Fishery Data Series No. 08-33

Abundance and Distribution of the Chinook Salmon Escapement on the Stikine River in 2005, and Production of Fish from Brood Year 1998

by

Philip Richards,

Keith A. Pahlke,

John A. Der Hovanisian,

Jan L. Weller,

and

Peter Etherton

June 2008

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

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

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

FISHERY DATA SERIES NO. 08–33

ABUNDANCE AND DISTRIBUTION OF THE CHINOOK SALMON ESCAPEMENT ON THE STIKINE RIVER IN 2005, AND PRODUCTION OF FISH FROM BROOD YEAR 1998

by
Philip Richards, Keith A. Pahlke, John A. Der Hovanisian
Division of Sport Fish, Douglas

Jan L. Weller
Division of Sport Fish, Ketchikan
and

Peter Etherton
Department of Fisheries and Oceans, Whitehorse, Yukon Territory, Canada

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

June 2008

Development and publication of this manuscript were partially financed by the Federal Aid in Sport fish Restoration Act (16 U.S.C.777-777K) under Project F-10-20 and F-10-21, Job No. S-1-3

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

Phillip Richards[a], Keith Pahlke, John Der Hovanisian,
Alaska Department of Fish and Game, Division of Sport Fish
802 3rd St., Douglas, AK 99824, P.O. Box 110024, Juneau, AK 99811, USA

Jan Weller,
Alaska Department of Fish and Game, Division of Sport Fish
2030 Sea Level Drive, Ketchikan, AK 99901, USA

and
Peter Etherton,
Department of Fisheries and Oceans, Stock Assessment Division
Suite 100-419 Range Road, Whitehorse, Yukon Territory, Canada Y1A3V1

[a] *Author to whom all correspondence should be addressed: phillip.richards@alaska.gov*

This document should be cited as:
Richards, P. J., K. A. Pahlke, J. A. Der Hovanisian, J. L. Weller, and P. Etherton. 2008. Abundance and distribution of the Chinook salmon escapement on the Stikine River in 2005, and production of fish from brood year 1998. Alaska Department of Fish and Game, Fishery Data Series No. 08-33, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Abundance of large (≥660mm MEF) and medium (440–559 mm MEF) Chinook salmon *Oncorhynchus tshawytscha* that returned to spawn in the Stikine River above the U.S./Canada border in 2005 was estimated using mark–recapture data. 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 1,096 immigrant Chinook salmon during May, June, and July, of which 1,059 large and 36 medium Chinook salmon were marked. Of these large fish, 369 were also implanted with radio telemetry tags which were tracked by aerial surveys and remote tracking stations. During July and August, Chinook salmon were captured at spawning sites and inspected for marks. Marked fish were also recovered from Canadian commercial and aboriginal fisheries. Using a modified Petersen model, an estimated 59,885 (SE = 2,724) large and 2,665 (SE = 532) medium fish immigrated to the Stikine River above Kakwan Point. Sibling and CPUE data were used to generate preseason and inseason abundance estimates for the inriver run of large Chinook salmon. The preseason abundance forecast allowed directed Chinook salmon fisheries in the U.S. and Canada for the first time in 20 years. Inriver fisheries on the Stikine River harvested 20,052 large and 1,218 medium Chinook salmon, leaving a spawning escapement of 39,833 (SE = 2,724) large and 1,447 (SE = 532) medium fish. The count of large fish at the Little Tahltan River weir was 7,253, representing about 18% of the estimated spawning escapement of large fish. The estimated spawning escapement of 41,280 (SE = 2,775) Chinook salmon was composed of 3.7% (SE = 0.6%) age-1.2 fish, 65.4% (SE = 1.5%) age-1.3 fish, and 29.5% (SE = 1.5%) age-1.4 fish. The estimated spawning escapement included 23,953 (SE = 1,746) females. Based on the radio telemetry results, estimated proportions of large Chinook spawning in each area of the Stikine River were: U.S. 0.7%, Iskut River 12.8%, Chutine River 2.9%, Christina River 5.1%, Tahltan River 45.8%, Little Tahltan River 17.2%, Upper Stikine River 12.1%, and Lower Stikine River 3.5%. Chinook salmon smolt from brood year 1998 were captured in the mainstem of the Stikine and Iskut rivers during spring 2000 and marked with an adipose finclip and a coded wire tag (CWT). Adult fish from the escapement were sampled in 2001 through 2005 to estimate the marked fraction θ, and CWTs were recovered in sampled marine fisheries. An estimated 5,957,528 (SE = 2,652,978) Chinook salmon smolt emigrated from the Stikine River in 2000. The total return of brood year 1998 Chinook salmon (age-.2 to -.5) was an estimated 77,027 (SE = 10,433), exploitation was 24.5% (SE = 9.3%), and marine survival was 1.3% (SE = 0.6%).

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Stikine River, Little Tahltan River, Verrett River, Andrew Creek, mark–recapture, spawning escapement, inriver run abundance, age and sex composition, preseason, inseason, CPUE, forecast, sibling data, coded wire tag, radio telemetry, smolt abundance.

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 and transboundary 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 targeted sockeye salmon *O. nerka* and were structured to limit the harvest of Chinook salmon to incidental catches. In 1985, the Alaskan and Canadian programs were incorporated into a comprehensive coastwide rebuilding program under the auspices of the U.S./Canada Pacific Salmon Treaty (PST). The rebuilding program has been evaluated, in part, by monitoring trends in escapement for important stocks. Escapements in 11 rivers (Situk, Alsek, Chilkat, Taku, King Salmon, Stikine, Unuk, Chickamin, Blossom, and Keta rivers, and Andrew Creek) in Southeast Alaska and Canada are directly estimated or surveyed annually. Total escapements of Chinook salmon have been estimated at least once in all 11 key index systems, providing expansion factors for index counts to estimate actual escapement of large Chinook salmon.

