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Abundance of the Chinook Salmon Escapement on the Stikine River, 2002

by

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June 2004

Alaska Department of Fish and Game **Division of Sport Fish**

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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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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 2002 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 1,172 immigrant chinook salmon during May, June, July, and August of which 1,153 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 a modified Petersen model, an estimated 53,893 (SE = 5,912) large and 7,433 (SE = 1,511) small-medium fish immigrated to the Stikine River above Kakwan Point and Rock Island. Canadian fisheries on the Stikine River harvested 3,018 large and 942 small-medium chinook salmon, leaving a spawning escapement of 50,875 (SE = 5,912) large and 6,491 (SE = 1,511) small-medium fish. Count of large fish at the Little Tahltan River live weir was 7,490, representing about 15% of the estimated spawning escapement of large fish. A foot survey and expansion factor were used to estimate an escapement of 1,752 large fish in Andrew Creek. The estimated spawning escapement of 57,366 (SE = 6,102) Chinook salmon was composed of 9.0% (SE = 2.0%) age-1.2 fish, 23.1% (SE = 1.4%) age-1.3 fish, and 65.4% (SE = 2.3%) age-1.4 fish. The estimated spawning escapement included 31,449 (SE = 3,719) females. The feasibility of using mark-recapture, CPUE, and sibling ratio 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, escapement, abundance, age and sex composition, pre-season, in-season, CPUE, sibling ratio

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 1981). 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 11 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 et al. 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 constitute 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 CTC is in the process of incorporating inriver abundance of this stock into the Pacific Salmon Commission (PSC) Chinook Model, which,

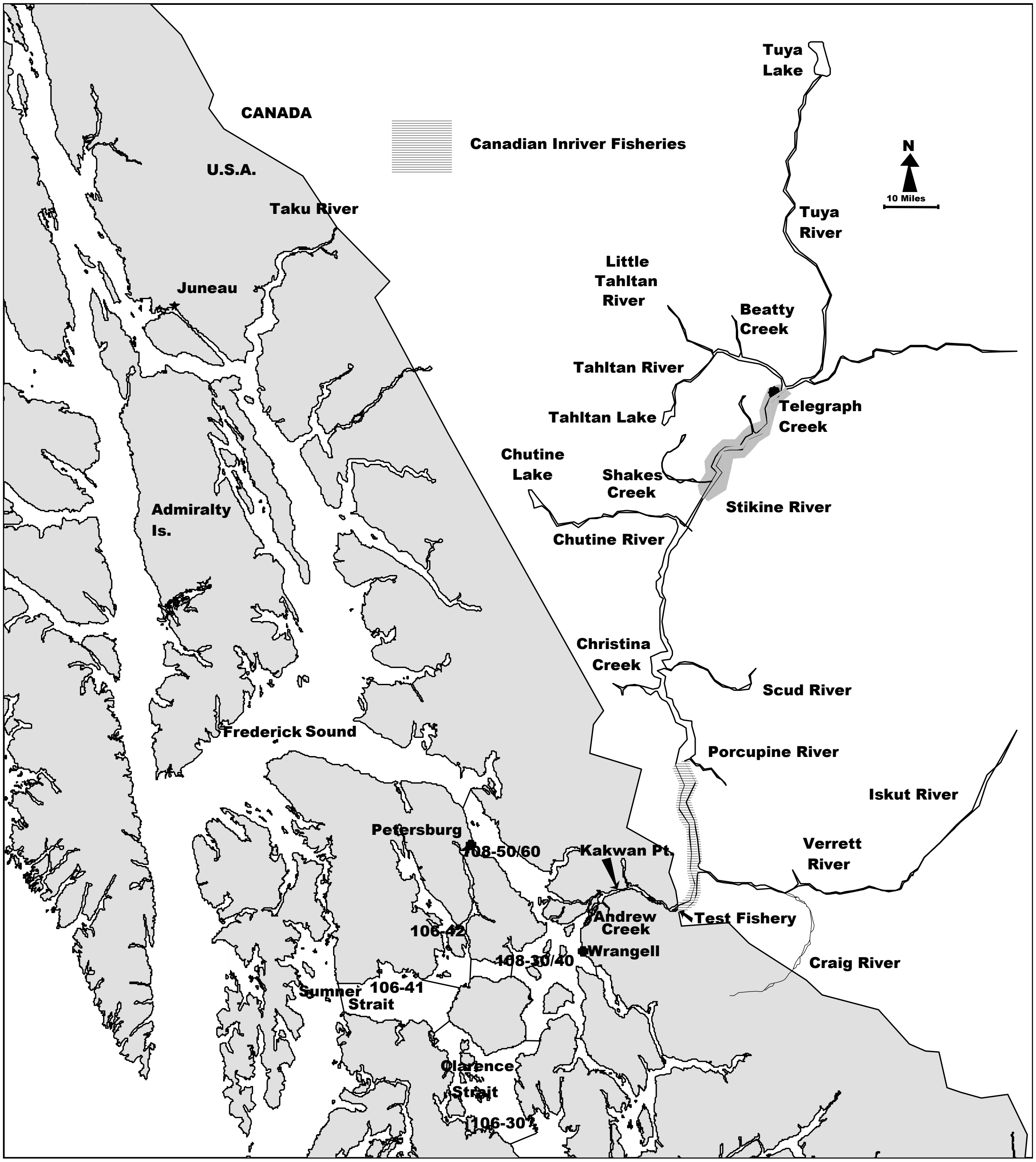

Figure 1.–Stikine River drainage, showing location of principal U.S. and Canadian fishing areas.

among other things, produces pre-season forecasts of abundance for setting annual quotas for fisheries under the jurisdiction of the PST. Hence, data from annual assessments are not only essential for 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) 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 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 terminal run exploitation of these populations 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). Since virtually all fish spawning in the Little Tahltan River spawn above the live 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 have been adjusted. Discontinuation of aerial surveys has been recommended (Bernard et al. 2000).

Historically, spawning escapement to the Stikine River was estimated by multiplying the Little Tahltan River live 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 a mark-recapture experiment.

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 live 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 provided 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

Table 1.–Harvests of chinook salmon in Canadian fisheries in the Stikine River and U.S. fisheries near the mouth of the Stikine River, 1975–2002.

	U. S.		CANADA											
	Dist. 108 gill-net[a]	Wrangell sport through mid-June[b]	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			Small-medium	Large	Small-medium[c]	Large	Small-medium	Large	Small-medium	Large	Small-medium	Large	Small-medium	Large
1975	1,534					178				1,024			-	1,202
1976	1,123					236				924			-	1,160
1977	1,443	1,463				62				100			-	162
1978	531	819				100				400			-	500
1979	91	813	63	712						850			63	1,562
1980	631	1,325		1,488		156				587			-	2,231
1981	283	1,068		664		154				586			-	1,404
1982	1,033	1,426		1,693		76				618			-	2,387
1983	47	1,346	430	492		75			215	851			645	1,418
1984	14	1,133	------	fishery	closed				59	643			59	643
1985	20	1,683	91	256		62			94	793	-	-	185	1,111
1986	102	1,825	365	806	41	104			569	1,026	12	27	987	1,963
1987	149	1,023	242	909	19	109			183	1,183	30	189	474	2,390
1988	207	1,361	201	1,007	46	175			197	1,178	29	269	473	2,629
1989	310	1,966	157	1,537	17	54			115	1,078	24	217	313	2,886
1990	557	2,630	680	1,569	20	48			259	633	18	231	977	2,481
1991	1,366	2,876	318	641	32	117			310	753	16	167	676	1,678
1992	967	2,674	89	873	19	56			131	911	182	614	421	2,454
1993	1,628	2,925	164	830	2	44			142	929	87	568	395	2,371
1994	1,996	1,625	158	1,016	1	76			191	698	78	295	428	2,085
1995	1,702	1,169	599	1,067	17	9			244	570	184	248	1,044	1,894
1996	1,717	1,578	221	1,708	44	41			156	722	76	298	497	2,769
1997	2,566	2,524	186	3,283	6	45			94	1,155	7	30	293	4,513
1998	460	720	359	1,585	0	12			95	538	11	25	465	2,160
1999	1,078	2,411	789	2,127	12	24			463	765	97	853	1,361	3,769
2000	1,692	2,191	936	1,274	2	7			386	1,100	334	389	1,658	2,770
2001	7	2,533	59	826	0	0	12	190	44	665	59	1,442	174	3,123
2002	25	2,149	209	433	3	2	46	420	366	927	323[e]	1,278	947	3,060

[a] Small-medium chinook salmon are not reported in U.S. gillnet catch, not legal in U.S. sport catch.

[b] Hatchery contribution included in U.S. catches.

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

[d] Inriver harvest not estimated prior to 2001.

[e] Chinook and sockeye test fisheries: 1,656 large and 323 small-medium chinook salmon were inspected, and 378 large fish were released.

Table 2.–Index and survey counts of large spawning chinook salmon in tributaries of the Stikine River, 1975–2002. H = helicopter survey, F = foot survey, W = weir count, A = airplane survey; E = excellent visibility, N = normal visibility, P = poor visibility.

Year	Little Tahltan River		Mainstem Tahltan River	Beatty Creek	Andrew Creek	North Arm Creek	Clear Creek[b]
	Peak count	Weir count[a]					
1975	700 E(H)	-	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)	-
1991 – 2000 avg.	2,224	5,863	1,271	276	556	38	15
2001	4,158 N(H)	9,730	-	-	1,054 N(F)	54 N(F)	-
2002	1,131[c] N(H)	7,476	-	-	876 N(F)	34 N(F)	8 N(A)

[a] Above-weir harvest and broodstock collections are removed from weir counts; in 2002, 14 large female fish were removed.

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

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

used to estimate annual spawning escapement abundance (Pahlke and Etherton 1998, 1999, 2000; Pahlke et al. 2000). In 1997, a radio-telemetry study was also conducted to estimate distribution of spawners, in concert with the mark-recapture experiment (Pahlke and Etherton 1999).

Objectives of the 2002 study were:

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

(2) estimate the factor used to expand counts of large chinook salmon at the weir on the Little Tahltan River to spawning abundance in the Stikine River,

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

(4) index abundance of chinook salmon spawning in Andrew Creek, and

(5) estimate age, sex and length composition of chinook salmon spawning in Andrew Creek.

Mark-recapture data were also used to estimate the abundance of small-medium (<660 mm MEF) chinook salmon.

Additionally, results from the study 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 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, Iskut, and Tuya rivers (Figure 1). The lower river and most tributaries are glacially occluded (e.g., Chutine, Scud, 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.

METHODS

KAKWAN POINT AND ROCK ISLAND TAGGING

Drift gillnets 120 ft (36.5 m) long, 18 ft (5.5 m) deep, of 7¼-inch (18.-cm) stretch mesh, were fished near Kakwan Point (Figure 2) between May 9 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. If fishing time was lost because of entanglements, snags, cleaning the net, etc., the lost time (processing time) was added on to the end of the day to bring fishing time to 4 h per net.

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 ft (36.5m) long and 18 ft (5.5 m) deep, between June 20 and August 30, 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 h per day.

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 $\geq$660 mm, as 'medium' if their MEF was 440-659 mm or 'small' if their MEF was <440 mm (Pahlke and Bernard 1996). Fish maturation was judged on a scale from 1 to 4, where 1 is a silver bright fish, 2 is a fish with slight coloration, 3 is a fish with obvious coloration and the onset of sexual dimorphism, and 4 is a fish with the characteristics listed in category 3 that released gametes upon capture. The presence or absence of sea lice (*Lepeophtheirus* sp.) was also noted. General health and appearance of the fish 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" (~5-cm) section of Floy tubing shrunk and laminated onto a 15" (~38-cm) piece of 80-lb (~36.3-kg) monofilament fishing line using a modified design developed by Johnson et al. 1993. The monofilament was sewn through the musculature of the fish approximately ½" (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" (7-mm) diameter hole in the upper (dorsal) portion of its left operculum applied with a paper punch, and by amputation of its left axillary appendage

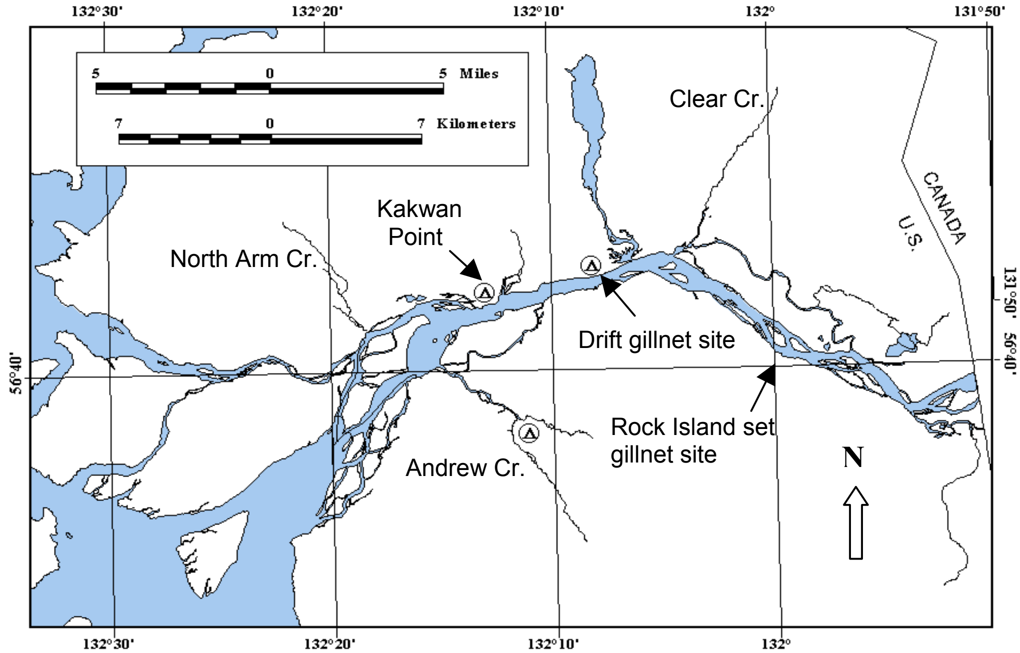

Figure 2.–Locations of drift and set gillnet sites on the lower Stikine River, 2002.

