Fishery Data Series No. 05-25

Abundance of the Chinook Salmon Escapement on the Stikine River, 2003

by

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May 2005

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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May 2005

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C.777-777K) under Project F-10-18 and F-10-19, Job No. S-1-3.

The Division of Sport Fish Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or group of closely related projects. Since 2004, the Division of Commercial Fisheries has also used the Fishery Data Series. Fishery Data Series reports are intended for fishery and other technical professionals. Fishery Data Series reports are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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This document should be cited as:

Der Hovanisian, J. A., P. Etherton, and K. A. Pahlke. 2005. Abundance of the Chinook salmon escapement on the Stikine River, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 05-25, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Abundance of large (≥660mm MEF) and small-medium (<660 mm MEF) Chinook salmon *Oncorhynchus tshawytscha* that returned to spawn in the Stikine River above the U.S./Canada border in 2003 was estimated using mark-recapture data. Age, sex, and length compositions for the immigration were also estimated. Drift and set gillnets fished near the mouth of the Stikine River were used to capture 1,552 immigrant Chinook salmon during May, June, July, and August of which 1,472 Chinook salmon were initially marked. During July and August, Chinook salmon were captured at spawning sites and inspected for tags. Marked fish were also recovered from Canadian commercial, test and aboriginal fisheries. Using Darroch and modified Petersen models, an estimated 49,881 (SE = 6,078) large and 10,648 (SE = 1,108) small-medium fish immigrated to the Stikine River above Kakwan Point and Rock Island. Canadian fisheries on the Stikine River harvested 3,057 large and 1,682 small-medium Chinook salmon, leaving a spawning escapement of 46,824 (SE = 6,078) large and 8,966 (SE = 1,108) small-medium fish. The count of large fish at the Little Tahltan River weir was 6,492, representing about 14% of the estimated spawning escapement of large fish. A helicopter survey and expansion factor were used to estimate an escapement of 1,190 large fish in Andrew Creek. The estimated spawning escapement of 55,790 (SE = 6,178) Chinook salmon was composed of 16.8% (SE = 2.1%) age-1.2 fish, 56.9% (SE = 2.2%) age-1.3 fish, and 23.9% (SE = 1.7%) age-1.4 fish. The estimated spawning escapement included 25,742 (SE = 3,466) females. The feasibility of using mark-recapture, CPUE, and sibling data to generate pre- and in-season abundance estimates for the inriver run of large Chinook salmon was also investigated.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Stikine River, Little Tahltan River, Verrett River, Andrew Creek, mark-recapture, spawning escapement, inriver run abundance, age and sex composition, pre-season, in-season, CPUE, 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 structured program in 1981 to rebuild Southeast Chinook salmon stocks over a 15-year period (roughly three life cycles; ADF&G *Unpublished*). In 1979, the Canadian Department of Fisheries and Oceans (DFO) initiated commercial fisheries on the transboundary Taku and Stikine rivers. The fisheries primarily target sockeye salmon *O. nerka* and have been structured to limit the harvest of Chinook salmon to incidental catches. In 1985, the Alaskan and Canadian programs were incorporated into a comprehensive coast wide 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 eleven key index systems, providing expansion factors for index counts to estimate total escapement.

Chinook salmon escapements in the Stikine River have rebounded to healthy levels since initiation of the rebuilding program (Pahlke and Etherton 2000).

The Stikine River is a transboundary river, originating in British Columbia (B.C.) and flowing to the sea near Wrangell, Alaska (Figure 1). Chinook salmon in this river comprise one of over 50 indicator stocks included in annual assessments by the Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC) to determine stock status, effects of management regimes, and other requirements of the PST. The river is one of the largest producers of Chinook salmon in Northern B.C. and Southeast Alaska.

The ADF&G has developed a database and has proposed incorporating inriver abundance of this stock into the Pacific Salmon Commission (PSC) Chinook Model, which, among other things, produces pre-season forecasts of abundance for setting annual quotas for fisheries under the

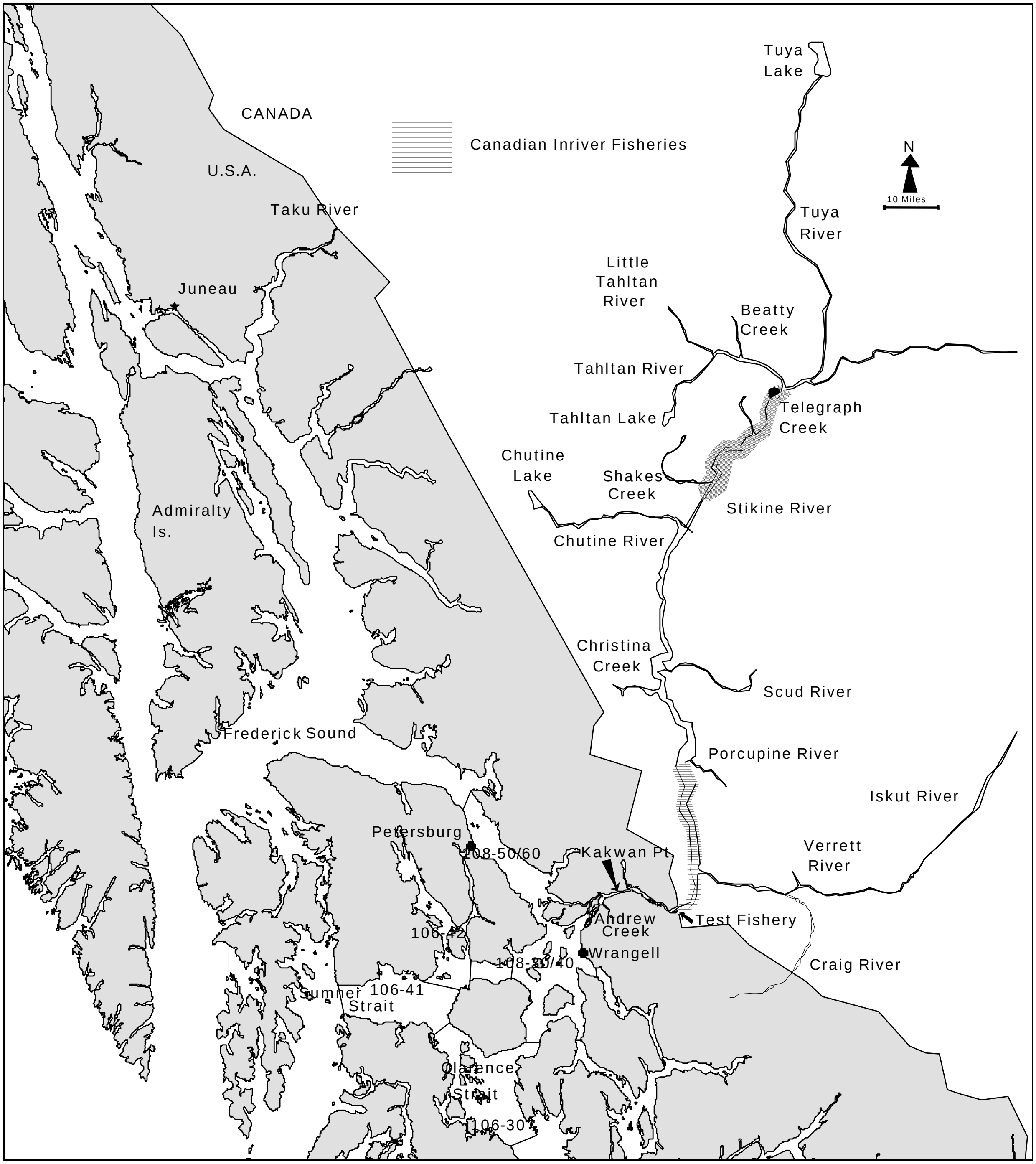


Figure 1.–Stikine River drainage, showing location of principal U.S. and Canadian fishing areas.

jurisdiction of the PST. Hence, data from annual assessments are not only essential for development of management tools for this stock, but other coast-wide stocks as well.

A major enhancement program for sockeye salmon in the Stikine River has been ongoing since 1989 [Pacific Salmon Commission (PSC) PSC 2000]. The run timing of sockeye salmon overlaps the latter component of the Chinook salmon migration, and mature Chinook salmon returning to the Stikine River are caught incidentally to sockeye salmon in U.S. marine gillnet fisheries in Districts 106 and 108 offshore of the river mouth, and in riverine Canadian commercial and test fisheries;

aboriginal food fisheries target Chinook and sockeye salmon (Table 1, Figure 1). 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. The exploitation of terminal runs is managed jointly by the U.S. and Canada through the PSC.

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 (Table 2). 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 two sources of information, and spawning escapement estimates from surveys conducted prior to 1985 were revised based on that relationship. Discontinuation of aerial surveys has been recommended (Bernard et al. 2000).

The number of spawners that produces maximum sustained yield (S_{MSY}) for this stock has been estimated at 17,368 based on analysis of 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), which corresponds to counts at the Little Tahltan River weir of 2,700 and 5,300, 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 TTC; the TTC accepted the range in March, 2000.

The Chinook salmon population in Andrew Creek, a lower river tributary in the U.S., has historically been treated as separate from those spawning upriver in Canada. Escapements into Andrew Creek have been assessed annually since 1975 by foot, airplane, or helicopter surveys. In addition, a weir was operated to collect hatchery brood stock from 1976 to 1984 and also provide escapement counts. Another weir was operated in 1997 and 1998 to count escapement, sample Chinook salmon for age, sex and length data, and to recover tags. North Arm and Clear creeks, two small streams in the U.S., have been periodically surveyed by foot, helicopter, and fixed-wing aircraft.

Only large (typically age-.3, -.4, and -.5 fish) Chinook salmon, approximately ≥660 mm mideye-to-fork length (MEF), are counted during aerial or foot surveys. No attempt is made to accurately count smaller (typically age-.1 and -.2 fish) Chinook salmon <660 mm MEF, which are primarily males. These smaller Chinook salmon are easy to separate visually from older fish under most conditions because of their short, compact bodies and lighter color; they are, however, difficult to distinguish from other smaller species, such as pink *O. gorbuscha* and sockeye salmon.

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 1997, Pahlke and Etherton 1999, 2000; Pahlke et al. 2000; Der Hovanisian et al. 2001, 2003, 2004). In 1997, a radio-telemetry study to estimate distribution of spawners was also conducted in concert with the mark-recapture experiment (Pahlke and Etherton 1999).

Captured Chinook salmon were placed in a plastic fish tote filled with water, quickly untangled or cut from the net, marked, measured for length (MEF, and post orbital hypural length POH), classified by sex and maturity, and sampled for scales. Fish were classified as "large" if their MEF measurement was ≥660mm, as "medium" if their MEF was 440-659mm or "small" if their MEF was <440mm (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

Table 1.–Harvests of Chinook salmon in Canadian fisheries in the Stikine River and U.S. fisheries near the mouth of the Stikine River, 1975-2003.

	United States[a, b]		**Canada**											
			Commercial harvest, lower Stikine		Commercial harvest, upper Stikine		Inriver sport harvest[d], Tahltan River		Aboriginal fishery, Telegraph Creek		Lower river test fishery		**Total inriver** commercial, sport, aboriginal, test	
Year	Dist. 108 gillnet	Petersburg/ Wrangell sport	Small-medium	Large	Small-medium[c]	Large	Small-medium	Large	Small-medium	Large	Small-medium	Large	Small-medium	Large
1975	1,529	-				178				1,024				1,202
1976	1,101	-				236				924			-	1,160
1977	1,378	2,282				62				100			-	162
1978	-	1,743				100				400			-	500
1979	-	1,759	63	712						850			63	1,562
1980	39	2,498		1,488		156				587			-	2,231
1981	235	2,022		664		154				586			-	1,404
1982	737	2,929		1,693		76				618			-	2,387
1983	-	2,634	430	492		75			215	851			645	1,418
1984	-	2,171		Fishery	Closed				59	643			59	643
1985	-	2,953	91	256		62			94	793	-	-	185	1,111
1986	25	2,475	365	806	41	104			569	1,026	12	27	987	1,963
1987	89	1,834	242	909	19	109			183	1,183	30	189	474	2,390
1988	137	2,440	201	1,007	46	175			197	1,178	29	269	473	2,629
1989	130	2,776	157	1,537	17	54			115	1,078	24	217	313	2,886
1990	244	4,283	680	1,569	20	48			259	633	18	231	977	2,481
1991	793	3,657	318	641	32	117			310	753	16	167	676	1,678
1992	462	3,322	89	873	19	56			131	911	182	614	421	2,454
1993	680	4,227	164	830	2	44			142	929	87	568	395	2,371
1994	1,236	2,140	158	1,016	1	76			191	698	78	295	428	2,085
1995	887	1,218	599	1,067	17	9			244	570	184	248	1,044	1,894
1996	778	2,464	221	1,708	44	41			156	722	76	298	497	2,769
1997	1,790	3,475	186	3,283	6	45			94	1,155	7	30	293	4,513
1998[e]	142	1,438	359	1,585	0	12			95	538	11	25	465	2,160
1999	631	3,668	789	2,127	12	24			463	765	97	853	1,361	3,769
2000	723	2,581	936	1,274	2	7			386	1,100	334	389	1,658	2,770
2001	-	2,263	59	826	0	0	12	190	44	665	59	1,442	174	3,123
2002	-	3,077	209	433	3	2	46	420	366	927	323	1,278	947	3,060
2003	48	3,252	459	908	12	19	46	167	373	682	792	1,281	1,682	3,057

[a] District 108 gillnet catch of Chinook salmon through SW29 excluding Alaska hatchery fish.

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

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

[d] Inriver harvest not estimated prior to 2001.

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

Table 2.–Index and survey counts of large spawning Chinook salmon in tributaries of the Stikine River, 1975–2003.