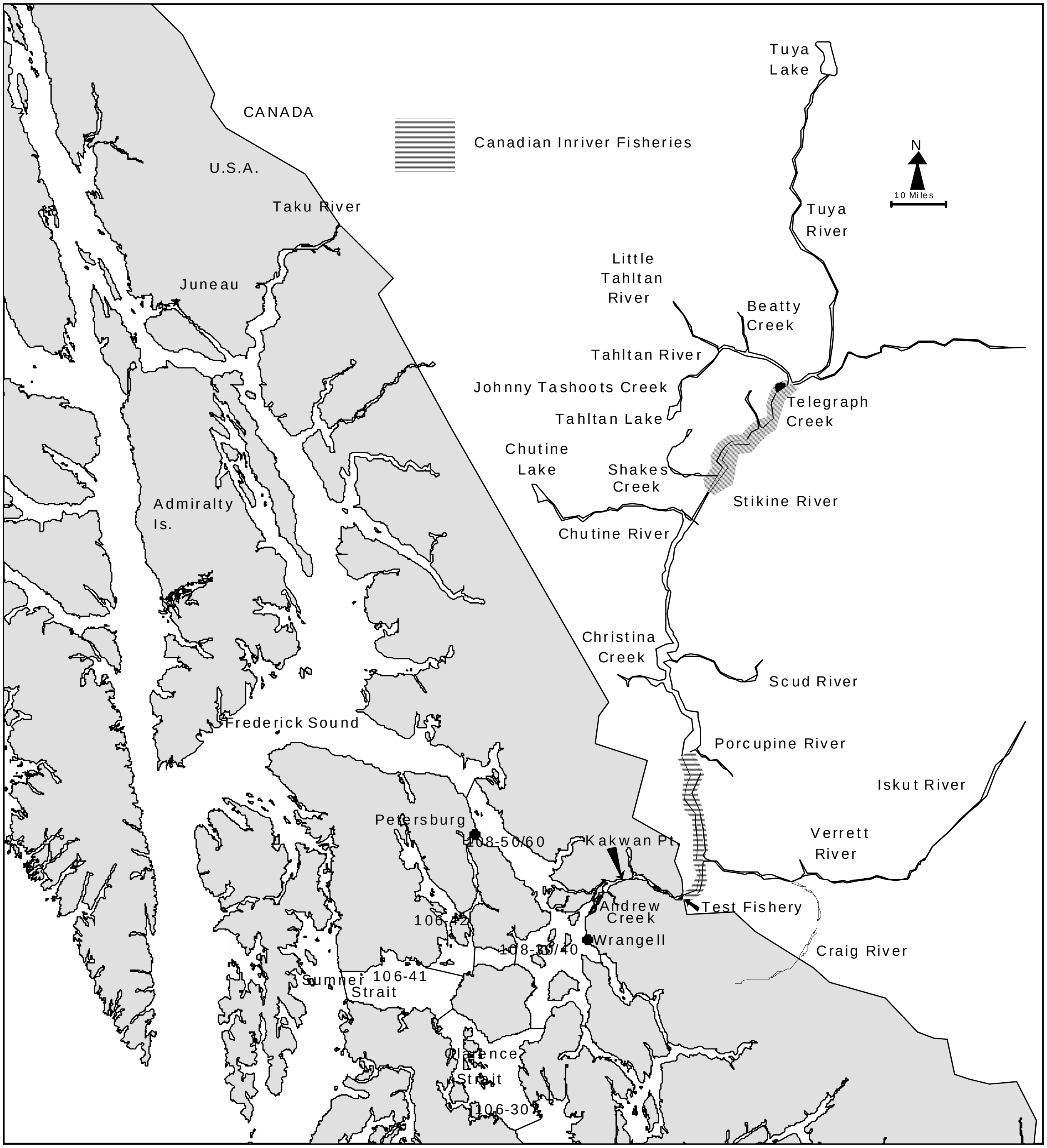


Figure 1.–Stikine River drainage, showing location of principal U.S. and Canadian fishing areas.

Escapements in the Stikine River have rebounded 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 compose 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 contemplating incorporating the inriver abundance of Stikine River Chinook salmon into the PSC Chinook Model, which, among other things, produces preseason forecasts of abundance for setting annual quotas for fisheries under the jurisdiction of the PST. Hence, data from annual assessments are not only essential for development of management tools for this stock, but may serve in the management of other coastwide stocks as well.

A major enhancement program for sockeye salmon in the Stikine River has been ongoing since 1989 (PSC 2000). The run timing of sockeye salmon overlaps the latter component of the Chinook salmon migration, hence 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 the riverine Canadian commercial fishery. Aboriginal food fisheries target Chinook and sockeye salmon (Table 1, Figure 1). Stikine River Chinook salmon are also caught in marine recreational fisheries near Wrangell and Petersburg, in the commercial troll fishery in Southeast Alaska, and in recreational fisheries in Canada. The exploitation of terminal runs is managed jointly by the U.S. and Canada through the PSC.

In February 2005, an agreement was negotiated between the United States and Canada by the Transboundary Rivers Panel and approved by the PSC for directed harvest of wild Chinook salmon returning the Stikine and Taku Rivers (PSC 1999, Annex IV, Paragraph 3). The agreement allowed for harvest sharing and exemption of the catches from harvest quotas above average base catches for the years 1985–2003. The harvest exemptions for transboundary rivers apply only to Stikine and Taku river fish harvested by the United States in Southeast Alaska Management Districts 8 and 11 and by Canada in the inriver fisheries on both rivers. This was the first commercial fishery directed at harvesting Stikine River Chinook salmon since 1976. The allowable harvest for the first few weeks of the fisheries is based on the preseason forecast until inseason projections are derived from the mark–recapture program.

Helicopter surveys of the Little Tahltan River have been conducted annually since 1975, and a fish counting weir has been operated at the mouth of the Little Tahltan River since 1985 (Table 2). Because virtually all fish spawning in the Little Tahltan River spawn above the weir, counts from the weir represent the spawning escapement to that tributary. Sufficient data have since been collected to establish a relationship between the 2 sources of information, and spawning escapement estimates from surveys conducted prior to 1985 were revised based on that relationship. Discontinuation of aerial surveys has been recommended (Bernard et al. 2000).

The number of Stikine River Chinook spawners that produces maximum sustained yield (S_{MSY}) has been estimated at 17,368 based on analysis of spawner-recruit data from the 1977 to 1991 brood years (Bernard et al. 2000). This estimate may be biased slightly low, but a more complex model that incorporates survival estimates and better estimates of harvest in marine fisheries should improve accuracy. This information will be acquired in the future from results of a smolt coded wire tagging program that was initiated in 2000. Based on the estimate of S_{MSY}, an escapement goal range of 14,000 to 28,000 adult spawners (age-.3, -.4, and -.5 fish), which corresponds to counts at the Little Tahltan River weir of 2,700 and 5,300, was recommended and accepted by the CTC and an internal review committee of ADF&G in spring 1999. The Pacific Scientific Advice Review Committee of DFO declined to pass judgment on this range in deference to a decision by the Transboundary Technical Committee (TTC) of the PSC; the TTC accepted the range in March, 2000.

Chinook salmon spawning in Andrew Creek, a lower river tributary in the U.S., have historically been treated as a separate stock from salmon 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 to estimate age, sex and length composition of escapements, and to inspect fish for marks. North Arm and Clear creeks, two small streams in the U.S., have been periodically surveyed by foot, helicopter, and fixed-wing aircraft.

Table 1.–Harvests of small-medium (sm-med) and large Chinook salmon in Canadian fisheries on the Stikine River and in U.S. fisheries near the mouth of the Stikine River, 1975–2005.

	United States[a, b]						Canada												Total Dist. 8 and inriver harvest of Stikine River Chinook	
	Psg/Wrn sport	Dist. 108 troll	Dist. 108 gillnet		U.S. inriver subsistence		Commercial harvest, lower Stikine[c]		Commercial harvest, upper Stikine[d]		Inriver sport harvest, Tahltan River[e]		Aboriginal fishery, Telegraph Creek		Lower river test fishery			
Year			Sm-med[f]	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large	Sm-med	Large
1975				1,529						178				1,024			0	2,731
1976	-			1,101						236				924			0	2,261
1977	-			1,378						62				100			0	1,540
1978	2,282			-						100				400			0	2,782
1979	1,759			48			63	712			10	74	80	323			153	2,916
1980	2,498			407				1,488		156	18	136	171	686			189	5,371
1981	2,022			258				664		154	28	213	118	473			146	3,784
1982	2,929			1032				1,693		76	24	181	124	499			148	6,410
1983	2,634			46			430	492		75	5	38	215	851			650	4,136
1984	2,171			14			Fishery Closed				11	83	59	643			70	2,911
1985	2,953			20			91	256		62	12	92	94	793			197	4,176
1986	2,475			76			365	806	41	104	12	93	569	1,026	12	27	999	4,607
1987	1,834			94			242	909	19	109	18	138	183	1,183	30	189	492	4,456
1988	2,440			137			201	1,007	46	175	27	204	197	1,178	29	269	500	5,410
1989	2,776			227			157	1,537	17	54	18	132	115	1,078	24	217	331	6,021
1990	4,283			308			680	1,569	20	48	17	129	259	633	18	231	994	7,201
1991	3,657			876			318	641	32	117	17	129	310	753	16	167	693	6,340
1992	3,322			528			89	873	19	56	24	181	131	911	182	614	445	6,485
1993	4,227			866			164	830	2	44	52	386	142	929	87	568	447	7,850
1994	2,140			1,402			158	1,016	1	76	29	218	191	698	78	295	457	5,845
1995	1,218			945			599	1,067	17	9	14	107	244	570	184	248	1058	4,164
1996	2,464			878			221	1,708	44	41	22	162	156	722	76	298	519	6,273
1997	3,475			1,934			186	3,283	6	45	25	188	94	1,155	7	30	318	10,110
1998	1,438			157			359	1,585	0	12	22	165	95	538	11	25	487	3,920
1999	3,668			688			789	2,127	12	24	22	166	463	765	97	853	1383	8,291
2000	2,581			737			936	1,274	2	7	30	226	386	1,100	334	389	1688	6,314
2001	2,263			7			59	826	0	0	12	190	44	665	59	1,442	174	5,393
2002	3,077			26			209	433	3	2	46	420	366	927	323	1,278	947	6,163
2003	3,252			103			459	908	12	19	46	167	373	682	792	1,281	1,682	6,412
2004	2,939			5,515	19	12	1,773	2,735	1	0	18	91	1,184	738	79	62	3,074	12,092
2005	3,002	4,317	955	23,621	8	15	1,181	19,070	1	28	0	118	94	800	33	21	2,272	50,992