(McPherson et al. 1996). Fish that were seriously injured were sampled but not marked.

UPSTREAM SAMPLING

Pre- and post-spawning fish were sampled at the Little Tahltan River live and carcass weirs and post-spawning fish were speared at Verrett River. The Little Tahltan River flows southeast and empties into the Tahltan River approximately 30 km northwest of Telegraph Creek, British Columbia. As fish accumulated below the live weir across the Little Tahltan River, a portion were captured with dipnets, 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. In addition, some post-spawning fish and carcasses were sampled at a carcass weir upstream of the live weir.

Sampling also occurred at Verrett River, and Andrew, Christina, and Shakes creeks in early August (Figures 1 and 2). Numbers of fish observed were recorded and carcasses and moribund chinook salmon were sampled to obtain scales and information on length, sex, and marks.

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 large chinook salmon $\hat{N}_L$ 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). 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 increases 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 abundance estimate. The number of large marked fish recovered from marine commercial fisheries (District 108) through sampling by CFD was expanded by the sampling fraction and censored from the mark-recapture experiment. All large marked fish caught in the U.S. recreational harvest were assumed to be reported and were also censored from the experiment on a per-tag basis. No large marked fish were recovered in Andrew Creek.

The estimated number of large marked fish available for recapture on the spawning grounds and inriver fisheries was $\hat{M}_L = T_L - \hat{H}_L$, where T_L was the initial number of large marked fish released near Kakwan Point and at Rock Island, and $\hat{H}_L$ was the estimated number of large fish that moved downstream to be caught in U.S. fisheries.

Variance, bias, and confidence intervals for $\hat{N}_L$ were estimated with bootstrap procedures described in Buckland and Garthwaite (1991) as modified in McPherson et al. (1996) by establishing seven capture histories:

Capture history	Large	Source of statistics
Marked, but censored in recreational fishery	2	Returned
Marked, but censored in marine commercial fishery	2	Observed/0.4853
Marked, but censored in Andrew Creek	0	No tagged fish recovered
Marked and not sampled on spawning grounds and inriver fisheries	860	$\hat{M}_L - R_L$
Marked and recaptured on spawning grounds and inriver fisheries	75	R_L
Not marked but captured on spawning grounds and inriver fisheries	4,300	$C_L - R_L$
Not marked and not sampled on spawning grounds or inriver fisheries	48,658	$\hat{N}_L - \hat{M}_L - C_L + R_L$
Effective population for simulations	53,897	$\hat{N}_L^+$

A bootstrap sample was built by drawing with replacement a sample of size $\hat{N}_L^+$ (i.e., 53,897) from the empirical distribution defined by the capture histories. A new set of statistics from each bootstrap sample $\{\hat{M}_L^*, C_L^*, R_L^*, \hat{H}_L^*, T_L^*\}$ was generated, along with the new estimate $\hat{N}_L^*$, and 1,000 such bootstrap samples were drawn creating the empirical distribution $\hat{F}(\hat{N}_L^*)$, which is an estimate of $\mathrm{F}(\hat{N}_L)$. The difference between the average $\overline{\hat{N}}_L^*$ of the bootstrap estimates and $\hat{N}_L$ 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:

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

where B is the number of bootstrap samples.

The abundance of small-medium chinook salmon $\hat{N}_{SM}$ that passed by Kakwan Point and Rock Island was also estimated with Chapman's modification of Petersen's estimator. Variance, bias, and confidence intervals for $\hat{N}_{SM}$ were estimated as described above, but in this case only four capture histories were required because censoring was not necessary:

Capture history	Small-medium	Source of statistics
Marked and not sampled on spawning grounds and inriver fisheries	189	$M_{SM} - R_{SM}$
Marked and recaptured on spawning grounds and inriver fisheries	25	R_{SM}
Not marked but captured on spawning grounds and inriver fisheries	873	$C_{SM} - R_{SM}$
Not marked and not sampled on spawning grounds or inriver fisheries	6,346	$\hat{N}_{SM} - M_{SM} - C_{SM} + R_{SM}$
Effective population for simulations	7,433	$\hat{N}_{SM}^+$

The spawning escapement of large $\hat{N}_{L,esc}$ and small-medium $\hat{N}_{SM,esc}$ chinook salmon was estimated by subtracting the respective inriver harvest of large and small-medium fish from $\hat{N}_L$ and $\hat{N}_{SM}$. Confidence intervals and associated variances were estimated per the procedures described above. 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 $v(\hat{N}_{SM,esc})$.

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, since temporal mixing can not occur in the experiment. Assumption (a) also implies that sampling is not size-selective. If capture on the spawning grounds were not size-selective, fish of different sizes would be captured with equal probability. If assumption (a) were 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, the lower river chinook test fishery, Andrew Creek, Verrett River, and the Little Tahltan River live and carcass weirs were processed at the ADF&G Scale Aging Lab in Douglas; the lower river sockeye test and commercial gillnet fisheries samples were processed at the DFO lab in Nanaimo, B.C.

Estimated age compositions for the Little Tahltan and Verrett rivers were compared with Fisher's exact (for small samples) or chi-square tests to determine if the samples could be pooled and used to estimate spawning population proportions. For these tests, age-0. and -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 Verrett rivers:

$$\hat{p}_{ij} = \frac{m_{ij}}{m_i} \tag{2}$$

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

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 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*:

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

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

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

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

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

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

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

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 9 and July 31 at Kakwan Point and Rock Island, 939 large (≥660 mm MEF), 162 medium (440–659 mm MEF), and 52 small (<440 mm MEF) chinook salmon were initially captured, marked, and released (Table 3).

Drift gillnet effort near Kakwan Point was maintained at 4 h per net per day (two nets fishing), although reduced sampling effort occurred on several days (Figure 3). From May 9 through July 7, 872 large and 78 small-medium chinook salmon were captured; one fish with a missing adipose fin was recovered, but the head was lost (Appendices A1 and A11). Catch rates ranged from 0 to 5.20 large fish/hour, and the highest catch occurred on May 26 when 42 large fish were captured (Figure 4). The date of 50% cumulative catch of large fish was June 1. Catch rates for small-medium fish ranged from 0 to 0.62 fish/hour, and the date of 50% cumulative catch of small-medium fish was June 11. 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, 149 sockeye salmon were captured and released (Appendix A1).

Table 3.–Numbers of chinook salmon marked on lower Stikine River, removed by fisheries and inspected for marks in tributaries in 2002, by size category. Numbers in **bold** were used in mark-recapture estimates.

		Length (MEF) in mm			
		0-439 (small)	440-659 (med.)	≥660 (large)	Total
A. Released at Kakwan Point		0	78	869	947
B. Released at Rock Island		52	84	70	206
C. Removed by:					
1. U.S. fisheries		0	0	2 [a]	2
2. U.S experimental troll		0	0	2 [b]	2
3. Andrew Creek		0	0	0	0
Subtotal of removals		0	0	4	4
D. Estimated number of marked fish remaining in mark-recapture experiment		**52**	**162**	**935**	1,149
E. Canadian recreational fisheries	harvested [c]	6	40	420	466
Tahltan River	marked	0	0	5	5
	marked/harvested	0.0000	0.0000	0.0119	0.0107
F. Inspected at:					
1. L. Tahltan live weir	inspected	45	125	**1,096**	1,266
	marked	0	2	**14**	16
	marked/inspected	0.0000	0.0160	0.0128	0.0126
2. L. Tahltan carcass weir	inspected	97	86	154	337
	marked	0	0	4	4
	marked/inspected	0.0000	0.0000	0.0260	0.0119
3. Verrett River	inspected	1	16	**263**	280
	marked	0	2	**3**	5
	marked/inspected	0.0000	0.1250	0.0114	0.0179
Subtotal: L. Tahltan/Verrett	inspected	143	227	1,513	1,883
	marked	0	4	21	25
	marked/inspected	0.0000	0.0176	0.0139	0.0133
G. Lower river commercial/test[d] gillnet	harvested [e,f,g]	**68**	**464**	**2,089**	2,621
	marked	**4**	**12**	**41**	57
	marked/harvested	0.0588	0.0259	0.0196	0.0217
I. Upper river gillnet	harvested[h]	**41**	**325**	**927**	1,293
Aboriginal	marked	**0**	**9**	**17**	26
	marked/harvested	0.0000	0.0277	0.0183	0.0201
Subtotal: lower river/ upper river gillnet	harvested	**109**	**789**	**3,016**	3,914
	marked	**4**	**21**	**58**	83
	marked/harvested	0.0367	0.0266	0.0192	0.0212
Total: L. Tahltan, Verrett lower river/upper river gillnet	inspected	252	1,016	4,529	5,797
	marked	4	25	79	108
	marked/inspected	0.0159	0.0246	0.0185	0.0186
H. Other upriver recoveries:					
1. Shakes Creek	inspected	11	9	7	27
	marked	0	0	0	0
	marked/inspected	0.0000	0.0000	0.0000	0.0000
2. Christina Creek	inspected	5	39	58	102
	marked	0	0	1	1
	marked/inspected	0.0000	0.0000	0.0172	0.0098
Subtotal: other upriver recoveries	inspected	16	48	65	129
	marked	0	0	1	1
	marked/inspected	0.0000	0.0000	0.0154	0.0078
Andrew Creek	inspected	7	20	183	210
	marked	0	0	0	0
	marked/inspected	0.0000	0.0000	0.0000	0.0000

-continued-

Table 3.–Page 2 of 2.

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[a] Voluntary returns.

[b] The number of large marked chinook salmon recovered in the experimental troll fishery (1) was expanded by the fraction sampled by the CFD during port sampling operations (478 sampled/985 harvested).

[c] The Canadian recreational harvest of 466 fish was apportioned into size categories based on the Tahltan River creel length sample data: (4/305)466 = 6 small, (26/305)466 = 40 medium, (275/305)466 = 420 large.

[d] Chinook and sockeye salmon test fisheries.

[e] The lower river test fishery harvest of 323 small-medium fish was apportioned into small and medium size categories using length sample data collected during the test fishery: (15/71)323 = 68 small, (56/71)323 = 255 medium.

[f] The lower river commercial fishery harvest of 209 small-medium fish was apportioned into small and medium size categories using length sample data collected during the commercial fishery: 0/24(209) = 0 small, 24/24(209) = 209 medium.

[g] 378 of 1,659 large fish inspected were released during the chinook test fishery.

[h] The aboriginal harvest of 366 small-medium fish was apportioned into small and medium size categories using length sample data collected during the aboriginal fishery: (6/53)366 = 41 small, (47/53)366 = 325 medium.

Set gillnet effort at Rock Island was maintained at about 7.0 h 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 June 20 through August 30, 79 large and 143 small-medium chinook salmon were captured (Appendix A2), but as previously noted, only fish captured through July 31 were included in the experiment to preclude inclusion of post-spawn fish. One fish with a missing adipose fin was recovered (Appendix A11). Catch rates ranged from 0 to 1.87 large fish/hour, and the highest catch occurred on June 23 when 14 large fish were captured (Figure 6). Catch rates for small-medium fish ranged from 0 to 1.87 fish/hour, and the highest catches occurred on June 23 and June 30 when 14 small-medium fish were captured each day (Figure 6). In addition, 1,565 sockeye salmon were captured (Appendix A2).

