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Abundance of the Chinook Salmon Escapement in the Stikine River, 2006-2008

by

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and

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March 2012

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

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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 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)

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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

A cooperative study involving the Alaska Department Fish and Game, Department of Fisheries and Oceans Canada, and the Tahltan First Nation was conducted to estimate the number of spawning Chinook salmon *Oncorhynchus tshawytscha* in the Stikine River from 2006 to 2008. The abundance of large (≥660mm MEF) Chinook salmon that returned to spawn was estimated using mark-recapture data. The abundance of small-medium (<660 mm MEF) Chinook salmon that returned to spawn was estimated using size composition data from the spawning grounds. Age, sex, and length compositions for the immigration were also estimated for each year. Fish captured near the mouth of the Stikine River using drift gillnets were marked with spaghetti tags during May, June, and July. Fish sampled in the Canadian commercial fisheries were used to estimate the fraction of the population that had been marked. Spawning abundance of large Chinook salmon was estimated at 24,405 (SE = 6,746) in 2006, 14,560 (SE = 2,206) in 2007, and 18,352 (SE = 3,003) in 2008. Spawning abundance of small-medium fish was estimated at 1,869 (SE = 581) in 2006, 1,828 (SE = 462) in 2007, and 922 (SE = 250) in 2008. The estimated spawning escapement was composed of 75.9% age-1.4 fish in 2006, 61.3%, age-1.3 fish in 2007, and 62.1% age-1.4 fish in 2008. Weir counts of large fish at the Little Tahltan River represented 16%, 4%, and 15% of the estimated spawning escapement in 2006, 2007, and 2008 respectively. Sibling and CPUE data were used to generate pre- and inseason abundance estimates for the inriver run of large Chinook salmon. The preseason abundance forecast allowed directed Chinook salmon fisheries in the U.S. and Canada in 2006, 2007, and 2008.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Stikine River, Little Tahltan River, Verrett River, mark-recapture, spawning escapement, inriver run abundance, age and sex composition, preseason, inseason, CPUE, forecast, sibling data.

INTRODUCTION

Many Southeast Alaska and transboundary river Chinook salmon *Oncorhynchus tshawytscha* stocks were depressed in the mid- to late 1970s, relative to historical levels of production (Kissner 1982). The Alaska Department of Fish and Game (ADF&G) developed a program in 1981 to rebuild Southeast and transboundary Chinook salmon stocks over a 15-year period (roughly 3 life cycles; ADF&G 1981). In 1979, the Canadian Department of Fisheries and Oceans (DFO) initiated commercial fisheries on the transboundary Taku and Stikine rivers. The fisheries primarily targeted sockeye salmon *O. nerka* and were structured to limit the harvest of Chinook salmon to incidental catches. In 1985, the Alaskan and Canadian programs were incorporated into a comprehensive coastwide rebuilding program under the auspices of the U.S./Canada Pacific Salmon Treaty (PST). The rebuilding program has been evaluated, in part, by monitoring trends in escapement for important stocks. Escapements in 11 rivers in

Southeast Alaska and Canada are directly estimated or surveyed annually: the Situk, Alsek, Chilkat, Taku, King Salmon, Stikine, Unuk, Chickamin, Blossom, and Keta rivers, and Andrew Creek. Total escapements of Chinook salmon have been estimated at least once in all 11 key index systems, providing expansion factors for index counts to estimate actual escapement of large Chinook salmon. Escapements in the Stikine River have rebounded since initiation of the rebuilding program (Pahlke et al. 2000).

The Pacific Salmon Commission (PSC) Chinook Technical Committee (CTC) is contemplating incorporating the inriver abundance of Stikine River Chinook salmon into the PSC Chinook Model, which, among other things, produces preseason forecasts of abundance for setting annual quotas for fisheries under the jurisdiction of the PST. Hence, data from annual assessments are not only essential for management of this stock, but may serve in the management of other coastwide stocks as well.

Chinook salmon returning to the Stikine River are caught incidentally to sockeye salmon in the U.S. marine gillnet fishery (District 108) and in the inriver Canadian commercial fishery, as the run timing of sockeye salmon overlaps the latter component of the Chinook salmon migration (Figure 1; Appendix A1). Stikine River Chinook salmon are also caught in marine recreational fisheries near Wrangell and Petersburg, in the commercial troll fishery in Southeast Alaska, and in recreational fisheries in Canada (Pahlke et al. 2010). The exploitation of terminal runs is managed jointly by the U.S. and Canada through the PSC.

In February 2005 an agreement was negotiated between the United States and Canada by the Transboundary Rivers Panel and approved by the PSC for directed harvest of wild Chinook salmon returning to the Stikine River (Annex IV, Paragraph 3). The agreement allowed for harvest sharing and exemption of the catches estimated to be in surplus of escapement needs and base level catches. Escapement needs are tied to the existing escapement goal and base level catches are the average catches seen in the existing sport and commercial fisheries from 1985–2003. For the U.S., harvest exemptions are Stikine River fish harvested in Southeast Alaska Management District 108 (Figure 1).

The escapement goal that produces maximum sustained yield (S_{MSY}) has been estimated at 17,368 based on spawner-recruit data from the 1977 to 1991 brood years (Bernard et al. 2000). This estimate may be biased slightly low, but a more complex model that incorporates survival estimates and better estimates of harvest in marine fisheries should improve accuracy. This information will be acquired in the future from results of a smolt coded wire tagging program that was initiated in 2000. Based on the estimate of S_{MSY}, an escapement goal range of 14,000 to 28,000 adult spawners (age-.3, -.4, and -.5 fish), was chosen. This range was recommended and accepted by the CTC and an internal review committee of ADF&G in spring 1999. The Pacific Scientific Advice Review Committee of DFO declined to pass judgment on this range in deference to a decision by the Transboundary Technical Committee (TTC) of the PSC; the TTC accepted the range in March 2000.

Helicopter surveys of the Little Tahltan River have been conducted annually since 1975, and a fish counting weir has been operated at the mouth of the Little Tahltan River since 1985. Because virtually all fish spawning in the Little Tahltan River spawn above the weir, counts from the weir represent the spawning escapement to that tributary. Sufficient data have since been collected to establish a relationship between the weir count and the helicopter survey data. The relationship was then used to predict total spawning escapement to the Little Tahltan River from survey data collected prior to 1985 (prior to weir counts). Discontinuation of aerial surveys has been recommended (Bernard et al. 2000).

Chinook salmon spawning in Andrew Creek, a lower river tributary in the U.S., are treated as a separate stock from Chinook salmon spawning upriver in Canada. Escapements into Andrew Creek have been assessed annually since 1975 by foot, airplane, or helicopter surveys (Pahlke 2009). In addition, a weir operated to collect hatchery brood stock from 1976 to 1984 also provided escapement counts. Another weir was operated in 1997 and 1998 to count escapement, sample Chinook salmon to estimate age, sex and length composition of escapements, and to inspect fish for marks. North Arm and Clear creeks, two small streams in the U.S., have been periodically surveyed by foot, helicopter, and fixed-wing aircraft (Pahlke 2010).

In 1995, the DFO, in cooperation with the Tahltan First Nation (TFN), ADF&G, and the U.S. National Marine Fisheries Service (NMFS) instituted a project to determine the feasibility of a mark-recapture experiment to estimate abundance of Chinook salmon spawning in the Stikine River above the U.S./Canada border. Since 1996 a revised, expanded mark-recapture study has been used to estimate annual spawning escapement abundance (Pahlke and Etherton 1998–2000; Pahlke et al. 2000; Der Hovanisian et al. 2001, 2003–2005; Der Hovanisian and Etherton 2006; Richards et al. 2008). In 1997 and 2005, radio-telemetry was used in concert with the mark-recapture experiment to estimate the distribution of spawners (Pahlke and Etherton 1999; Richards et al. 2008).

In 2000, a program to capture Chinook salmon smolt in the lower Stikine River and mark them with coded wire tags began. Tagged fish recovered as adults in fisheries and on the spawning grounds are used to estimate smolt production and harvest by brood year (Pahlke et al. 2010).

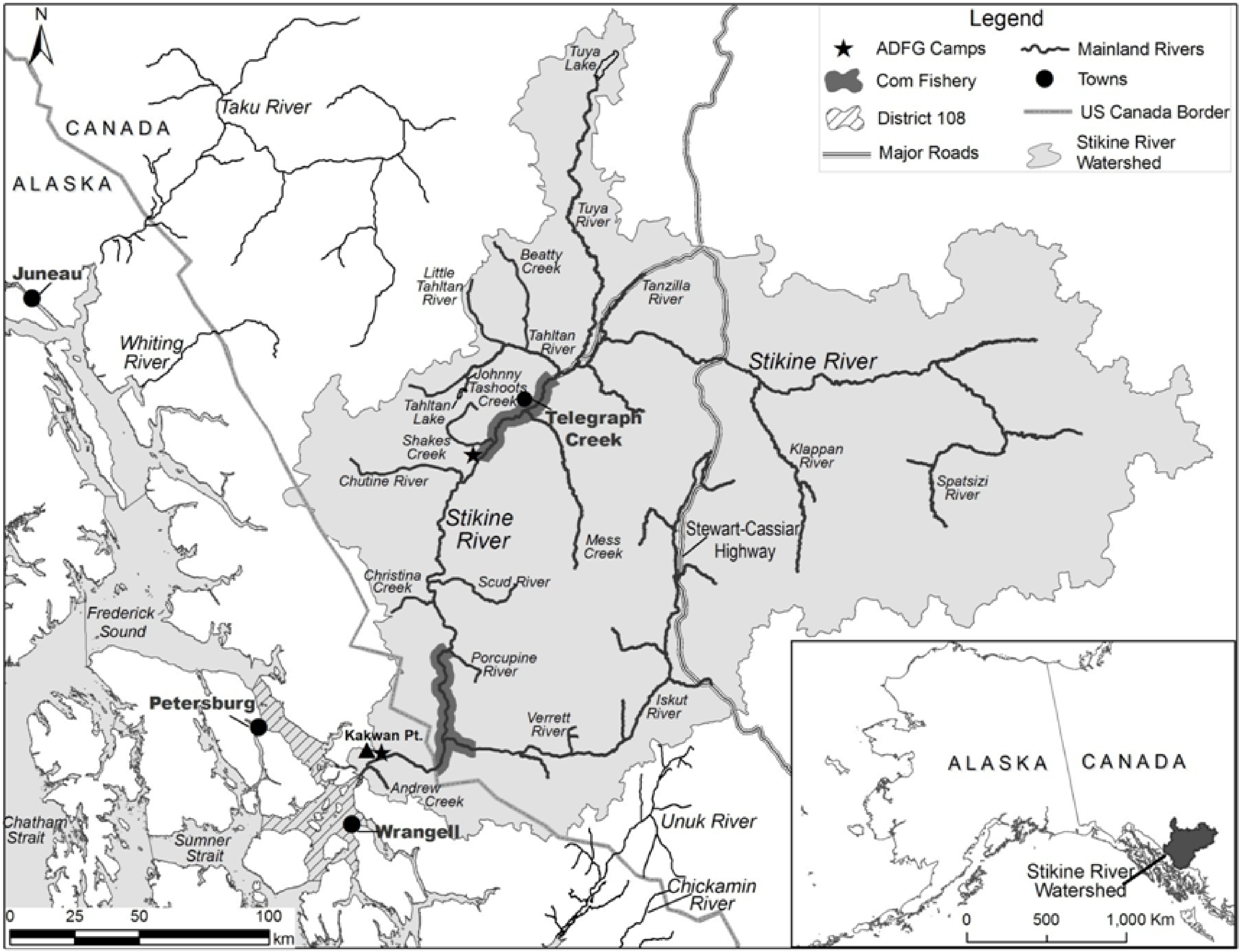

Figure 1.–Stikine River drainage showing major tributaries and location of principal U.S. and Canadian fishing areas.

OBJECTIVES

The objectives of the 2006, 2007, and 2008 studies were:

(1) estimate the abundance of large (≥660 mm MEF) Chinook salmon spawning in the Stikine River above the U.S./Canada border.

(2) estimate the age, sex, and length compositions of Chinook salmon spawning in the Stikine River above the U.S./Canada border.

Tasks included:

a) estimate the factor used to expand counts of large Chinook salmon at the weir on the Little Tahltan River to spawning abundance in the Stikine River.

b) use the proportion of small-medium (<660 mm MEF) Chinook salmon observed on the spawning grounds to estimate the spawning abundance of small-medium Chinook salmon.

c) estimate the inriver run by age at Kakwan Point.

Additional tasks were to provide information on the run timing through the lower Stikine River of Chinook salmon bound for the various spawning areas, and other stock assessment and management information needs such as construction of spawner-recruit tables and inseason predictions of end-of-season terminal abundances.

STUDY AREA

The Stikine River drainage covers about 52,000 km^2 (Bigelow et al. 1995), much of which is inaccessible to anadromous fish because of natural barriers. Principal tributaries include the Tahltan, Chutine, Scud, Porcupine, Tanzilla, Iskut, Klappan, Spatsizi and Tuya rivers (Figure 1). The lower river and most tributaries are glacially occluded (e.g., Chutine, Scud, Porcupine, and Iskut rivers). Only 2% of the drainage is in Alaska (Beak Consultants Limited 1981), and most of the spawning areas used by Chinook salmon are located in British Columbia, Canada in the Tahltan, Little Tahltan, and Iskut rivers (Pahlke and Etherton 1999; Richards et al 2008). Andrew Creek, in the U.S. portion of the watershed and considered a separate stock, supports a small run of Chinook salmon averaging about 5% of the above-border escapement. The upper portion of the Stikine River drainage is accessible via the Telegraph Creek Road and the Stewart Cassiar Highway (Figure 1).

METHODS

SAMPLING

Kakwan Point Tagging

Drift gillnets 36.5-m long, 5.5-m deep, 18.5-cm stretch mesh, were fished near Kakwan Point (Figure 1) from approximately May 10 to July 10 annually. Two nets were fished concurrently daily, unless high water or staff shortages occurred. Nets were watched continuously, and fish were removed from the net immediately upon capture. Daily sampling effort was held reasonably constant across the temporal span of the migration at 4 hours per net. Time lost because of entanglements, snags, cleaning the net, etc. (processing time) did not count towards fishing time.

Captured Chinook salmon were placed in a plastic fish tote filled with water, quickly untangled or cut from the net; marked, measured for length mideye to fork of tail (MEF), and post orbital hypural length (POH) rounded to the nearest 5 mm; classified by sex and maturity; and sampled for scales. Fish were classified as "large" if their MEF measurement was ≥660 mm, as "medium" if their MEF was 440–659 mm or "small" if their MEF was <440 mm (Pahlke and Bernard 1996). Fish maturation was judged on a scale from 1 to 4, where 1 is a silver bright fish, 2 is a fish with slight coloration, 3 is a fish with obvious coloration and the onset of sexual dimorphism, and 4 is a fish with the characteristics listed in category 3 that released gametes upon capture. The presence or absence of sea lice (*Lepeophtheirus* sp.) was also noted. General health and appearance of the fish were recorded, including injuries caused by handling or predators. Each uninjured fish was marked with a uniquely numbered, blue spaghetti tag consisting of a 2-inch (approximately 5 cm) section of tubing shrunk and laminated onto a 15-inch (approximately 38 cm) piece of 80-lb (approximately 36.3 kg) monofilament fishing line using a modified design developed by Johnson et al. (1993). The monofilament was sewn through the musculature of the fish approximately 13 mm posterior and ventral to the dorsal fin and secured by crimping both ends in a metal sleeve. Each fish was also marked with a 7-mm diameter hole in the upper portion of its left operculum applied with a paper punch, and by excision of its left axillary appendage (McPherson et al. 1996). Fish that were classified as injured were sampled but not marked.

Upstream Sampling

Prespawning and post-spawning fish and carcasses were collected with spears, dipnets, and snagging gear at, Verrett River, the Little Tahltan River weir, and Johnny Tashoots Creek (Figure 1). Only a portion of the fish passing through the Little Tahltan River weir were individually sampled; the remainder were passed without handling. All sampled fish were inspected for tags and marks, sampled for length, sex, and scales, and marked with a hole punched in the lower left opercle to prevent resampling. Carcasses were also slashed along the left side.

Tags recovered upstream of the marking site in the Canadian commercial gillnet, aboriginal, and recreational fisheries were voluntarily returned. A reward (Can. $5) was offered to ensure tags were returned. Tags were also recovered in the U.S. marine commercial and recreational fisheries. Catches were sampled in these fisheries to estimate age, sex, and length composition.

ABUNDANCE

Inriver Abundance and Spawning Escapement: Large Chinook Salmon

The inriver abundance of large Chinook salmon that passed by Kakwan Point, $N_{L\,Run}$, was estimated with a two-event mark-recapture experiment on a closed population. Fish captured by gillnet and marked in the lower river near Kakwan Point were included in event 1, and sampling on the spawning grounds and inriver fisheries constituted event 2.

All marked fish subsequently captured below Kakwan Point were removed from the experiment to reduce bias in the inriver abundance estimate. The numbers of marked fish recovered in Andrew Creek, expanded by sampling fractions, were censored from the experiment. All marked fish caught in the U.S. recreational and commercial harvest were assumed to have been reported and were also censored on a per tag basis from the experiment.

The estimated number of marked fish available for recapture on the spawning grounds and inriver fisheries was $\hat{M} = T - \hat{H}$, where T is the initial number of marked fish released near Kakwan Point, and $\hat{H}$ is the estimated number of marked fish that moved downstream to be caught in U.S. fisheries or spawn in Andrew Creek.

If all of the following assumptions (Seber, 1982) were met, then Chapman's modification of Petersen's estimator was used:

(a) every fish passing through the lower river has an equal probability of being marked, *or* that every fish has an equal probability of being inspected for marks upriver, *or* that marked fish mix completely with unmarked fish between sampling events

(b) both recruitment and "death" (emigration) do not occur between events

(c) marking does not affect catchability (or mortality) of the fish

(d) fish do not lose their marks between events

(e) all recaptured fish are reported; *and*

(f) double sampling does not occur.

The best chance for meeting assumption (a) was to mark fish (first event) with equal probability of capture. From the perspective of spawning ground sampling (second event), spatial mixing is precluded as stocks separate between events and equal probability of capture cannot be assumed as all spawning locations were not sampled. Equal run timing of stocks at the tagging site, equal probability of capture among stocks at any given time, and representative sampling over the run on the spawning grounds were also conditions that would allow Chapman's estimator to be used. From the perspective of taking a second event sample from the inriver fishery, temporal mixing was precluded as fish migrate in order through the fishery, although it was possible that a representative sample could be taken if the harvest occurred in proportion to the run.

Temporal and size-gender conditions associated with assumption (a) were investigated with a battery of statistical tests (Appendices B1 and B2). Assumption (b) was met because the life history of Chinook salmon isolates those fish returning to the Stikine River as a “closed” population. Mortality rates for marked and unmarked fish were assumed to be the same (assumption c). Past telemetry studies in the Stikine River indicate that a high percentage of Chinook salmon captured in this study, but fitted with esophageal radio transmitters, survived to spawn (Pahlke and Etherton 1999; Richards et al. 2008). To avoid effects of tag loss (assumption d), all marked fish carried secondary (a dorsal opercle punch), and tertiary marks (the left axillary appendage was clipped). Similarly, all fish captured on the spawning grounds were inspected for marks, and a reward (Can$5) was given for each tag returned from the inriver commercial, aboriginal, and recreational fisheries (assumption e). Double sampling was prevented by an additional mark (ventral opercle punch, assumption f).

