Fishery Data Series No. 10-03

Production of Chinook Salmon from the Stikine River, 1999–2002

by

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and

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February 2010

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Department of Fish and Game	ADF&G
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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TABLE OF CONTENTS

Page

LIST OF TABLES ii

LIST OF FIGURES ii

LIST OF APPENDICES ii

ABSTRACT 1

INTRODUCTION 1

METHODS 4

Smolt Capture and Coded Wire Tagging 4
- Smolt Length and Weight 4
- Glenora Incubation Project 4

Smolt Abundance 5
Marine Harvest 5
Inriver Abundance and Escapement 6
Return, Marine Exploitation, and Marine Survival 6

RESULTS 7

Production of Chinook Salmon-Brood Year 1999 7
Production of Chinook Salmon-Brood Year 2000 7
Production of Chinook Salmon-Brood Year 2001 7
Production of Chinook Salmon-Brood Year 2002 8

DISCUSSION 9

CONCLUSIONS 14

ACKNOWLEDGEMENTS 14

REFERENCES CITED 15

APPENDIX A 17

APPENDIX B 35

APPENDIX C 37

APPENDIX D 39

LIST OF TABLES

Table **Page**

1. Number of Chinook salmon coded-wire-tagged in the Stikine River, 1979–1981, 2000–2008. 8
2. Marked fractions (θ), of Chinook salmon from brood years 1998–2002, estimated from recoveries of coded wire tagged fish in the Stikine River, 2001–2009. 9
3. Estimated number of outmigrating smolt, smolt per spawner, return, return per spawner, marine survival, harvest and exploitation for Stikine River Chinook salmon, brood years 1998–2002. 10
4. Length (mm), weight (g), and condition factor of Chinook salmon smolt sampled on the Stikine River, 2000–2004. 10
5. Marine recoveries of CWTs from Stikine River Chinook salmon, by brood year and fishery, 1998–2002. 11
6. Estimates of harvest of Stikine-bound Chinook salmon in the District 8 gillnet fishery by A) fish ticket/hatchery removals and B) by recovery of CWTs from wild Stikine fish. 12
7. Estimated marine harvest of wild Stikine-bound Chinook salmon, by year and fishery, 2003–2008. 14
8. Estimated marine harvest and proportion of Stikine-bound Chinook salmon in terminal (commercial fishing Districts 6, 7, and 8, and Petersburg/Wrangell sport) and non-terminal fisheries, 2004–2008. 14

LIST OF FIGURES

Figure **Page**

1. Stikine River drainage, showing location of U.S. drift gillnet fishing District 108 and Canadian fishing areas. 2
2. Estimated marine survival rate for wild Chinook salmon from the Stikine and Taku rivers and Crystal Lake Hatchery, BY 1998–2002. 11
3. ADF&G commercial fishing districts and quadrants, Southeast Alaska troll fishery. 13

LIST OF APPENDICES

Appendix **Page**

A1. Smolt tagged, adults subsequently sampled for marks, marked fraction, estimated smolt abundance with standard errors for year classes 1998–2002 for Stikine River Chinook salmon. 18

A2. Numbers of unmarked and marked adult Chinook salmon gathered by year and age class during CWT sampling in the Stikine River from 2001 to 2009 and the resulting χ^2 test statistic and P-value obtained from tests for differences in marked rates between age classes by year class. 23

A3. Estimated marine harvest of Stikine-bound Chinook salmon from brood years 1998–2002. 24

A4. Number of minnow traps checked, numbers of Chinook salmon smolt captured and tagged, and water temperature and depth on the Stikine River by date, 2000. 28

A5. Number of minnow traps checked, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2001. 30

A6. Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2002. 31

A7. Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2003. 32

A8. Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2004. 33

B1. Counts at the weir on the Little Tahltan River, mark–recapture estimates of inriver run abundance and spawning escapement, and other statistics for large Chinook salmon in the Stikine River, 1998–2008. 36

C1. Number of Chinook salmon coded wire tagged at Canadian incubation project near Glenora on the Stikine River, 2001–2002. 38

C2. Recoveries of Glenora tags in marine fisheries. 38

C3. Estimation of the overwinter survival of juvenile Stikine Chinook salmon tagged as fry in the spring of 2001 and 2002. 38

D1. Computer Files used to complete this report. 40

ABSTRACT

A program to mark Chinook salmon smolt with coded wire tags was reinstituted on the Stikine River in 2000 (1998 brood year). The program has improved steadily and the results from brood years (BY) 1999–2002 are presented along with revised results from 1998. The number of smolt marked with coded wire tags ranged from 14,560 in calendar year 2000 to 26,630 in 2004. Estimated number of smolt emigrating from the Stikine River ranged from approximately 2.5 million from BY 2002 to 4.5 million from BY 2001. Marine survival estimates ranged from 0.7% in BY 2001 to 3.9% in BY 2000, and marine exploitation rates ranged from 21% for BY 1998 to 44% for BY 2001. Results from Glenora incubation box releases from BY 2000 and 2001 are also included.

Key words: Chinook salmon, smolt, coded wire tag, harvest, survival, production, exploitation, Stikine River.

INTRODUCTION

The Stikine River is a transboundary river, originating in British Columbia and flowing to the sea near Wrangell, Alaska (Figure 1). The river is one of the largest producers of Chinook salmon *Oncorhynchus tshawytscha* in Northern British Columbia/Southwest Yukon Territory and Southeast Alaska (SEAK).

Chinook salmon from the Stikine River are a "spring run" of salmon, i.e., adults pass through SEAK from late April through early July on their way to spawn in Canada from late July to mid-September. Almost all juveniles rear for 1 year in freshwater after emergence. These fish leave freshwater as yearling (age 2) smolt, then rear offshore west and north of SEAK in the Gulf of Alaska and the Bering Sea (Kissner and Hubartt 1986). Mature adults migrate back through SEAK after 1 to 5 years at sea. Fish maturing at a younger age (age-1.1 and -1.2 fish), are almost exclusively males and are commonly referred to as jacks, while older fish (age-1.3, -1.4. and -1.5 fish) are, on average, about 50% females. Age-1.2, -1.3, and -1.4 fish dominate the annual spawning population, while age-1.5 fish are uncommon (<5%). Most spawning occurs in the Tahltan and Little Tahltan rivers and clearwater tributaries to the Stikine.

A commercial fishery for Chinook salmon has operated near Wrangell since the late 1800s (Rich and Ball 1933). Commercial harvests of Chinook salmon peaked at over 66,000 fish in 1923 (Kissner 1982). Commercial gillnet harvests appear to have averaged 5,000 or fewer Chinook salmon since, except during the 1950s when harvests averaged about 10,000. These figures include harvests for the entire season and include harvests of other stocks. The Stikine Chinook stock undoubtedly also contributed substantially to the spring troll fishery in SEAK since the early 1900s. The marine recreational fishery near Petersburg/Wrangell targets the Stikine stock from April to late June.

Beginning in 1976, commercial fishing for Chinook salmon in SEAK was reduced substantially in terminal areas as part of what subsequently became a coastwide, international rebuilding program under the Pacific Salmon Treaty (PSC 1999) signed in 1985. The spring troll fishery was closed in inside waters of SEAK in 1978, and the regulatory opening date of the drift gillnet fishery in District 108 (District 8) was delayed until the third Sunday in June. Stikine-bound Chinook salmon continued to be harvested incidentally during the District 6 and 8 sockeye salmon *O. nerka* fisheries.

Terminal exploitation of this population is jointly managed by the Alaska Department of Fish and Game (ADF&G) and the Canadian Department of Fisheries and Oceans (DFO) through the Transboundary River Technical Committee (TTC) of the Pacific Salmon Commission (PSC) (PSC 1999).

The commercial gillnet fishery in Canada started in 1979 and has harvested Chinook salmon on the Stikine River incidentally to the take of sockeye salmon until 2005. In 2005, the U.S. and Canada reached agreement under the transboundary river portion of the PST and implemented directed commercial fisheries on Stikine River Chinook salmon. Inriver Canadian aboriginal and recreational fishery participants also harvest a few hundred Chinook salmon annually.

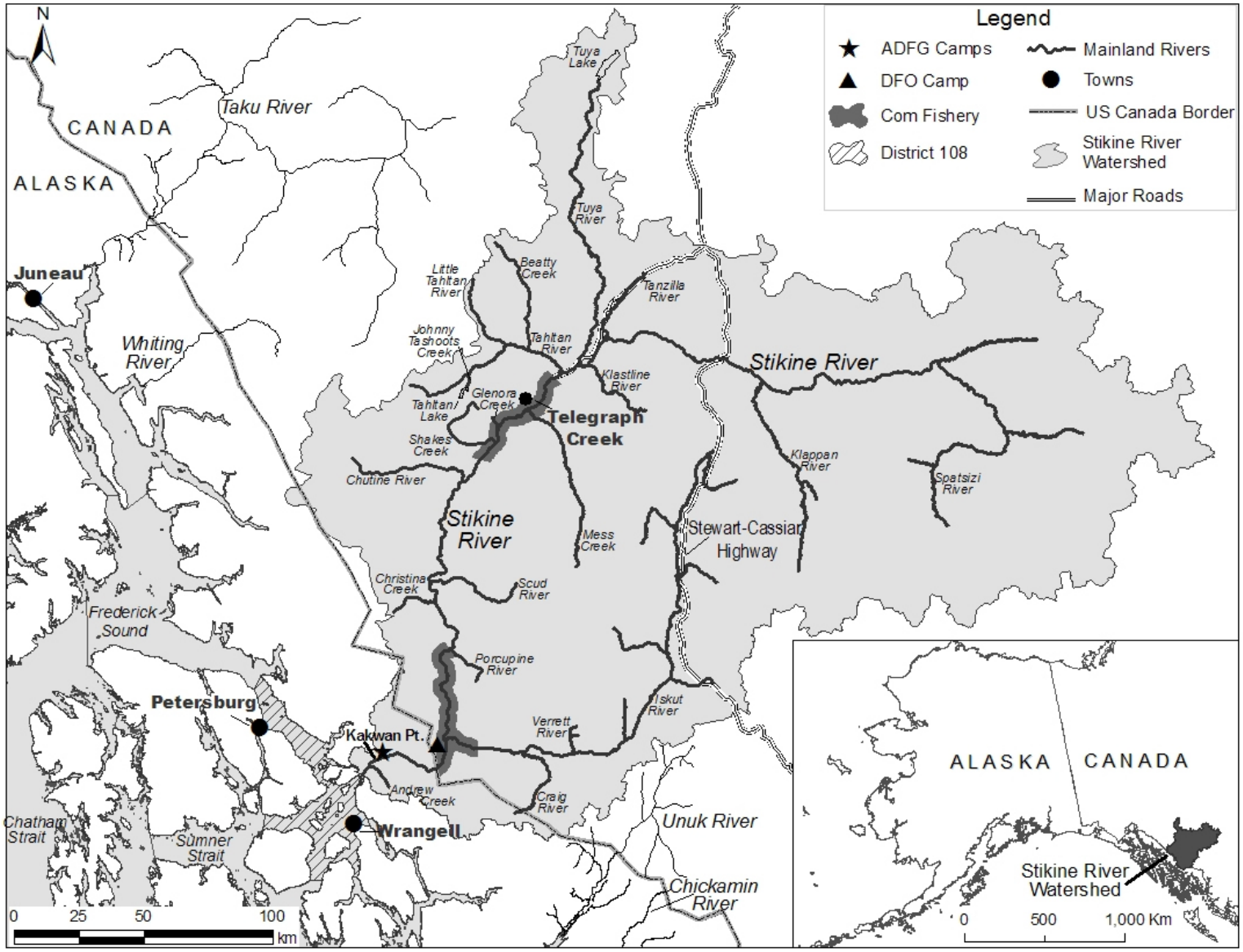

Figure 1.–Stikine River drainage, showing location of U.S. drift gillnet fishing District 108 and Canadian fishing areas.

Chinook salmon escapement to the Stikine River has been monitored since 1975 by counting spawners at the Little Tahltan River and at Andrew Creek. An ongoing cooperative program between the ADF&G, the DFO and the Tahltan First Nation (TFN) began in 1996 to estimate Chinook salmon escapement to the Stikine River (Pahlke and Etherton 1999; Appendix B1). From 1978–1981 juvenile Chinook salmon were captured in the Stikine River, marked with coded wire tags and released. Recoveries of those tags provided the first information on the migration and harvest patterns of this stock (Kissner and Hubartt 1986).