UPSTREAM SAMPLING

The lower river test and commercial gillnet fisheries began May 8 and June 23, respectively, and harvested 1,711 large and 532 small-medium chinook salmon. An additional 378 large fish were inspected and released. Forty-one (41) large and 16 small-medium chinook salmon with tags were recovered. The aboriginal fishery near Telegraph Creek harvested 927 large and 366 small-medium chinook salmon and 26 tags were recovered. The upper river commercial fishery harvested 2 large and 3 small-medium fish, and no tags were recovered. Five (5) large marked fish were reported from the Canadian recreational fishery on the Tahltan River, sampled in 2002; an estimated 420 large and 46 small-medium chinook were harvested. Two (2) large marked fish were reported from the recreational fishery near Petersburg and Wrangell, and all marked fish in the recreational harvest were presumably reported. One tag, which was expanded to two based on the sampling fraction, was recovered during CFD port sampling operations from a large fish that was caught in the U.S. District 108 experimental troll fishery (Tables 1 and 3).

Technicians examined 1,266 chinook salmon for marks at the Little Tahltan River live weir, of which 1,096 were large fish. Fourteen (14) large marked fish were recovered, and none of these fish had lost its numbered tag. Two (2) small-medium marked fish were also recovered, and none of these had lost its tag. An additional 337 (97 small, 86 medium, and 154 large) previously unsampled carcasses were examined above the weir, of which 4 large fish were marked; none of these had lost their tags (Table 3).

At Verrett River, 280 live and dead chinook salmon were examined (1 small, 16 medium, and 263 large); five (5) marked fish were recovered, and none of these had lost its tag (Table 3).

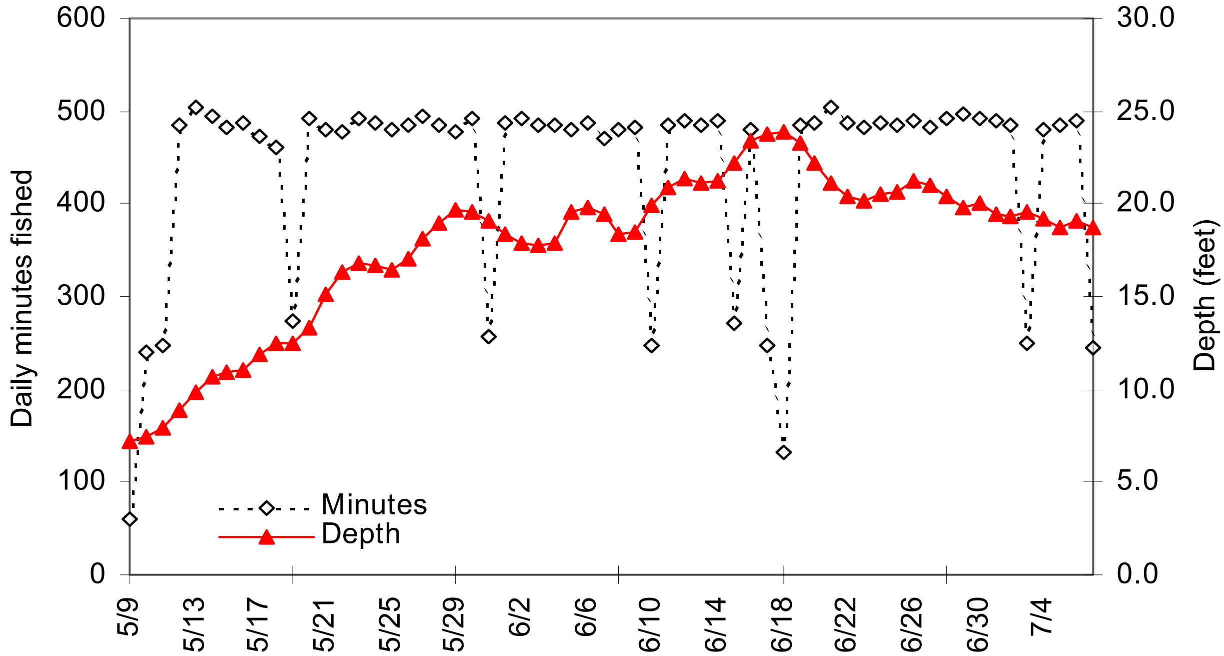


Figure 3.–Daily drift gillnet fishing effort (minutes) **and river depth** (feet) **near Kakwan Point, lower Stikine River, 2002.**

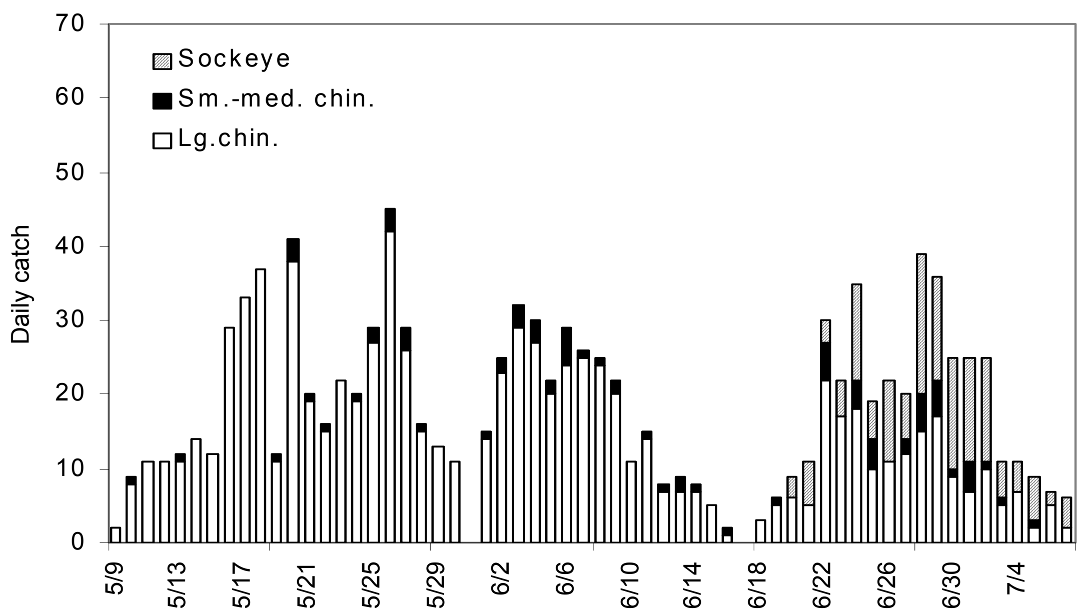


Figure 4.–Daily catch of chinook and sockeye salmon near Kakwan Point, lower Stikine River, 2002.

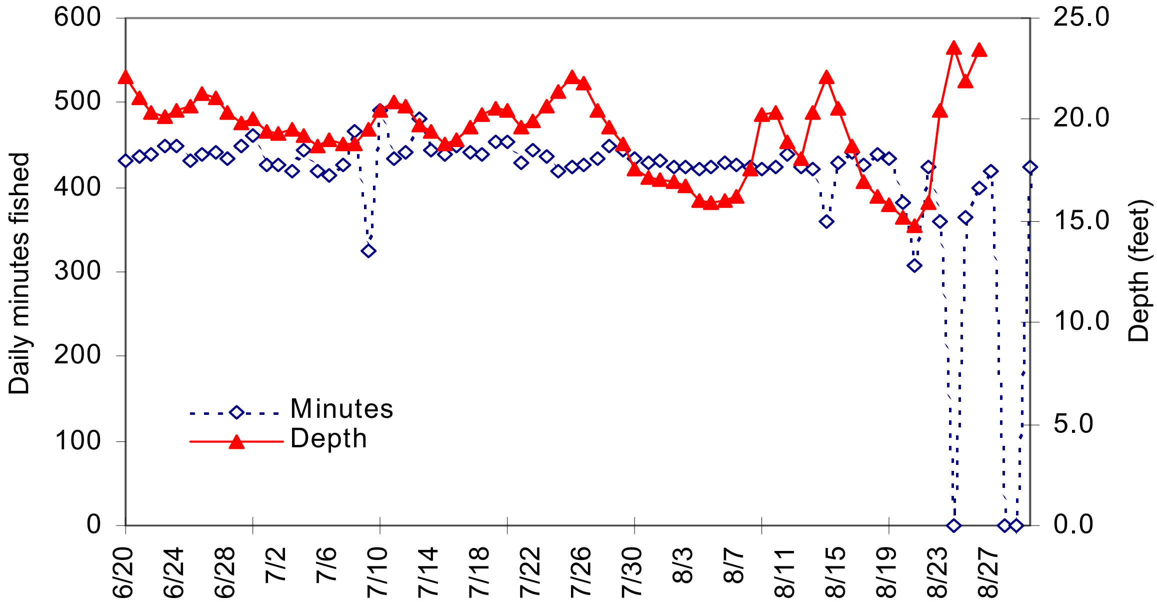


Figure 5.–Daily set gillnet fishing effort (minutes) and river depth (feet) at Rock Island, lower Stikine River, 2002.

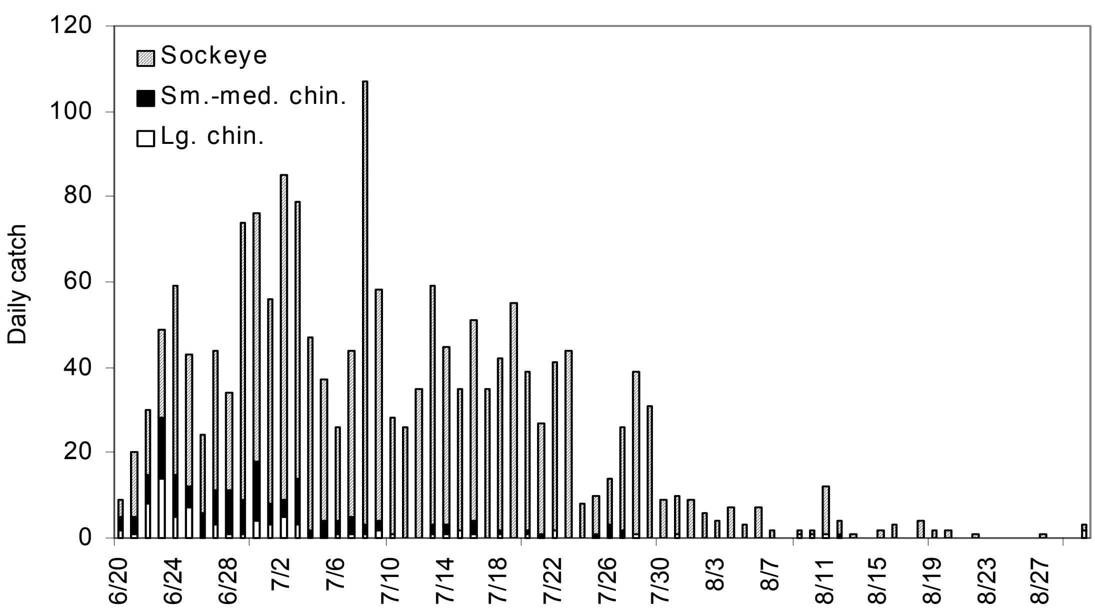


Figure 6.–Daily catch of chinook and sockeye salmon at Rock Island, lower Stikine River, 2002.

At Andrew Creek, 210 (7 small, 20 medium and 183 large) fish were examined in 2002. No tags were recovered.

In addition to sampling at the Little Tahltan and Verrett rivers and Andrew Creek, the 2002 crew sampled fish at Christina and Shakes creeks, which are located upstream of the U.S./Canada border. Of 129 chinook salmon examined (16 small, 48 medium, and 65 large), only one had a tag (Table 3).

ABUNDANCE OF LARGE CHINOOK SALMON

The estimated abundance of large chinook salmon passing above Kakwan Point and Rock Island, based on fish inspected at Little Tahltan live weir and samples from Verrett River, the lower river commercial and test gillnet fisheries, and the aboriginal fishery is 53,893 salmon (SE = 5,912; bias = 0.31%; 95% CI: 43,798 to 67,023; $\hat{M}_L$ = 935, C = 4,375, R = 75). For this estimate, all large marked fish intercepted by U.S. experimental troll (2 fish) and recreational fisheries (2 fish, assuming all marked fish in the recreational harvest were reported) were censored from the experiment (Table 3).

Evidence from upstream sampling supports the supposition that every large chinook salmon passing by Kakwan Point and Rock Island had a near equal chance of being marked regardless of when they passed these sites. The majority of fish bound for the Little Tahltan River pass by these sites in May and June, and the majority of fish bound for Verrett River pass by in June and early July (Pahlke and Etherton 1999). The Little Tahltan live weir was operated from mid-June through late August, the lower river commercial and test gillnet fisheries began in May and June, respectively, and the aboriginal fishery began in June; all fisheries continued into and/or through August. Therefore the live weir and inriver fisheries would intercept fish passing by Kakwan Point and Rock Island from early May through July. Marked fractions (Table 3) estimated for large fish at the Little Tahltan live weir (0.0128), Verrett River (0.0114), the lower river commercial and test gillnet fisheries (0.0196), and the aboriginal fishery (0.0183) were not significantly different (χ^2 = 2.52, df = 3, P = 0.47). Recovery rates for large chinook salmon tagged at Kakwan Point and Rock Island during the period of project overlap (June 20 to July 7) were also compared:

	Kakwan Point	Rock Island
Released	179	56
Recaptured	6	6
Fraction	0.0335	0.1071

These marked fractions were not significantly different (Fisher's exact, P = 0.08), though power of the test was low.