-continued-

Table 1.–Page 2 of 2.

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

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

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

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

[e] Sport harvests in 2001–2005 are based on creel census. Harvests in 1979–2000 are based on the harvest at the Tahltan River mouth area fishery vs. the Little Tahltan River weir counts (3.9%). All harvests are apportioned by the combined 2001–2003 age-sex-length samples from the creel. An additional estimated 25 fish are harvested at other Canadian sites (Verrett, Craig, and Little Tahltan rivers).

[f] District 108 sm-med Chinook harvest was reported and sampled beginning in 2005.

Table 2.–Index and survey counts of large spawning Chinook salmon in tributaries of the Stikine River, 1975–2005. Abbreviations: H = helicopter survey, F = foot survey, W = weir count, A = airplane survey; E = excellent visibility, N = normal visibility, P = poor visibility.

	Little Tahltan River		Mainstem			North Arm	
Year	Peak count	Weir count[a]	Tahltan River	Beatty Creek	Andrew Creek	Creek	Clear Creek[b]
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)[c]	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)	4,733	-	-	605 E(A)	22 N(A)	1 N(A)
2000	2,720 N(H)	6,631	-	-	690 N(A)	35 N(A)	-
2001	4,158 N(H)	9,730	-	-	1,054 N(F)	54 N(F)	-
2002	1,131[d] N(H)	7,476	-	-	876 N(F)	34 N(F)	8 N(A)
2003	1,903 N(H)	6,492	-	-	595 N(H)	39[e] N(F)	19 N(A)
2004	6,014 N(H)	16,381	-	-	1,534 N(H)	60 N(A)	65 P(F)
2005	2,157 N(H)	7,253	-	-	1,015 N(H)	78 N(A)	102 N(F)
1996–2005 avg.	2,616	7,471			748	40	41

[a] Above weir harvest and broodstock collections are removed from weir counts (maximum 14 fish); there was no broodstock collection in 2005.

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

[c] Visibility conditions were not recoded for Beatty Creek in 1984.

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

[e] Partial survey.

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

In 1995, the DFO, in cooperation with the Tahltan First Nation (TFN), ADF&G, and the U.S.

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

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

The objectives of the 2005 study were to:

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

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

(3) estimate the proportion of spawning Chinook salmon in each major spawning area of the Stikine River, and

(4) estimate the smolt production and adult harvest by fishery of Chinook salmon from brood year 1998, marked as smolt in 2000.

An additional task included estimation of the factor used to expand counts of large Chinook salmon at the weir on the Little Tahltan River to spawning abundance in the Stikine River. Mark–recapture data were also used to estimate the spawning abundance of medium (<660 mm MEF) Chinook salmon.

Results from the study also provide information on the run timing through the lower Stikine River of Chinook salmon bound for the various spawning areas, and other stock assessment and management information needs such as construction of spawner-recruit tables and inseason inriver run abundance estimates.

STUDY AREA

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

METHODS

KAKWAN POINT AND ROCK ISLAND TAGGING

Drift gillnets 120 feet (36.5m) long, 18 feet (5.5m) deep, of 7¼ inch (18.5cm) stretch mesh, were fished near Kakwan Point (Figure 2) between May 10 and July 7. Two nets were fished concurrently daily, unless high water or staff shortages occurred. Nets were watched continuously, and fish were removed from the net immediately upon capture. Daily sampling effort was held reasonably constant across the temporal span of the migration at 4 hours per net. Time lost because of entanglements, snags, cleaning the net, etc. (processing time) did not count towards fishing time.

Captured Chinook salmon were placed in a plastic fish tote filled with water, quickly untangled or cut from the net, marked, measured for length (MEF, and post orbital hypural length POH), classified by sex and maturity, and sampled for scales. Fish were classified as “large” if their MEF measurement was ≥660mm, as “medium” if their MEF was 440-659mm or “small” if their MEF was <440mm (Pahlke and Bernard. 1996). Fish maturation was judged on a scale from 1 to 4, where 1 is a silver bright fish, 2 is a fish with slight coloration, 3 is a fish with obvious coloration and the onset of sexual dimorphism,