In 1998 ADF&G submitted a proposal to conduct a 5-year Stikine River Chinook coded wire tag study and on March 31, 2000, the PSC allocated monies to ADF&G. The National Marine Fisheries Service transferred funding to ADF&G, under NOAA award NA07FP0397, for work on *Estimation of Smolt Production and Harvest of Stikine River Chinook Salmon*. DFO contributed funding and staff to the project starting in 2000. The PSC through the Northern Fund granted funding to augment the project in 2005–2008. Objectives for the study were to estimate: 1) the abundance of Chinook salmon smolt leaving the Stikine River in 2000–2004 (1998–2002 brood years); 2) harvests of Chinook from those brood years (BY) in 2001–2009; and 3) survival and exploitation rates for those brood years.

The Chinook Technical Committee (CTC) of the PSC uses a Chinook Model for various analyses. One important output from this model is estimation of an annual Abundance Index (AI), which is used to specify annual harvest limits in aggregate abundance-based management regimes (AABM). SEAK sport, net and troll fisheries are to be managed under an AABM approach (PST, Chapter 3).

At present, the CTC Chinook Model includes one SEAK "model stock" in the annual AI. This single SEAK model stock is comprised of escapements from 6 naturally spawning (escapement indicator) stocks (King Salmon, Unuk, Chickamin, Blossom and Keta rivers and Andrew Creek), coupled with exploitation data from hatcheries in central and southern SEAK.

ADF&G feels that inclusion of a single SEAK stock has limitations because: 1) the escapements of the 5 largest Chinook salmon stocks in SEAK are not included and 2) differences in distribution and exploitation of the 6 stocks that are included may warrant further separation. For that reason, ADF&G has developed data for 5 model stocks and proposes to include them in the CTC modeling process when capabilities exist to include more stocks into the Chinook Model. (PSC CWT Workgroup 2008)

Adding smolt tagging to the Stikine Chinook stock assessment program will enable the CTC to incorporate it in the planned SEAK Transboundary River (Taku & Stikine) model stock, and will provide the CTC, DFO and ADF&G with improved management capabilities for abundance-based management. This model stock will be comprised of escapement data from the Taku and Stikine rivers and wild-stock coded wire tag (CWT) data for estimating harvests, exploitation rates, and marine survival. These are the 2 largest populations of Chinook salmon in the SEAK region and there are no hatcheries that release brood stock from either river; hence the need for wild stock CWT data. The Taku River has a relatively long CWT database; the CWT recovery and subsequent parameter estimates for the Stikine River, such as exploitation rate and survival, will be compared to those from the Taku River.

This project will also provide essential data for escapement goal analysis for this stock. The escapement goal was revised in 2000 and one of the recommendations of the report was that the CWT program be reinstated (Bernard et al. 2000). This project provides data from which to estimate total mortalities for the Stikine River stock. The PST specifies that all parties manage for total mortalities under the 1999 agreement (PSC 1999; Chapter 3, Paragraph 3).

This report presents abundance and harvest estimates and survival and exploitation rates for brood years 1999–2002. Richards et al. (2008) summarized harvest and production estimates for brood year 1998, but sampling irregularities for that brood year have since been identified and addressed, and revised results are included in this report.

METHODS

SMOLT CAPTURE AND CODED WIRE TAGGING

Chinook salmon smolt from BY 1999, 2000, 2001, and 2002 were captured in the mainstem of the Stikine and Iskut rivers during spring 2001, 2002, 2003, and 2004 respectively, and marked with an adipose finclip and a CWT. Adult fish returning to the river were sampled in 2002 through 2009 to estimate the marked fraction (θ).

Chinook salmon smolt were captured in G-40 minnow traps baited with disinfected salmon eggs (Magnus et al. 2006) at various locations above and below the international border. Two or three 2-person crews fished approximately 100–150 traps per crew from early April to early June 2001–2004, and checked them at least once a day. Crew members immediately released non-target species at the trapping site. Remaining fish were transported to holding pens for processing at a central tagging location.

In 2002 we began using beach seines to augment the minnow trap catches. Seining has been very effective at capturing Chinook salmon smolt and has been the primary means of capture since 2002 (Richards et al. 2008; Appendix A4-A8).

All healthy Chinook salmon smolt ≥50 mm FL were injected with a CWT and externally marked by excision of the adipose fin (Magnus et al. 2006). Prior to marking, fish were first tranquilized in a solution of tricaine methanesulfonate (MS 222) buffered with sodium bicarbonate. All marked fish were held overnight to check for 24-hour tag retention and handling-induced mortality. The following morning, overnight mortalities were tallied and 100 fish were randomly selected and checked for the retention of CWTs. If tag retention was 98/100 or greater, mortalities were counted and all live fish from that batch were released. If tag retention was less than 98/100, the entire batch was checked for tag retention and those that tested negative were retagged.

The number of fish tagged, number of tagging-related mortalities, and number of fish that had shed their tags were compiled and submitted to the ADF&G Mark, Tag, and Age Laboratory in Juneau at the completion of the field season.

Smolt Length and Weight

Every 50th smolt ≥50 mm FL was measured to the nearest mm FL and weighed to the nearest 0.1 g. Mean length and weight were estimated with standard sample summary statistics (Cochran 1977). Fulton condition factors were calculated from the length and weight data as an index of the condition of the smolt (Anderson and Neumann 1996).

Glenora Incubation Project

In 2000 and 2001, Chinook salmon brood stock were collected at the Little Tahltan River weir for use at a remote incubation project near Glenora, just downstream from Telegraph Creek, British Columbia. The Glenora Chinook project was operated by TFN staff with assistance from local volunteers and DFO. While not part of this project, results are included here because the Glenora fish returned concurrently with those tagged in this project and complicated the analysis.

Chinook eggs and milt were gathered at the Tahltan River weir. Gametes were transported dry and separate to the Glenora project where eggs were fertilized and loaded into Heath stack incubators. In 2000 and 2001, approximately 45,000 and 42,000 eggs were taken, respectively. The Chinook swim-up fry were ponded in mid January and fry were fed a diet of EWOS starter feed.

The fry were marked with CWTs from April 27 to May 1, 2001, and from May 19 to 22, 2002, when they weighed an average of 1.8 grams. In 2001, a total of 21,172 fry were marked with CWTs and released, along with 4,654 unmarked fry, in Dojatin Creek (Six Mile Creek) and Winter Creek, 2 streams located between Glenora and Telegraph Creek. In 2002, 21,910 fry were CWT-marked and released, along with 1,925 unmarked fry, in Dojatin Creek (Appendix C1).

The overwinter survival of marked Chinook salmon fry was estimated by the relative odds of survival against smolt marked downriver the following spring (Appendix A7 in Weller and McPherson 2003).

SMOLT ABUNDANCE

A two-event mark–recapture experiment was used to estimate the annual abundance of Chinook salmon smolt that emigrated from the Stikine River in 2001–2004. The first event consisted of smolt tagged and marked in year *y*. The second event was comprised of Chinook salmon adults originating from year *y* smolt that were sampled on the spawning grounds or caught in inriver fisheries in years *y*+1, *y*+2, *y* +3, *y*+4, and possibly *y*+5. Adults were inspected for missing adipose fins in 2002 through 2009. With few exceptions, those fish missing adipose fins were sacrificed for CWTs. Fish that were inspected but not aged were assigned to the appropriate brood year using age-length data from aged fish spanning the lengths of the unaged fish.

Smolt abundance for brood year *b*, N_{sb} was estimated with Chapman's modification of the Petersen estimator (Seber 1982). The variance of $\hat{N}_{sb}$ was estimated by simulation that incorporated the variability incurred due to estimation of the brood year of adults sampled in the second event that were not aged.

The conditions for accurate use of this methodology were: (a) all smolt in a given marking year *y* had an equal probability of being marked; or all adults from marking year *y* had an equal probability of being inspected for marks in years *y*+1, through *y*+5; or marked fish mixed completely with unmarked fish in the population between years; and (b) there was no recruitment to the population between marking and recovery events; and (c) there was no tag-induced mortality; and (d) there was no trap induced behavior; and (e) fish did not lose their marks and all marks were recognizable (Seber 1982).

Minnow traps and beach seines (from 2002 on) were fished continuously during the smolt emigrations and smolt were of relatively uniform size. These 2 factors tended to promote equal probabilities of capture throughout the migration. Temporal changes (over years) in the fraction of adults from a brood year with valid CWTs were tested against a χ^2 distribution. If one of the first or third conditions in assumption (a) was met, the marked fraction would not change over return years; a failure to reject the hypothesis of equal marked fractions for a cohort over return years was therefore considered evidence of equal marking probabilities or mixing and the data were pooled over years. (otherwise, the marked fraction was averaged over years). Adult immigrations (second event) were sampled continuously in gillnet catches and regularly on the spawning grounds. Little can be said, however, regarding the likelihood of equal probability of capture in the second event because of differing levels of sampling and fishing effort among the years during which a given marked cohort returned.

Because almost all surviving smolts return to their natal stream as adults to spawn, there was no meaningful recruitment added to the population of "smolts" while at sea (assumption b). Results from other studies (Elliott and Sterritt 1990; Vander Haegen et al. 2005; Vincent-Lang 1993) indicate that excising adipose fins and implanting CWTs does not increase the mortality of marked salmon (assumption c). Further, trap-induced behavior was unlikely because different sampling gears were used to capture smolts and adults (assumption d). Finally, adipose fins do not regenerate if excised at the base (Thompson and Blankenship 1997), and sampling crews were trained to inspect adult fish for adipose finclips (assumption e).

MARINE HARVEST

Harvests of Stikine River Chinook salmon from brood years 1999–2002 and their variances were estimated from fish sampled in commercial and sport fisheries in 2002 through 2009 according to the methods in Bernard and Clark (1996). Because several fisheries harvested Chinook salmon bound for the Stikine River, harvest was estimated over several strata, each a combination of time, area, and fishery type. Statistics from the commercial troll fishery were stratified by fishing period and quadrant, the drift gillnet fishery by week and district, and sport fisheries by fortnight and location. Harvest from brood year b in fishery stratum *i* was estimated by:

$$\hat{r}_{bi} = H_i \left[\frac{m_{bi}}{\lambda_i n_i} \right] \hat{\theta}_b^{-1}; \qquad \lambda_i = \frac{a_i' t_i'}{a_i t_i} \tag{1}$$

where

H_i = total harvest in the fishery stratum,

n_i = number of fish inspected (the sample),

a_i = number of fish missing an adipose fin,

a_i' = number of heads sent to the Mark, Tag, and Age Laboratory,

t_i = number of heads with CWTs detected,

t_i' = number of CWTs that were dissected from heads and decoded,

m_{bi} = number of CWTs from brood year b with code(s) of interest,

λ_i = decoding rate of CWTs for marked fish in the sample from stratum i,

and $\hat{\theta}_b$ = estimated fraction of the cohort from brood year b, tagged with code(s) of interest.

The equations used to estimate the variance of the contribution depend on whether the fishery is recreational (harvest estimated) or commercial (harvest known); the 2 variance equations are described in Table 2 of Bernard and Clark (1996). Estimates of harvest were summed across all strata to obtain an estimate of total harvest $\hat{T}_b = \sum \hat{r}_{bi}$. Variance of $\hat{T}_b$ was estimated by summing variances across strata.

Equation (1) is often referred to as an expansion. Technically it is 2 expansions plus an adjustment to the number sampled. The adjustment modifies the sampled number to account for the fact that not all adipose finclips observed are recovered (for instance a head is lost at the processor, etc.) and that not all CWTs can be read, or a CWT is lost at the lab, or some other problem exists with the CWT. The "first" expansion accounts for the fact that only a proportion of the smolt population was tagged. If 10% of the smolt population in a particular brood year was tagged, $\theta = 0.1$, then each tagged fish actually represents 10 fish from the smolt population, so m is expanded by $\hat{\theta}^{-1}$ (1/.1 or 10 in our example). The "second" expansion deals with the fact that only a proportion of the catch in a particular stratum is sampled for CWTs. If 100 fish were harvested in a stratum but only 20 were sampled for CWTs, then m is expanded by 100/20 or 5 to account for unsampled fish in the catch.

INRIVER ABUNDANCE AND ESCAPEMENT

Inriver abundance of Chinook salmon to the Stikine River has been estimated annually since 1996 using mark–recapture methods by a cooperative program between the ADFG, the DFO and the TFN (Pahlke and Etherton 1999). In the first event of the mark–recapture experiment, returning Chinook salmon are captured by drift gillnet in the lower Stikine River near Kakwan Point, sampled and marked. Marked fish are recaptured in Canadian inriver fisheries and on the spawning grounds (Richards et al. 2008). Spawning escapement is estimated by subtracting harvest upstream of the mark–recapture site.