Size-selective sampling among large fish did not appear to occur during events 1 or 2 (Appendix A3). The size distributions of fish marked at Kakwan Point and Rock Island versus combined samples of fish inspected at the live weir on the Little Tahltan River, Verrett River, in the lower river commercial and test gillnet fisheries, and in the aboriginal fishery were not significantly different (Kolmogorov-Smirnov: d_{max} = 0.026; n = 934, 2,065; P = 0.75; Figure 7). The size distributions of fish marked and recaptured also were not significantly different (Kolmogorov-Smirnov: d_{max} = 0.071; n = 934, 75; P = 0.85; Figure 8).

Additional evidence from upstream sampling also supports 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 live weir, the 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 (849 mm MEF) to permit comparison of marked fractions:

	660 – 849 mm	>849 mm
Marked	32	43
Unmarked	2,086	2,214
Marked	0.015	0.019

These marked fractions were not significantly different (χ^2 = 1.01, df = 1, P = 0.31).

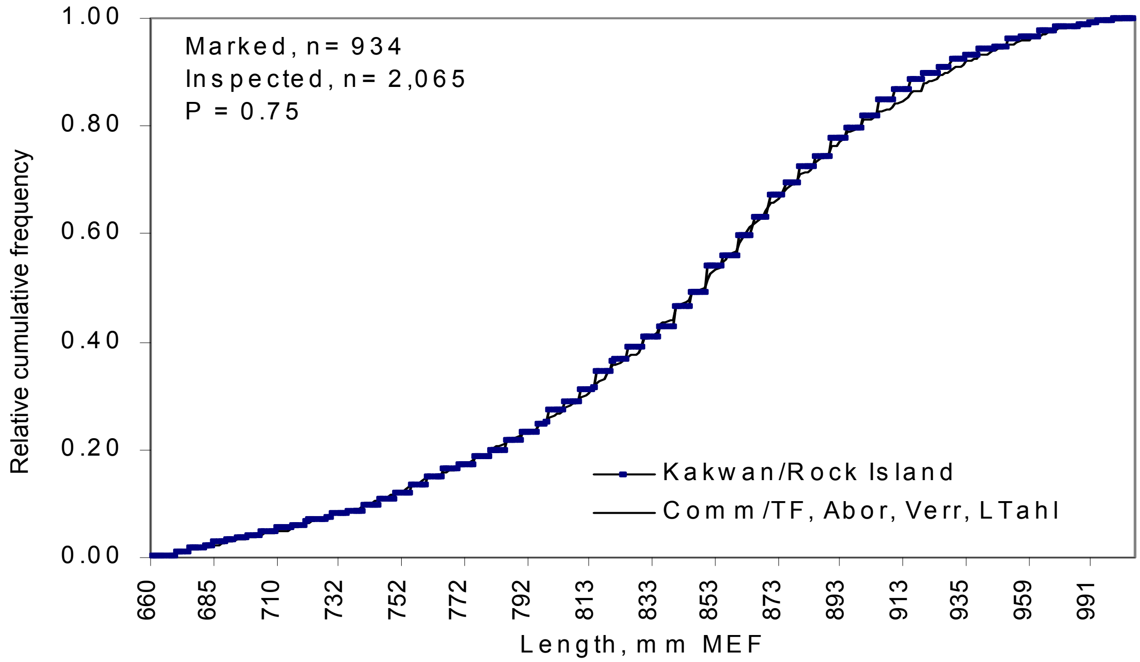


Figure 7.–Cumulative relative frequency of large chinook salmon (≥660 mm MEF) **captured at Kakwan Point and Rock Island, and inspected at the live weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, Stikine River, 2002.**

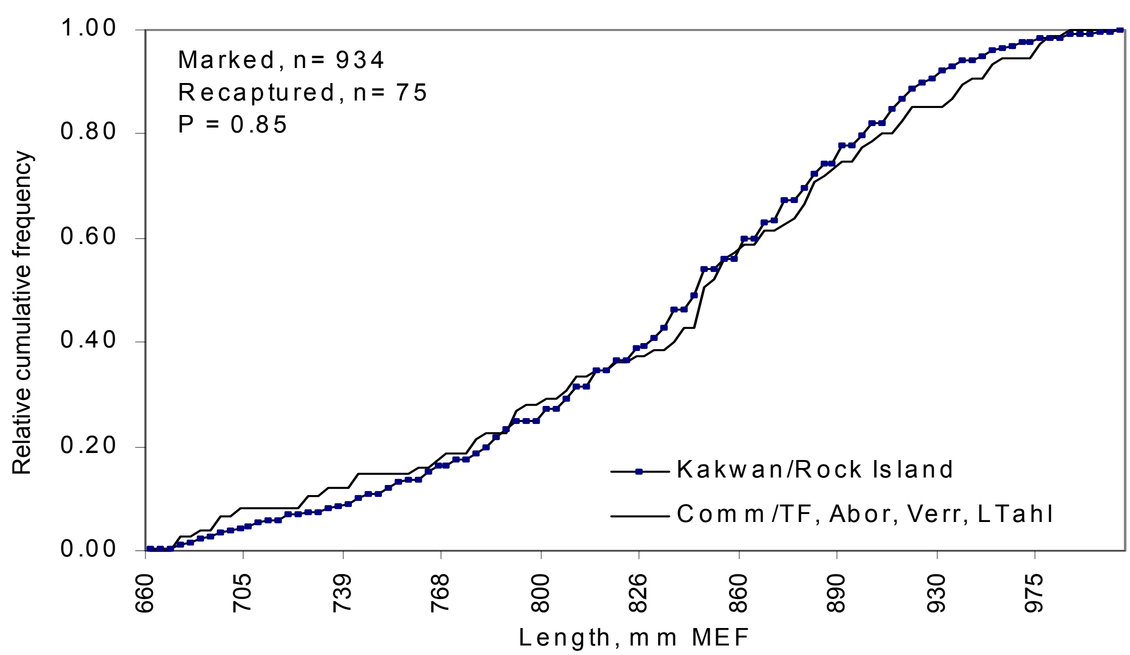


Figure 8.–Cumulative relative frequency of large chinook salmon (≥660 mm MEF) **captured at Kakwan Point and Rock Island, and recaptured at the live weir on the Little Tahltan River, at Verrett River, in the lower river commercial and test fisheries, and in the aboriginal fishery, lower Stikine River, 2002.**

Finally, evidence from upstream sampling also supports 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 live 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. After censoring marked fish that were removed by U.S. recreational and experimental troll fisheries (two fish ≤849 and two fish >849 mm MEF), the fractions (rates) of recaptured fish were compared as surrogates for probabilities of capture upstream:

	660–849 mm	>849 mm
Released	459	476
Recaptured	32	43
Fraction recaptured	0.070	0.090

These fractions recaptured were not significantly different (χ^2 = 1.15, df = 1, P = 0.28).

The peak count on Andrew Creek was 876 large fish (foot survey, August 16). 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 1,752 large fish.

ABUNDANCE OF SMALL-MEDIUM CHINOOK SALMON

A sufficient number of small-medium chinook salmon were marked and recaptured in 2002 to estimate abundance. The estimated abundance of small-medium fish passing by Kakwan Point and Rock Island, based on samples from the lower river commercial and test gillnet fisheries, and the aboriginal fishery is 7,433 (SE = 1,511; bias = 3.41%; 95% C.I.: 5,522, 11,370; M = 214, C = 898, R = 25).

Marked fractions in the lower river commercial and test gillnet fisheries and aboriginal fishery samples support 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. These fisheries are geographically separated (lower river vs. upper river), and as previously noted, exploit fish passing by Kakwan Point and Rock Island from early May through July by virtue of their periods of operation. Small-medium fish inspected and/or harvested in the inriver fisheries were pooled and marked fractions were compared:

	Lower river comm./test	Aboriginal
Inspected/ harvested	532	366
Marked	16	9
Fraction recaptured	0.030	0.025

The marked fractions were not significantly different (χ^2 = 0.228, df = 1, P = 0.63). Recovery rates for large chinook salmon tagged at Kakwan Point and Rock Island during the period of project overlap (June 20 to July 7) were also compared:

	Kakwan Point	Rock Island
Released	33	117
Recaptured	6	13
Fraction recaptured	0.182	0.111

The marked fractions were not significantly different (Fisher's exact, P = 0.39).

Small-medium chinook salmon appeared to have a near equal chance of being *marked* regardless of their size. Pooled length samples from the lower river commercial and test fisheries and the aboriginal fishery were arbitrarily split into two groups at the median length of small-medium fish (544 mm MEF) to permit comparison of marked fractions:

	≤544 mm	545–659 mm
Marked	12	13
Unmarked	437	436
Marked fraction	0.027	0.030

These marked fractions were not significantly different (χ^2 = 0.04, df = 1, P = 0.84).

Every small-medium chinook salmon also appeared to have a near equal chance of being *captured* upstream regardless of their size. Pooled length samples of small-medium fish from the lower river commercial and test fisheries and the aboriginal fishery were again split into two size groups as were samples of small-medium fish marked at Kakwan Point and Rock Island (one unmeasured age-1.2 male that was released at Rock Island was included in the ≤544 mm group because the average length of age-1.2 males released at this site was 450 mm MEF). The fractions (rates) of recaptured fish were compared as surrogates for probabilities of capture upstream:

	≤544 mm	545–659 mm
Released	100	114
Recaptured	12	13
Fraction recaptured	0.120	0.114

The marked fractions were not significantly different (χ^2 = 0.01, df = 1, P = 0.90).

Although there was little evidence supporting size-selective sampling of small-medium chinook salmon, size distributions of fish marked at Kakwan Point and Rock Island versus samples of fish inspected in the lower river commercial and test gillnet fisheries and the aboriginal fishery were significantly different (Kolmogorov-Smirnov: d_{max} = 0.125; n = 213, 167; P = 0.09; Figure 9). The size distributions for marked and recaptured fish were not significantly different (Kolmogorov-Smirnov: d_{max} = 0.160; n = 213, 25; P = 0.56; Figure 10), but the recapture sample may have been too small to detect a difference. The results of these tests suggest that size-selective sampling occurred during events 1 and 2 (Case III, Appendix A3).

Abundance estimates were subsequently generated for two length groups (≤544 mm and 545 – 659 mm MEF). Estimated abundance of fish ≤544 mm was 3,495 (SE = 859, M = 100, C = 449, R = 12); for fish 545 – 659 mm, abundance was estimated at 3,695 (SE = 880, M = 114, C = 449, R = 13). Combining the strata estimates yielded an overall estimate of 7,191 small-medium fish. Because the stratified estimate was similar to the unstratified estimate (bias = 3.3%), the unstratified estimate of 7,433 was accepted.

AGE, SEX, AND LENGTH COMPOSITION

Age-1.4 chinook salmon dominated all samples except those from Rock Island and the Little Tahltan River carcass weir, constituting an estimated 70% of fish captured at Kakwan Point, 21% at Rock Island, 74% in the lower river test and commercial fisheries, 73% at Verrett River, 64% at the Little Tahltan River live weir, 31% at the Little Tahltan River carcass weir, and 60% at Andrew Creek (Appendices A4-A10). The predominance of age-1.4 (1996 brood year) chinook salmon in 2002 follows a strong return of age-1.3 fish in 2001, when this age class accounted for 75% of the spawning escapement (Der Hovanisian et al. 2003). Age-1.2 fish dominated the Rock Island sample (39%), and age-1.1 fish the Little Tahltan carcass weir sample (28%).

Estimated age compositions from the Little Tahltan River live weir and Verrett River samples were compared to determine if they could be pooled and used to estimate spawning population proportions. Within the small-medium size category, age composition estimates for age-1.1 and –1.2 fish were not significantly different (Fisher's exact, P = 0.69), nor were estimates for age-1.2 and –1.3 fish (Fisher's exact, P = 1.0) and age-1.1 and –1.3 fish (Fisher's exact, P = 1.0). Among large fish, composition estimates were similar for age-1.3 and –1.4 fish (χ^2 = 1.89, df = 1, P = 0.17). Composition estimates across size categories were significantly different (χ^2 = 8.57, df = 2, P = 0.01), but comparisons by size category suggested that the all-size comparison was not biologically significant, so the Little Tahltan River live weir and Verrett River samples were pooled.

Spawning escapement by age and sex (Table 4) for chinook salmon of all sizes was estimated on the basis of combined samples collected at the Little Tahltan River live weir and Verrett River. The estimated spawning escapement of 57,366 (SE = 6,102, bias = 0.73%, 95% CI: 47,112 to 70,760) was composed of 9% age-1.2 fish, 23% age-1.3 fish, and 65% age-1.4 fish, and included 31,449 (SE = 3,719) females.