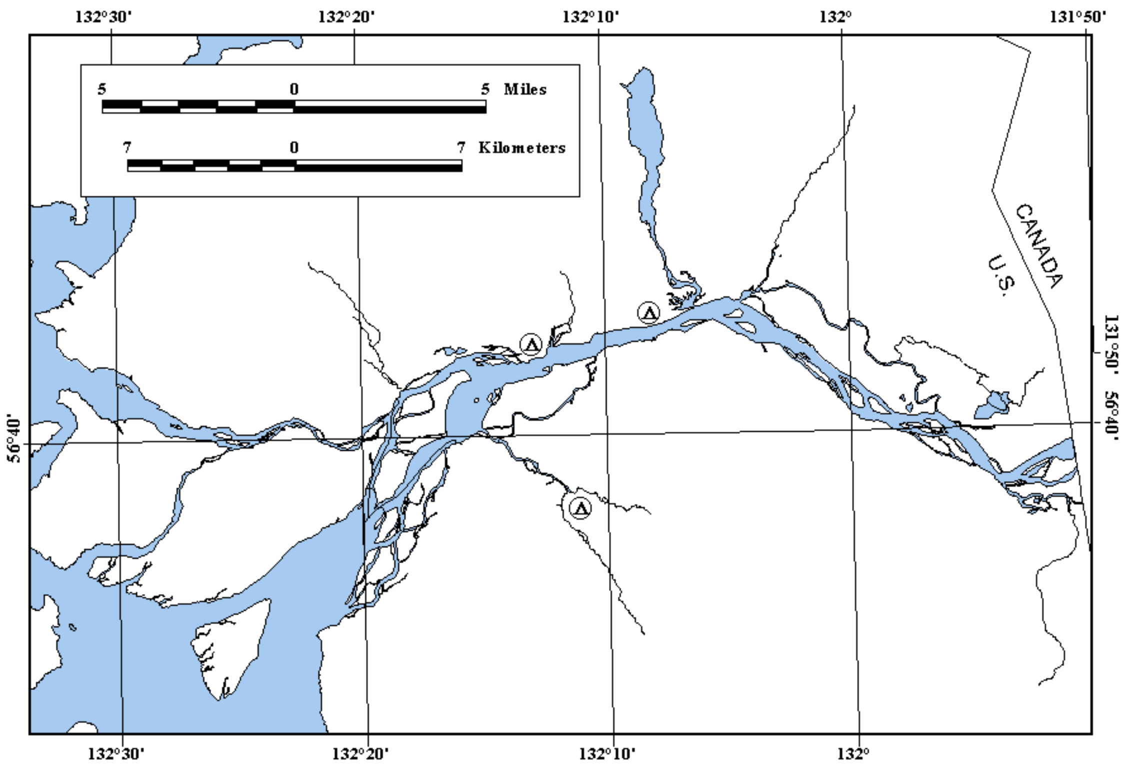


Figure 2.–Location of the drift gillnet site on the lower Stikine River, 2005

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"(~5cm) section of Floy tubing shrunk and laminated onto a 15" (~38cm) piece of 80-lb (~36.3kg) monofilament fishing line using a modified design developed by Johnson et al. (1993). The monofilament was sewn through the musculature of the fish approximately ½ inch (20 mm) posterior and ventral to the dorsal fin and secured by crimping both ends in a metal sleeve. Each fish was also marked with a ¼ inch (7 mm) diameter hole in the upper (dorsal) portion of its left operculum applied with a paper punch, and by amputation of its left axillary appendage (McPherson et al. 1996). Fish that were seriously injured were sampled but not marked.

Catches near Kakwan Point were augmented by Chinook salmon captured in a project at Rock Island directed at sockeye salmon and run jointly by DFO, ADF&G Commercial Fisheries Division (CFD), and TFN (Figure 2). Salmon were caught in a 5 to 5½ inch (12.7 to 13.8 cm) stretch mesh set gillnet 120 feet (36.5m) long and 18 feet (5.5 m) deep between June 16 and October 8. The net was watched continuously, and fish were removed from the net immediately upon capture. If more fish were caught than could be effectively sampled, or if high water rendered the net difficult to fish, the net was shortened. Sampling effort was held reasonably constant at about 7 hours per day.

SPAWNING GROUND AND FISHERY SAMPLING

Pre- and post-spawning fish and carcasses were collected with spears, dip nets, and snagging gear at Andrew Creek, Verrett River, the Little Tahltan River weir, and other spawning ground sites (Figures 1 and 2). A portion of the fish passing through the Little Tahltan River weir were individually sampled, the remainder were passed without handling. All sampled fish were inspected for tags and marks, sampled for length, sex, and scales, and marked with a hole punched in the lower left opercle to prevent re-sampling. Carcasses were also slashed along the left side.

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

ABUNDANCE

The abundance of Chinook salmon that passed by Kakwan Point was estimated with Chapman's modification of Petersen's estimator for a two-event mark–recapture experiment on a closed population (Seber 1982) if assumptions of the model were met (i.e., stratification by time of marking and/or recapture area were not required). A Darroch (1961) model was used otherwise. Fish captured by gillnet and marked in the lower river near Kakwan Point were included in event 1, and sampling on the spawning grounds and inriver fisheries constituted the second event.

Handling and tagging have caused a downstream movement and/or a delay in upstream migration of marked Chinook salmon (Bernard et al. 1999). This "sulking" behavior may increase the probability of capture by U.S. commercial and recreational fisheries near the mouth of the Stikine River (Pahlke and Etherton 1999). Further, fish marked at Kakwan Point may spawn in Andrew Creek. The numbers of marked fish recovered in Andrew Creek and the U.S. commercial fisheries, expanded by sampling fractions, were censored from the experiment, to reduce bias in the inriver abundance estimate. All marked fish caught in the U.S. recreational harvest were assumed to have been reported and were also censored on a per tag basis from the experiment.

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

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

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

where B is the number of bootstrap samples.

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

The spawning escapements of large $\hat{N}_{L,esc}$ and medium $\hat{N}_{SM,esc}$ Chinook salmon were estimated by subtracting the respective inriver harvest of large and medium fish from $\hat{N}_{L}$ and $\hat{N}_{SM}$.

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

The validity of the mark–recapture experiment rests on several assumptions, including:

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

Because temporal mixing cannot occur in the experiment, and because not all spawning grounds were sampled, assumption (a) would be met only if fish are marked in proportion to abundance during immigration, or if there is no difference in migratory timing among stocks bound for different spawning locations upstream. Assumption (a) also implies that sampling is not size or gender selective. If capture on the spawning grounds was not size selective, fish of different sizes would be captured with equal probability. If assumption (a) was met, samples of fish taken in upper watershed (Little Tahltan River, aboriginal fishery), in the Iskut River (Verrett River) and in the inriver commercial fishery in the lower watershed would have similar proportions of marked fish. Temporal and size-gender conditions associated with assumption (a) were investigated with a battery of statistical tests. 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 indicate that a high percentage of Chinook salmon captured in this study, but fitted with esophageal radio transmitters, survived to spawn (Pahlke and Etherton 1999). To avoid effects of tag loss (assumption d), all marked fish carried secondary (a dorsal opercle punch), and tertiary (the left axillary appendage was clipped) marks. 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, Andrew Creek, and Verrett River were processed at the ADF&G scale aging laboratory in Douglas; all others were processed at the DFO laboratory in Nanaimo, B.C.

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

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

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

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

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/or Verrett rivers.

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

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

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

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

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):

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

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 because sex of spawning and post-spawning fish is obvious on inspection.

Age, sex, and age-sex composition and associated variances for fish caught at Kakwan Point, in Little Tahltan and Verrett rivers, and in inriver fisheries were estimated with equations 2 and 3.

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

DISTRIBUTION OF SPAWNERS

Initially, every second large healthy Chinook salmon had a 148 MHz Lotek radio transmitter esophageally inserted into its stomach (Eiler 1990). However, capture rates were higher than anticipated and on June 7 the radio-tagging rate was decreased to every fifth fish. Individual transmitters were identified by frequency and encoded signal pattern (Pahlke and Waugh 2003). The battery life of the radio tags was 200 d so as radio tags were recovered in U.S. and Canadian fisheries they were returned to the Kakwan Point crew and redeployed in new fish.

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 10 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 (2 sites), Chutine, and Tahltan rivers; at the mouth of the Tuya River; at the confluence of the Little Tahltan and Tahltan rivers; along the mainstem of the Stikine River at approximately km 100 (Flood River), km 140 (Butterfly Creek), and km 180 (Shakes Creek); and an additional tower was located at the outlet of Tahltan Lake as part of a concurrent sockeye salmon telemetry study.