RETURN, MARINE EXPLOITATION, AND MARINE SURVIVAL

Inriver return $N_{b,t}$ of Chinook salmon from brood year b (b = 1999–2002) in calendar year t (t = 2002–2009) was estimated by the mark–recapture study as the product of inriver abundance in year t and proportion of fish of appropriate age in year t.

The total inriver return and variance for brood year b was then estimated by:

$$\hat{N}_b = \sum_{t=b+3}^{b+7} \hat{N}_{b,t} \tag{4}$$

$$\mathrm{var}\left[\hat{N}_b\right] = \sum_t \mathrm{var}\left[\hat{N}_{b,t}\right] \tag{5}$$

Total return and variance for brood year b was estimated by:

$$\hat{R}_b = \hat{N}_b + \hat{T}_b \tag{6}$$

$$\mathrm{var}\left[\hat{R}_b\right] = \mathrm{var}\left[\hat{N}_b\right] + \mathrm{var}\left[\hat{T}_b\right] \tag{7}$$

Marine exploitation $\hat{U}_b$ and marine survival $\hat{S}_b$ for brood year b were estimated by:

$$\hat{U}_b = \frac{\hat{T}_b}{\hat{R}_b} \tag{8}$$

$$\text{var}\left[\hat{U}_b\right] = \frac{\text{var}\left[\hat{T}_b\right]\hat{N}_b^{\,2}}{R_b^{\,4}} + \frac{\text{var}\left[\hat{N}_b\right]\hat{T}_b^{\,2}}{R_b^{\,4}} \qquad (9)$$

$$\hat{S}_b = \frac{\hat{R}_b}{\hat{N}_s} \qquad (10)$$

$$\text{var}\left[\hat{S}_b\right] = \hat{S}_b^{\,2}\left[\frac{\text{var}\left(\hat{R}_b\right)}{\hat{R}_b^{\,2}} + \frac{\text{var}\left(\hat{N}_s\right)}{\hat{N}_s^2}\right] \qquad (11)$$

The variances in equations 9 and 11 were derived by the delta method (Seber 1982).

RESULTS

PRODUCTION OF CHINOOK SALMON-BROOD YEAR 1999

From 9 April to 1 June 2001, 5,774 Chinook salmon smolt were captured and marked with CWTs (Table 1, Appendix A5). From 2002 to 2006, a total of 4,119 adult fish from the 1999 brood year were sampled in the Kakwan tagging program, the Canadian inriver fisheries, and on the spawning grounds. Six CWTs were recovered, for an estimated tagging fraction $\hat{\theta}$ of 0.0015 (Table 2, Appendix A1). The estimated emigration of smolt in 2001 was 3,398,999 (simulated SE = 1,972,729; Table 3). The condition factor of smolt was estimated to be 0.127 (Table 4).

Seventeen marked fish were recovered in marine fisheries between 2003 and 2006. Six were recovered in troll fisheries, 9 in the District 8 gillnet fishery, and 2 from sport harvests (Table 5). Total estimated marine harvest was 26,061 (SE = 8,796) fish (Table 3, Appendix A3), the exploitation rate was estimated to be 29% (SE = 0.07), and marine survival was 2.7% (SE = 0.016) (Table 3).

PRODUCTION OF CHINOOK SALMON-BROOD YEAR 2000

From 23 April to 13 June 2002, 17,411 Chinook salmon smolt were captured and marked with CWTs (Table 1, Appendix A6). In addition, 21,172 fed fry were tagged and released at Glenora (Appendix C1).

A total of 8,482 adult Chinook salmon from the 2000 brood year were sampled in the Kakwan tagging program, the inriver fisheries, and on the spawning grounds from 2003 to 2007 (Table 2). Forty-two valid tags were recovered and $\hat{\theta}$ was estimated to be 0.0050 (Table 2, Appendix A1). The estimated emigration of smolt in 2002 was 3,435,022 (SE = 555,228, Table 3). The condition factor of smolt was estimated to be 0.135 (Table 4).

From 2004 to 2006, 112 marked fish were recovered in marine fisheries. Thirty-four were recovered in troll fisheries, 64 in drift gillnet fisheries, 13 in sport fisheries and 1 in a high seas trawl fishery near Dutch Harbor (Table 5). The total estimated marine harvest was 43,274 (SE 4,709) fish (Table 3). The exploitation rate was estimated to be 33% (SE = 0.03) and marine survival was 3.9% (SE = 0.006) (Table 3).

In addition, 9 tags were recovered from fish tagged at Glenora (Appendix C2).

PRODUCTION OF CHINOOK SALMON-BROOD YEAR 2001

From 21 April to 9 June 2003, 19,927 Chinook salmon smolt were captured and marked with CWTs (Table 1, Appendix A7). In addition, 21,910 fed fry were tagged and released at Glenora (Appendix C).

A total of 2,693 adult Chinook salmon from the 2001 brood year were sampled in the Kakwan tagging program, the inriver fisheries, and on the spawning grounds from 2004 to 2008 (Table 2). Eleven valid tags were recovered and $\hat{\theta}$ was estimated to be 0.0041 (Table 2, Appendix A1). The estimated emigration of smolt in 2003 was 4,473,835 (SE = 1,665,363, Table 3). The condition factor of smolt was estimated to be 0.131 (Table 4).

From 2005 to 2007, 25 marked fish were recovered in marine fisheries. Seven were recovered in troll fisheries, 14 in drift gillnet fisheries, and 4 in sport fisheries (Table 5). Total estimated marine harvest was 12,944 (SE 3,273) fish (Table 3). The exploitation rate in marine fisheries was estimated to be 44% (SE = 0.07) and marine survival was 0.7% (SE = 0.003) (Table 3).

Table 1.–Number of Chinook salmon coded-wire-tagged in the Stikine River, 1979–1981, 2000–2008.

	Tag code	Brood year	Stage	Year released	Date last released	Adipose clipped and tagged	Adipose clipped not tagged	Total released
Previous study		1978	FRY	1979	10/1/79	24,164	0	24,164
Kissner and		1976	SMOLT	1978	5/1/78	1,284	0	1,284
Hubartt 1986		1979	FRY	1980	11/1/80	29,322	1,063	30,385
		1980	FRY	1981	11/1/81	40,071	3,017	43,088
This	40357	1998	SMOLT	2000	6/13/00	9,715	10	9,725
study	40358	1998	SMOLT	2000	5/30/00	1,842	0	1,842
	40359	1998	SMOLT	2000	6/13/00	3,003	9	3,012
						14,560		
	40459	1999	SMOLT	2001	6/1/01	5,774	17	5,791
						5,774		
	40533	2000	SMOLT	2002	6/1/02	10,953	44	10,997
	40534	2000	SMOLT	2002	6/13/02	6,458	13	6,471
						17,411		
	40802	2001	SMOLT	2003	5/28/03	11,269	34	11,303
	40803	2001	SMOLT	2003	6/9/03	8,658	17	8,675
						19,927		
	40804	2002	SMOLT	2004	5/11/04	11,351	46	11,397
	40956	2002	SMOLT	2004	5/21/04	11,387	46	11,433
	40957	2002	SMOLT	2004	5/30/04	3,892	0	3,892
						26,630		
	41130	2003	SMOLT	2005	5/11/05	10,822	54	10,876
	41131	2003	SMOLT	2005	6/2/05	10,862	0	10,862
						21,684		
	41148	2004	SMOLT	2006	5/31/06	7,783	16	7,799
	41149	2004	SMOLT	2006	5/26/06	6,645	0	6,645
	41297	2004	SMOLT	2006	5/8/06	10,592	21	10,613
	41298	2004	SMOLT	2006	5/13/06	11,062	33	11,095
	41299	2004	SMOLT	2006	5/17/06	11,166	22	11,188
						47,248		
	41132	2005	SMOLT	2007	5/22/07	11,610	12	11,622
	41469	2005	SMOLT	2007	5/28/07	10,847	44	10,891
	41470	2005	SMOLT	2007	5/28/07	1,302	8	1,310
						23,759		
	41471	2006	SMOLT	2008	5/14/08	23,042	69	23,111
	41547	2006	SMOLT	2008	5/29/08	9,702	0	9,702
	41551	2006	SMOLT	2008	5/19/08	11,268	23	11,291
						44,012		

In addition, 28 tags were recovered from fish tagged at Glenora (Appendix C2).

PRODUCTION OF CHINOOK SALMON-BROOD YEAR 2002

From 19 April to 29 May 2004, 26,630 Chinook salmon smolt were captured and marked with CWTs (Table 1, Appendix A8).

A total of 8,359 adult Chinook salmon from the 2002 brood year were sampled in the Kakwan tagging program, the inriver fisheries, and on the spawning grounds from 2005–2009 (Table 2).

Eighty-four valid tags were recovered and $\hat{\theta}$ was estimated to be 0.0100 (Table 2, Appendix table A1). The estimated emigration of smolt in 2002 was 2,553,065 (SE = 266,648, Table 3). The condition factor of smolt was estimated to be 0.120 (Table 4).

From 2005 to 2009, 87 marked fish were recovered in marine fisheries. Twenty-two were

Table 2.–Marked fractions (θ), of Chinook salmon from brood years 1998–2002, estimated from recoveries of coded wire tagged fish in the Stikine River, 2001–2009.

Brood year	Age class[a]	Year examined	Estimated number examined	Adipose clips	Total valid tags	Valid marked fraction θ
1998	1.1	2001	152	0	0	0.000%
1998	1.2	2002	410	1	1	0.024%
1998	1.3	2003	2,197	9	9	0.410%
1998	1.4	2004	1,338	4	3	0.220%
1998	1.5	2005	29	0	0	0.000%
1998 brood year total			4,126[b]	15	14[c]	0.340%
1999	1.1	2002	37	0	0	0.000%
1999	1.2	2003	881	0	0	0.000%
1999	1.3	2004	1,725	5	5	0.290%
1999	1.4	2005	1,421	1	1	0.070%
1999	1.5	2006	55	0	0	0.00%
1999 brood year total			4,119	6	6	0.150%
2000	1.1	2003	159	0	0	0.000%
2000	1.2	2004	1,018	0	0	0.000%
2000	1.3	2005	2,747	16	16	0.580%
2000	1.4	2006	4,416	26	26	0.590%
2000	1.5	2007	142	0	0	0.00
2000 brood year total			8,482	42	42	0.500%
2001	1.1	2004	34	0	0	0.000%
2001	1.2	2005	111	0	0	0.000%
2001	1.3	2006	906	4	4	0.440%
2001	1.4	2007	1,627	6	6	0.370%
2001	1.5	2008	15	1	1	0.067%
2001 brood year total			2,693	11	11	0.410%
2002	1.1	2005	45	0	0	0.000%
2002	1.2	2006	585	10	10	1.710%
2002	1.3	2007	3,718	34	33	0.890%
2002	1.4	2008	3,992	43	41	1.030%
2002	1.5	2009	19	0	0	0.000%
2002 brood year total			8,359	87	84	1.000%

[a] Age-0. and -.2 grouped with appropriate brood year.

[b] Revised numbers from Richards et al. 2008.

[c] Expanded to 15 total tags to account for unsacrificed clips.

recovered in troll fisheries, 50 in drift gillnet fisheries, 13 in sport fisheries, and 2 on the high seas (Table 5). Total estimated marine harvest was 14,874 (SE 1,688) fish (Table 3). The exploitation rate was estimated to be 27% (SE = 0.03, Table 3) and marine survival was 2.2% (SE = 0.003) (Table 3).

DISCUSSION

Estimated annual smolt abundance ranged from about 2.5–4.5 million fish for BY 1998–2002, and marine survival estimates ranged from less than 1% to almost 4% (Table 3). These survival rates showed similar trends to rates estimated for wild Taku River Chinook salmon and Crystal Lake Hatchery releases of Andrew Creek brood stock (Susan Doherty, Southern Southeast Regional Aquaculture Association and Edgar Jones, ADF&G, Douglas, personal communication; Figure 3). Wild Chinook salmon smolt have been marked by CWT annually on the Taku River since 1989, and estimated smolt abundance from BY 1991–2003 has ranged from 1.1 to 2.1 million fish. Estimated smolt production from the Stikine River for BY 1998–2002 has been much higher, albeit with poorer precision. Our most precise estimate is for BY 2000 with an estimate of 3.4 million smolt (SE = 555,000; relative precision 29%) and the 2002 BY looks to be even better at 2.5 million smolt (SE = 276,000; relative precision 21%).

Table 3.–Estimated number of outmigrating smolt, smolt per spawner, return, return per spawner, marine survival, harvest and exploitation for Stikine River Chinook salmon, brood years 1998–2002.