	Little Tahltan River			Mainstem		Beatty		Andrew		North Arm		Clear	
Year	Peak count		Weir count[a]	**Tahltan River**		**Creek**		**Creek**		**Creek**		**Creek[b]**	
1975	700	E(H)[c]	-	2,908	E(H)	-		260	(F)	-		-	
1976	400	N(H)	-	120	(H)	-		468	(W)	-		-	
1977	800	P(H)	-	25	(A)	-		534	(W)	-		-	
1978	632	E(H)	-	756	P(H)	-		400	(W)	24	E(F)	-	
1979	1,166	E(H)	-	2,118	N(H)	-		382	(W)	16	E(F)	-	
1980	2,137	N(H)	-	960	P(H)	122	E(H)	363	(W)	68	N(F)	-	
1981	3,334	E(H)	-	1,852	P(H)	558	E(H)	654	(W)	84	E(F)	4	P(F)
1982	2,830	N(H)	-	1,690	N(F)	567	E(H)	947	(W)	138	N(F)	188	N(F))
1983	594	E(H)	-	453	N(H)	83	E(H)	444	(W)	15	N(F)	-	
1984	1,294	(H)	-	-		126	(H)	389	(W)	31	N(F)	-	
1985	1,598	E(H)	3,114	1,490	N(H)	147	N(H)	319	E(F)	44	E(F)	-	
1986	1,201	E(H)	2,891	1,400	P(H)	183	N(H)	707	N(F)	73	N(F)	45	E(A)
1987	2,706	E(H)	4,783	1,390	P(H)	312	E(H)	788	E(H)	71	E(F)	122	N(F))
1988	3,796	E(H)	7,292	4,384	N(H)	593	E(H)	564	E(F)	125	N(F)	167	N(F)
1989	2,527	E(H)	4,715	-		362	E(H)	530	E(F)	150	N(A)	49	N(H)
1990	1,755	E(H)	4,392	2,134	N(H)	271	E(H)	664	E(F)	83	N(F)	33	P(H)
1991	1,768	E(H)	4,506	2,445	N(H)	193	N(H)	400	N(A)	38	N(A)	46	N(A)
1992	3,607	E(H)	6,627	1,891	N(H)	362	N(H)	778	E(H)	40	E(F)	31	N(A)
1993	4,010	P(H)	11,437	2,249	P(H)	757	E(H)	1,060	E(F)	53	E(F)		
1994	2,422	N(H)	6,373	-		184	N(H)	572	E(H)	58	E(F)	10	N(A)
1995	1,117	N(H)	3,072	696	E(H)	152	N(H)	343	N(H)	28	P(A)	1	E(A)
1996	1,920	N(H)	4,821	772	N(H)	218	N(H)	335	N(H)	35	N(F)	21	N(A)
1997	1,907	N(H)	5,547	260	P(H)	218	E(H)	293	N(F)	-		-	
1998	1,385	N(H)	4,873	587	P(H)	125	E(H)	487	E(F)	35	N(A)	28	N(A)
1999	1,379	N(H)	4,738	-		-		605	E(A)	22	N(A)	1	N(A)
2000	2,720	N(H)	6,631	-		-		690	N(A)	35	N(A)	-	
2001	4,158	N(H)	9,730	-		-		1,054	N(F)	54	N(F)	-	
2002	1,131[d]	N(H)	7,476	-		-		876	N(F)	34	N(F)	8	N(A)
2003	1,903	N(H)	6,492					595	N(H)	39[e]	N(F)	19	N(A)
1994 – 2003 avg.	2,004		5,975	578		179		585		38		13	

[a] Above weir harvest and broodstock collections are removed from weir counts; there was no broodstock collection in 2003.

[b] "Clear Creek" is a local name. The ADFG survey name is "West of Hot Springs", stream number 108-40-13A.

[c] Abbreviations: H = helicopter survey, F = foot survey, W = weir count, A = airplane survey; E = excellent visibility, N = normal visibility, P = poor visibility.

[d] The Little Tahltan River survey was conducted on 14 August and was considered post-peak.

[e] Partial survey.

and the onset of sexual dimporhism, and 4 is a fish with the characteristics listed in category 3 that released gametes upon capture.

The objectives of the 2003 study were to:

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

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

An additional task included estimation of 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. Mark-recapture data were also used to estimate the spawning abundance of small-medium (<660 mm MEF) Chinook salmon.

Results from the study also 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 in-season inriver run abundance estimates.

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, 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 Chinook salmon spawning areas in the watershed are located in B.C., Canada in the Tahltan, Little Tahltan, and Iskut rivers (Pahlke and Etherton 1999). Andrew Creek, in the U.S. portion of the Stikine River, supports a small run of Chinook salmon averaging about 5% of the above-border escapement. The upper drainage of the Stikine is accessible via the Telegraph Creek Road and the Stewart Cassiar Highway.

METHODS

KAKWAN POINT AND ROCK ISLAND TAGGING

Drift gillnets 120 feet (36.5m) long, 18 feet (5.5m) deep, of 7¼ inch (18.5cm) stretch mesh, were fished near Kakwan Point (Figure 2) between May 10 and July 7. 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.

Catches near Kakwan Point were augmented by Chinook salmon captured and tagged during a sockeye salmon tagging project operated by DFO, ADF&G Commercial Fisheries Division (CFD), and TFN at Rock Island (Figure 2). Chinook salmon were caught in a 5 to 5½ inch (12.7 to 13.8 cm) stretch mesh set gillnet 120 feet (36.5m) long and 18 feet (5.5 m) deep between May 8 and August 15, but fish tagged after July 31 were omitted from the experiment to preclude inclusion of post-spawn fish. The net was watched continuously, and fish were removed from the net immediately upon capture. If more fish were caught than could be effectively sampled, or if high water rendered the net difficult to fish, the net was shortened. Sampling effort was held reasonably constant at about 7 hours per day.

The presence or absence of sea lice (*Lepeophtheirus* sp.) was also noted. General health and appearance of the fish was recorded, including injuries caused by handling or predators. Each uninjured fish was marked with a uniquely numbered, blue spaghetti tag consisting of a 2″(~5cm) section of Floy[1] tubing shrunk and laminated onto a 15″(~38cm) piece of 80-lb (~36.3kg) monofilament fishing line using a modified design developed by Johnson et al. 1993. The monofilament was sewn through the musculature of the fish approximately ½ inch (20 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 ¼ inch (7 mm) diameter hole in the upper (dorsal) portion of its left operculum applied with a paper punch, and by amputation of its left auxiliary appendage (McPherson et al. 1996). Fish that were seriously injured were sampled but not marked.

UPSTREAM SAMPLING

Pre- and post-spawning fish and carcasses were collected with spears, dipnets, and snagging gear at Andrew Creek, Verrett River, and the Little Tahltan River weir (Figures 1 and 2). As fish accumulated below the weir, a portion were captured with dipnets. Previously unsampled post-spawning fish and carcasses that washed against the weir were also sampled. All fish were inspected for tags and marks, and sampled for length, sex, and scales. Each sampled fish was marked with a hole punched in its lower left opercle to prevent resampling and released if

[1] Product names are included in this report for scientific completeness, but do not constitute a product endorsement.

alive. Carcasses were also slashed along the left side.

Tags were recovered from the Canadian commercial and test gillnet, aboriginal, and recreational fisheries, and from the U.S. marine commercial and recreational fisheries. Catches were sampled in some of these fisheries to obtain age, sex, and length composition data.

ABUNDANCE

The abundance of Chinook salmon that passed by Kakwan Point and Rock Island was estimated with Chapman's modification of Petersen's estimator for a two-event mark-recapture experiment on a closed population (Seber 1982, p. 59-61) if assumptions of the model were met (i.e., stratification by time of marking and/or recapture area were not required). A Darroch model was used otherwise (Seber 1982). Fish captured by gillnet and marked in the lower river near Kakwan Point and at Rock Island were included in event 1, and sampling on the spawning grounds and inriver fisheries constituted the second event.

Handling and tagging have caused a downstream movement and/or a delay in continuing upstream migration of marked Chinook salmon (Bernard et al. 1999). This "sulking" behavior may increase the probability of capture by commercial and recreational fisheries near the mouth of the Stikine River (Pahlke and Etherton 1999). Further, fish marked at Kakwan Point and Rock Island may spawn in Andrew Creek. Censoring marked Chinook salmon killed in downstream fisheries or spawning in Andrew Creek reduces bias in the inriver run abundance estimate. All marked fish caught in the U.S. recreational harvest were assumed reported and were censored from the experiment on a per tag basis. The number of marked fish recovered in Andrew Creek, expanded by the sampling fraction, was also censored 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 at Rock Island, and $\hat{H}$ is the estimated number of fish that moved downstream to be caught in U.S. fisheries or spawn in Andrew Creek.

Petersen model variance, bias, and confidence intervals were estimated with bootstrap procedures described in Buckland and Garthwaite (1991). McPherson et al. (1996) provide modifications that account for $\hat{M}$. A bootstrap sample was built by drawing with replacement a sample of size $\hat{N}^{+}$ from the empirical distribution defined by the capture histories. A new set of statistics from each bootstrap sample $\{\hat{M}^{*}, C^{*}, R^{*}, \hat{H}^{*}, T^{*}\}$ was generated, along with the new estimate $\hat{N}^{*}$, and 1,000 such bootstrap samples were drawn creating the empirical distribution $\hat{F}(\hat{N}^{*})$, which is an estimate of $\mathrm{F}(\hat{N})$. The difference between the average $\overline{\hat{N}}^{*}$ of the bootstrap estimates and $\hat{N}$ is an estimate of statistical bias in the later statistic (Efron and Tibshirani 1993, Section 10.2). Confidence intervals were estimated from $\hat{F}(\hat{N}^{*})$ with the percentile method (Efron and Tibshirani 1993, Section 13.3). Variance was estimated as:

$$v(\hat{N}^{*}) = (B-1)^{-1} \sum_{b=1}^{B} \left(\hat{N}_b^{*} - \overline{\hat{N}}^{*}\right)^2 \qquad (1)$$

where B is the number of bootstrap samples.

If a Darroch model was needed, 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/or spatial strata were pooled to find admissible (non-negative) estimates, reduce the number of parameters, increase precision, and assess goodness-of-fit. However, standard errors calculated by SPAS are biased low when *M* is estimated because the error in *M* cannot be incorporated into the program.

The spawning escapements of large $\hat{N}_{L,esc}$ and small-medium $\hat{N}_{SM,esc}$ Chinook salmon were

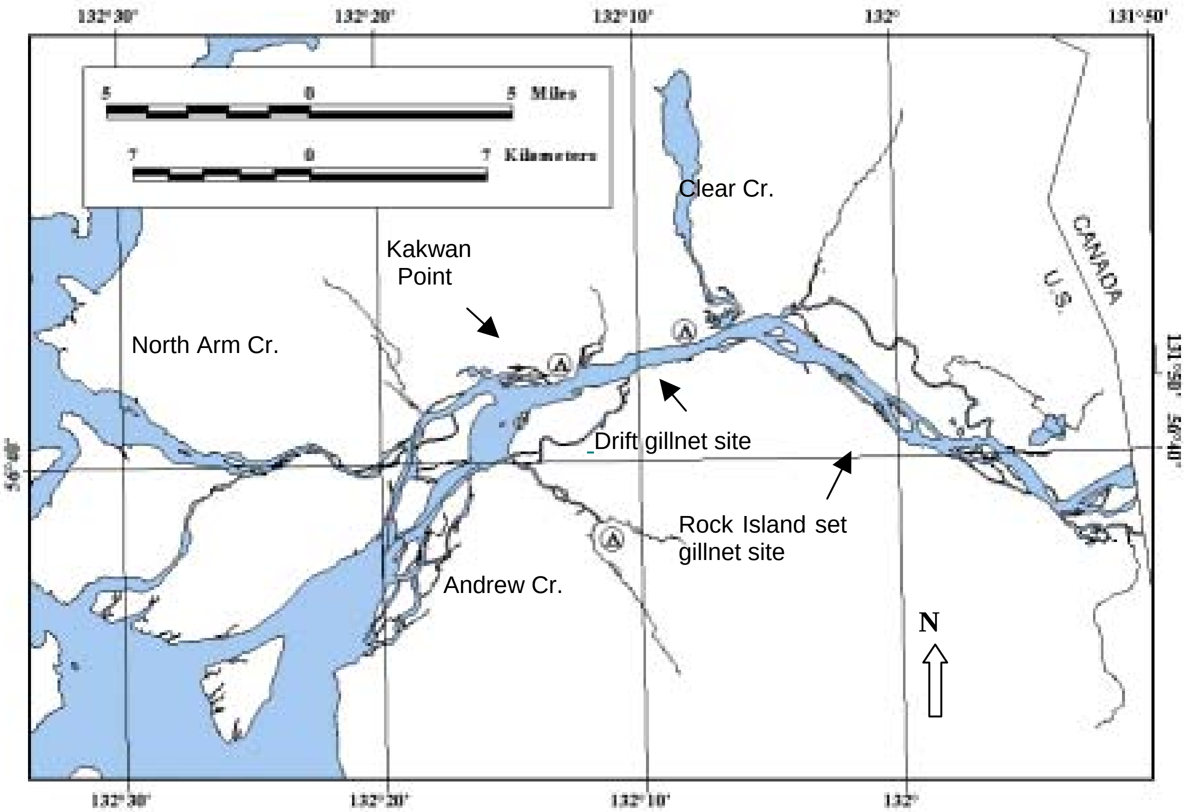


Figure 2.–Locations of drift and set gillnet sites on the lower Stikine River, 2003**.**

estimated by subtracting the respective inriver harvest of large and small-medium fish from $\hat{N}_L$ and $\hat{N}_{SM}$. Variance was estimated as described above or by SPAS. The estimated spawning escapement of large and small-medium fish $\hat{N}_{esc}$ was the sum of $\hat{N}_{L,esc}$ and $\hat{N}_{SM,esc}$, and its variance $v(\hat{N}_{esc})$ was the sum of $v(\hat{N}_{L,esc})$ and $v(\hat{N}_{SM,esc})$. Its confidence interval was estimated as described above or by normal approximation.

The validity of the mark-recapture experiment rests on several assumptions, including: (a) every fish has an equal probability of being marked in event 1, *or* that every fish has an equal probability of being captured in event 2, *or* that marked fish mix completely with unmarked fish between events; *and* (b) both recruitment and "death" (emigration) do not occur between events; *and* (c) marking does not affect catchability (or mortality) of the fish; *and* (d) fish do not lose their marks between events; *and* (e) all recaptured fish are reported; *and* (f) double sampling does not occur (Seber 1982). Assumption (a) implies that fish are marked in proportion to abundance during immigration, or if it does not, that there is no difference in migratory timing among stocks bound for different spawning locations because temporal mixing cannot occur in the experiment. Assumption (a) also implies that sampling is not size-selective. If capture on the spawning grounds was not size-selective, fish of different sizes would be captured with equal probability. If assumption (a) was met, samples of fish taken in upper watershed (Little Tahltan River, aboriginal fishery), in the Iskut River (Verrett River) and in the inriver test and commercial fisheries in the lower watershed would have similar proportions of marked fish. Contingency table analysis was used to test the null hypothesis that such estimated proportions were the same. Samples were stratified by size to detect and eliminate potential effects of size-selective sampling. 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 from natural causes for marked and unmarked fish were assumed to be the same (assumption c). Past telemetry studies in the Stikine River have shown that Chinook salmon captured in this study, but fitted with esophageal radio transmitters, survived to spawn (Pahlke and Etherton 1999). 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).

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 later from the pattern of circuli on images of scales magnified 70×. Samples from Kakwan Point, Rock Island, Andrew Creek, and Verrett River 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 and used to estimate spawning population proportions. For these tests, age-2. Chinook salmon were pooled with age-1. fish of the same brood year, and only age classes common to each sample were compared.

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

$$\hat{p}_{ij} = \frac{m_{ij}}{m_i} \qquad (2)$$

$$v[\hat{p}_{ij}] = \frac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{m_i - 1} \qquad (3)$$

where $\hat{p}_{ij}$ is the estimated proportion of the population of age *j* in size category *i*, and m_{ij} is the number of Chinook salmon of age *j* in size category *i* in the sample *m* taken in the Little Tahltan and/or Verrett rivers.

Numbers of spawning fish by age were estimated as the summation of products of estimated age composition and estimated spawning escapement within size category *i*:

$$\hat{N}_j = \sum_i \left(\hat{p}_{ij} \hat{N}_{i,esc} \right) \qquad (4)$$

with a sample variance calculated according to procedures in Goodman (1960):

$$v(\hat{N}_j) = \sum_i \begin{pmatrix} v(\hat{p}_{ij})\hat{N}_{i,esc}^2 + v(\hat{N}_{i,esc})\hat{p}_{ij}^2 \\ - v(\hat{p}_{ij})v(\hat{N}_{i,esc}) \end{pmatrix} \qquad (5)$$

The proportion of the spawning population composed of a given age was estimated by:

$$\hat{p}_j = \frac{\hat{N}_j}{\hat{N}_{esc}} \qquad (6)$$

Variance of $\hat{p}_j$ was approximated according to the procedures in Seber (1982, p. 8-9):

$$v(\hat{p}_j) = \frac{\sum_i \left(v(\hat{p}_{ij})\hat{N}_i + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2 \right)}{\hat{N}_{esc}^2} \qquad (7)$$

Sex and age-sex composition for the spawning population and associated variances were also estimated with the equations above by first redefining the binomial variables in the samples to produce estimated proportions by sex $\hat{p}_k$, where *k* denotes sex, such that $\sum_k \hat{p}_k = 1$, and by age-sex, such that $\sum_j \sum_k \hat{p}_{jk} = 1$. Sex composition was estimated from samples collected on the spawning grounds since spawning and post-spawning fish provide more reliable sex composition estimates.