For each of 2006–2008, the equal probability of capture/mixing assumption (assumption a) was violated, leading to use of a Darroch model (Seber 1982) to estimate abundance of large Chinook salmon for each year. Marking and recapture events were stratified temporally.

The computer program Stratified Population Analysis System (SPAS; Arnason et al. 1996) was used to estimate abundance, standard errors, and confidence intervals. Similar temporal and spatial strata were pooled to find admissible (non-negative) estimates, reduce the number of parameters, and increase precision. However, standard errors calculated by SPAS are biased low when M is estimated because the error in M cannot be incorporated into the program by the user.

The estimated spawning escapement of large Chinook salmon, $\hat{N}_{L,Esc}$, was calculated by subtracting the inriver harvest of large fish, N_{LH}, from the inriver run estimate of large fish, $\hat{N}_{L\,Run}$:

$$\hat{N}_{L,Esc} = \hat{N}_{L\,Run} - N_{LH} \qquad (1)$$

N_{LH} is known, so

$$\mathrm{var}(\hat{N}_{L,Esc}) = \mathrm{var}(\hat{N}_{L,Run}) \qquad (2)$$

Inriver Abundance and Spawning Escapement: Small-Medium Chinook Salmon

For 2006–2008, the inriver run of small-medium fish was estimated by first estimating their spawning escapement, $\hat{N}_{SM\,Esc}$, and then adding the known harvest of small-medium fish, $N_{SM\,H}$:

$$\hat{N}_{SM\,Esc} = \hat{N}_{L\,Esc}\left(\frac{1}{\hat{p}_{L\,Esc}} - 1\right) \qquad (3)$$

where $\hat{p}_{LEsc}$ is the estimated proportion of large Chinook salmon in the spawning ground sample:

$$\hat{p}_{LEsc} = \frac{m_{LEsc}}{n_{Esc}} \qquad (4)$$

where m_{LEsc} is the number of large fish in the spawning ground sample, $n_{Esc\cdot}$. Variance of $\hat{N}_{SM\,Esc}$ was estimated:

$$\mathrm{var}(\hat{N}_{SM\,Esc}) = \hat{N}^2_{L\,Esc}\,\mathrm{var}\left(\frac{1}{\hat{p}_{LEsc}}\right) + \left(\frac{1}{\hat{p}_{LEsc}} - 1\right)^2 \mathrm{var}(\hat{N}_{L\,Esc}) - \mathrm{var}\left(\frac{1}{\hat{p}_{LEsc}}\right)\mathrm{var}(\hat{N}_{L\,Esc}) \qquad (5)$$

where,

$$\mathrm{var}\left(\frac{1}{\hat{p}_{LEsc}}\right) \approx \frac{1}{\hat{p}^4_{LEsc}}\,\frac{\hat{p}_{LEsc}(1-\hat{p}_{LEsc})}{(n_{Esc}-1)}$$

The estimated inriver run of small-medium Chinook salmon at Kakwan Point was then estimated as:

$$\hat{N}_{SM\,Run} = \hat{N}_{SM\,Esc} + N_{SMH} \tag{6}$$

with variance estimated as (harvest known):

$$\mathrm{var}(\hat{N}_{SM,Run}) = \mathrm{var}(\hat{N}_{SM\,Esc}).$$

Inriver Abundance and Spawning Escapement: All Chinook Salmon

Total inriver abundance (all sizes) at Kakwan Point was estimated as:

$$\hat{N}_{Run} = \hat{N}_{L\,Run} + \hat{N}_{SM\,Run} \tag{7}$$

with variance estimated as:

$$\begin{aligned}\mathrm{var}(\hat{N}_{Run}) &= \frac{1}{\hat{p}^2_{LEsc}}\mathrm{var}(\hat{N}_{L\,Run}) + \\ &\left(\hat{N}_{L\,Run} - N_{LH}\right)^2 \mathrm{var}\left(\frac{1}{\hat{p}_{LEsc}}\right) - \\ &\mathrm{var}\left(\frac{1}{\hat{p}_{LEsc}}\right)\mathrm{var}(\hat{N}_{L\,Run})\end{aligned} \tag{8}$$

Total spawning abundance was estimated as:

$$\hat{N}_{Esc} = \hat{N}_{L\,Esc} + \hat{N}_{SM\,Esc} \tag{9}$$

with estimated variance:

$$\mathrm{var}(\hat{N}_{Esc}) = \mathrm{var}(\hat{N}_{Run}) \tag{10}$$

because harvest is known.

AGE, SEX, AND LENGTH COMPOSITION

Scale samples were collected, processed, and aged according to procedures in Olsen (1995). Five scales were collected from the preferred area of each fish (Welander 1940), mounted on gum cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956). Age of each fish was determined from the pattern of circuli on images of scales magnified 70×. Samples from Kakwan Point and Andrew Creek were processed at the ADF&G scale aging lab in Douglas; all others were processed at the DFO lab in Nanaimo, B.C.

Estimated age compositions for the Little Tahltan and Verrett rivers were compared with chi-square tests to determine if the samples could be pooled. For these tests, freshwater age-2 Chinook salmon were pooled with freshwater age-1 fish of the same brood year, and only age classes common to each sample were compared.

Spawning Escapement Composition

The proportion of the spawning population composed of a given age-sex class within the small-medium or large size categories *i* was estimated as a binomial variable from the pooled sample of fish from the Little Tahltan and/or Verrett rivers:

$$\hat{p}_{ij\,Esc} = \frac{m_{ijEsc}}{n_{i\,Esc}} \tag{11}$$

and

$$v[\hat{p}_{ij\,Esc}] = \frac{\hat{p}_{ij\,Esc}(1 - \hat{p}_{ij\,Esc})}{n_{i\,Esc} - 1} \tag{12}$$

where m_{ijEsc} is the number of Chinook salmon of age-sex class *j* in n_{iEsc}, the size of the pooled spawning sample for size category *i*.

The number of fish in the spawning escapement by age-sex class was estimated as the summation of products of estimated age composition and estimated spawning escapement within size category *i*:

$$\hat{N}_{jEsc} = \sum_{i}\left(\hat{p}_{ij\,Esc}\hat{N}_{i,Esc}\right) \tag{13}$$

Variance of individual components of equation 13 was estimated according to procedures in Goodman (1960):

$$\begin{aligned}\mathrm{var}(\hat{p}_{ijEsc}\hat{N}_{iEsc}) &= \hat{p}^2_{ijEsc}\,\mathrm{var}(\hat{N}_{i\,Esc}) + \\ &\hat{N}^2_{i\,Esc}\,\mathrm{var}(\hat{p}_{ijEsc}) - \mathrm{var}(\hat{N}_{i\,Esc})\,\mathrm{var}(\hat{p}_{ijEsc})\end{aligned} \tag{14}$$

Use of the proportionality method to estimate the number of small-medium Chinook salmon in the escapement means there is dependence between the $\hat{p}_{ijEsc}\hat{N}_{i,Esc}$ terms in equation 13 for *i* = large and *i* = small-medium, so the variance of $\hat{N}_{jEsc}$ was estimated through simulation.

The proportion of the spawning escapement composed of a given age/sex class was estimated by:

$$\hat{p}_{jEsc} = \frac{\hat{N}_{jEsc}}{\hat{N}_{Esc}} \tag{15}$$

with variance of $\hat{p}_{jEsc}$ estimated through simulation.

Age, sex, and age-sex composition and associated variances for fish caught at Kakwan Point, in Little Tahltan and Verrett rivers were estimated separately with equations 11 and 12.

Estimates of mean length at age and their estimated variances were calculated with standard sample summary statistics (Cochran 1977).

Inriver run at Kakwan Point

The number of fish in the inriver run by age at Kakwan Point was estimated as the summation of estimated spawning escapement by age and estimated harvest in the lower river by age.

Harvest by age was estimated:

$$\hat{N}_{jH} = \sum_i \hat{p}_{ijH} N_{iH} \tag{16}$$

where $\hat{p}_{ijH}$ is the estimated proportion of the age class *j* in the harvest of fish of size category *i:*

$$\hat{p}_{ijH} = \frac{m_{ijH}}{n_{iH}} \tag{17}$$

$$\text{var}[\hat{p}_{ijH}] = \frac{\hat{p}_{ijH}(1 - \hat{p}_{ijH})}{n_{iH} - 1} \tag{18}$$

where m_{ijH} is the number of Chinook salmon of age class *j* in sample of harvest of size category *i*, n_{iH}.

Variance of harvest by age was estimated:

$$\text{var}(\hat{N}_{jH}) = \sum_i N_{iH}^2 \text{ var}(\hat{p}_{ijH}) \tag{19}$$

Inriver run by age was estimated:

$$\hat{N}_{jRun} = \hat{N}_{jEsc} + \hat{N}_{jH} \tag{20}$$

$$\text{var}(\hat{N}_{jRun}) = \text{var}(\hat{N}_{jEsc}) + \text{var}(\hat{N}_{jH}) \tag{21}$$

RESULTS

SAMPLING

Kakwan Point Tagging

2006

Between May 7 and July 7, 547 Chinook salmon were captured near Kakwan Point, of which 543 (28 small-medium, and 515 large) were marked and released (Appendix A2; Table 1).

Drift gillnet effort near Kakwan Point was maintained at 4 hours per net per day (2 nets fishing), although reduced sampling effort occurred on several days (Figure 2). Catch rates ranged from 0.00 to 4.23 large fish/hour, and the highest catch occurred on June 24 when 34 large fish were captured (Figure 3). The date of 50% cumulative catch of large fish was June 1. Catch rates for small-medium fish ranged from 0.00 to 0.62 fish/hour, and the date of 50% cumulative catch of small-medium fish was June 28. Catches decreased during the last week in May and the second and third weeks in June because of high water (Figures 2 and 3, Appendix A2).

2007

Between May 7 and July 9, 381 Chinook salmon were captured near Kakwan Point, of which 377 (27 small-medium, and 350 large) were marked and released (Appendix A3; Table 2).

Drift gillnet effort near Kakwan Point was maintained at 4 hours per net per day (2 nets fishing), although reduced sampling effort occurred on several days (Figure 4). Catch rates ranged from 0.00 to 2.48 large fish/hour, and the highest catch occurred on May 16 and June 25 when 19 large fish were captured (Figure 5). The date of 50% cumulative catch of large fish was June 18. Catch rates for small-medium fish ranged from 0.00 to 0.39 fish/hour, and the date of 50% cumulative catch of small-medium fish was June 21. Catches decreased during the last week in May and the first, second, and forth weeks in June because of to high water (Figures 4 and 5, Appendix A3).

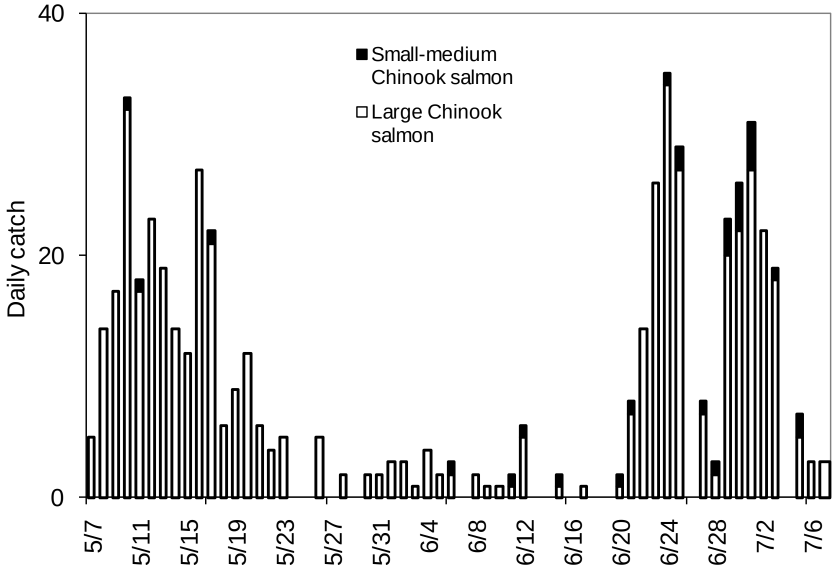

Figure 2.–Daily drift gillnet fishing effort (minutes) and river depth (meters) near Kakwan Point, lower Stikine River, 2006.

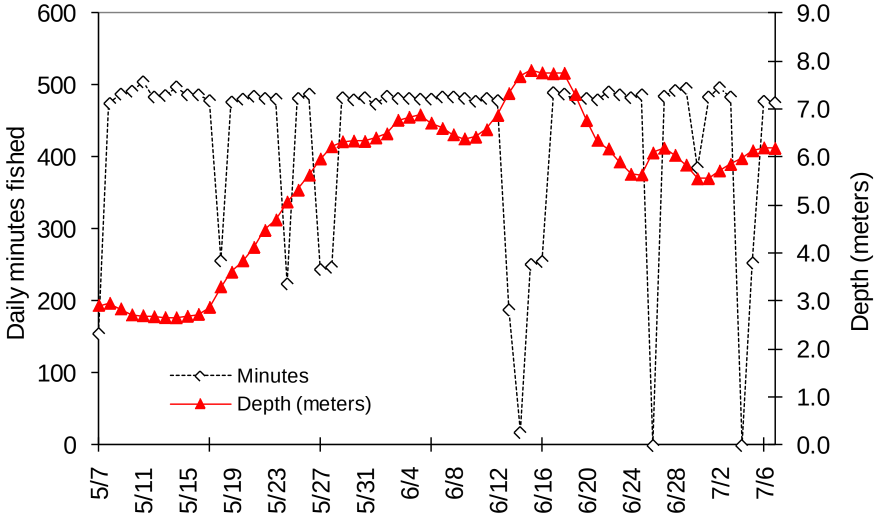

Figure 3.–Daily catch of Chinook salmon near Kakwan Point, lower Stikine River, 2006.

Table 1.–Numbers of Chinook salmon marked and released into the lower Stikine River, removed by fisheries and inspected for marks in 2006, by size category. Numbers in bold were used in mark-recapture estimates.

		Length (MEF) in mm	
		0–659 (sm-med	≥660 (large)
Captured at Kakwan Point		28	519
Released at Kakwan Point		28	515
Removed by:			
1. U.S. recreational fisheries [a]		0	1
2. U.S marine gillnet fisheries[b]		1	6
3. Andrew Creek[c]		0	11
Subtotal of removals		1	18
Estimated number of marked fish remaining in mark-recapture experiment		27	**497**
Lower river commercial gillnet	Harvested	1,955	**15,098**
	Marked	5	**132**
	Marked/harvested	0.0026	0.0087
Upper river gillnet	Harvested	122	616
Aboriginal	Marked	0	9
	Marked/inspected	0.0000	0.0146
Canadian recreational fisheries	Harvested	0	40
Tahltan River	Marked	0	0
	Marked/inspected	0.0000	0.0000
Upper river commercial	Harvested	1	22
	Marked	0	0
	Marked/inspected	0.0000	0.0000
Little Tahltan weir	Inspected	24	335
Live fish	Marked	0	4
	Marked/inspected	0.0000	0.0119
Verrett River	Inspected	25	305
	Marked	0	4
	Marked/inspected	0.0000	0.0131

[a] Voluntary return.

[b] Voluntary returns.

[c] One tag recovered expanded to 11.

2008

Between May 8 and July 8, 471 Chinook salmon were captured near Kakwan Point, of which 465 (33 small-medium, and 432 large) were marked and released (Appendix A4; Table 3).

Drift gillnet effort near Kakwan Point was maintained at 4 hours per net per day (2 nets fishing), although reduced sampling effort occurred on several days (Figure 6). Catch rates ranged from 0.00 to 3.66 large fish/hour, and the highest catch occurred on May 10 when 29 large fish were captured (Figure 7). The date of 50% cumulative catch of large fish was June 7. Catch rates for small-medium fish ranged from 0.00 to 0.37 fish/hour, and the date of 50% cumulative catch of small-medium fish was June 7. Catches decreased during the last week in May and the last week in June due to high water (Figures 6 and 7, Appendix A4).

Upstream Sampling

2006

Upstream sampling statistics for 2006 are presented in Table 1. The Canadian inriver fisheries harvested 15,776 large and 2,078 small-medium Chinook salmon. Fishermen turned in 141 tags recovered from large fish and 5 tags recovered from small-medium fish. Technicians examined 640 large and 49 small-medium Chinook salmon for marks on the spawning grounds. There were 8 large and 0 small-medium marked fish recovered.

2007

Upstream sampling statistics for 2007 are presented in Table 2. The Canadian inriver fisheries harvested 10,509 large and 1,727 small-medium Chinook salmon. Fishermen turned in 114 tags recovered from large fish and 5 tags recovered from small-medium fish. Technicians examined 215 large and 27 small-medium Chinook salmon for marks on the spawning grounds. There were 2 large and 1 small-medium marked fish recovered.

2008

Upstream sampling statistics for 2008 are presented in Table 3. The Canadian inriver fisheries harvested 7,932 large and 1,081 small-medium Chinook salmon. Fishermen turned in 112 tags recovered from large fish and 11 tags recovered from small-medium fish. Technicians examined 484 large and 42 small-medium Chinook salmon for marks on the spawning grounds. There were 4 large and 1 small-medium marked fish recovered.

ABUNDANCE

Abundance of Large Chinook Salmon

In 2006, 2007, and 2008, the abundance estimates for Stikine River large Chinook salmon were based on tagging data from Kakwan Point and recovery data from the lower commercial fishery; because of poor sampling conditions, only very sparse data were collected from spawning grounds and weirs (Tables 1, 2, and 3). A maximum likelihood Darroch estimator was used for the abundance estimates because different capture probabilities in the tagging and recovery strata were evident, probably due to fluctuations in river level (Figures 2, 4 and 6) and the fact that mixing was impossible. Tagging and recovery data were pooled by statistical week and then possibly further pooled to obtain the ‘best’ model (see below).

2006

A Darroch model was used to estimate the inriver run abundance of large Chinook salmon that passed by Kakwan Point. Based on fish inspected at the lower river commercial fishery, the estimate is 40,181 large fish (SE = 6,746; 95% CI: 26,960 to 53,402; $\hat{M}_L$ = 497, C_L = 15,098, R_L = 132).

Several temporal stratifications of both the tagging and recovery events were investigated using SPAS. The stratification, with reference to river level, that satisfied the fitting tests in Arnason et al. (1996) and yielded the lowest percent CV for the abundance estimate was used. A total of 132 tags with corresponding recovery date information were returned from 15,098 Chinook salmon harvested in the lower river Canadian fishery (Table 1). After referring to Figures 2 and 3, tagging data from statistical weeks 19 through 20, 21 through 24, and 25 through 27 were pooled because recapture rates were statistically similar. Recovery data from statistical weeks 19 through 21, 22 through 23, 24 through 25, 26 through 27, and 28 through 31 were each pooled because either marked fractions were statistically similar, or sample sizes were small. Tagging and recovery data were grouped into 3 and 5 strata, respectively (Appendix A23).