Brood year	Escapement	Esc. SE	Number smolt	SE Smolt	Smolt/ spawner	Total Return	SE Return	Return per spawner	$\hat{S}$ Marine survival	SE Survival	$\hat{T}$ Marine harvest	SE Marine harvest	$\hat{U}$ Marine exploitation	SE Exploitation
1998	25,968	3,931	3,755,827	1,114,376	145	73,891	6,661	2.85	2.0%	0.006	15,721	5,378	0.21	0.06
1999	19,947	3,240	3,398,999	1,972,729	170	90,418	9,217	4.53	2.7%	0.016	26,061	8,796	0.29	0.07
2000	27,531	3,168	3,435,022	555,228	125	132,493	5,676	4.81	3.9%	0.006	43,274	4,709	0.33	0.03
2001	63,523	5,853	4,473,835	1,665,363	70	29,337	6,706	0.46	0.7%	0.003	12,944	3,273	0.44	0.07
2002	50,875	5,912	2,533,065	266,648	50	55,417	6,148	1.09	2.2%	0.003	14,874	1,688	0.27	0.03
Ave.	37,569	4,421	3,519,350	1,114,869	112	76,311	6,882	2.75	2.3%	0.007	22,575	4,769	0.31	0.05

Table 4.–Length (mm), weight (g), and condition factor of Chinook salmon smolt sampled on the Stikine River, 2000–2004.

Year	Gear	Sample Size	Total catch	Mean length	SD length	Min length	Max length	Mean weight	SD weight	Min weight	Max weight	Fultons Condition Factor		
												Mean	Max	Min
2000	Trap	216	14,560	74	8	53	96	5.2	1.8	1.2	11.2	0.122	0.276	0.044
2001	Trap	242	5,774	75.0	8	60	119	5.5	1.6	2.5	14.0	0.127	0.206	0.100
2002	Trap	302	17,411	77	11	54	116	6.3	2.3	2.3	17.5	0.135	0.329	0.080
2003	Trap	82	3,579	69	8	52	86	4.3	1.4	2.0	7.7	0.133	0.490	0.060
	Seine	228	16,053	73	10	53	112	5.1	1.9	1.4	16.3	0.128	0.490	0.060
	Combined	310	19,632	72	8	52	112	4.9	1.2	1.4	16.3	0.131	0.049	0.060
2004	Trap	75	3,848	65	7	50	82	3.5	1.2	1.6	6.6	0.120	0.173	0.086
	Seine	434	23,142	72	9	53	105	4.5	1.7	1.7	12.3	0.120	0.484	0.072
	Combined	509	26,990	71	8	50	105	4.4	1.5	1.6	12.3	0.120	0.484	0.072

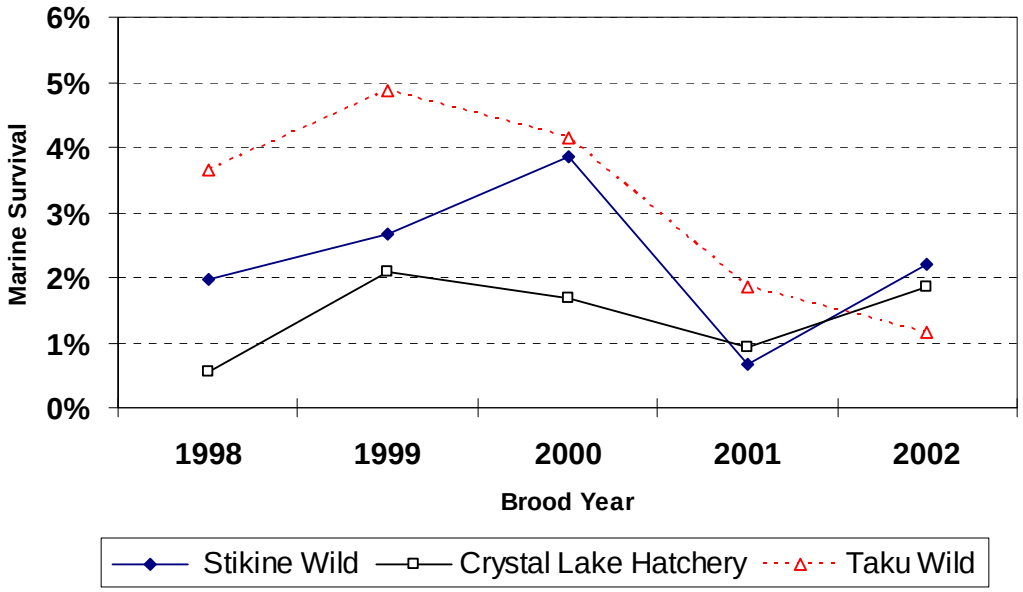

Figure 2.–Estimated marine survival rate for wild Chinook salmon from the Stikine and Taku rivers and Crystal Lake Hatchery, BY 1998–2002.

Table 5.–Marine recoveries of CWTs from Stikine River Chinook salmon, by brood year and fishery, 1998–2002.

	Fishery				
Brood year	Drift gillnet	High seas	Sport	Troll	Total
1998			3	14	17
1999	9		2	6	17
2000	64	1	13	34	112
2001	14		4	7	25
2002	50	2	13	22	87
Total	137	3	35	83	258

Marked fractions across age classes for major year classes were not significantly different (Appendix A2). All other year classes had consistent marked fractions across age classes sampled, with P-values ranging between 0.01 and 0.42.

We have been unable to assess whether tagged smolt represented all subpopulations in the Stikine River in near equal proportions. In 2000 we tried to capture enough smolt from the Iskut River to mark with a unique code in the hope that we would be able to determine if population parameters for this tributary differed from those for the Stikine population as a whole. We were unable to capture enough smolt in the Iskut River itself, and spawning ground samples from the Verrett River tributary of the Iskut River have been inconclusive. The Iskut River is estimated to produce 13–18% of the total Stikine River production of Chinook salmon, and 65–75% are produced in the upper tributaries of the Tahltan River (Richards et al. 2008; Smith et al. *In prep.*).

The CWT program allowed us to verify traditional methods of harvest estimation for Stikine-bound Chinook salmon in the commercial gillnet fishery in District 8, near Petersburg and Wrangell. These methods assumed that all fish caught through mid July (ADF&G statistical weeks 25–29) were Stikine-bound, with the exception of contributions of hatchery fish, which were estimated from CWT recoveries and subtracted from the total harvest in District 8.

Expansions of CWTs from wild Stikine-bound fish harvested in the gillnet fishery yield estimates similar to those of traditional methods, showing that most of the wild Chinook salmon caught in the District 8 commercial gillnet fishery are indeed likely to be of Stikine origin (Table 6).

The harvest of Stikine-bound Chinook salmon in the Petersburg/Wrangell recreational fishery has traditionally been estimated by subtracting the

Table 6.–Estimates of harvest of Stikine-bound Chinook salmon in the District 8 gillnet fishery by A) fish ticket/hatchery removals and B) by recovery of CWTs from wild Stikine fish.

Year	Large[a] Chinook caught	AK hatchery Chinook	Non-AK hatch./ non-Stikine Chinook	Estimate large Stikine Chinook (A)	Estimate from wild CWT recoveries (B)	SE	B/A %
2005	23,926	1,408	90	22,428	16,348	3,947	73%
2006	26,845	4,793	160	21,892	18,548	3,201	85%
2007	14,394	5,227	58	9,109	8,936	2,010	98%
2008	12,902	5,624	8	7,270	5,934	771	82%

[a] Large Chinook are ≥660mm MEF length.

harvest of hatchery stocks estimated from CWT recoveries from the spring harvests. Spring harvests include harvests from late April to late June, estimated by creel census or postal survey (Richards et al. 2008). Using this method, estimated spring harvests of large (≥660 mm MEF) Stikine-bound Chinook salmon in the Petersburg/Wrangell recreational fishery averaged 2,689 from 1978–2008. Estimated sport harvests of wild Stikine Chinook from the CWT project described in this study averaged about 1,000 fish from 2006–2008. Until 2006, this fishery was sampled at relatively low rates for CWTs (<20%) except for derby harvests that are generally sampled completely. Sampling rates have increased since 2006, but still few random CWTs have been recovered in this fishery (ranging from 1 to 11 per brood year for the 1998–2002 broods), resulting in poor relative precision of harvest estimates.

Harvests of Stikine-bound Chinook salmon in the commercial troll fishery in Southeast Alaska were estimated directly from CWT recoveries (Table 7, Appendix A3). This fishery harvests numerous stocks and has been sampled at high rates for recovery of CWTs, averaging 40–45%. Significant harvests occurred in 3 of the 4 troll fishery management quadrants, with the southern outside quadrant (SW, Districts 3 and 4, Figure 3) the only one without any tags recovered. Many of the tags were recovered in the experimental troll fisheries implemented in the spring to increase the harvest of Alaskan hatchery fish (Lynch and Skannes 2008). Harvests and sample sizes in most of the experimental fisheries were small so the recoveries were pooled by period and quadrant.

Kissner and Hubartt (1986) found the major areas of harvest for Stikine-bound Chinook to be districts 109, 110 and 113, with 1 recovery in the Bering Sea. Based on the recoveries of 34 tags from 1982 to 1986, they concluded the majority of Stikine River Chinook salmon reared offshore beyond Southeast Alaska fisheries and passed Cape Ommaney as they returned to the Stikine River at maturity. The troll and drift gillnet fisheries were greatly restricted during May and June of those years. In general, our results agree with theirs. In over 250 tags recovered, we have only recovered 3 tags, all from BY 1998, south of SEAK in northern British Columbia fisheries; the remainder were recovered throughout the northern districts of SEAK and District 8. There were several recoveries in Districts 112 and 114, which indicates that at least some of the fish enter SEAK through Icy Straits rather than passing Cape Ommaney and Chatham Strait. We also had 3 recoveries from the Bering Sea trawl fisheries.

The estimated proportion of the marine harvest taken in terminal areas (Districts 6, 7, and 8, and Petersburg/Wrangell sport) has increased steadily since 2004 (Table 8).

The Glenora releases were not part of this project, but they returned over some of the same years and complicated the analysis of our returns. We were unable to include any adipose-clipped fish without valid tags in our study because we could not assume that Glenora releases lost tags at the same rate as fish tagged in this study; the Glenora fish were tagged as fry and by inexperienced crews.

Hendrich et al. (2008) were able to include samples of adipose-clipped fish whose heads and or tags were not recovered in their calculations of marked fraction. They were working on the Unuk River where there were no other tagged fish expected and where the age at length relationship is well known. Estimated tag loss in the Unuk River program averaged <7.3% over 10 years. Our estimates of smolt abundance are therefore

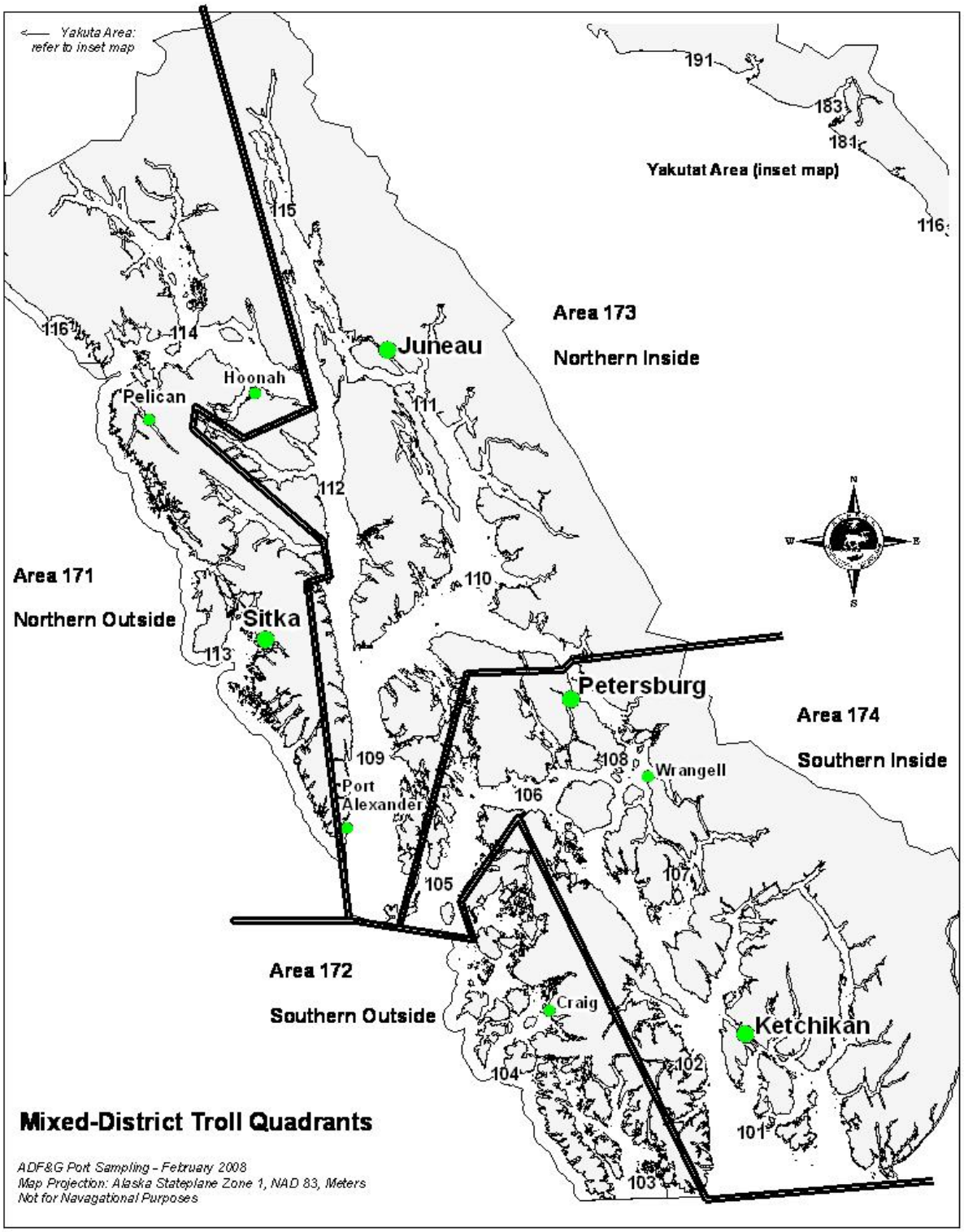

Figure 3.–ADF&G commercial fishing districts and quadrants, Southeast Alaska troll fishery.