Age, sex, and age-sex composition and associated variances for the Kakwan Point, Rock Island, Little Tahltan and Verrett rivers, and the inriver fisheries samples were estimated with equations 2 and 3 by substituting n_{ij} for m_{ij} and n_i for m_i, where n_{ij} is the number of Chinook salmon of age j in size category i in the sample n.

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

RESULTS

KAKWAN POINT AND ROCK ISLAND TAGGING

Between May 8 and July 31 at Kakwan Point and Rock Island, one thousand, ninety-five (1,095) large, 344 medium, and 33 small Chinook salmon were initially captured, marked, and released (Table 3). Fish caught and tagged after July 31 were omitted to preclude inclusion of post-spawn fish.

Drift gillnet effort near Kakwan Point was maintained at 4 hours per net per day (two nets fishing), although reduced sampling effort occurred on several days (Figure 3). From May 10 through July 7, 956 large and 184 small-medium Chinook salmon were captured; one fish with a missing adipose fin was recovered (Appendices A1 and A12). Catch rates ranged from 0 to 6.97 large fish/hour, and the highest catch occurred on June 20 when 57 large fish were captured (Figure 4). The date of 50% cumulative catch of large fish was June 13. Catch rates for small- medium fish ranged from 0 to 1.83 fish/hour, and the date of 50% cumulative catch of small-medium fish was June 19. Catches were low in mid-June because of high water conditions (Figures 3 and 4, Appendix A1). Harbor seals killed or injured several fish before they could be removed from the nets, especially early in the season. In addition, 62 sockeye salmon were captured and released (Appendix A1).

Set gillnet effort at Rock Island was maintained at about 7.0 hours per day with one net fishing, although reductions in sampling effort occurred on several days because of high catch or water conditions (Figure 5). From May 8 through August 15, 153 large and 259 small-medium Chinook salmon were captured (Appendix A2), but as previously noted, fish captured after July 31 were omitted from the experiment to preclude inclusion of post-spawn fish. Catch rates ranged from 0 to 1.54 large fish/hour, and the highest catches occurred on June 18 and 19 when 10 large fish were captured each day (Figure 6). Catch rates for small-medium fish ranged from 0 to 4.43 fish/hour, and the highest catches occurred on June 18 when 32 small-medium fish were captured (Figure 6). In addition, 2,629 sockeye salmon were captured (Appendix A2).

UPSTREAM SAMPLING

The lower river test and commercial gillnet fisheries began May 8 and June 22, respectively, and harvested 2,189 large and 1,251 small-medium Chinook salmon. Forty-five (45) large and 50 small-medium Chinook salmon with tags were recovered. The aboriginal fishery near Telegraph Creek harvested 682 large and 373 small-medium Chinook salmon and 24 tags were recovered. The upper river commercial fishery harvested 19 large and 12 small-medium fish, and no tags were recovered. Six marked fish were reported from the Canadian recreational fishery on the Tahltan River, which was sampled in 2003; an estimated 167 large and 46 small-medium Chinook were harvested. One large marked fish was reported from the recreational fishery near Petersburg and Wrangell, and all marked fish in the recreational harvest were presumably reported. No marked fish were recovered in U.S. marine commercial fisheries (Tables 1 and 3).

Technicians examined 1,306 Chinook salmon for marks at the Little Tahltan River weir, of which 946 were large fish. Thirteen (13) large marked fish were recovered, one of which had lost its numbered tag. Five small-medium marked fish were also recovered, and none of these had lost its tag. An additional 80 (25 small, 42 medium, and 13 large) previously unsampled carcasses were examined above the weir; one large fish was marked and it had retained its tag (Table 3).

At Verrett River, 967 live and dead Chinook salmon were examined (14 small, 74 medium, and

879 large); 40 marked fish were recovered, three of which had lost their tags (Table 3).

At Andrew Creek 300 (3 small, 40 medium and 257 large) fish were examined. One large marked fish was recovered.

ABUNDANCE OF LARGE CHINOOK SALMON

A Darroch model was used to estimate the inriver run abundance of large Chinook salmon that passed by Kakwan Point and Rock Island. Based on fish inspected at the Little Tahltan River weir and samples from Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery, the estimate is 49,881 large fish (SE = 6,078; 95% CI: 37,968 to 61,795; $\hat{M}_L$ = 1,089, C_L = 4,696, R_L = 118).

For this estimate, all large marked fish intercepted by U.S. fisheries (one fish in the recreational fishery, assuming all marked fish in the harvest were reported) were censored from the experiment (Table 3). Additionally, the number of large Chinook salmon recovered in Andrew Creek (one fish, tagged at Rock Island) was expanded by the fraction sampled, for an estimated total of five marked fish. Five large fish, including the one that was recovered, were tagged at Rock Island between July 10 and 31. These fish were culled from the experiment by truncating the Rock Island tag release sample at July 9, which seemed reasonable because most of the fish recaptured in Andrew Creek since 1996 have been tagged after mid-July (Figure 7).

Tests were administered to determine the validity of the "or" assumptions of the modified Peterson model (p. 9). Estimated marked fractions (Table 3) for large fish at the Little Tahltan weir (0.0275), Verrett River (0.0444), the lower river commercial and test gillnet fisheries (0.0206), and the aboriginal fishery (0.0117) were significantly different (χ^2 = 19.2, df = 3, P < 0.001), so several temporal-spatial stratifications were investigated using SPAS. The stratification that satisfied the fitting tests in Arnason et al. (1996) and yielded the lowest percent % CV for the abundance estimate was used (Appendix A3).

The "or" assumptions also imply that sampling is not size-selective. Evidence from upstream sampling supported the supposition that every large Chinook salmon passing by Kakwan Point and Rock Island had a near equal chance of being marked regardless of their size. Pooled length samples of large fish from the Little Tahltan River weir, Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery were arbitrarily split into two groups at the median length of large fish (789 mm MEF) to permit comparison of marked fractions:

	660 – 789 mm	>789 mm
Marked	61	57
Unmarked	2,387	2,191
Marked fraction	0.26	0.26

The marked fractions were not significantly different (χ^2 = 0.009, df = 1, P = 0.92).

Further evidence from upstream sampling also supported the supposition that every large Chinook salmon had a near equal chance of being captured upstream regardless of their size. Pooled length samples of large fish from the Little Tahltan weir, Verrett River, the lower river commercial and test gillnet fisheries, and the upriver gillnet fisheries were again split into two size groups as were samples of large fish marked at Kakwan Point and Rock Island. The fractions (rates) of recaptured fish were compared as surrogates for probabilities of capture upstream:

	660 – 789 mm	>789 mm
Released	470	619
Recaptured	61	57
Fraction recaptured	0.130	0.092

The fractions recaptured were not significantly different (χ^2 = 3.15, df = 1, P = 0.08).

Although there is little evidence that size selective sampling occurred, additional analyzes were contradictory and suggested that sampling was size selective during the second event (Case IV, Appendix A4). The size distributions of fish captured at Kakwan Point and Rock Island versus combined samples of fish captured at the weir on the Little Tahltan River, Verrett River, in the

Table 3.–Numbers of Chinook salmon marked on lower Stikine River, removed by fisheries and inspected for marks in tributaries in 2003, by size category.

		Length (MEF) in mm			
		0-439 (small)	440-659 (medium)	>660 (large)	Total
A. Released at Kakwan Point		0	184	955	1,139
B. Released at Rock Island		33	160	140	333
C. Removed by:					
1. U.S. recreational fisheries		0	0	1[a]	1
2. U.S marine commercial fisheries		0	0	0	0
3. Andrew Creek		0	0	5[b]	5
Subtotal of removals		0	3	6	6
D. Estimated number of marked fish remaining in mark-recapture experiment		**33[c]**	**341[d]**	**1,089**	1,463
E. Canadian recreational fisheries	Harvested[e]	2	44	167	213
Tahltan River	Released	1	33	125	159
	Marked	0	2	4	6
	Marked/(harvested and released)	0.0000	0.0260	0.0137	0.0161
F. Inspected at:					
1. Little Tahltan weir	Inspected	**35**	**325**	**946**	1,306
	Marked	**0**	**5**	**26**	31
	Marked/inspected	0.0000	0.0154	0.0275	0.0237
2. Little Tahltan River	Inspected	25	42	13	80
post-spawn fish and carcasses	Marked	0	0	1	1
	Marked/inspected	0.0000	0.0000	0.0769	0.0125
3. Verrett River	Inspected	**14**	**74**	**879**	967
	Marked	**0**	**1**	**39**	40
	Marked/inspected	0.0000	0.0135	0.0444	0.0414
Subtotal: Little Tahltan weir/Verrett	Inspected	49	399	1,825	2,273
	Marked	0	6	65	71
	Marked/inspected	0.0000	0.0150	0.0356	0.0312
G. Lower river commercial/test[f] gillnet	Harvested[g,h]	**173**	**1,078**	**2,189**	3,440
	Marked	**6**	**44**	**45**	95
	Marked/harvested	0.0347	0.0482	0.0206	0.0276
I. Upper river gillnet	Harvested[i]	**30**	**343**	**682**	1,055
Aboriginal	Marked	**0**	**16**	**8**	24
	Marked/harvested	0.0000	0.0466	0.0117	0.0227
Subtotal: lower river/upper river gillnet	Harvested	203	1,421	2,871	4,495
	Marked	6	60	53	119
	Marked/harvested	0.0296	0.0422	0.0256	0.0265
Total: Little Tahltan weir, lower river/upper river gillnet	Inspected, harvested	**252**	**1,820**	**4,696**	6,768
	Marked	**6**	**66**	**118**	190
	Marked/insp. and harv.	0.0238	0.0363	0.0251	0.0281
Andrew Creek	Inspected	3	40	257	300
	Marked	0	0	1	1
	Marked/inspected	0.0000	0.0000	0.0039	0.0033

Note: Numbers in bold were used in mark-recapture estimates.

-continued-

Table 3. Page 2 of 2.

[a] Voluntary return.

[b] The number of large marked Chinook salmon recovered in Andrew Creek (1) was expanded by the fraction sampled (1 large recovery/(1,190 large escapement/257 large sampled) = 5). The large fish that was recovered and four others were tagged at Rock Island between July 10 and 31. These fish were culled from the experiment by truncating the Rock Island tag release sample at July 9. Fish tagged in August were ignored to preclude inclusion of post-spawn fish.

[c] Numbers in bold were used in mark-recapture estimates.

[d] Three medium fish were released at Rock Island after July 9. These fish were removed from the experiment.

[e] The Canadian recreational harvest of 213 fish was apportioned into size categories based on the Tahltan River creel length sample data: (1/88)213 = 2 small, (18/88)213 = 44 medium, (69/88)213 = 167 large. Another 159 fish were released and these were similarly apportioned into size categories.

[f] Chinook and sockeye salmon test fisheries.

[g] The lower river test fishery harvest of 2,073 fish was apportioned into size categories using length sample data collected during the test fishery: (89/1,665)2,073 = 111 small, (547/1,665)2,073 = 681 medium, (1,029/1,665)2,073 = 1,281 large.

[h] The lower river commercial fishery harvest of 1,367 fish was apportioned into size categories using length sample data collected during the commercial fishery: (20/441)1,367 = 62 small, (128/441)1,367 = 397 medium, (293/441)1,367 = 908 large.

[i] The aboriginal harvest of 373 small-medium fish was apportioned into small and medium size categories using length sample data collected during the aboriginal fishery: (5/62)373 = 30 small, (57/62)373 = 343 medium.

lower river commercial and test gillnet fisheries, and in the aboriginal fishery were significantly different (Kolmogorov-Smirnov: d_{max} = 0.075; n = 1,107, 3,185; P < 0.001; Figure 8). The size distributions of fish marked and recaptured were marginally different (Kolmogorov-Smirnov: d_{max} = 0.117; n = 1,088, 118; P = 0.10; Figure 9). Still, sample sizes were large and the Kolmogorov-Smirnov tests were probably sensitive to small differences.

Given the inconclusiveness of the size-selectivity tests, inriver run abundance estimates were subsequently generated using SPAS for two length groups (660 - 789 and >789 mm MEF) to assess bias in the Darroch estimate. The estimated abundance of fish 660-789 mm was 24,276 (SE = 5,287); for fish >789 mm, abundance was estimated at 26,382 (SE = 4,165). Combining these estimates yielded an overall estimate of 50,568 large fish. Because this estimate was similar to that for the combined lengths groups (bias = 1.56%), the later estimate of 49,881 was accepted.

The peak count on Andrew Creek was 595 large fish (helicopter survey, August 12). The total escapement of large Chinook salmon to Andrew Creek was estimated by expanding the survey count by a factor of 2.0 (Pahlke 1999), for an estimate of 1,190 large fish.

ABUNDANCE OF SMALL-MEDIUM CHINOOK SALMON

A modified Petersen model was used to estimate the inriver run abundance of small-medium fish that passed by Kakwan Point and Rock Island. Based on fish inspected at the Little Tahltan River weir and samples from Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery, the estimate is 10,648 small-medium fish (SE = 1,108; bias = 0.85%; 95% C.I.: 8,770, 13,237; M_{SM} = 374, C_{SM} = 2,072, R_{SM} = 72). Variance, bias, and confidence intervals were estimated as described above, but M was not estimated so there was on need to account for $\hat{M}$:

Capture history	Small-Medium	Source of statistics
Marked and not sampled	302	$M_{SM} - R_{SM}$
Marked and recaptured	72	R_{SM}
Not marked but captured	2,000	$C_{SM} - R_{SM}$
Not marked and not sampled	8,274	$\hat{N}_{SM} - M_{SM} - C_{SM} + R_{SM}$
Effective population for simulations	10,648	$\hat{N}^{+}_{SM}$

Evidence from upstream sampling supports the supposition that every small-medium Chinook salmon passing by Kakwan Point and Rock Island had a near equal chance of being marked regardless of when they passed these sites. Estimated marked fractions at the Little Tahltan weir (0.0139), Verrett River (0.0114), the lower river commercial and test gillnet fisheries 0.0400), and the aboriginal fishery (0.0429) were not significantly different (χ^2 = 7.44, df = 3, P = 0.06).

Small-medium Chinook salmon appeared to have a near equal chance of being marked regardless of their size. Pooled length samples from the Little Tahltan weir, Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery were arbitrarily split into two groups at the median length of small-medium fish (553 mm MEF) to permit comparison of marked fractions:

	≤553 mm	544–659 mm
Marked	30	42
Unmarked	1,007	993
Marked fraction	0.030	0.042

These marked fractions were not significantly different (χ^2 = 2.10, df = 1, P = 0.15).

