			
	Adjusted expanded	1075	3954	166	169		5364	4289
	Average Rel/Tag Value	32	38	34	23	25	152	119
	Average Expanded	1029	4187	198	138	0	5553	4523
	AverageAdjusted Expanded	1029	4387	208	144		5768	4739
Female	Observed CWT			3	1		4	4
	Adjusted observed	0.000	0.000	3.000	1.000	0.000		
	Estimated	0	0	19	6	0	25	25
	Expanded			206	180		386	386
	Adjusted expanded			206	180		386	386
	Average Rel/Tag Value	32	38	34	23	25	152	119
	Average Expanded	0	0	633	147	0	780	780
	AverageAdjusted Expanded			633	147		780	780
TOTAL (river)	Total Adjusted Expanded	1,075	3,954	372	348	-	5,750	4,675
	Total Avg. Adjusted Expand	1029	4387	841	291	0	6548	5519

Scale Age composition (number at age in sample - jacks applied directly):

	Age 2	Age 3	Age 4	Age 5	Age 6	Ttl Jacks	Total Adults
Males	-	314	42	7		-	363
Females	0	74	121	91	5	0	291

Pooled Age composition (est cwt + scale by age)/(total sample adults only):

	Age 2	Age 3	Age 4	Age 5	Age 6	Total
Males	100.0%	87.5%	9.8%	2.6%	0.0%	100.0%
Females		23.4%	44.2%	30.8%	1.6%	100.0%

In-River return of 'Sample Population' by age (based on pooled samples, include jack estimate directly):

This excludes hatchery swim-ins released back to the river.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult	Total eggs taken
Males	1149	4899	551	148	0	6747	5598	
Females	0	596	1126	784	40	2546	2546	
Total	1149	5495	1677	932	40	9293	8144	**7,422,695**
% hatchery (exp cwt)	*94%*	*72%*	*22%*	*37%*	*0%*	*62%*	*57%*	
% hatchery (exp cwt) - using avg rel/tag	*90%*	*80%*	*50%*	*31%*	*0%*	*70%*	*68%*	
% hatchery (otolith)								
Otolith sample size								

Appendix Table 2 cont'd. Total escapement into Stamp River, hatchery and natural spawning.

D. TOTAL ESCAPEMENT RUN TO STAMP RIVER <u>ABOVE</u> STAMP FALLS (spawning esc. + prespawn morts + hatchery & sport rod removals).

		Age 2	Age 3	Age 4	Age 5	Age 6	Total	Ttl adult
Males	-	4612	34465	1525	181	0	40783	36171
Females	-	0	1321	1837	1072	44	4274	4274
Total	**-**	**4612**	**35786**	**3362**	**1253**	**44**	**45057**	**40445**
Total adjusted expanded CWT		2797	24742	842	449	0	28831	26033
% hatchery (exp cwt)		*61%*	*69%*	*25%*	*36%*	*0%*	*64%*	*64%*
Total avg. adjusted expanded CWT		2707	26504	1227	440	0	30878	28171
% hatchery (exp cwt)-using avg rel/tag		*59%*	*74%*	*36%*	*35%*	*0%*	*69%*	*70%*
% hatchery (otolith)								
% Return At Age (adults)								

<u>notes:</u>

total fishway count includes swim count Sep 6, fishway sep 6 - nov 9

fishway counts were adjusted for observer error

fishway counts were adjusted for night time migration (using night time video)

total run into hatchery is that killed for broodstock,surplus, etc....all sampled for marks...all others released

assume released chinook are part of river number, but never part of any sample.

note: GCL broodstock. Samples captured and released directly above the dam were not considered as part of the sample.

note: inriver c/s. Hatchery releases excluded as part of sample popn. They are added in lower down.

Appendix Table 3. Total escapement into the Stamp River, including natural spawners, potential eggs, and hatchery removals during the period of the intensive "keystream" surveys, 1985-2001. The 2002 forecast of potential eggs is total eggs for hatchery and inriver spawning and does not make assumptions of any prespawn mortality.