For this estimate, all large marked fish intercepted by U.S. fisheries were censored from the experiment (6 in the commercial fishery and 1 in the sport fishery). At Andrew Creek, 186 large and 14 small-medium fish were examined and 1 large marked fish was recovered (expanded to 11 tags). Therefore 11 large marked Chinook salmon were also censored (Table 1).

There was no evidence that size-selective sampling violated assumption (a). Size distributions of fish marked downstream and recaptured upstream were not significantly different *(P* = 0.83; Figure 8), which indicates that capture probabilities were similar regardless of size during the second event. However, the size distributions of fish marked at Kakwan Point versus fish captured in the Canadian commercial gillnet fishery were significantly different *(P* = 0.003; Figure 9). Size distributions of fish recaptured upstream versus samples of fish captured in the lower river commercial gillnet fishery were not significantly different *(P* = 0.340). According to Appendix B1, a Case I is recommended, noting that the significant test of marked versus captured fish was attributed to large sample sizes.

Table 2.–Numbers of Chinook salmon marked and released into the lower Stikine River, removed by fisheries and inspected for marks in 2007, by size category. Numbers in bold were used in mark-recapture estimates.

		Length (MEF) in mm	
		0–659 (sm-med)	≥660 (large)
Captured at Kakwan Point		27	354
Released at Kakwan Point		27	350
Removed by:			
1. U.S. recreational fisheries		0	0
2. U.S marine gillnet fisheries[a]		0	8
3. Andrew Creek		0	0
Subtotal of removals		0	7
Estimated number of marked fish remaining in mark-recapture experiment		27	**342**
Lower river commercial gillnet	Harvested	1,469	**10,130**
	Marked	4	**113**
	Marked/harvested	0.0027	0.0112
Upper river gillnet	Harvested	233	364
Aboriginal	Marked	1	1
	Marked/inspected	0.0043	0.0027
Upper river commercial	Harvested	25	10
	Marked	0	0
	Marked/inspected	0.0000	0.0000
Lower river test fish	Harvested	0	5
sockeye	Marked	0	0
	Marked/inspected	0.0000	0.0000
Little Tahltan weir	Inspected	23	126
Live fish	Marked	1	1
	Marked/inspected	0.0435	0.0079
Verrett River	Inspected	4	89
	Marked	0	1
	Marked/inspected	0.0000	0.0112

[a] Voluntary return.

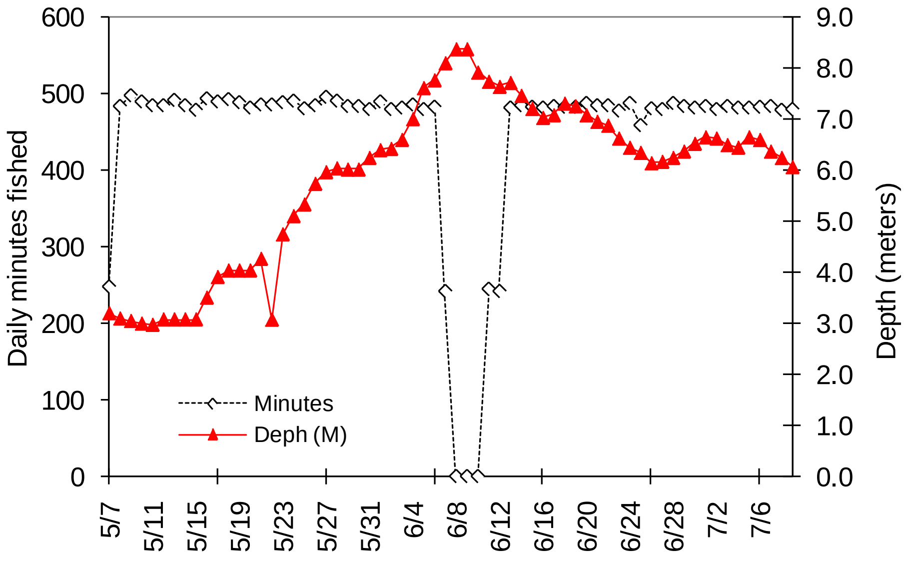

Figure 4.–Daily drift gillnet fishing effort (minutes) and river depth (meters) near Kakwan Point, lower Stikine River, 2007.

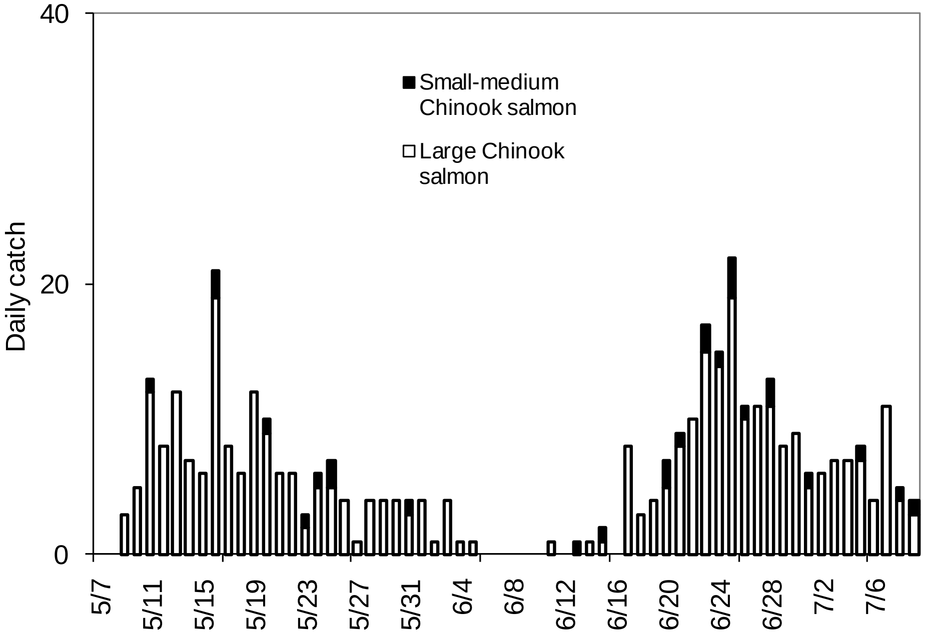

Figure 5.–Daily catch of Chinook salmon near Kakwan Point, lower Stikine River, 2007

Table 3.–Numbers of Chinook salmon marked and released into the lower Stikine River, removed by fisheries and inspected for marks in 2008, by size category. Numbers in bold were used in mark-recapture estimates.

		Length (MEF) in mm	
		0–659 (sm-med)	≥660 (large)
Captured at Kakwan Point		34	437
Released at Kakwan Point		33	432
Removed by:			
1. U.S. recreational fisheries[a]		0	2
2. U.S marine gillnet fisheries[b]		0	9
3. Andrew Creek		0	0
Subtotal of removals		0	11
Estimated number of marked fish remaining in mark-recapture experiment		33	**421**
Lower river commercial gillnet	Harvested	908	**7,051**
	Marked	8	**102**
	Marked/harvested	0.0088	0.0145
Upper river gillnet	Harvested	150	769
Aboriginal	Marked	2	9
	Marked/inspected	0.0133	0.0117
Canadian recreational fisheries	Harvested	3	46
Tahltan River	Marked	1	1
	Marked/inspected	0.3333	0.0217
Upper river commercial	Harvested	9	40
	Marked	0	0
	Marked/inspected	0.0000	0.0000
Lower river test fish	Harvested	11	26
Sockeye[c]	Marked	0	0
	Marked/inspected	0.0000	0.0000
Little Tahltan weir	Inspected	20	355
Live fish	Marked	0	2
	Marked/inspected	0.0000	0.0056
Little Tahltan weir	Inspected	20	9
post-spawn fish	Marked	1	0
	Marked/inspected	0.0500	0.0000
Johnny Tashoots Creek	Inspected	0	37
	Marked	0	2
	Marked/inspected	0.0000	0.0541
Verrett River	Inspected	2	83
	Marked	0	0
	Marked/inspected	0.0000	0.0000

[a] Voluntary returns.

[b] Voluntary returns.

[c] Includes 1 small-medium and 13 large fish harvested in the Tuya River sockeye test fishery.

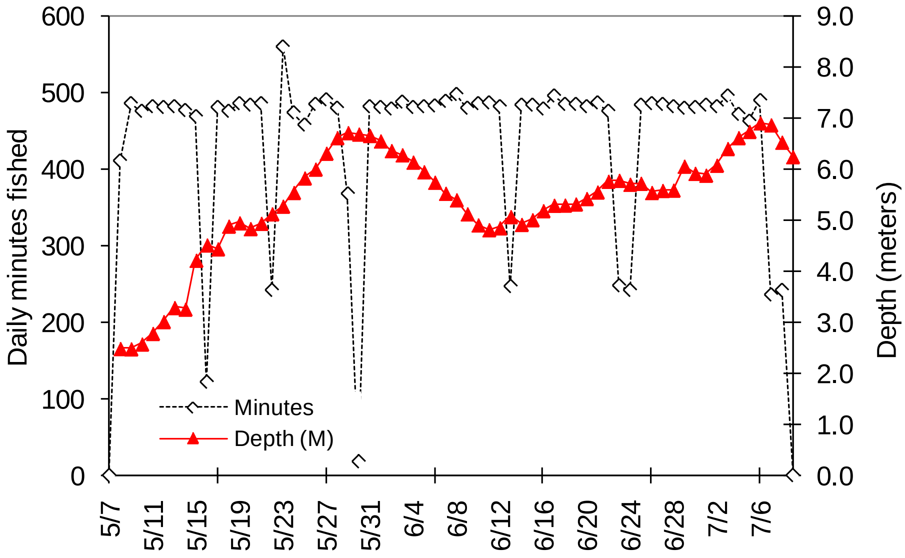

Figure 6.–Daily drift gillnet fishing effort (minutes) and river depth (meters) near Kakwan Point, lower Stikine River, 2008.

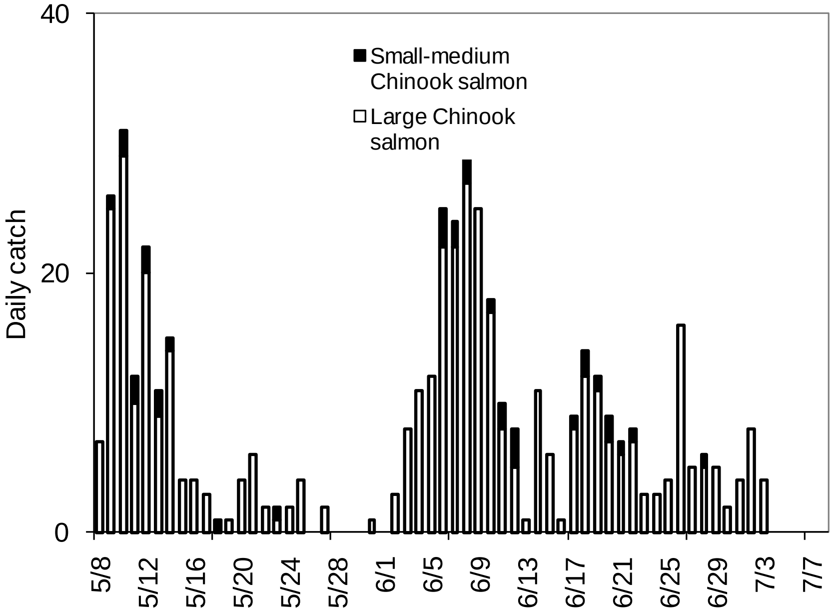

Figure 7.–Daily catch of Chinook salmon near Kakwan Point, lower Stikine River, 2008.

2007

A Darroch model was used to estimate the inriver run abundance of large Chinook salmon that passed by Kakwan Point. Based on fish inspected at the lower river commercial fishery, the estimate is 25,069 large fish (SE = 2,206; 95% CI: 20,745 to 29,393; $\hat{M}_L$ = 342, C_L = 10,130, R_L = 113).

Several temporal stratifications of both the tagging and recovery events were investigated using SPAS. The stratification, with reference to river level, that satisfied the fitting tests in Arnason et al. (1996) and yielded the lowest percent CV for the abundance estimate was used. A total of 113 tags with corresponding recovery date information were returned from 10,130 Chinook salmon harvested in the lower river Canadian fisheries (Table 2). After referring to Figures 4 and 5, tagging data from statistical weeks 19 through 21, 22 through 24, and 25 through 28 were pooled, because recapture rates were statistically similar. Recovery data from statistical weeks 19 through 21, 23 through 24, and 28 through 32 were each pooled because either marked fractions were statistically similar, or sample sizes were small. Tagging and recovery data were grouped into 3 and 7 strata, respectively (Appendix A24).

For this estimate, all large marked fish intercepted by U.S. fisheries were censored from the experiment (8 in the commercial fishery). At Andrew Creek, 186 large and 14 small-medium fish were examined, and no marked fish were recovered (Table 2).

There was no evidence that size-selective sampling violated assumption (a). Size distributions of fish marked downstream and recaptured upstream were not significantly different (*P* = 0.987; Figure 10), which indicates that capture probabilities were similar regardless of size during the second event. However, the size distributions of fish marked at Kakwan Point versus fish captured in the Canadian commercial gillnet fishery were marginally different (*P* = 0.053; Figure 11). Size distributions of fish recaptured upstream versus samples of fish captured in the lower river commercial gillnet fishery were not significantly different (*P* = 0.182). According to Appendix B1, a Case I is recommended, noting that the marginally significant test of marked versus captured fish was attributed to large sample sizes.

2008

A Darroch model was used to estimate the inriver run abundance of large Chinook salmon that passed by Kakwan Point. Based on fish inspected at the lower river commercial fishery, the estimate is 26,284 large fish (SE = 3,003; 95% CI: 20,398 to 32,169; $\hat{M}_L$ = 421, C_L = 7,051, R_L = 102).

Several temporal stratifications of both the tagging and recovery events were investigated using SPAS. The stratification, with reference to water level, that satisfied the fitting tests in Arnason et al. (1996) and yielded the lowest percent % CV for the abundance estimate was used. A total of 102 tags with corresponding recovery date information were returned from 7,051 Chinook salmon harvested in the lower river Canadian fisheries (Table 3). After referring to Figures 6 and 7, tagging data from statistical weeks 19 through 20, 21 through 22, 23 through 24, and 25 through 27 were pooled because recapture rates were statistically similar. Recovery data from statistical weeks 19 through 22, 23 through 24, 26 through 29, and 30 through 32 were each pooled because either marked fractions were statistically similar, or sample sizes were small. Tagging and recovery data were grouped into 4 and 5 strata, respectively (Appendix A25). For this estimate, all large marked fish intercepted by U.S. fisheries were censored from the experiment (9 in the commercial fishery, 2 in the U.S. sport fishery). At Andrew Creek, 45 large and 5 small-medium fish were examined, and no marked fish were recovered (Table 3).

There was no evidence that size-selective sampling violated assumption (a). Size distributions of fish marked downstream and recaptured upstream were not significantly different (*P* = 0.400; Figure 12), which indicates that capture probabilities were similar regardless of size during the second event. However, the size distributions of fish marked at Kakwan Point versus fish captured in the Canadian commercial gillnet fishery were significantly different (*P* < 0.001; Figure 13). Size distributions of fish recaptured upstream versus samples of fish captured in the lower river commercial gillnet fishery were not significantly different (*P* = 0.215). According to Appendix B1, a Case I is recommended, noting that the significant test of marked versus captured fish was attributed to large sample sizes.

Abundance of Small-Medium Chinook Salmon

Insufficient numbers of small-medium fish were marked and/or recaptured in 2006, 2007, and 2008; therefore mark-recapture estimates were not available (Tables 1, 2, and 3). The ratio of large:small-medium fish observed on the spawning grounds was used to estimate the spawning escapement and inriver run of small-medium Chinook in 2006, 2007, and 2008.

2006

The proportion of large fish in the spawning ground sample in 2006 was 0.939, resulting in an estimated abundance of 1,869 (SE = 581) small-medium fish.

2007

The proportion of large fish in the spawning ground sample in 2007 was 0.888, resulting in an estimated abundance of 1,828 (SE = 462) small-medium fish.

2008

The proportion of large fish in the spawning ground sample in 2008 was 0.952, resulting in an estimated abundance of 922 (SE = 250) small-medium fish.

AGE, SEX AND LENGTH COMPOSITION

Spawning Escapement

2006

Estimated age compositions from the Little Tahltan River weir and Verrett River samples were compared to determine if they could be pooled. No comparison was possible within the medium size category, but comparisons within the large category were marginally significant (χ^2 = 5.56, df = 1, P = 0.02). Little Tahltan River weir and Verrett River samples were pooled to estimate population proportions in spite of the significant result (project leaders believe the combined sample represented the spawning population).

Age-1.4 Chinook salmon dominated the escapement (76%). Sample-specific estimates are given in Appendix A5–A9). The estimated spawning escapement of 26,274 (SE = 7,267; 95% CI: 12,103 to 40,445) was composed of 6.9% age-1.2 fish, 15.7% age-1.3 fish, and 75.9% age-1.4 fish, and included 17,380 (SE = 4,762) females (Table 4).

2007

Estimated age compositions from the Little Tahltan River weir and Verrett River samples were compared to determine if they could be pooled and used to estimate spawning population proportions. No comparison was possible within the medium size category, but comparisons within the large category were not significantly different (χ^2 = 0.26, df = 1, P = 0.61). Consequently, the Little Tahltan River weir and Verrett River samples were pooled to estimate spawning population proportions.

Age-1.3 Chinook salmon dominated the escapement (61%). Sample-specific estimates are given in Appendices A10–A14. The estimated spawning escapement of 16,388 (SE = 2,505; 95% CI: 11,503 to 21,273) was composed of 9.1% age-1.2 fish, 61.3% age-1.3 fish, and 26.9% age-1.4 fish, and included 9,481 (SE = 1,559) females (Table 5).

2008

Estimated age compositions from the Little Tahltan River weir and Verrett River samples were compared to determine if they could be pooled and used to estimate spawning population proportions. No comparison was possible within the medium size category, but comparisons within the large category were not significantly different (χ^2 = 2.82, df = 1, P = 0.09). Consequently, the Little Tahltan River weir and Verrett River samples were pooled to estimate spawning population proportions.

Age-1.4 Chinook salmon dominated the escapement (62%). Sample-specific estimates are given in Appendices A15–A19. The estimated spawning escapement of 19,274 (SE = 3,160; 95% CI: 13,112 to 25,436) was composed of 3.1% age-1.2 fish, 33.4% age-1.3 fish, and 62.1% age-1.4 fish, and included 11,261 (SE = 1,910) females (Table 6).

Inriver Run

The estimated age compositions for the 2006, 2007, and 2008 inriver runs are presented in Appendices A20–A22.

