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Abundance and Distribution of the Chinook Salmon Escapement on the Stikine River, 1997

by

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and

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July 1999

Alaska Department of Fish and Game Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd
Spell out acre and ton.	

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s
Spell out year, month, and week.	

Physics and chemistry

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

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
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
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

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	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
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.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
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
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 99-06

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by

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ABSTRACT

The distribution and abundance of large (≥660mm MEF) chinook salmon *Oncorhynchus tshawytscha* that returned to spawn in the Stikine River above the U.S./Canada border in 1997 were estimated by means of radio telemetry and a mark-recapture experiment. Age, sex, and length compositions for the immigration were also estimated. Drift gillnets fished near the mouth of the Stikine River were used to capture 731 immigrant chinook salmon during May, June, and July, 1997; 702 of these fish were marked with spaghetti tags, opercle punches and axillary appendage clips, and 255 also had radio transmitters inserted into their stomachs. 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 (M = 653, C = 4,528, R = 93) we estimated that 31,509 (SE = 2,960) large chinook salmon immigrated to the Stikine River above Kakwan Pt. Canadian fisheries on the Stikine River harvested 4,513 large chinook salmon, which left an escapement of 26,996 large fish. The total count at the Little Tahltan River weir was 5,557 large chinook salmon, about 20% of the estimated spawning escapement. We used weir counts and a foot survey to estimate an escapement of 478 large fish in Andrew Creek. From the radio telemetry study, we estimated that 17.7% of the spawning chinook salmon went to the Little Tahltan River, 17.5% to the Iskut, 4.7% to the Chutine, 3.5% to the Christina, 25.8% to the Tahltan, 21.8% to upper Stikine, 7.2% to lower Stikine and 1.8% to U.S. tributaries.

An estimated 2% of the Kakwan Point gillnet catch was age -1.2, 26% age -1.3, 70% age -1.4, and 1% age -1.5; 232 males and 352 females were captured. An estimated 3% of spawning ground samples were age -1.2, 24% age -1.3, 72% age -1.4, and 0.4% age -1.5; 323 males and 438 females were sampled.

Key words: chinook salmon, *Oncorhynchus tshawytscha*, Stikine River, Little Tahltan River, Verrett Creek, Andrew Creek, mark-recapture, escapement, radio telemetry, abundance.

INTRODUCTION

Many chinook salmon *Oncorhynchus tshawytscha* stocks in the Southeast Alaska region 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 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 (PSC). The rebuilding program has been evaluated, in part, by monitoring trends in indices of escapement for important stocks. Eleven rivers in Southeast Alaska and Canada are 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 eight of these eleven index systems: Stikine, Situk, Chilkat, Taku, Unuk, Chickamin and King Salmon rivers, and Andrew Creek.

The Stikine River is a transboundary river, originating in British Columbia and flowing to the sea near Wrangell, Alaska (Figure 1). The river is one of the largest producers of chinook salmon in northern B.C/southwest Yukon Territory and in Southeast Alaska. Chinook salmon stocks in the river appear to be responding well to the rebuild-ing program (Pahlke 1996). The program as originally developed was to be completed in 1995; if assessment of the stocks indicated a surplus at that time, increased harvest could be warranted.

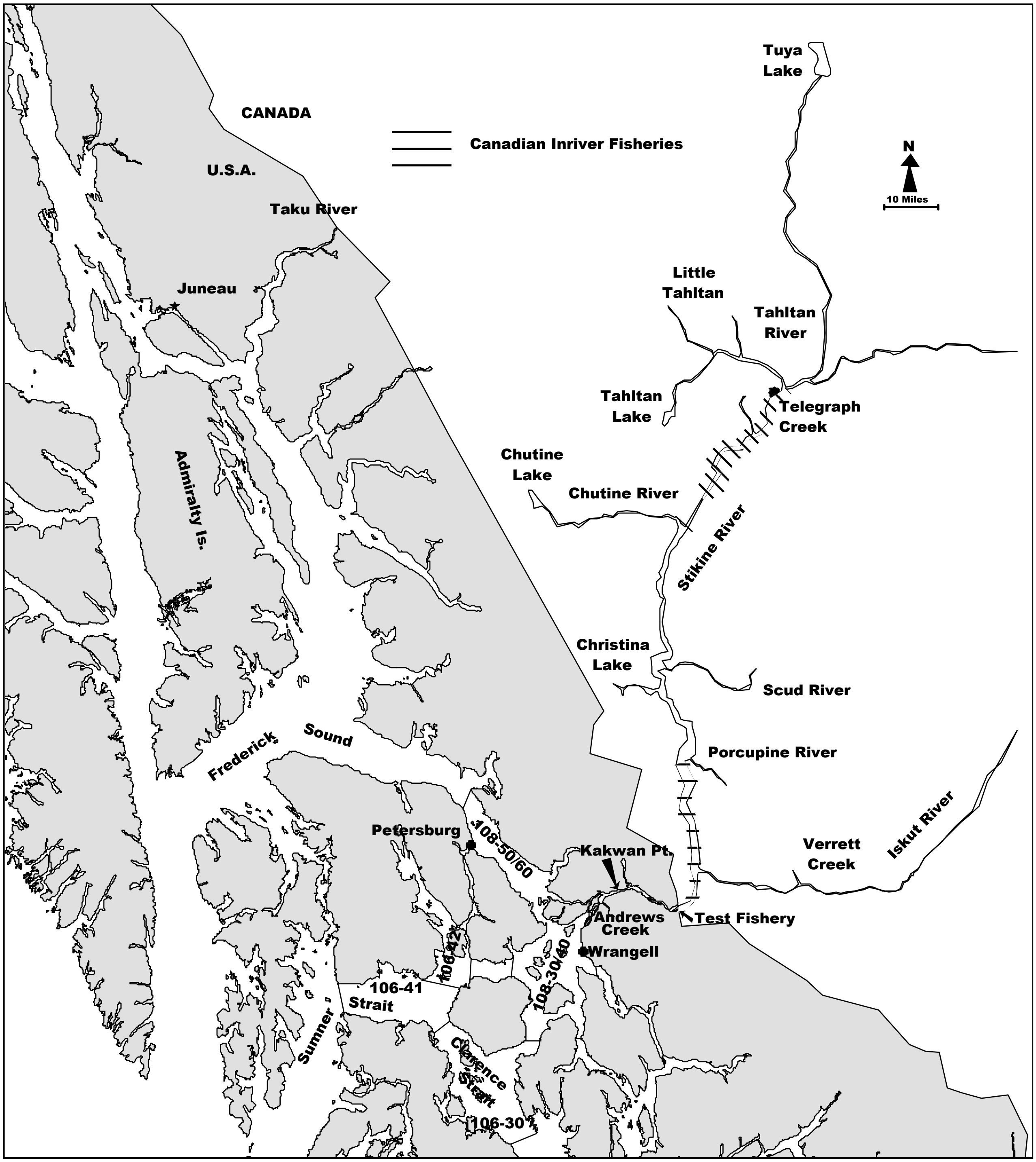


Figure 1.–Stikine River drainage, showing location of principal U.S. and Canadian fishing areas.

A major sockeye salmon *O. nerka* enhancement program in the Stikine River has been ongoing since 1989; the run timing of sockeye salmon overlaps the chinook migration, and migrating chinook salmon from the Stikine River are caught incidentally to sockeye salmon in U.S. marine gillnet fisheries in Districts 106 and 108, and in riverine Canadian commercial and aboriginal food fisheries (Table 1). An increase in the harvest rate on enhanced sockeye will likely result in increased harvest of chinook salmon as well. Stikine River chinook salmon

Table 1.–Chinook salmon harvest in Canadian Stikine River fisheries and U.S. fisheries near the mouth of the river, 1975-1997.

	United States		Canada									
	District 108	Wrangell sport through mid-June	Commercial harvest lower Stikine		Commercial harvest upper Stikine		Aboriginal fishery Telegraph Creek		Lower Stikine test fishery		TOTAL INRIVER Commercial, aboriginal, test	
Year	gillnet[a]		Jacks	Large	Jacks[b]	Large	Jacks	Large	Jacks	Large	Jacks	Large
1975	1,534					178		1,024			-	1,202
1976	1,123	c				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	2,329	186	3,283	6	45	94	1,155	7	30	293	4,513

[a] Jacks not reported in U.S. gillnet catch, not legal in U.S. sport catch.

[b] Jacks not segregated in Canadian fisheries before 1983.

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

are also caught in marine recreational and commercial fisheries near Wrangell and Petersburg, in the commercial troll fishery in Southeast Alaska, and in recreational fisheries in Canada. Exploitation of these populations is managed jointly by the U.S. and Canada through a subcommittee of the PSC. Chinook salmon escapement to the Stikine River has been monitored since 1975 by counting spawners at the Little Tahltan River and also at the mainstem Tahltan River and Andrew Creek (Table 2). The escapement goal for the Stikine River was based on peak counts in the Little Tahltan River. Historically, total escapement to the Stikine was estimated by multiplying the Little Tahltan River count by an expansion factor (4×), thought to represent the proportion of the escapement represented by that tributary (Pahlke 1996). The original expansion factors were based on judgment rather than empirical data, and in 1991 the Transboundary Technical Committee of the PSC decided to use only the actual counts of escapement to the Little Tahltan River to assess rebuilding (PSC 1991). Expansion factors and escapement goals will be revised when sufficient information is available.

Helicopter surveys of the Little Tahltan River have been conducted annually since 1975, and a fish counting weir has been operated at the

Table 2.–Counts of large spawning chinook salmon in tributaries of the Stikine River, 1975–1997. Abbreviations: 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 Peak count		Little Tahltan River Weir count	Mainstem Tahltan River		Beatty Creek		Andrew Creek		North Arm Creek		Clear Creek	
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	F(E)	-	
1979	1,166	E(H)	-	2,118	N(H)	-		382	(W)	16	F(E)	-	
1980	2,137	N(H)	-	960	P(H)	122	E(H)	363	(W)	68	F(N)	-	
1981	3,334	E(H)	-	1,852	P(H)	558	E(H)	654	(W)	84	F(E)	4	F(P)
1982	2,830	N(H)	-	1,690	N(F)	567	E(H)	947	(W)	138	F(N)	188	F(N)
1983	594	E(H)	-	453	N(H)	83	E(H)	444	(W)	15	F(N)	-	
1984	1,294	(H)	-	-		126	(H)	389	(W)	31	F(N)	-	
1985	1,598	E(H)	3,114	1,490	N(H)	147	N(H)	319	E(F)	44	F(E)	-	
1986	1,201	E(H)	2,891	1,400	P(H)	183	N(H)	707	N(F)	73	F(N)	45	A(E)
1987	2,706	E(H)	4,783	1,390	P(H)	312	E(H)	788	E(H)	71	F(E)	122	F(N)
1988	3,796	E(H)	7,292	4,384	N(H)	593	E(H)	564	E(F)	125	F(N)	167	F(N)
1989	2,527	E(H)	4,715	-		362	E(H)	530	E(F)	150	A(N)	49	H(N)
1990	1,755	E(H)	4,392	2,134	N(H)	271	E(H)	664	E(F)	83	F(N)	33	H(P)
1991	1,768	E(H)	4,506	2,445	N(H)	193	N(H)	400	N(A)	38	A(N)	46	A(N)
1992	3,607	E(H)	6,627	1,891	N(H)	362	N(H)	778	E(H)	40	F(E)	31	A(N)
1993	4,010	P(H)	11,449	2,249	P(H)	757	E(H)	1,060	E(F)	53	F(E)		
1994	2,422	N(H)	6,426	-		184	N(H)	572	E(H)	58	F(E)	10	A(N)
1995	1,117	N(H)	3,259	696	E(H)	152	N(H)	343	N(H)	28	A(P)	1	A(E)
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)	5,557	260	P(H)	218	E(H)	293	N(F)	-		-	
1987–1996 avg.	2,563		5,829	1,995		340		603		72		56	

mouth of the Little Tahltan River since 1985. Since virtually all fish spawning in the Little Tahltan River spawn above the weir, counts from the weir represent the escapement to that tributary. Andrew Creek chinook salmon escapement has been surveyed annually since 1975 by foot, aerial or helicopter surveys. In addition, a weir was operated to collect hatchery brood stock from 1976 to 1984 and also provided escapement counts. A weir was operated in 1997 to count the escapement, and to sample fish for age, sex and length data, and tag recovery. North Arm Creek and Clear Creek are two small chinook systems in the U.S. portion of the Stikine drainage which have been periodically surveyed.

Only large, (typically age-.3, -.4, and -.5) chinook salmon ≥660 mm mideye-to-fork length (MEF), are counted during aerial or foot surveys. No attempt is made to accurately count small (typically age-.1 and -.2) chinook salmon <660 mm (MEF) (Mecum 1990). These small chinook salmon, also called jacks, are primarily males that are considered to be surplus to spawning escapement needs. They are easy to separate visually from their older age counterparts 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 Canadian Department of Fisheries and Oceans (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 Stikine River chinook salmon, along with a radio-tracking study to estimate distribution. The results of the feasibility project were encouraging, and in 1996 a revised, expanded mark-recapture study was conducted (Pahlke and Etherton, 1998). The project was continued in 1997 along with a radio-tracking study to estimate spawning distribution.

The objectives of the 1997 study were:

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

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

(3) detect all spawning areas in the Stikine River drainage which receive ≥ 5% of the large immigrant salmon.

(4) census chinook salmon spawning in Andrew Creek, and

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

Results from the study provide a survey-to-abundance expansion factor, *i.e.*, an estimate of the fraction of total escapement seen in the peak survey count, and at the Little Tahltan River weir. Results also identify major spawning areas and provide information on the run timing through the lower Stikine River of chinook salmon bound for the various spawning areas.

STUDY AREA

The Stikine River originates in British Columbia and flows to the sea approximately 32 km south of Petersburg, Alaska (Figure 1). The drainage covers about 52,000 km^2, much of which is inaccessible to anadromous fish because of natural barriers. Principal tributaries include the Tahltan, Chutine, Scud, Iskut, and Tuya rivers. 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 identified chinook salmon spawning areas in the watershed are located in British Columbia, Canada in the mainstem Tahltan and Little Tahltan rivers (including Beatty Creek). Andrew and North Arm Creeks, in the U.S. portion of the Stikine River, also support small runs of chinook salmon. The upper drainage of the Stikine is accessible via the Telegraph Creek Road.