Return Year	Total Natural Spawners Incl jacks	Total Natural Adult Spawners	Best Estimate Inriver Egg Deposition	Total Hatchery Swimins	Total Adults in Hatchery	Total Adult Escapement
1985	74,941	74,279	167,282,000	19,076	18,875	93,154
1986	29,306	29,306	69,225,560	13,935	6,983	36,289
1987	15,454	14,491	9,744,800	38,694	36,156	50,647
1988	62,411	54,305	112,514,000	14,533	12,505	66,810
1989	50,990	44,786	67,998,400	28,929	18,258	63,044
1990	81,840	76,064	107,049,600	45,850	35,998	112,062
1991	96,907	85,843	149,254,400	35,354	30,425	116,268
1992	119,986	117,248	248,124,800	25,126	24,398	141,646
1993	77,644	76,487	176,551,600	20,415	20,043	96,530
1994	47,498	46,605	120,852,800	11,132	11,105	57,710
1995	25,460	23,313	80,042,198	4,990	4,522	27,834
1996	11,121	9,410	8,631,450	18,829	17,920	27,330
1997	13,623	12,785	14,140,245	19,415	19,309	32,095
1998	28,263	28,044	60,617,712	11,876	11,847	39,891
1999	15,375	15,312	47,199,407	2,162	2,137	17,449
2000	4,034	3,506	10,100,000	5,307	2,907	6,413
2001	9,293	8,221	10,884,559	35,687	32,224	40,445
2002 forecast			140,000,000			80,297

Appendix Table 4. Coded-wire tag groups utilized in the cohort analyses for this analysis. The format of this listing is by Brood Year followed by the 6-digit tag code. Tag codes are selected to represent "production" and "both production and experimental" releases from the facility and are reviewed by Stock Assessment Division and the Salmonid Enhancement Program.

@83 (Brood year)
022662
022663
022708
022753
082247
082248
@84
023131
023132
023133
023134
023135
023136
023142
023143
023144
023145
023151
023203
023204
023206
023208
023304
@85
023734
023735
023736
023737
023738
023739
023740
023741
@86
024256
024257
024361
024362
024363
024401
@87
024311
024802
024809
024810
024951
024952
024958
024959
@87(continued)
024960
024961
025326
025327
025328
025329
@88
025014
025836
025837
025838
025839
026055
026056
026057
@89
020645
020646
020950
020949
020948
020648
020647
020153
020152
020151
@90
021549
021550
021551
021552
021553
021208
021209
@91
180620
180621
180622
180623
180802
180803
180804
180805
@92
180259
180260
180261
180262
180624
180625
180626
180627
@93
181539
181540
181541
181542
181543
181544
181545
181546
@94
181455
181456
181457
181458
181459
181460
182220
182221
182222
182223
182224
182225
@95
182226
182227
182228
182229
182230
182231
182502
182503
182504
182505
182506
182507
182508
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182233
182234
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182543
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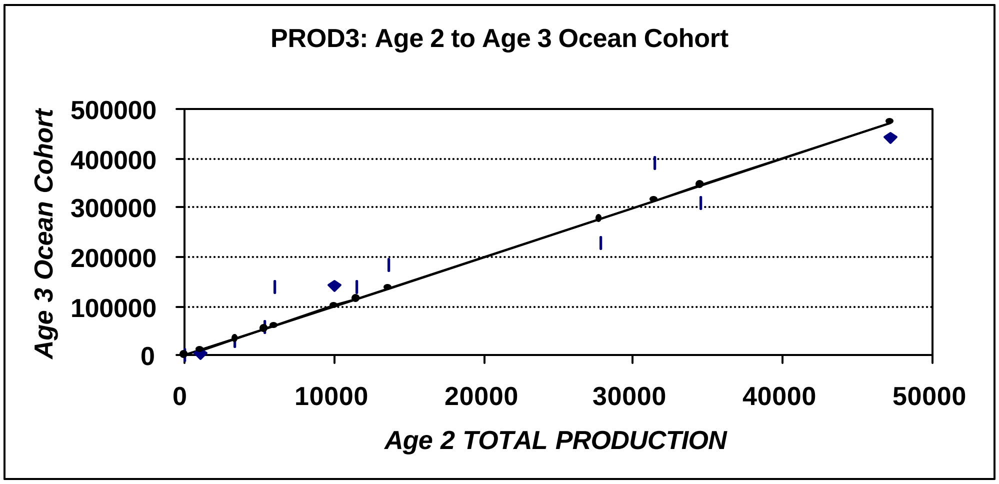
182544
182545
182546
182547

