



REVIEW OF 2005 WCVI CHINOOK SALMON RETURNS AND FORECAST ABUNDANCE FOR STAMP RIVER / ROBERTSON CREEK HATCHERY INDICATOR STOCK IN 2006

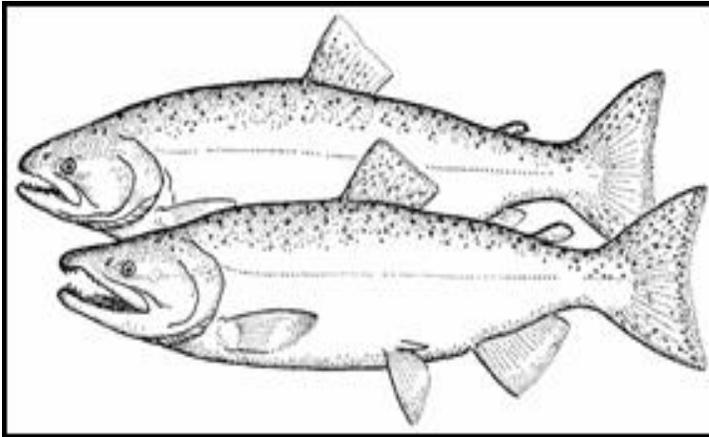


Figure 1: Chinook salmon adults.

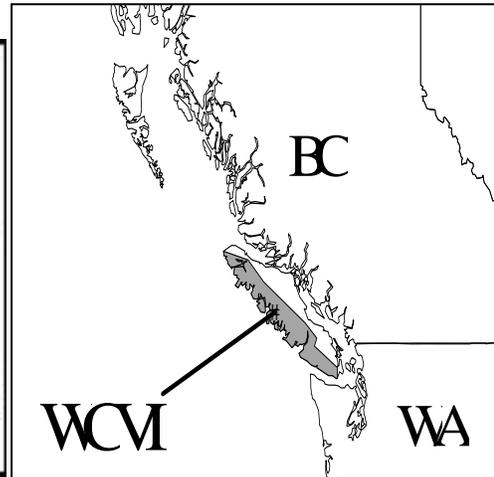


Figure 2: The Province of British Columbia showing the west coast of Vancouver Island (WCVI).

Context

The Stamp River/Robertson Creek Hatchery (RCH) Chinook salmon (*Oncorhynchus tshawytscha*) stock is a key indicator stock for exploitation rate and distribution pattern of west coast Vancouver Island (WCVI) populations. The intensive assessments of the WCVI hatchery and natural population aggregates and abundance forecast for the Stamp River/RCH are undertaken annually for indication of stock status and management of ocean and terminal fisheries. The forecasts are key inputs to the annual PSC Chinook model calibration which calculates abundance indices and associated allowable catch levels for the WCVI and Northern BC AABM fisheries. The forecasts also contribute to the management of other Canadian and US fisheries.

SUMMARY

- The 2005 terminal return to the Stamp River/RCH indicator stock was estimated to be 100,000 adults and 6,600 jacks (age-2 males), approximately 30% less than the 2004 return.
- When compared to 2004 returns, 2005 returns decreased 50% for the 6 PSC indicator stocks in northwest Vancouver Island and 60% for all WCVI systems. Some populations remain low with fewer than 100 spawners.
- The 2005 Canadian ocean exploitation rate was 19% and the terminal exploitation rate was 27%, based on an analysis of coded wire tags (CWTs).
- The 2006 forecast total return of Stamp River/RCH Chinook, in the absence of Canadian ocean fisheries, is 115,600 adults to the terminal area of Barkley Sound and Alberni Inlet.

The 2006 forecast represents a 25% decrease in total return to Canada over 2005 (based on modeled total mortality).

- In 2006, age-4 and age-5 components are forecast to comprise 74% of the terminal run (25% age-3, 28% age-4, and 46% age-5), with an expected sex ratio of 50%.

INTRODUCTION

Detailed assessments and forecasts of the Stamp/RCH indicator stock are required annually for management and as an indicator of the status and expected returns to the naturally spawning WCVI populations. Assessment and forecasting requires accurate information for the Stamp River/RCH indicator stock. Sampling of ocean fisheries provides CWT data to determine exploitation rates. Intensive terminal assessment programs, including catch and escapement monitoring and sampling are conducted in Pacific Fisheries Management Area (PFMA) 23 to determine the terminal catch and escapement of the indicator stock.