METHODS

KAKWAN POINT TAGGING

The number of chinook salmon in the Stikine River escapement was estimated from a two-event mark-recapture experiment on a closed population (Seber 1982:59-61). Fish captured by gillnet in the lower river near Kakwan Point and marked were included in event 1. Kakwan Point is below all known spawning areas with the exception of Andrew and North Arm Creeks (Figure 2), and is upstream of any tidal influence. Chinook salmon captured upstream on or near their spawning grounds constituted event 2 in the mark-recapture experiment. Drift gillnets 120 feet (36.5m) long, 18 feet (5.5m) deep, and made of 7.25-inch (18.5 cm) stretch mesh, were fished on the lower Stikine River, between May 7 and July 7. Two nets were fished daily, unless high water or staff shortages occurred. Nets were fished with the lead lines as close to the bottom as possible while missing snags. The north bank of the river near the drift net site is a cut bank with lots of large trees and snags, the south bank is mostly gravel bar with many less snags and drift netting was concentrated along a short stretch of the south bank. Nets were watched continuously, and a captured fish was removed from the net as soon as it was observed. Sampling effort was held reasonably constant across the temporal span of the migration. If fishing time was lost due to 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 hours per net.

Captured chinook salmon were placed in a box filled with water, quickly untangled or cut from the net, tagged, scale sampled, and their length and sex recorded during a visual examination (as per Johnson et al. 1993). Fish were classified as "large" if their mid-eye to fork length (MEF) was $\geq$660 mm or "small" if their MEF was <660 mm (Pahlke and Bernard 1996). Fish were judged to be "bright" or "dark" based on external appearance, and the presence or absence of sea lice *Lepeophtheirus* sp. was noted. General health and appearance of the fish was recorded, including injuries due to 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 onto a 15" (~38-cm) piece of 80-lb (~36.3-kg) monofilament fishing line. The monofilament was sewn through the musculature of the fish approximately 20 mm posterior and ventral to the dorsal fin and secured by crimping both ends in a line crimp. Each fish was also marked with a ¼-inch-diameter hole in the upper (dorsal) portion of the operculum applied with a paper punch, and by amputation of the left axillary appendage (as per McPherson et al. 1996). A portion of the large fish caught were also fitted with esophageal radio-transmitters. Fish that were seriously injured were sampled for length, scales and sex but not tagged.

SPAWNING GROUND SAMPLING

During event 2, pre- and post spawning fish were sampled at the Little Tahltan River weir. Post spawning fish were speared at Verrett and Shakes Creeks, and samples were collected from Canadian gillnet fisheries. Little Tahltan River flows southeast and empties into the Tahltan River about 30 km northwest of Telegraph Creek, B.C. As fish accumulated below the weir across the Little Tahltan River, a portion were captured with dip nets, sampled for length, sex, scales and inspected for marks and released. Each sampled fish was marked with a hole punched in its lower opercle flap to prevent resampling. The majority of fish were passed through the weir without being individually handled. A few pickets were pulled and fish were allowed to swim upstream while an observer counted them and recorded size (large or jack), sex, and the presence of spaghetti tags. In addition, some post-spawning fish and carcasses were sampled upstream of the weir.

Verrett Creek flows south into the Iskut River approximately 60 km upstream of the confluence of the Iskut and Stikine rivers. The lower 1 km of the Creek is used by spawning chinook, sockeye, and coho (*O. kisutch*) salmon. Daily foot surveys of the spawning area were conducted from August 5–13, 1997. Numbers of fish observed were recorded and carcasses and moribund chinook salmon were sampled for length, sex, scales and marks.

Shakes Creek flows into the Stikine River approximately 15 km below the town of Telegraph Creek. The lower 3 km of the Creek is used by spawning chinook, sockeye, and coho salmon. Daily foot surveys of the spawning area were conducted from July 28–August 20. Numbers of fish observed were recorded and carcasses and moribund chinook salmon were sampled for length, sex, scales and marks.

Andrew Creek flows northwest into the Stikine River approximately 4 km below Kakwan Pt. A weir was installed in 1997 to count chinook salmon escapement and to sample the escapement for age, sex, length and tag recovery.

FISHERY SAMPLING

Catches in the lower and upper Stikine Canadian commercial gillnet, aboriginal, and test fisheries and the U.S. gillnet and marine recreational fisheries located near the mouth of the Stikine were sampled for age, sex, and length data and inspected for tags.

ABUNDANCE

The number of marked fish on the spawning grounds was estimated by subtracting the estimated number of marked fish removed by fishing or recovered in the U.S. (censored from the experiment) from the number of fish tagged in event 1 (Table 3). Handling and tagging has caused a downstream movement and/or a delay in continuing upstream migration of marked chinook salmon (Bendock and Alexandersdottir

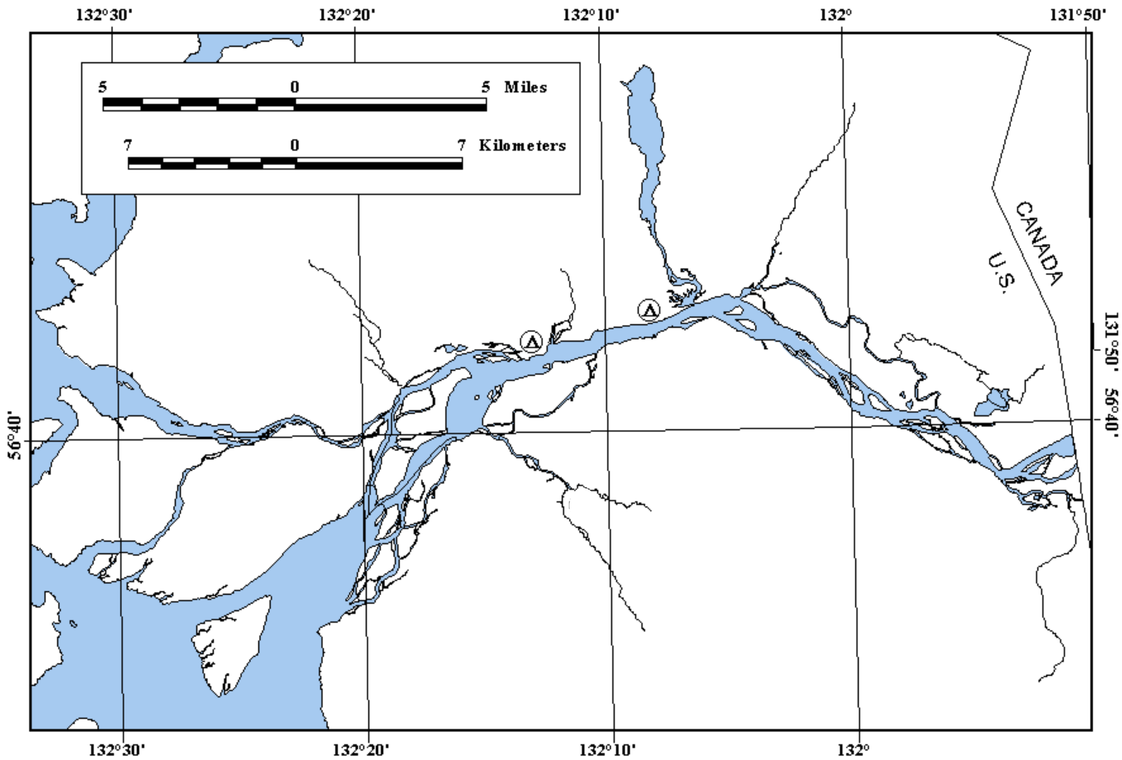


Figure 2.–Location of drift gillnet sites on the lower Stikine River, 1997.

1993, Johnson et al. 1992, Milligan et al. 1984). This behavior puts marked fish at greater risk from commercial fisheries for sockeye salmon that begin in mid-June. Censoring marked chinook salmon killed in these fisheries avoids bias in estimates of abundance from this phenomenon.

This censoring also makes estimates germane to the number of spawning fish, not to the number passing by Kakwan Point. The number of tagged salmon recovered from the Alaska gillnet fishery at the mouth of the Stikine (Dist. 108) was expanded by the fraction of the catch of chinook salmon sampled. Because of a reward (Can$2 for spaghetti tag; $10 for radio tag) for each tag returned from the inriver Canadian gillnet and aboriginal fisheries, tags from all marked fish caught in these fisheries were considered recovered.

Andrew Creek is slightly downstream from Kakwan Point and chinook salmon spawning there have historically been treated as a separate population from those spawning upriver in Canada. Tags recovered in Andrew Creek were censored from the mark-recapture experiment and a separate escapement estimate was calculated for Andrew Creek .

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; (b) *both* recruitment and "death" (emigration) do not occur between sampling events; (c) marking does not affect catchability (or mortality) of the fish; (d) fish do not lose their marks between sample events; (e) all recovered marks are reported; and (f) double sampling does not occur (Seber 1982). Assumption (a) implies that tagging must occur 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.

Table 3.–Numbers of chinook salmon marked on lower Stikine River, removed by fisheries and inspected for marks in tributaries in 1997, by length group.

		Length (MEF) in mm			
		0–439	440–659	≥660	Total
A. Released at Kakwan Point		0	28	674	702
B. Removed by:					
1. Sport fisheries, U.S. and Canada		0	1	5	6
2. U.S. gillnet [a]		0	0	2	2
3. Aboriginal fishery, upper river		0	3	12	15
4. Andrew Creek		0	1	2	3
Subtotal of removals		0	5	21	26
C. Estimated number of marked fish remaining in mark-recapture experiment		0	17	521	538
D. Spawning ground samples					
Observed at:	Inspected [b]	0	54	5,557	5,611
Little Tahltan weir	Marked[c]	0	0	71	74
	Marked/unmarked		0.0000	0.0128	0.0132
Inspected at:					
1a. L. Tahltan weir	Inspected	4	43	997	1,044
	Marked	0	0	22	22
	Marked/unmarked	0.0000	0.0000	0.0221	0.0211
1b. Above weir	Inspected	10	18	271	299
Carcasses	Marked	0	1	3	4
	Marked/unmarked	0.0000	0.0055	0.0111	0.0133
2a. Verrett River	Inspected	0	16	194	210
Fresh	Marked	0	0	4	4
	Marked/unmarked		0.0000	0.0206	0.0190
2b. Verrett River	Inspected	0	0	277	277
Old carcasses	Marked	0	0	3	3
	Marked/unmarked			0.0108	0.0108
3. Shakes Creek	Inspected	0	2	54	56
	Marked	0	0	1	1
	Marked/unmarked		0.0000	0.0185	0.0179
4. Andrew Creek	Inspected	9	50	279	338
	Marked	0	1	2	3
	Marked/unmarked	0.0000	0.0200	0.0072	0.0089
Canadian gillnet	Inspected		193	3,313	3,506
Lower river & test	Marked		3	66	69
	Marked/unmarked		0.0155	0.0199	0.0197

[a] Estimated by expanding 1 recovery in the U.S. gillnet fishery in District 106. In this fishery 45.5% of chinook salmon were sampled yielding estimate of 2 tagged chinook salmon.

[b] Includes fish inspected in (1a).

[c] 47 tags observed expanded for tag loss (1 out of 22, 0.045) and by size comp plus 22 inspected.

Assumption (a) also implies that sampling is not size or sex-selective. If capture on the spawning grounds was not size-selective, fish of different sizes would be captured with equal probability. The same is true for sex selective sampling on the spawning grounds. If assumption (a) was met, fish sampled in upper (Little Tahltan River) and Iskut River (Verrett Creek) spawning sites and the lower Stikine River gillnet fishery would be marked at similar rates. Contingency table analysis was used to test the assumption of proportional tagging. Assumption (b) was met because the life history of chinook salmon isolates those fish returning to the Stikine River as a "closed" population. We assumed tagged and untagged fish experience the same mortality (assumption c) due to natural causes, and adjustments were made to account for some increased harvest rate of marked fish in the lower river gillnet fishery. To minimize effects of tag loss, all marked fish received secondary (a dorsal opercle punch), and tertiary marks (the left axillary appendage was clipped). Similarly, we inspected all fish captured on the spawning grounds for marks (assumption e), and double sampling was prevented by an additional mark (ventral opercle punch) (assumption f). Variance, bias, and confidence intervals for the abundance estimate were estimated with modifications of bootstrap procedures in Buckland and Garthwaite (1991).

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

All fish captured in the Kakwan Pt gillnet and spawning ground surveys were sampled for scales to enable age determination (Olsen 1995). In addition, a portion of the Canadian gillnet harvest was sampled for length, sex and age data. 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× (Olsen 1995). Kakwan Point and Andrew Creek scale samples were processed at the ADF&G scale aging lab in Douglas, all other samples were processed at the DFO lab in Nanaimo, B.C. All scales were read by one staff member of the scale aging lab, unusual or questionable scales were read again by one or more staff. Proportions by age or by sex in gillnet and spawning grounds samples were estimated by

$$\hat{p}_i = \frac{n_i}{n} \qquad (1)$$

$$v[\hat{p}_i] = \frac{\hat{p}_i(1-\hat{p}_i)}{n-1} \qquad (2)$$

where p_i = the proportion in the age, sex, or length group i;

n_i = the number in the sample of group i; and

n = the sample size.

Estimated age composition of chinook salmon captured in the different spawning areas was compared using a chi-square test, prior to combining these samples. Estimated age composition of the gillnet samples was compared with estimated age composition from data pooled across spawning grounds using another chi-square test. Estimates of mean length at age and their estimated variances were calculated with standard normal procedures.

DISTRIBUTION OF SPAWNERS

Initially, every third large healthy chinook salmon had a 150-151 MHz Advanced Telemetry Systems (ATS) radio transmitter esophageally inserted into its stomach (Eiler 1990). However, capture rates were lower than anticipated and on June 19 the radio tagging rate was increased to every other fish. Individual transmitters were identified by frequency and signal pattern (Eiler 1995).