Every small-medium Chinook salmon also appeared to have a near equal chance of being captured upstream regardless of their size. The samples were again split into two size groups at the median length of small-medium fish and the fractions of recaptured fish were compared as surrogates for probabilities of capture upstream:

	≤543 mm	544–659 mm
Released	135	239
Recaptured	30	42
Fraction recaptured	0.222	0.176

The marked fractions were not significantly different (χ^2 = 0.80, df = 1, P = 0.37).

Although there was little evidence supporting size-selective sampling of small-medium Chinook salmon, size distributions of fish captured at Kakwan Point and Rock Island versus samples of fish captured at the Little Tahltan weir, Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery were significantly different (Kolmogorov-Smirnov: d_{max} = 0.075; n = 443, considered relevant to all spawners in the Stikine River (Bernard et al. 2000), this sample was used to estimate spawning population proportions.

The estimated spawning escapement of 55,790 (SE = 6,178, 95% CI: 43,681 to 67,900) was composed of 17% age-1.2 fish, 57% age-1.3 fish, and 24% age-1.4 fish, and included 27,017 (SE = 3,476) females (Table 4).

DISCUSSION

As previously noted, standard errors of the Darroch estimates calculated by SPAS are biased low when *M* is estimated because the error in *M* cannot be incorporated into the program. However, the number of tags removed from the experiment was small (one tag recovered in Andrew Creek expanded to five, one voluntary return from the U.S. recreational fishery) in relation to the number initially marked and released (1,095), so the magnitude of the bias should be low.

To estimate the spawning escapement of large Chinook salmon that passed by Kakwan Point and Rock Island, harvests in the commercial, test, aboriginal, and sport fisheries were subtracted from the inriver run abundance estimate. The final estimate of the spawning escapement for large Chinook salmon above the U.S./Canada border in 2003 is 46,824 (= 49,881 - 3,057).

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 Transboundary Technical Committee (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 weir counts and the spawning escapement for the watershed is being refined through weir operations and this mark-recapture experiment.

The total weir count in 2003 of 6,492 large fish in the Little Tahltan River was 14% of the estimated spawning escapement, for an expansion factor of

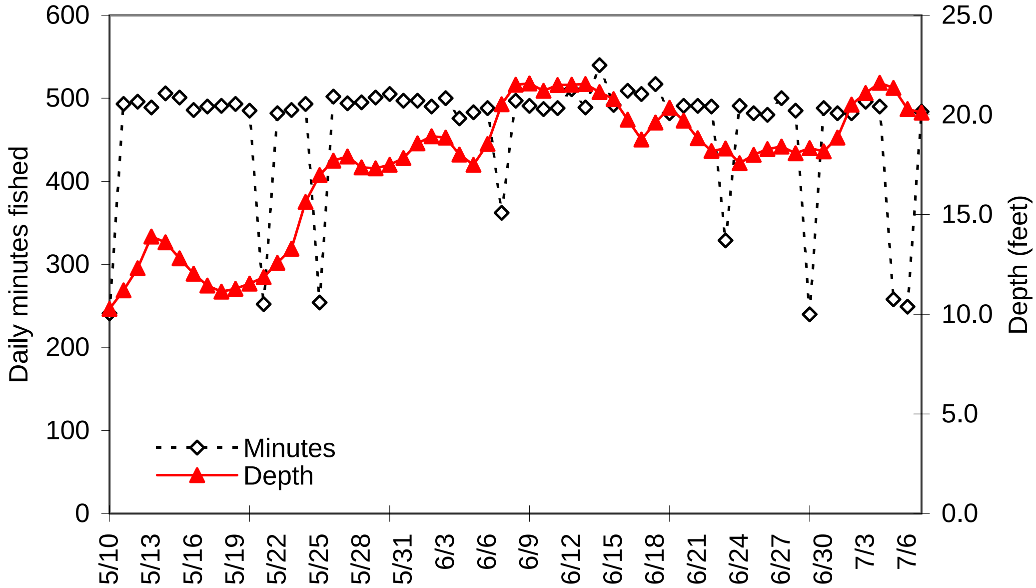


Figure 3.–Daily drift gillnet fishing effort (minutes) and river depth (feet) near Kakwan Point, lower Stikine River, 2003.

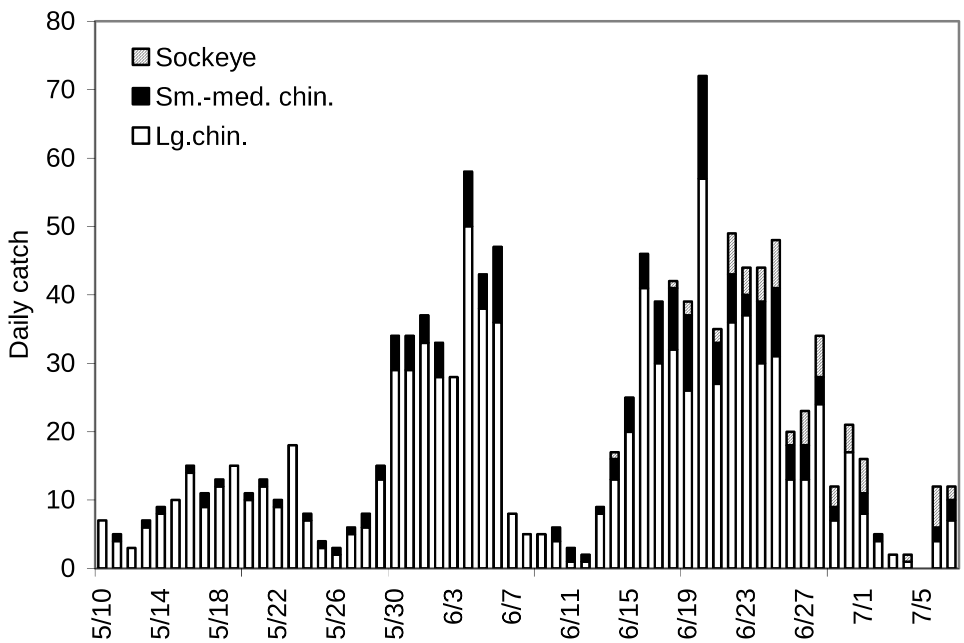


Figure 4.– Daily catch of Chinook and sockeye salmon near Kakwan Point, lower Stikine River, 2003**.**

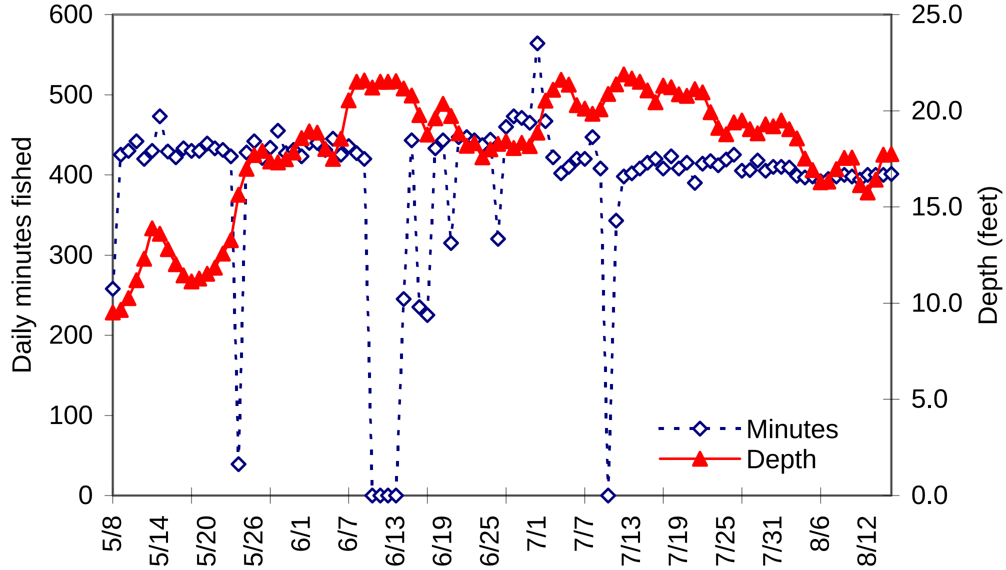


Figure 5.–Daily set gillnet fishing effort (minutes) and river depth (feet) at Rock Island, lower Stikine River, 2003.

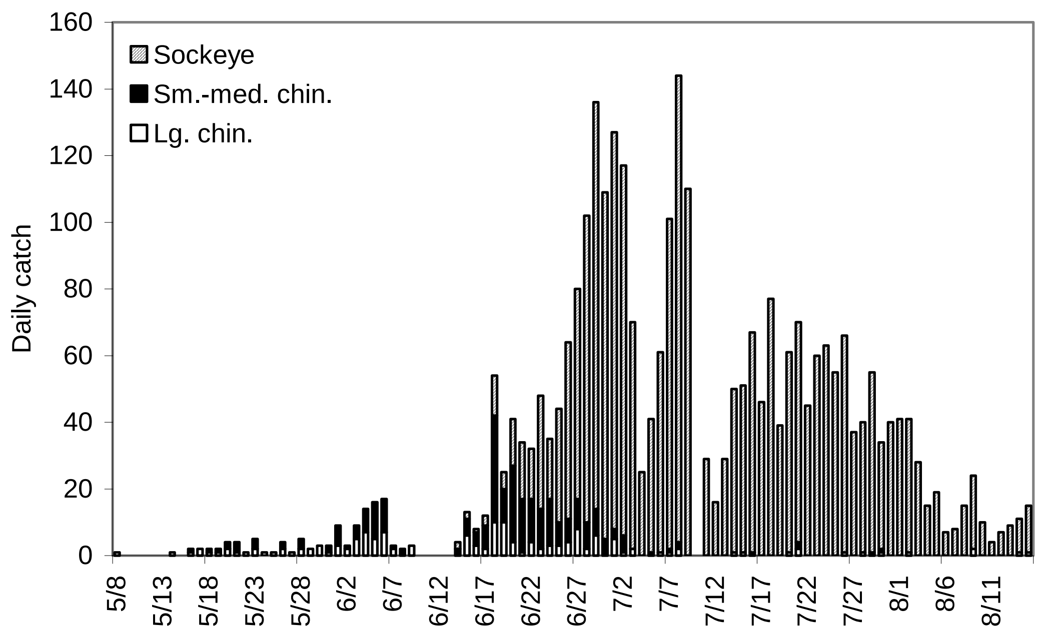


Figure 6.–Daily catch of Chinook and sockeye salmon at Rock Island, lower Stikine River, 2003.

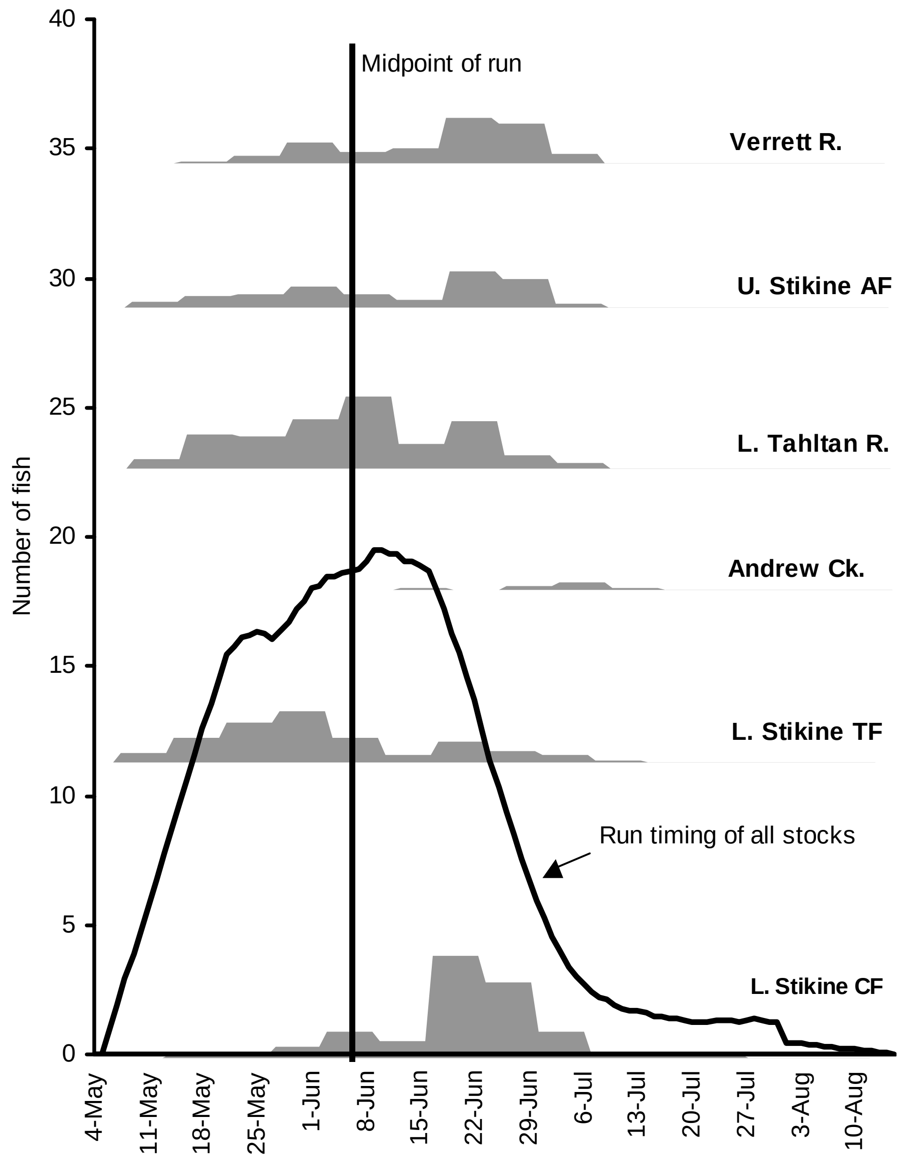
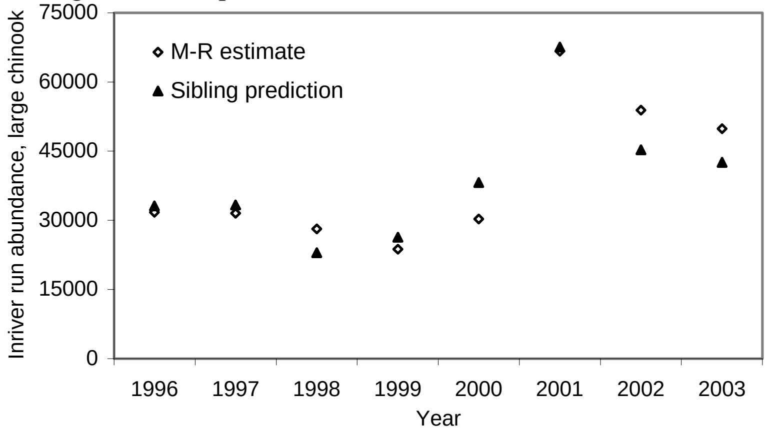


Figure 7.–Weekly total numbers of recaptured Chinook salmon sampled at six locations (bar graphs) and associated time of marking, set against the average daily drift and set gillnet catches in the lower Stikine River (line graph), 1996-2003. X-axis pertains to time of marking.