Table 7.–Estimated marine harvest of wild Stikine-bound Chinook salmon, by year and fishery, 2003–2008.

	Drift gillnet		High seas trawl		Sport		Troll	
	Estimated harvest	SE	Estimated harvest	SE	Estimated harvest	SE	Estimated harvest	SE
2003					604	427	10,877	5,175
2004			379	378	1,339	1,085	8,860	3,203
2005	16,3486	3,94747	166	165	12,275	6,476	13,890	4,722
2006	19,262	3,230	165	164	1,299	538	7,183	1,907
2007	8,936	2,010			1,677	581	6,805	1,954
2008	5,934	771			788	264	2,303	637

Table 8.–Estimated marine harvest and proportion of Stikine-bound Chinook salmon in terminal (commercial fishing Districts 6, 7, and 8, and Petersburg/Wrangell sport) and non-terminal fisheries, 2004–2008.

	2004	SE	2005	SE	2006	SE	2007	SE	2008	SE
Non-terminal	5,149	2,065	13,428	5,099	5,805	1,664	4,654	1,609	982	471
Terminal	5,429	2,705	29,251	7,338	22,104	3,409	9,470	2,368	5,122	921
Terminal %	51.3%		68.5%		79.2%		67.0%		83.9%	

biased high according to the degree to which smolt tagged in this study lost tags. The extent of tag loss in studies such as this is considered relatively low, however.

There were very few recoveries (9) from the Glenora release of BY 2000, indicating either poor survival or poor tag retention. There were many more recoveries (28) from BY 2001. Overwinter survival estimated from the relative odds of survival against smolt marked the following spring jumped from about 7% for BY 2000 to 98% for BY 2001 (Weller and McPherson 2003; Appendix C3). The estimate of overwinter survival for BY 2001 is extraordinary, but is supported by the similar return rate of that brood tagged in our study (28 tags from 21,910 release at Glenora, versus 25 tags from 19,927 in this study). With that kind of survival it is possible that some similar incubation project would be feasible as a method of releasing substantial numbers of CWT-marked fish very efficiently.

CONCLUSIONS

Projects involving tagging juvenile Chinook salmon take a long time to produce results. We started this project in 2000 and the first results were documented in 2008. There were many sampling irregularities in the early years of the study that have been addressed. In 2002 the use of beach seines allowed us to tag about 26,600 smolt from BY 2000, the highest number tagged on the Stikine up to that year. The estimated tagging fraction for that brood year was almost 1% and the 95% relative precision estimate of the total harvest was 21%, the best so far. The project has successfully met the objectives and is still improving.

Each year the field crews have improved their capture methodology and numbers tagged. The institution of the inriver fishery in Canada has provided a substantial increase in the sample size of returning adults with a resulting increase in data quality.

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APPENDIX A

Appendix A1.–Smolt tagged, adults subsequently sampled for marks, marked fraction, estimated smolt abundance with standard errors for year classes 1998–2002 for Stikine River Chinook salmon.

Year	Brood year	Age	Location sampled	Sample size	Adipose clips	Valid tags	Marked fraction	Smolt tagged	Smolt estimate	SE estimate
2001	1998	.1	Kakwan	1						
			Inriver commercial	5						
			Test	52[a]						
			Little Tahltan weir	103						
			Rock Island	38						
			Verrett	5						
			Subtotal	152[b]	1	0	0.0000	14,560		
2002	1998	.2	Kakwan	78						
			Inriver commercial	20						
			Little Tahltan weir	211	1	1	0.0047			
			Test	137[a]						
			Rock Island	90						
			Verrett	11						
			Subtotal	410[b]	1	1	0.0024	14,560	2,992,285	1,723,270
2003	1998	.3	Kakwan	614	1	1	0.0016			
			Inriver commercial	220	4	4	0.0182			
			Little Tahltan weir	677	3	3	0.0044			
			Test	816[a]			0.0000			
			Rock Island	111			0.0000			
			Verrett	575	1	1	0.0017			
			Subtotal	2,197[b]	9	9	0.0041	14,560	3,200,507	962,461
2004	1998	.4	Kakwan	573			0.0000			
			Inriver commercial	222	2	2	0.0090			
			Little Tahltan weir	373	1	1	0.0027			
			Test	15[a]			0.0000			
			Rock Island	65			0.0000			
			Verrett	678	1	0	0.0000			
			Subtotal	1,338[b]	4	3	0.0022	14,560	3,899,435	1,588,690
2005	1998	.5	Kakwan	8			0.0000			
			Inriver commercial	24			0.0000			
			Test	0						
			Little Tahltan weir	4			0.0000			
			Rock Island	1			0.0000			
			Verrett	0						
			Subtotal	29	0	0	0.0000	14,560		
	1998		Brood Year totals	4,126	15	14	0.0034	14,560	3,755,827	908,655

[a] Sample not included in marked fraction due to sampling irregularities.

[b] Revised from Richards et al. 2008.

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Appendix A1.–Page 2 of 5.

Year	Brood year	Age	Location sampled	Sample size	Adipose clips	Valid tags	Marked fraction	Smolt tagged	Smolt estimate	SE estimate
2002	1999	.1	Kakwan	8	0	0				
			Inriver commercial	24	0	0				
			Little Tahltan weir	4	0	0				
			Rock Island	1	0	0				
			Verrett	0	0	0				
			Subtotal	37	0	0	0.0000	5,774		
2003	1999	.2	Kakwan	188						
			Inriver commercial	115						
			Little Tahltan weir	297						
			little Tahltan weir B	39						
			Test	650[a]						
			Rock Island	178						
			Verrett	64						
			Subtotal	881	0	0	0.0000	5,774		
2004	1999	.3	Kakwan	731[a]			0.0000			
			Inriver commercial	483	3	3	0.0062			
			Little Tahltan weir	710	1	1	0.0014			
			Test	41[a]			0.0000			
			Rock Island	117	1	1	0.0085			
			Verrett	415			0.0000			
			Subtotal	1,725	5	5	0.0029	5,774	1,661,274	626,485
2005	1999	.4	Kakwan	384[a]			0.0000			
			Inriver commercial	955	1	1	0.0010			
			Little Tahltan weir	363	0	0	0.0000			
			Rock Island	32			0.0000			
			Verrett	71			0.0000			
			Subtotal	1,421	1	1	0.0007	5,774	4,106,024	2,368,536
2006	1999	.5	Kakwan	4	0	0	0.0000			
			Inriver commercial	44	0	0	0.0000			
			Inriver commercial 2	6	0	0	0.0000			
			Little Tahltan weir							
			Rock Island							
			Verrett	1	0	0	0.0000			
			Subtotal	55	0	0	0.0000	5,774		
	1999		Brood Year totals	4,119	6	6	0.0015	5,774	3,398,999	1,199,979

[a] Sample not included in marked fraction due to sampling irregularities.

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Appendix A1.–Page 3 of 5.

Year	Brood year	Age	Location sampled	Sample size	Adipose clips	Valid tags	Marked fraction	Smolt tagged	Smolt estimate	SE estimate
2003	2000	.1	Kakwan	0						
			Inriver commercial	20						
			Test	90[a]						
			Little Tahltan weir	22						
			Little Tahltan weir B	25						
			Rock Island	77						
			Verrett	15						
			Subtotal	159	0	0	0.0000	17,411		
2004	2000	.2	Kakwan	400[a]						
			Inriver commercial	429						
			Little Tahltan weir	263						
			Test	81[a]						
			Rock Island	185						
			Verrett	141						
			Subtotal	1,018	0	0	0.0000	17,411		
2005	2000	.3	Kakwan	692[a]	0	0	0.0000			
			Inriver commercial	1,691	13	13	0.0077			
			Little Tahltan weir	701	3	3	0.0043			
			Rock Island	143	0	0	0.0000			
			Verrett	212	0	0	0.0000			
			Subtotal	2,747	16	16	0.0058	17,411	2,814,598	661,029
2006	2000	.4	Kakwan	413	2	2	0.0048			
			Inriver commercial	3,317	18	18	0.0054			
			Inriver commercial 2	442	4	4	0.0090			
			Little Tahltan weir	[a]						
			Rock Island	[a]	0	0				
			Verrett	244	2	2	0.0082			
			Subtotal	4,416	26	26	0.0059	17,411	2,848,473	536,247
2007	2000	.5	Kakwan	5	0	0				
			Inriver commercial	104	0	0				
			Little Tahltan weir	3	0	0				
			Inriver commercial 2	27	0	0				
			Verrett	3	0	0				
			Subtotal	142	0	0	0.0000	17,411		
	2000		Brood Year totals	8,482	42	42	0.0050	17,411	3,435,022	515,897

[a] Sample not included in marked fraction due to sampling irregularities.

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Appendix A1.–Page 4 of 5.

Year	Brood year	Age	Location sampled	Sample size	Adipose clips	Valid tags	Marked fraction	Smolt tagged	Smolt estimate	SE estimate
2004	2001	.1	Kakwan	0						
			Inriver commercial	13						
			Little Tahltan weir	13						
			Test	2[a]						
			Rock Island	5						
			Verrett	3						
			Subtotal	34	0	0	0.0000	19,927	697,479	486,084
2005	2001	.2	Kakwan	12		0				
			Inriver commercial	27		0				
			Little Tahltan weir	55		0				
			Rock Island	26		0				
			Verrett	3		0				
			Subtotal	111	0	0	0.0000	19,927	2,231,935	1,571,116
2006	2001	.3	Kakwan	97	0	0	0.0000			
			Inriver commercial	660	3	3	0.0045			
			Inriver commercial 2	86	0	0	0.0000			
			Little Tahltan weir	[a]						
			Rock Island	[a]						
			Verrett	63	1	1	0.0159			
			Subtotal	906	4	4	0.0044	19,927	3,614,938	1,471,534
2007	2001	.4	Kakwan	97[a]	1	1	0.0103			
			Lower River commercial	1,172	5	5	0.0043			
			Little Tahltan weir	40	0	0	0.0000			
			Inriver commercial 2	289	0	0	0.0000			
			Verrett	29	0	0	0.0000			
			Subtotal	1,627	6	6	0.0037	19,927	4,634,682	1,634,794
2008	2001	.5	Kakwan	0						
			Inriver commercial	9	1	1	0.1111			
			Little Tahltan weir	1	0	0	0.0000			
			Inriver commercial 2	4			0.0000			
			Verrett	1	0	0	0.0000			
			Subtotal	15	1	1	0.0667	19,927	159,423	86,094
	2001		Brood Year totals	2,693	11	11	0.0041	19,927	4,473,835	1,237,679

[a] Sample not included in marked fraction due to sampling irregularities.

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Appendix A1.–Page 5 of 5.