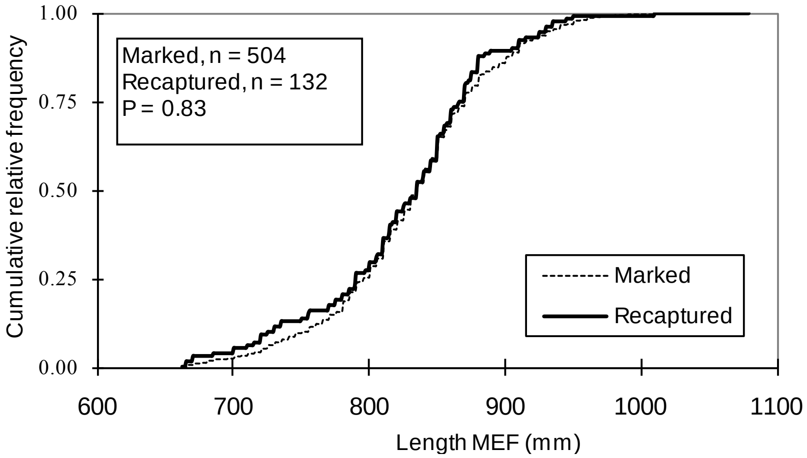

Figure 8.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and recaptured in the lower river commercial fishery, 2006.

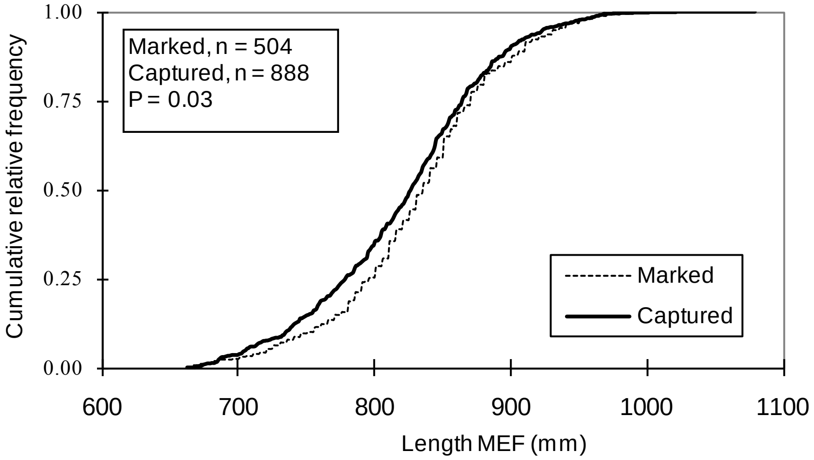

Figure 9.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and captured in the lower river commercial fishery, 2006.

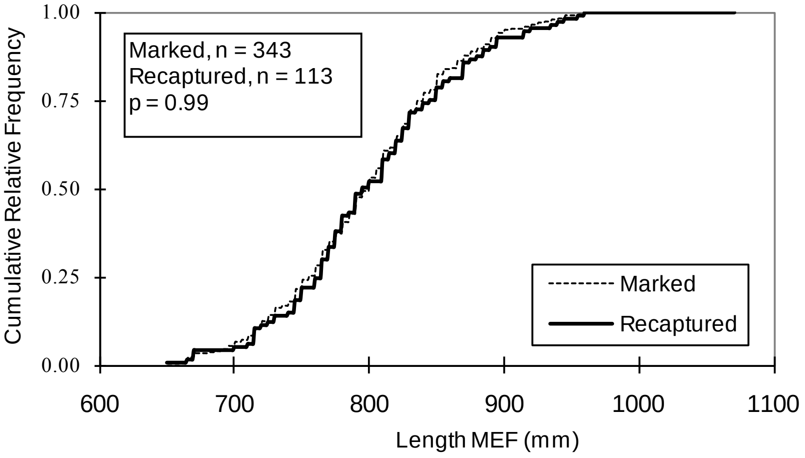

Figure 10.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and recaptured in the lower river commercial fishery, 2007.

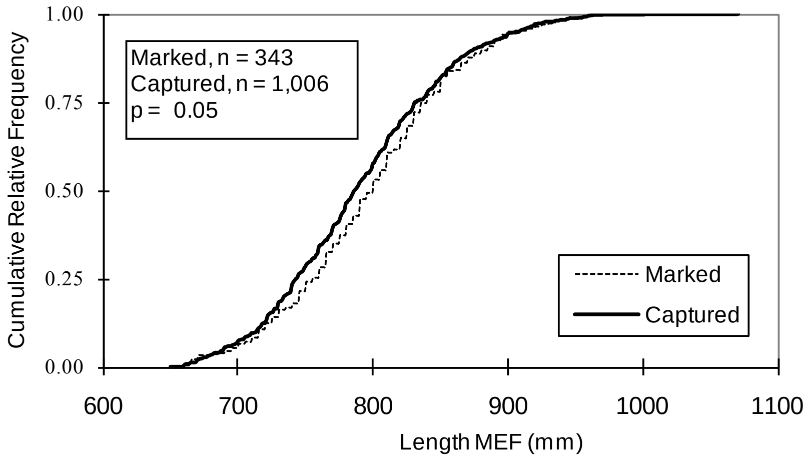

Figure 11.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and captured in the lower river commercial fishery, 2007.

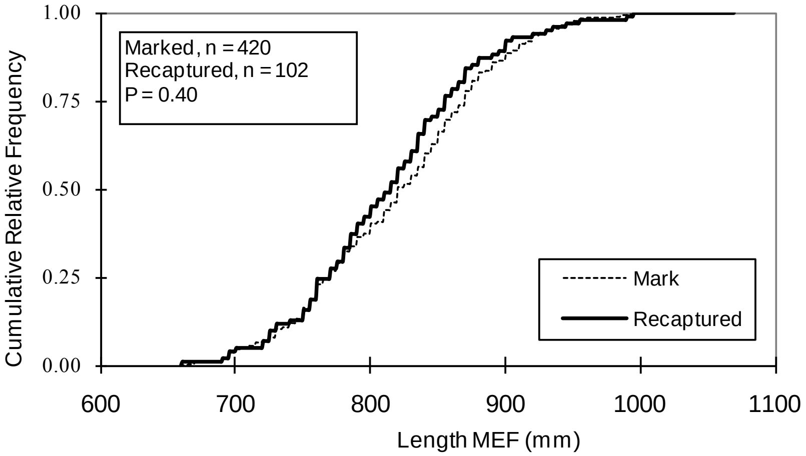

Figure 12.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and recaptured in the lower river commercial fishery, 2008.

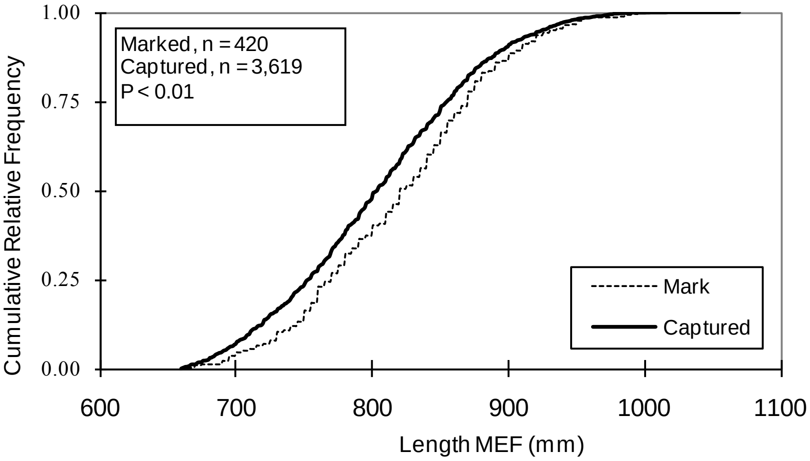

Figure 13.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and captured in the lower river commercial fishery, 2008.

Table 4.–Estimated age and sex composition by size category of the spawning escapement of Chinook salmon in the Stikine River, 2006.

		Panel A. Small and medium Chinook salmon (<660 mm MEF)									
		Brood year and age class									
		2003	2002	2002	2001	2001	2000	2000	1999	1999	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
Males	n	1		23							24
	%	3.6%		82.1%							85.7%
	SE of %	3.6%		7.4%							6.7%
	Escapement	67		1,535							1,602
	SE of esc.	67		495							512
Females	n			4							4
	%			14.3%							14.3%
	SE of %			6.7%							6.7%
	Escapement			267							267
	SE of esc.			146							146
Combined	n	1		27							28
	%	3.6%		96.4%							100.0%
	SE of %	3.6%		3.6%							0.0%
	Escapement	67		1,802							1,869
	SE of esc.	67		564							581
		Panel B. Large Chinook salmon (≥660 MEF)									
Males	n		3			26		93	1	1	124
	%		0.7%			6.3%		22.4%	0.2%	0.2%	29.9%
	SE of %		0.4%			1.2%		2.0%	0.2%	0.2%	2.2%
	Escapement		176			1,529		5,469	59	59	7,292
	SE of esc.		109			507		1,586	59	59	2,084
Females	n					44		246		1	291
	%					10.6%		59.3%		0.2%	70.1%
	SE of %					1.5%		2.4%		0.2%	2.2%
	Escapement					2,588		14,467		59	17,113
	SE of esc.					798		4,039		59	4,760
Combined	n		3			70		339	1	2	415
	%		0.7%			16.9%		81.7%	0.2%	0.5%	100.0%
	SE of %		0.4%			1.8%		1.9%	0.2%	0.3%	0.0%
	Escapement		176			4,117		19,936	59	118	24,405
	SE of esc.		109			1,217		5,529	59	86	6,746
		Panel C. Small, medium and large Chinook salmon									
Males	n	1	3	23		26		93	1	1	148
	%	0.3%	0.7%	5.8%		5.8%		20.8%	0.2%	0.2%	33.9%
	SE of %	0.3%	0.4%	2.3%		1.1%		2.0%	0.2%	0.2%	2.6%
	Escapement	67	176	1,535		1,529		5,469	59	59	8,894
	SE of esc.	67	109	495		507		1,586	59	59	2,146
Females	n			4		44		246		1	295
	%			1.0%		9.8%		55.1%		0.2%	66.1%
	SE of %			0.6%		1.4%		2.8%		0.2%	2.6%
	Escapement			267		2,588		14,467		59	17,380
	SE of esc.			146		798		4,039		59	4,762
Combined	n	1	3	27		70		339	1	2	443
	%	0.3%	0.7%	6.9%		15.7%		75.9%	0.2%	0.4%	100.0%
	SE of %	0.3%	0.4%	2.7%		1.8%		2.9%	0.2%	0.3%	0.0%
	Escapement	67	176	1,802		4,117		19,936	59	118	26,274
	SE of esc.	67	109	564		1,217		5,529	59	86	7,267

Table 5.–Estimated age and sex composition by size category of the spawning escapement of Chinook salmon in the Stikine River, 2007.

		Brood year and age class									
		2004	2003	2003	2002	2002	2001	2001	2000	2000	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
Panel A. Small and medium Chinook salmon (<660 mm MEF)											
Males	n			9		2					11
	%			81.8%		18.2%					100.0%
	SE of %			12.2%		12.2%					0.0%
	Escapement			1,496		332					1,828
	SE of esc.			435		232					462
Females	n										0
	%										0.0%
	SE of %										0.0%
	Escapement										0
	SE of esc.										0
Combined	n			9		2					11
	%			81.8%		18.2%					100.0%
	SE of %			12.2%		12.2%					0.0%
	Escapement			1,496		332					1,828
	SE of esc.			435		232					462
Panel B. Large Chinook salmon (≥660 MEF)											
Males	n					33		11		1	45
	%					25.6%		8.5%		0.8%	34.9%
	SE of %					3.9%		2.5%		0.8%	4.2%
	Escapement					3,725		1,242		113	5,079
	SE of esc.					792		402		113	980
Females	n					53		28	1	2	84
	%					41.1%		21.7%	0.8%	1.6%	65.1%
	SE of %					4.3%		3.6%	0.8%	1.1%	4.2%
	Escapement					5,982		3,160	113	226	9,481
	SE of esc.					1,101		710	113	161	1,559
Combined	n					86		39	1	3	129
	%					66.7%		30.2%	0.8%	2.3%	100.0%
	SE of %					4.2%		4.1%	0.8%	1.3%	0.0%
	Escapement					9,707		4,402	113	339	14,560
	SE of esc.					1,588		887	113	198	2,206
Panel C. Small, medium and large Chinook salmon											
Males	n			9		35		11		1	56
	%			9.1%		24.8%		7.6%		0.7%	42.1%
	SE of %			2.7%		3.7%		2.2%		0.7%	4.2%
	Escapement			1,496		4,057		1,242		113	6,908
	SE of esc.			435		825		402		113	1,083
Females	n					53		28	1	2	84
	%					36.5%		19.3%	0.7%	1.4%	57.9%
	SE of %					4.0%		3.3%	0.7%	1.0%	4.2%
	Escapement					5,982		3,160	113	226	9,481
	SE of esc.					1,101		710	113	161	1,559
Combined	n			9		88		39	1	3	140
	%			9.1%		61.3%		26.9%	0.7%	2.1%	100.0%
	SE of %			2.7%		4.2%		3.7%	0.7%	1.2%	0.0%
	Escapement			1,496		10,039		4,402	113	339	16,388
	SE of esc.			435		1,605		887	113	198	2,505

Table 6.–Estimated age and sex composition by size category of the spawning escapement of Chinook salmon in the Stikine River, 2008.

Panel A. Small and medium Chinook salmon (<660 mm MEF)											
		Brood year and age class									
		2005	2004	2004	2003	2003	2002	2002	2001	2001	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
Males	n	3		10		6					19
	%	15.8%		52.6%		31.6%					100.0%
	SE of %	8.6%		11.8%		11.0%					0.0%
	Escapement	146		485		291					922
	SE of esc.	86		168		125					250
Females	n										0
	%										0.0%
	SE of %										0.0%
	Escapement										0
	SE of esc.										0
Combined	n	3		10		6					19
	%	15.8%		52.6%		31.6%					100.0%
	SE of %	8.6%		11.8%		11.0%					0.0%
	Escapement	146		485		291					922
	SE of esc.	86		168		125					250
Panel B. Large Chinook salmon (≥660 MEF)											
Males	n			1		42	1	75			119
	%			0.3%		13.6%	0.3%	24.4%			38.6%
	SE of %			0.3%		2.0%	0.3%	2.4%			2.8%
	Escapement			60		2,503	60	4,469			7,091
	SE of esc.			60		542	60	855			1,265
Females	n			1		61		126		1	189
	%			0.3%		19.8%		40.9%		0.3%	61.4%
	SE of %			0.3%		2.3%		2.8%		0.3%	2.8%
	Escapement			60		3,635		7,508		60	11,261
	SE of esc.			60		723		1,329		60	1,910
Combined	n			2		103	1	201		1	308
	%			0.6%		33.4%	0.3%	65.3%		0.3%	100.0%
	SE of %			0.5%		2.7%	0.3%	2.7%		0.3%	0.0%
	Escapement			119		6,137	60	11,976		60	18,352
	SE of esc.			85		1,116	60	2,021		60	3,003
Panel C. Small, medium and large Chinook salmon											
Males	n	3		11		48	1	75			138
	%	0.8%		2.8%		14.5%	0.3%	23.2%			41.6%
	SE of %	0.5%		1.0%		2.0%	0.3%	2.4%			2.8%
	Escapement	146		545		2,794	60	4,469			8,012
	SE of esc.	86		178		556	60	855			1,289
Females	n			1		61		126		1	189
	%			0.3%		18.9%		39.0%		0.3%	58.4%
	SE of %			0.3%		2.2%		2.7%		0.3%	2.8%
	Escapement			60		3,635		7,508		60	11,261
	SE of esc.			60		723		1,329		60	1,910
Combined	n	3		12		109	1	201		1	327
	%	0.8%		3.1%		33.4%	0.3%	62.1%		0.3%	100.0%
	SE of %	0.5%		1.0%		2.6%	0.3%	2.8%		0.3%	0.0%
	Escapement	146		604		6,428	60	11,976		60	19,274
	SE of esc.	86		188		1,123	60	2,021		60	3,160

DISCUSSION

Extended periods of high water influenced catches at Kakwan Point in 2006, 2007, and 2008. When water levels reached approximately 6.7 m or more, catch rates at Kakwan Point noticeably dropped (Figures 2 to 7). This is most likely attributed to fish passing under or around the nets during high water. It is also possible fish movement is minimal during periods of high water.

To estimate the spawning escapement of large Chinook salmon that passed by Kakwan Point, inriver harvests in the commercial, aboriginal, and Tahltan River sport fisheries were subtracted from the inriver run abundance estimate. The final estimates of the spawning escapement for large Chinook salmon above Kakwan Point in 2006, 2007, and 2008 are 24,405 (= 40,181- 15,776), 14,560 (= 25,069-10,509), and 18,352 (= 26,284 - 7,932), respectively (Tables 4, 5, and 6).

Historically, spawning escapement to the Stikine River was estimated by multiplying the Little Tahltan River weir count by an expansion factor (4.0) thought to represent the proportion of the spawning escapement represented by that tributary (Pahlke 1996). The original expansion factor was based on professional judgment rather than empirical data, and in 1991 the TTC of the PSC decided to use only the actual counts of escapement to the Little Tahltan River to assess rebuilding (PSC 1991). The relationship between the Little Tahltan River weir count and the Stikine River spawning escapement for the watershed is being refined over time.

The total weir counts in 2006, 2007, and 2008 were 3,860, 562, 2,663 large fish. The proportion of the spawning escapement represented by the Little Tahltan River weir was 16%, 4%, and 15% respectively. The expansion factors are 6.32 (24,405/3,860), 25.91 (14,560/562), and 6.89 (18,352/2,663) for weir counts to escapement (Table 7). The count of 562 large fish at the Little Tahltan weir in 2007 was the lowest count since the weir was installed in 1985 (see Table 7 for 1996 to 2008 data, and Bernard et al. 2000 for 1985 to 1996 data). The cause of the proportionally low weir count in 2007 is unknown.

The U.S. and Canada signed a PST Agreement in June 1999, which included a specific directive in Annex IV of the treaty to develop abundance-based management of Stikine River Chinook salmon by 2005. Towards that end, sibling relationships have been analyzed in which previous-year inriver run abundance estimates of age-1.2, age-1.3, and age-1.4 fish were used to predict (forecast) current-year abundance of age-1.3 age-1.4 and age-1.5 fish. Prior to 2005, the harvest of Stikine-bound Chinook salmon in District 108 was not included in the forecast because the District 108 harvest was consistent and minimal, and forecasting the inriver run was considered suitable for planning purposes. Since 2005 however, significant numbers of large Stikine River bound Chinook salmon were harvested in District 108 because of the start of the directed Chinook salmon fisheries (Tables 8 and 9). Therefore, beginning in 2006, a terminal run forecast including all Stikine River origin fish harvested in District 108 has been used.

The 2006, 2007, and 2008 preseason terminal run forecasts were 60,600, 37,400, and 46,100 large Chinook salmon. The estimated terminal runs in 2006, 2007, and 2008 were 66,918, 38,824, and 35,999 large Chinook salmon (Table 8).

In 2006, 2007, and 2008 models were used that describe linear relationships between the season-end inriver run abundance of large Chinook salmon and cumulative CPUE at Kakwan Point at a given period. These models provided useful inseason estimates by about statistical week 22, and an inseason method by which to judge preseason forecasts.

The new 2008 PST Agreement states that Southeast Alaska fisheries will be managed to achieve escapement objectives for the Chinook salmon stocks (PST Chapter 1). Estimated escapements have met or exceeded the escapement goal range (established in 2000) of 14,000 to 28,000 adult spawners since 1985. Chinook salmon in the Stikine River have recovered from the recruitment overfishing of the 1970s (Bernard et al. 2000).