7.21 (46,824/6,492) for weir counts to escapement (Table 5). The average expansion factor of 5.62 (SE = 1.10, 18% of the spawning population) is greater than the factor of 4.0 (25% of the spawning escapement) that was formerly used to expand weir counts in the Little Tahltan River In 2003, fish <660 mm MEF composed 83% of the sample collected above the Little Tahltan River weir, while this group comprised only 24% of the weir sample. However, the proportion of fish <660 mm in the weir sample was not significantly different from the proportion in the combined Kakwan Point and Rock Island samples (28%; χ^2 = 2.29, df = 1, P = 0.13).Seventeen (17) Chinook salmon with missing adipose fins were recovered in the Stikine River in2003 (Appendix A12). Seven of these were recovered in Andrew Creek, four of which were sacrificed; those fish were of hatchery origin (Crystal Lake and Hidden Falls). The remaining ten were recovered near Kakwan Point, in inriver fisheries, Verrett River, and the Little Tahltan River. All but one were of Stikine River origin (1998 brood year), and the exception was a fish that was tagged and released in the

Taku River (1999 brood year). That fish was recovered in the lower river test fishery on June 1 and may have only temporarily entered the river. The U.S. and Canada signed a new 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 2004. Towards that end, we have analyzed sibling relationships in which previous-year inriver run abundance estimates of age-1.2, age-1.3, and age-1.4 fish were used to predict current-year abundance of age-1.3 (R^2 = 0.88, $P < 0.01$), age-1.4 (R^2 = 0.85, $P < 0.01$), and age-1.5 fish (R^2 = 0.53, P = 0.04).

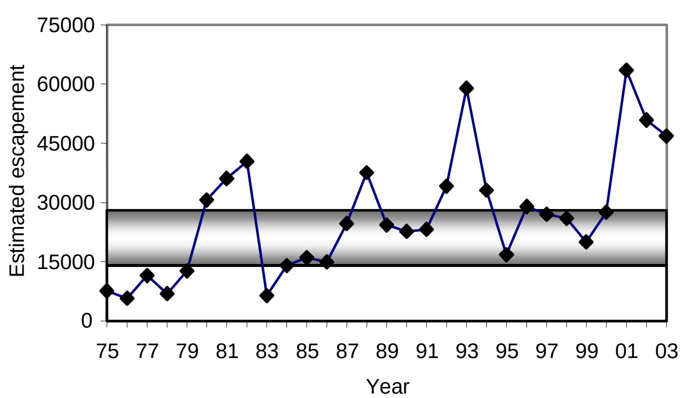
The sum of these predictions, graphically compared to corresponding post-season inriver run abundance estimates from 1996-2003 below, have an average absolute forecast error of 10%:



The 2003 preseason inriver run forecast was 42,594 large Chinook salmon, which compared reasonably well with the post-season estimate of 49,881 (forecast error = -15%).

In 2003 we continued to test the feasibility of using a mark-recapture experiment to estimate the inriver run abundance of large Chinook salmon in-season. Tagging data from Kakwan Point and recovery data from the Canadian Chinook salmon test fishery were collected concurrently beginning in early May. Additionally, tagging operations were initiated at Rock Island in early May to increase tagging rates. For an in-season estimate to be useful, our goal was to provide an estimate by May 31. Unfortunately, an insufficient number of fish (3) were recovered by that date for an unbiased estimate. CPUE at Kakwan Point on May 31 and the estimated inriver run abundance of large Chinook salmon (R^2 = 0.93, $P < 0.001$). This model predicted an inriver run of 35,425 large Chinook salmon, which compared well with the preseason estimate. This and similar models may provide timely in-season estimates and a method by which to judge preseason forecasts.

The 1999 PST Agreement states that we will manage Southeast Alaska fisheries to achieve escapement objectives for Southeast Alaska and transboundary river Chinook stocks (Chapter 3, Attachment 1, footnote 5). Estimated escapements have met or exceeded the escapement goal range (established in 2000) of 14,000 to 28,000 adult spawners since 1985. The ADF&G and DFO assessment is that Chinook salmon in the Stikine River have recovered from the recruitment overfishing and poor survival of the 1970s (Bernard et al. 2000):



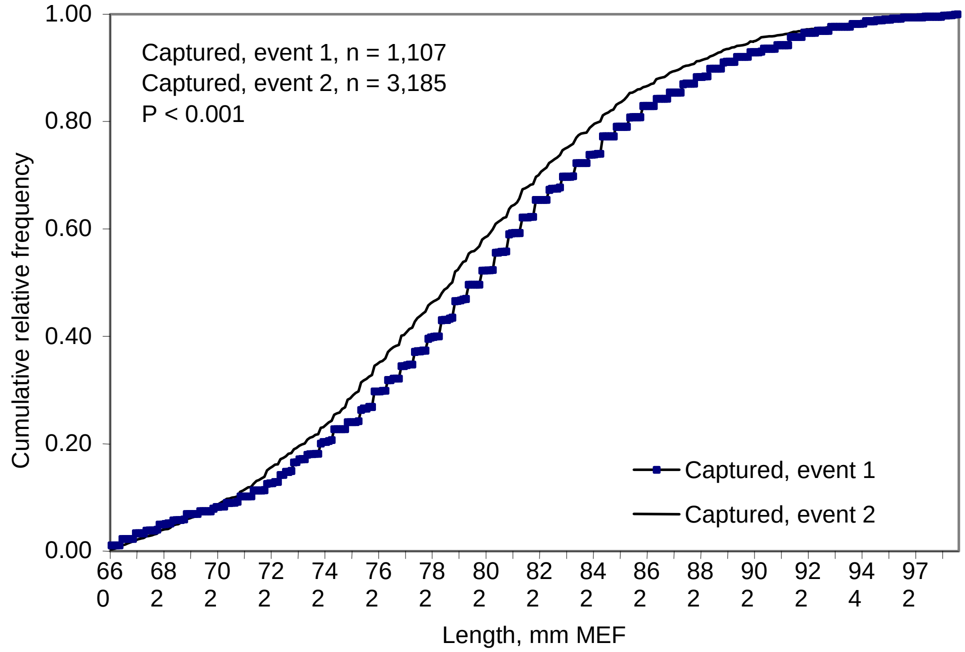


Figure 8.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) captured at Kakwan Point and Rock Island, and captured at the weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, Stikine River, 2003.

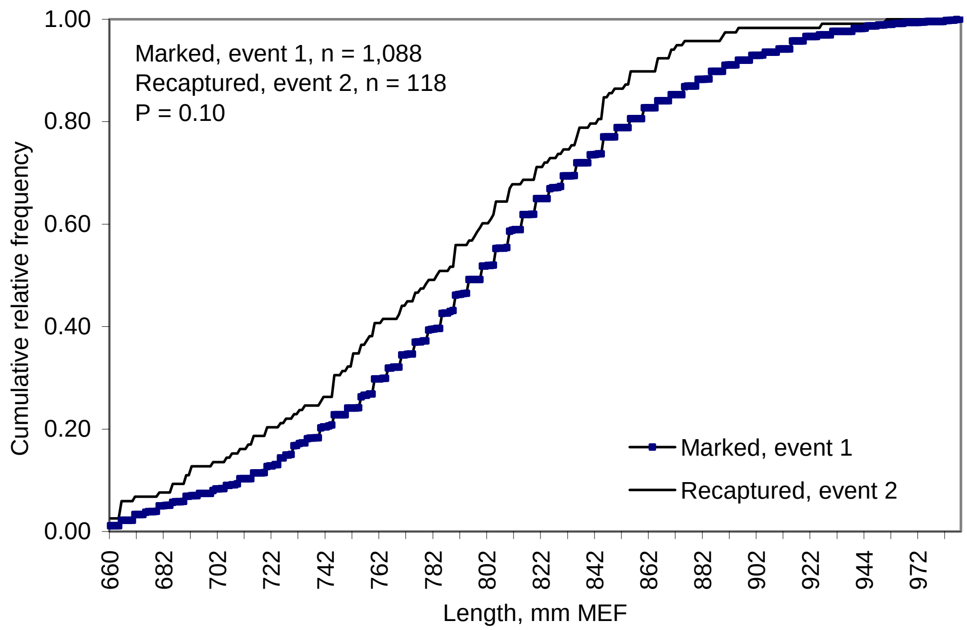


Figure 9.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and Rock Island, and recaptured at the weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, lower Stikine River, 2003.

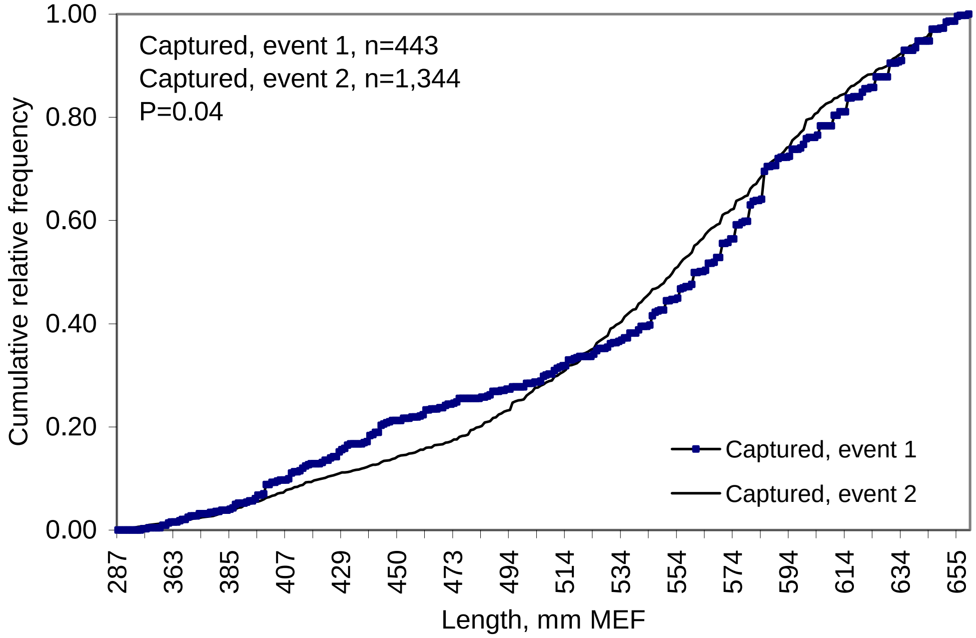


Figure 10.–Cumulative relative frequency of small-medium Chinook salmon (<660 mm MEF) captured at Kakwan Point and Rock Island, and captured at the weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, Stikine River, 2003.

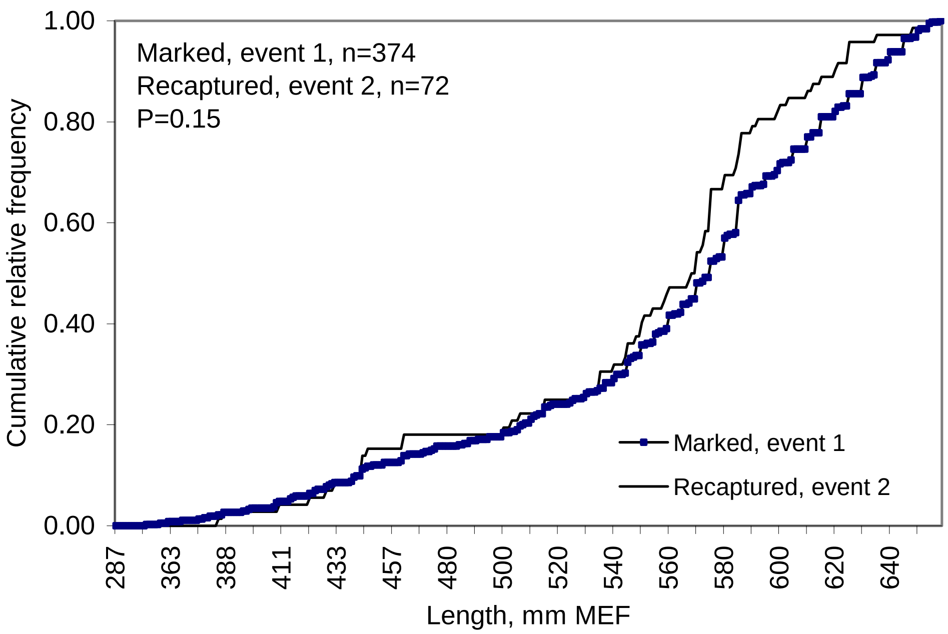


Figure 11.–Cumulative relative frequency of small-medium Chinook salmon (<660 mm MEF) marked at Kakwan Point and Rock Island, and recaptured at the weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, Stikine River, 2003.

Table 4.–Estimated age and sex composition by size category of the spawning escapement of Chinook salmon in the Stikine River, 2003.

Panel A. Small and medium Chinook salmon (<660 mm MEF)											
		Brood year and age class									
		2000	1999	1999	1998	1998	1997	1997	1996	1996	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
Females	n			28		1					29
	%			13.7		0.5					14.2
	SE of %			2.4		0.5					2.5
	Escapement			1,231		44					1,275
	SE of esc.			263		44					269
Males	n	15	3	145	3	9					175
	%	7.4	1.5	71.1	1.5	4.4					85.8
	SE of %	1.8	0.8	3.2	0.8	1.4					2.5
	Escapement	659	132	6,373	132	396					7,691
	SE of esc.	182	77	837	77	137					975
Combined	n	15	3	173	3	10					204
	%	7.4	1.5	84.8	1.5	4.9					100.0
	SE of %	1.8	0.8	2.5	0.8	1.5					0.0
	Escapement	659	132	7,604	132	440					8,966
	SE of esc.	182	77	966	77	145					1,108
Panel B. Large Chinook salmon (≥660 MEF)											
Females	n			7		227	2	111		1	348
	%			1.1		35.9	0.3	17.5		0.2	55.0
	SE of %			0.4		1.9	0.2	1.5		0.2	2.0
	Escapement			518		16,792	148	8,211		74	25,742
	SE of esc.			204		2,353	105	1,276		74	3,466
Males	n			17		196	2	69	1		285
	%			2.7		31.0	0.3	10.9	0.2		45.0
	SE of %			0.6		1.8	0.2	1.2	0.2		2.0
	Escapement			1,258		14,499	148	5,104	74		21,082
	SE of esc.			340		2,067	105	878	74		2,887
Combined	n			24		423	4	180	1	1	633
	%			3.8		66.8	0.6	28.4	0.2	0.2	100.0
	SE of %			0.8		1.9	0.3	1.8	0.2	0.2	0.0
	Escapement			1,775		31,290	296	13,315	74	74	46,824
	SE of esc.			421		4,154	151	1,919	74	74	6,078
Panel C. Small, medium and large Chinook salmon											
Females	n			35		228	2	111		1	377
	%			3.1		30.2	0.3	14.7		0.1	48.4
	SE of %			0.6		1.8	0.2	1.3		0.1	2.0
	Escapement			1,748		16,836	148	8,211		74	27,017
	SE of esc.			333		2,353	105	1,276		74	3,476
Males	n	15	3	162	3	205	2	69	1		460
	%	1.2	0.2	13.7	0.2	26.7	0.3	9.1	0.1		51.6
	SE of %	0.3	0.1	1.8	0.1	1.7	0.2	1.1	0.1		2.0
	Escapement	659	132	7,630	132	14,894	148	5,104	74		28,773
	SE of esc.	182	77	903	77	2,071	105	878	74		3,047
Combined	n	15	3	197	3	433	4	180	1	1	837
	%	1.2	0.2	16.8	0.2	56.9	0.5	23.9	0.1	0.1	100.0
	SE of %	0.3	0.1	2.1	0.1	2.2	0.3	1.7	0.1	0.1	0.0
	Escapement	659	132	9,379	132	31,730	296	13,315	74	74	55,790
	SE of esc.	182	77	1,054	77	4,156	151	1,919	74	74	6,178

Table 5.–Little Tahltan River weir counts, mark-recapture estimates of inriver run abundance and spawning escapement, expansion factors, and other statistics for large Chinook salmon in the Stikine River, 1996-2003.