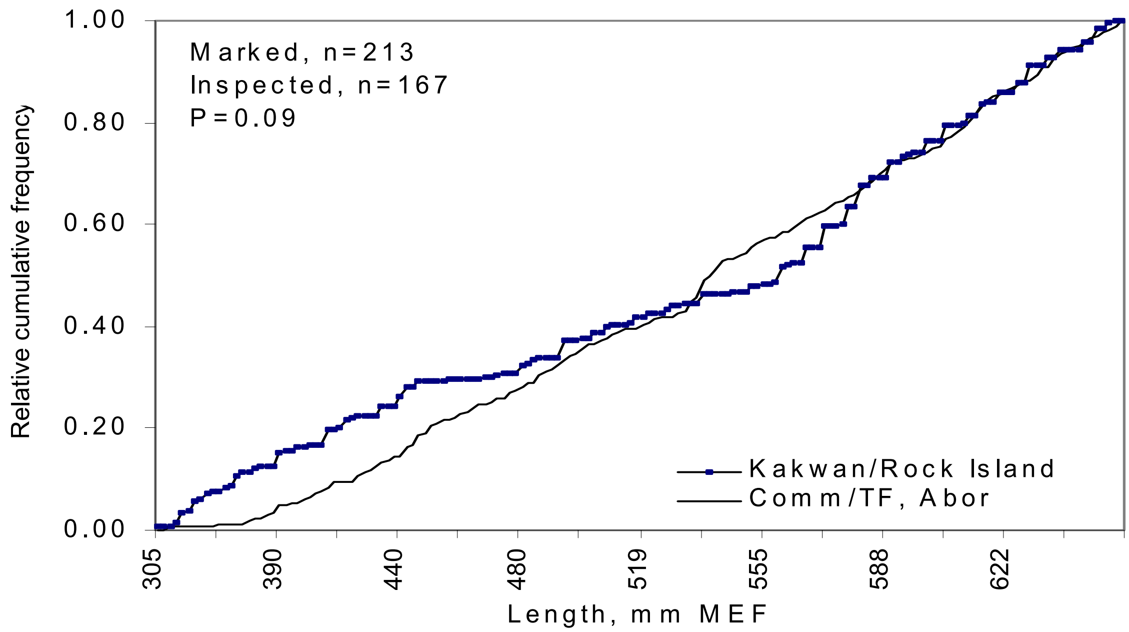


Figure 9.–Cumulative relative frequency of small-medium chinook salmon (<660 mm MEF) **captured at Kakwan Point and Rock Island, and inspected in the lower river commercial and test fisheries and the aboriginal fishery, Stikine River, 2002.**

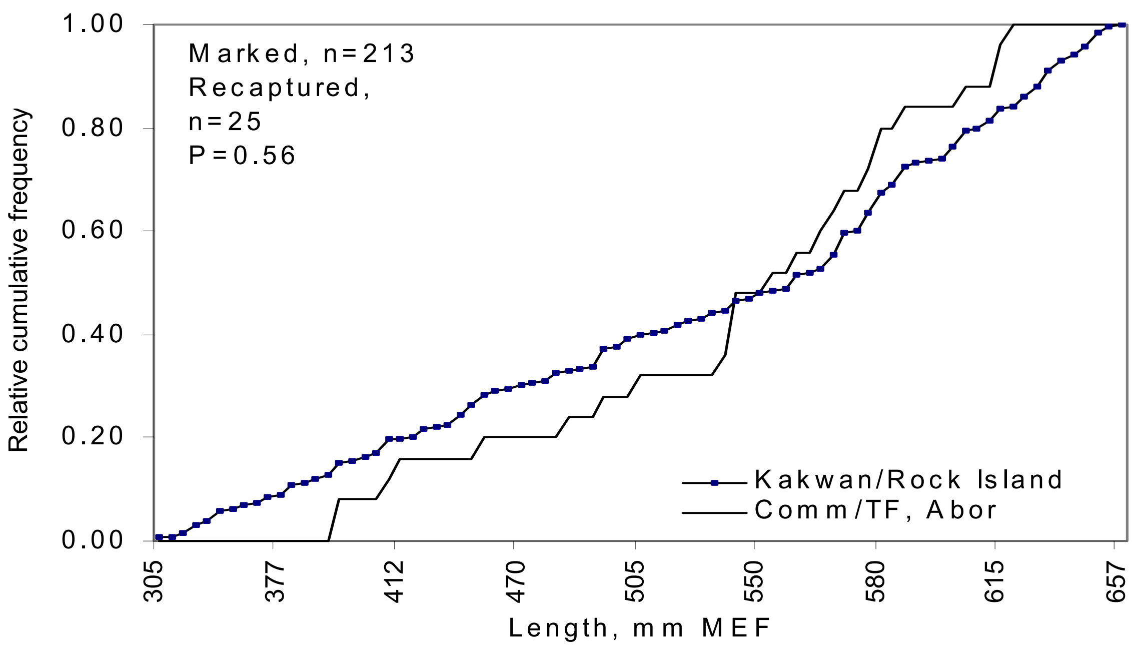


Figure 10.–Cumulative relative frequency of small-medium chinook salmon (<660 mm MEF) **captured at Kakwan Point and Rock Island, and recaptured in the lower river commercial and test fisheries and the aboriginal fishery, Stikine River, 2002.**

Table 4.–Estimated age and sex composition by size category of the spawning escapement of chinook salmon in the Stikine River, 2002.

		Brood year and age class									
		1999	1998	1998	1997	1997	1996	1996	1995	1995	
		1.1	2.1	1.2	2.2	1.3	2.3	1.4	2.4	1.5	Total
PANEL A. Small and medium chinook salmon (<660 mm MEF)											
Females	n			3				1			4
	%			2.5				0.8			3.4
	SE of %			1.5				0.8			1.7
	Escapement			165				55			220
	SE of esc.			100				55			117
Males	n	19		84		11					114
	%	16.1		71.2		9.3					96.6
	SE of %	3.4		4.2		2.7					1.7
	Escapement	1,045		4,621		605					6,271
	SE of esc.	322		1,095		220					1,464
Combined	n	19		87		11		1			118
	%	16.1		73.7		9.3		0.8			100.0
	SE of %	3.4		4.1		2.7		0.8			0.0
	Escapement	1,045		4,786		605		55			6,491
	SE of esc.	324		1,144		221		55			1,511
PANEL B. Large chinook salmon (≥660 MEF)											
Females	n					128		445	4		577
	%					13.6		47.3	0.4		61.4
	SE of %					1.1		1.6	0.2		1.6
	Escapement					6,928		24,084	216		31,229
	SE of esc.					984		2,917	110		3,717
Males	n			7		106		247	2	1	363
	%			0.7		11.3		26.3	0.2	0.1	38.6
	SE of %			0.3		1.0		1.4	0.2	0.1	1.6
	Escapement			379		5,737		13,368	108	54	19,646
	SE of esc.			148		846		1,715	77	54	2,420
Combined	n			7		234		692	6	1	940
	%			0.7		24.9		73.6	0.6	0.1	100.0
	SE of %			0.3		1.4		1.4	03	0.1	0.0
	Escapement			379		12,665		37,453	325	54	50,875
	SE of esc.			148		1,635		4,413	137	54	5,912
PANEL C. Small, medium and large chinook salmon											
Females	n			3		128		446	4		581
	%			0.3		12.1		42.1	0.4		54.8
	SE of %			0.2		1.1		1.9	0.2		2.1
	Escapement			165		6,928		24,139	216		31,449
	SE of esc.			100		984		2,918	110		3,719
Males	n	19		91		117		247	2	1	477
	%	1.8		8.7		11.1		23.3	0.2	0.1	45.2
	SE of %	0.6		1.9		1.0		1.4	0.1	0.1	2.1
	Escapement	1,045		5,000		6,342		13,368	108	54	25,917
	SE of esc.	324		1,118		875		1,715	77	54	2,828
Combined	n	19		94		245		693	6	1	1,058
	%	1.8		9.0		23.1		65.4	0.6	0.1	100.0
	SE of %	0.6		2.0		1.4		2.3	0.2	0.1	0.0
	Escapement	1,045		5,165		13,270		37,508	325	54	57,366
	SE of esc.	324		1,153		1,650		4,413	137	54	6,102

DISCUSSION

In the initial years of this study, there were inconsistencies between the results from tests for size-selective sampling and the length distribution of samples of large fish taken at Kakwan Point and the spawning grounds. Capture probabilities suggested that selective sampling had not occurred, whereas length distributions implied that it had. These discrepancies were attributed to differences in migratory timing among stocks, differences in the size of fish across stocks, and differences in time of sampling. Chinook salmon spawning in the Little Tahltan River tend to pass Kakwan Point earlier than do fish bound for Verrett River and are larger (but not older), while Verrett River fish enter later and are usually smaller (but not younger) than chinook salmon spawning in other tributaries. The commercial and test fisheries also began after half the run passed Kakwan Point, which consequently resulted in interception of smaller fish. In 2000 through 2002 we augmented catches of chinook salmon at Kakwan Point with fish captured at Rock Island. Because the tagging operation at Rock Island extends into August and a smaller mesh net is used, smaller fish late in the run are tagged more intensively than they had been in the past. In 2001 and 2002, we started the test fishery at the same time tagging at Kakwan Point was initiated, thereby increasing the opportunity to inspect fish early in the run during event 2. The net effect has been that length distributions of large fish sampled during events 1 and 2 are similar (Figures 7 and 8). The marked sample in 2002 also had the second highest number of small and medium fish to date (214 versus 86, 237, 58, 24, 28, and 43 in 2001, 2000, 1999, 1998, 1997, and 1996, respectively).

In the 1996 study, discrepancies among estimates of abundance and observed tagging rates in samples arose because of sampling problems at Kakwan Point. Daily catch is dependent not only on effort, but also on river conditions (stage), which can change dramatically from day to day. In an attempt to correct these problems, we added another technician to the tagging crew in 1997. We were able to increase the total fishing effort at Kakwan Point from 362 net-hours in 1996 to about 450 net-hours in subsequent years, thus maintaining a higher level of effort. With addition of the Rock Island project in 2000, fishing effort was substantially increased. We also increased the sample size of fish physically inspected at the Little Tahltan weir and Verrett River. The fractions marked in samples of large fish taken at the Little Tahltan River, Verrett River, the lower river commercial and test fisheries, and the aboriginal fisheries were not statistically nor meaningfully different in 2002, indicating every fish had an essentially equal chance of being marked in event 1. This was in spite of high water conditions that affected the catch per net hour at Kakwan around mid-June (Figure 3). The setnet operation at Rock Island and high water conditions, which may delay migrant fish, could have offset the reduction in fishing efficiency at Kakwan Point.

To make the abundance estimate of large chinook salmon that passed by Kakwan Point and Rock Island comparable to other estimates of spawning escapement, harvests in the commercial, test, and aboriginal fisheries should be subtracted. The final estimate of the spawning escapement for large chinook salmon above the U.S./Canada border in 2002 is 50,875 (= 53,893-3,018).

The expansion factor of 6.79 (50,875/7,490) for 2002 is the largest expansion factor estimated thus far and the average expansion factor of 5.42 is greater than the factor of 4.0 (25% of the spawning escapement) that was traditionally used to expand weir counts in the Little Tahltan River:

Year	Estimated expansion	SE	Source
1996	6.00	0.41	M-R experiment[a]
1997	4.86	0.53	M-R experiment[b]
1997	5.48	0.95	Telemetry study
1998	5.32	0.81	M-R experiment
1999	4.21	0.68	M-R experiment
2000	4.15	0.48	M-R experiment
2001	6.52	0.60	M-R experiment
2002	6.79	0.79	M-R experiment
Avg[c]	**5.42**	**0.99**	

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

[b] Modified from data in Pahlke and Etherton (1999).

[c] The mean expansion factor is 5.42 with an estimated SD of 0.99 (= $\sqrt{\text{var}(6.00,4.86,...6.79)}$.

Estimated age compositions for the population in the Stikine River tend to differ from those in the nearby Taku River. Age-1.1 and -1.2 fish are common in the Taku chinook salmon run, often making up 20% or more of the return. These age classes usually constitute a much smaller percentage of the Stikine River run, but were more prevalent in 1999 and 2000 (about 23 and 31% of the spawning escapement, respectively), rivaling returns to the Taku River. In 2002, fish <660 mm MEF constituted 55% of the carcass weir sample collected above the Little Tahltan River live weir, while this group was only 13% of the weir sample. This suggests that the smaller fish may be able to pass through the weir unobserved, or are misidentified. However, carcass weirs tend to be biased towards males, which tend to be younger, smaller fish (McPherson et al. 1996).

Chinook salmon of hatchery origin were not found in samples collected in Andrew Creek in 2002. However, two fish with missing adipose fins were recovered in the mainstem river, one during tagging operations at Kakwan Point, and one at Rock Island. One had been tagged and released at the Stikine River in 2000 (1998 brood year), and the head from the second fish was lost (Appendix A11). The second fish was ≥660 mm MEF and, because age-1.1 and –1.2 fish were expected back from coded-wire tag releases in 2000 and 2001, it is unlikely that this fish was of Stikine River origin.