Table 7.–Counts at the weir on the Little Tahltan River, mark-recapture estimates of inriver run abundance and spawning escapement, expansion factors, and other statistics for large Chinook salmon in the Stikine River, 1996–2008.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Weir count	4,821	5,557	4,879	4,738	6,640	9,738	7,490	6,492	16,381	7,253	3,860	562	2,663
M[a]	359	653	405	252	612	1,416	935	1,089	1,509	1,022	497	342	421
C	2,006	4,528	3,048	4,030	3,657	5,596	4,375	4,696	5,914	21,249	15,098	10,130	7,051
R	47	93	43	42	73	118	75	118	169	362	132	113	102
Inriver run abundance	31,718[b]	31,509	28,133	23,716	30,301	66,646	53,893	49,881	52,538	59,885	40,181	25,069	26,284
SE	1,978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078[d]	3,896	2,538	6,746	2,206	3,003
CV	6.20%	9.40%	14.00%	13.70%	10.50%	8.80%	11.00%	12.20%	7.40%	4.20%	16.79%	8.80%	11.43%
95% lower C.I.	NA	NA	NA	NA	24,879	56,521	43,798	37,968	45,817	54,392	26,960	20,745	20,398
95% upper C.I.	NA	NA	NA	NA	38,049	78,982	67,023	61,795	61,217	64,641	53,402	29,393	32,169
Bias	NA	NA	NA	NA	1.00%	0.76%	0.31%	NA	0.47%	2.55%	NA	NA	NA
Spawning escapement	28,949	26,996	25,968	19,947	27,531	63,523	50,875	46,824	48,900	39,833	24,405	14,560	18,352
SE	1978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078[d]	3,896	2,538	6,746	2,206	3,003
CV	6.80%	11.00%	15.10%	16.20%	11.50%	9.20%	11.60%	13.00%	8.00%	6.40%	27.64%	15.15%	16.36%
95% lower C.I.	NA	NA	NA	NA	22,220	53,741	40,675	34,911	42,179	34,859	11,183	10,236	12,466
95% upper C.I.	NA	NA	NA	NA	34,565	75,718	63,900	58,738	57,579	44,807	37,627	18,884	24,238
Bias	NA	NA	NA	NA	1.14%	0.79%	0.33%	NA	0.50%	NA	NA	NA	NA
Expansion factor	6.00[e]	4.86[f]	5.32	4.21	4.15	6.52	6.79	7.21	2.99	5.49	6.32	25.91	6.89

[a] Estimated in 1998 and 2001–05.

[b] An estimated 15,052 large Chinook immigrated to the Stikine River after June 12. This estimate, prorated for differences in sampling effort, was expanded to 31,718 for the entire season (see Pahlke and Etherton 1998).

[c] This is a minimum estimate because variance of the prorated expansion was not estimable.

[d] A Darroch model was used to estimate run abundance and escapement using the program SPAS. Because *M* was estimated and the error in *M* could not be incorporated into the program, the standard error was biased low.

[e] Modified from data in Pahlke and Etherton (1998).

[f] Modified from data in Pahlke and Etherton (1999). The expansion factor based on radio telemetry, which was included in the average, was 5.48 (SE = 0.95).

Table 8.–Terminal run reconstruction for large (≥660mm MEF) Stikine River Chinook salmon, 2005–2008.

		2005	2006	2007	2008
U.S. harvest	U.S. inriver subsistence[a]	15	37	37	26
	Petersburg/Wrangell sport[b]	3,002	2,944	3,273	1,352
	Dist. 108 gillnet[c]	22,402	21,861	9,099	7,274
	Dist. 108 troll	4,308	1,895	1,346	1,063
	Total U.S. harvest	29,727	26,737	13,755	9,715
Canadian harvest	Upper Stikine commercial harvest	28	22	10	40
	Lower Stikine commercial harvest[d]	19,070	15,098	10,130	7,051
	Inriver sport harvest, Tahltan River	118	40	0	46
	Aboriginal fishery, Telegraph Creek	800	616	364	769
	Lower River test fishery	33	0	5	13
	Miscellaneous catches[e]				13
	Total Canadian harvest	20,049	15,776	10,509	7,932
Totals	Inriver run estimate	59,855	40,181	25,069	26,284
	Escapement	39,806	24,405	14,560	18,352
	Terminal run[f]	89,582	66,918	38,824	35,999

[a] The U.S. subsistence harvest occurs below Kakwan Point so it is included in the marine harvest.

[b] The estimated sport harvests (based on creel census) are the number of legal size (≥28" total length) Stikine River Chinook salmon landed in the Petersburg/Wrangell (Psg/Wrn) ports from biweek 9–12 (i.e., approximately early April to early June).

[c] District 108 harvest of Chinook salmon through SW29 excluding Alaska hatchery fish. Directed district 108 Chinook Salmon gillnet and troll fisheries began in 2005.

[d] The lower Stikine River commercial harvest was apportioned into size categories based on length samples and may not reflect catches reported by fishers.

[e] 2008 Tuya River sockeye salmon test fishery.

[f] The terminal run is the sum of the U.S. harvest and the inriver run estimate.

Table 9.–Terminal run reconstruction for small-medium (<660mm MEF) Stikine River Chinook salmon, 2005-2008.

		2005	2006	2007	2008
U.S. harvest	U.S. inriver subsistence[a]	8	17	15	6
	Petersburg/Wrangell sport[b]	0	0	0	0
	Dist. 108 gillnet[c]	1,866	2,711	1,382	578
	Dist. 108 troll	0	0	0	0
	Total U.S. harvest	1,874	2,728	1,397	584
Canadian harvest	Upper Stikine commercial harvest	1	1	25	9
	Lower Stikine commercial harvest[d]	1,181	1,955	1,469	908
	Inriver sport harvest, Tahltan River	0	0	0	3
	Aboriginal fishery, Telegraph Creek	94	122	233	150
	Lower River test fishery	21	0	0	10
	Miscellaneous catches[e]				1
	Total Canadian harvest	1,297	2,078	1,727	1,081
Totals	Inriver run estimate	2,665	3,947	3,555	2,003
	Escapement	1,368	1,869	1,828	922
	Terminal run[f]	4,539	6,675	4,952	2,587

[a] The U.S. subsistence harvest occures below Kakwan Point so it is included in the marine harvest.

[b] The estimated sport harvests (based on creel census) are the number of legal size (≥28" total length) Stikine River Chinook salmon landed in the Petersburg/Wrangell (Psg/Wrn) ports from biweek 9–12 (i.e., approximately early April to early June).

[c] District 108 harvest of Chinook salmon through SW29 excluding Alaska hatchery fish. Directed district 108 Chinook Salmon gillnet and troll fisheries began in 2005.

[d] The lower Stikine River commercial harvest was apportioned into size categories based on length samples and may not reflect catches reported by fishers.

[e] 2008 Tuya River sockeye salmon test fishery.

[f] The terminal run is the sum of the U.S. harvest and the inriver run estimate.

CONCLUSIONS AND RECOMMENDATION

The work performed through 2008 culminated the 13th year of estimating Chinook salmon spawning escapement in the Stikine River. These results confirm that drift gillnets are an effective means of capturing large Chinook salmon for tagging and use in mark-recapture studies and that counts of salmon through the Little Tahltan River weir are a useful index (i.e., the counts represent a relatively constant percentage of the escapement, except for 2007) of Chinook salmon escapement to the Stikine River. However, the weir counts do not serve as a timely indicator for inseason abundance. Instead, CPUE models and mark-recapture estimates have been useful as inseason indicators of run strength. Preseason forecasts using sibling models have proven to be useful tools as evidenced by managers announcing openings for directed fisheries in 2006 through 2008 that resulted in the some of the largest harvests in over 50 years. Later, inseason estimates essentially replaced the preseason forecasts providing real-time information for the management of the fishery.

We recommend that the escapement goal be formally reviewed after the 2012 season.

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APPENDIX A

Appendix A1.–Harvests of small-medium (sm-med) and large Chinook salmon in Canadian fisheries on the Stikine River and in U.S. fisheries near the mouth of the Stikine River, 1975–2008.

	United States[a, b]						Canada											
	Psg/Wrn sport	Dist. 108 troll	Dist. 108 gillnet		U.S. inriver subsistence		Commercial harvest, lower Stikine		Commercial harvest, upper Stikine [c, d]		Inriver sport harvest, Tahltan River[e]		Aboriginal fishery, Telegraph Creek		Lower river test fishery[f]		Total Dist. 8 and inriver harvest of Stikine River Chinook	
Year			Sm-med[f]	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large
1975				1,529						178				1,024			0	2,731
1976	ND			1,101						236				924			0	2,261
1977	ND			1,378						62				100			0	1,540
1978	2,282			ND						100				400			0	2,782
1979	1,759			48			63	712		ND	10	74	80	323			153	2,916
1980	2,498			407				1,488		156	18	136	171	686			189	5,371
1981	2,022			258				664		154	28	213	118	473			146	3,784
1982	2,929			1,032				1,693		76	24	181	124	499			148	6,410
1983	2,634			46			430	492		75	5	38	215	851			650	4,136
1984	2,171			14			Fishery Closed				11	83	59	643			70	2,911
1985	2,953			20			91	256		62	12	92	94	793			197	4,176
1986	2,475			76			365	806	41	104	12	93	569	1,026	12	27	999	4,607
1987	1,834			94			242	909	19	109	18	138	183	1,183	30	189	492	4,456
1988	2,440			137			201	1,007	46	175	27	204	197	1,178	29	269	500	5,410
1989	2,776			227			157	1,537	17	54	18	132	115	1,078	24	217	331	6,021
1990	4,283			308			680	1,569	20	48	17	129	259	633	18	231	994	7,201
1991	3,657			876			318	641	32	117	17	129	310	753	16	167	693	6,340
1992	3,322			528			89	873	19	56	24	181	131	911	182	614	445	6,485
1993	4,227			866			164	830	2	44	52	386	142	929	87	568	447	7,850
1994	2,140			1,402			158	1,016	1	76	29	218	191	698	78	295	457	5,845
1995	1,218			945			599	1,067	17	9	14	107	244	570	184	248	1,058	4,164
1996	2,464			878			221	1,708	44	41	22	162	156	722	76	298	519	6,273
1997	3,475			1,934			186	3,283	6	45	25	188	94	1,155	7	30	318	10,110
1998	1,438			157			359	1,585	0	12	22	165	95	538	11	25	487	3,920
1999	3,668			688			789	2,127	12	24	22	166	463	765	97	853	1,383	8,291
2000	2,581			737			936	1,274	2	7	30	226	386	1,100	334	389	1,688	6,314
2001	2,263			7			59	826	0	0	12	190	44	665	59	1,442	174	5,393
2002	3,077			26			209	433	3	2	46	420	366	927	323	1,278	947	6,163
2003	3,252			103			459	908	12	19	46	167	373	682	792	1,281	1,682	6,412
2004	2,939			5,515	19	12	1,773	2,735	1	0	18	91	1,184	738	79	62	3,074	12,092
2005	3,002	4,308	1,866	22,402	8	15	1,181	19,070	1	28	0	118	94	800	21	33	3,171	49,776
2006	2,944	1,895	2,711	21,861	17	37	1,955	15,098	1	22	0	40	122	616	0	0	4,806	42,513
2007	3,273	1,346	1,382	9,099	15	37	1,469	10,130	25	10	0	0	233	364	0	5	3,124	24,264
2008	1,352	1,063	578	1,346	6	26	908	7,051	9	40	3	46	150	769	10	13	1,665	17,647

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Appendix A1.–Page 2 of 2.

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[a] District 108 harvest of Chinook salmon through SW29 excluding Alaska hatchery fish. Directed District 108 gillnet and troll fisheries began in 2005.

[b] The estimated sport harvest is the number of legal size (>28” TL) Stikine River Chinook salmon landed in the Petersburg/Wrangell (Psg/Wrn) ports from biweek 9–12 (i.e., approximately early April to early June).

[c] Small-medium Chinook salmon were not segregated before 1983.

[d] Harvests were apportioned into size categories based on length samples beginning in 1998 and may not reflect catches reported by fishers.

[e] Sport harvests in 2001–2004 are based on creel census. Harvests in 1979–2000 are based on the harvest at the Tahltan River mouth area fishery vs. the Little Tahltan River weir counts (3.9%). All harvests are apportioned by the combined 2001–2003 age-sex-length samples from the creel. An additional estimated 25 fish are harvested at other Canadian sites (Verrett, Craig, and Little Tahltan rivers).

[f] The lower river test fishery includes the harvest of the Tuya test fishing in 2008 (1small-medium and 13 large).

Appendix A2.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2006.

					Large Chinook		Small-medium Chinook	
Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Fish per h	Cum. percent	Fish per h	Cum. percent
5/7/2006	155	5	0	2.91	1.94	0.01	0.00	0.00
5/8/2006	474	14	0	2.95	1.77	0.04	0.00	0.00
5/9/2006	487	17	0	2.83	2.09	0.07	0.00	0.00
5/10/2006	491	32	1	2.71	3.91	0.13	0.12	0.04
5/11/2006	504	17	1	2.69	2.02	0.16	0.12	0.07
5/12/2006	483	23	0	2.67	2.86	0.21	0.00	0.07
5/13/2006	485	19	0	2.65	2.35	0.24	0.00	0.07
5/14/2006	497	14	0	2.65	1.69	0.27	0.00	0.07
5/15/2006	486	12	0	2.68	1.48	0.29	0.00	0.07
5/16/2006	486	27	0	2.72	3.33	0.35	0.00	0.07
5/17/2006	478	21	1	2.87	2.64	0.39	0.13	0.11
5/18/2006	256	6	0	3.29	1.41	0.40	0.00	0.11
5/19/2006	476	9	0	3.60	1.13	0.42	0.00	0.11
5/20/2006	480	12	0	3.84	1.50	0.44	0.00	0.11
5/21/2006	484	6	0	4.12	0.74	0.45	0.00	0.11
5/22/2006	481	4	0	4.47	0.50	0.46	0.00	0.11
5/23/2006	480	5	0	4.69	0.63	0.47	0.00	0.11
5/24/2006	224	0	0	5.07	0.00	0.47	0.00	0.11
5/25/2006	481	0	0	5.31	0.00	0.47	0.00	0.11
5/26/2006	487	5	0	5.63	0.62	0.48	0.00	0.11
5/27/2006	244	0	0	5.96	0.00	0.48	0.00	0.11
5/28/2006	247	2	0	6.22	0.49	0.48	0.00	0.11
5/29/2006	482	0	0	6.32	0.00	0.48	0.00	0.11
5/30/2006	479	2	0	6.34	0.25	0.49	0.00	0.11
5/31/2006	482	2	0	6.33	0.25	0.49	0.00	0.11
6/1/2006	473	3	0	6.40	0.38	0.50	0.00	0.11
6/2/2006	484	3	0	6.49	0.37	0.50	0.00	0.11
6/3/2006	481	1	0	6.77	0.12	0.50	0.00	0.11
6/4/2006	481	4	0	6.84	0.50	0.51	0.00	0.11
6/5/2006	480	2	0	6.89	0.25	0.51	0.00	0.11
6/6/2006	480	2	1	6.71	0.25	0.52	0.13	0.14
6/7/2006	483	0	0	6.60	0.00	0.52	0.00	0.14
6/8/2006	483	2	0	6.47	0.25	0.52	0.00	0.14
6/9/2006	481	1	0	6.39	0.12	0.52	0.00	0.14
6/10/2006	477	1	0	6.42	0.13	0.53	0.00	0.14
6/11/2006	481	1	1	6.57	0.12	0.53	0.12	0.18
6/12/2006	478	5	1	6.87	0.63	0.54	0.13	0.21
6/13/2006	188	0	0	7.33	0.00	0.54	0.00	0.21
6/14/2006	18	0	0	7.68	0.00	0.54	0.00	0.21
6/15/2006	251	1	1	7.81	0.24	0.54	0.24	0.25
6/16/2006	255	0	0	7.76	0.00	0.54	0.00	0.25
6/17/2006	489	1	0	7.74	0.12	0.54	0.00	0.25
6/18/2006	487	0	0	7.75	0.00	0.54	0.00	0.25
6/19/2006	481	0	0	7.31	0.00	0.54	0.00	0.25
6/20/2006	481	1	1	6.77	0.12	0.54	0.12	0.29
6/21/2006	479	7	1	6.36	0.88	0.56	0.13	0.32
6/22/2006	490	14	0	6.18	1.71	0.58	0.00	0.32
6/23/2006	486	26	0	5.90	3.21	0.63	0.00	0.32
6/24/2006	482	34	1	5.64	4.23	0.70	0.12	0.36

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Appendix A2.–Page 2 of 2.

					Large Chinook		Small-medium Chinook	
Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Fish per h	Cum. percent	Fish per h	Cum. percent
6/25/2006	486	27	2	5.63	3.33	0.75	0.25	0.43
6/26/2006	0	0	0	6.09		0.75		0.43
6/27/2006	484	7	1	6.19	0.87	0.76	0.12	0.46
6/28/2006	492	2	1	6.04	0.24	0.77	0.12	0.50
6/29/2006	495	20	3	5.84	2.42	0.81	0.36	0.61
6/30/2006	385	22	4	5.55	3.43	0.85	0.62	0.75
7/1/2006	483	27	4	5.55	3.35	0.90	0.50	0.89
7/2/2006	496	22	0	5.72	2.66	0.94	0.00	0.89
7/3/2006	483	18	1	5.85	2.24	0.98	0.12	0.93
7/4/2006	0	0	0	5.97		0.98		0.93
7/5/2006	253	5	2	6.14	1.19	0.99	0.47	1.00
7/6/2006	477	3	0	6.20	0.38	0.99	0.00	1.00
7/7/2006	475	3	0	6.18	0.38	1.00	0.00	1.00
Total	436 hrs	519	28					

Appendix A3.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2007.