	1996	1997	1998	1999	2000	2001	2002	2003	Average
Weir count	4,821	5,557	4,879	4,738	6,640	9,738	7,490	6,492	6,294
M[a]	359	653	405	252	612	1,416	935	1,089	715
C	2,006	4,528	3,048	4,030	3,657	5,596	4,375	4,696	3,992
R	47	93	43	42	73	118	75	118	76
Inriver run abundance	31,718[b]	31,509	28,133	23,716	30,301	66,646	53,893	49,881	39,475
SE	1,978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078	4,140
CV	6.2%	9.4%	14.0%	13.7%	10.5%	8.8%	11.0%	12.2%	10.5%
95% lower C.I.	NA	NA	NA	NA	24,879	56,521	43,798	37,968	
95% upper C.I.	NA	NA	NA	NA	38,049	78,982	67,023	61,795	
Bias	NA	NA	NA	NA	1.0%	0.76%	0.31%	NA	
Spawning escapement	28,949	26,996	25,968	19,947	27,531	63,523	50,875	46,824	36,327
SE	1,978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078	4,140
CV	6.8%	11.0%	15.1%	16.2%	11.5%	9.2%	11.6%	13.0%	11.4%
95% lower C.I.	NA	NA	NA	NA	22,220	53,741	40,675	34,911	
95% upper C.I.	NA	NA	NA	NA	34,565	75,718	63,900	58,738	
Bias	NA	NA	NA	NA	1.14%	0.79%	0.33%	NA	
Expansion factor	6.00[d]	4.86[e]	5.32	4.21	4.15	6.52	6.79	7.21	5.62
SE	0.41	0.53	0.81	0.68	0.48	0.60	0.79	0.94	1.10[f]

[a] Estimated in 1998 and 2001-03.

[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 1997).

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

[d] Modified from data in Pahlke and Etherton (1997).

[e] 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).

[f] $SD = \sqrt{var(6.00, 4.86 ... 7.21)}$).

CONCLUSIONS AND RECOMMENDATIONS

This was the eighth year of estimating the spawning escapement of Chinook salmon to the Stikine River, and drift gillnets have proven to be an effective method of capturing enough large Chinook salmon for a post-season estimate. The use of a set gillnet at Rock Island has also provided a larger marked release group of Chinook salmon <660 mm MEF that has, in some years, been sufficient for a mark-recapture estimate. The results of eight years of study also confirm 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) of Chinook salmon escapement to the Stikine River. However, the weir counts do not serve as a timely indicator for in-season abundance-based management per the 1999 PST.

In an effort to obtain useful in-season mark-recapture run estimates, in 2000 we moved the start-up date for the test fishing operation to early May to recover more tags. But we were unable to recapture enough fish to form estimates using that strategy alone. In 2003, we not only began the test fishery in early May, but also initiated the tagging operation at Rock Island at that time (versus mid-June as in past years) to increase tagging rates. That endeavor, unfortunately, did not yield favorable results either. However, models that predict inriver abundance from CPUE data are encouraging, and although CPUE varies with changing river conditions, it is a promising in-season indicator of run strength. Pre-season forecast models using sibling information also show potential.

Sampling rates at the weir should be maintained or increased and efforts continued to ensure that smaller fish are not passing unobserved.

ACKNOWLEDGMENTS

Tom Rockne, Stephen Todd, Roger Wagner, Dan McPherson, Ivan Quock, and Dan Etzerza conducted field work and data collection. Mary Meucci and Kim Fisher helped with project logistics and accounting. Mitch Engdahl and Fabian Vance operated the Little Tahltan River weirs. Bill Waugh supervised the Little Tahltan River weir and Tahltan River creel census conducted by Odelia Dennis. Andy Carlick and Michael Nole monitored the Canadian commercial and test fisheries. Alex Joseph conducted the Verrett Creek recovery work. Cherie Frocklage and Marilyn Norby helped coordinate stock assessment work. William Bergmann, Vera Goudima, and others helped with many aspects of the project. Sue Millard aged scales for ADF&G and Darlene Gilliespie aged scales for DFO. Dave Bernard provided extensive biometric review and Scott McPherson helped plan this project and provided editorial comments on the operational plan and this report. Canadian and U.S. fishers returned tags. The staff of the USFS Stikine LeConte Wilderness Area was helpful in the operation of the project. This work was partially funded by aid authorized under the U.S. Federal Sport Fish Restoration Act, by Canada, the Tahltan First Nation, and by the recreational anglers fishing in Alaska. Judy Shuler prepared this manuscript for final publication.

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APPENDIX A

Appendix A1.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2003.

							Large Chinook		Small-medium Chinook	
Date	Minutes	Large Chinook	Sm-med Chinook	Sockeye	Temp	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
5/10/03	241	7	0	0	7.5	10.26	1.74	0.01	0.00	0.00
5/11/03	493	4	1	0	8.0	11.20	0.49	0.01	0.12	0.01
5/12/03	496	3	0	0	7.5	12.31	0.36	0.01	0.00	0.01
5/13/03	489	6	1	0	7.0	13.89	0.74	0.02	0.12	0.01
5/14/03	506	8	1	0	7.0	13.61	0.95	0.03	0.12	0.02
5/15/03	501	10	0	0	7.0	12.81	1.20	0.04	0.00	0.02
5/16/03	486	14	1	0	6.5	12.03	1.73	0.05	0.12	0.02
5/17/03	490	9	2	0	8.0	11.44	1.10	0.06	0.24	0.03
5/18/03	491	12	1	0	7.5	11.13	1.47	0.08	0.12	0.04
5/19/03	493	15	0	0	8.0	11.28	1.83	0.09	0.00	0.04
5/20/03	485	10	1	0	8.0	11.53	1.24	0.10	0.12	0.04
5/21/03	252	12	1	0	8.0	11.85	2.86	0.12	0.24	0.05
5/22/03	482	9	1	0	7.0	12.58	1.12	0.12	0.12	0.05
5/23/03	486	18	0	0	7.0	13.28	2.22	0.14	0.00	0.05
5/24/03	493	7	1	0	7.5	15.64	0.85	0.15	0.12	0.06
5/25/03	254	3	1	0	7.0	16.98	0.71	0.15	0.24	0.07
5/26/03	502	2	1	0	7.5	17.70	0.24	0.16	0.12	0.07
5/27/03	494	5	1	0	8.0	17.91	0.61	0.16	0.12	0.08
5/28/03	495	6	2	0	7.5	17.37	0.73	0.17	0.24	0.09
5/29/03	501	13	2	0	7.0	17.32	1.56	0.18	0.24	0.10
5/30/03	505	29	5	0	7.0	17.49	3.45	0.21	0.59	0.13
5/31/03	497	29	5	0	8.0	17.83	3.50	0.24	0.60	0.15
6/01/03	497	33	4	0	8.0	18.58	3.98	0.28	0.48	0.17
6/02/03	490	28	5	0	8.0	18.93	3.43	0.31	0.61	0.20
6/03/03	500	28	0	0	9.0	18.86	3.36	0.33	0.00	0.20
6/04/03	476	50	8	0	9.0	18.01	6.30	0.39	1.01	0.24
6/05/03	483	38	5	0	9.0	17.50	4.72	0.43	0.62	0.27
6/06/03	488	36	11	0	10.0	18.54	4.43	0.46	1.35	0.33
6/07/03	362	8	0	0	10.0	20.54	1.33	0.47	0.00	0.33
6/08/03	497	5	0	0	11.0	21.51	0.60	0.48	0.00	0.33
6/09/03	491	5	0	0	10.0	21.58	0.61	0.48	0.00	0.33
6/10/03	487	4	2	0	11.0	21.21	0.49	0.49	0.25	0.34
6/11/03	488	1	2	0	10.0	21.50	0.12	0.49	0.25	0.35
6/12/03	511	1	1	0	10.0	21.51	0.12	0.49	0.12	0.36
6/13/03	489	8	1	0	9.5	21.54	0.98	0.50	0.12	0.36
6/14/03	540	13	3	1	8.5	21.15	1.44	0.51	0.33	0.38
6/15/03	492	20	5	0	9.0	20.79	2.44	0.53	0.61	0.41
6/16/03	509	41	5	0	9.0	19.77	4.83	0.58	0.59	0.43
6/17/03	505	30	9	0	9.0	18.77	3.56	0.61	1.07	0.48
6/18/03	517	32	9	1	8.0	19.61	3.71	0.64	1.04	0.53
6/19/03	482	26	11	2	8.0	20.36	3.24	0.67	1.37	0.59
6/20/03	491	57	15	0	9.5	19.72	6.97	0.73	1.83	0.67
6/21/03	491	27	6	2	9.0	18.83	3.30	0.76	0.73	0.71
6/22/03	490	36	7	6	10.0	18.18	4.41	0.79	0.86	0.74
6/23/03	329	37	3	4	9.0	18.31	6.75	0.83	0.55	0.76
6/24/03	491	30	9	5	9.5	17.58	3.67	0.86	1.10	0.81
6/25/03	482	31	10	7	9.0	17.99	3.86	0.90	1.24	0.86

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Appendix A1.–Page 2 of 2.

Date	Minutes	Large Chinook	Sm-med Chinook	Sockeye	Temp	Depth	Large Chinook Fish/hour	Large Chinook Cum. Percent	Small-medium Chinook Fish/hour	Small-medium Chinook Cum. Percent
6/26/03	480	13	5	2	9.0	18.28	1.63	0.91	0.63	0.89
6/27/03	500	13	5	5	9.0	18.42	1.56	0.92	0.60	0.92
6/28/03	485	24	4	6	8.0	18.07	2.97	0.95	0.49	0.94
6/29/03	240	7	2	3	9.0	18.33	1.75	0.96	0.50	0.95
6/30/03	488	17	0	4	10.0	18.17	2.09	0.97	0.00	0.95
7/01/03	482	8	3	5	9.0	18.86	1.00	0.98	0.37	0.97
7/02/03	482	4	1	0	9.0	20.52	0.50	0.99	0.12	0.97
70/3/03	496	2	0	0	9.0	21.09	0.24	0.99	0.00	0.97
7/04/03	490	1	0	1	9.0	21.61	0.12	0.99	0.00	0.97
7/05/03	258	0	0	0	9.0	21.36	0.00	0.99	0.00	0.97
7/06/03	249	4	2	6	9.0	20.29	0.96	0.99	0.48	0.98
7/07/03	484	7	3	2	9.5	20.11	0.87	1.00	0.37	1.00
Total		956	184	62						

Appendix A2.–Set gillnet daily effort (minutes fished), catches, and catch per hour, at Rock Island, Stikine River, 2003.

							Large Chinook		Small-medium Chinook	
Date	Minutes	Large Chinook	Sm-med Chinook	Sockeye	Temp	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
05/08/03	258	1	0			9.52	0.23	0.01	0.00	0.00
05/09/03	425	0	0			9.65	0.00	0.01	0.00	0.00
05/10/03	430	0	0			10.26	0.00	0.01	0.00	0.00
05/11/03	442	0	0			11.20	0.00	0.01	0.00	0.00
05/12/03	420	0	0			12.31	0.00	0.01	0.00	0.00
05/13/03	430	0	0			13.89	0.00	0.01	0.00	0.00
05/14/03	473	1	0			13.61	0.13	0.01	0.00	0.00
05/15/03	429	0	0			12.81	0.00	0.01	0.00	0.00
05/16/03	422	1	1			12.03	0.14	0.02	0.14	0.00
05/17/03	433	2	0			11.44	0.28	0.03	0.00	0.00
05/18/03	430	1	1			11.13	0.14	0.04	0.14	0.01
05/19/03	430	1	1			11.28	0.14	0.05	0.14	0.01
05/20/03	439	2	2			11.53	0.27	0.06	0.27	0.02
05/21/03	433	1	3			11.85	0.14	0.07	0.42	0.03
05/22/03	431	1	0			12.58	0.14	0.07	0.00	0.03
05/23/03	423	2	3			13.28	0.28	0.08	0.43	0.04
05/24/03	39	1	0			15.64	1.54	0.09	0.00	0.04
05/25/03	428	1	0			16.98	0.14	0.10	0.00	0.04
05/26/03	442	2	2			17.70	0.27	0.11	0.27	0.05
05/27/03	421	1	0			17.91	0.14	0.12	0.00	0.05
05/28/03	434	2	3			17.37	0.28	0.13	0.41	0.06
05/29/03	455	2	0			17.32	0.26	0.14	0.00	0.06
05/30/03	427	3	0			17.49	0.42	0.16	0.00	0.06
05/31/03	431	1	2			17.83	0.14	0.17	0.28	0.07
06/01/03	423	3	6			18.58	0.43	0.19	0.85	0.09
06/02/03	440	2	1			18.93	0.27	0.20	0.14	0.10
06/03/03	440	5	4			18.86	0.68	0.24	0.55	0.11
06/04/03	431	7	7			18.01	0.97	0.28	0.97	0.14
06/05/03	445	5	11			17.50	0.67	0.31	1.48	0.18
06/06/03	425	7	10			18.54	0.99	0.36	1.41	0.22
06/07/03	436	2	1			20.54	0.28	0.37	0.14	0.22
06/08/03	427	0	2			21.51	0.00	0.37	0.28	0.23
06/09/03	420	3	0			21.58	0.43	0.39	0.00	0.23
06/10/03	no fishing					21.21				
06/11/03	no fishing					21.50				
06/12/03	no fishing					21.51				
06/13/03	no fishing					21.54				
06/14/03	245	0	2	2		21.15	0.00	0.39	0.49	0.24
06/15/03	443	6	5	2		20.79	0.81	0.43	0.68	0.26
06/16/03	235	3	4	1		19.77	0.77	0.45	1.02	0.27
06/17/03	225	2	7	3		18.77	0.53	0.46	1.87	0.30
06/18/03	433	10	32	12		19.61	1.39	0.53	4.43	0.42
06/19/03	443	10	10	5		20.36	1.35	0.59	1.35	0.46
06/20/03	315	4	23	14		19.72	0.76	0.62	4.38	0.55
06/21/03	447	1	16	17		18.83	0.13	0.63	2.15	0.61
06/22/03	447	4	13	15		18.18	0.54	0.65	1.74	0.66
06/23/03	443	2	12	34		18.31	0.27	0.67	1.63	0.71