An abundance forecast by age is calculated for the Stamp River/RCH indicator stock as well as the minimum escapement required to reach the egg targets for RCH brood stock and Stamp River spawners. The annual assessment includes monitoring escapement and providing an outlook for the WCVI natural escapement indicator stocks.

ASSESSMENT

Terminal Return

The terminal run is defined as catch in PFMA 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 estimate the terminal run at 106,586 Stamp River/RCH Chinook (Table 1). About 6% of the run was age-2 jacks, and females accounted for 45% of the adult return.

The Stamp River/RCH stock is the main indicator for the WCVI stock group. Management actions taken to achieve goals for this stock are supposed to have similar effects on other WCVI stocks. Spawning levels of 18 other WCVI Chinook escapement indicator stocks are monitored by an extensive spawner survey program. The results are the basis for the overall assessment of status of WCVI Chinook stocks. In most systems the numbers of spawners decreased relative to 2004 levels (Figure 3). Returns for the 6 PSC indicator stocks in northwest Vancouver Island decreased about 50% from 2004 levels. Returns for all WCVI systems decreased by 60% relative to 2004 and some populations remain low with fewer than 100 spawners.

Cohort Analysis

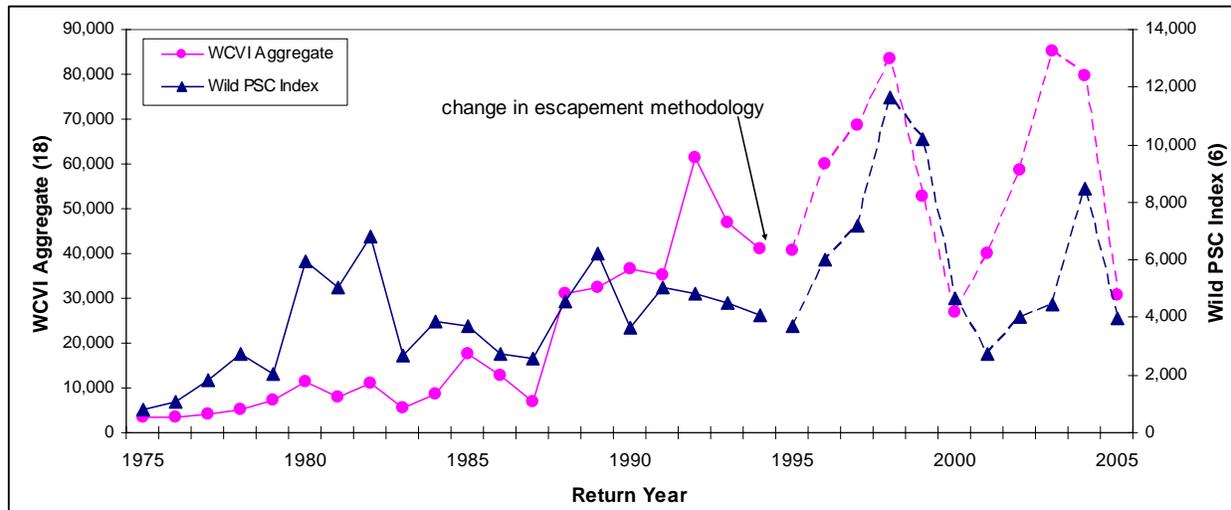
The analytical framework for forecasting returns of Stamp River/RCH Chinook has been previously reviewed in Riddell et al. (PSARC X96-01). Cohort analyses for 1983-2003 RCH brood releases were completed using recoveries of select CWT from fisheries and escapement to the hatchery and the Stamp River.

Table 1. Summary of the 2005 terminal run of Stamp River Chinook, including jacks (age-2) and adults (ages 3-6).

Fishery	#Age 2	#Age 3	#Age 4	#Age 5	#Age 6	Total Adult	Total
Alberni Inlet Sport	0	486	5,823	1,456	970	8,735	8,735
First Nations	52	2,316	24,987	2,885	51	30,239	30,291
Commercial GN	0	831	8,553	914	123	10,421	10,421
Commercial SN	393	840	3,103	384	26	4,354	4,747
Barkley Sound Sport	167	4,307	2,777	1,170	0	8,255	8,422
Hatchery Returns	2,054	2,952	3,528	334	14	6,828	8,882
River Escapement ¹	4,274	6,147	22,841	1,588	239	30,815	35,089
Total Terminal Run	6,940	17,879	71,612	8,731	1,424	99,647	106,586
Percent at age	7%	17%	67%	8%	1%		

¹ Stamp River only, includes prespaw mortality

Figure 3. Trends in adult Chinook escapement to 6 wild PSC indicators and combined wild indicators and extensively surveyed systems along the WCVI.