Radio-tagged fish that moved upriver were recorded by fixed, remote tracking stations at selected sites in the drainage. The tracking stations were constructed and operated as described in Eiler (1995), except that they did not have satellite up-link capabilities. Instead, records of radio-tagged fish movements were periodically downloaded from tracking station computers to a laptop computer.

Tracking stations were installed at six locations on the Stikine River drainage (Figure 3). The lowest station was located near the U.S./Canada border to record all radio-tagged fish that moved upriver into Canada. Tracking stations were installed on the Iskut and Chutine rivers to record any transmitters going up those tributaries and the three remaining stations were located along the mainstem of the Stikine River at approximately km 130 (Little Canyon), km 168 (Kirk Creek), and km 210 (Telegraph Creek).

Assumptions of the experiment to estimate spawning distributions include: a) fish were captured for radio-tracking in proportion to abundance during the immigration, b) tagging did not change the destination (fate) of a fish; and c) fates of radio-tracked fish are accurately determined. The first assumption will be true if fishing effort and catchability were constant for all “stocks” (fish spawning in the same area) in the immigration (stocks might be characterized by their age composition and immigration timing). Catchability would presumably vary with river conditions. Thus, sampling effort was held as constant as practically possible during the immigration. The river stage (height) was recorded for comparison to catch rates at the gillnet sites.

Beginning June 17, an attempt was made to locate each radio transmitter periodically by airplane or helicopter. The location of each tag was recorded by river kilometer from the mouth of the river or tributary. Transmitters used in this study were equipped with motion (mortality) sensors that doubled the pulse rate to 2 pulses per second following 3 to 4 h of inactivity. Subsequent movement reset the transmitter to the normal mode. Signals from radio-tagged fish were recorded as either normal or mortality mode (Eiler 1990, Bendock and Alexandersdottir 1992, Johnson et al. 1993).

After combining the data from the tracking stations and the tracking surveys, each radio-tagged fish was assigned one of four possible fates (Table 4; Johnson et al. 1993). Each fish assigned to fate 1 (probable spawning in a tributary) was then further assigned to one of 8 final spawning areas.

The proportion of large (660 mm and larger) chinook salmon spawning in each area was estimated

$$\hat{P}_a = \frac{\sum_{t=1}^{y}\left(\frac{N_t}{n_t}\right) r_{a,t}}{\sum_{a=1}^{x}\sum_{t=1}^{y}\left(\frac{N_t}{n_t}\right) r_{a,t}} \qquad (3)$$

where

$r_{a,t}$ = the number of large fish tagged with radios in period t that were tracked to and assumed to spawn in area a (= 1 to 8) , or captured in the inriver Canadian drift gillnet fishery (a = gn = 9);

N_t = the number of large fish captured in gillnets in period t; and

n_t = the number of large fish tagged in period t that were tracked to a spawning area or caught in the inriver fishery.

Period (t) refers to distinct spans of time when the tagging fraction was constant. Transmitters assigned to fates not associated with successful spawning or the gillnet fishery (Table 4) are ignored in computing $\hat{P}_a$, so that the sum of the estimated proportions equals one. The proportions for fish captured in the Canadian gillnet fishery ($p_{gn,t}$) were proportionally re-assigned to spawning areas upriver from the gillnet fishery (sites a = 2 to 8 in this experiment) according to the relation

$$\hat{P}_{a,t} = p_{a,t} + p_{gn,t}\frac{p_{a,t}}{\sum_{a=2}^{8} p_{a,t}} \qquad a=2,3,..8 \qquad (4)$$

The standard error of $\hat{P}_a$ was estimated using simulation with 1,100 trials. In each period, n_t new samples were drawn from all assigned fates (Table 4) using the empirical distribution of the data, and new values of $\hat{P}_a$ computed. Samples associated with the gillnet fishery were re-assigned to upriver spawning areas by drawing from the empirical distribution of the upriver

Table 4.–Criteria to assign fates to radio-tagged chinook salmon, Stikine River, 1997.

FATE CODE	FATE AND CRITERIA
1	**Probable spawning in a tributary:** a chinook salmon whose radio transmitter was tracked into a tributary, and remained in or was tracked downstream from that location. When a transmitter was tracked to more than one tributary, the last tributary was assumed to be the spawning location.
2	**Mortality or regurgitation:** a chinook salmon whose radio transmitter either did not advance upstream after tagging, or stopped in the mainstem Stikine River and broadcast in the mortality mode (perhaps intermittently) over at least 4 weeks, and never tracked to a lower location in the river.
3	**Gillnet mortality:** chinook salmon captured in the Stikine River commercial, test or aboriginal gillnet fisheries.
4	**U.S. tributary:** a chinook salmon whose radio transmitter was tracked to a spawning area in the U.S portion of the Stikine drainage, including Andrew, North Arm, and Clear Creeks and the Kikahe River.

data. Confidence intervals for the estimated proportions were calculated from the 1,100 trials using the percentile method (Efron and Tibshirani 1993), since the assumption of normality was clearly inappropriate for the smaller estimated proportions.

RESULTS

KAKWAN POINT TAGGING

Six hundred ninety-one (691) large (≥660 mm MEF) and 40 small chinook salmon were captured in the lower Stikine River between May 7 and July 7, 1997, of which 674 large fish became the marked population for the mark-recapture experiment (Table 3, Appendices A1 and A2). Drift gillnet effort was maintained at 4 hours per net per day, with two nets fishing, although reduced sampling effort occurred on several days (Figure 4; Appendix A2). Catch rates ranged from 0 to 6.3 fish/net/hour, peaking on June 10, when 53 large chinook were captured (Figure 5). The date of 50% cumulative catch was June 10. Harbor seals killed or injured many fish before they could be removed from the nets, especially early in the season. The sex ratio of chinook salmon caught in the gillnets was skewed towards females (426 females, 282 males). In addition, 61 sockeye were captured and released (Appendix A2).

FISHERY SAMPLING

The lower inriver Canadian commercial and test gillnet fisheries harvested 3,313 large and 193 jack chinook salmon—including 69 tagged fish (Table 3). The aboriginal and commercial fisheries near Telegraph Creek harvested 1,200 large and 100 jack chinook salmon with 15 tagged fish recovered, and sport fishermen in Canada reported five tagged fish caught, four

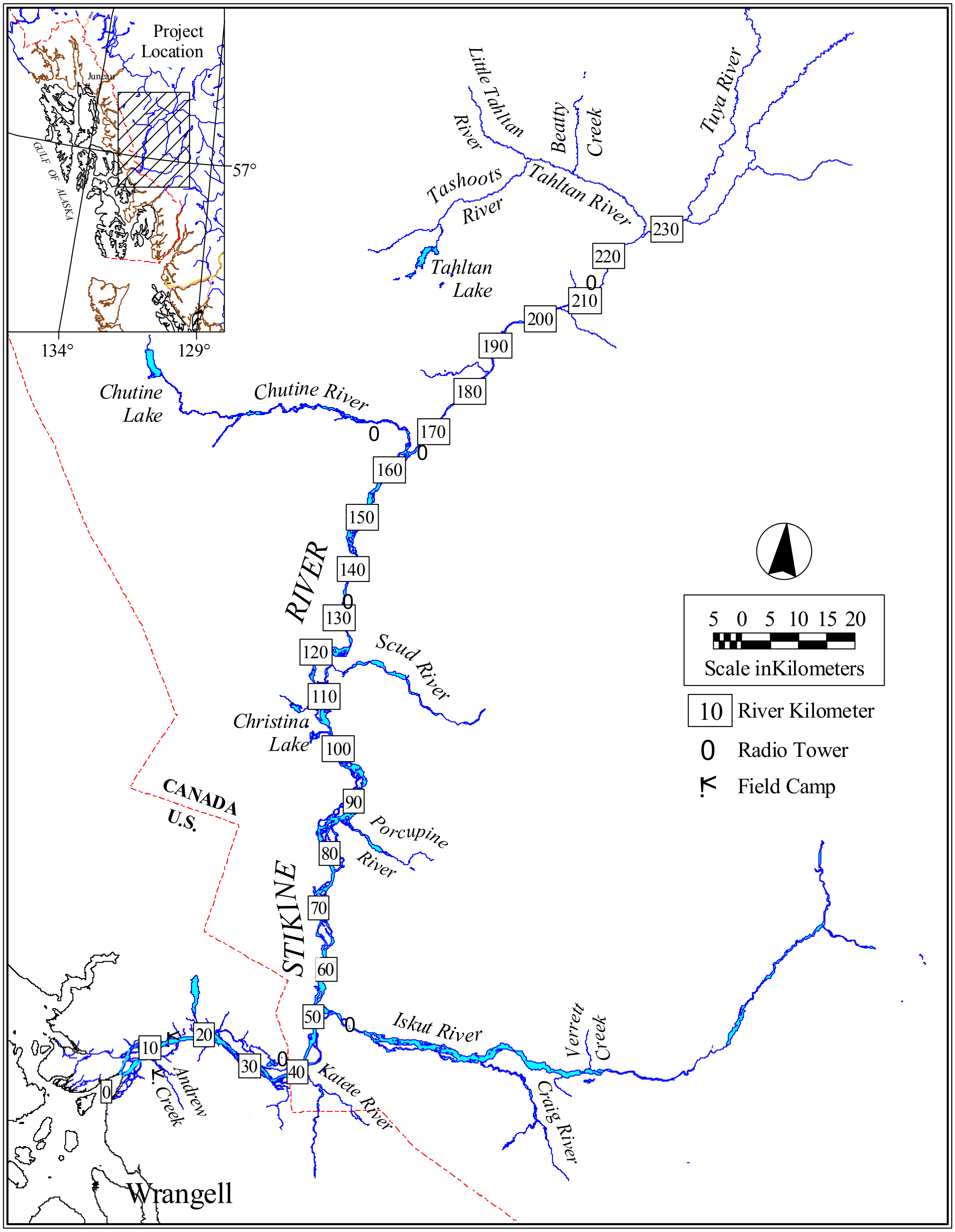


Figure 3.–Spawning tributaries on the Stikine River and location of remote telemetry sites in 1997.

from the Tahltan River and one from the Verrett River. No tags were recovered from a creel survey of the U.S. recreational fishery near Petersburg and Wrangell; however, one tag was voluntarily turned in. One marked chinook was recovered in the U.S. District 106 gillnet fishery. That recovery was expanded by the fraction of the catch sampled (45.5% in 1997), resulting in an estimate of two marked fish removed by this fishery.

SPAWNING GROUND SAMPLING

One thousand forty-four (1,044) chinook salmon were examined for marks at the Little Tahltan River weir, and 22 marked fish were recovered (Table 3). One of the recovered fish had lost the numbered tag and could not be identified as to tagging date. The remaining 4,567 fish passing through the weir were not physically examined for marks; however, each fish was observed from a distance and the size category and sex of each was estimated and the presence of 47 spaghetti tags noted. An additional 299 previously unsampled chinook were examined above the weir, and four marked fish were recovered.

At Verrett Creek, 487 spawning chinook and carcasses were examined for marks, with 7 marked fish recovered (Table 2). Two hundred ten (210) live or freshly killed fish were sampled for sex, length, scales and tags, with 4 tags recovered and an additional 277 old carcasses were sampled. Most of these had deteriorated beyond the point where length measurement or scales could be taken, generally only opercular hole punches could have been observed. Three marked fish were recovered, two of which were missing the spaghetti tag.

At Shakes Creek on the upper Stikine River, 56 chinook salmon were sampled and 1 tag was recovered. At the Andrew Creek weir 338 fish were examined and 3 spaghetti tags were recovered.

ABUNDANCE

Sampling below the weir on the Little Tahltan River and at Verrett Creek was demonstrably not size-selective, whereas sampling at the Kakwan Point tagging event probably was. Length distributions of fish marked in event 1 (Kakwan Pt.) were not significantly different from fish recovered at Little Tahltan River (KS tests, P = 0.45; Figure 6a) or for fish recovered at Verrett Creek (P = 0.89). Length distributions of all fish sampled at the Little Tahltan weir and at Verrett Creek were significantly different, (KS test, P = <0.0001), with Verrett Creek fish being consistently smaller, as seen in 1996. Length distributions of fish marked in event 1 and sampled at Little Tahltan weir were significantly different (KS test, P = 0.014) (however, not biologically different, Fig. 6b); those for event 1 and Verrett Creek were also significantly different (KS test, P = <0.0001), the Verrett Creek samples being composed of smaller fish.

The probability of recovering a marked fish at any of the three main recovery strata: Little Tahltan weir, Verrett Creek or the Lower Stikine gillnet fishery was equal (χ^2 = 0.83, df =2, P = 0.662) (Table 2).

There are at least four opportunities to estimate abundance (Table 5). The estimate based only on fish physically handled on the spawning grounds is 31,965 large chinook salmon or 34,766 fish of all sizes. If fish observed passing through the weir on the Little Tahltan River are included, the estimate increases to 44,709 large fish, 46,777 all sizes.

An estimate based on recoveries from the Canadian lower Stikine commercial and test fisheries is 24,468 for fish of all sizes passing by Kakwan Point after June 9. For this estimate, all fish marked prior to June 10 and all those marked that migrated downstream to be captured in marine fisheries were censored from the experiment. The Canadian inriver test fishery started on June 15 and the commercial fishery opened on June 22. The chinook salmon harvested in these fisheries were smaller and younger than the fish marked at Kakwan Point (Figure 7, KS test, P = <0.0001), as a result of the smaller mesh gillnets used in these sockeye salmon fisheries. Despite the smaller mesh gear, 69 marked fish were recovered in the inriver fisheries, one with a missing spaghetti tag. Only 11 of the recovered fish were tagged prior to June 10, the approximate halfway point of the chinook migration. Both sampling events were also stratified by size and abundance estimated for each stratum. The estimate of 24,062 (SE = 2,963) large fish is similar to the estimate of 24,468 fish of all sizes (Table 5), which indicates that the unstratified estimate is relatively unbiased by size-selective sampling, probably due to the overall low incidence of jacks in the population (Table 6 and 8).