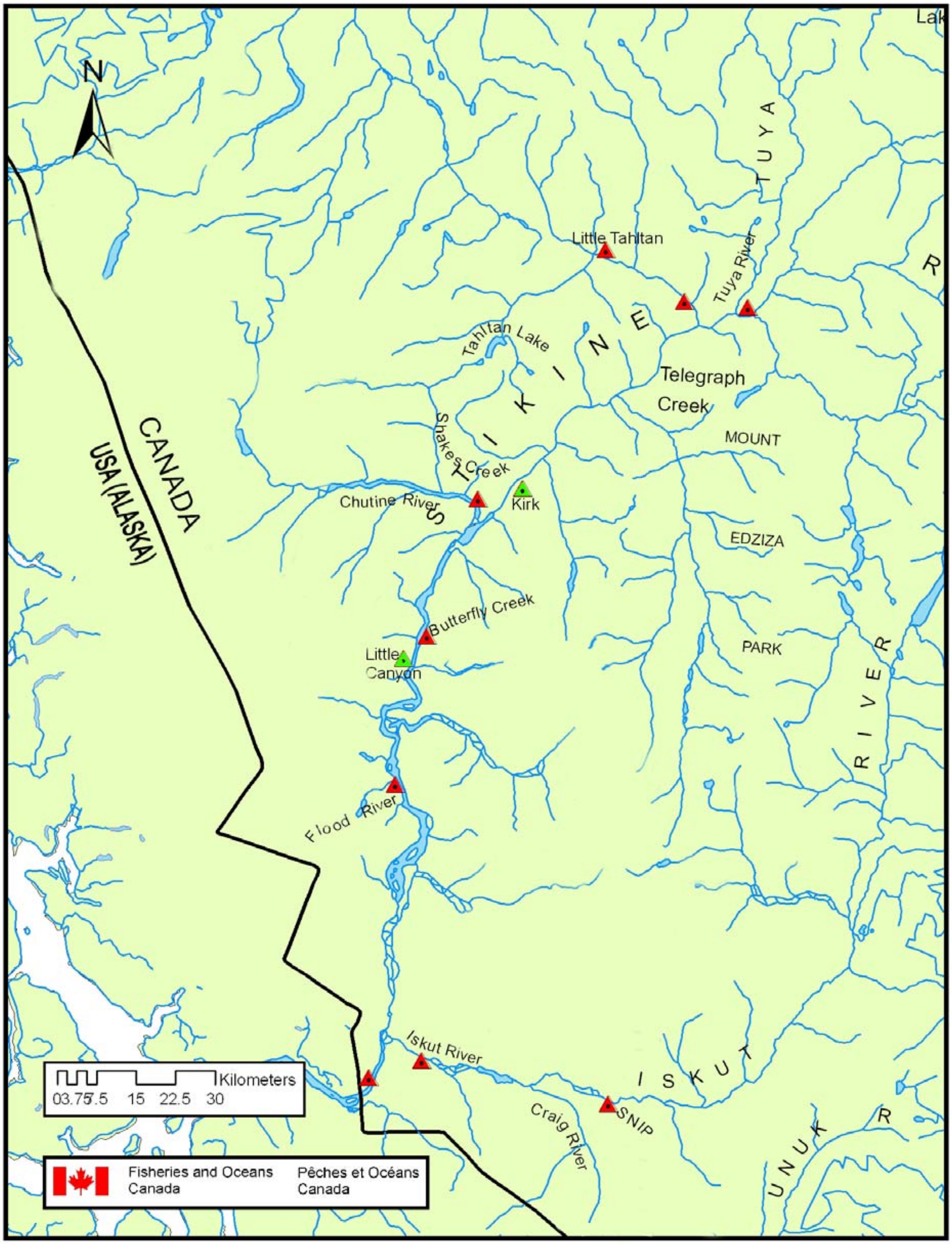


Figure 3.–Locations of radio telemetry remote tracking stations on the Stikine River, 1997 and 2005. Little Canyon and Kirk Creek sites in 1997 were replaced by Butterfly and Shakes Creek in 2005.

Assumptions of the experiment to estimate spawning distributions include: a) fish were captured for radiotracking in proportion to abundance during the immigration, b) tagging did not change the destination (fate) of a fish; and c) fates of radiotracked fish were 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.

Table 3.–Criteria to assign fates to radio-tagged Chinook salmon, Stikine River, 2005.

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 1 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 was never tracked to a lower location in the river.
3 Fishery mortality	Chinook salmon captured in the Canadian commercial, test, sport, and aboriginal fisheries or in U.S commercial and sport 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.

An attempt was made to locate each radio transmitter periodically by helicopter. The location of each tag was recorded on a portable global position system (GPS) unit. After the data from the tracking stations and aerial surveys was combined, each radio-tagged fish was assigned to one of four possible fates (Table 3). Each fish assigned to fate 1 (probable spawning in a tributary) was then assigned to one of 8 final spawning areas. The proportion of large Chinook salmon spawning in each area P_a was estimated by:

$$\hat{P}_{a,t} = \frac{r_{a,t}}{m_t - c_t - x_t} \quad (8a)$$

$$\hat{P}_a = \sum_t \hat{w}_t \hat{P}_{a,t} \quad (8b)$$

$$\hat{w}_t = \frac{M_t}{\sum_{t=1}^{T} M_t} \quad (8c)$$

where:

$r_{a,t}$ = number of large fish released with transmitters during period t that survived inriver fisheries to spawn in area a (= 1 to 8);

m_t = the number of large fish released with transmitters during period t (or day d);

c_t = number of large fish released with transmitters during period t caught in inriver fisheries;

x_t = number of large fish released with transmitters during period t, but subsequently lost;

M_t = number of large fish captured near Kakwan Point during period t; and

$\hat{w}_t$ = estimated weight.

Variances for the $\hat{P}_a$ were estimated with parametric simulation. Daily statistics were calculated for fraction of passage by Kakwan Point in period t (θ_t), harvest rate in inriver fisheries for fish fitted with transmitters in period t (u_t), the fraction of test subjects fitted with transmitters in period t that will arrive on the spawning ground ($\rho_{a,t}$), and the fraction of fish fitted with transmitters in period that fail (ζ_t):

$$\hat{\theta}_t = M_t / M \quad (9a)$$

$$\hat{u}_t = c_t / m_t \quad (9b)$$

$$\hat{\rho}_{a,t} = r_{a,t} / m_t \quad (9c)$$

$$\hat{\zeta}_t = \frac{x_t}{m_t} \quad (9d)$$

A seasonal statistic was calculated for the fraction passing Kakwan Point (q):

$$\hat{q} = M / \hat{N} \quad (10)$$

For each iteration of the simulation (again denoted by the subscript b), a vector of daily abundance passing by Kakwan Point was generated with the following multinomial distribution:

$$(N^*_{1(b)} \ldots N^*_{t(b)} \ldots) \sim \text{multinomial}$$

$$(\hat{N}, \hat{\theta}_1 \ldots \hat{\theta}_t \ldots)$$

In turn this vector was translated into numbers of large fish caught and the number of test subjects with transmitters released each day:

$$M^*_{t(b)} = N^*_{t(b)} \hat{q} \qquad m^*_{t(b)} = M^*_{t(b)} / z_t \quad (11)$$

where z_t is the number of fish caught at Kakwan Pt. that are represented by a transmitter in period t.

For each day within each iteration, a vector of daily recoveries on the spawning grounds, catches, and failures was generated with the following multinomial distribution:

$$(r^*_{1,t(b)} \ldots r^*_{a,t(b)} \ldots r^*_{8,t(b)}, c^*_{t(b)}, x^*_{t(b)}) \sim \text{Multinomial} (m^*_{t(b)}, \hat{\rho}_{1,t} \ldots \hat{\rho}_{a,t} \ldots \hat{\rho}_{8,t}, \hat{u}_t, \hat{\zeta}) \quad (12)$$

The resulting vectors were plugged into equations (8) along with other simulated statistics as per obvious substitution to produce a simulated value $P^*_{a(b)}$ for each iteration. Variance for P^*_a was estimated following procedures similar to those described in (9).

PRODUCTION AND HARVEST, BROOD YEAR 1998

Chinook salmon smolt from brood year 1998 were captured in the mainstem of the Stikine and Iskut rivers during spring 2000 and marked with an adipose finclip and a coded wire tag (CWT). Adult fish from the escapement were sampled in 2001 through 2005 to estimate the marked fraction θ, and CWTs were recovered in sampled marine fisheries.

Smolt Capture and Coded Wire Tagging

Chinook salmon smolt were captured in G-40 minnow traps baited with disinfected salmon eggs (Washington Department of Fish and Wildlife 1996) at various locations above the international border.