The cohort analysis provides estimates of brood year survival and annual exploitation rates (including total fishing mortality). Marine survival rates (Table 2) improved for brood years 1997–2001, but have declined recently to less than 2% (2002 and 2003).

Ocean exploitation rates, including Alaskan fisheries, averaged about 35% since conservation actions were first taken in 1995, compared to 48% prior to 1995 (Table 3). In 2005, the total fishing mortality in ocean fisheries, based on CWTs, was estimated to be 44% including 19% in Canada (excluding Barkley Sound harvest from WCVI sport after August 1st) and 25% in Alaska. Terminal exploitation was 27.1%. It is likely that only the Nahmint River population in Alberni Inlet would be subject to this additional level of exploitation. Exploitation will likely be lower for other WCVI populations since they would be subjected to fewer terminal fisheries.

Table 2. Estimated survival rates (smolts released to Age 2 pre-fishing cohort) of CWT groups released from RCH by brood year. Survival to Age-2 cohort includes all recoveries, estimated incidental fishing mortality, and annual rates of natural mortality for all ages (ages 2-5).

Brood Year	Estimated % Survival Rate for Age-2 cohort CWT groups
1983	0.1%
1984	4.5%
1985	4.3%
1986	12.2%
1987	10.4%
1988	13.0%
1989	9.3%
1990	5.7%
1991	1.0%
1992	0.0%
1993	2.2%
1994	4.9%
1995	0.4%
1996	0.2%
1997	0.1%
1998	3.5%
1999	6.4%
2000	4.4%
2001	7.7% incomplete brood
2002	1.9% incomplete brood
2003	1.8% incomplete brood

Forecast

Riddell et al. (PSARC X96-01) outlined the analytical framework for forecasting returns of Stamp River / RCH Chinook, and this forecast follows those same procedures. The forecast is based on the average return from two sibling regression models that use terminal returns (Model Prod 2) or total production (Model Prod 3) of younger age classes to predict subsequent age classes. The total cohort size available to ocean fisheries is presented in Table 4 as "Pre-fishery abundance". Management scalars were applied to 1984-90 brood year average exploitation rates in Alaskan fisheries, based on an expected 346,800 total allowable catch (PSC Chinook Model Calibration 0604, SEAK Abundance Index =1.69) to determine impacts on the WCVI stocks. Assuming no fisheries in Canada and based on recent average maturation rates (0.17 for Age 3, and 0.60 for Age 4), the remaining cohort was assigned to the expected terminal run, or to the surviving cohort remaining at sea. The 2006 terminal run in the absence of Canadian fisheries is forecast to be 115,600 adult Chinook composed of 50% females. A cumulative probability distribution for the average forecast indicates the forecast return at 50% probability of occurrence is approximately 98,400 adult Chinook, and the 50% confidence bound on that estimate is 76,800 to 116,600.

Changes in the RCH indicator stock indicate production changes in the WCVI natural populations. Given the reduced 2005 escapement, declining marine survivals for brood years 2002 and 2003, and the smaller size of these populations, it would be appropriate to maintain caution in managing these WCVI natural populations during 2006.

Table 3. Distribution of total fishing mortality for RCH Chinook stock; based on CWT cohort analysis through 2005. Some fisheries with very few recoveries have been combined, e.g. Southern US nets and Southern US sport.