A final estimate based only on live fish inspected at Little Tahltan weir, fresh samples at Verrett and Shakes creeks and samples from the lower river Canadian gillnet fishery is 31,509 large fish (SE = 2,960; M = 653, C = 4,528, R = 93; Table 5). When the inriver harvest of 4,513 large fish is removed, the estimate of large spawning chinook salmon is 26,996. This estimate has the lowest variance and relative bias and we feel is the most appropriate estimate.

Andrew Creek weir operated from July 3 to August 18. A significant portion of the chinook salmon in the system did not pass upstream through the weir. When the weir was removed on August 18, 284 large chinook salmon had passed and on that date a survey count was conducted downstream of the weir and 103 large chinook were counted. The mean proportion of chinook salmon counted during surveys of Andrew Creek on four other years when a weir was operated was 53.1% (Pahlke 1996). The 1997 count downstream of the weir was expanded by 53.1% to an estimate of 194 large chinook below the weir, which summed with the weir count of 284 resulted in an estimated escapement of 478 large fish. Sixty-five (65) jack chinook salmon were also passed through the weir (Appendix A 3).

In addition at Andrew Creek weir, 6 fish with adipose finclips were sacrificed to collect coded wire tags from their heads, and 6 coded wire tags from three different hatcheries were recovered from these heads (Appendix A4).

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

Age 1.4 chinook salmon dominated all samples, constituting an estimated 70% of fish passing by Kakwan Point, 74% at the weir across the Little Tahltan River, 63% at Verrett Creek, 65% in the Canadian gillnet fishery, and 51% at the Andrew Creek weir (Tables 6–12).

The same brood year (1991) also dominated age composition of the 1996 return of chinook salmon to the Stikine River as age 1.3 fish. Estimated age composition was not significantly different between Kakwan Point and either Little Tahltan (χ^2 = 7.79, df = 3, P = .05) or Verrett Creek locations (χ^2 = 4.45, df = 3, P = 0.21); these two spawning ground locations, however, differed significantly from each other (χ^2 = 9.1, df = 3, P = .01), and the Canadian gillnet samples differed from Kakwan Point samples (χ^2 = 27.3, df = 3, P <0.00001). Sampled populations were 56–63% females, not unusual considering the strong age 1.4 year-class, which tends to have higher proportions of females than age 1.3 fish (Olsen 1995). As seen in 1996, mean lengths were dissimilar among sampled populations, the chinook salmon from Verrett Creek being significantly smaller than fish in other sampled populations (Tables 7, 9, 11 and 13; Figure 6) This difference is consistent with difference in cumulative distribution reported in the previous section.

DISTRIBUTION OF SPAWNERS

Of the 255 fish marked with radio transmitters 229 (90%) were successfully tracked to spawning areas or were captured in fisheries. The remaining 26 transmitters were either regurgitated, lost because a fish died before spawning, never found, or tracked in a way that defied assignment of a fate (Appendix A1). One radio-tagged fish moved downriver and was captured in the U.S. District 106 gillnet fishery, and four went downstream to Andrew Creek. The lower Stikine commercial gillnet fishery captured 28 radio-tagged fish, and the remaining 196 moved upriver to spawn in Canada.

Spawning radio-tagged fish were assigned to one of the following eight areas: 1) U.S, included Andrew Creek and Kikahe River; 2) Iskut River, includes all fish recorded at Iskut Tower, or tracked to Verrett Creek or Craig River; 3) Chutine River: fish tracked to Chutine or recorded

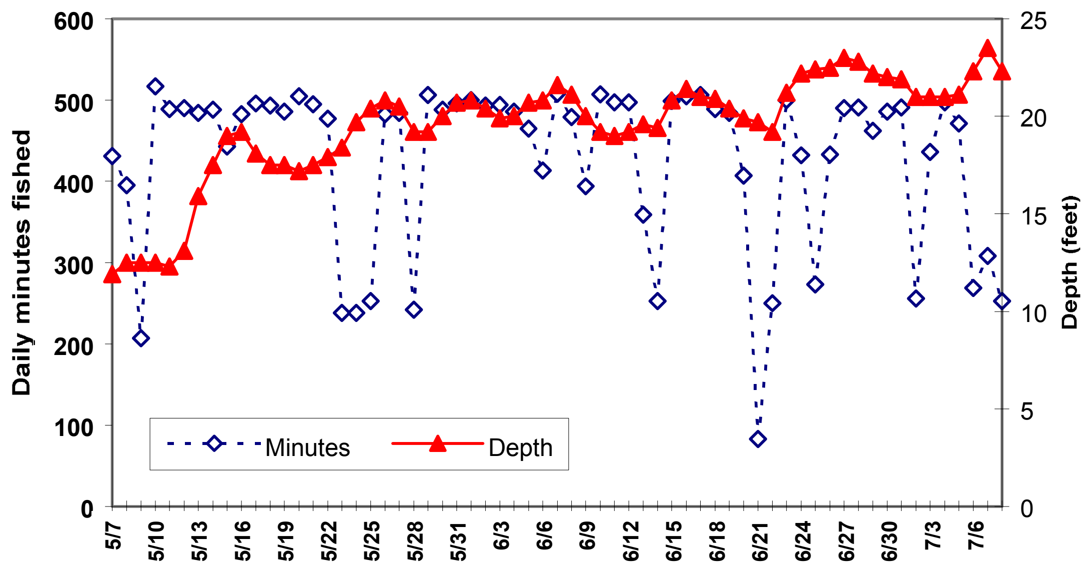


Figure 4.–Daily fishing effort (min) and river depth (ft), Stikine River near Kakwan Point, 1997.

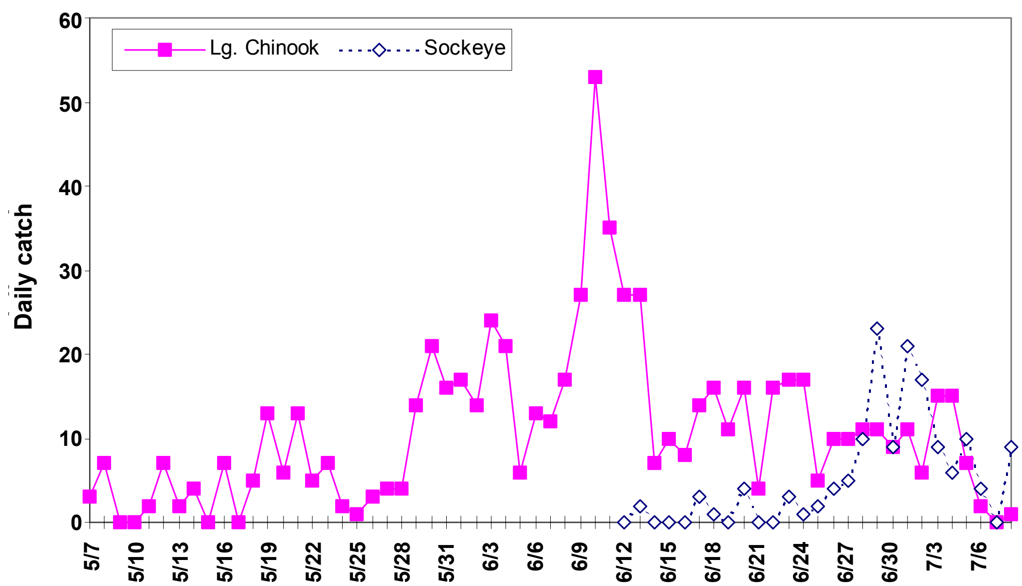


Figure 5.–Daily catch of chinook and sockeye salmon near Kakwan Point, 1997.

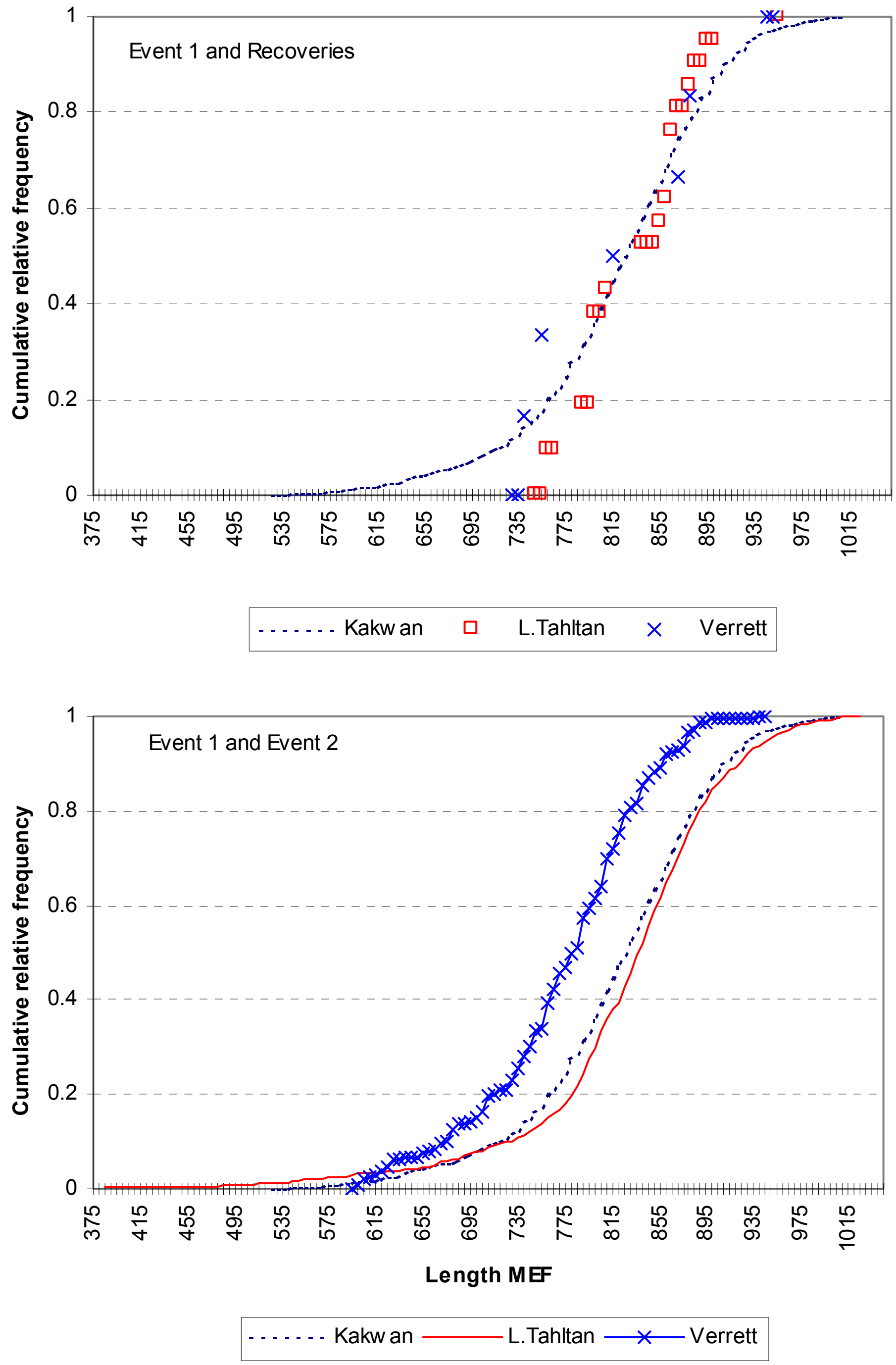


Figure 6.–Cumulative relative frequency of chinook salmon captured in event 1 (Kakwan Point gillnet) and marked chinook salmon recaptured in event 2 (spawning ground sampling, L. Tahltan and Verrett)(upper figure: 6a) and cumulative relative frequency of chinook salmon capture in event 1 and all chinook salmon sampled in event 2 (lower figure: 6b), Stikine River, 1997.

Table 5.–Comparison of estimated abundances of chinook salmon, Stikine River, 1997. Confidence intervals were estimated with the percentile method on distribution of simulated estimates from bootstrapped capture histories (see Buckland and Garthwaite, 1991).

Model	Data used	M (marked)	C (inspected)	R (recaps)	Estimated N	SE	95% bootstrap CI Lower	95% bootstrap CI Upper	Bias
A	Tahltan, Verrett, all sizes, just fish handled:	607	1,886	32	34,766	5,747	26,198	49,922	0.6%
	Large fish only:	587	1,793	32	31,965	5,276	24,139	45,293	2.4%
B	Verrett, L. Tahltan		6,154			4,812	39,087		
	Observed, but not handled:	607		79	46,777			58,364	1.2%
	Large only:	587	6,082	79	44,709	4,587	37,279	54,508	0.7%
C	Inriver harvest, fish tagged:	408	3,469	57	24,468	2,926	20,037	31,795	1.3%
	After June 9, all sizes:				*41,365 Prorated to entire season*				
	Inriver harvest, fish tagged:	402	3,283	54	24,062	2,962	19,193	31,791	2.3%
	After June 9, *large only:*				*40,678 Prorated to entire season*				
D	Tahltan, Verrett, Shakes,							38,412	
	fish handled, plus inriver harvest, large only:	653	4,528	93[a]	31,509	*2,960*	26,074		0.5%

[a] Includes 22 from L. Tahltan weir, 4 Verrett Cr., 1 Shakes Cr., and 66 from lower river gillnet harvest (Table 3).