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. In 2002 we continued to test the feasibility of using a mark-recapture experiment to estimate the 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 from early May to the beginning of the lower river commercial fishery on June 23. Travel time between the tagging and test fishery sites has averaged 13 days, so the release and recovery data were lagged accordingly. The data were temporally stratified and analyzed with the computer program SPAS (Arnason et al. 1996). The earliest possible estimate was based on release data through May 26 and recovery data through June 8:

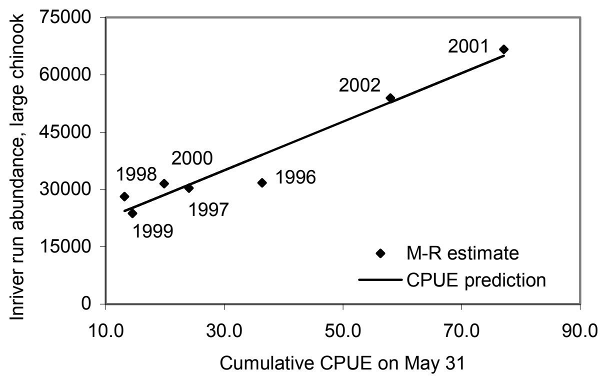
Release strata, *i*	Recovery strata, *j*		
	5/9-5/18	5/19-6/8	Released
5/9-5/18	2	1	167
5/19-5/26	0	10	193
Unmarked	259	861	
p_j	0.008	0.013	

Capture probabilities were not significantly different ($\chi^2 = 0.43$, df = 1, P = 0.51), so a pooled Peterson estimate of 29,240 (SE = 7,356) was valid. Statistical bias was low (5%), but precision was poor (CV = 25%). Further, about 25% of the run, based on 1996 through 2002 tagging data, has passed Kakwan Point by May 26, so the pooled estimate should have been around 25% of the postseason estimate, or 13,473 (53,893 x 0.25). The next (and last) possible in-season estimate was based on release data through June 2 and recovery data through June 15:

Release strata, *i*	Recovery strata, *j*		
	5/9-5/18	5/19-6/15	Released
5/9-5/18	2	3	167
5/19-6/2	0	12	295
Unmarked	259	1,141	
p_j	0.008	0.013	

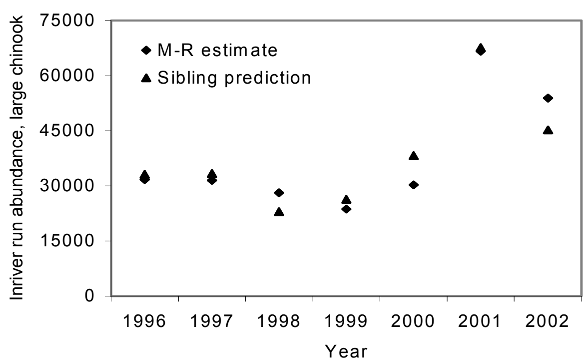
Again, capture probabilities were not significantly different ($\chi^2 = 0.51$, df = 1, P = 0.48), so a pooled Peterson estimate of 36,473 (SE = 8,151) was valid. Statistical bias was high (7%), precision was poor (CV = 22%), and the estimate should have been about 38% of the postseason estimate, or 20,479, based on the proportion of the run that has historically passed Kakwan Point by June 2. These analyses indicate that, given quota limits on the test fishery sample, tagging rates need to be increased in May to boost recoveries. Additional information, such as preseason forecasts, will also be required to corroborate in-season estimates.

Preliminary analysis indicates there is a linear relationship ($R^2 = 0.93$, $P < 0.001$) between cumulative CPUE at Kakwan Point and estimated inriver run abundance of large chinook salmon. Cumulative CPUE on May 31 was regressed on abundance estimates from 1996 to 2002:



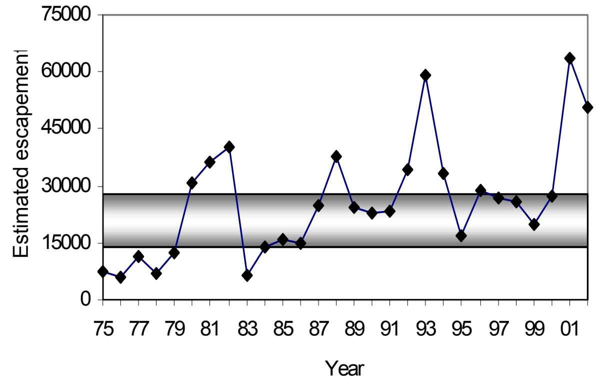
This or similar models may provide timely in-season estimates and a method by which to judge (or substitute for) those obtained through mark-recapture.

In additional analyses, sibling relationships were analyzed in which previous-year inriver run abundance estimates of age-1.2 (small-medium), age-1.3, and age-1.4 fish were used to predict current-year inriver run abundance of age-1.3, age-1.4, and age-1.5 fish. The sum of these predictions were graphically compared to abundance estimates from 1996 to 2002; the average absolute forecast error was 12%:



If the strength of these relationships persists, sibling models could be useful for preseason forecasting and corroboration of in-season estimates.

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). Retrospectively, 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).



CONCLUSIONS AND RECOMMENDATIONS

This was the seventh year of estimating the spawning escapement of chinook salmon to the Stikine River. We continue to improve our methods and mark-recapture estimates. Drift gillnets are an effective method of capturing enough large chinook salmon migrating up the Stikine River for a post-season estimate, but may be inadequate for in-season management. The use of a set gillnet at Rock Island in 2000 through 2002 has proven effective and will hopefully in the future provide a larger marked release group of chinook salmon earlier in the run and more tagged fish <600 mm MEF. The results of seven years of study also confirm that counts of salmon through the Little Tahltan River live weir are a useful index (i.e., the counts represent a relatively constant percentage of the run) of chinook salmon escapement to the Stikine River. However, the weir counts do not serve as a timely indicator of run strength for in-season abundance-based management per the 1999 PST. In 2000 we started the test fishing operation in early May to cover the entire chinook salmon migration and continued that effort in 2002. Preliminary analysis indicates that tagging rates need to be increased to obtain meaningful in-season abundance estimates. Because tagging effort at Kakwan Point has been maximized, we recommend initiating the tagging operation at Rock Island in early May. Use of a 6-inch net in the test fishery should be continued to mitigate size-selective sampling. Models that describe the relationship between CPUE and abundance data are encouraging, and although CPUE varies with changing river conditions, it seems to be a good indicator of run strength. Other indicators, such as a pre-season forecast utilizing brood year strength, may be useful early in the season. Sampling rates at the weir should be maintained or increased and efforts continued to ensure that smaller fish are not passing unobserved.

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APPENDIX A

Appendix A1.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2002.

							Large chinook		Small-medium chinook	
Date	Minutes	Lg. chin.	Sm-med chin.	Sockeye	Temp	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
5/09/02	60	2	0	0	5.0	7.24	2.00	0.00	0.00	0.00
5/10/02	241	8	1	0	5.5	7.41	1.99	0.01	0.25	0.01
5/11/02	248	11	0	0	5.5	7.89	2.66	0.02	0.00	0.01
5/12/02	484	11	0	0	5.0	8.88	1.36	0.04	0.00	0.01
5/13/02	505	11	1	0	5.0	9.80	1.31	0.05	0.12	0.03
5/14/02	495	14	0	0	4.5	10.67	1.70	0.07	0.00	0.03
5/15/02	482	12	0	0	5.5	10.92	1.49	0.08	0.00	0.03
5/16/02	487	29	0	0	5.5	11.10	3.57	0.11	0.00	0.03
5/17/02	472	33	0	0	5.5	11.88	4.19	0.15	0.00	0.03
5/18/02	462	37	0	0	5.0	12.45	4.81	0.19	0.00	0.03
5/19/02	274	11	1	0	6.0	12.46	2.41	0.21	0.22	0.04
5/20/02	491	38	3	0	5.5	13.33	4.64	0.25	0.37	0.08
5/21/02	480	19	1	0	6.5	15.07	2.38	0.27	0.13	0.09
5/22/02	478	15	1	0	5.5	16.31	1.88	0.29	0.13	0.10
5/23/02	491	22	0	0	6.0	16.81	2.69	0.31	0.00	0.10
5/24/02	488	19	1	0	6.5	16.63	2.34	0.33	0.12	0.12
5/25/02	479	27	2	0	6.0	16.45	3.38	0.37	0.25	0.14
5/26/02	485	42	3	0		17.03	5.20	0.41	0.37	0.18
5/27/02	495	26	3	0	8.0	18.11	3.15	0.44	0.36	0.22
5/28/02	484	15	1	0	7.0	18.97	1.86	0.46	0.12	0.23
5/29/02	478	13	0	0	7.0	19.64	1.63	0.48	0.00	0.23
5/30/02	491	11	0	0	6.5	19.57	1.34	0.49	0.00	0.23
5/31/02	257	0	0	0	7.0	19.07	0.00	0.49	0.00	0.23
6/01/02	488	14	1	0	6.5	18.40	1.72	0.50	0.12	0.24
6/02/02	491	23	2	0	7.5	17.93	2.81	0.53	0.24	0.27
6/03/02	484	29	3	0	7.5	17.79	3.60	0.56	0.37	0.31
6/04/02	486	27	3	0	7.5	17.88	3.33	0.60	0.37	0.35
6/05/02	481	20	2	0	7.0	19.57	2.49	0.62	0.25	0.37
6/06/02	487	24	5	0	7.5	19.86	2.96	0.65	0.62	0.44
6/07/02	471	25	1	0	7.0	19.39	3.18	0.67	0.13	0.45
6/08/02	481	24	1	0	8.0	18.38	2.99	0.70	0.12	0.46
6/09/02	483	20	2	0	7.0	18.42	2.48	0.72	0.25	0.49
6/10/02	247	11	0	0	8.0	19.93	2.67	0.74	0.00	0.49
6/11/02	485	14	1	0	8.5	20.83	1.73	0.75	0.12	0.50
6/12/02	489	7	1	0	8.0	21.31	0.86	0.76	0.12	0.51
6/13/02	486	7	2	0	9.5	21.18	0.86	0.77	0.25	0.54
6/14/02	489	7	1	0	9.5	21.25	0.86	0.78	0.12	0.55
6/15/02	272	5	0	0	10.0	22.24	1.10	0.78	0.00	0.55
6/16/02	481	1	1	0	9.5	23.45	0.12	0.78	0.12	0.56
6/17/02	247	0	0	0	9.5	23.71	0.00	0.78	0.00	0.56
6/18/02	132	3	0	0	9.0	23.84	1.36	0.79	0.00	0.56
6/19/02	484	5	1	0	9.5	23.31	0.62	0.79	0.12	0.58
6/20/02	488	6	0	3	8.0	22.14	0.74	0.80	0.00	0.58
6/21/02	503	5	0	6	8.5	21.08	0.60	0.81	0.00	0.58
6/22/02	488	22	5	3	9.0	20.37	2.70	0.83	0.61	0.64
6/23/02	482	17	0	5	9.0	20.12	2.12	0.85	0.00	0.64
6/24/02	488	18	4	13	8.5	20.49	2.21	0.87	0.49	0.69
6/25/02	486	10	4	5	8.0	20.65	1.23	0.88	0.49	0.74
6/26/02	490	11	0	11	8.0	21.25	1.35	0.90	0.00	0.74

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							Large chinook		Small-medium chinook	
Date	Minutes	Lg. chin.	Sm-med chin.	Sockeye	Temp	Depth	Fish/hour	Cum. Percent	Fish/hour	Cum. Percent
6/27/02	483	12	2	6	8.0	21.06	1.49	0.91	0.25	0.77
6/28/02	493	15	5	19	8.5	20.35	1.83	0.93	0.61	0.83
6/29/02	498	17	5	14	9.0	19.81	2.05	0.95	0.60	0.90
6/30/02	491	9	1	15	8.5	20.04	1.10	0.96	0.12	0.91
7/01/02	489	7	4	14	9.0	19.45	0.86	0.96	0.49	0.96
7/02/02	484	10	1	14	7.5	19.29	1.24	0.98	0.12	0.97
7/03/02	250	5	1	5	8.0	19.53	1.20	0.98	0.24	0.99
7/04/02	480	7	0	4	8.0	19.25	0.88	0.99	0.00	0.99
7/05/02	485	2	1	6	8.0	18.74	0.25	0.99	0.12	1.00
7/06/02	489	5	0	2	8.5	19.04	0.61	1.00	0.00	1.00
7/07/02	246	2	0	4	9.0	18.77	0.49	1.00	0.00	1.00
Total	438 hrs.	872	78	149						

Appendix A2.–Set gillnet daily effort (minutes fished), catches, and catch per hour, at Rock Island, Stikine River, 2002.