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	Geo ST Sport	South US Sport	Term Net	Term Sport	Total Ocean Fishing Mortality	Total Fishing Mortality	Escape
1985	15.2%	15.6%	0.5%	1.9%	14.9%	3.8%	1.8%	1.7%	0.0%	0.1%	0.0%	0.7%	0.0%	1.3%	16.0%	56.2%	73.6%	26.4%
1986	18.2%	9.0%	1.5%	4.4%	12.1%	3.1%	0.9%	0.2%	0.6%	1.0%	1.3%	0.0%	1.0%	0.5%	20.5%	53.3%	74.3%	25.8%
1987	11.5%	7.6%	2.9%	2.9%	4.0%	2.2%	1.0%	0.4%	0.9%	0.6%	0.4%	0.5%	0.1%	0.7%	18.8%	35.0%	54.5%	45.5%
1988	12.4%	8.7%	1.6%	4.8%	4.3%	1.8%	0.2%	0.3%	1.4%	1.1%	4.4%	0.6%	0.2%	7.3%	12.9%	41.9%	62.0%	38.0%
1989	13.5%	8.9%	1.4%	3.3%	6.5%	1.0%	1.0%	0.1%	1.4%	1.0%	1.6%	0.7%	0.1%	15.8%	14.5%	40.5%	70.9%	29.1%
1990	19.2%	8.8%	2.5%	7.6%	3.6%	1.5%	0.6%	0.0%	1.8%	0.9%	1.9%	0.3%	0.1%	8.5%	7.9%	48.8%	65.2%	34.8%
1991	19.5%	9.4%	2.8%	5.9%	2.7%	0.6%	0.6%	0.0%	3.1%	0.8%	1.1%	0.3%	0.1%	12.8%	12.0%	46.7%	71.5%	28.5%
1992	16.8%	7.4%	2.8%	17.8%	7.9%	0.8%	0.3%	0.1%	1.8%	1.4%	2.0%	0.1%	0.1%	0.4%	5.4%	59.3%	65.1%	34.9%
1993	15.7%	7.3%	2.0%	13.7%	2.1%	0.4%	0.8%	0.0%	2.6%	1.4%	2.6%	0.5%	0.1%	7.1%	12.9%	49.3%	69.3%	30.7%
1994	18.1%	9.0%	1.0%	5.2%	4.6%	1.0%	0.2%	0.0%	3.6%	1.1%	4.2%	0.4%	0.1%	11.6%	16.6%	48.4%	76.7%	23.4%
1995	17.4%	3.6%	0.4%	1.7%	0.1%	0.4%	0.1%	0.2%	5.1%	1.4%	3.1%	1.4%	0.0%	6.6%	10.0%	35.0%	51.6%	48.4%
1996	14.8%	2.9%	0.7%	1.7%	1.4%	0.1%	0.0%	0.0%	5.8%	5.3%	0.6%	1.5%	0.0%	0.4%	0.0%	34.7%	35.1%	64.9%
1997	13.4%	5.0%	1.8%	0.1%	6.2%	0.4%	0.1%	0.0%	4.5%	3.2%	2.0%	0.6%	0.0%	6.0%	16.8%	37.5%	60.4%	39.6%
1998	16.7%	6.0%	0.1%	0.0%	3.1%	0.0%	0.0%	0.0%	5.0%	2.3%	3.3%	0.6%	0.0%	4.0%	16.0%	37.3%	57.4%	42.6%
1999	12.7%	3.3%	0.2%	0.0%	0.9%	0.0%	0.0%	0.0%	8.0%	3.2%	3.6%	0.9%	0.0%	6.7%	19.6%	32.7%	59.0%	41.0%
2000	12.3%	1.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%	9.3%	1.4%	3.0%	0.0%	0.1%	0.2%	30.3%	30.6%	69.4%
2001	8.8%	0.8%	0.1%	0.0%	1.4%	0.0%	0.0%	0.0%	3.5%	3.6%	2.5%	2.1%	0.0%	0.4%	1.9%	22.7%	25.0%	75.0%
2002	15.1%	3.1%	0.1%	0.3%	3.9%	0.0%	0.0%	0.0%	2.4%	5.4%	2.1%	0.8%	0.0%	7.8%	6.9%	33.5%	48.1%	51.9%
2003	12.5%	0.9%	0.0%	0.0%	6.0%	0.0%	0.0%	0.0%	3.2%	10.4%	4.6%	0.6%	0.0%	2.7%	17.8%	38.1%	58.5%	41.5%
2004	10.8%	2.1%	0.0%	0.1%	18.2%	0.0%	0.0%	0.0%	2.4%	5.6%	1.4%	1.3%	0.1%	10.4%	12.7%	42.0%	65.1%	34.9%
2005	15.9%	3.1%	0.0%	0.0%	4.9%	0.0%	0.0%	0.0%	4.1%	13.4%	2.0%	0.8%	0.0%	17.6%	9.5%	44.1%	71.2%	28.8%
Average																		
1985-94	16.0%	9.2%	1.9%	6.8%	6.3%	1.6%	0.7%	0.3%	1.7%	0.9%	1.9%	0.4%	0.2%	6.6%	13.8%	47.9%	68.3%	31.7%
1995-04	13.7%	2.9%	0.3%	0.4%	4.2%	0.1%	0.0%	0.0%	4.2%	5.7%	2.4%	1.2%	0.0%	5.7%	10.1%	35.2%	51.1%	48.9%

Table 4. Summary of the 2006 forecast abundance and terminal run size of Stamp River/RCH Chinook salmon with no Canadian fisheries.