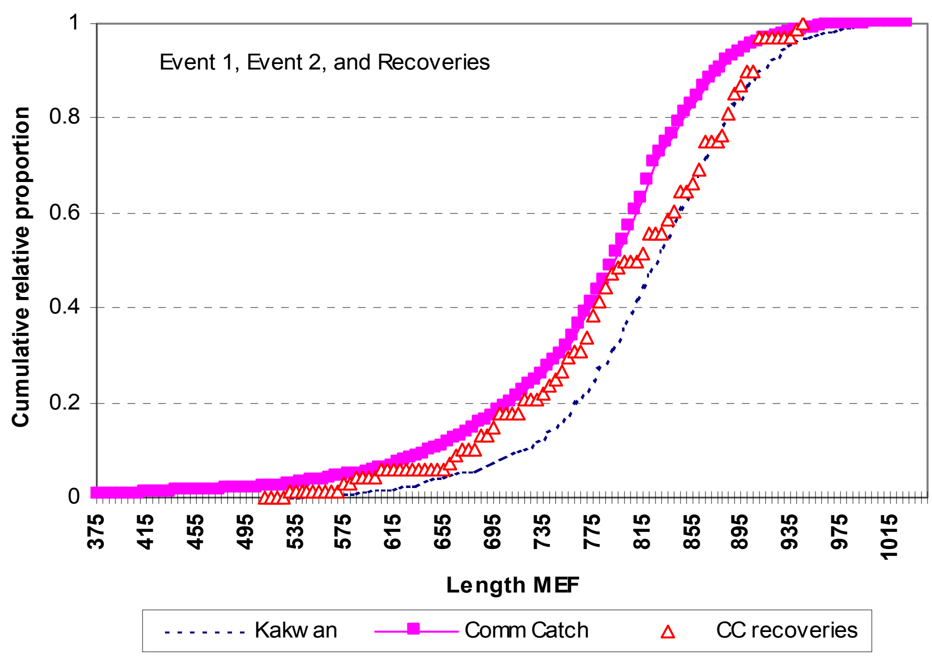


Figure 7.–Cumulative relative frequency of chinook salmon captured in event 1 (Kakwan Point gillnet) and all chinook salmon sampled in event 2 (Canadian commercial gillnet fishery) and marked chinook salmon recaptured in event 2, 1997.

Table 6.–Estimated age composition of chinook salmon in the Kakwan Point drift gillnet catch, by sex and age class, 1997.

		Brood year and age class							
		1994	1993	1992	1992	1991	1990	1990	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	Total
Male	Sample size	0	9	74	0	147	0	2	232
	Percent	0.0	1.5	12.7	0.0	25.2	0.0	0.3	39.7
	SE (%)		0.5	1.4		1.8		0.2	2.0
Female	Sample size	0	1	79	0	264	4	4	352
	Percent	0.0	0.2	13.5	0.0	45.2	0.7	0.7	60.3
	SE (%)		0.2	1.4		2.1	0.3	0.3	2.0
Total	Sample size	0	10	153	0	411	4	6	584
	Percent	0.0	1.7	26.2	0.0	70.4	0.7	1.0	100.0
	SE (%)		0.5	1.8		1.9	0.3	0.4	0.0

Table 7.–Estimated length at age (MEF) of chinook salmon in the Kakwan Point drift gillnet catch, by sex, 1997.

		Brood year and age class							
		1994	1993	1992	1992	1991	1991	1990	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	Total
Male	Sample size	0	9	74	0	147	0	2	232
	Average length		594	742		876		945	
	SD		42.2	70.3		71.2		21.2	
Female	Sample size	0	1	79	0	264	4	4	352
	Average length		640	766		840	815	868	
	SD			45.2		42.5	39.8	54.5	
Total	Sample size	0	10	153	0	411	4	6	584
	Average length		599	754		853	815	893	
	SD		42.3	59.7		57.2	39.8	59.0	

Table 8.–Estimated age composition of chinook salmon on Stikine River spawning grounds sampled in 1997.

		Brood year and age class							
		1994	1993	1992	1992	1991	1991	1990	
Little Tahltan weir		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	2	18	84	1	156	3	2	266
	Percent	0.3	3.0	13.9	0.2	25.7	0.5	0.3	43.9
	SE (%)	0.2	0.7	1.4	0.2	1.8	0.3	0.2	2.0
Female	Sample size	0	0	45	0	294	1	0	340
	Percent	0.0	0.0	7.4	0.0	48.5	0.2	0.0	56.1
	SE (%)			1.1		2.0	0.2		2.0
Total	Sample size	2	18	129	1	450	4	2	606
	Percent	0.3	3.0	21.3	0.2	74.3	0.7	0.3	100.0
	SE (%)	0.2	0.7	1.7	0.2	1.8	0.3	0.2	0.0
Verrett Creek									
Male	Sample size	0	5	29	0	23	0	0	57
	Percent	0.0	3.2	18.7	0.0	14.8	0.0	0.0	36.8
	SE (%)		1.4	3.1		2.9			3.9
Female	Sample size	0	0	22	0	75	0	1	98
	Percent	0.0	0.0	14.2	0.0	48.4	0.0	0.6	63.2
	SE (%)			2.8		4.0		0.6	3.9
Total	Sample size	0	5	51	0	98	0	1	155
	Percent	0.0	3.2	32.9	0.0	63.2	0.0	0.6	100.0
	SE (%)		1.4	3.8		3.9		0.6	0.0
Combined Little Tahltan weir and Verrett Creek samples									
Male	Sample size	2	23	113	1	179	3	2	323
	Percent	0.3	3.0	14.8	0.1	23.5	0.4	0.3	42.4
	SE (%)	0.2	0.6	1.3	0.1	1.5	0.2	0.2	1.8
Female	Sample size	0	0	67	0	369	1	1	438
	Percent	0.0	0.0	8.8	0.0	48.5	0.1	0.1	57.6
	SE (%)			1.0		1.8	0.1	0.1	1.8
Total	Sample size	2	23	180	1	548	4	3	761
	Percent	0.3	3.0	23.7	0.1	72.0	0.5	0.4	100.0
	SE (%)	0.2	0.6	1.5	0.1	1.6	0.3	0.2	

Table 9.–Estimated length at age (MEF) of chinook salmon on the Stikine River spawning grounds, by sex, 1997.

		Brood year and age class							
		1994	1993	1992		1991		1990	
Little Tahltan		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	2	18	84	1	156	3	2	266
	Average length	354	570	757	631	892	814	914	
	SD	14.7	89.2	74.4		62.4	117.3	54.9	
Female	Sample size	0	0	45	0	294	1	0	340
	Average length			778		841	1		
	SD			39.3		37.5			
Total	Sample size	2	18	129	1	450	4	2	606
	Average length	354	570	764	631	858	820	914	
	SD	14.7	89.2	64.9		53.4	96.7	54.9	

Verrett Creek									
Male	Sample size	0	5	29	0	23	0	0	57
	Average length		631	715		812			
	SD		29.0	55.2		81.8			
Female	Sample size	0	0	22	0	75	0	1	98
	Average length			760		802		900	
	SD			35.3		41.1			
Total	Sample size	0	5	51	0	98	0	1	155
	Average length		631	734		805		900	
	SD		29.0	52.6		52.8			

Table 10.–Estimated age composition of chinook salmon harvested in the Canadian gillnet fishery, by sex, 1997.

		Brood year and age class							
		1994	**1993**	**1992**	**1992**	**1991**	**1991**	**1990**	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	2	33	44	1	88	0	3	171
	Percent	0.5	7.5	10.0	0.2	20.0	0.0	0.7	38.8
	SE (%)	0.3	1.3	1.4	0.2	1.9		0.4	2.3
Female	Sample size	0	5	65	0	197	0	3	270
	Percent	0.0	1.1	14.7	0.0	44.7	0.0	0.7	61.2
	SE (%)		0.5	1.7		2.4		0.4	2.3
Total	Sample size	2	38	109	1	285	0	6	441
	Percent	0.5	8.6	24.7	0.2	64.6	0.0	1.4	100.0
	SE (%)	0.3	1.3	2.1	0.2	2.3		0.6	0.0

Table 11.–Estimated length at age (MEF) of chinook salmon harvested in the Canadian gillnet fishery, by sex, 1997.

		Brood year and age class							
		1994	**1993**	**1992**	**1992**	**1991**	**1991**	**1990**	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	2	33	44	1	88	0	3	171
	Average length	372	533	718	543	847		886	
	SD	10.6	74.9	112.3		68.8		116.4	
Female	Sample size	0	5	65	0	197	0	3	270
	Average length		650	729		806		882	
	SD		20.2	52.9		46.2		75.9	
Total	Sample size	2	38	109	1	285	0	6	441
	Average length	372	549	725	543	819		884	
	SD	10.6	80.6	81.9		57.2		87.9	

Table 12.–Estimated age composition of chinook salmon sampled at the Andrew Creek weir, 1997.

		Brood year and age class							
		1994	**1993**	**1992**	**1992**	**1991**	**1991**	**1990**	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	5	17	37	0	31	0	1	91
	Percent	5.5	18.7	40.7	0.0	34.1	0.0	1.1	51.4
	SE (%)	1.7	2.9	3.7		3.6		0.8	3.8
Female	Sample size	0	0	26	0	60	0	0	86
	Percent	0.0	0.0	30.2	0.0	69.8	0.0	0.0	48.6
	SE (%)			3.5		3.5			3.8
Total	Sample size	5	17	63	0	91	0	1	177
	Percent	2.8	9.6	35.6	0.0	51.4	0.0	0.6	100.0
	SE (%)	1.2	2.2	3.6		3.8		0.6	

Table 13.–Estimated length at age (MEF) of chinook salmon sampled at the Andrew Creek weir, 1997.

		Brood year and age class							
		1994	**1993**	**1992**	**1992**	**1991**	**1991**	**1990**	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	**Total**
Male	Sample size	5	17	37	0	31	0	1	91
	Average length	335	538	705		804		840	
	SD	22.4	60.0	80.9		71.9			
Female	Sample size	0	0	26	0	60	0	0	86
	Average length			747		824			
	SD			56.8		48.0			
Total	Sample size	5	17	63	0	91	0	1	177
	Average length	335	538	722		817		840	
	SD	22.4	60.0	74.4		57.6			

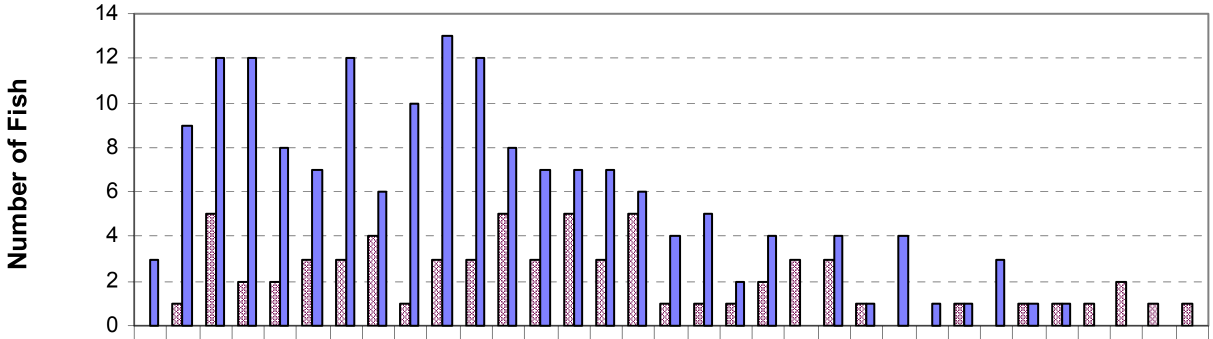
at Chutine tower; 4) Christina Creek: fish tracked to Christina Creek; 5) Tahltan River, includes fish tracked to mainstem Tahltan River above and below confluence of Little Tahltan, Beatty Creek and Tashoots Creek; 6) Little Tahltan River: any fish above the Little Tahltan weir; 7) Upper Stikine, includes fish recorded at either Little Canyon, Kirk Creek or Telegraph Creek Towers and not in Tahltan, Little Tahltan or Chutine rivers, includes Tuya River, Dokdaon, Shakes and Telegraph creeks; 8) Lower Stikine: all fish recorded at border tower and never found again. Based on the radio telemetry results, estimated proportions of large chinook spawning in each area of the Stikine River were: U.S. 1.8%, Iskut 17.5%, Chutine 4.7%, Christina 3.5%, Tahltan 25.8%, Little Tahltan 17.7%, Upper Stikine 21.8%, and Lower Stikine 7.2%. Bootstrap confidence intervals for the proportions spawning in each area were asymmetric for the areas with small contributions (Table 14). Weighting distribution estimates to account for the radio-tagged fish captured in the lower river gillnet fishery did not change the estimates significantly (Table 14).

The median time for radio-tagged fish to travel the 20 km from Kakwan Pt to the tracking station near the border was 10 days (range 1–32 days), and the median travel time for fish marked only with spaghetti tags that were recaptured in the Canadian lower river fishery was 13 days (range 2–60 days; Figure 8). Fish marked later in the run tended to move faster than fish marked earlier. Fish migrating to Verrett Creek and other Iskut River tributaries in general migrated by the Kakwan Pt. tagging site later in the year than fish heading to the Tahltan and other upriver spawning areas, a trend also noted in 1996 (Figure 9).

Table 14.–Summary of fates assigned to radio transmitters on Stikine River, 1997. Tags were assigned to fates by tagging period, estimated proportions spawning in each tributary, weighted as in equation (4), and unweighted, with SE and upper and lower confidence intervals for weighted estimates.

	Period		Estimated proportion spawning in tributary		Bootstrap (%)		
ASSIGNED FATE	**1** (5/7–6/18)	**2** (6/19–7/9)	Weighted	Unweighted	SE	LCI	UCI
Tributary:							
U.S.	1	4	1.8	1.9	0.8	0.3	3.6
Iskut	14	26	17.5	17.1	2.4	13.1	22.9
Chutine	8	0	4.7	4.8	1.6	1.9	7.9
Christina	6	0	3.5	3.6	1.3	1.0	6.2
Tahltan	35	15	25.8	25.9	2.9	19.9	31.3
Little Tahltan	26	7	17.7	17.8	2.6	12.5	22.6
Upper	27	17	21.8	21.8	2.8	16.6	27.6
Lower	8	7	7.2	7.1	1.7	4.2	10.8
Subtotal	125	76	100	100			
Mort/regurgitation	14	12					
Lower river gillnet	14	14					
Total	153	102					

LCI = lower 95% confidence interval, UCI = upper 95% confidence interval.



Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	31	32	33	35	60
no. spag. tags	0	1	5	2	2	3	3	4	1	3	3	5	3	5	3	5	1	1	1	2	3	3	1	0	0	1	0	1	1	1	2	1	1
no. radio tags	3	9	12	12	8	7	12	6	10	13	12	8	7	7	7	6	4	5	2	4	0	4	1	4	1	1	3	1	1	0	0	0	0

Figure 8.–Travel time in days for chinook salmon tagged with spaghetti tags and recovered in the lower Stikine gillnet fishery and for fish tagged with radio tags and recorded passing the tracking station at the U.S. /Canada border, 1997.