							Large chinook		Small-medium chinook	
Date	Minutes	Lg. chin.	Sm-med chin.	Sockeye	Temp	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
06/20/02	431	2	3	4	8.0	22.14	0.28	0.03	0.42	0.02
06/21/02	436	1	4	15	8.5	21.08	0.14	0.04	0.55	0.05
06/22/02	438	8	7	15	9.0	20.37	1.10	0.14	0.96	0.10
06/23/02	450	14	14	21	9.0	20.12	1.87	0.32	1.87	0.20
06/24/02	450	5	10	44	8.5	20.49	0.67	0.38	1.33	0.27
06/25/02	431	7	5	31	8.0	20.65	0.97	0.47	0.70	0.30
06/26/02	438	0	6	18	8.0	21.25	0.00	0.47	0.82	0.34
06/27/02	442	3	8	33	8.0	21.06	0.41	0.51	1.09	0.40
06/28/02	434	1	10	23	8.5	20.35	0.14	0.52	1.38	0.47
06/29/02	450	1	8	65	9.0	19.81	0.13	0.53	1.07	0.52
06/30/02	460	4	14	58	8.5	20.04	0.52	0.58	1.83	0.62
07/01/02	426	3	5	48	9.0	19.45	0.42	0.62	0.70	0.66
07/02/02	426	5	4	76	7.5	19.29	0.70	0.68	0.56	0.69
07/03/02	420	3	11	65	8.0	19.53	0.43	0.72	1.57	0.76
07/04/02	443	0	2	45	8.0	19.25	0.00	0.72	0.27	0.78
07/05/02	420	0	4	33	8.0	18.74	0.00	0.72	0.57	0.80
07/06/02	415	1	3	22	8.5	19.04	0.14	0.73	0.43	0.83
07/07/02	427	1	4	39	9.0	18.77	0.14	0.75	0.56	0.85
07/08/02	465	1	2	104		18.76	0.13	0.76	0.26	0.87
07/09/02	325	2	2	54		19.56	0.37	0.78	0.37	0.88
07/10/02	492	1	0	27		20.42	0.12	0.80	0.00	0.88
07/11/02	435	0	0	26		20.87	0.00	0.80	0.00	0.88
07/12/02	441	0	0	35		20.69	0.00	0.80	0.00	0.88
07/13/02	480	1	2	56		19.69	0.13	0.81	0.25	0.90
07/14/02	445	1	2	42		19.40	0.13	0.82	0.27	0.91
07/15/02	440	2	0	33		18.81	0.27	0.85	0.00	0.91
07/16/02	450	1	3	47		18.98	0.13	0.86	0.40	0.93
07/17/02	441	0	0	35		19.62	0.00	0.86	0.00	0.93
07/18/02	440	1	1	40		20.28	0.14	0.87	0.14	0.94
07/19/02	453	0	0	55		20.53	0.00	0.87	0.00	0.94
07/20/02	453	1	1	37		20.49	0.13	0.89	0.13	0.94
07/21/02	430	0	1	26		19.67	0.00	0.89	0.14	0.95
07/22/02	445	2	0	39		19.90	0.27	0.91	0.00	0.95
07/23/02	437	0	0	44		20.67	0.00	0.91	0.00	0.95
07/24/02	420	0	0	8		21.40	0.00	0.91	0.00	0.95
07/25/02	425	0	1	9		22.12	0.00	0.91	0.14	0.96
07/26/02	426	0	3	11		21.84	0.00	0.91	0.42	0.98
07/27/02	435	0	2	24		20.49	0.00	0.91	0.28	0.99
07/28/02	450	1	0	38		19.66	0.13	0.92	0.00	0.99
07/29/02	445	0	0	31		18.80	0.00	0.92	0.00	0.99
07/30/02	435	0	0	9		17.54	0.00	0.92	0.00	0.99
07/31/02	430	1	0	9		17.13	0.14	0.94	0.00	0.99
08/01/02	431	0	0	9		17.05	0.00	0.94	0.00	0.99
08/02/02	425	0	0	6		16.98	0.00	0.94	0.00	0.99
08/03/02	423	0	0	4		16.75	0.00	0.94	0.00	0.99
08/04/02	422	0	0	7		16.06	0.00	0.94	0.00	0.99
08/05/02	423	0	0	3		15.87	0.00	0.94	0.00	0.99
08/06/02	428	0	0	7		16.00	0.00	0.94	0.00	0.99
08/07/02	426	0	0	2		16.24	0.00	0.94	0.00	0.99

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							Large chinook		Small-medium chinook	
Date	Minutes	Lg. chin.	Sm-med chin.	Sockeye	Temp	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
08/08/02	425	0	0	0		17.55	0.00	0.94	0.00	0.99
08/09/02	422	1	0	1		20.24	0.14	0.95	0.00	0.99
08/10/02	424	1	0	1		20.33	0.14	0.96	0.00	0.99
08/11/02	438	1	0	11		18.87	0.14	0.97	0.00	0.99
08/12/02	425	0	1	3		18.03	0.00	0.97	0.14	1.00
08/13/02	422	0	0	1		20.36	0.00	0.97	0.00	1.00
08/14/02	360	0	0	0		22.07	0.00	0.97	0.00	1.00
08/15/02	430	0	0	2		20.60	0.00	0.97	0.00	1.00
08/16/02	442	0	0	3		18.65	0.00	0.97	0.00	1.00
08/17/02	427	0	0	0		16.96	0.00	0.97	0.00	1.00
08/18/02	438	0	0	4		16.20	0.00	0.97	0.00	1.00
08/19/02	433	0	0	2		15.85	0.00	0.97	0.00	1.00
08/20/02	383	0	0	2		15.14	0.00	0.97	0.00	1.00
08/21/02	307	0	0	0		14.82	0.00	0.97	0.00	1.00
08/22/02	425	0	0	1		15.88	0.00	0.97	0.00	1.00
08/23/02	360	0	0	0		20.50	0.00	0.97	0.00	1.00
08/24/02	0	0	0	0		23.55	0.00	0.97	0.00	1.00
08/25/02	364	0	0	0		21.93	0.00	0.97	0.00	1.00
08/26/02	400	0	0	0		23.49	0.00	0.97	0.00	1.00
08/27/02	420	0	0	1			0.00	0.97	0.00	1.00
08/28/02	0	0	0	0			0.00	0.97	0.00	1.00
08/29/02	0	0	0	0			0.00	0.97	0.00	1.00
08/30/02	423	2	0	1			0.28	1.00	0.00	1.00
Total	306 hrs.	79	143	1,565						

Appendix A3.–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 MARKED during the first event and INSPECTED 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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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*
$\hat{p}_{ij} = \dfrac{n_{ij}}{n_i}$	Estimated fraction of fish of age *j* in stratum *i*. Note that $\sum_j \hat{p}_{ij} = 1$
$v(\hat{p}_{ij}) = \dfrac{\hat{p}_{ij}(1 - \hat{p}_{ij})}{n_i - 1}$	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]
$\hat{p}_j = \dfrac{\hat{N}_j}{\sum_i \hat{N}_i} = \dfrac{\hat{N}_j}{\hat{N}}$	Estimated fraction of fish in age group *j* in the population
$v(\hat{p}_j) = \dfrac{\sum_i (v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2)}{\hat{N}^2}$	An approximate estimate of variance[d]

[a] The K-S test is significant at P ≤ 0.20 and the χ^2 test at P ≤ 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 A4.–Estimated age and sex composition and mean length by age of chinook salmon passing by Kakwan Point , 2002.

		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		18		1						19
	% age comp.		25.4		1.4						26.8
	SE of %		5.2		1.4						5.3
	Avg. length		601		620						602
	SE		7								7
Males	n		48		4						52
	% age comp.		67.6		5.6						73.2
	SE of %		5.6		2.8						5.3
	Avg. length.		596		618						598
	SE		5		31						5
Sexes combined	n		66		5						71
	% age comp.		93.0		7.0						100.0
	SE of %		3.1		3.1						0.0
	Avg. length.		597		618						599
	SE		4		24						4
Large chinook salmon											
Females	n				99		417	2	1	2	521
	% age comp.				13.2		55.5	0.3	0.1	0.3	69.4
	SE of %				1.2		1.8	0.2	0.1	0.2	1.7
	Avg. length				766		856	763	865	820	852
	SE				4		2	38		35	4
Males	n		4		63	1	160	2			230
	% age comp.		0.5		8.4	0.1	21.3	0.3			30.6
	SE of %		0.3		1.0	0.1	1.5	0.2			1.7
	Avg. length.		685		757	690	894	835			852
	SE		15		7		5	45			6
Sexes combined	n		4		162	1	577	4	1	2	751
	% age comp.		0.5		21.6	0.1	76.8	0.5	0.1	0.3	100.0
	SE of %		0.3		1.5	0.1	1.5	0.3	0.1	0.2	0.0
	Avg. length.		685		763	690	867	799	865	820	842
	SE		15		4		2	32		35	2
Small, medium, and large chinook salmon											
Females	n		18		100		417	2	1	2	540
	% age comp.		2.2		12.2		50.7	0.2	0.1	0.2	65.7
	SE of %		0.5		1.1		1.7	0.2	0.1	0.2	1.7
	Avg. length		601		765		856	763	865	820	830
	SE		7		5		2	38		35	3
Males	n		52		67	1	160	2			282
	% age comp.		6.3		8.2	0.1	19.5	0.2			34.3
	SE of %		0.8		1.0	0.1	1.4	0.2			1.7
	Avg. length.		603		749	690	894	835			805
	SE		6		8		5	45			8
Sexes combined	n		70		167	1	577	4	1	2	822
	% age comp.		8.5		20.3	0.1	70.2	0.5	0.1	0.2	100.0
	SE of %		1.0		1.4	0.1	1.6	0.2	0.1	0.2	0.0
	Avg. length.		602		758	690	867	799	865	820	821
	SE		5		4		2	32		35	3

Appendix A5.–Estimated age and sex composition and mean length by age of chinook salmon passing by Rock Island , 2002.

		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		6								6
	% age comp.		7.0								7.0
	SE of %		2.8								2.8
	Avg. length		541								541
	SE		28								28
Males	n	30	47	1	1	1					80
	% age comp.	34.9	54.7	1.2	1.2	1.2					93.0
	SE of %	5.2	5.4	1.2	1.2	1.2					2.8
	Avg. length.	392	516	570	600	570					472
	SE	6	8								9
Sexes combined	n	30	53	1	1	1					86
	% age comp.	34.9	61.6	1.2	1.2	1.2					100.0
	SE of %	5.2	5.3	1.2	1.2	1.2					0.0
	Avg. length.	392	519	570	600	570					477
	SE	6	8								9
Large chinook salmon											
Females	n				11		20				31
	% age comp.				21.6		39.2				60.8
	SE of %				5.8		6.9				6.9
	Avg. length				745		817				791
	SE				8		9				9
Males	n				9		9	1	1		20
	% age comp.				17.6		17.6	2.0	2.0		39.2
	SE of %				5.4		5.4	2.0	2.0		6.9
	Avg. length.				753		833	740	720		787
	SE				22		26				18
Sexes combined	n				20		29	1	1		51
	% age comp.				39.2		56.9	2.0	2.0		100.0
	SE of %				6.9		7.0	2.0	2.0		0.0
	Avg. length.				748		822	740	720		789
	SE				10		10				9
Small, medium, and large chinook salmon											
Females	n		6		11		20				37
	% age comp.		4.4		8.0		14.6				27.0
	SE of %		1.8		2.3		3.0				3.8
	Avg. length		541		745		817				751
	SE		28		8		9				18
Males	n	30	47	1	10	1	9	1	1		100
	% age comp.	21.9	34.3	0.7	7.3	0.7	6.6	0.7	0.7		73.0
	SE of %	3.5	4.1	0.7	2.2	0.7	2.1	0.7	0.7		3.8
	Avg. length.	392	516	570	738	570	833	740	0.7		535
	SE	6	8		25		14		720		15
Sexes combined	n	30	53	1	21	1	29	1	1		137
	% age comp.	21.9	38.7	0.7	15.3	0.7	21.2	0.7	0.7		100.0
	SE of %	3.5	4.2	0.7	3.1	0.7	3.5	0.7	0.7		0.0
	Avg. length.	392	519	570	741	570	822	740	720		593
	SE	6	8		12		10				14

Appendix A6.–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, 2002.