Two 2-person crews fished approximately 100-150 traps per day from April 13 to June 12, 2000 and checked them at least once everyday. Crew members immediately released non-target species at the trapping site. Remaining fish were transported to holding pens for processing at a central tagging location.

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

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

Smolt Abundance

A two-event mark–recapture experiment was used to estimate the abundance of Chinook salmon smolt that emigrated from the Stikine River in 2000. The first event consisted of smolt tagged and marked in 2000, and the second event was comprised of Chinook salmon in the escapement from brood year 1998 that were inspected inriver for missing adipose fins in 2001 through 2005. With few exceptions, those fish missing adipose fins were sacrificed for CWTs. Fish that were inspected but not aged were assigned to the appropriate brood year using age-length data to apportion unaged samples.

Smolt abundance $\hat{N}_s$ was estimated with Chapman's modification of the Petersen estimator (Seber 1982). The conditions for accurate use of this methodology were: (a) all smolt had an equal probability of being marked in 2000; or all adults had an equal probability of being inspected for marks in 2001 through 2005; or marked fish mixed completely with unmarked fish in the population between years; and (b) there was no recruitment to the population between years; and (c) there was no tag-induced mortality; and (d) and there was no trap induced behavior; and (e) fish did not lose their marks and all marks were recognizable (Seber 1982).

Minnow traps were fished continuously during the smolt emigration, and adult immigrations were sampled almost continuously in gillnet catches and regularly at spawning locations. These methods tended to promote equal probabilities of capture throughout the migrations. Temporal changes (over years) in the fraction of adults from the 1998 brood year with valid CWTs were tested against a χ^2 distribution. If at least one of the first three conditions in assumption (a) was met, the marked fraction θ would not change over time and the data could be pooled over years. Otherwise, θ was averaged over years. Assumption (a) also implies that sampling was not size-selective. Although minnow traps and gill nets can be size-selective, this was not problematic because Chinook salmon smolt were of a near uniform size (all one age) at any given point in the emigration, and there is no relationship between the size of smolt (when marked) and the size of returning adults (when recaptured).

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

Because some of the fish inspected inriver for missing adipose fins were not sacrificed and unaged fish were assigned to the appropriate brood year using age-length data, a simulation was used to incorporate variances from adipose-clip sampling and age assignments into $v\left[1/\hat{\theta}\right]$. The variance of $\hat{N}_s$ was estimated by:

$$v\left[\hat{N}_S\right] = v\left[M_S \; 1/\hat{\theta}\right] = M^2 v\left[1/\hat{\theta}\right] \qquad (13)$$

Smolt Length and Weight

A sample of smolt was selected prior to tagging sessions by gently mixing all the fish in the holding pen with a dip net, taking a scoop, and sampling all fish in the scoop. Smolt ≥50 mm FL were measured to the nearest mm FL and weighed to the nearest 0.1 g. Mean length and weight were estimated with standard sample summary statistics (Cochran 1977).

Marine Harvest

Harvest of Stikine River Chinook salmon from brood year 1998 and its variance were estimated from fish sampled in commercial and sport fisheries in 2001 through 2005 according to the methods in Bernard and Clark (1996). Because several fisheries harvested Chinook salmon bound for the Stikine River, harvest was *initially* estimated over several strata, each a combination of time, area, and fishery type. Statistics from the commercial troll fishery were stratified by fishing period and quadrant, and by fortnight and location for sport fisheries. Harvest from brood year 1998 in fishery stratum i was estimated by:

$$\hat{r}_i = H_i\left[\frac{m_i}{\lambda_i n_i}\right]\hat{\theta}^{-1}; \qquad \lambda_i = \frac{a_i' t_i'}{a_i t_i} \qquad (14)$$

where H_i = total harvest in the fishery, n_i = number of fish inspected (the sample), a_i = number of fish missing an adipose fin, a_i' = number of heads sent to the Mark, Tag, and Age Laboratory, t_i = number of heads with CWTs detected, t_i' = number of CWTs that were dissected from heads and decoded, m_i = number of CWTs with code(s) of interest, and $\hat{\theta}$ = estimated fraction of the cohort tagged with code(s) of interest. The marked fraction $\hat{\theta}$ was estimated from fish inspected inriver for missing adipose fins in 2001 through 2005. As previously noted, some of those fish were not sacrificed for CWTs and unaged fish were assigned to the appropriate brood year using age-length data; a simulation was used to incorporate those sources of uncertainty into $v[1/\hat{\theta}]$, which was in turn used to estimate $v[\hat{r}_i]$. Estimates of harvest were summed across strata and fisheries to obtain an estimate of total harvest $\hat{T} = \sum \hat{r}_i$. Variance of $\hat{T}$ was estimated by summing variances across strata.

Return, Exploitation, and Marine Survival

Inriver returns $\hat{N}_{r,t}$ in year t of Chinook salmon from brood year 1998 were estimated in 2001 through 2005 from escapement E and inriver harvest h data:

$$\hat{N}_{r,t} = \hat{E}_{r,t} + \hat{h}_{r,t} \tag{15}$$

$$v[\hat{N}_{r,t}] = v[\hat{E}_{r,t}] + v[\hat{h}_{r,t}] \tag{16}$$

The total inriver return $\hat{N}_R$ and total return $\hat{R}$ were estimated by:

$$\hat{N}_R = \sum_t \hat{N}_{r,t} \tag{17}$$

$$v[\hat{N}_R] = \sum_t v[\hat{N}_{r,t}] \tag{18}$$

$$\hat{R} = \hat{N}_R + \hat{T} \tag{19}$$

$$v[\hat{R}] = v[\hat{N}_R] + v[\hat{T}] \tag{20}$$

Exploitation $\hat{U}$ and marine survival $\hat{S}$ were estimated by:

$$\hat{U} = \frac{\hat{T}}{\hat{R}} \tag{21}$$

$$v[\hat{U}] = \frac{v[\hat{T}]\hat{N}_R^2}{R^4} + \frac{v[\hat{N}_R]\hat{T}^2}{R^4} \tag{22}$$

$$\hat{S} = \frac{\hat{R}}{\hat{N}_s} \tag{23}$$

$$v[\hat{S}] = \hat{S}^2\left[\frac{v(\hat{R})}{\hat{R}^2} + \frac{v(\hat{N}_s)}{\hat{N}_s^2}\right] \tag{24}$$

RESULTS

KAKWAN POINT TAGGING

Between May 7 and July 7, 1,096 Chinook salmon were captured near Kakwan Point, of which 1,095 (0 small, 36 medium, and 1,059 large) were marked and released (Appendix Table A1; Table 4).

Drift gillnet effort near Kakwan Point was maintained at 4 hours per net per day (two nets fishing), although reduced sampling effort occurred on several days (Figure 4). Catch rates ranged from 0.12 to 6.31 large fish/hour, and the highest catch occurred on June 24 when 43 large fish were captured (Figure 5). The date of 50% cumulative catch of large fish was June 7. Catch rates for medium fish ranged from 0 to 0.81 fish/hour, and the date of 50% cumulative catch of medium fish was June 18. Catches decreased slightly during the second and third weeks in June due to high water (Figures 4 and 5, Appendix A1). No adipose-finclipped Chinook salmon were recovered. Three sockeye salmon were captured and released (Appendix A1).

Rock Island Tagging

Fish tagged at Rock Island were removed from the mark–recapture experiment in 2005. Tagging commenced June 16, after approximately 50% of the run passed Rock Island, therefore violating assumption (a). Set gillnet effort at Rock Island was maintained at about 7.0 hours per day with one net fishing. From June 16 through October 8, 177 large and 62 small-medium Chinook salmon were captured.