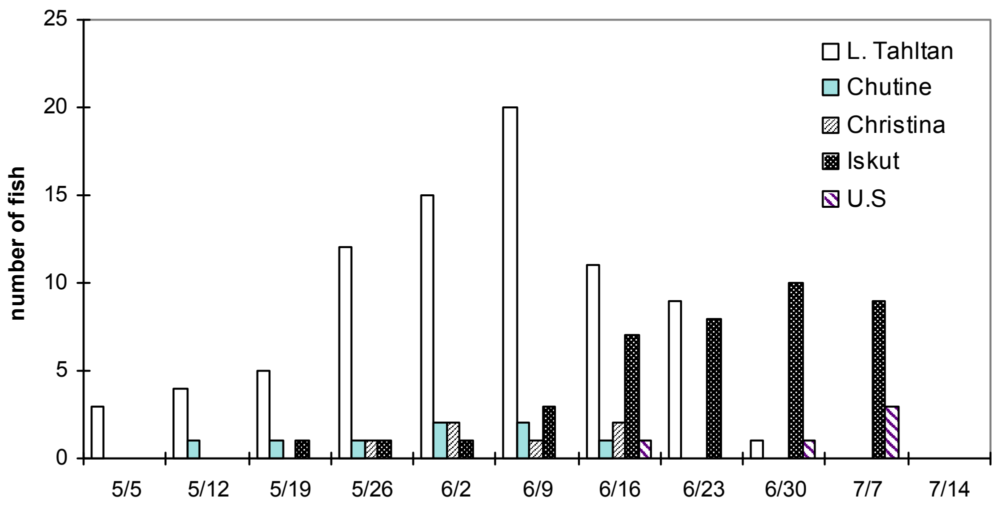


Figure 9.–Final destination of radio tagged chinook salmon, by week tagged at Kakwan Point, Stikine River, 1997. Iskut includes Verrett Creek and Craig River; U.S. includes Andrew Creek and Kikahe River.

The remote tracking stations did not record every radio-tagged fish that passed them. For example, the Border station recorded 170 unique tag codes while at least 224 radio tagged fish were tracked upriver, recorded at other stations, or recovered in fisheries or spawning ground samples. This was unexpected, as Eiler (1995) reported 97.8 to 100% tracking success for similar units used under similar conditions on the Taku River. Aerial surveys were important in supplementing the data from the remote tracking stations.

DISCUSSION

Length and sex composition data in this study indicate that size selective sampling may have occurred during gillnet fishing (Seber 1982). The lengths of tagged fish recovered at Verrett Creek indicate possible size selection during event 1, whereas the recoveries at Little Tahltan do not. When pooled, data from Little Tahltan River and Verrett Creek show no signs of size-selective sampling. Only when separated, did data from Verrett Creek indicate that sampling in that stream was biased towards smaller fish. This dichotomy most likely arises because fish returning to Verrett Creek are *smaller regardless of age*. Results from statistical tests on mean length at age, age compositions, and length distributions of sampled fish in 1996 and 1997 are consistent with this conclusion.

The Canadian commercial fishery provided a large sample size for event 2. Also, the regular pattern of fishing in the commercial fishery would tend to equalize the probability that every chinook salmon passing by Kakwan Point after June 9 would be caught in event 2. Although the commercial fishery was size-selective towards smaller chinook salmon, the effect of this violation of assumption (a) on accuracy of the estimate was negligible. Unfortunately, the estimate is for only those fish passing by Kakwan Point after June 9. The timing curve of fish sampled at Kakwan Point must be prorated for differences in sampling effort to expand the estimate to cover the entire season. This prorated expansion is 24,468 fish (43.0%) passing prior to June 10, leaving a seasonal estimate of 41,365 (40,678 large) chinook salmon past Kakwan Point. Unfortunately, the estimated variance of 33,032,866 is a minimum estimate because the variance in the prorated expansion is not estimable.

In the 1996 study, discrepancies among estimates of abundance and observed tagging rates in samples arose because of sampling problems in the Little Tahltan River and at Kakwan Point. Daily catch is dependent not only on effort but on river conditions, which can change dramatically from day to day. Sampling effort in 1996 was erratic at Kakwan Point. The period between June 7 and 25 had the highest average daily fishing time, along with the bulk of captured fish. Most of the salmon (92%) recovered in Verrett Creek in 1996 were tagged in this interval; 50% of the salmon recovered in the Little Tahltan were tagged before this period.

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 from 362 net-hours in 1996 to 453 net-hours in 1997 and maintain a more consistently high level of effort. We also increased the sample size of fish physically inspected at the Little Tahltan weir. The probability of recovering a marked fish was not significantly different in samples inspected at the Little Tahltan weir, Verrett Creek, or lower river commercial fishery ($\chi^2 = 0.83$, 2 df, $P = 0.662$), indicating that assumption (a)(every fish had an equal chance of being marked in event 1) was met.

Observation of fish passing by the Little Tahltan weir obviously boosted sample sizes, but was also less reliable than actually handling fish. The blue tag used in the study was designed to blend into the partially occluded waters of the upper Stikine River to prevent predators from targeting on marked fish. Unfortunately, this same quality would hamper recognition at a distance by technicians as well, which may explain why the tagged rate of inspected fish at the weir was higher than the rate for observed fish. Another explanation for the difference in tagging rates between the two recovery methods may be a natural propensity for the crew to target on tagged fish while sampling.

In the 1996 study we thought the discrepancy between tagged rates of chinook salmon inspected at the weir and those sampled upstream was likely due to low sampling effort early in the season at Kakwan Point. This explanation is less likely in 1997 where effort was high and reasonably consistent from early in the run. Even with the improved spaghetti tags and secondary marks carcass samples tended to have a lower marking rate than live or freshly killed chinook salmon, consequently carcass samples were not included in the preferred abundance estimate.

Thirty-three (33) radio-tagged fish were tracked above the Little Tahltan River weir, 26 were tagged in period 1 and seven in period 2. Based on the radio tagging rates (period 1 = 1 out of every 3.2 large fish tagged, period 2 = 1 of 1.8), we would expect to see about 96 large spaghetti tagged fish at the weir. Actual numbers were less: 22 inspected plus 47 observed, indicating either higher than estimated tag loss or that not all spaghetti tags were seen in the observation of live fish passing through the weir. The marked rate of fresh (live or recently killed) fish sampled on the Verrett River was higher than on old carcasses sampled there which makes us suspect some tag loss in carcass samples, even with the improved spaghetti tag and secondary marks.

Given the difficulties with the data from the fish observed but not handled at the Little Tahltan weir and concerns about carcass samples, the most reliable estimate of abundance is that derived from tags recovered from fish actually sampled at the weir, fresh samples at Verrett and Shakes creeks, and the lower river commercial and test gillnet fishery. This estimate has the smallest SE and best relative precision of all the estimates examined. To make the estimate of abundance past Kakwan Point comparable to other estimates of spawning abundance, harvests in the commercial and aboriginal fisheries should be subtracted. The final estimate of large spawning abundance is 26,996 fish (31,509 - 4,513; SE = 2,960).

The telemetry study confirmed the importance of the Tahltan/Little Tahltan systems and helped quantify the importance of the Iskut River to spawning chinook salmon. The weir count of 5,557 large fish is 20.6% of the estimated escapement, which is similar to the 17.7% (including U.S.) estimated from the telemetry study and the 15.1% estimated in the 1996 mark-recapture study.

No significant unknown spawning areas were identified, but almost one-third of the fish tracked upriver were not tracked to a specific spawning area. Some of those fish may have spawned in the mainstem Stikine River, although several tracking flights were conducted over the majority of the mainstem without any radio tags found. The long distances between refueling sites made surveying the Stikine drainage difficult and expensive. Many small tributaries were surveyed only once or not at all. There were 15 fish that were recorded at the Border tracking station and nowhere else. These fish were classified as lower river spawners (Table 14), but all we know for sure is that they swam upriver far enough to be recorded at the Border. Possible fates of these fish include: 1) transmitter failure; 2) fish that turned around after being recorded and went back out to sea; 3) regurgitated the tag or died without transmitter being found again; 4) spawned below next tracking station (lower river spawners); 5) not recorded by other tracking stations even though they passed upstream and not found again. We have no information on which of these possibilities is most likely; however, the numbers are small enough that estimates of distribution would not change much.

The failure of the remote tracking stations to record each fish was a big disappointment. The Telegraph Creek and Chutine River sites had equipment failures that were easily diagnosed, but the remaining units appeared to function properly throughout the study. The sites were carefully selected, but apparently some radio-tagged fish were able to pass without being picked up by the receivers. Other investigators use multiple units to provide backup and insure that each and every transmitter is recorded. The remote tracking units and aerial surveys are both expensive, requiring careful planning to meet project objectives and stay within budget.

Migration patterns and run timing of chinook salmon returning to the Stikine River are similar to those of fish returning to the Taku River, another large transboundary river (McPherson et al. 1996). However, age 1.1 and 1.2 fish (jacks) are common in the Taku chinook salmon run, often making up over 20% of the return, sometimes much more, while jacks are much rarer in Stikine River chinook salmon.

Iskut River chinook salmon are smaller and later running than upriver stocks—which may result in higher harvest rates in gillnet fisheries that target sockeye salmon.

CONCLUSIONS AND RECOMMENDATIONS

This was the second attempt at estimating the total escapement of chinook salmon to the Stikine River. We confirmed that it is feasible to conduct a mark-recapture experiment with acceptable results using methods developed in 1995 and 1996. Drift gillnets are an effective method of capturing large chinook salmon migrating up the Stikine River. The results of the 1996 and 1997 studies confirm that the Little Tahltan River weir count is a valid index of chinook salmon escapement to the Stikine River; however, the present expansion of 4 times the weir count probably underestimates the escapement.

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APPENDIX A

Appendix A1.–Locations of radio transmitters implanted in large chinook salmon on the Stikine River in 1997, by radio frequency, code, date tagged Julian date located, by tracking tower, survey date and final destination.

					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
1	1	7-May	150.672	105	127	140		160	N				165		Chutine
2	2	8-May	150.693	105	128	132		N	N						
3	3	11-May	150.732	105	131	149		161	164					T20(198)	
4	4	12-May	150.712	105	132	149		172	N					T16(273)	Tahltan
5	5	12-May	150.773	105	132	156		166	170					JT1(217)	Tashoots
6	6	13-May	150.794	105	133	164		172	176					B1 (273)	Beatty
7	7	13-May	150.832	105	133	143		N	N				175	CH40(217)	Chutine
8	8	16-May	150.754	105	136	N		N	N					S0(258)	N
9	9	16-May	150.814	105	136	152		166	172					LT(198)	L.Tahltan
10	10	16-May	150.870	105	136	N		N	N						N
11	11	18-May	150.853	105	138	N		N	N					T5(198)	
12	12	19-May	150.892	105	139	161		N	170					T (269)	Tahltan
13	13	19-May	150.932	105	139	164		N	180					LT(198)	L.Tahltan
14	14	19-May	150.953	105	139	N		N	N					V(217)	Verrett
15	15	20-May	150.972	105	140	160		N	N				173	CH35(217)	Chutine
16	16	20-May	150.913	105	140	N		N	N			159			
17	17	21-May	151.013	105	141	155		164	170					T31(273)	Tahltan
18	18	21-May	150.993	105	141	164		N	191	196				LT (273)	L.Tahltan
19	19	21-May	151.033	105	141	151		N	N						
20	20	21-May	151.293	105	141	N		N	N						N
21	21	21-May	151.073	165	141	N		N	N						N
22	22	22-May	151.094	105	142	156		173	184					T (269)	Tahltan
23	23	23-May	151.112	105	143	153		170	173					T16(273)	Tahltan
24	24	23-May	151.174	105	143	162		167	171					T20(273)	Tahltan
25	25	23-May	151.193	105	143	N		N	N						N
26	26	25-May	151.213	105	145	?		N	N						N
27	27	26-May	151.053	105	146	173		189	194	197				S210(198)	
28	28	27-May	151.133	105	147	151		165	172					T25(198)	Tahltan
29	29	27-May	151.234	105	147	163		172	185					T (269)	Tahltan
30	30	28-May	151.153	105	148	163	183	179	N						

-continued-

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
31	31	29-May	151.273	105	149	N		N	N						N
32	32	29-May	151.392	105	149	N		169	N				181	CH (217)	Chutine
34	33	29-May	151.373	105	149	162		N	N					CT(217)	Christina
35	34	30-May	151.314	105	150	167	167	N	N						Gillnet
36	35	30-May	151.334	105	150	177		191	N	195				LT1(217)	L.Tahltan
37	36	30-May	151.354	105	150	153		172	181					T35(217)	Tahltan
38	37	30-May	151.412	105	150	162		171	176					T15(198)	Tahltan
39	38	30-May	151.433	105	150	158		N	N			159			
40	39	30-May	151.454	105	150	N		N	N						N
41	40	31-May	151.533	105	151	161		168	172					TU1(269)	Tuya
42	41	31-May	151.574	105	151	166		186	191	193				TU1(269)	Tahltan
43	42	31-May	151.473	105	151	162		168	171						
44	43	31-May	151.493	105	151	175		183	186				191	CH35(217)	Chutine
45	44	31-May	151.514	105	151	163		172	176					LT7/17	L.Tahltan
46	45	1-Jun	151.653	105	152	N	183	N	N						Gillnet
47	46	1-Jun	151.672	105	152	164		184	186	191					
48	47	1-Jun	151.693	105	152	171		184	187	193				LT7/17	L.Tahltan
49	48	1-Jun	151.592	105	152	160		184	189	192				JT1(217)	Tashoots
50	49	1-Jun	151.612	105	152	?		187	194	195				T27(198)	Tahltan
51	50	2-Jun	151.712	105	153	171		182	188	193					
52	51	2-Jun	151.733	105	153	175	175	N	N						Gillnet
53	52	2-Jun	151.633	105	153	N		N	N						N
54	53	2-Jun	151.774	105	153	N		N	N						N
55	54	2-Jun	151.793	105	153	160		172	186	193				T (269)	Tahltan
56	55	3-Jun	151.753	105	154	164		177	185	208					
57	56	3-Jun	151.872	105	154	160		183	N					CT(217)	Christina
58	57	3-Jun	151.812	105	154	161		164	171					T25(217)	L.Tahltan
59	58	3-Jun	151.833	105	154	186	186	N	N						Gillnet
60	59	3-Jun	151.853	105	154	176		189	201	204				S195(217)	
61	60	3-Jun	151.913	105	154	172		N	N				200	CH25(217)	Chutine
62	61	3-Jun	151.934	105	154	159		165	N			162		V(217)	Verrett
63	62	4-Jun	151.892	105	155	162		174	181						