		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		7		3		4				14
	% age comp.		11.3		4.8		6.5				22.6
	SE of %		4.1		2.7		3.1				5.4
	Avg. length		526		632		631				579
	SE		32		7		7				21
Males	n		37		11						62
	% age comp.		59.7		17.7						100.0
	SE of %		6.3		4.9						0.0
	Avg. length.		500		602						523
	SE		13		14						10
Sexes combined	n		44		14		4				62
	% age comp.		71.0		22.6		6.5				100.0
	SE of %		5.8		5.4		3.1				0.0
	Avg. length.		504		608		631				536
	SE		12		12		7				11
Large chinook salmon											
Females	n				28		166		2	2	198
	% age comp.				5.8		34.3		0.4	0.4	40.9
	SE of %				1.1		2.2		0.3	0.3	2.2
	Avg. length				757		825		848	862	816
	SE				7		5		18	32	5
Males	n		2		46		232	1	3	2	286
	% age comp.		0.4		9.5		47.6	0.2	0.6	0.4	59.1
	SE of %		0.3		1.3		2.3	0.2	0.4	0.3	2.2
	Avg. length.		680		756		886	845	870	835	863
	SE		10		9		4		56	55	5
Sexes combined	n		2		74		398	1	5	4	484
	% age comp.		0.4		15.3		82.2	0.2	1.0	0.8	100.0
	SE of %		0.3		1.6		1.7	0.2	0.5	0.4	0.0
	Avg. length.		680		756		860	845	861	848	844
	SE		10		6		4		32	27	4
Small, medium, and large chinook salmon											
Females	n		7		31		170		2	2	212
	% age comp.		1.3		5.7		31.1		0.4	0.4	38.8
	SE of %		0.5		1.0		2.0		0.3	0.3	2.1
	Avg. length		526		745		820		848	862	800
	SE		32		9		5		18	32	6
Males	n		39		57		232	1	3	2	334
	% age comp.		7.1		10.4		42.5	0.2	0.5	0.4	61.2
	SE of %		1.1		1.3		2.1	0.2	0.3	0.3	2.1
	Avg. length.		509		726		886	845	870	835	814
	SE		14		11		4		56	55	8
Sexes combined	n		46		88		402	1	5	4	546
	% age comp.		8.4		16.1		73.6	0.2	0.9	0.7	100.0
	SE of %		1.2		1.6		1.9	0.2	0.4	0.4	0.0
	Avg. length.		512		732		858	845	861	848	809
	SE		12		8		4		32	27	5

Appendix A7.–Estimated age and sex composition and mean length by age of chinook salmon at Little Tahltan River live weir, 2002.

		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				2
	% age comp.		0.9				0.9				1.9
	SE of %		0.9				0.9				1.3
	Avg. length		572				649				611
	SE										39
Males	n	18	77		9	1					105
	% age comp.	16.8	72.0		8.4	0.9					98.1
	SE of %	3.6	4.4		2.7	0.9					1.3
	Avg. length.	380	548		626	508					526
	SE	8	6		8						8
Sexes combined	n	18	78		9	1	1				107
	% age comp.	16.8	72.9		8.4	0.9	0.9				100.0
	SE of %	3.6	4.3		2.7	0.9	0.9				0.0
	Avg. length.	380	548		626	508	649				527
	SE	8	6		8						8
						Large chinook salmon					
Females	n				104		340			2	446
	% age comp.				14.1		46.3			0.3	60.7
	SE of %				1.3		1.8			0.2	1.8
	Avg. length				793		846			837	834
	SE				6		2			19	2
Males	n		6		87		194	1		1	289
	% age comp.		0.8		11.8		26.4	0.1		0.1	39.3
	SE of %		0.3		1.2		1.6	0.1		0.1	1.8
	Avg. length.		670		814		885	842		776	858
	SE		3		9		4				5
Sexes combined	n		6		191		534	1		3	735
	% age comp.		0.8		26.0		72.7	0.1		0.4	100.0
	SE of %		0.3		1.6		1.6	0.1		0.2	0.0
	Avg. length.		670		803		860	842		816	843
	SE		3		5		2			23	2
						Small, medium, and large chinook salmon					
Females	n		1		104		341			2	448
	% age comp.		0.1		12.4		40.5			0.2	53.2
	SE of %		0.1		1.1		1.7			0.2	1.7
	Avg. length		572		793		846			837	833
	SE				6		2			19	2
Males	n	18	83		96	1	194	1		1	394
	% age comp.	2.1	9.9		11.4	0.1	23.0	0.1		0.1	46.8
	SE of %	0.5	1.0		1.1	0.1	1.5	0.1		0.1	1.7
	Avg. length.	380	557		796	508	885	842		776	770
	SE	8	7		10		4				8
Sexes combined	n	18	84		200	1	535	1		3	842
	% age comp.	2.1	10.0		23.8	0.1	63.5	0.1		0.4	100.0
	SE of %	0.5	1.0		1.5	0.1	1.7	0.1		0.2	0.0
	Avg. length.	380	557		795	508	860	842		816	803
	SE	8	7		6		2			23	4

Appendix A8.–Estimated age and sex composition and mean length by age of dead chinook salmon (carcasses) above the weir on the Little Tahltan River, 2002.

		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		3		1						4
	% age comp.		1.7		0.6						2.3
	SE of %		1.0		0.6						1.1
	Avg. length		578		596						583
	SE		25								18
Males	n	89	75	2	3		1				170
	% age comp.	51.1	43.1	1.1	1.7		0.6				97.7
	SE of %	3.8	3.8	0.8	1.0		0.6				1.1
	Avg. length.	333	550	387	606		609				436
	SE	3	6	7	24						9
Sexes combined	n	89	78	2	4		1				174
	% age comp.	51.1	44.8	1.1	2.3		0.6				100.0
	SE of %	3.8	3.8	0.8	1.1		0.6				0.0
	Avg. length.	333	551	387	603		609				439
	SE	3	6	7	17						9
		Large chinook salmon									
Females	n				14		55	1			70
	% age comp.				9.7		38.2	0.7			48.6
	SE of %				2.5		4.1	0.7			4.2
	Avg. length				750		839	705			820
	SE				17		5				7
Males	n		2		28		44				74
	% age comp.		1.4		19.4		30.6				51.4
	SE of %		1.0		3.3		3.9				4.2
	Avg. length.		671		775		890				840
	SE		4		14		10				11
Sexes combined	n		2		42		99	1			144
	% age comp.		1.4		29.2		68.8	0.7			100.0
	SE of %		1.0		3.8		3.9	0.7			0.0
	Avg. length.		671		767		862	705			830
	SE		4		11		6				6
		Small, medium, and large chinook salmon									
Females	n		3		15		55	1			74
	% age comp.		0.9		4.7		17.3	0.3			23.3
	SE of %		0.5		1.2		2.1	0.3			2.4
	Avg. length		578		740		839	705			807
	SE		25		19		5				9
Males	n	89	77	2	31		45				244
	% age comp.	28.0	24.2	0.6	9.7		14.2				76.7
	SE of %	2.5	2.4	0.4	1.7		2.0				2.4
	Avg. length.	333	553	387	758		883				559
	SE	3	6	7	15		12				14
Sexes combined	n	89	80	2	46		100	1			318
	% age comp.	28.0	25.2	0.6	14.5		31.4	0.3			100.0
	SE of %	2.5	2.4	0.4	2.0		2.6	0.3			0.0
	Avg. length.	333	554	387	752		859	705			616
	SE	3	6	7	12		6				12

Appendix A9.–Estimated age and sex composition and mean length by age of moribund and recently expired chinook salmon in Verrett River, 2002.

		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		2								2
	% age comp.		18.2								18.2
	SE of %		12.2								12.2
	Avg. length		563								563
	SE		65								65
Males	n	1	7		1						9
	% age comp.	9.1	63.6		9.1						81.8
	SE of %	9.1	15.2		9.1						12.2
	Avg. length.	363	596		649						576
	SE		13								29
Sexes combined	n	1	9		1						11
	% age comp.	9.1	81.8		9.1						100.0
	SE of %	9.1	12.2		9.1						0.0
	Avg. length.	363	588		649						573
	SE		15								25
Large chinook salmon											
Females	n				24		105			2	131
	% age comp.				11.7		51.2			1.0	63.9
	SE of %				2.3		3.5			0.7	3.4
	Avg. length				740		827			865	811
	SE				8		4			60	5
Males	n		1		19		52		1	1	74
	% age comp.		0.5		9.3		25.4		0.5	0.5	36.1
	SE of %		0.5		2.0		3.0		0.5	0.5	3.4
	Avg. length.		680		745		869		934	863	835
	SE				15		6				9
Sexes combined	n		1		43		157		1	3	205
	% age comp.		0.5		21.0		76.6		0.5	1.5	100.0
	SE of %		0.5		2.9		3.0		0.5	0.8	0.0
	Avg. length.		680		742		841		934	864	820
	SE				8		4			35	5
Small, medium, and large chinook salmon											
Females	n		2		24		105			2	133
	% age comp.		0.9		11.1		48.6			0.9	61.6
	SE of %		0.7		2.1		3.4			0.7	3.3
	Avg. length		563		740		827			865	808
	SE		65		8		4			60	6
Males	n	1	8		20		52		1	1	83
	% age comp.	0.5	3.7		9.3		24.1		0.5	0.5	38.4
	SE of %	0.5	1.3		2.0		2.9		0.5	0.5	3.3
	Avg. length.	363	606		740		869		934	863	807
	SE		15		15		6				12
Sexes combined	n	1	10		44		157		1	3	216
	% age comp.	0.5	4.6		20.4		72.7		0.5	1.4	100.0
	SE of %	0.5	1.4		2.7		3.0		0.5	0.8	0.0
	Avg. length.	363	598		740		841		934	864	807
	SE		16		8		4			35	6

Appendix A10.–Estimated age and sex composition and mean length by age of chinook salmon in Andrew Creek, 2002.

		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										
	% age comp.										
	SE of %										
	Avg. length										
	SE										
Males	n	6	17		3						26
	% age comp.	23.1	65.4		11.5						100.0
	SE of %	8.4	9.5		6.4						0.0
	Avg. length.	381	554		572						516
	SE	25	14		74						19
Sexes combined	n	6	17		3						26
	% age comp.	23.1	65.4		11.5						100.0
	SE of %	8.4	9.5		6.4						0.0
	Avg. length.	381	554		572						516
	SE	25	14		74						19
Large chinook salmon											
Females	n				12		75		2		89
	% age comp.				8.1		50.7		1.4		60.1
	SE of %				2.3		4.1		1.0		4.0
	Avg. length				763		839		908		830
	SE				10		6		33		6
Males	n		2		27		29		1		59
	% age comp.		1.4		18.2		19.6		0.7		39.9
	SE of %		1.0		3.2		3.3		0.7		4.0
	Avg. length.		663		753		839		925		795
	SE		3		12		13				11
Sexes combined	n		2		39		104		3		148
	% age comp.		1.4		26.4		70.3		2.0		100.0
	SE of %		1.0		3.6		3.8		1.2		0.0
	Avg. length.		663		756		839		913		816
	SE		3		9		5		20		6
Small, medium, and large chinook salmon											
Females	n				12		75		2		89
	% age comp.				6.9		43.1		1.1		51.1
	SE of %				1.9		3.8		0.8		3.8
	Avg. length				763		839		908		830
	SE				10		6		33		6
Males	n	6	19		30		29		1		85
	% age comp.	3.4	10.9		17.2		16.7		0.6		48.9
	SE of %	1.4	2.4		2.9		2.8		0.6		3.8
	Avg. length.	381	566		735		839		925		710
	SE	25	14		16		13				17
Sexes combined	n	6	19		42		104		3		174
	% age comp.	3.4	10.9		24.1		59.8		1.7		100.0
	SE of %	1.4	2.4		3.3		3.7		1.0		0.0
	Avg. length.	381	566		743		839		913		771
	SE	25	14		12		5		20		10

Appendix A11.–Origin of coded-wire tags recovered from chinook salmon collected in the Stikine River, 2002.

Year	Head	Tag code	Brood year	Agency	Rearing	Recovery site	Location	Date released	Release site	Tag ratio
2002	65930	040359	1998	ADFG	W	Stikine River	Stikine River	6/13/00	Stikine River	1.003
2002	61047	(head lost)								

Appendix A12.–Computer files used to estimate the spawning abundance of chinook salmon in the Stikine River in 2002.

File name	Description
CAPTPROB02.xls	EXCEL spreadsheet with chi-square capture probability tests.
PRE-INSEASON02.xls	EXCEL spreadsheet with 2002 CPUE and sibling models.
LGSTIK02.BAS	QBASIC bootstrap program for estimating the abundance of large chinook salmon, variance, bias, and confidence intervals
LGSTIK02.DAT	Input file for LGSTIK02.BAS
LGSTIK02.OUT	Output file from LGSTIK02.BAS
MR4FATE.BAS	QBASIC bootstrap program for estimating the abundance of small-medium chinook salmon, variance, bias, and confidence intervals
POSTSEASON02.xls	EXCEL spreadsheet with 2002 post-season abundance and spawning escapement estimates including bootstrap output for variance and bias estimation
SMSTIK02.DAT	Input file for MR4FATE.BAS
SMSTIK02.OUT	Output file from MR4FATE.BAS
STIKMR-CPUE02.xls	EXCEL spreadsheet with Kakwan Point and Rock Island catch-effort, hydrology, and temperature data including charts.
SIZESELPOST02.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
STIKMR-TAG&ASL02.xls	EXCEL spreadsheet with Kakwan Point, Rock Island, and spawning ground tag, recovery, and age-sex-size data.