SPAWNING GROUND AND FISHERY SAMPLING

The lower river commercial gillnet fisheries began May 8 and harvested 20,251 Chinook salmon (19,070 large 1,084 medium, 97 small), the largest harvest since the fishery was initiated in 1979. Fishermen turned in 321 large and 13 medium

Table 4.–Numbers of Chinook salmon marked on lower Stikine River, removed by fisheries and inspected for marks in 2005, by size category. Numbers in bold were used in mark–recapture estimates.

		Length (MEF) in mm			
		0-439 (small)	440-659 (medium)	>660 (large)	Total
A. Released at Kakwan Point		0	36	1,059	1,095
B. Removed by:					
1. U.S. recreational fisheries[a]		0	0	1	1
2. U.S marine gillnet fisheries[b]		0	0	31	31
3. Andrew Creek[c]		0	0	5	5
Subtotal of removals		0	0	37	37
C. Estimated number of marked fish remaining in mark–recapture experiment		0	**36**	**1,022**	1,058
D. Canadian recreational fisheries	Harvested[d]	0	0	118	118
Tahltan River	Marked	0	0	4	4
	Marked/harvested	0.0000	0.0000	0.0339	0.0339
E. Inspected at:					
1. L. Tahltan weir, live fish	Inspected	3	**48**	**1,094**	1,145
	Marked	0	**1**	**21**	22
	Marked/inspected	0.0000	0.0208	0.0192	0.0192
2. L. Tahltan weir, post-spawn fish	Inspected	10	10	20	40
and carcasses	Marked	0	0	2	2
	Marked/inspected	0.0000	0.0000	0.0100	0.0500
3. Verrett River[e]	Inspected	1	17	**285**	303
	Marked	0	0	**3**	3
	Marked/inspected	0.0000	0.0000	0.0105	0.0099
4. Johnny Tashoots Creek	Inspected	0	57	147	204
	Marked	0	0	0	0
	Marked/inspected	0.0000	0.0000	0.0000	0.0000
Subtotal: L. Tahltan weir/Verrett/	Inspected	14	132	1,546	1,692
Johnny Tashoots	Marked	0	1	26	27
	Marked/inspected	0.0000	0.0076	0.0168	0.0160
F. Lower river commercial gillnet	Harvested[f]	97	**1,084**	**19,070**	20,251
	Marked	0	**13**	**321**	334
	Marked/harvested	0.0000	0.0120	0.0168	0.0165
G. Upper river gillnet	Harvested[g]	2	**92**	**800**	894
Aboriginal	Marked	0	**2**	**17**	19
	Marked/harvested	0.0000	0.0217	0.0213	0.0213
Subtotal: lower river/upper river gillnet	Harvested	99	1,176	19,870	21,145
	Marked	0	15	338	353
	Marked/harvested	0.0000	0.0128	0.0170	0.0167
Total: L. Tahltan weir, Verrett,	Inspected, harvested	113	1,308	21,416	22,837
Tashoots, lower river/upper	Marked	0	16	364	380
river gillnet	Marked/insp. and harv.	0.0000	0.0122	0.0170	0.0166
Andrew Creek	Inspected	1	25	216	242
	Marked	0	0	0	0
	Marked/inspected	0.0000	0.0000	0.0000	0.0000

[a] Voluntary return.

[b] The number of marked Chinook salmon recovered in U.S. marine gillnet fisheries was expanded by the fraction sampled. Twenty large fish recovered in D8 were expanded to 31 (20 recoveries x 25,741 harvested / 16,666 sampled).

[c] One radio tag was tracked to Andrew Creek which expanded to 5 tags based on the radio tag proportion during that period.

[d] The recreational harvest of 118 fish in the Tahltan River was apportioned into size categories based on the creel length data.

[e] No size data were provided for 43 skeletons in the original sample so they were removed (346 original sample – 43 skeletons = 303 total sample).

[f] The lower river commercial fishery harvest of 20,251 was apportioned into size categories using length sample data collected during the commercial fishery and weighted by statistical week.

[g] The aboriginal harvest of 894 was apportioned into size categories using length sample data collected during the aboriginal fishery and weighted by statistical week.

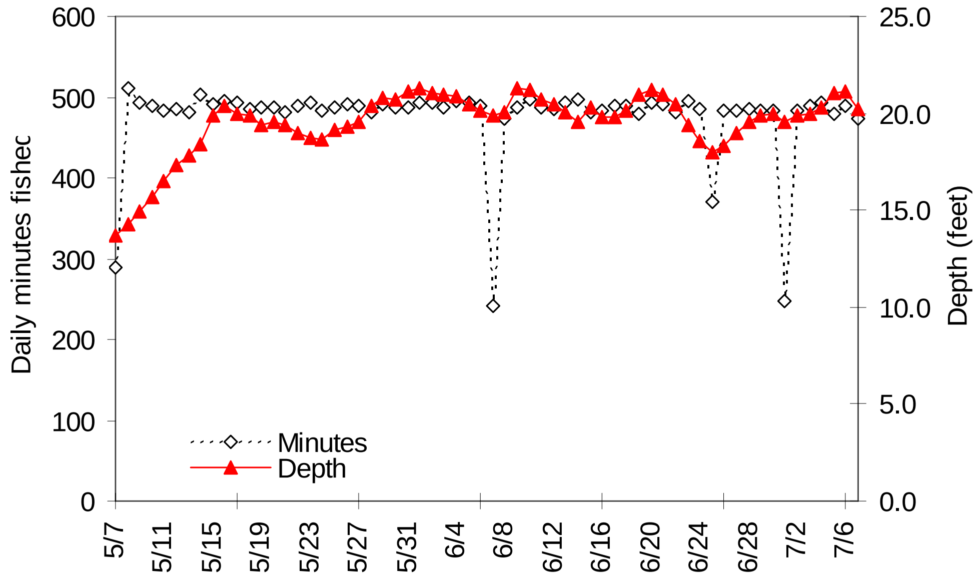


Figure 4.–Daily drift gillnet fishing effort (minutes) and river depth (feet) near Kakwan Point, lower Stikine River, 2005.

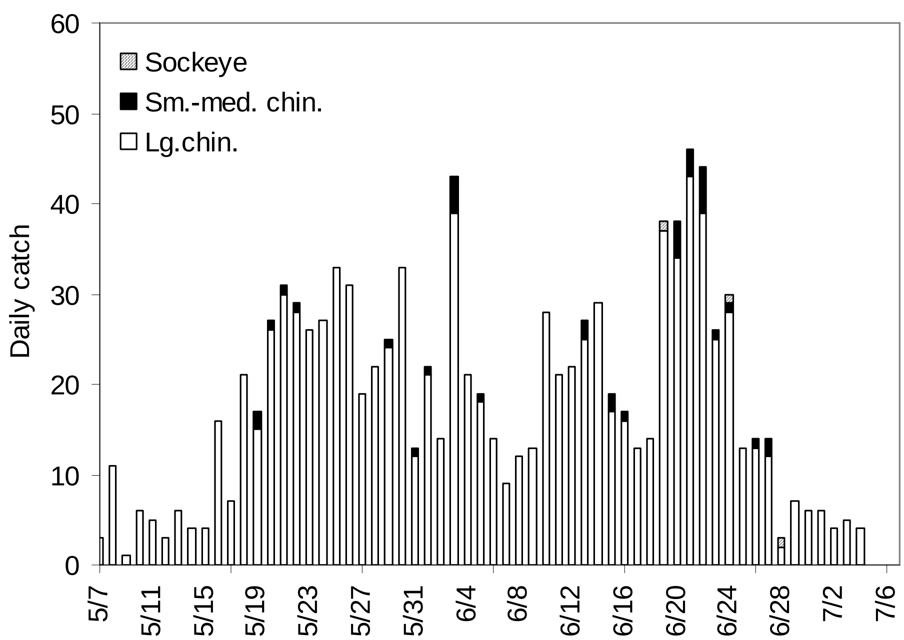


Figure 5.–Daily catch of Chinook and sockeye salmon near Kakwan Point, lower Stikine River, 2005.