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
64	63	4-Jun	150.692	125	155	172		181	184						
65	64	4-Jun	150.712	125	155	158		168	N				182		Chutine
66	65	4-Jun	151.954	105	155	162		183	174					JT4(217)	Tashoots
67	66	4-Jun	151.972	105	155	158		167	172					LT7/17	L.Tahltan
68	67	4-Jun	150.672	125	155	161		167	N					LT (273)	L.Tahltan
69	68	4-Jun	150.732	125	155	171		180	184	195					
70	69	5-Jun	150.754	125	156	182		190	193	195					
71	70	5-Jun	150.814	125	156	N		N	N						N
72	71	6-Jun	150.773	125	157	N		N	N					V(217)	Verrett
73	72	6-Jun	151.553	105	157	166		174	N					T (269)	Tahltan
74	73	6-Jun	150.794	125	157	172		N	N					CT(223)	Christina
75	74	6-Jun	150.833	125	157	166		N	N						
76	75	6-Jun	150.853	125	157	N		N	N					T5(217)	Tahltan
77	76	7-Jun	150.870	125	158	171		N	184						
78	77	7-Jun	150.892	125	158	164		N	192					SH1(217)	Shakes Cr.
79	78	7-Jun	150.913	125	158	N		N	190	193				LT (273)	L.Tahltan
80	79	7-Jun	151.392	125	158	169		175	184					T (269)	Tahltan
81	80	7-Jun	151.133	125	158	N		186	192	194					
82	81	8-Jun	151.153	125	159	163		170	171						
83	82	8-Jun	150.973	125	159	161			172					LT1(273)	L.Tahltan
84	83	8-Jun	150.953	125	159	179		N	191	193					
85	84	8-Jun	150.932	125	159	163		N	174	191					
86	85	8-Jun	150.993	125	159	183	189	N	N						Gillnet
87	86	9-Jun	151.073	125	160	166		172	174					T6(198)	Tahltan
88	87	9-Jun	151.092	125	160	184		N	N						
89	88	9-Jun	151.112	125	160	164		173	180					T (269)	Tahltan
90	89	9-Jun	151.073	105	160	165		183	185	190				LT7/17	L.Tahltan
91	90	9-Jun	151.013	125	160	N		184	186					T16(273)	Tahltan
92	91	9-Jun	151.053	125	160	161		N	N			162			
93	92	9-Jun	151.174	125	160	163		176	183					LT1(217)	L.Tahltan
94	93	9-Jun	151.253	125	160	N		184	193	197				T13(198)	Tahltan
95	94	9-Jun	151.273	125	160	171		N	N						

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
96	95	10-Jun	151.293	125	161	172		178	182						
97	96	10-Jun	151.314	125	161	N		182	N					LT (273)	L.Tahltan
98	97	10-Jun	151.334	125	161	174		192	198	200				T (269)	Tahltan
99	98	10-Jun	151.472	125	161	170		178	183					LT7/17	L.Tahltan
100	99	10-Jun	151.493	125	161	N		177	185						
101	100	10-Jun	151.514	125	161	175	176	N	N					LT1/217	
102	101	10-Jun	151.633	125	161	163		N	N			181		CR16(217)	Craig
103	102	10-Jun	151.193	125	161	172		182	186	192				LT7/17	L.Tahltan
104	103	10-Jun	151.213	125	161	171		181	185					LT7/17	L.Tahltan
105	104	10-Jun	151.234	125	161	171		180	183					T30(273)	Tahltan
106	105	10-Jun	151.354	125	161	163		N	N					CR14(217)	Craig
107	106	10-Jun	151.412	125	161	?		179	183						L.Tahltan
108	107	10-Jun	151.433	125	161	168		173	N						L.Tahltan
109	108	10-Jun	151.454	125	161	164		N	N					CR5(217)	Craig
110	109	10-Jun	151.533	125	161	N		191	193	194				T40(217)	Tahltan
111	110	10-Jun	151.553	125	161	171		181	187	191				T10(217)	Tahltan
112	111	10-Jun	151.592	125	161	171		181	186	192					
113	112	11-Jun	151.653	125	162	N		183	N				190	CH32(217)	Chutine
114	113	11-Jun	151.672	125	162	180	180	N	N						Gillnet
115	114	11-Jun	151.693	125	162	172		183	188	194				T (269)	Tahltan
116	115	11-Jun	151.913	125	162	170		173	182					T5(198)	Tahltan
117	116	11-Jun	151.934	125	162	174		186	191	193				LT4(198)	L.Tahltan
118	117	11-Jun	151.954	125	162	178	178	170	N						Gillnet
119	118	11-Jun	151.612	125	162	169		N	N					V(217)	Verrett
120	119	11-Jun	151.712	125	162	172		182	185	193				LT7/17	L.Tahltan
121	120	11-Jun	151.733	125	162	166		173	180					LT7/17	L.Tahltan
122	121	11-Jun	151.753	125	162	171		182	185					Tuya(217)	Tuya
123	122	11-Jun	151.774	125	162	173	184	N	N						Gillnet
124	123	12-Jun	151.972	125	163	N		176	N						
125	124	12-Jun	150.672	165	163	183		187	193	201					
126	125	12-Jun	150.693	165	163	N		N	N					AN(223)M	Andrew Cr
127	126	12-Jun	151.793	165	163	166		N	N						

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
129	128	12-Jun	151.872	125	163	172		172	184					LT7/17	L.Tahltan
130	129	12-Jun	151.892	125	163	N		N	N			188		CR15(217)	Craig
131	130	12-Jun	150.712	165	163	185	184	N	N						Gillnet
132	131	13-Jun	150.732	165	164	166		N	N						
133	132	13-Jun	150.754	165	164	191		197	199	202				T (269)	Tahltan
134	133	13-Jun	150.773	165	164	N		N	N			180		V(217)	Verrett
135	134	13-Jun	150.794	165	164	170		174	183					LT7/17	L.Tahltan
136	135	13-Jun	150.814	165	164	N		N	N						N
137	136	13-Jun	151.832	165	164	N		N	N						N
138	137	14-Jun	150.853	195	165	N		N	N						N
139	138	14-Jun	150.892	165	165	180		N	192	194					L.Tahltan
140	139	15-Jun	150.832	165	166	N		N	N						N
141	140	15-Jun	150.913	165	166	N		N	N					V(217)	Verrett
142	141	15-Jun	150.870	165	166	186	186	N	N						Gillnet
143	142	16-Jun	150.932	165	167	171		N	199	202					
144	143	16-Jun	151.133	165	167	168		184	190	193					
145	144	17-Jun	151.092	165	168	172		N	N						
146	145	17-Jun	151.153	165	168	171		182	N	190				T (269)	Tahltan
147	146	17-Jun	151.954	165	168	N		182	N					CT(217)	Christina
148	147	17-Jun	151.174	165	168	185		189	192	193				LT (273)	L.Tahltan
149	148	17-Jun	151.193	165	168	177		186	193	195					
150	149	18-Jun	151.234	165	169	174	177	N	N						Gillnet
151	150	18-Jun	151.273	165	169	183		194	197	199					
152	151	18-Jun	151.293	165	169	171		N	N			173		V(217)	Verrett
153	152	18-Jun	151.334	165	169	179		N	N					CT(217)	Christina
154	153	18-Jun	151.314	165	169	N		193	199	202				T15(269)	Tahltan
155	154	19-Jun	151.412	165	170	184	Reference tag	N	N						
156	155	19-Jun	151.354	165	170	N		192	195	197				B1(273)	Beatty
157	156	19-Jun	151.373	125	170	171		185	191	194				T4(198)	Tahltan
158	157	19-Jun	151.373	165	170	175		192	197	201				T(269)	Tahltan
159	158	19-Jun	151.392	165	170	N		N	N					S90(217)	

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
160	159	20-Jun	151.472	165	171	N		N	N						N
161	160	20-Jun	151.493	165	171	N		191	194	197				T(269)	Tahltan
162	161	20-Jun	151.533	165	171	180		188	195	197					
163	162	20-Jun	151.433	165	171	182		192	196	199				T (269)	Tahltan
164	163	20-Jun	151.454	165	171	189		201	210					S158(217)	
165	164	20-Jun	151.972	165	171	174		189	N			179		V(217)	Verrett
166	165	20-Jun	150.853	165	171	N		N	197	199					
167	166	20-Jun	151.872	165	171	N		N	N						N
168	167	21-Jun	151.892	165	172	183		N	196	198				T1(198)	Tahltan
169	168	21-Jun	151.913	165	172	179		N	N			181			
170	169	22-Jun	151.592	165	173	N		N	N			186			
171	170	22-Jun	151.612	165	173	N		N	N			189			Verrett
172	171	22-Jun	151.633	165	173	N		201	205	207					
173	172	22-Jun	151.653	165	173	N		N	N						N
174	173	22-Jun	151.672	165	173	185	185	N	N						Gillnet
175	174	22-Jun	151.693	165	173	N		191	194	196				LT (273)	L.Tahltan
176	175	22-Jun	150.672	195	173	N		N	N			193		V(217)	Verrett
177	176	22-Jun	150.693	195	173	N		N	184					V(217)	Verrett
178	177	23-Jun	150.712	195	174	183		191	195	198					
179	178	23-Jun	150.732	195	174	180		195	198	201				T (269)	Tahltan
180	179	23-Jun	150.754	195	174	N		195	199	202					
181	180	23-Jun	150.773	195	174	N		200	205	207				V(259)	
182	181	23-Jun	150.794	195	174	N		N	N					V(217)	Verrett
183	182	23-Jun	150.814	195	174	N		N	N	193					L.Tahltan
184	183	23-Jun	150.972	165	174	179		N	202						
185	184	23-Jun	150.953	165	174	186	185	N	N						Gillnet
186	185	23-Jun	150.953	195	174	N		N	N						
187	186	24-Jun	151.013	195	175	N		197	199	202				T (269)	Tahltan
188	187	24-Jun	150.993	195	175	N		N	N					V(217)	Verrett
189	188	24-Jun	151.092	195	175	184		191	193	195				LT(198)	L.Tahltan
190	189	24-Jun	151.033	165	175	N		N	N						N
191	190	24-Jun	150.832	195	175	N		N	N			186			

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
192	191	24-Jun	150.870	195	175	178		N	N						
193	192	24-Jun	150.913	195	175	183		N	196	198				T (269)	Tahltan
194	193	24-Jun	150.932	195	175	187		N	N			191		V(217)	Verrett
195	194	25-Jun	151.133	195	176	181		193	196						
196	195	25-Jun	150.892	195	176	N		N	N						N
197	196	25-Jun	151.073	195	176	180		N	N						
198	197	26-Jun	151.053	165	177	N		197	200	202				T (269)	Tahltan
199	198	26-Jun	151.213	165	177	N		N	N						N
200	199	26-Jun	151.153	195	177	188		197	199	201				T15(217)	Tahltan
201	200	26-Jun	151.174	195	177	188		198	201	203				T (269)	Tahltan
202	201	27-Jun	151.314	195	178	194		N	N			195			Iskut
203	202	27-Jun	150.993	165	178	N		N	N						N
204	203	27-Jun	151.193	195	178	186		194	196	199				LT(198)	L.Tahltan
205	204	27-Jun	151.213	195	178	192	192	N	N						Gillnet
206	205	27-Jun	151.033	195	178	N		N	N			189		V(217)	Verrett
207	206	28-Jun	150.972	195	179	186		N	198	201					
208	207	28-Jun	151.053	195	179	N		195	198	199				T (269)	Tahltan
209	208	28-Jun	151.334	195	179	182	182	N	N						Gillnet
210	209	28-Jun	151.354	195	179	194		199	203	206					
211	210	28-Jun	151.253	165	179	184	185	N	N						Gillnet
212	211	28-Jun	151.234	195	179	185		N	N			185		V(217)	Verrett
213	212	29-Jun	151.253	195	180	189		N	N						
214	213	29-Jun	151.273	195	180	187		199	203	206					
215	214	29-Jun	151.293	195	180	N		200	202	204				T12(198)	Tahltan
216	215	29-Jun	151.373	195	180	191	190	N	N						Gillnet
217	216	29-Jun	151.392	195	180	185	185	N	N						Gillnet
218	217	30-Jun	151.433	195	181	197		N	N			198			
219	218	30-Jun	151.412	195	181	?	Reference	N	N					V(217)	Verrett
220	219	30-Jun	151.454	195	181	185		N	N					V(217)	Verrett
221	220	30-Jun	151.472	195	181	N		N	N			185			
222	221	30-Jun	151.514	195	181	N		N	N					AN(223)M	Andrew C
223	222	1-Jul	151.533	195	182	197		N	N						

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					Julian	Tower site									
Fish	Count no.	Tag date	Radio frequency	Code	date tagged	Border tower	Inriver gillnet	Little Canyon	Kirk Creek	Teleg Creek	Little Tahltan	Iskut	Chutine	Survey location(day)	Final destination
224	223	1-Jul	151.553	195	182	N		N	N					V(217)	Verrett
225	224	1-Jul	151.493	195	182	184	185	N	N						Gillnet
226	225	1-Jul	151.592	195	182	193	194	N	N						Gillnet
227	226	1-Jul	151.612	195	182	N		N	N					V(259)	Verrett
228	227	2-Jul	151.633	195	183	190	189	N	N						Gillnet
229	228	2-Jul	151.712	195	183	190		N	N			193			
230	229	2-Jul	151.693	195	183	190	194	N	N						Gillnet
231	230	3-Jul	151.712	165	184	198		N	N						
232	231	3-Jul	151.774	195	184	188	188	N	N						Gillnet
233	232	3-Jul	151.753	195	184	186		N	N			191			
234	233	3-Jul	151.833	195	184	N		N	N			192		CR10(217)	Craig
235	234	3-Jul	151.653	195	184	N		N	N					CR10(217)	Craig
236	235	3-Jul	151.672	195	184	186		N	N			186		V(217)	Verrett
237	236	3-Jul	151.733	165	184	N		N	N					Kikahe(223)	Kikahe
238	237	4-Jul	151.733	195	185	N		N	N			198		CR5(217)	Craig
239	238	4-Jul	151.753	165	185	198		N	N						
240	239	4-Jul	151.853	165	185	N		197	N					S5(223)M	
241	240	4-Jul	151.793	195	185	193	194	N	N						Gillnet
242	241	4-Jul	151.812	195	185	N		197	N						
243	242	4-Jul	151.853	195	185	N		195	N					AN(216)	Andrew Cr.
244	243	5-Jul	151.892	195	186	190	190	191	N						Gillnet
245	244	5-Jul	151.972	195	186	N		198	N			197		V(217)	Verrett
246	245	5-Jul	151.954	195	186	196		197	N						
247	246	5-Jul	150.993	125	186	189	189	N	N						Gillnet
248	247	6-Jul	151.872	195	187	N		N	N					AN(223)M	Andrew Cr.
249	248	8-Jul	151.934	165	189	192		193	204	206					
250	249	9-Jul	151.334	195	190	N	Reused	N	N						N
251	250	15-Jun	151.013	165	166	168		185	187	193					L.Tahltan
252	251	21-May	151.033	125	141	154		164	170						Upper
253	252	29-May	151.253	105	150	162		169	171					JT(273)	Tashoots
254	253	3-Jul	151.774	160	185	N		189	194	197				T8(198)	LT8(217)
255	254	13-Jun	151.812	160	165	178		185	187	202					L.Tahltan
256	255	13-Jun	151.833	125	164	N		164	N						

Appendix 2.–Drift gillnet daily effort (minutes fished), catches, and catch per net hour, near Kakwan Point, Stikine River, 1997.