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Date	Minutes	Large Chinook	Sm-med Chinook	Sockeye	Temp	Depth	Large Chinook Fish/hour	Large Chinook Cum. Percent	Small-medium Chinook Fish/hour	Small-medium Chinook Cum. Percent
06/24/03	437	3	14	18		17.58	0.41	0.69	1.92	0.76
06/25/03	444	3	7	34		17.99	0.41	0.71	0.95	0.79
06/26/03	320	4	7	53		18.28	0.75	0.73	1.31	0.82
06/27/03	460	8	9	63		18.42	1.04	0.78	1.17	0.85
06/28/03	473	2	8	92		18.07	0.25	0.80	1.01	0.88
06/29/03	471	6	8	122		18.33	0.76	0.84	1.02	0.92
06/30/03	465	0	5	104		18.17	0.00	0.84	0.65	0.93
07/01/03	564	5	3	119		18.86	0.53	0.87	0.32	0.95
07/02/03	467	1	5	111		20.52	0.13	0.88	0.64	0.97
07/03/03	422	2	0	68		21.09	0.28	0.89	0.00	0.97
07/04/03	402	0	0	25		21.61	0.00	0.89	0.00	0.97
07/05/03	410	0	1	40		21.36	0.00	0.89	0.15	0.97
07/06/03	420	1	0	60		20.29	0.14	0.90	0.00	0.97
07/07/03	420	1	1	99		20.11	0.14	0.90	0.14	0.97
07/08/03	447	2	2	140		19.84	0.27	0.92	0.27	0.98
07/09/03	408	0	0	110		20.08	0.00	0.92	0.00	0.98
07/10/03	no fishing					20.87				
07/11/03	343	0	0	29		21.37	0.00	0.92	0.00	0.98
07/12/03	398	0	0	16		21.89	0.00	0.92	0.00	0.98
07/13/03	402	0	0	29		21.67	0.00	0.92	0.00	0.98
07/14/03	408	1	0	49		21.51	0.15	0.92	0.00	0.98
07/15/03	415	1	0	50		21.05	0.14	0.93	0.00	0.98
07/16/03	420	0	1	66		20.45	0.00	0.93	0.14	0.98
07/17/03	408	0	0	46		21.30	0.00	0.93	0.00	0.98
07/18/03	423	0	0	77		21.23	0.00	0.93	0.00	0.98
07/19/03	408	0	0	39		20.85	0.00	0.93	0.00	0.98
07/20/03	415	1	0	60		20.77	0.14	0.93	0.00	0.98
07/21/03	390	2	2	66		21.12	0.31	0.95	0.31	0.99
07/22/03	414	0	0	45		20.96	0.00	0.95	0.00	0.99
07/23/03	417	0	0	60		19.92	0.00	0.95	0.00	0.99
07/24/03	412	0	0	63		19.11	0.00	0.95	0.00	0.99
07/25/03	419	0	0	55		18.78	0.00	0.95	0.00	0.99
07/26/03	425	1	0	65		19.39	0.14	0.95	0.00	0.99
07/27/03	405	0	0	37		19.49	0.00	0.95	0.00	0.99
07/28/03	406	1	0	39		19.05	0.15	0.96	0.00	0.99
07/29/03	418	0	1	54		18.83	0.00	0.96	0.14	1.00
07/30/03	405	1	1	32		19.30	0.15	0.97	0.15	1.00
07/31/03	410	0	0	40		19.19	0.00	0.97	0.00	1.00
08/01/03	410	0	0	41		19.50	0.00	0.97	0.00	1.00
08/02/03	409	1	0	40		19.05	0.15	0.97	0.00	1.00
08/03/03	399	0	0	28		18.56	0.00	0.97	0.00	1.00
08/04/03	397	0	0	15		17.51	0.00	0.97	0.00	1.00
08/05/03	398	0	0	19		16.91	0.00	0.97	0.00	1.00
08/06/03	392	0	0	7		16.28	0.00	0.97	0.00	1.00
08/07/03	395	0	0	8		16.32	0.00	0.97	0.00	1.00
08/08/03	398	0	0	15		16.97	0.00	0.97	0.00	1.00
08/09/03	400	2	0	22		17.54	0.30	0.99	0.00	1.00

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Appendix A2.—Page 3 of 3.

Date	Minutes	Large Chinook	Sm-med Chinook	Sockeye	Temp	Depth	Large Chinook Fish/hour	Large Chinook Cum. Percent	Small-medium Chinook Fish/hour	Small-medium Chinook Cum. Percent
08/10/03	398	0	0	10		17.57	0.00	0.99	0.00	1.00
08/11/03	394	0	0	4		16.14	0.00	0.99	0.00	1.00
08/12/03	400	0	0	7		15.76	0.00	0.99	0.00	1.00
08/13/03	400	0	0	9		16.42	0.00	0.99	0.00	1.00
08/14/03	400	1	0	10		17.71	0.15	0.99	0.00	1.00
08/15/03	401	1	0	14		17.75	0.15	1.00	0.00	1.00
Total		153	259	2,629						

Appendix A3.–Release and recovery strata for large Chinook salmon, Stikine River, 2003.

	Releases	Recoveries		
Release time strata	Kakwan and Rock Island	Test, commercial, aboriginal fisheries	Verrett	Little Tahltan River weir
5/8-6/15[a]	573	30	6	15
6/16-7/9	516	23	33[b]	11[c]
Total	1,089	53	39	26
Total examined		2,871	879	946

[a] Ninety-four were tagged and released near Kakwan Point, but a fish that was caught in the U.S. recreational fishery was culled from the experiment.

[b] Includes three fish that lost tags. The peak of the run occurred June 20 – these fish were placed in this stratum under the assumption that they were tagged during this time period.

[c] Includes one fish that lost its tag. The peak of the run occurred June 20 – this fish was placed in this stratum under the assumption that it was tagged during this time period.

Appendix A4.–Detection of size-selectivity in sampling and its effects on estimation of size composition.

Results of hypothesis tests (K-S and χ^2)[a] on lengths of fish MARKED during the first event and RECAPTURED during the second event	Results of hypothesis tests (K-S) on lengths of fish CAPTURED during the first event and CAPTURED during the second event
Case I	
"Accept H_o"	"Accept H_o"
There is no size-selectivity during either event	
Case II	
"Accept H_o"	"Reject H_o"
There is no size-selectivity during the second sampling event but there is during the first	
Case III	
"Reject H_o"	"Accept H_o"
There is size-selectivity during both sampling events	
Case IV	
"Reject H_o"	"Reject H_o"
There is size-selectivity during the second sampling event; the status of size-selectivity during the first event is unknown	

Case I: Calculate one unstratified abundance estimate and pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition.

Case II: Calculate one unstratified abundance estimate and only use lengths, sexes, and ages from the second sampling event to estimate proportions in compositions.

Case III: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Pool lengths, sexes, and ages from both sampling events to improve precision of proportions in estimates of composition, and apply formulae to correct for size bias to the pooled data.

Case IV: Completely stratify both sampling events and estimate abundance for each stratum. Add abundance estimates across strata to get a single estimate for the population. Use lengths, sexes, and ages from only the second sampling event to estimate proportions in compositions, and apply formulae to correct for size bias to the data from the second sampling event.

Whenever the results of the hypothesis tests indicate that there has been size-selective sampling (Case III or IV), there is still a chance that the bias in estimates of abundance from this phenomenon is negligible. Produce a second estimate of abundance by not stratifying the data as recommended above. If the two estimates (stratified and unbiased vs. biased and unstratified) are dissimilar, the bias is meaningful, the stratified estimate should be used, and data on compositions should be analyzed as described above for Case III or IV. However, if the two estimates of abundance are similar, the bias is negligible in the UNSTRATIFIED estimate, and the analysis can proceed as if there were no size-selective sampling during the second event (Case I or II).

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Appendix A4.–Page 2 of 2.

Case III or IV: Size-selective sampling in both sampling events

n_i	Number of unique fish sampled during **SECOND** event **ONLY** within stratum *i*
n_{ij}	Number of unique fish of age *j* sampled during the **SECOND** event **ONLY** within stratum *i*
$\hat{p}_{ij} = \frac{n_{ij}}{n_i}$	Estimated fraction of fish of age *j* in stratum *i*. Note that $\sum_j \hat{p}_{ij} = 1$
$v(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_i - 1}$	An unbiased of variance[b]
$\hat{N}_i$	Estimated abundance in stratum *i* from the mark-recapture experiment
$\hat{N}_j = \sum_i (\hat{p}_{ij}\hat{N}_i)$	Estimated abundance of fish in age group *j* in the population
$v(\hat{N}_j) = \sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)\hat{p}^2{}_{ij} - v(\hat{p}_{ij})v(\hat{N}_i))$	An unbiased estimate of variance[c]
$\hat{p}_j = \frac{\hat{N}_j}{\sum_i \hat{N}_i} = \frac{\hat{N}_j}{\hat{N}}$	Estimated fraction of fish in age group *j* in the population
$v(\hat{p}_j) = \frac{\sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2)}{\hat{N}^2}$	An approximate estimate of variance[d]

[a] The K-S test is significant at $P \le 0.20$ and the χ^2 test at $P \le 0.05$

[b] Page 52 in Cochran, W.G. 1977. Sampling techniques, 3rd ed. John Wiley and Sons, Inc. New York.

[c] From methods in Goodman, L.G. 1960. On the exact variance of a product. Journal of the American Statistical Association.

[d] From the delta method, page 8 in Seber, G.A.F. 1982. The estimation of animal abundance and relate parameters, 2nd ed. Charles Griffin and Company, Limited. London.

Appendix A5.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Kakwan Point , 2003.

		Small and medium Chinook salmon									
		Age class									
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Females	n		9		1			1			11
	% age comp.		5.6		0.6			0.6			6.8
	SE of %		1.8		0.6			0.6			2.0
	Avg. length		619		645			630			622
	SE		7								7
Males	n		133		16	1					150
	% age comp.		82.6		9.9	0.6					93.2
	SE of %		3.0		2.4	0.6					2.0
	Avg. length.		591		628	600					595
	SE		3		6						3
Sexes combined	n		142		17	1		1			161
	% age comp.		88.2		10.6	0.6		0.6			100.0
	SE of %		2.6		2.4	0.6		0.6			0.0
	Avg. length.		592		629	600		630			596
	SE		3		5						3
		Large Chinook salmon									
Females	n		9		298		181	1	2	1	492
	% age comp.		1.1		37.2		22.6	0.1	0.2	0.1	61.4
	SE of %		0.4		1.7		1.5	0.1	0.2	0.1	1.7
	Avg. length		717		782		842	825	870	880	803
	SE		24		3		3		10		3
Males	n		15		195		95		4		309
	% age comp.		1.9		24.3		11.9		0.5		38.6
	SE of %		0.5		1.5		1.1		0.2		1.7
	Avg. length.		671		776		874		948		803
	SE		3		5		6		39		5
Sexes combined	n		24		493		276	1	6	1	801
	% age comp.		3.0		61.5		34.5	0.1	0.7	0.1	100.0
	SE of %		0.6		1.7		1.7	0.1	0.3	0.1	0.0
	Avg. length.		689		779		853	825	922	880	803
	SE		10		2		3		29		2
		Small, medium, and large Chinook salmon									
Females	n		18		299		181	2	2	1	503
	% age comp.		1.9		31.1		18.8	0.2	0.2	0.1	52.3
	SE of %		0.4		1.5		1.3	0.1	0.1	0.1	1.6
	Avg. length		668		781		842	728	870	880	799
	SE		17		3		3	98	10		3
Males	n		148		211	1	95		4		459
	% age comp.		15.4		21.9	0.1	9.9		0.4		47.7
	SE of %		1.2		1.3	0.1	1.0		0.2		1.6
	Avg. length.		599		764	600	874		948		735
	SE		3		5		6		39		6
Sexes combined	n		166		510	1	276	2	6	1	962
	% age comp.		17.3		53.0	0.1	28.7	0.2	0.6	0.1	100.0
	SE of %		1.2		1.6	0.1	1.5	0.1	0.3	0.1	0.0
	Avg. length.		606		774	600	853	728	922	880	769
	SE		4		3		3	98	29		3

Appendix A6.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Rock Island , 2003.

		Small and medium Chinook salmon									
		Age class									
		0.2	**1.1**	**0.3**	**1.2**	**1.3**	**0.5**	**1.4**	**2.3**	**1.5**	**Total**
Females	n				3	3		1			7
	% age comp.				1.5	1.5		0.5			3.5
	SE of %				0.9	0.9		0.5			1.3
	Avg. length				606	630		581			612
	SE				14	5					9
Males	n	2	58		133	2					195
	% age comp.	1.0	28.7		65.8	1.0					96.5
	SE of %	0.7	3.2		3.3	0.7					1.3
	Avg. length.	492	422		530	658					499
	SE	1	7		5	2					6
Sexes combined	n	2	58		136	5		1			202
	% age comp.	1.0	28.7		67.3	2.5		0.5			100.0
	SE of %	0.7	3.2		3.3	1.1		0.5			0.0
	Avg. length.	492	422		532	641		581			503
	SE	1	7		5	7					6
		Large Chinook salmon									
Females	n			1	1	44		16		1	63
	% age comp.			0.8	0.8	36.7		13.3		0.8	52.5
	SE of %			0.8	0.8	4.4		3.1		0.8	4.6
	Avg. length			758	676	759		821		829	775
	SE					7		9			7
Males	n			1	2	33	1	20			57
	% age comp.			0.8	1.7	27.5	0.8	16.7			47.5
	SE of %			0.8	1.7	4.1	0.8	3.4			4.6
	Avg. length.			772	672	747	945	812			771
	SE				7	8		14			9
Sexes combined	n			2	3	77	1	36		1	120
	% age comp.			1.7	2.5	64.2	0.8	30.0		0.8	100.0
	SE of %			1.2	1.4	4.4	0.8	4.2		0.8	0.0
	Avg. length.			765	673	754	945	816		829	773
	SE			7	4	5		9			5
		Small, medium, and large Chinook salmon									
Females	n			1	4	47		17		1	70
	% age comp.			0.3	1.2	14.6		5.3		0.3	21.7
	SE of %			0.3	0.6	2.0		1.2		0.3	2.3
	Avg. length			758	623	751		807		829	758
	SE				20	8		16			8
Males	n	2	58	1	135	35	1	20			252
	% age comp.	0.6	18.0	0.3	41.9	10.9	0.3	6.2			78.3
	SE of %	0.4	2.1	0.3	2.8	1.7	0.3	1.3			2.3
	Avg. length.	492	422	772	532	742	945	812			561
	SE	1	7		6	8		14			9
Sexes combined	n	2	58	2	139	82	1	37		1	322
	% age comp.	0.6	18.0	0.6	43.2	25.5	0.3	11.5		0.3	100.0
	SE of %	0.4	2.1	0.4	2.8	2.4	0.3	1.8		0.3	0.0
	Avg. length.	492	422	765	535	747	945	810		829	604
	SE	1	7	7	6	6		11			8

Appendix A7.–Estimated age and sex composition and mean length by age of Chinook salmon harvested in the Canadian commercial and test gillnet fisheries on the Lower Stikine River, 2003.