Year	Brood year	Age	Location sampled	Sample size	Adipose clips	Valid tags	Marked fraction	Smolt tagged	Smolt estimate	SE estimate
2005	2002	.1	Kakwan	0	0	0				
			Inriver commercial	6	0	0				
			Little Tahltan weir	2	0	0				
			Rock Island	36	0	0				
			Verrett	1	0	0				
			Subtotal	45	0	0	0.0000	26,631	1,225,071	856,773
2006	2002	.2	Kakwan	33	0	0	0.0000			
			Inriver commercial	465	9	9	0.0194			
			Inriver commercial 2	62	1	1	0.0161			
			Little Tahltan weir	[a]	0	0				
			Rock Island	[a]	0	0				
			Verrett	25	0	0	0.0000			
			Subtotal	585	10	10	0.0171	26,631	1,418,758	405,614
2007	2002	.3	Kakwan	255	3	3	0.0118			
			Inriver commercial	2,663	25	25	0.0094			
			Little Tahltan weir	96	1	1	0.0104			
			Inriver commercial 2	647	5	4	0.0062			
			Verrett	57	0	0	0.0000			
			Subtotal	3,718	34	33	0.0089	26,631	2,829,839	469,107
2008	2002	.4	Kakwan	282	4	3	0.0106			
			Inriver commercial	2,333	21	21	0.0090			
			Little Tahltan weir	233	1	1	0.0043			
			Inriver commercial 2	1,082	17	16	0.0148			
			Verrett	62	0	0	0.0000			
			Subtotal	3,992	43	41	0.0103	26,631	2,416,853	357,997
2009	2002	.5	Kakwan	0	0	0	0.0000			
			Inriver commercial	7	0	0	0.0000			
			inriver commercial 2	5	0	0	0.0000			
			Little Tahltan weir	7	0	0	0.0000			
			Verrett	0	0	0	0.0000			
			Subtotal	19	0	0	0.0000			
	2002		Brood Year totals	8,369	87	84	0.0104	26,631	2,533,065	266,648

[a] Sample not included in marked fraction due to sampling irregularities.

Appendix A2.–Numbers of unmarked and marked adult Chinook salmon gathered by year and age class during CWT sampling in the Stikine River from 2001 to 2009 and the resulting χ^2 test statistic and P-value obtained from tests for differences in marked rates between age classes by year class.

Year	Class	Age-1.2	Age-1.3	Age-1.4	Total	χ^2 test statistic	P-value
1998	Unmarked	409	2,188	1,335	3,932		
	Marked	1	9	3	13		
	Marked-fraction	0.0024	0.0041	0.0022	0.0033	0.97	0.61
1999	Unmarked	881	1,720	1,420	4021		
	Marked	0	5	1	6		
	Marked-fraction	0.0000	0.0029	0.0007	0.0015	0.91[a]	0.34
2000	Unmarked	1,018	2,731	4,390	8,139		
	Marked	0	16	26	42		
	Marked-fraction	0.0000	0.0058	0.0059	0.0051	1.07	0.30
2001	Unmarked	111	902	1,621	2,634		
	Marked	0	4	6	10		
	Marked-fraction	0.0000	0.0044	0.0037	0.0038	0.01[a]	0.92
2002	Unmarked	575	3,685	3,951	8,211		
	Marked	10	33	41	84		
	Marked-fraction	0.0171	0.0089	0.0103	0.0101	3.42	0.18

[a] Pooled age -1.2 and age-1.3 strata.

Appendix A3.–Estimated marine harvest of Stikine-bound Chinook salmon from brood years 1998–2002.

Panel A: 1998 Brood year $\hat{\theta} = 0.00339$, $G[1/\theta] = 0.126$

Harvest type	Fishery	Year	Age	Period	Area	H Harvest	var H	n Sample	a_1 Adipose clips	A_2 Heads received	m_1 Tags detected	m_2 Tags decoded	mj Codes of interest	rj Harvest of interest	SE[rj]
Trad	troll	2003	1.3	3	NW	187,173	0	52,928	3,003	2,947	2,199	2,195	1	1,064	1,064
Trad	troll	2003	1.3	2	SE	6,748	0	4,749	329	315	277	277	2	875	656
Trad	troll	2003	1.3	2	NW	18,858	0	8,314	532	529	457	457	1	672	672
PSG DE	sport	2003	1.3	11		105	0[a]	100	2	2	1	1	1	309	309
Sitka DE	sport	2003	1.3	11		419	0[a]	419	19	19	17	17	1	295	294
Northern BC	troll	2003	1.3	18	6	9,195	0	1,014	83	73	73	73	1	3,039	3,038
Northern BC	troll	2003	1.3	19	6	4,649	0	435	58	51	51	51	1	3,582	3,582
Trad	troll	2004	1.4	1	NE	4,235	0	1,331	115	115	80	79	1	950	949
Petersburg	sport	2004	1.4	11	106	503	0	503	19	19	15	15	1	295	294
Trad	troll	2004	1.4	2	NW	32,586	0	13,759	766	757	650	650	2	1,413	1,059
Trad	troll	2004	1.4	2	NE	9,438	0	3,445	285	283	240	240	2	1,626	1,220
Trad	troll	2004	1.4	3	SE	10,444	0	5,826	378	374	333	333	3	1,602	1,034
Northern BC	sport	2004	1.4										1		
						284,353	0	92,823	5,589	5,484	4,393	4,388	18	15,721[b]	5,378

Panel B: 1999 Brood year $\hat{\theta} = 0.00146$, $G[1/\theta] = 0.639$

Harvest type	Fishery	Year	Age	Period	Area	H Harvest	var H	n Sample	a_1 Adipose clips	A_2 Heads received	m_1 Tags detected	m_2 Tags decoded	mj Codes of interest	rj Harvest of interest	SE[rj]
Trad	troll	2003	1.2	2	NW	32,586		13,759	766	757	650	650	1	1,645	1,645
Trad	troll	2004	1.3	2	SE	10,444		5,826	378	374	333	333	2	2,488	2,252
Trad	drift	2005	1.4	21	108	2,935		2,492	24	24	22	22	2	1,617	1,464
Trad	drift	2005	1.4	22	108	2,197		1,744	10	10	9	9	1	865	865
Trad	drift	2005	1.4	23	108	5,899		4,848	40	40	37	37	4	3,341	2,853
Trad	drift	2005	1.4	24	108	8,118		4,911	37	37	30	30	1	1,135	1,135
Trad	troll	2005	1.4	2	SE	15,000		9,196	513	507	449	448	1	1,136	1,135
Trad	troll	2005	1.4	2	NE	12,198		3,713	282	281	252	252	2	4,527	4,098
Petersburg	sport	2005	1.4	12	-	215	7,084	26	1	1	1	1	1	5,677	5,677
Sitka	sport	2005	1.4	12	-	5,280	353,950	1,628	84	83	73	73	1	2,253	2,253
Trad	drift	2006	1.5	24	108	5,223		2,645	61	60	56	56	1	1,378	1,378
						100,095		50,788	2,196	2,174	1,912	1,911	17	26,061[b]	8,796

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Panel C: 2000 brood year $\hat{\theta}$ = 0.0050, G[1/θ] = 0.028

Harvest type	Fishery	Year	Age	Period	Area	*H* Harvest	var H	*n* Sample	a_1 Adipose clips	A_2 354	m_1 Tags detected	m_2 Tags decoded	*mj* Codes of interest	*rj* Harvest of interest	SE[*rj*]
Trad	Troll	2004	1.2	5	NW	9,672		2,510	354	3	210	209	1	782	781
Wrangell	Sport	2004	1.2	12	-	300		58	3	55	55	3	1	1,045	1,044
Trawl	High Sea	2004	1.2			54,014		28,783	55	5	5	55	1	379	378
Trad	Drift	2005	1.3	23	108	444		105	5			5	0	0	0
Trad	Drift	2005	1.3	19	108	632		312	4	4	4	4	1	409	409
Trad	Drift	2005	1.3	21	108	2,935		2,492	24	24	22	22	6	1,427	620
Trad	Drift	2005	1.3	22	108	2,197		1,744	10	10	9	9	2	509	364
Trad	Drift	2005	1.3	23	108	5,899		4,848	40	40	37	37	12	2,949	970
Trad	Drift	2005	1.3	24	108	8,118		4,911	37	37	30	30	9	3,004	1,105
Trad	Drift	2005	1.3	25	108	1,160		794	14	14	12	11	2	644	461
Trad	Drift	2005	1.3	26	108	721		325	15	15	15	15	1	448	448
Trad	Troll	2005	1.3	3	NW	95,209		28,826	1,530	1,474	1,238	1,235	1	694	694
Trad	Troll	2005	1.3	5	NW	4,472		1,922	214	213	160	158	1	478	478
Trad	Troll	2005	1.3	6	NE	1,802		654	203	203	193	192	1	559	559
Exp area	Troll	2005	1.3	2	SE	15,000		9,196	513	507	449	448	10	3,341	1,179
Exp area	Troll	2005	1.3	2	NE	12,198		3,713	282	281	252	252	2	1,332	954
Exp area	Troll	2005	1.3	2	NW	26,483		11,781	669	666	573	573	4	1,824	948
Petersburg	Sport	2005	1.3	11	-	689	0	689	25	25	25	25	1	202	201
Petersburg	Sport	2005	1.3	11	-	190	8,000	26	3	3	3	3	1	1,476	1,475
Ketchikan	Sport	2005	1.3	11	-	1,134		898	52	51	49	48	2	531	380
Wrangell	Sport	2005	1.3	11	-	690		130	2	2	1	1	1	1,072	1,071
Craig		2005	1.3	12	-	2,086		396	15	15	15	15	1	1,064	1,063
Trad	Troll	2006	1.4	1	NE	2,377		885	105	104	101	101	1	548	547
Trad	Troll	2006	1.4	1	SE	4,891		2,476	142	141	117	117	2	804	575
Exp area	Troll	2006	1.4	2	SE	9,168		4,040	220	217	190	189	2	934	669
Exp area	Troll	2006	1.4	2	NE	8,651		4,458	543	532	500	497	5	2,012	947
Exp area	Troll	2006	1.4	2	NW	15,184		5,561	316	314	285	285	4	2,220	1,154
Trad	Drift	2006	1.4	18	108	358		194	2	2	2	2	2	745	534
Trad	Drift	2006	1.4	19	108	940		484	4	4	2	2	1	392	392
Trad	Drift	2006	1.4	20	108	1,249		758	17	17	16	16	3	998	591
Trad	Drift	2006	1.4	21	108	3,173		2,134	35	35	28	28	2	601	430
Trad	Drift	2006	1.4	22	108	4,274		2,126	44	43	37	37	4	1,662	864
Trad	Drift	2006	1.4	23	108	5,314		2,735	46	46	45	45	7	2,747	1,119
Trad	Troll	2006	1.4	1	NE	2,377		885	105	104	101	101	1	548	547

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Harvest type	Fishery	Year	Age	Period	Area	H Harvest	var H	n Sample	a_1 Adipose clips	A_2 Heads received	m_1 Tags detected	m_2 Tags decoded	mj Codes of interest	rj Harvest of interest	SE[rj]
2000 Brood year (continued)															
Trad	Drift	2006	1.4	24	108	5,223		2,645	61	60	56	56	6	2,433	1,058
Trad	Drift	2006	1.4	25	108	3,923		2,888	119	119	114	114	5	1,372	645
Trad	Drift	2006	1.4	21	111	1,097		650	19	19	19	19	1	341	340
Petersburg	Sport	2006	1.4	11	-	702		702	47	47	46	45	3	619	366
Wrangell	Sport	2006	1.4	11	-	180	0	140	3	3	2	2	1	260	259
Elfin Cove	Sport	2006	1.4	10	-	53	0	50	2	2	2	2	1	214	214
Elfin Cove	Sport	2006	1.4	12	-	103	0	101	7	7	6	6	1	206	205
						312,905		138,140					112	43,274[b]	4,709
Panel D: 2001 Brood year $\hat{\theta}$ = 0.0041, G[1/θ] = 0.224															
Exp area	Troll	2006	1.3	2	SE	9,168		4,040	220	217	190	189	1	566	566
Trad	Drift	2006	1.3	21	108	3,173		2,134	35	35	28	28	1	364	364
Trad	Drift	2006	1.3	22	108	4,274		2,126	44	43	37	37	5	2,518	1,550
Trad	Drift	2006	1.3	23	108	5,314		2,735	46	46	45	45	2	951	744
Trad	Drift	2006	1.3	24	108	5,223		2,645	61	60	56	56	1	491	491
Trad	Drift	2006	1.3	25	108	3,923		2,888	119	119	114	114	2	665	520
Exp area	Troll	2007	1.4	2	NE	13,486		6,175	940	939	883	882	2	1,072	838
Exp area	Troll	2007	1.4	2	SE	14,395		5,583	308	306	265	265	2	1,271	994
Trad	Troll	2007	1.4	1	NW	29,540		9,788	620	615	408	407	2	1,493	1,168
Trad	Drift	2007	1.4	21	108	899		526	18	18	16	16	1	418	418
Trad	Drift	2007	1.4	22	108	1,316		1,045	27	27	25	25	1	308	308
Trad	Drift	2007	1.4	26	108	2,214		303	24	24	23	23	1	1,789	1,788
Wrangell	Sport	2007	1.4	11	-	304		288	4	4	3	3	1	258	258
Wrangell	Sport	2007	1.4	12	-	145		123	4	4	4	4	1	289	288
Sitka	Sport	2007	1.4	11	-	809		809	43	43	36	36	1	245	244
Petersburg	Sport	2007	1.4	11	-	438		438	22	22	22	22	1	245	244
						94,621		41,646					25	12,944[b]	3,273
Panel E: 2002 Brood year $\hat{\theta}$ = 0.0101, G[1/θ] = 0.012															
Trawl	High Sea	2005	1.1			69,908		41,835	52	52	45	45	1	166	165
Trad	Drift	2006	1.2	24	106	171		192	4	4	4	4	1	88	88
Trad	Drift	2006	1.2	26	106	398		159	11	11	8	8	1	249	248
Trad	Drift	2006	1.2	25	108	3,923		2,888	119	119	114	114	2	270	191
Trad	Drift	2006	1.2	24	108	5,223		2,645	61	60	56	56	5	997	455
Test	Troll	2006	1.2	25	114	34		34	4	4	3	3	1	99	99