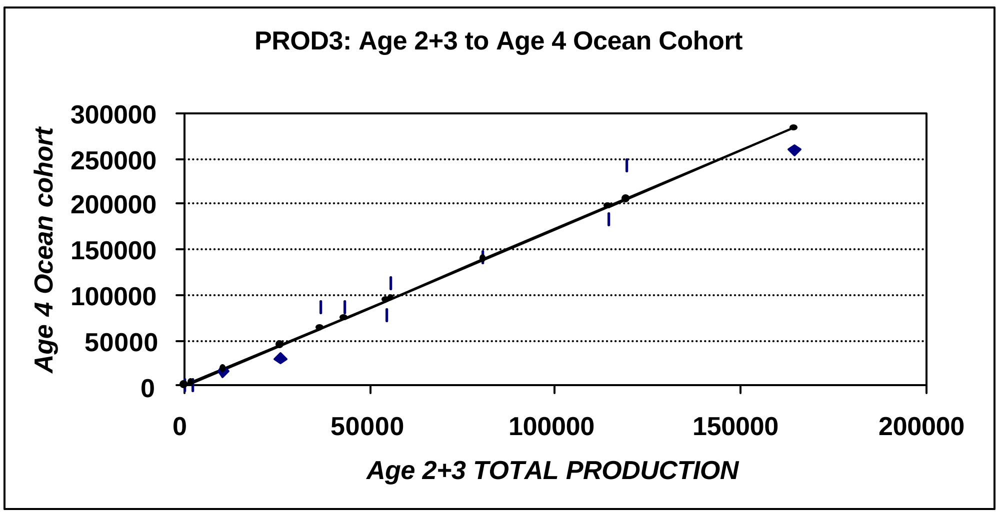
@97
182814
182815
182816
182817
183153
183154
183155
183156
183157
183158

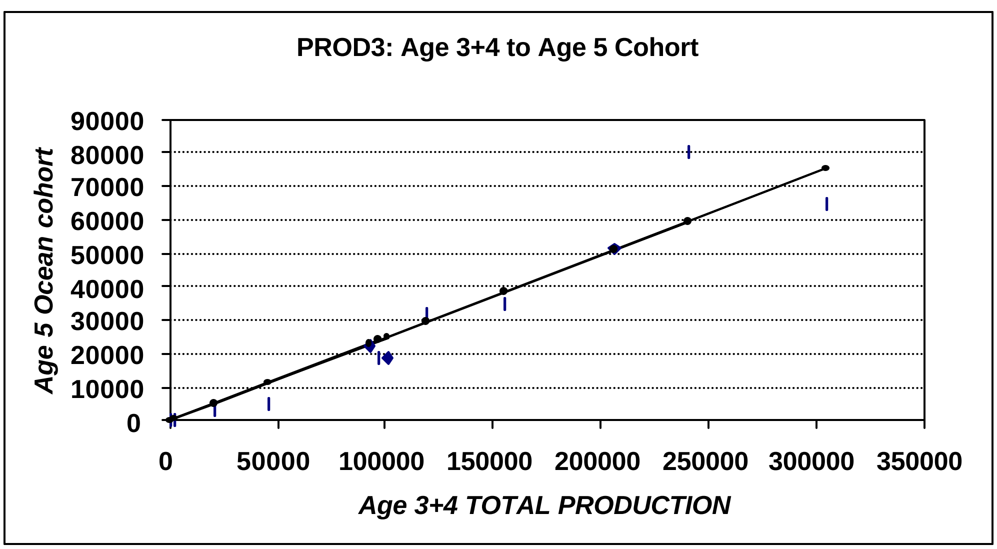
@98
180362
180363
183432
183433
183434
183831

@99
182160
182161
182162
182163
184541
184605
184606

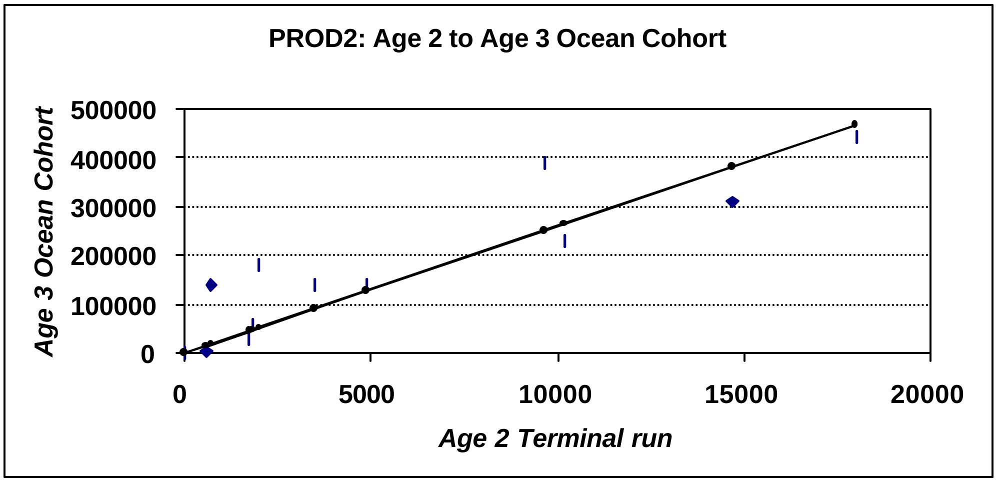
Appendix Figure 1. Model "Prod3" sibling relationships.