					Large Chinook		Small-medium Chinook	
Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Fish per h	Cum. percent	Fish per h	Cum. percent
5/7/2007	248	0	0	3.2	0.00	0.00	0.00	0.00
5/8/2007	484	0	0	3.1	0.00	0.00	0.00	0.00
5/9/2007	498	3	0	3.0	0.36	0.01	0.00	0.00
5/10/2007	490	5	0	3.0	0.61	0.02	0.00	0.00
5/11/2007	485	12	1	3.0	1.48	0.06	0.12	0.04
5/12/2007	485	8	0	3.1	0.99	0.08	0.00	0.04
5/13/2007	492	12	0	3.1	1.46	0.11	0.00	0.04
5/14/2007	485	7	0	3.1	0.87	0.13	0.00	0.04
5/15/2007	479	6	0	3.1	0.75	0.15	0.00	0.04
5/16/2007	494	19	2	3.5	2.31	0.20	0.24	0.11
5/17/2007	490	8	0	3.9	0.98	0.23	0.00	0.11
5/18/2007	493	6	0	4.0	0.73	0.24	0.00	0.11
5/19/2007	489	12	0	4.0	1.47	0.28	0.00	0.11
5/20/2007	482	9	1	4.0	1.12	0.30	0.12	0.15
5/21/2007	486	6	0	4.3	0.74	0.32	0.00	0.15
5/22/2007	486	6	0	3.1	0.74	0.34	0.00	0.15
5/23/2007	489	2	1	4.7	0.25	0.34	0.12	0.19
5/24/2007	491	5	1	5.1	0.61	0.36	0.12	0.22
5/25/2007	481	5	2	5.3	0.62	0.37	0.25	0.30
5/26/2007	485	4	0	5.7	0.49	0.38	0.00	0.30
5/27/2007	496	1	0	6.0	0.12	0.38	0.00	0.30
5/28/2007	491	4	0	6.0	0.49	0.40	0.00	0.30
5/29/2007	484	4	0	6.0	0.50	0.41	0.00	0.30
5/30/2007	484	4	0	6.0	0.50	0.42	0.00	0.30
5/31/2007	480	3	1	6.2	0.38	0.43	0.13	0.33
6/1/2007	490	4	0	6.4	0.49	0.44	0.00	0.33
6/2/2007	480	1	0	6.4	0.13	0.44	0.00	0.33
6/3/2007	482	4	0	6.6	0.50	0.45	0.00	0.33
6/4/2007	486	1	0	7.0	0.12	0.45	0.00	0.33
6/5/2007	480	1	0	7.6	0.13	0.46	0.00	0.33
6/6/2007	483	0	0	7.8	0.00	0.46	0.00	0.33
6/7/2007	242	0	0	8.1	0.00	0.46	0.00	0.33
6/8/2007	0	0	0	8.4		0.46		0.33
6/9/2007	0	0	0	8.4		0.46		0.33
6/10/2007	0	0	0	7.9		0.46		0.33
6/11/2007	245	1	0	7.7	0.24	0.46	0.00	0.33
6/12/2007	242	0	0	7.6	0.00	0.46	0.00	0.33
6/13/2007	482	0	1	7.7	0.00	0.46	0.12	0.37
6/14/2007	485	1	0	7.5	0.12	0.46	0.00	0.37
6/15/2007	483	1	1	7.2	0.12	0.47	0.12	0.41
6/16/2007	482	0	0	7.0	0.00	0.47	0.00	0.41
6/17/2007	484	8	0	7.1	0.99	0.49	0.00	0.41
6/18/2007	483	3	0	7.3	0.37	0.50	0.00	0.41
6/19/2007	483	4	0	7.3	0.50	0.51	0.00	0.41
6/20/2007	488	5	2	7.1	0.61	0.52	0.25	0.48
6/21/2007	485	8	1	7.0	0.99	0.55	0.12	0.52
6/22/2007	485	10	0	6.9	1.24	0.57	0.00	0.52
6/23/2007	478	15	2	6.6	1.88	0.62	0.25	0.59
6/24/2007	488	14	1	6.4	1.72	0.66	0.12	0.63

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Appendix A3.–Page 2 of 2.

Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Large Chinook Fish per h	Large Chinook Cum. percent	Small-medium Chinook Fish per h	Small-medium Chinook Cum. percent
6/25/2007	459	19	3	6.3	2.48	0.71	0.39	0.74
6/26/2007	481	10	1	6.1	1.25	0.74	0.12	0.78
6/27/2007	480	11	0	6.2	1.38	0.77	0.00	0.78
6/28/2007	488	11	2	6.2	1.35	0.80	0.25	0.85
6/29/2007	484	8	0	6.4	0.99	0.82	0.00	0.85
6/30/2007	482	9	0	6.5	1.12	0.85	0.00	0.85
7/1/2007	484	5	1	6.7	0.62	0.86	0.12	0.89
7/2/2007	480	6	0	6.6	0.75	0.88	0.00	0.89
7/3/2007	484	7	0	6.5	0.87	0.90	0.00	0.89
7/4/2007	482	7	0	6.4	0.87	0.92	0.00	0.89
7/5/2007	482	7	1	6.7	0.87	0.94	0.12	0.93
7/6/2007	483	4	0	6.6	0.50	0.95	0.00	0.93
7/7/2007	484	11	0	6.4	1.36	0.98	0.00	0.93
7/8/2007	479	4	1	6.2	0.50	0.99	0.13	0.96
7/9/2007	480	3	1	6.1	0.38	1.00	0.13	1.00
Total	476 hrs.	354	27					

Appendix A4.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2008.

					Large Chinook		Small-medium Chinook	
Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Fish per h	Cum. percent	Fish per h	Cum. percent
5/8/2008	411	7	0	2.5	1.02	0.02	0.00	0.00
5/9/2008	486	25	1	2.5	3.09	0.07	0.12	0.03
5/10/2008	476	29	2	2.6	3.66	0.14	0.25	0.09
5/11/2008	482	10	2	2.8	1.24	0.16	0.25	0.15
5/12/2008	481	20	2	3.0	2.49	0.21	0.25	0.21
5/13/2008	482	9	2	3.3	1.12	0.23	0.25	0.26
5/14/2008	477	14	1	3.3	1.76	0.26	0.13	0.29
5/15/2008	469	4	0	4.2	0.51	0.27	0.00	0.29
5/16/2008	122	4	0	4.5	1.97	0.28	0.00	0.29
5/17/2008	481	3	0	4.5	0.37	0.29	0.00	0.29
5/18/2008	476	0	1	4.9	0.00	0.29	0.13	0.32
5/19/2008	486	1	0	5.0	0.12	0.29	0.00	0.32
5/20/2008	484	4	0	4.8	0.50	0.30	0.00	0.32
5/21/2008	486	6	0	5.0	0.74	0.31	0.00	0.32
5/22/2008	242	2	0	5.1	0.50	0.32	0.00	0.32
5/23/2008	560	1	1	5.3	0.11	0.32	0.11	0.35
5/24/2008	474	2	0	5.6	0.25	0.32	0.00	0.35
5/25/2008	458	4	0	5.8	0.52	0.33	0.00	0.35
5/26/2008	485	0	0	6.0	0.00	0.33	0.00	0.35
5/27/2008	491	2	0	6.3	0.24	0.34	0.00	0.35
5/28/2008	480	0	0	6.6	0.00	0.34	0.00	0.35
5/29/2008	368	0	0	6.7	0.00	0.34	0.00	0.35
5/30/2008	18	0	0	6.7	0.00	0.34	0.00	0.35
5/31/2008	482	1	0	6.7	0.12	0.34	0.00	0.35
6/1/2008	481	0	0	6.6	0.00	0.34	0.00	0.35
6/2/2008	479	3	0	6.4	0.38	0.35	0.00	0.35
6/3/2008	488	8	0	6.3	0.98	0.36	0.00	0.35
6/4/2008	481	11	0	6.2	1.37	0.39	0.00	0.35
6/5/2008	482	12	0	6.0	1.49	0.42	0.00	0.35
6/6/2008	483	22	3	5.8	2.73	0.47	0.37	0.44
6/7/2008	489	22	2	5.5	2.70	0.52	0.25	0.50
6/8/2008	498	27	2	5.4	3.25	0.58	0.24	0.56
6/9/2008	480	25	0	5.1	3.13	0.64	0.00	0.56
6/10/2008	486	17	1	4.9	2.10	0.68	0.12	0.59
6/11/2008	487	8	2	4.8	0.99	0.69	0.25	0.65
6/12/2008	482	5	3	4.9	0.62	0.70	0.37	0.74
6/13/2008	247	1	0	5.1	0.24	0.71	0.00	0.74
6/14/2008	484	11	0	4.9	1.36	0.73	0.00	0.74
6/15/2008	484	6	0	5.0	0.74	0.75	0.00	0.74
6/16/2008	479	1	0	5.2	0.13	0.75	0.00	0.74
6/17/2008	496	8	1	5.3	0.97	0.77	0.12	0.76
6/18/2008	485	12	2	5.3	1.48	0.79	0.25	0.82
6/19/2008	485	11	1	5.3	1.36	0.82	0.12	0.85
6/20/2008	482	7	2	5.4	0.87	0.84	0.25	0.91
6/21/2008	487	6	1	5.6	0.74	0.85	0.12	0.94
6/22/2008	476	7	1	5.8	0.88	0.86	0.13	0.97
6/23/2008	248	3	0	5.8	0.73	0.87	0.00	0.97
6/24/2008	242	3	0	5.7	0.74	0.88	0.00	0.97
6/25/2008	484	4	0	5.7	0.50	0.89	0.00	0.97

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Appendix A4.–Page 2 of 2.

					Large Chinook		Small-medium Chinook	
Date	Minutes	Lg. Chin.	Sm-med Chin.	Depth (m)	Fish per h	Cum. percent	Fish per h	Cum. percent
6/26/2008	486	16	0	5.6	1.98	0.92	0.00	0.97
6/27/2008	485	5	0	5.6	0.62	0.94	0.00	0.97
6/28/2008	482	5	1	5.6	0.62	0.95	0.12	1.00
6/29/2008	480	5	0	6.1	0.63	0.96	0.00	1.00
6/30/2008	481	2	0	5.9	0.25	0.96	0.00	1.00
7/1/2008	484	4	0	5.9	0.50	0.97	0.00	1.00
7/2/2008	482	8	0	6.1	1.00	0.99	0.00	1.00
7/3/2008	496	4	0	6.4	0.48	1.00	0.00	1.00
7/4/2008	472	0	0	6.6	0.00	1.00	0.00	1.00
7/5/2008	463	0	0	6.8	0.00	1.00	0.00	1.00
7/6/2008	490	0	0	6.9	0.00	1.00	0.00	1.00
7/7/2008	236	0	0	6.9	0.00	1.00	0.00	1.00
7/8/2008	242	0	0	6.5	0.00	1.00	0.00	1.00
Total	459 hrs.	437	34					

Appendix A5.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Kakwan Point, 2006.

Small and medium Chinook salmon															
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n				2										2
	% age comp.				8.0										8.0
	SE of %				5.5										5.5
	Avg. length				651										651
	SE				1										1
Males	n				21			2							23
	% age comp.				84.0			8.0							92.0
	SE of %				7.5			5.5							5.5
	Avg. length.				602			638							605
	SE				6			3							6
Sexes combined	n				23			2							25
	% age comp.				92.0			8.0							100.0
	SE of %				5.5			5.5							0.0
	Avg. length.				607			638							609
	SE				6			3							6
Large Chinook slmon															
Females	n				3			38			217		2	1	261
	% age comp.				0.7			9.4			53.4		0.5	0.2	64.3
	SE of %				0.4			1.4			2.5		0.3	0.2	2.4
	Avg. length				677			770			833		841	830	822
	SE				6			8			3		85		3
Males	n				3			32			109		1		145
	% age comp.				0.7			7.9			26.8		0.2		35.7
	SE of %				0.4			1.3			2.2		0.2		2.4
	Avg. length.				667			772			883		940		855
	SE				2			10			6				6
Sexes combined	n				6			70			326		3	1	406
	% age comp.				1.5			17.2			80.3		0.7	0.2	100.0
	SE of %				0.6			1.9			2.0		0.4	0.2	0.0
	Avg. length.				672			771			850		874	830	834
	SE				4			6			3		59		3
Small, medium, and large Chinook salmon															
Females	n				5			38			217		2	1	263
	% age comp.				1.2			8.8			50.3		0.5	0.2	61.0
	SE of %				0.5			1.4			2.4		0.3	0.2	2.4
	Avg. length				666			770			833		841	830	821
	SE				7			8			3		85		3
Males	n				24			34			109		1		168
	% age comp.				5.6			7.9			25.3		0.2		39.0
	SE of %				1.1			1.3			2.1		0.2		2.4
	Avg. length.				610			764			883		940		821
	SE				7			11			6				9
Sexes combined	n				29			72			326		3	1	431
	% age comp.				6.7			16.7			75.6		0.7	0.2	100.0
	SE of %				1.2			1.8			2.1		0.4	0.2	0.0
	Avg. length.				620			767			850		874	830	821
	SE				7			6			3		59		4

Appendix A6.–Estimated age and sex composition and mean length by age of Chinook salmon harvested in the Canadian commercial fishery on the lower Stikine River, 2006.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n							1			3				4
	% age comp.							1.3			3.9				5.2
	SE of %							1.3			2.2				2.5
	Avg. length							592			617				611
	SE							0			16				13
Males	n		2		60			3			8				73
	% age comp.		2.6		77.9			3.9			10.4				94.8
	SE of %		1.8		4.8			2.2			3.5				2.5
	Avg. length.		421		547			597			603				551
	SE		53		8			24			14				7
Sexes combined	n		2		60			4			11				77
	% age comp.		2.6		77.9			5.2			14.3				100.0
	SE of %		1.8		4.8			2.5			4.0				0.0
	Avg. length.		421		547			596			607				555
	SE		53		8			17							7
Large Chinook salmon															
Females	n			1	5			48			294		2		350
	% age comp.			0.2	0.8			7.6			46.7		0.3		55.6
	SE of %			0.2	0.4			1.1			2.0		0.2		2.0
	Avg. length			718	817			767			822		843		814
	SE				29			8			3		25		3
Males	n				7			50			218		5		280
	% age comp.				1.1			7.9			34.6		0.8		44.4
	SE of %				0.4			1.1			1.9		0.4		2.0
	Avg. length.				705			758			854		941		834
	SE				16			8			4		45		5
Sexes combined	n			1	12			98			512		7		630
	% age comp.			0.2	1.9			15.6			81.3		1.1		100.0
	SE of %			0.2	0.5			1.4			1.6		0.4		0.0
	Avg. length.			718	752			763			835		913		823
	SE				22			6			3		37		3
Small, medium, and large Chinook Salmon															
Females	n			1	5			49			297		2		354
	% age comp.			0.1	0.7			6.9			42.0		0.3		50.1
	SE of %			0.1	0.3			1.0			1.9		0.2		1.9
	Avg. length			718	817			763			820		843		812
	SE				29			8			3		25		3
Males	n		2		67			53			226		5		353
	% age comp.		0.3		9.5			7.5			32.0		0.7		49.9
	SE of %		0.2		1.1			1.0			1.8		0.3		1.9
	Avg. length.		421		563			749			845		941		776
	SE		53		9			10			5		45		7
Sexes combined	n		2	1	72			102			523		7		707
	% age comp.		0.3	0.1	10.2			14.4			74.0		1.0		100.0
	SE of %		0.2	0.1	1.1			1.3			1.7		0.4		0.0
	Avg. length.		421	718	581			756			831		913		794
	SE		53		12			6			3		37		4

Appendix A7.–Estimated age and sex composition and mean length by age of moribund and recently expired Chinook salmon in Verrett River, 2006.

Small and medium Chinook salmon															
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n				4										4
	% age comp.				21.1										21.1
	SE of %				9.6										9.6
	Avg. length				589										589
	SE				30										30
Males	n				15										15
	% age comp.				78.9										78.9
	SE of %				9.6										9.6
	Avg. length.				587										587
	SE				10										10
Sexes	n				19										19
combined	% age comp.				100.0										100.0
	SE of %				0.0										0.0
	Avg. length.				587										587
	SE				10										10
Large Chinook salmon															
Females	n							34			153		1		188
	% age comp.							13.9			62.7		0.4		77.0
	SE of %							2.2			3.1		0.4		2.7
	Avg. length							750			796		820		788
	SE							10			3				3
Males	n				2			16			38				56
	% age comp.				0.8			6.6			15.6				23.0
	SE of %				0.6			1.6			2.3				2.7
	Avg. length.				685			751			826				799
	SE				5			13			8				8
Sexes	n				2			50			191		1		244
combined	% age comp.				0.8			20.5			78.3		0.4		100.0
	SE of %				0.6			2.6			2.6		0.4		0.0
	Avg. length.				685			750			802		820		791
	SE				5			8			3				3
Small, medium, and large Chinook salmon															
Females	n				4			34			153		1		192
	% age comp.				1.5			12.9			58.2		0.4		73.0
	SE of %				0.8			2.1			3.0		0.4		2.7
	Avg. length				589			750			796		820		784
	SE				30			10			3				4
Males	n				17			16			38				71
	% age comp.				6.5			6.1			14.4				27.0
	SE of %				1.5			1.5			2.2				2.7
	Avg. length.				598			751			826				754
	SE				12			13			8				12
Sexes	n				21			50			191		1		263
combined	% age comp.				8.0			19.0			72.6		0.4		100.0
	SE of %				1.7			2.4			2.8		0.4		0.0
	Avg. length.				597			750			802		820		776
	SE				11			8			3				5

Appendix A8.–Estimated age and sex composition and mean length by age of Chinook salmon at Little Tahltan River weir, 2006.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n		1		8										9
	% age comp.		11.1		88.9										100.0
	SE of %		11.1		11.1										0.0
	Avg. length.		549		559										558
	SE				16										14
Sexes combined	n		1		8										9
	% age comp.		11.1		88.9										100.0
	SE of %		11.1		11.1										0.0
	Avg. length.		549		559										558
	SE				16										14
Large Chinook salmon															
Females	n							10			93				103
	% age comp.							5.8			54.4				60.2
	SE of %							1.8			3.8				3.8
	Avg. length							812			837				835
	SE							15			4				4
Males	n				1			10			55		1	1	68
	% age comp.				0.6			5.8			32.2		0.6	0.6	39.8
	SE of %				0.6			1.8			3.6		0.6	0.6	3.8
	Avg. length.				805			799			858		790	936	849
	SE							24			8				8
Sexes combined	n				1			20			148		1	1	171
	% age comp.				0.6			11.7			86.5		0.6	0.6	100.0
	SE of %				0.6			2.5			2.6		0.6	0.6	0.0
	Avg. length.				805			806			845		790	936	840
	SE							14			4				4
Small, medium, and large Chinook salmon															
Females	n							10			93				103
	% age comp.							5.6			51.7				57.2
	SE of %							1.7			3.7				3.7
	Avg. length							812			837				835
	SE							15			4				4
Males	n		1		9			10			55		1	1	77
	% age comp.		0.6		5.0			5.6			30.6		0.6	0.6	42.8
	SE of %		0.6		1.6			1.7			3.4		0.6	0.6	3.7
	Avg. length.		549		587			799			858		790	936	815
	SE				31			24			8				13
Sexes combined	n		1		9			20			148		1	1	180
	% age comp.		0.6		5.0			11.1			82.2		0.6	0.6	100.0
	SE of %		0.6		1.6			2.3			2.9		0.6	0.6	0.0
	Avg. length.		549		587			806			845		790	936	826
	SE				31			14			4				6