	Pre-Fishery Abundance	Terminal Run with no Canadian Fisheries	Age composition
1. Model Prod 2 (Terminal vs Total Production)			
2003 brood	180,022	29,188	24%
2002 brood	70,824	36,923	30%
2001 brood	67,333	55,643	46%
Total	318,179	121,754	
2. Model Prod 3 (Total vs Total Production)			
2003 brood	77,469	12,560	14%
2002 brood	55,147	28,750	31%
2001 brood	62,267	51,456	55%
Total	194,882	92,766	
3. Average of Models Prod2, Prod3 (2003 brood based on Prod2 model only)			
2003 brood	128,745	29,188	25%
2002 brood	62,985	32,836	28%
2001 brood	64,800	53,550	46%
Total	256,531	115,574	

ADDITIONAL STAKEHOLDER PERSPECTIVES

WCVI Chinook salmon inhabit over 100 rivers, with 60 rivers supporting populations exceeding 100 spawners. Spawning population sizes range from less than 100 to more than 100,000 Chinook in rivers with major hatcheries. Twenty of the 60 rivers have some form of enhancement to supplement natural spawning; including major hatcheries on the Stamp, Conuma, and Nitinat rivers.

These populations are an important fishery resource to local First Nation peoples, and coastal fisheries from Vancouver Island north through S.E. Alaska. Since the development of Robertson Creek Hatchery 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.

CONCLUSIONS AND ADVICE

- In 2005, the terminal return of the Stamp River/RCH Chinook was approximately 106,600. The age-4 return (~71,000 Chinook) accounted for 71% of the adult return. Age-2 jacks were approximately double the previous year's return.
- The 2005 return was approximately 35% less than forecast and 30% less than 2004 return. Declines in escapement were evident in 17 of 18 extensively surveyed escapement indicator stocks, averaging ~60% of the 2004 spawning abundance.
- In 2005, based on analysis of CWTs, Canadian ocean fisheries (excluding terminal fisheries

targeting enhanced stocks) had a 19% exploitation rate on WCVI Chinook, which exceeded the 10% objective of the DFO Integrated Fishery Management Plan.

- For 2006, forecast total return of Stamp River/RCH Chinook to the terminal area of Alberni Inlet, in the absence of Canadian ocean fisheries, is approximately 115,600 based on age-3 forecast from the Prod2 model, and the average forecast of the Prod2 and Prod3 models for age-4 and age-5. The mean absolute percent error in the average forecast is 22%. The age structure is projected to be: 25% Age-3, 28% Age-4, and 46% Age-5. For 2006, the forecast return of female Chinook is approximately 58,000, 50% of the total return. Based on the forecast return by age, 31,400 spawners are required to meet the hatchery and natural escapement targets.
- The relative change in the Stamp River/RCH Chinook (by brood) is used as an indication of trends in other stocks along the WCVI. For 2006 expectations for WCVI natural stocks are 51% of the 2005 observed return. Management actions to limit fishing mortality on this indicator stock will be required to protect the spawners returning to natural systems.
- It is recommended that ocean fisheries impacting WCVI Chinook be limited by managing to the 10% target exploitation rate for the RCH indicator stock.

SOURCES OF INFORMATION

Canadian catch data are maintained in the CDFO Fishery Operations System [Lee Kearey contact CDFO South Coast Area (SCA)]. Data for CWTs recovered in fisheries are maintained by the Mark Recovery Program (Kathy Fraser contact). Data for CWT recoveries from escapement are available from Jeff Till (SCA). Terminal First Nations catch data are available from Dawn Lewis (SCA).

Many individuals participated in this assessment. The Stamp River fishway counts and video analysis were carried out by staff of the Hupacasath First Nation. Robertson Creek Hatchery staff provided hatchery escapement and biological data. Jeff Till (SCA) managed the in-river sampling program, and provided quality assurance of escapement data. Dawn Lewis (SCA) compiled catch, CWT, and age data for terminal fisheries. Seaton Taylor (SCA) managed the extensive WCVI escapement monitoring program. Gayle Brown (SAFE) performed the cohort analysis.

Riddell, B.E., A. Tompkins, W. Luedke and S. Lehmann. 1996. 1996 Abundance forecast, and preliminary outlook for 1997 for Robertson Creek Hatchery and the Stamp River Chinook salmon. PSARC Report X96-1. 36p.

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