Date	Minutes	Large chinook	jacks	Sockeye	Temp	Depth	Catch/ net/hour	Date	Lg. chin cum.	Cum. percent
5/7/97	431	3	0	0		11.9	0.42	5/7/97	3	0.004
5/8/97	395	7	0	0	5.5	12.5	1.06	5/8/96	10	0.014
5/9/97	207	0	0	0		12.5	0.00	5/9/96	10	0.014
5/10/97	517	0	0	0	5.5	12.5	0.00	5/10/96	10	0.014
5/11/97	489	2	0	0	6	12.3	0.25	5/11/96	12	0.017
5/12/97	490	7	0	0	5.2	13.1	0.86	5/12/96	19	0.027
5/13/97	484	2	0	0	6	15.9	0.25	5/13/96	21	0.030
5/14/97	488	4	0	0	6	17.5	0.49	5/14/96	25	0.036
5/15/97	443	0	0	0	6	19	0.00	5/15/96	25	0.036
5/16/97	483	7	0	0	5.5	19.2	0.87	5/16/96	32	0.046
5/17/97	496	0	0	0	7	18.1	0.00	5/17/96	32	0.046
5/18/97	493	5	0	0	7.5	17.5	0.61	5/18/96	37	0.054
5/19/97	486	13	2	0	7.5	17.5	1.60	5/19/96	50	0.072
5/20/97	505	6	0	0	8	17.2	0.71	5/20/96	56	0.081
5/21/97	495	13	0	0	8	17.5	1.58	5/21/96	69	0.100
5/22/97	477	5	1	0	8	17.9	0.63	5/22/96	74	0.107
5/23/97	238	7	0	0		18.4	1.76	5/23/96	81	0.117
5/24/97	238	2	0	0		19.7	0.50	5/24/96	83	0.120
5/25/97	253	1	0	0		20.4	0.24	5/25/96	84	0.122
5/26/97	483	3	0	0	8.5	20.8	0.37	5/26/96	87	0.126
5/27/97	484	4	0	0	8	20.5	0.50	5/27/96	91	0.132
5/28/97	242	4	0	0	8	19.2	0.99	5/28/96	95	0.137
5/29/97	506	14	0	0	8	19.2	1.66	5/29/96	109	0.158
5/30/97	488	21	0	0	9	20	2.58	5/30/96	130	0.188
5/31/97	496	16	0	0	9	20.7	1.94	5/31/96	146	0.211
6/1/97	500	17	0	0	8	20.8	2.04	6/1/96	163	0.236
6/2/97	493	14	0	0	9	20.4	1.70	6/2/96	177	0.256
6/3/97	494	24	0	0	9	19.9	2.91	6/3/96	201	0.291
6/4/97	486	21	0	0	9	20	2.59	6/4/96	222	0.321
6/5/97	465	6	0	0	9	20.7	0.77	6/5/97	228	0.330
6/6/97	413	13	0	0	9	20.8	1.89	6/6/96	241	0.349
6/7/97	508	12	1	0	8.2	21.6	1.42	6/7/96	253	0.366
6/8/97	479	17	1	0	10	21.1	2.13	6/8/96	270	0.391
6/9/97	394	27	1	0	11	20	4.11	6/9/96	297	0.430
6/10/97	507	53	1	0	11	19.2	6.27	6/10/96	350	0.507
6/11/97	497	35	0	0	9	19	4.23	6/11/96	385	0.557
6/12/97	497	27	3	0	9	19.2	3.26	6/12/96	412	0.596
6/13/97	359	27	1	2	8	19.6	4.51	6/13/96	439	0.635
6/14/97	253	7	0	0		19.4	1.66	6/14/96	446	0.645
6/15/97	499	10	1	0	8.5	20.8	1.20	6/15/96	456	0.660
6/16/97	505	8	1	0	8	21.4	0.95	6/16/96	464	0.671
6/17/97	506	14	0	3	9	21	1.66	6/17/96	478	0.692
6/18/97	489	16	2	1	9	20.9	1.96	6/18/96	494	0.715
6/19/97	484	11	1	0	8	20.4	1.36	6/19/96	505	0.731

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Date	Minutes	Large chinook	jacks	Sockeye	Temp	Depth	Catch/ net/hour	Date	Lg. chin cum.	Cum. percent
6/20/97	407	16	2	4	9	19.9	2.36	6/20/96	521	0.754
6/21/97	83	4	0	0	9	19.7	2.89	6/21/96	525	0.760
6/22/97	250	16	2	0	10	19.2	3.84	6/22/96	541	0.783
6/23/97	500	17	15	3	11	21.2	2.04	6/23/96	558	0.808
6/24/97	432	17	0	1	11	22.2	2.36	6/24/96	575	0.832
6/25/97	273	5	0	2	10	22.4	1.10	6/25/96	580	0.839
6/26/97	433	10	0	4	10.5	22.5	1.39	6/26/96	590	0.854
6/27/97	490	10	1	5	8	23	1.22	6/27/96	600	0.868
6/28/97	491	11	0	10	9	22.8	1.34	6/28/96	611	0.884
6/29/97	462	11	0	23	9	22.2	1.43	6/29/96	622	0.900
6/30/97	486	9	1	9	10	22	1.11	6/30/96	631	0.913
7/1/97	491	11	0	21	9	21.9	1.34	7/1/96	642	0.929
7/2/97	256	6	1	17	9	21	1.41	7/2/96	648	0.938
7/3/97	436	15	1	9	9	21	2.06	7/3/96	663	0.959
7/4/97	497	15	1	6	10	21	1.81	7/4/96	678	0.981
7/5/97	471	7	0	10	11	21.1	0.89	7/5/96	685	0.991
7/6/97	269	2	0	4	10.5	22.3	0.45	7/6/96	687	0.994
7/7/97	308	0	0	0	9	23.5	0.00	7/7/96	687	0.994
7/8/97	253	1	0	9	9	22.3	0.24	7/8/97	688	0.996
7/9/97	237	3	0	8	10	22.1	0.76	7/9/97	691	1.000

Appendix A3. Daily counts of chinook salmon through the Andrew Creek weir, 1997.

Date	Daily chinook			Cumulative chinook			Tagged		Air temp.	Water		Comments
	Small	med.	large	Small	medium	Large	Daily	Cum.		Temp.	Depth	
7/3/97	0	0	1	0	0	1	0	0			low	no thermometer
7/4/97	0	0	0	0	0	1	0	0			low	
7/5/97	0	0	0	0	0	1	0	0			low	
7/6/97	0	0	0	0	0	1	0	0	13	10	high	Flooding
7/7/97	0	0	1	0	0	2	0	0	15	11	med	
7/8/97	0	0	2	0	0	4	0	0	13.5	10.5	med	
7/9/97	0	0	2	0	0	6	0	0	14.5	10	med	
7/10/97	0	0	0	0	0	6	0	0	17	12.5	MED	
7/11/97	0	1	2	0	1	8	0	0	12	11	27.5	
7/12/97	0	0	2	0	1	10	0	0	14	11	31.5	
7/13/97	0	0	0	0	1	10	0	0	14	10	44	flooding, no samples
7/14/97	0	0	0	0	1	10	0	0	13	10	45	
7/15/97	0	0	3	0	1	13	0	0	14	11	40	1 large escaped, not sampled
7/16/97	0	0	0	0	1	13	0	0	14	10	52	Flooding
7/17/97	1	2	6	1	3	19	0	0	14	11	40	1 small not sampled
7/18/97	2	0	1	3	3	20	0	0	13	10	34	
7/19/97	0	1	9	3	4	29	0	0	14	10	44	
7/20/97	0	0	0	3	4	29	0	0	14	10	49	Flooding
7/21/97	0	4	6	3	8	35	0	0	13.5	10.5	39	
7/22/97	0	0	0	3	8	35	0	0	13	10	46	Flooding
7/23/97	0	0	0	3	8	35	0	0	13	10.5	58	Flooding
7/24/97	0	0	0	3	8	35	0	0	12.5	10	46	flood, bad scouring, weir moved
7/25/97	2	2	21	5	10	56	0	0	13.5	9	lower	
7/26/97	2	2	7	7	12	63	1	1	14	9	61	hatchery fish, new h2o scale
7/27/97	0	1	13	7	13	76	1	2	15	10	56	
7/28/97	2	2	10	9	15	86	0	2	15	11	58	
7/29/97	0	3	2	9	18	88	0	2	16	12	57	
7/30/97	0	1	5	9	19	93	0	2	15	10	8	
7/31/97	0	0	4	9	19	97	0	2	15	11	55	
8/1/97	0	0	1	9	19	98	0	2	14	10	53	
8/2/97	0	0	5	9	19	103	0	2	15	11	51	
8/3/97	0	2	12	9	21	115	0	2	15	11	51	
8/4/97	0	4	17	9	25	132	1	3	16	12	50	radio tag
8/5/97	0	2	7	9	27	139	0	3	15	11	49	
8/6/97	0	1	15	9	28	154	0	3	15	11.5	50	
8/7/97	0	2	7	9	30	161	1	4	14	11	51	hatchery fish
8/8/97	0	5	12	9	35	173	2	6	16	11.5	49	2 hatchery fish
8/9/97	0	1	10	9	36	183	1	7	18	12	48	hatchery fish
8/10/97	1	3	17	10	39	200	1	8	18	13	47	ad clip
8/11/97	0	3	8	10	42	208	0	8	18	15	46	
8/12/97	0	5	25	10	47	233	0	8	16	13.5	49	15 were large mort samples
8/13/97	0	1	18	10	48	251	0	8	15	13	64	
8/14/97	0	1	10	10	49	261	0	8	15	12	51	
8/15/97	0	0	0	10	49	261	0	8	14	11	53	
8/16/97	0	1	13	10	50	274	0	8	14	11	51	9 large were mort samples
8/17/97	0	5	9	10	55	283	0	8	14	11	50	
8/18/97	0	0	1	10	55	284	0	8				not sampled, passed thru pulled pickets
	Weir Pulled											

Appendix A4.–Origin of coded wire tags recovered from chinook salmon collected at Andrew Creek weir, 1997.

Year	ASTREAM NAME	HEAD	DATE (CWT)	LEN	TAG CODE	YEAR BROOD	Agency	LOCATION	RELEASED	RELEASE SITE	Tag ratio	Brood Stock
1997	ANDREW CR 108-40	76995	10-Aug-97	780	44036	1991	ADFG	SNETTISHAM	9-Jun-93	PORT ARMSTRONG109-10	8.883	Andrew
1997	ANDREW CR 108-40	76992	8-Aug-97	750	44240	1992	ADFG	CRYSTAL LK/EARL WEST	22-May-94	EARL WEST COV 107-40	6.332	Andrew Creek
1997	ANDREW CR 108-40	76993	8-Aug-97	725	44241	1992	ADFG	CRYSTAL LK/EARL WEST	22-May-94	EARL WEST COV 107-40	6.789	Andrew Creek
1997	ANDREW CR 108-40	76994	9-Aug-97	740	44241	1992	ADFG	CRYSTAL LK/EARL WEST	22-May-94	EARL WEST COV 107-40	6.789	Andrew Creek
1997	ANDREW CR 108-40	76981	26-Jul-97	630	44432	1993	ADFG	CRYSTAL LK/EARL WEST	21-May-95	EARL WEST COV 107-40	7.098	Andrew Creek
1997	ANDREW CR 108-40	76991	7-Aug-97	505	44416	1993	SSRA	CARROLL INLET	21-May-95	CARROLL INLET 101-45	7.219	Chicka-min R.

Appendix A5.–Computer files used to estimate the spawning abundance of chinook salmon in the Stikine River in 1997.

{PRIVATE }FILE NAME	DESCRIPTION
EFFORT97.xls	EXCEL spreadsheet with gillnet tagging data--daily effort, catch by species, and water depth by site; gillnet charts.
97STIK41.xls	EXCEL spreadsheet with recovery data for chinook salmon in the Stikine River in 1997. Includes recovery data by tributary (date, length (MEF), sex, age and any marks); length frequencies; length at age; age composition of gillnet and tributary samples; KS test data; charts.
Chisquared.XLS	Chi-square tests for Stikine chinook, 1997.
Ltahl97.xls	EXCEL spreadsheet with spawning ground samples--site, date, sex, length (MEF), age, tag numbers and comments.