Appendix A9.–Estimated age and sex composition and mean length by age of Chinook salmon, pooled Verrett River and Little Tahltan River weir, 2006.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n				4										4
	% age comp.				14.3										14.3
	SE of %				6.7										6.7
	Avg. length				589										589
	SE				30										30
Males	n		1		23										24
	% age comp.		3.6		82.1										85.7
	SE of %		3.6		7.4										6.7
	Avg. length.		549		577										576
	SE				9										9
Sexes combined	n		1		27										28
	% age comp.		3.6		96.4										100.0
	SE of %		3.6		3.6										0.0
	Avg. length.		549		579										578
	SE				9										8
Large Chinook salmon															
Females	n							44			246		1		291
	% age comp.							10.6			59.3		0.2		70.1
	SE of %							1.5			2.4		0.2		2.2
	Avg. length							764			812		820		805
	SE							9			3				3
Males	n				3			26			93		1	1	124
	% age comp.				0.7			6.3			22.4		0.2	0.2	29.9
	SE of %				0.4			1.2			2.0		0.2	0.2	2.2
	Avg. length.				725			769			845		790	936	826
	SE				40			13			6				6
Sexes combined	n				3			70			339		2	1	415
	% age comp.				0.7			16.9			81.7		0.5	0.2	100.0
	SE of %				0.4			1.8			1.9		0.3	0.2	0.0
	Avg. length.				725			766			821		805	936	811
	SE				40			7			3		15		3
Small, medium, and large Chinook salmon															
Females	n				4			44			246		1		295
	% age comp.				0.9			9.9			55.5		0.2		66.6
	SE of %				0.4			1.4			2.4		0.2		2.2
	Avg. length				589			764			812		820		802
	SE				30			9			3				3
Males	n		1		26			26			93		1	1	148
	% age comp.		0.2		5.9			5.9			21.0		0.2	0.2	33.4
	SE of %		0.2		1.1			1.1			1.9		0.2	0.2	2.2
	Avg. length.		549		594			769			845		790	936	786
	SE				13			13			6				9
Sexes combined	n		1		30			70			339		2	1	443
	% age comp.		0.2		6.8			15.8			76.5		0.5	0.2	100.0
	SE of %		0.2		1.2			1.7			2.0		0.3	0.2	0.0
	Avg. length.		549		594			766			821		805	936	796
	SE				12			7			3		15		4

Appendix A10.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Kakwan Point, 2007.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n														0
	% age														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n				23			3							26
	% age				88.5			11.5							100.0
	SE of %				6.4			6.4							0.0
	Avg. length.				583			615							587
	SE				9			26							8
Sexes combined	n				23			3							26
	% age				88.5			11.5							100.0
	SE of %				6.4			6.4							0.0
	Avg. length.				583			615							587
	SE				9			26							8
Large Chinook salmon															
Females	n							116			42	2	4		164
	% age							39.9			14.4	0.7	1.4		56.4
	SE of %							2.9			2.1	0.5	0.7		2.9
	Avg. length							775			828	768	890		791
	SE							4			5	23	20		4
Males	n				1			86			39		1		127
	% age				0.3			29.6			13.4		0.3		43.6
	SE of %				0.3			2.7			2.0		0.3		2.9
	Avg. length.				695			783			872		955		811
	SE							7			9				7
Sexes combined	n				1			202			81	2	5		291
	% age				0.3			69.4			27.8	0.7	1.7		100.0
	SE of %				0.3			2.7			2.6	0.5	0.8		0.0
	Avg. length.				695			778			850	768	903		800
	SE							55			6	23	45		4
Small, medium, and large Chinook salmon															
Females	n							116			42	2	4		164
	% age							36.6			13.2	0.6	1.3		51.7
	SE of %							2.7			1.9	0.4	0.6		2.8
	Avg. length							775			828	768	890		791
	SE							4			5	23	20		4
Males	n				24			89			39		1		153
	% age				7.6			28.1			12.3		0.3		48.3
	SE of %				1.5			2.5			1.8		0.3		2.8
	Avg. length.				588			777			872		955		773
	SE				10			7			9				9
Sexes combined	n				24			205			81		5		317
	% age				7.6			64.7			25.6		1.6		100.0
	SE of %				1.5			2.7			2.5		0.7		0.0
	Avg. length.				588			776			850		903		782
	SE				10			4			6		20		5

Appendix A11.–Estimated age and sex composition and mean length by age of Chinook salmon harvested in the Canadian commercial fishery on the lower Stikine River, 2007.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n			1	1			2			2	1			7
	% age comp.			1.5	1.5			3.0			3.0	1.5			10.6
	SE of %			1.5	1.5			2.1			2.1	1.5			3.8
	Avg. length			650	548			609			576	598			595
	SE							12			49				17
Males	n		2	1	39			16	1						59
	% age comp.		3.0	1.5	59.1			24.2	1.5						89.4
	SE of %		2.1	1.5	6.1			5.3	1.5						
	Avg. length.		430	505	566			604	567						571
	SE		5		9			10							8
Sexes combined	n		2	2	40			18	1		2	1			66
	% age comp.		3.0	3.0	60.6			27.3	1.5		3.0	1.5			100.0
	SE of %		2.1	2.1	6.1			5.5	1.5		2.1	1.5			0.0
	Avg. length.		430	578	566			605	567		576	598			573
	SE		5	73	9			9			49				7
Large Chinook salmon															
Females	n			3			2	192			75	7	3	3	285
	% age comp.			0.4			0.3	27.9			10.9	1.0	0.4	0.4	41.5
	SE of %			0.3			0.2	1.7			1.2	0.4	0.3	0.3	1.9
	Avg. length			756			834	763			813	806	841	832	779
	SE			14			14	3			6	14	62	11	3
Males	n			3	2		1	261		1	119	2	11	2	402
	% age comp.			0.4	0.3		0.1	38.0		0.1	17.3	0.3	1.6	0.3	58.5
	SE of %			0.3	0.2		0.1	1.9		0.1	1.4	0.2	0.5	0.2	1.9
	Avg. length.			812	800		824	769		919	856	838	868	940	800
	SE			40	55			4			6	12	19	20	4
Sexes combined	n			6	2		3	453		1	194	9	14	5	687
	% age comp.			0.9	0.3		0.4	65.9		0.1	28.2	1.3	2.0	0.7	100.0
	SE of %			0.4	0.2		0.3	1.8		0.1	1.7	0.4	0.5	0.3	0.0
	Avg. length.			784	800		830	767		919	840	813	862	875	791
	SE			23	55		8	2			4	12	19	28	3
Small, medium, and large Chinook salmon															
Females	n			4	1		2	194			77	8	3	3	292
	% age comp.			0.5	0.1		0.3	25.8			10.2	1.1	0.4	0.4	38.8
	SE of %			0.3	0.1		0.2	1.6			1.1	0.4	0.2	0.2	1.8
	Avg. length			730	548		834	762			807	780	841	832	775
	SE			28			14	3			7	29	62	11	3
Males	n		2	4	41		1	277	1	1	119	2	11	2	461
	% age comp.		0.3	0.5	5.4		0.1	36.8	0.1	0.1	15.8	0.3	1.5	0.3	61.2
	SE of %		0.2	0.3	0.8		0.1	1.8	0.1	0.1	1.3	0.2	0.4	0.2	1.8
	Avg. length.		430	736	578		824	759	567	919	856	838	868	940	770
	SE		5	82	12			4			6	12	19	20	5
Sexes combined	n		2	8	42		3	471	1	1	196	10	14	5	753
	% age comp.		0.3	1.1	5.6		0.4	62.5	0.1	0.1	26.0	1.3	1.9	0.7	100.0
	SE of %		0.2	0.4	0.8		0.2	1.8	0.1	0.1	1.6	0.4	0.5	0.3	0.0
	Avg. length.		430	733	577		830	760	567	919	837	791	862	875	772
	SE		5	40	12		8	3			5	24	19	28	3

Appendix A12.–Estimated age and sex composition and mean length by age of moribund and recently expired Chinook salmon in Verrett River, 2007.

Small and medium Chinook salmon															
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n				3										3
	% age comp.				100.0										100.0
	SE of %				0.0										0.0
	Avg. length.				503										503
	SE				28										28
Sexes combined	n				3										3
	% age comp.				100.0										100.0
	SE of %				0.0										0.0
	Avg. length.				503										503
	SE				28										28
Large Chinook salmon															
Females	n							36			15			1	52
	% age comp.							58.1			24.2				83.9
	SE of %							6.3			5.5				4.7
	Avg. length							743			798			740	759
	SE							5			9				6
Males	n							6			3		1		10
	% age comp.							9.7			4.8		1.6		16.1
	SE of %							3.8			2.7		1.6		4.7
	Avg. length.							783			887		900		826
	SE							37			62				32
Sexes combined	n							42			18		1	1	62
	% age comp.							67.7			29.0		1.6	1.6	100.0
	SE of %							6.0			5.8		1.6	1.6	0.0
	Avg. length.							749			813		900	740	770
	SE							7			14				8
Small, medium, and large Chinook salmon															
Females	n							36			15			1	52
	% age comp.							55.4			23.1			1.5	80.0
	SE of %							6.2			5.3			1.5	5.0
	Avg. length							743			798			740	759
	SE							5			9				6
Males	n				3			6			3		1		13
	% age comp.				4.6			9.2			4.6		1.5		20.0
	SE of %				2.6			3.6			2.6		1.5		5.0
	Avg. length.				503			783			887		900		751
	SE				28			37			62				46
Sexes combined	n				3			42			18		1		65
	% age comp.				4.6			64.6			27.7		1.5		100.0
	SE of %				2.6			6.0			5.6		1.5		0.0
	Avg. length.				503			749			813		900		757
	SE				28			7			14				10

Appendix A13.–Estimated age and sex composition and mean length by age of Chinook salmon at Little Tahltan River weir, 2007.

		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n				6			2							8
	% age comp.				75.0			25.0							100.0
	SE of %				16.4			16.4							0.0
	Avg. length.				550			587							559
	SE				21			11							17
Sexes combined	n				6			2							8
	% age comp.				75.0			25.0							100.0
	SE of %				16.4			16.4							0.0
	Avg. length.				550			587							559
	SE				21			11							17
Large Chinook salmon															
Females	n							17			13		2		32
	% age comp.							25.4			19.4		3.0		47.8
	SE of %							5.4			4.9		2.1		6.1
	Avg. length							785			855		876		819
	SE							6			12		32		9
Males	n							27			8				35
	% age comp.							40.3			11.9				52.2
	SE of %							6.0			4.0				6.1
	Avg. length.							786			889				809
	SE							10			11				11
Sexes combined	n							44			21		2		67
	% age comp.							65.7			31.3		3.0		100.0
	SE of %							5.8			5.7		2.1		0.0
	Avg. length.							786			868		876		814
	SE							7			9		32		7
Small, medium, and large Chinook salmon															
Females	n							17			13		2		32
	% age comp.							22.7			17.3		2.7		42.7
	SE of %							4.9			4.4		1.9		5.7
	Avg. length							785			855		876		819
	SE							6			12		32		9
Males	n				6			29			8				43
	% age comp.				8.0			38.7			10.7				57.3
	SE of %				3.2			5.7			3.6				5.7
	Avg. length.				550			772			889				763
	SE				21			13			11				18
Sexes combined	n				6			46			21		2		75
	% age comp.				8.0			61.3			28.0		2.7		100.0
	SE of %				3.2			5.7			5.2		1.9		0.0
	Avg. length.				550			777			868		876		787
	SE				21			9			9		32		11

Appendix A 14.–Estimated age and sex composition and mean length by age of Chinook salmon, pooled Little Tahltan River wier and Verrett River, 2007.

		Small and medium Chinook salmon													
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n				9			2							11
	% age comp.				81.8			18.2							100.0
	SE of %				12.2			12.2							0.0
	Avg. length.				534			587							544
	SE				18			11							16
Sexes combined	n				9			2							11
	% age comp.				81.8			18.2							100.0
	SE of %				12.2			12.2							0.0
	Avg. length.				534			587							544
	SE				18			11							16
		Large Chinook salmon													
Females	n							53			28		2	1	84
	% age comp.							41.1			21.7		1.6	0.8	65.1
	SE of %							4.3			3.6		1.1	0.8	4.2
	Avg. length							757			825		876	740	782
	SE							5			9		32		6
Males	n							33			11		1		45
	% age comp.							25.6			8.5		0.8		34.9
	SE of %							3.9			2.5		0.8		4.2
	Avg. length.							785			888		900		813
	SE							10			16				11
Sexes combined	n							86			39		3	1	129
	% age comp.							66.7			30.2		2.3	0.8	100.0
	SE of %							4.2			4.1		1.3	0.8	0.0
	Avg. length.							768			843		884	740	793
	SE							5			9		20		70
		Small, medium, and large Chinook salmon													
Females	n							53			28		2	1	84
	% age comp.							37.9			20.0		1.4	0.7	60.0
	SE of %							4.1			3.4		1.0	0.7	4.2
	Avg. length							757			825		876	740	782
	SE							5			9		32		6
Males	n				9			35			11		1		56
	% age comp.				6.4			25.0			7.9		0.7		40.0
	SE of %				2.1			3.7			2.3		0.7		4.2
	Avg. length.				534			774			888		900		760
	SE				18			13			16				17
Sexes combined	n				9			88			39		3	1	140
	% age comp.				6.4			62.9			27.9		2.1	0.7	100.0
	SE of %				2.1			4.1			3.8		1.2	0.7	0.0
	Avg. length.				534			764			843		884	740	773
	SE				18			6			9		20		66

Appendix A15.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Kakwan Point, 2008.

Small and medium Chinook salmon															
							Age class								
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n				12			2							14
	% age comp.				85.7			14.3							100.0
	SE of %				9.7			9.7							0.0
	Avg. length.				593			618							596
	SE				11			3							10
Sexes combined	n				12			2							14
	% age comp.				85.7			14.3							100.0
	SE of %				9.7			9.7							0.0
	Avg. length.				593			618							596
	SE				11			3							10
Large Chinook salmon															
Females	n							27			60				87
	% age comp.							16.7			37.0				53.7
	SE of %							2.9			3.8				3.9
	Avg. length							765			842				818
	SE							10			10				6
Males	n				1			27			47				75
	% age comp.				0.6			16.7			29.0				46.3
	SE of %				0.6			2.9			3.6				3.9
	Avg. length.				660			767			849				823
	SE							9			9				9
Sexes combined	n				1			54			107				162
	% age comp.				0.6			33.3			66.0				100.0
	SE of %				0.6			3.7			3.7				0.0
	Avg. length.				660			767			849				821
	SE							6			6				5
Small, medium, and large Chinook salmon															
Females	n							27			60				87
	% age comp.							15.3			34.1				49.4
	SE of %							2.7			3.6				3.8
	Avg. length							765			842				818
	SE							8			5				6
Males	n				13			29			47				89
	% age comp.				7.4			16.5			26.7				50.6
	SE of %				2.0			2.8			3.3				3.8
	Avg. length.				598			758			858				788
	SE				11			12			11				12
Sexes combined	n				13			56			107				176
	% age comp.				7.4			31.8			60.8				100.0
	SE of %				2.0			3.5			3.7				0.0
	Avg. length.				598			761			849				803
	SE				11			7			6				7

Appendix A16.–Estimated age and sex composition and mean length by age of Chinook salmon harvested in the Canadian commercial gillnet fishery in the lower Stikine River, 2008.

		Small and medium Chinook salmon													
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n				1			5							6
	% age comp.				1.1			5.7							6.8
	SE of %				1.1			2.5							2.7
	Avg. length				596			635							628
	SE							10							10
Males	n	1	2	1	55			22	1						82
	% age comp.	1.1	2.3	1.1	62.5			25.0	1.1						93.2
	SE of %	1.1	1.6	1.1	5.2			4.6	1.1						2.7
	Avg. length.	468	430	624	549			626	610						568
	SE		20		7			7							7
Sexes combined	n	1	2	1	56			27	1						88
	% age comp.	1.1	2.3	1.1	63.6			30.7	1.1						100.0
	SE of %	1.1	1.6	1.1	5.2			4.9	1.1						0.0
	Avg. length.	468	430	624	550			628	610						572
	SE		20		7			6							7
		Large Chinook salmon													
Females	n			2	1		2	127			215			1	348
	% age comp.			0.2	0.1		0.2	15.1			25.6			0.1	41.5
	SE of %			0.2	0.1		0.2	1.2			1.5			0.1	1.7
	Avg. length			715	722		822	747			813			849	788
	SE			3			12	4			3				3
Males	n				4			171			313	2	1		491
	% age comp.				0.5			20.4			37.3	0.2	0.1		58.5
	SE of %				0.2			1.4			1.7	0.2	0.1		1.7
	Avg. length.				681			747			855	697	855		816
	SE				8			4			3	25			3
Sexes combined	n			2	5		2	298			528	2	1	1	839
	% age comp.			0.2	0.6		0.2	35.5			62.9	0.2	0.1	0.1	100.0
	SE of %			0.2	0.3		0.2	1.7			1.7	0.2	0.1	0.1	0.0
	Avg. length.			715	689		822	747			838	697	855	849	804
	SE			3	10		12	3			3	25			2
		Small, medium, and large Chinook salmon													
Females	n			2	2		2	132			215			1	354
	% age comp.			0.2	0.2		0.2	14.2			23.2			0.1	38.2
	SE of %			0.2	0.2		0.2	1.1			1.4			0.1	1.6
	Avg. length			716	659		822	742			813			849	786
	SE			3	63		12	4			3				3
Males	n	1	2	1	59			193	1		313	2	1		573
	% age comp.	0.1	0.2	0.1	6.4			20.8	0.1		33.8	0.2	0.1		61.8
	SE of %	0.1	0.2	0.1	0.8			1.3	0.1		1.6	0.2	0.1		1.6
	Avg. length.	468	430	623	558			733	610		855	697	855		780
	SE		20		8			5			3	25			5
Sexes combined	n	1	2	3	61		2	325	1		528	2	1	1	927
	% age comp.	0.1	0.2	0.3	6.6		0.2	35.1	0.1		57.0	0.2	0.1	0.1	100.0
	SE of %	0.1	0.2	0.2	0.8		0.2	1.6	0.1		1.6	0.2	0.1	0.1	0.0
	Avg. length.	468	430	685	562		822	737	610		838	697	855	849	782
	SE		20	31	8		12	3			3	25			3

Appendix A17.–Estimated age and sex composition and mean length by age of moribund and recently expired Chinook salmon in Verrett River, 2008.

Small and medium Chinook salmon															
						Age class									
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n							1							1
	% age comp.							100.0							100.0
	SE of %														
	Avg. length.							640							640
	SE														
Sexes combined	n							1							1
	% age comp.							100.0							100.0
	SE of %														
	Avg. length.							640							640
	SE														
Large Chinook salmon															
Females	n							7			30		1		38
	% age comp.							12.7			54.5		1.8		69.1
	SE of %							4.5			6.8		1.8		6.3
	Avg. length							729			820		855		804
	SE							16			6				8
Males	n							6			11				17
	% age comp.							10.9			20.0				30.9
	SE of %							4.2			5.4				6.3
	Avg. length.							779			831				813
	SE							24			11				12
Sexes combined	n							13			41		1		55
	% age comp.							23.6			74.5		1.8		100.0
	SE of %							5.8			5.9		1.8		0.0
	Avg. length.							752			823		855		807
	SE							15			5				7
Small, medium, and large Chinook salmon															
Females	n							7			30		1		38
	% age comp.							12.5			53.6		1.8		67.9
	SE of %							4.5			6.7		1.8		6.3
	Avg. length							729			820		855		804
	SE							16			6				8
Males	n							7			11				18
	% age comp.							12.5			19.6				32.1
	SE of %							4.5			5.4				6.3
	Avg. length.							759			831				803
	SE							28			11				15
Sexes combined	n							14			41		1		56
	% age comp.							25.0			73.2		1.8		100.0
	SE of %							5.8			6.0		1.8		0.0
	Avg. length.							744			823		855		804
	SE							16			5				7

Appendix A18.–Estimated age and sex composition and mean length by age of Chinook salmon at Little Tahltan River weir, 2008.