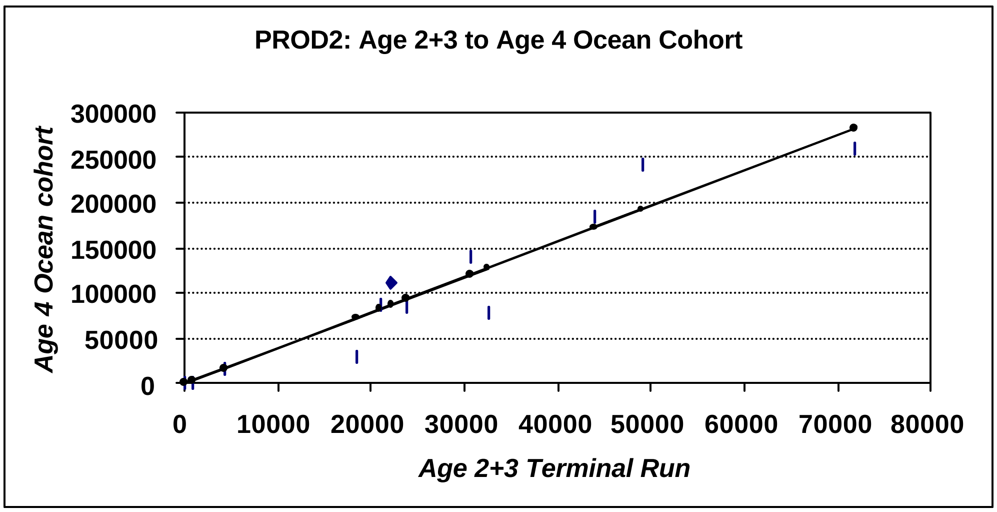


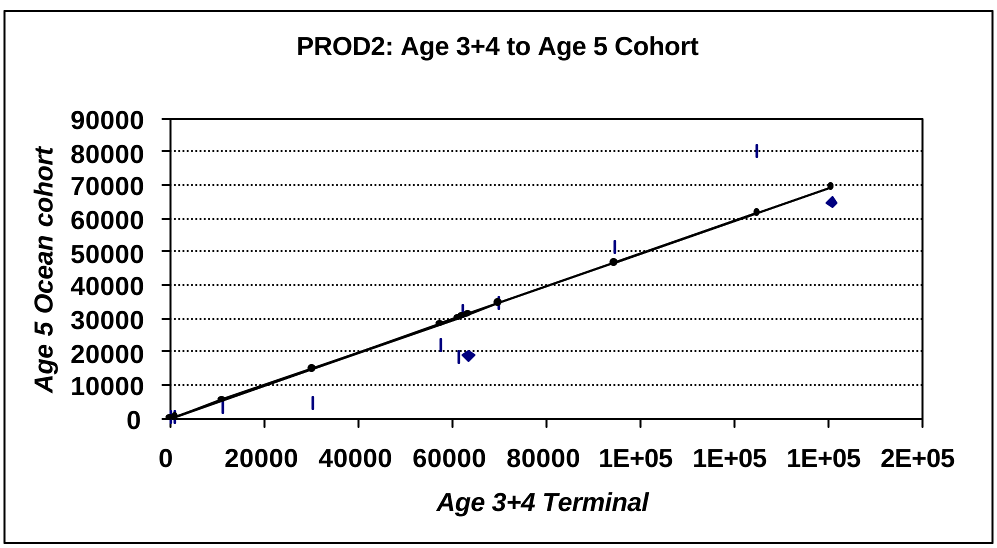


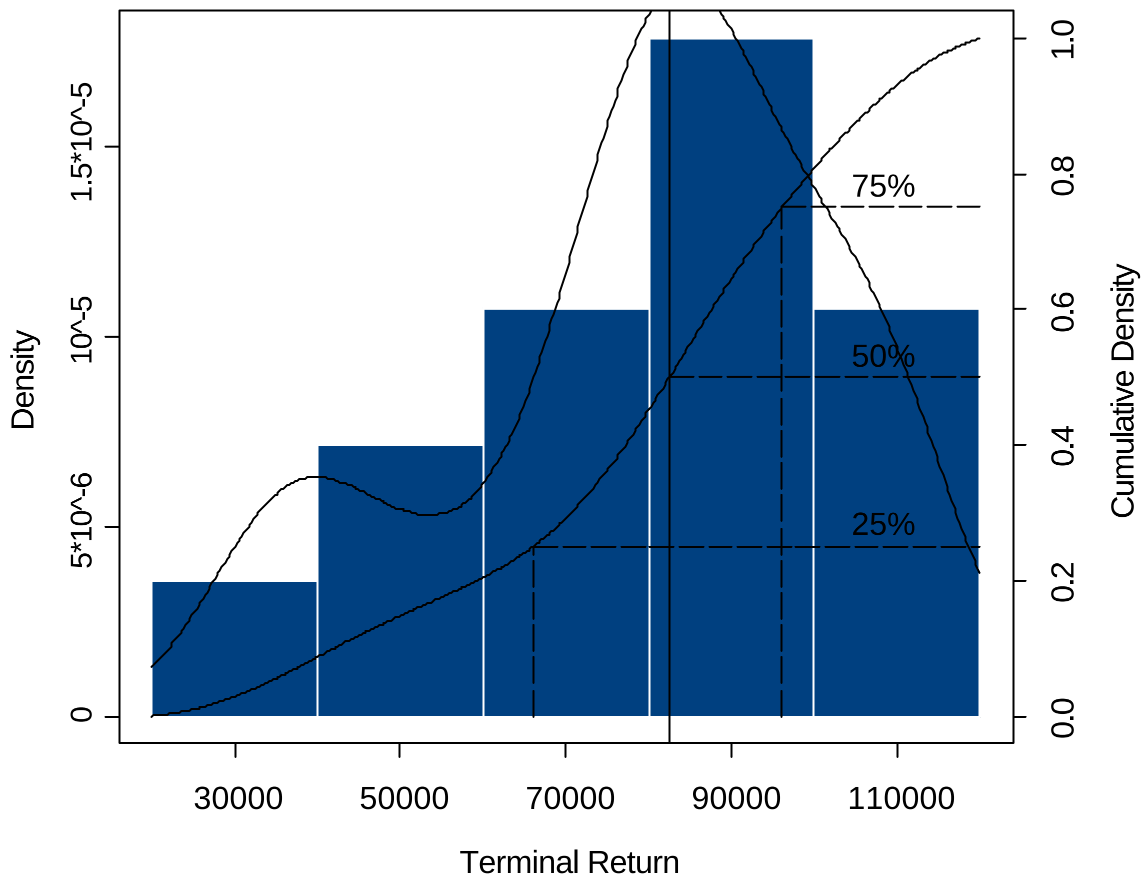


Appendix Figure 2. Model "Prod2" sibling relationships.









Appendix Figure 3. Cumulative probability distribution of the “average” forecast (average of Prod2 and Prod3) for the year 2002 terminal run to the Stamp River/RCH indicator chinook stock (WCVI). Horizontal dashed lines represent the 25%, 50%, and 75% cumulative probabilities.

Appendix Table 5. Estimated 2001 impact on Stamp River / RCH chinook in B.C. fisheries based on otolith identification of RCH chinook.