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2002 Brood year (continued)

Harvest type	Fishery	Year	Age	Period	Area	H Harvest	var H	n Sample	a_1 Adipose clips	A_2 Heads received	m_1 Tags detected	m_2 Tags decoded	mj Codes of interest	rj Harvest of interest	SE[rj]
Trawl	High Sea	2006	1.2			83,103		50,015	74	74	35	35	1	165	164
Trad	Drift	2007	1.3	19	108	255		114	7	7	7	7	2	444	315
Trad	Drift	2007	1.3	20	108	408		245	5	5	4	4	2	331	235
Trad	Drift	2007	1.3	21	108	899		526	18	18	16	16	4	679	345
Trad	Drift	2007	1.3	22	108	1,316		1,045	27	27	25	25	3	375	218
Trad	Drift	2007	1.3	23	108	1,729		812	16	16	14	14	2	423	300
Trad	Drift	2007	1.3	24	108	4,933		2,876	73	71	69	69	5	875	400
Trad	Troll	2007	1.3	1	NW	29,540		9,788	620	615	408	407	2	606	430
Exp area	Troll	2007	1.3	2	SE	14,395		5,583	308	306	265	265	4	1,031	524
Exp area	Troll	2007	1.3	2	NE	13,486		6,175	940	939	883	882	4	869	442
Exp area	Troll	2007	1.3	2	NW	19,578		7,292	395	392	335	335	1	269	268
Term	Troll	2007	1.3	2	107-35	124		63	4	4	4	4	1	195	195
Elfin Cove	Sport	2007	1.3	13	-	142		140	8	8	8	8	1	101	100
Wrangell	Sport	2007	1.3	12	-	145		123	4	4	4	4	1	117	117
Petersburg	Sport	2007	1.3	11	-	438		438	22	22	22	22	2	199	141
Wrangell	Sport	2007	1.3	10	-	161		143	2	2	2	2	2	224	158
Trad	Drift	2008	1.4	20	108	769		508	14	14	13	13	1	150	150
Trad	Drift	2008	1.4	21	108	1,591		1,041	40	40	39	39	7	1,062	415
Trad	Drift	2008	1.4	22	108	1,396		1,015	31	31	29	29	5	683	312
Trad	Drift	2008	1.4	23	108	1,538		1,232	28	28	26	26	5	620	283
Trad	Drift	2008	1.4	24	108	1,267		655	29	29	29	29	4	768	390
Trad	Drift	2008	1.4	25	108	2,258		837	52	52	49	49	1	268	267
Trad	Troll	2008	1.4	1	NE	1,455		863	95	95	83	83	1	167	167
Trad	Troll	2008	1.4	1	NW	10,799		3,854	241	238	173	172	2	567	402
Trad	Troll	2008	1.4	1	SE	3,319		1,872	75	74	66	66	2	357	253
Exp area	Troll	2008	1.4	2	SE	5,881		2,889	189	187	169	168	3	616	359
Exp area	Troll	2008	1.4	2	NE	12,623		8,503	1,760	1,749	1,647	1,639	1	149	149
Sitka	Sport	2008	1.4	11	-	125		125	7	7	6	6	1	99	99
Wrangell	Sport	2008	1.4	10	-	100		98	2	2	1	1	1	101	101
Wrangell	Sport	2008	1.4	9	-	58		58	2	2	2	2	2	199	141
Petersburg	Sport	2008	1.4	11	-	102		102	4	4	4	4	3	298	173
						293,590							87	14,874[b]	1,688

Note: Trad=Traditional fishery. Exp area=Experimental area.

[a] Derby catches (DE) are total harvests and are not estimated, therefore there is no variance (Mike Jaenicke, Fishery Biologist, ADF&G, Douglas, personal communication).

[b] Harvest equals sum of fishery subtotals, SE equals the square root of the fishery subtotal variances.

Appendix A4.–Number of minnow traps checked, numbers of Chinook salmon smolt captured and tagged, and water temperature and depth on the Stikine River by date, 2000.

Tagging date	Trap sets	CWT applied	CPUE	Morts	Tags released	Water temp, °C	Stage height, ft
4/14	64	14	0.2	1	13		
4/15	48	14	0.3	0	14	1	5.8
4/16	80	54	0.7	1	53	2	5.8
4/17					0	4	5.9
4/18					0	3	6.0
4/19					0	3	6.2
4/20	248	244	1.0	0	244	3	6.3
4/21	120	121	1.0	0	121	3	7.1
4/22					0	4	7.7
4/23	214	305	1.4	0	305	4	7.4
4/24	125	145	1.2	0	145	4	7.0
4/25	70	83	1.2	0	83	4	6.7
4/26	134	353	2.6	1	352	5	6.6
4/27	155	555	3.6	2	553	5.5	6.7
4/28	161	563	3.5	1	562	4	7.0
4/29	73	405	5.5	1	404	5	7.1
4/30	158	393	2.5	2	391	4.5	7.5
5/1					0	3.5	8.4
5/2	222	975	4.4	3	972	4	8.5
5/3	204	671	3.3	3	668	6	8.7
5/4	153	558	3.6	0	558	5.5	9.0
5/5	157	364	2.3	2	362	6	9.3
5/6	147	784	5.3	8	776	6	9.3
5/7	168	744	4.4	13	731	6	9.4
5/8	168	672	4.0	1	671	6.5	9.5
5/9	150	597	4.0	2	591	6.5	9.8
5/10	83	323	3.9	5	312	6.5	10.4
5/11	193	514	2.7	2	512	6	10.9
5/12	162	554	3.4	9	545	6	11.5
5/13	169	269	1.6	3	266	6.5	11.8
5/14					0	6.5	11.9
5/15	278	451	1.6	23	424	6.5	12.0
5/16	160	250	1.6	2	248	6.5	12.1
5/17					0	6	12.2
5/18	318	539	1.7	9	530	6	12.9
5/19					0	7	13.4
5/20	303	312	1.0	8	304	6.5	13.7
5/21					0	6	13.0
5/22	317	362	1.1	9	353	5.5	13.2
5/23					0	6	13.1
5/24	336	549	1.6	4	545	6	12.6
5/25					0	6.5	12.0
5/26					0	7	11.7
5/27	345	813	2.4	7	806	7.5	11.7
5/28					0	8	12.0
5/29	339	388	1.1	2	386	7	12.8
5/30					0	7	13.0
5/31					0	9	13.0
6/1	509	551	1.1	4	547	8	13.6
6/2					0	9	14.7
6/3					0	9	15.6
6/4	382	135	0.4	3	132	9	16.5
6/5					0	8	16.9

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Appendix A4.–Page 2 of 2.

Tagging date	Trap sets	CWT applied	CPUE	Morts	Tags released	Water temp, °C	Stage height, ft
6/6					0	9.5	17.5
6/7	430	70	0.2	3	67	8	19.0
6/8					0	7	19.6
6/9					0	8	19.9
6/10	318	18	0.1	0	18	8	20.0
6/11					0	8	20.7
6/12	198	5	0.0	4	1	9	21.5
Total	7,859	14,717		138	14,560[a]		

[a] 19 fish released without tags.

Appendix A5.–Number of minnow traps checked, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2001.

Tagging date	Trap sets	CWT applied	CPUE	Overnight morts	Tags released	Water temp, °C	Stage height, ft
4/10						0	5.4
4/11						1	5.3
4/12	327	59	0.2	0	59	2	5.4
4/13					0	3	5.0
4/14	324	74	0.2	0	74	4	4.9
4/15					0	4	4.9
4/16	362	55	0.2	0	55	4	5.0
4/17					0	5	5.1
4/18	307	83	0.3	1	82	5	5.4
4/19					0	5.5	5.8
4/20	339	124	0.4	0	124	5.5	6.1
4/21	191	85	0.4	0	85	5.5	6.4
4/22	198	83	0.4	0	83	6	6.0
4/23	203	85	0.4	0	85	6	6.7
4/24					0	5	7.0
4/25					0		8.1
4/26	590	113	0.2	0	113	5.5	7.8
4/27	199	111	0.6	0	111	5	8.0
4/28					0	6	8.1
4/29					0	6	8.0
4/30	592	92	0.2	0	92	5	
5/1	191	118	0.6	0	118	5.5	
5/2					0	6.5	
5/3					0	6	
5/4	596	149	0.3	0	149	6	
5/5					0	6	
5/6					0	6	
5/7	594	174	0.3	0	174	7	
5/8					0	6	8.1
5/9	395	202	0.5	0	202	6	8.3
5/10					0	6	7.9
5/11	388	229	0.6	0	229	7	7.8
5/12					0	7.5	8.0
5/13					0	8	8.3
5/14	575	311	0.5	0	311	7	8.5
5/15					0	7.5	8.8
5/16	368	502	1.4	0	502	7.5	9.1
5/17					0	7.5	9.4
5/18					0	7.5	9.3
5/19	480	307	0.6	0	307	7	9.2
5/20					0	8	8.9
5/21	359	704	2.0	1	703	8	9.2
5/22	166	710	4.3	3	707	9	10.0
5/23					0	8	11.8
5/24					0	8	12.1
5/25	506	586	1.2	5	581	8	11.9
5/26					0	9.5	11.8
5/27					0	9	11.9
5/28					0	9	12.6
5/29	676	835	1.2	20	815	9.5	14.3
5/30					0	8	15.7
5/31	129	30	0.2	0	30	9	16.4
Total	9,055	5,821	0.6	30	5,774[a]		

[a] 17 released without tags.

Appendix A6.–Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2002.

Tagging date	Trap sets	Seine sets	CWT applied traps	CWT applied seine	Trap CPUE	Seine CPUE	Overnight morts	Water temp, °C	Stage height, ft
4/24								3.0	5.4
4/25	312	0	170	0	0.5		0		5.3
4/26								3.5	5.5
4/27	301	0	185	0	0.6		0	4.0	5.7
4/28								5.0	6.0
4/29	278	0	237	0	0.9		0	5.0	6.4
4/30								5.5	7.1
5/1	213	0	83	0	0.4		0	5.0	8.3
5/2								5.0	9.6
5/3								5.0	9.8
5/4								5.0	8.9
5/5	359	0	33	0	0.1		1	5.0	8.2
5/6	113	0	20	0	0.2		0	4.0	7.8
5/7	119	0	119	0	1.0		0	5.0	7.4
5/8								6.0	7.3
5/9								6.0	7.2
5/10	406	7	159	0	0.4	0.0	0	7.0	7.4
5/11	112	18	377	298	3.4	16.6	0	7.0	7.9
5/12								6.0	8.9
5/13								6.0	9.8
5/14	185	24	348	434	1.9	18.1	1	6.0	10.7
5/15								7.0	10.9
5/16	229	15	173	242	0.8	16.1	1	7.0	11.1
5/17								8.0	11.9
5/18								6.5	12.5
5/19	444	6	275	0	0.6	0.0	1	7.0	12.5
5/20								7.0	13.3
5/21								8.0	15.1
5/22	382	0	295	0	0.8		5	7.0	16.3
5/23								7.5	16.8
5/24	45	48	0	2,202	0.0	45.9	18	7.5	16.6
5/25	45	25	0	844	0.0	33.8	13	8.0	16.5
5/26	43	27	23	911	0.5	33.7	9	9.0	17.0
5/27	36	16	72	1,468	2.0	91.8	57	9.0	18.1
5/28	6	31	0	709	0.0	22.9	2	9.0	19.0
5/29	0	25	0	667		26.7	41	8.0	19.6
5/30	0	38	0	1,590		41.8	141		19.6
5/31								9.0	19.1
6/1	0	77	0	1,685		21.9	2	8.0	18.4
6/2								8.0	17.9
6/3								9.0	17.8
6/4	0	89	0	1,047		11.8	8	9.0	17.9
6/5	0	45	0	715		15.9	16	9.0	19.6
6/6								10.0	19.9
6/7	0	23	0	948		41.2	3	9.0	19.4
6/8								9.0	18.4
6/9	0	43	0	997		23.2	15	10.0	18.4
6/10								10.0	19.9
6/11	0	51	0	482		9.5	6	10.5	20.8
Total	3,628	608	2,569	15,239[a]	0.7	25.1	340		

[a] Total of 17,808 marked, minus340 morts, 57 no tags, for total CWT released of 17,411.