		Age Class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon															
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n		3		10			5							18
	% age comp.		16.7		55.6			27.8							100.0
	SE of %		9.0		12.1			10.9							0.0
	Avg. length.		473		557			605							556
	SE		41		12			22							15
Sexes combined	n		3		10			5							18
	% age comp.		16.7		55.6			27.8							100.0
	SE of %		9.0		12.1			10.9							0.0
	Avg. length.		473		557			605							556
	SE		41		12			22							15
Large Chinook salmon															
Females	n				1			54			96				151
	% age comp.				0.4			21.3			37.9				59.7
	SE of %				0.4			2.6			3.1				3.1
	Avg. length				776			799			848				830
	SE							7			4				4
Males	n				1			36			64	1			102
	% age comp.				0.4			14.2			25.3	0.4			40.3
	SE of %				0.4			2.2			2.7	0.4			3.1
	Avg. length.				674			837			896	932			873
	SE							12			8				7
Sexes combined	n				2			90			160	1			253
	% age comp.				0.8			35.6			63.2	0.4			100.0
	SE of %				0.6			3.0			3.0	0.4			0.0
	Avg. length.				725			814			867	932			847
	SE				51			7			4				4
Small, medium, and large Chinook salmon															
Females	n				1			54			96				151
	% age comp.				0.4			19.9			35.4				55.7
	SE of %				0.4			2.4			2.9				3.0
	Avg. length				776			799			848				830
	SE							7			4				4
Males	n		3		11			41			64	1			120
	% age comp.		1.1		4.1			15.1			23.6	0.4			44.3
	SE of %		0.6		1.2			2.2			2.6	0.4			3.0
	Avg. length.		473		568			809			896	932			826
	SE		41		15			16			8				12
Sexes combined	n		3		12			95			160	1			271
	% age comp.		1.1		4.4			35.1			59.0	0.4			100.0
	SE of %		0.6		1.3			2.9			3.0	0.4			0.0
	Avg. length.		473		585			803			867	932			828
	SE		41		22			8			4				6

Appendix A19.–Estimated age and sex composition and mean length by age of Chinook salmon, pooled Little Tahltan River weir and Verrett River, 2008.

Small and medium Chinook salmon															
		Age class													
		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	0.5	1.4	2.3	1.5	2.4	Total
Females	n														0
	% age comp.														0.0
	SE of %														0.0
	Avg. length														0
	SE														0
Males	n		3		10			6							19
	% age comp.		15.8		52.6			31.6							100.0
	SE of %		8.6		11.8			11.0							0.0
	Avg. length.		473		557			611							561
	SE		41		12			19							15
Sexes combined	n		3		10			6							19
	% age comp.		15.8		52.6			31.6							100.0
	SE of %		8.6		11.8			11.0							0.0
	Avg. length.		473		557			611							561
	SE		41		12			19							15
Large Chinook salmon															
Females	n				1			61			126		1		189
	% age comp.				0.3			19.8			40.9		0.3		61.4
	SE of %				0.3			2.3			2.8		0.3		2.8
	Avg. length				776			791			841		855		825
	SE				0			7			4				4
Males	n				1			42			75	1			119
	% age comp.				0.3			13.6			24.4	0.3			38.6
	SE of %				0.3			2.0			2.4	0.3			2.8
	Avg. length.				674			829			886	932			865
	SE							11			7				7
Sexes combined	n				2			103			201	1	1		308
	% age comp.				0.6			33.4			65.3	0.3	0.3		100.0
	SE of %				0.5			2.7			2.7	0.3	0.3		0.0
	Avg. length.				725			806			858	932	855		840
	SE				51			6			4				4
Small, medium, and large Chinook salmon															
Females	n				1			61			126		1		189
	% age comp.				0.3			18.7			38.5		0.3		57.8
	SE of %				0.3			2.2			2.7		0.3		2.7
	Avg. length				776			791			841		855		825
	SE							7			4				4
Males	n		3		11			48			75	1			138
	% age comp.		0.9		3.4			14.7			22.9	0.3			42.2
	SE of %		0.5		1.0			2.0			2.3	0.3			2.7
	Avg. length.		473		568			801			886	932			823
	SE		41		15			15			7				11
Sexes combined	n		3		12			109			201	1	1		327
	% age comp.		0.9		3.7			33.3			61.5	0.3	0.3		100.0
	SE of %		0.5		1.0			2.6			2.7	0.3	0.3		0.0
	Avg. length.		473		585			795			858	932	855		824
	SE		41		22			7			4				5

Appendix A20.–Estimated age composition of the inriver run of small, medium, and large Chinook salmon in the Stikine River, 2006.

	Brood year and age class													
	2003	2003	2002	2002	2002	2001	2001	2001	2000	2000	2000	1999	1999	
	1.1	0.2	2.1	1.2	0.3	2.2	1.3	0.4	2.3	1.4	0.5	2.4	1.5	Total
Inriver run	121	0	176	3,721	25	0	6,678	0	0	33,054	0	59	293	44,128
SE (inriver run)	80	0	117	589	5	0	1,254	0	0	5,529	0	64	113	

Appendix A21.–Estimated age composition of the inriver run of small, medium, and large Chinook salmon in the Stikine River, 2007.

	Brood year and age class													
	2004	2004	2003	2003	2003	2002	2002	2002	2001	2001	2001	2000	2000	
	1.1	0.2	2.1	1.2	0.3	2.2	1.3	0.4	2.3	1.4	0.5	2.4	1.5	Total
Inriver run	52	0	0	2,573	144	26	17,440	46	164	7,422	15	189	553	28,624
SE (inriver run)	37	0	0	449	52	26	1,674	26	53	926	15	118	175	

Appendix A22.–Estimated age composition of the inriver run of small, medium, and large Chinook salmon in the Stikine River, 2008.

	Brood year and age class													
	2005	2005	2004	2004	2004	2003	2003	2003	2002	2002	2002	2001	2001	
	1.1	0.2	2.1	1.2	0.3	2.2	1.3	0.4	2.3	1.4	0.5	2.4	1.5	Total
Inriver run	170	12	0	1,339	31	12	9,577	19	78	16,968	0	9	69	28,286
SE (inriver run)	91	12	0	209	18	12	1,178	13	62	2,024	0	9	62	

Appendix A23.–Tagging and recovery data from the 2006 Stikine River Chinook salmon mark-recapture program. Data includes numbers of Chinook salmon tagged at Kakwan Point and recovered in the inriver Canadian commercial fishery by statistical week (downstream recoveries excluded).

Statistical week of tagging	Statistical week of recovery													Total tags recovered	Total tags applied	Tag ratio recovered applied
	19	20	21	22	23	24	25	26	27	28	29	30	31			
19	1	12	6	2	2	0	1	3	1	0	0	0	0	28	127	0.220
20	0	4	9	6	7	4	9	6	0	0	0	0	0	45	94	0.479
21	0	0	1	1	1	0	4	1	0	0	0	0	0	8	19	0.421
22	0	0	0	0	2	0	0	2	0	0	0	0	0	4	13	0.308
23	0	0	0	0	0	0	2	3	0	0	0	0	0	5	11	0.455
24	0	0	0	0	0	0	0	2	0	0	1	0	0	3	8	0.375
25	0	0	0	0	0	0	0	4	7	1	2	0	0	14	81	0.173
26	0	0	0	0	0	0	0	0	5	8	3	0	0	16	104	0.154
27	0	0	0	0	0	0	0	0	0	7	2	0	0	9	40	0.225
Total	1	16	16	9	12	4	16	21	13	16	8	0	0	132	497	0.266
Chinook examined	150	970	901	1,189	1659	1,087	4,694	2,482	1,166	574	203	17	6	Total	15,098	

Appendix A24.–Tagging and recovery data from the 2007 Stikine River Chinook salmon mark-recapture program. Data includes numbers of Chinook salmon tagged at Kakwan Point and recovered in the inriver Canadian commercial fishery by statistical week (downstream recoveries excluded).

Statistical week of tagging	Statistical week of recovery														Total tags recovered	Total tags applied	Tag ratio recovered/ applied
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
19	0	8	0	1	0	1	0	1	0	0	0	0	0	0	11	27	0.407
20	0	1	6	7	1	4	3	5	0	0	1	0	0	0	28	66	0.424
21	0	0	1	1	0	5	3	2	0	1	0	0	0	0	13	33	0.394
22	0	0	0	0	0	1	3	5	1	0	0	0	0	0	10	21	0.476
23	0	0	0	0	0	0	2	3	0	0	0	0	0	0	5	6	0.833
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.000
25	0	0	0	0	0	0	2	9	1	3	1	0	0	0	16	52	0.308
26	0	0	0	0	0	0	0	5	4	5	3	2	1	0	20	80	0.250
27	0	0	0	0	0	0	0	0	2	2	2	1	1	0	8	47	0.170
28	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	7	0.286
Total	0	9	7	9	1	11	13	30	8	11	7	3	2	0	113	342	0.330
Chinook examined	77	559	518	784	193	1,051	2,223	2,460	1,331	345	383	141	60	5	Total	10,130	

Appendix A25.–Tagging and recovery data from the 2008 Stikine River Chinook salmon mark-recapture program. Data includes numbers of Chinook salmon tagged at Kakwan Point and recovered in the inriver Canadian commercial fishery by statistical week (downstream recoveries excluded).

Statistical week of tagging	Statistical week of recovery														Total tags recovered	Total tags applied	Tag ratio recovered/ applied
	19	20	21	22	23	24	25	26	27	28	29	30	31	32			
19	0	6	6	2	3	2	1	0	0	0	0	0	0	0	20	60	0.333
20	0	0	6	1	8	5	2	0	0	0	0	0	0	0	22	56	0.393
21	0	0	0	0	3	2	0	0	0	0	0	0	0	0	5	13	0.385
22	0	0	0	0	1	2	1	0	0	0	0	0	0	0	4	7	0.571
23	0	0	0	0	0	3	7	2	0	0	1	0	0	0	13	77	0.169
24	0	0	0	0	0	0	17	3	2	1	0	1	0	0	24	94	0.255
25	0	0	0	0	0	0	1	3	1	0	0	0	0	0	5	50	0.100
26	0	0	0	0	0	0	0	0	5	1	0	1	0	0	7	42	0.167
27	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	22	0.091
Total	0	6	12	3	15	14	29	8	9	3	1	2	0	0	102	421	0.242
Chinook examined	99	393	530	470	1,423	1,752	1,059	647	356	177	90	41	9	5	Total	7,051	

APPENDIX B

Appendix B1.–Detection of size-selectivity in sampling and its effects on estimation of size composition.

Size selective sampling: The Kolmogorov-Smirnov two sample test (Conover 1980) is used to detect significant evidence that size selective sampling occurred during the first or second sampling events. The second sampling event is evaluated by comparing the length frequency distribution of all fish marked during the first event (M) with that of marked fish recaptured during the second event (R), using the null test hypothesis of no difference. The first sampling event is evaluated by comparing the length frequency distribution of all fish inspected for marks during the second event (C) with that of R. A third test, comparing M and C, is conducted and used to evaluate the results of the first two tests when sample sizes are small. Guidelines for small sample sizes are <30 for R and <100 for M or C.

Sex selective sampling. Contingency table analysis (Chi^2-test) is generally used to detect significant evidence that sex selective sampling occurred during the first of second sampling events. The counts of observed males to females are compared between M&R, C&R, and M&C as described above, using the null hypothesis that the probability that a sampled fish is male or female is independent of sample. When the proportions by gender are estimated for a sample (usually C), rather an observed for all fish in the sample, contingency table analysis is not appropriate and the proportions of females (or males) are compared between samples using a two sample test (e.g. Student's t-test).

M vs. R   C vs. R   M vs. C

Case I:

Fail to reject H_o Fail to reject H_o Fail to reject H_o

There is no size/sex selectivity detected during either sampling event.

Case II:

Reject H_o Fail to reject H_o Reject H_o

There is no size/sex selectivity detected during the first event but there is during the second event sampling.

Case III:

Fail to reject H_o Reject H_o Reject H_o

There is no size/sex selectivity detected during the second event but there is during the first event sampling.

Case IV:

Reject H_o Reject H_o Reject H_o

There is size/sex selectivity detected during both the first and second sampling events.

Evaluation Required:

Fail to reject H_o Fail to reject H_o Reject H_o

Sample sizes and powers of tests must be considered:

A. If sample sizes for M vs. R and C vs. R tests are not small and sample sizes for M vs. C test are very large, the M vs. C test is likely detecting small differences which have little potential to result in bias during estimation. *Case I* is appropriate.

B. If a) sample sizes for M vs. R are small, b) the M vs. R p-value is not large (~0.20 or less), and c) the C vs. R sample sizes are not small and/or the C vs. R p-value is fairly large (~0.30 or more), the rejection of the null in the M vs. C test was likely the result of size/sex selectivity during the second event which the M vs. R test was not powerful enough to detect. *Case I* may be considered but *Case II* is the recommended, conservative interpretation.

C. If a) sample sizes for C vs. R are small, b) the C vs. R p-value is not large (~0.20 or less), and c) the M vs. R sample sizes are not small and/or the M vs. R p-value is fairly large (~0.30 or more), the rejection of the null in the M vs. C test was likely the result of size/sex selectivity during the first event which the C vs. R test was not powerful enough to detect. *Case I* may be considered but *Case III* is the recommended, conservative interpretation.

D. If a) sample sizes for C vs. R and M vs. R are both small, and b) both the C vs. R and M vs. R p-values are not large (~0.20 or less), the rejection of the null in the M vs. C test may be the result of size/sex selectivity during both events which the C vs. R and M vs. R tests were not powerful enough to detect. *Cases I, II, or III* may be considered but *Case IV* is the recommended, conservative interpretation.

-continued-

Case I. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated after pooling length, sex, and age data from both sampling events.

Case II. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the first sampling event without stratification. If composition is estimated from second event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the M vs. R test) within strata. Composition parameters are estimated within strata, and abundance for each stratum needs to be estimated using a Petersen-type formula. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance according to the formulae below.

Case III. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the second sampling event without stratification. If composition is estimated from first event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the C vs. R test) within strata. Composition parameters are estimated within strata, and abundance for each stratum needs to be estimated using a Petersen-type type formula. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance according to the formulae below.

Case IV. Data must be stratified to eliminate variability in capture probability within strata for at least one or both sampling events. Abundance is calculated using a Petersen-type model for each stratum, and estimates are summed across strata to estimate overall abundance. Composition parameters may be estimated within the strata as determined above, but only using data from sampling events where stratification has eliminated variability in capture probabilities within strata. If data from both sampling events are to be used, further stratification may be necessary to meet the condition of capture homogeneity within strata for both events. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance.

Appendix B2.–Tests of consistency for the Petersen estimator (from Seber 1982, page 438).

Tests of Consistency for Petersen Estimator

Of the following conditions, at least one must be fulfilled to meet assumptions of a Petersen estimator:

1. Marked fish mix completely with unmarked fish between events;
2. Every fish has an equal probability of being captured and marked during event 1; or,
3. Every fish has an equal probability of being captured and examined during event 2.

To evaluate these three assumptions, the chi-square statistic will be used to examine the following contingency tables as recommended by Seber (1982). At least one null hypothesis needs to be accepted for assumptions of the Petersen model (Bailey 1951, 1952; Chapman 1951) to be valid. If all three tests are rejected, a geographically stratified estimator (Darroch 1961) should be used to estimate abundance.

I.-Test for complete mixing[a]

Section Where Marked	Section Where Recaptured				Not Recaptured
	A	**B**	**…**	**F**	(n_1-m_2)
A					
B					
…					
F					

II.-Test for equal probability of capture during the first event[b]

	Section Where Examined			
	A	**B**	**…**	**F**
Marked (m_2)				
Unmarked (n_2-m_2)				

III.-Test for equal probability of capture during the second event[c]

	Section Where Marked			
	A	**B**	**…**	**F**
Recaptured (m_2)				
Not Recaptured (n_1-m_2)				

---

[a] This tests the hypothesis that movement probabilities (θ) from section *i* (*i* = 1, 2, ...s) to section *j* (*j* = 1, 2, ...t) are the same among sections: H_0: $\theta_{ij} = \theta_j$.

[b] This tests the hypothesis of homogeneity on the columns of the 2-by-t contingency table with respect to the marked to unmarked ratio among sections: H_0: $\Sigma_i a_i\theta_{ij} = kU_j$, where *k* = total marks released/total unmarked in the population, U_j = total unmarked fish in stratum *j* at the time of sampling, and a_i = number of marked fish released in stratum *i*.

[c] This tests the hypothesis of homogeneity on the columns of this 2-by-s contingency table with respect to recapture probabilities among sections: H_0: $\Sigma_j\theta_{ij}p_j$ = d, where p_j is the probability of capturing a fish in section *j* during the second event, and d is a constant.

APPENDIX C

Appendix C1.–Computer files used to estimate the spawning abundance of Chinook salmon in the Stikine River in 2006.

File Name	Description
2006 Stikine MR data	Input file for 2006 large SPAS MR analysis
2006 Stikine MR results	Output file for 2006 large SPAS MR analysis
STIKBYAGE2006.xls	EXCEL spreadsheet with the small-medium spawning abundance estimate and the age composition of the spawning escapement and the inriver run.
PRE-INSEASON2006.xls	EXCEL spreadsheet with and preseason sibling forecast and inseason CPUE models.
SIZESELPOST06.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
STIKMR-CPUE06.xls	EXCEL spreadsheet with Kakwan Point catch-effort, hydrology, and temperature data including charts.
STIKMR-TAGASL06.xls	EXCEL spreadsheet with Kakwan Point and inriver fishery/spawning ground tag, recovery, and age-sex-size data.

Appendix C2.–Computer files used to estimate the spawning abundance of Chinook salmon in the Stikine River in 2007.

File Name	Description
2007 Stikine MR data	Input file for 2007 large MR SPAS analysis
2007 Stikine MR results	Output file for 2007 large MR SPAS analysis
PRE-INSEASON2007.xls	EXCEL spreadsheet with and preseason sibling forecast and inseason CPUE models.
STIKBYAGE2007.xls	EXCEL spreadsheet with the small-medium spawning abundance estimate and the age composition of the spawning escapement and the inriver run.
SIZESELPOST07.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
STIKMR-CPUE07.xls	EXCEL spreadsheet with Kakwan Point catch-effort, hydrology, and temperature data including charts.
STIKMR-TAGASL07.xls	EXCEL spreadsheet with Kakwan Point and inriver fishery/spawning ground tag, recovery, and age-sex-size data.

Appendix C3.–Computer files used to estimate the spawning abundance of Chinook salmon in the Stikine River in 2008.

File Name	Description
2008 Stikine MR data	Input file for the 2008 large MR SPAS analysis
2008 Stikine MR results	Output file for the 2008 large MR SPAS analysis
PRE-INSEASON2008.xls	EXCEL spreadsheet with and preseason sibling forecast and inseason CPUE models.
STIKBYAGE2007.xls	EXCEL spreadsheet with the small-medium spawning abundance estimate and the age composition of the spawning escapement and the inriver run.
SIZESELPOST08.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
STIKMR-CPUE08.xls	EXCEL spreadsheet with Kakwan Point catch-effort, hydrology, and temperature data including charts.
STIKMR-TAGASL08.xls	EXCEL spreadsheet with Kakwan Point and inriver fishery/spawning ground tag, recovery, and age-sex-size data.