		Age Class											
		0.1	**0.2**	**1.1**	**1.2**	**2.1**	**0.4**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**Total**
Small and medium Chinook salmon													
Females	n				19			6		1			26
	% age comp.				4.2			1.3		0.2			5.7
	SE of %				0.9			0.5		0.2			1.1
	Avg. length				568			627		631			584
	SE				9			8					9
Males	n	1	1	51	336	4		29	1	4			427
	% age comp.	0.2	0.2	11.3	74.2	0.9		6.4	0.2	0.9			94.3
	SE of %	0.2	0.2	1.5	2.1	0.4		1.2	0.2	0.4			1.1
	Avg. length.	491	519	399	545	408		584	503	621			530
	SE			4	3	8		12		16			3
Sexes combined	n	1	1	51	355	4		35	1	5			453
	% age comp.	0.2	0.2	11.3	78.4	0.9		7.7	0.2	1.1			100.0
	SE of %	0.2	0.2	1.5	1.9	0.4		1.3	0.2	0.5			0.0
	Avg. length.	491	519	399	546	408		591	503	623			533
	SE			4	3	8		11		13			3
Large Chinook salmon													
Females	n				6		1	205	1	131	2	2	348
	% age comp.				0.9		0.1	30.7	0.1	19.6	0.3	0.3	52.1
	SE of %				0.4		0.1	1.8	0.1	1.5	0.2	0.2	1.9
	Avg. length				720		850	769	671	855	769	965	802
	SE				19			4		5	49	65	4
Males	n				8		1	203		104	2	2	320
	% age comp.				1.2		0.1	30.4		15.6	0.3	0.3	47.9
	SE of %				0.4		0.1	108		1.4	0.2	0.2	1.9
	Avg. length.				704		848	759		809	788	915	775
	SE				18			3		4	8	20	3
Sexes combined	n				14		2	408	1	235	4	4	668
	% age comp.				2.1		0.3	61.1	0.1	35.2	0.6	0.6	100.0
	SE of %				0.6		0.2	1.9	0.1	1.8	0.3	0.3	0.0
	Avg. length.				710		849	764	671	834	778	940	789
	SE				13		1	3		4	21	31	3
Small, medium, and large Chinook salmon													
Females	n				27		1	209		105	2	2	346
	% age comp.				2.4		0.1	18.6		9.4	0.2	0.2	30.9
	SE of %				0.5		0.1	1.2		0.9	0.1	0.1	1.4
	Avg. length				608		848	755		807	788	915	761
	SE				15			3		5	8	20	4
Males	n	1	1	51	342	4	1	234	2	135	2	2	775
	% age comp.	0.1	0.1	4.5	30.5	0.4	0.1	20.9	0.2	12.0	0.2	0.2	69.1
	SE of %	0.1	0.1	0.6	1.4	0.2	0.1	1.2	0.1	1.0	0.1	0.1	1.4
	Avg. length.	491	519	399	548	408	850	746	587	848	769	965	652
	SE			4	3	8		6	84	6	49	65	6
Sexes combined	n	1	1	51	369	4	2	443	2	240	4	4	1,121
	% age comp.	0.1	0.1	4.5	32.9	0.4	0.2	39.5	0.2	21.4	0.4	0.4	100.0
	SE of %	0.1	0.1	0.6	1.4	0.2	0.1	1.5	0.1	1.2	0.2	0.2	0.0
	Avg. length.	491	519	399	553	408	849	750	587	830	778	940	685
	SE			4	3	8	1	3	84	4	21	31	4

Appendix A8.–Estimated age and sex composition and mean length by age of Chinook salmon at Little Tahltan River weir, 2003.

		Small and medium Chinook salmon									
		Age class									
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Females	n		28		1						29
	% age comp.		13.7		0.5						14.2
	SE of %		2.4		0.5						2.5
	Avg. length		573		604						574
	SE		8								8
Males	n	15	145	3	9	3					175
	% age comp.	7.4	71.1	1.5	4.4	1.5					85.8
	SE of %	1.8	3.2	0.8	1.4	0.8					2.5
	Avg. length.	419	573	421	588	629					559
	SE	6	4	15	14	6					5
Sexes	n	15	173	3	10	3					204
combined	% age comp.	7.4	84.8	1.5	1.54.9	1.5					100.0
	SE of %	1.8	2.5	0.8	589	0.8					0.0
	Avg. length.	419	573	421	12	629					561
	SE	6	4	15		6					5
		Large Chinook salmon									
Females	n		7		227		111	2	1		348
	% age comp.		1.1		35.9		17.5	0.3	0.2		55.0
	SE of %		0.4		1.9		1.5	0.2	0.2		2.0
	Avg. length		732		785		838	777	887		801
	SE		24		3		4	31			3
Males	n		17		196		69	2		1	285
	% age comp.		2.7		31.0		10.9	0.3		0.2	45.0
	SE of %		0.6		1.8		1.2	0.2		0.2	2.0
	Avg. length.		713		795		885	789		978	813
	SE		16		5		8	55			5
Sexes	n		24		423		180	4	1	1	633
combined	% age comp.		3.8		66.8		28.4	0.6	0.2	0.2	100.0
	SE of %		0.8		1.9		1.8	0.3	0.2	0.2	0.0
	Avg. length.		718		790		856	783	887	978	806
	SE		13		3		4	26			3
		Small, medium, and large Chinook salmon									
Females	n		35		228		111	2	1		377
	% age comp.		4.2		27.2		13.3	0.2	0.1		45.0
	SE of %		0.7		1.5		1.2	0.2	0.1		1.7
	Avg. length		605		784		838	777	887		784
	SE		13		3		4	31			4
Males	n	15	162	3	205	3	69	2		1	460
	% age comp.	1.8	19.4	0.4	24.5	0.4	8.2	0.2		0.1	55.0
	SE of %	0.5	1.4	0.2	1.5	0.2	1.0	0.2		0.1	1.7
	Avg. length.	419	588	421	786	629	885	789		978	716
	SE	6	5	15	5	6	8	55			7
Sexes	n	15	197	3	433	3	180	4	1	1	837
combined	% age comp.	1.8	23.5	0.4	51.7	0.4	21.5	0.5	0.1	0.1	100.0
	SE of %	0.5	1.5	0.2	1.7	0.2	1.4	0.2	0.1	0.1	0.0
	Avg. length.	419	591	421	785	629	856	783	887	978	747
	SE	6	5	15	3	6	4	26			4

Appendix A9.–Estimated age and sex composition and mean length by age of post-spawn and dead Chinook salmon (carcasses) above the weir on the Little Tahltan River, 2003.

		Age class									
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon											
Females	n		1								1
	% age comp.		1.7								1.7
	SE of %		1.7								1.7
	Avg. length		486								486
	SE										
Males	n	21	33	1	2						57
	% age comp.	36.2	56.9	1.7	3.4						98.3
	SE of %	6.4	6.6	1.7	2.4						1.7
	Avg. length.	372	550	386	606						483
	SE	7	9		9						13
Sexes combined	n	21	34	1	2						58
	% age comp.	36.2	58.6	1.7	3.4						100.0
	SE of %	6.4	6.5	1.7	2.4						0.0
	Avg. length.	372	548	386	606						483
	SE	7	9		12						13
Large Chinook salmon											
Females	n				3		1				4
	% age comp.				25.0		8.3				33.3
	SE of %				13.1		8.3				14.2
	Avg. length				766		861				790
	SE				18						27
Males	n				7		1				8
	% age comp.				58.3		8.3				66.7
	SE of %				14.9		8.3				14.2
	Avg. length.				777		890				791
	SE				22						24
Sexes combined	n				10		2				12
	% age comp.				83.3		16.7				100.0
	SE of %				11.2		11.2				0.0
	Avg. length.				774		876				791
	SE				16		15				17
Small, medium, and large Chinook salmon											
Females	n		1		3		1				5
	% age comp.		1.4		4.3		1.4				7.1
	SE of %		1.4		2.4		1.4				3.1
	Avg. length		486		766		861				729
	SE				18						64
Males	n	21	33	1	9		1				65
	% age comp.	30.0	47.1	1.4	12.9		1.4				92.9
	SE of %	5.5	6.0	1.4	4.0		1.4				3.1
	Avg. length.	372	550	386	739		890				521
	SE	7	9		30						17
Sexes combined	n	21	34	1	12		2				70
	% age comp.	30.0	48.6	1.4	17.1		2.9				100.0
	SE of %	5.5	6.0	1.4	4.5		2.0				0.0
	Avg. length.	372	548	386	746		876				536
	SE	7	9		23		15				18

Appendix A10.–Estimated age and sex composition and mean length by age of moribund and recently expired Chinook salmon in Verrett River, 2003.

		Small and medium Chinook salmon									
		Age class									
		1.1	**1.2**	**2.1**	**1.3**	**2.2**	**1.4**	**2.3**	**1.5**	**2.4**	**Total**
Females	n		5		5						10
	% age comp.		7.1		7.1						14.3
	SE of %		3.1		3.1						4.2
	Avg. length		603		634						618
	SE		10		5						8
Males	n	13	37		10						60
	% age comp.	18.6	52.9		14.3						85.7
	SE of %	4.7	6.0		4.2						4.2
	Avg. length.	383	579		620						543
	SE	11	7		5						12
Sexes	n	13	42		15						70
combined	% age comp.	18.6	60.0		21.4						100.0
	SE of %	4.7	5.9		4.9						0.0
	Avg. length.	383	582		625						554
	SE	11	7		4						11
		Large Chinook salmon									
Females	n		2		252		148				402
	% age comp.		0.3		40.8		23.9				65.0
	SE of %		0.2		2.0		1.7				1.9
	Avg. length		715		751		810				773
	SE		5		2		4				2
Males	n		7		149		60				216
	% age comp.		1.1		24.1		9.7				35.0
	SE of %		0.4		1.7		1.2				1.9
	Avg. length.		675		762		858				786
	SE		4		4		9				5
Sexes	n		9		401		208				618
combined	% age comp.		1.5		64.9		33.7				100.0
	SE of %		0.5		1.9		1.9				0.0
	Avg. length.		684		755		823				777
	SE		7		2		4				2
		Small, medium, and large Chinook salmon									
Females	n		7		257		147				412
	% age comp.		1.0		37.4		21.5				59.9
	SE of %		0.4		1.8		1.6				1.9
	Avg. length		635		749		810				769
	SE		22		3		4				3
Males	n	13	44		159		60				276
	% age comp.	1.9	6.4		23.1		8.7				40.1
	SE of %	0.5	0.9		1.6		1.1				1.9
	Avg. length.	383	594		753		858				733
	SE	11	8		5		9				8
Sexes	n	13	51		416		208				688
combined	% age comp.	1.9	7.4		60.5		30.2				100.0
	SE of %	0.5	1.0		1.9		1.8				0.0
	Avg. length.	383	600		751		823				755
	SE	11	8		2		4				4

Appendix A11.–Estimated age and sex composition and mean length by age of Chinook salmon in Andrew Creek, 2003.

		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon											
		Age class									
Females	n	3	34		1						38
	% age comp.	7.7	87.2		2.6						97.4
	SE of %	4.3	5.4		2.6						2.6
	Avg. length	358	593		640						576
	SE	9	8								13
Males	n		1								1
	% age comp.		2.6								2.6
	SE of %		2.6								2.6
	Avg. length.		600								600
	SE										
Sexes combined	n	3	35		1						39
	% age comp.	7.7	89.7		2.6						100.0
	SE of %	4.3	4.9		2.6						576
	Avg. length.	358	593		640						12
	SE	9	8								
Large Chinook salmon											
Females	n		1		51		45		3		100
	% age comp.		0.5		23.5		20.7		1.4		46.1
	SE of %		0.5		2.9		2.8		0.8		3.4
	Avg. length		675		791		833		858		811
	SE				5		5		16		4
Males	n		4		69		39		5		117
	% age comp.		1.8		31.8		18.0		2.3		53.9
	SE of %		0.9		3.2		2.6		1.0		3.4
	Avg. length.		669		768		859		880		800
	SE		5		7		9		46		7
Sexes combined	n		5		120		84		8		217
	% age comp.		2.3		55.3		38.7		3.7		100.0
	SE of %		1.0		3.4		3.3		1.3		0.0
	Avg. length.		670		778		845		872		805
	SE		4		4		5		28		4
Small, medium, and large Chinook salmon											
Females	n		2		51		45		3		101
	% age comp.		0.8		19.9		17.6		1.2		39.5
	SE of %		0.6		2.5		2.4		0.7		3.1
	Avg. length		638		791		833		858		809
	SE		38		5		5		16		5
Males	n	3	38		70		39		5		155
	% age comp.	1.2	14.8		27.3		15.2		2.0		60.5
	SE of %	0.7	2.2		2.8		2.3		0.9		3.1
	Avg. length.	358	601		766		859		880		745
	SE	9	8		7		9		46		10
Sexes combined	n	3	40		121		84		8		256
	% age comp.	1.2	15.6		47.3		32.8		3.1		100.0
	SE of %	0.7	2.3		3.1		2.9		1.1		0.0
	Avg. length.	358	603		777		845		872		770
	SE	9	8		5		5		28		7

Appendix A12.–Origin of coded-wire tags recovered from Chinook salmon collected in the Stikine River, 2003.

Year	Head	Tag code	Brood year	Agency	Rearing	Recovery site	Location	Date released	Release site
2003	72740	40357	1998	ADFG	W	Kakwan Pt.	Stikine R.	6/13/00	Stikine R.
2003	65942	40359	1998	ADFG	W	Inriver fisheries	Stikine R.	6/13/00	Stikine R.
2003	3171E	40358	1998	ADFG	W	Inriver fisheries	Stikine R.	6/13/00	Stikine R.
2003	3173E	40358	1998	ADFG	W	Inriver fisheries	Stikine R.	6/13/00	Stikine R.
2003	65949	40358	1998	ADFG	W	Inriver fisheries	Stikine R.	6/13/00	Stikine R.
2003	3174E	40359	1998	ADFG	W	Verrett R.	Stikine R.	6/13/00	Stikine R.
2003	14490	40357	1998	ADFG	W	Little Tahltan R.	Stikine R.	6/13/00	Stikine R.
2003	14491	40357	1998	ADFG	W	Little Tahltan R	Stikine R.	6/13/00	Stikine R.
2003	14492	40357	1998	ADFG	W	Little Tahltan R	Stikine R.	6/13/00	Stikine R.
2003	3172E	40373	1999	ADFG	W	Inriver fisheries	Taku R.	6/9/01	Taku R.
2003	76984	40419	1998	ADFG	H	Andrew Creek	Crystal Lake	5/30/00	Earl West
2003	76987	40419	1998	ADFG	H	Andrew Creek	Crystal Lake	5/30/00	Earl West
2003	76985	44818	1997	NSRA	H	Andrew Creek	Hidden Falls	6/1/99	Kasnyku Bay
2003	900641	Not sacrificed				Andrew Creek			
2003	900642	Not sacrificed				Andrew Creek			
2003	900643	Not sacrificed				Andrew Creek			
2003	76986	40182	1999	SSRA	H	Andrew Creek	Crystal Lake	5/23/01	Anita Bay

Appendix A13.–Computer files used to estimate the spawning abundance of Chinook salmon in the Stikine River in 2003.

File Name	Description
CAPTPROB03.xls	EXCEL spreadsheet with chi-square capture probability tests.
LGSTIK03.BAS	QBASIC bootstrap program for estimating abundance (Petersen model) of large Chinook salmon, variance, bias, and confidence intervals.
LGSTIK03.DAT	Input file for LGSTIK03.BAS.
LGSTIK03.OUT	Output file from LGSTIK03.BAS.
MR4FATE.BAS	QBASIC bootstrap program for estimating abundance (Petersen model) of small-medium Chinook salmon, variance, bias, and confidence intervals.
POSTSEASON03.xls	EXCEL spreadsheet with 2003 Darroch and Petersen abundance estimates including bootstrap output for variance, confidence interval and bias estimation.
PRE-INSEASON03.xls	EXCEL spreadsheet with 2003 CPUE and sibling models.
SIZESELPOST03.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
SMSTIK03.DAT	Input file for MR4FATE.BAS.
SMSTIK03.OUT	Output file from MR4FATE.BAS.
STIKMR-CPUE03.xls	EXCEL spreadsheet with Kakwan Point and Rock Island catch-effort, hydrology, and temperature data including charts.
STIKMR-TAG&ASL03.xls	EXCEL spreadsheet with Kakwan Point, Rock Island, and spawning ground tag, recovery, and age-sex-size data.