FISHERY AND CATCH IN 2001						ESTIMATED IMPACT IN 2001 FISHERIES						FORECAST
Area	Month	# CN caught	#CN released	# CN kept, <77cm	# CN kept 77cm+	sample size	%RCH all brood years	#RCH from total kept, release mort	ER using total RCH	#RCH age 4+	ER using age 4+ only	Expected 2002 Impact
Langara	6	6,987	13525	3,494	3,494		0.7%	64	0.15%	7	0.13%	0.16%
Langara	7	6,992	9,255	3,496	3,496	143	0.7%	59	0.14%	7	0.12%	0.15%
Langara	8	5,754	4,831	2,877	2,877	106	8.5%	555	1.30%	64	1.13%	1.41%
Langara	9	995	221	498	498	14	7.1%	74	0.17%	9	0.15%	0.19%
2W	6	229	98	115	115		0.7%	2	0.00%	0	0.00%	0.00%
2W	7	440	-	220	220		0.7%	3	0.01%	0	0.01%	0.01%
2W	8	2,968	914	1,484	1,484		8.5%	266	0.62%	31	0.54%	0.68%
2W	9	40	-	20	20		7.1%	3	0.01%	0	0.01%	0.01%
NTR	4,5	1,333			1,333	390	1.3%	17	0.04%	2	0.04%	0.04%
NTR	6,7	2,300			2,300		1.3%	30	0.07%	3	0.06%	2.12%
NTR	8,9	8,436			8,436		2.6%	221	0.52%	26	0.45%	0.52%
27	6	174	429	17	157		0.0%	-	0.00%	-	0.00%	0.00%
27	7	73	97	24	49	from 126	1.2%	1	0.00%	0	0.00%	0.01%
27	8	198	3,168	35	163	from 126	2.4%	16	0.04%	2	0.03%	0.10%
26	7	61	136	34	27		0.0%	-	0.00%	-	0.00%	0.00%
26	8	36	16	31	5		2.4%	1	0.00%	0	0.00%	0.01%
126	6	33	-	33	-		0.0%	-	0.00%	-	0.00%	0.00%
126	7	697	617	341	356		1.2%	10	0.02%	1	0.02%	0.06%
126	8	455	631	284	171	41	2.4%	13	0.03%	2	0.03%	0.08%
25	6	134	-	126	8		0.0%	-	0.00%	-	0.00%	0.00%
25	7	2,116	177	1,206	910	39	0.0%	-	0.00%	-	0.00%	0.00%
25	8	3,609	87	3,032	577	33	0.0%	-	0.00%	-	0.00%	0.00%
25	9	-	462	462	-		0.0%	-	0.00%	-	0.00%	0.00%
125	7	2,467	-	2,467	-	23	8.7%	217	0.51%	25	0.44%	1.32%
125	8	156	-	117	39		0.0%	-	0.00%	-	0.00%	0.00%
124	4	22	-	22	-		0.0%	-	0.00%	-	0.00%	0.00%
124	5	35	-	35	-		0.0%	-	0.00%	-	0.00%	0.00%
124	6	1,148	142	608	540		0.0%	-	0.00%	-	0.00%	0.00%
124	7	2,032	237	1,077	955		0.0%	-	0.00%	-	0.00%	0.00%
124	8	1,233	541	653	580	298	4.0%	53	0.12%	6	0.11%	0.11%
124	9	116	-	116	-		4.0%	5	0.01%	1	0.01%	0.01%
123	3	7		7	-		0.0%	-	0.00%	-	0.00%	0.00%
123	4	209		31	178		0.0%	-	0.00%	-	0.00%	0.00%
123	5	468		150	318		0.0%	-	0.00%	-	0.00%	0.00%
123	6	6,084	2,930	3,285	2,799		0.0%	-	0.00%	-	0.00%	0.00%
123	7	6,396	75	4,157	2,239	6	0.0%	-	0.00%	-	0.00%	0.00%
123	8	5,277	416	2,427	2,850	298	4.0%	215	0.50%	25	0.44%	0.44%
123	9	4,509	-	2,976	1,533	8	4.0%	182	0.43%	21	0.37%	0.37%
23A	8-9	-	650	-	-		100.0%	98	0.23%	11	0.20%	
23B	6	2,557	1,732	2,225	332		0.0%	-	0.00%	-	0.00%	0.00%
23B	7	4,749	1,410	3,562	1,187		0.0%	-	0.00%	-	0.00%	0.00%
23B	8-9	-	2,160	-	-	7	11.0%	36	0.08%	4	0.07%	2.00%
21	7	154	-	154	-		0.0%	-	0.00%	-	0.00%	0.00%
21	8	305	78	227	156		0.0%	-	0.00%	-	0.00%	0.00%
21	9	100	-	49	51		0.0%	-	0.01%	-	0.00%	0.00%
WCVI TR	9	18,682	3,111			32	0.0%	-	0.00%	-	0.00%	0.00%
WCVI FN								-	0.00%	-	0.00%	1.00%
Totals		100,766				1,438		2,141	5.02%	248	4.35%	10.78%
		Total Catch in Canada + Escapement adult Stamp chinook						42,715	5.01%	5,703	4.35%	