Appendix A7.–Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2003.

Tagging date	Trap sets	Seine sets	CWT applied traps	CWT applied seine	Trap CPUE	Seine CPUE	Overnight morts	Water temp, °C	Stage height, ft
4/21								3.5	NA
4/22	126		95		0.8		0	3.0	NA
4/23								2.5	NA
4/24	195		72		0.4		0	2.0	NA
4/25								4.0	NA
4/26			Project paused in response to crew tragedy.					4.0	NA
4/27									NA
4/28									NA
4/29									NA
4/30									NA
5/1									NA
5/2									NA
5/3									NA
5/4								5.0	NA
5/5								5.0	10.7
5/6	131	9	116	237	0.9	26.3	1	5.5	10.1
5/7								6.0	9.6
5/8	185	4	229	37	1.2	9.3	1	7.0	9.5
5/9								7.0	9.7
5/10	237	8	416	138	1.8	17.3	1	8.0	10.3
5/11								8.0	11.2
5/12	243	2	334	209	1.4	104.5	1	8.0	12.3
5/13								8.0	13.9
5/14	124	33	20	873	0.2	26.5	14	6.0	13.6
5/15	58	18	51	785	0.9	43.6	11	7.0	12.8
5/16	69	22	117	843	1.7	38.3	2	7.5	12.0
5/17	116	19	298	662	2.6	34.8	9	8.0	11.4
5/18	133	16	352	293	2.6	18.3	6	8.0	11.1
5/19	132	6	359	133	2.7	22.2	1	9.0	11.3
5/20	124	15	459	513	3.7	34.2	1	9.0	11.5
5/21	123	12	122	291	1.0	24.3	1	9.0	11.9
5/22	103	15	207	329	2.0	21.9	16	8.0	12.6
5/23								8.5	13.3
5/24	194	25	330	816	1.7	32.6	40	7.5	15.6
5/25	38	9		560	0.0	62.2	22	8.0	17.0
5/26								8.0	17.7
5/27	80	42		1,152		27.4	18	8.5	17.9
5/28	23	27		1,400		51.9	8	8.0	17.4
5/29	30	39		610		15.6	8	8.0	17.3
5/30								9.0	17.5
5/31	54	60		462		7.7	4	10.0	17.8
6/1	27	52		717		13.8	0	10.0	18.6
6/2	17	16		1,441		90.1	2	10.0	18.9
6/3	7	64		936		14.6	11	9.5	18.9
6/4	15	15		958		63.9	4	9.5	18.0
6/5								10.0	17.5
6/6	21	95		840		8.8	2	11.0	18.5
6/7		34		761		22.4	6	11.0	20.5
6/8		17		601		35.4	6		21.5
6/9									21.6
Total	2,605	674	3,577	16,597[a]	1.4	24.6	196		

[a] Total of 20,174 marked, minus 196 morts, 51 no tags, for total of 19,927 marked fish released.

Appendix A8.–Number of minnow traps checked, beach seine hauls, numbers of Chinook salmon smolt captured and tagged, and river temperature and depth on the Stikine River by date, 2004.

Tagging date	Trap sets	Seine sets	CWT applied traps	CWT applied seine	Trap CPUE	Seine CPUE	Overnight morts	Water temp, °C	Stage height, ft
4/17								3.0	6.6
4/18								3.0	6.5
4/19	195	0	246	0	1.3		0	2.0	6.4
4/20	157	0	227	0	1.4		3	2.0	6.3
4/21	0	0	0	0			0	3.0	6.3
4/22	375	1	845	0	2.3		0	3.0	6.4
4/23	200	0	500	0	2.5		1	3.0	7.1
4/24	208	0	383	0	1.8		2	3.0	7.2
4/25	214	0	361	0	1.7		2	2.0	7.4
4/26	210	0	188	0	0.9		2	2.0	8.4
4/27	182	4	177	0	1.0		1	3.0	9.0
4/28	194	0	139	0	0.7		0	4.0	8.7
4/29	0	0	0	0			0	5.0	9.8
4/30	322	6	213	0	0.7		1	4.0	10.0
5/1	113	23	501	0	4.4		3	4.0	11.0
5/2	56	21	0	413		19.7	9	4.0	12.4
5/3	0	0	0	0			0	4.0	13.3
5/4	26	43	0	1,464		34.0	16	4.0	13.9
5/5	0	0	0	0			0	4.0	14.6
5/6	21	52	0	1,479		28.4	9	3.0	14.2
5/7	11	31	0	1,526		49.2	8	4.0	13.1
5/8	13	27	0	640		23.7	6	4.0	13.0
5/9	9	24	0	801		33.4	2	5.0	13.3
5/10	36	29	0	1,368		47.2	9	5.0	13.7
5/11	0	0	0	0			0	5.0	13.6
5/12	58	60	0	865		14.4	6	5.0	13.4
5/13	29	21	11	1,217	0.4	58.0	11	5.0	13.7
5/14	47	36	0	2,059		57.2	6	6.0	14.7
5/15	0	44	0	1,072		24.4	1	6.0	15.6
5/16	24	27	57	3,833	2.4	142.0	38	6.0	16.2
5/17	0	0	0	0			0	6.0	16.5
5/18	0	24	0	1,287		53.6	3	6.0	16.9
5/19	0	0	0	0			0	7.0	17.4
5/20	0	52	0	1,161		22.3	64	7.0	18.3
5/21	0	22	0	1,300		59.1	53	7.0	19.5
5/22	0	5	0	806		161.2	9	7.0	20.1
5/23	0	0	0	0			0	7.0	19.4
5/24	0	0	0	0			0	7.0	18.8
5/25	0	61	0	632		10.4	5	7.0	19.0
5/26	0	27	0	378		14.0	5	7.0	20.0
5/27	0	0	0	0			0	7.0	20.8
5/28	0	38	0	656		17.3	7	7.0	20.5
5/29	0	29	0	203		7.0	4	7.0	19.6
5/30									
Total	2,700	707	3,848	23,160[a]	1.4	32.8	286		

[a] Total of 27,008 marked, minus 286 morts, 92 no tags, for total CWT released of 26,630.

APPENDIX B

Appendix B1.–Counts at the weir on the Little Tahltan River, mark–recapture estimates of inriver run abundance and spawning escapement, and other statistics for large[a] Chinook salmon in the Stikine River, 1998–2008[b].

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Weir count	4,879	4,738	6,640	9,738	7,490	6,492	16,381	7,387	3,860	562	2,657
M-1st event	405	252	612	1,416	935	1,089	1,509	1,022	497	343	420
C-2nd event	3,048	4,030	3,657	5,596	4,375	4,696	5,914	21,249	15,098	10,691	7,242
R-recaptures	43	42	73	118	75	118	169	362	132	113	102
Inriver run abundance (T)	28,133	23,716	30,301	66,646	53,893	49,881	52,538	59,885	40,181	27,023	26,052
SE	3,931	3,240	3,168	5,853	5,912	6,078	3,896	2,538	6,746	2,331	2,981
CV	14.0%	13.7%	10.5%	8.8%	11.0%	12.2%	7.4%	4.2%			
95% L.C.I.	NA	NA	24,879	56,521	43,798	37,968	45,817	54,392	26,960	22,455	20,795
95% U.C.I.	NA	NA	38,049	78,982	67,023	61,795	61,217	64,641	53,402	31,592	33,154
Spawning escapement (E)	25,968	19,947	27,531	63,523	50,875	46,824	48,900	39,833	24,405	15,953	18,843
SE	3,931	3,240	3,168	5,853	5,912	6,078	3,896	2,538	6,746	2,331	3,153
CV	15.1%	16.2%	11.5%	9.2%	11.6%	13.0%	8.0%	6.4%			
95% L.C.I.	NA	NA	22,220	53,741	40,675	34,911	42,179	20,052			
95% U.C.I.	NA	NA	34,565	75,718	63,900	58,738	57,579	59,885			

[a] Large Chinook are ≥660mm MEF length.

[b] Richards et al. 2008; Richards and Etherton *In prep.*

APPENDIX C

Appendix C1.–Number of Chinook salmon coded wire tagged at Canadian incubation project near Glenora on the Stikine River, 2001–2002.

Tag code	Brood year	Stage	Wt	Year released	Date last released	Adipose clipped and tagged	Adipose clipped not tagged	Total released
20604	2000	FED FRY	2	2001	5/1/01	21,172	463	26,289
181739	2001	FED FRY	1.8	2002	5/2/02	10,988	167	12,120
181740	2001	FED FRY	1.8	2002	5/3/02	10,922	166	12,048
						21,910	333	24,168

Appendix C2.–Recoveries of Glenora tags in marine fisheries.

Harvest Type	Fishery	Year	Age	Period	Area	H Harvest	n Sampled	mj Codes of interest
Panel. A: 2000 Brood Year								
Trad	drift	2004	1.2	25	106	195	73	1
Trad	drift	2005	1.3	26	106	402	54	1
Trad	drift	2005	1.3	23	108	5,899	4,848	1
Trad	drift	2005	1.3	24	108	8,118	4,911	3
Exp area	troll	2005	1.3	2	SE	15,000	9,196	2
Petersburg	sport	2005	1.3	11	-	689	689	1
						30,303	19,771	9
Panel B: 2001 Brood Year								
Trad	drift	2005	1.2	20	108	985	756	2
Trad	drift	2005	1.2	21	108	2,935	2,492	1
Trad	drift	2005	1.2	22	108	2,197	1,744	1
Trad	drift	2005	1.2	24	108	8,118	4,911	5
Exp area	troll	2005	1.2	2	NW	15,184	5,561	1
Trad	drift	2006	1.3	21	108	3,173	2,134	1
Trad	drift	2006	1.3	22	108	4,274	2,126	3
Trad	drift	2006	1.3	23	108	5,314	2,735	3
Trad	drift	2006	1.3	24	108	5,223	2,645	1
Trad	drift	2006	1.3	26	106	398	159	1
Trad	troll	2006	1.3	1	NW	24,432	7,311	1
Exp area	troll	2006	1.3	2	NE	8,651	4,458	1
Exp area	troll	2006	1.3	2	SE	9,168	4,040	2
Wrangell	sport	2006	1.3	9	-	14	13	2
Sitka	sport	2006	1.3	11		846	846	1
Trad	drift	2007	1.4	22	108	1,316	1,045	1
Petersburg	sport	2007	1.4	22	108	438	438	1
						92,666	43,414	28

Trad=Traditional fishery. Exp area=Experimental area.

Appendix C3.–Estimation of the overwinter survival of juvenile Stikine Chinook salmon tagged as fry in the spring of 2001 and 2002.

Brood year	Year tagged	Fry/smolt	Number tagged	Tags recovered	Overwinter survival	SE
2000	2001	Fry	21,172	13	0.069	0.020
2000	2002	Smolt	17,411	156		
2001	2002	Fry	21,910	40	0.983	0.224
2001	2003	Smolt	19,927	37		

Note: Methodology from Weller and McPherson (2003).

APPENDIX D

Appendix D1.–Computer Files used to complete this report.

File Name	Description
Stik_theta_master.xls	Estimation of theta
Harvest Estimate Table.xls	Calculation of harvest of Stikine Chinook by fishery, and smolt per spawner, marine survival and exploitation
Chinook CWT recoverie.xls	ADFG Tag lab recoveries of Stikine CWTs
PMFCrecovs.xls	PMFC Database recoveries
Troll catch by quad.dif	CWT expansion factors for troll harvest by quadrant
AKgillnet sampling data.xls	CWT expansion factors for gillnet harvest