Chinook salmon with tags. The aboriginal fishery near Telegraph Creek harvested 800 large, 92 medium, and 2 small Chinook salmon, and 19 tags were recovered. The Canadian recreational fishery on the Tahltan River, which was sampled in 2005, reported 4 marked fish; an estimated 118 large Chinook were harvested. The upper river commercial fishery harvested 29 fish (28 large, 1 medium), and the test fishery harvested 54 (21 large, 33 medium). The U.S. subsistence fishery harvested 15 large and 8 medium Chinook salmon. There was one voluntarily returned tag from the recreational fishery near Petersburg and Wrangell, and all marked fish in the recreational harvest were presumably reported. Twenty marked fish (expanded by the sampling fraction to 31) were recovered in U.S. marine commercial fisheries (Tables 1 and 4).

Technicians examined 1,145 Chinook salmon for marks at the Little Tahltan River weir, of which 1,094 were large fish. There were 21 large and 1 medium marked fish recovered, of which 1 large fish had lost its tag. An additional 40 previously unsampled carcasses were examined above the weir; 2 of these were marked and all had retained their tags (Table 4). An additional 204 Chinook were sampled and no tags recovered at Johnny Tashoots Creek, the outlet to Tahltan Lake,

At Verrett River, 303 live and dead Chinook salmon were examined; 3 marked fish were recovered, none of which had lost their tags (Table 4). At Andrew Creek, 242 fish were examined and no marked fish were recovered. However, 1 radio tag (expanded to 5 tags) was tracked to Andrew Creek.

ABUNDANCE OF LARGE CHINOOK SALMON

A modified Petersen model was used to estimate the inriver run abundance of large Chinook salmon that passed by Kakwan Point. Based on fish inspected at the Little Tahltan River weir and samples from Verrett River, the lower river commercial fishery, and the aboriginal fishery, the estimate is 59,885 large fish (SE = 2,724; bias = 2.55%; 95% CI: 54,392 to 64,641; $\hat{M}_L$ = 1,022, C_L = 21,249, R_L = 362). Variance, bias, and confidence intervals were estimated as described above given 7 capture histories:

Capture history	Large	Source of statistics
Marked, but censored in recreational fishery	1	Voluntary return
Marked, but censored in Andrew Creek	5	Observed/0.20
Marked, but censored in marine gillnet fishery	31	Observed/0.65
Marked and never seen again	660	$\hat{M}_L - R_L$
Marked and recaptured in event 2	362	R_L
Unmarked and captured in event 2	20,887	$C_L - R_L$
Unmarked and never seen	37,976	$\hat{N}_L - \hat{M}_L - C_L + R_L$
Effective population for simulations	59,922	$\hat{N}_L^+$

For this estimate, all large marked fish intercepted by U.S. fisheries (1 fish in the recreational fishery, assuming all marked fish in the harvest were reported in the marine gillnet fishery, expanded to 31) were censored from the experiment. The number of large marked Chinook salmon recovered in Andrew Creek (1 radio, expanded to 5), were also censored (Table 4).

Evidence from sampling upstream supports the supposition that every large Chinook salmon passing by Kakwan Point had a near equal chance of being marked regardless of when they passed this site. Estimated marked fractions (Table 4) for large fish at the Little Tahltan weir (0.0192), Verrett River (0.0105), the lower river commercial gillnet fishery (0.0168), and the aboriginal fishery (0.0213) were not significantly different (χ^2 = 1.86, df = 3, P = 0.60). The majority of fish bound for the Little Tahltan River passed by Kakwan Point in May and June and most fish bound for Verrett River passed in June and early July; sampling at the Little Tahltan weir, Verrett River, and the inriver fisheries occurs from late June though August such that fish that passed the tagging sites from May through July are intercepted (Figure 6).

There was evidence that size-selective sampling violated assumption (a). Size distributions of fish marked downstream and recaptured upstream were not significantly different (Kolmogorov-Smirnov: d_{max} = 0.062; n = 1,057, 361; P = 0.24; Figure 7). However, size distributions of fish marked at Kakwan Point versus combined samples of fish captured at the weir on the Little Tahltan River, Verrett River, in the lower river commercial gillnet fishery, and in the aboriginal fishery were significantly different (Kolmogorov-Smirnov: d_{max} = 0.130; n = 1,057, 4,015; P < 0.001; Figure 8).

Size distributions of fish recaptured upstream versus combined samples of fish captured at the weir on the Little Tahltan River, Verrett River, in the lower river commercial gillnet fishery, and in the aboriginal fishery were also significantly different (Kolmogorov-Smirnov: d_{max} = 0.093; n = 361, 4,015; P = 0.007) suggesting capture probabilities for salmon of different sizes were not equal during the first event. These results suggest that an unstratified estimate was appropriate (Appendix B1, Case III).

The peak count on Andrew Creek was 1,015 large fish (helicopter survey, August 15). 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 2,030 large fish.

ABUNDANCE OF MEDIUM CHINOOK SALMON

A modified Petersen model was used to estimate the inriver run abundance of medium fish that passed by Kakwan Point. No small fish were tagged in 2005, therefore all small fish were removed from event 2. Based on fish inspected at the Little Tahltan River weir, aboriginal fishery and the lower river commercial gillnet fishery, the estimate is 2,665 medium fish (SE = 532; bias = 0.73%; 95% C.I.: 1,934, 4,167; M_{SM} = 36, C_{SM} =1,224, R_{SM} = 16).

Variance, bias, and confidence intervals were estimated as described above given 7 capture histories:

Capture history	Sm-med	Source of statistics
Marked, but censored in recreational fishery	0	
Marked, but censored in Andrew Creek	0	
Marked, but censored in marine gillnet fishery	0	
Marked and never seen again	20	$\hat{M}_{SM} - R_{SM}$
Marked and recaptured in event 2	16	R_{SM}
Unmarked and captured in event 2	1,208	$C_{SM} - R_{SM}$
Unmarked and never seen	1,421	$\hat{N}_{SM} - \hat{M}_{SM} - C_{SM} + R_{SM}$
Effective population for simulations	2,665	$\hat{N}^{+}_{SM}$

No medium marked fish were censored from the experiment in 2005 (Table 4). Estimated marked fractions at the Little Tahltan weir (0.0208), the lower river commercial fishery (0.0120), and the aboriginal fishery (0.0217) were not significantly different (Fisher Exact Test: P = 0.31).

The size distributions of fish marked downstream and recaptured upstream were not significantly different (Kolmogorov-Smirnov: dmax = 0.229; n = 36, 16; P = 0.53; Figure 9), which indicates that capture probabilities were similar regardless of size during the second event. However, the size distributions of fish marked at Kakwan Point versus combined samples of fish captured at the weir on the Little Tahltan River, aboriginal fishery, and in the lower river commercial gillnet fishery, were significantly different (Kolmogorov-Smirnov: d_{max} = 0.257; n = 36, 176; P = 0.02; Figure 10). Size differences of fish recaptured upstream versus combined samples of fish captured at the weir on the Little Tahltan River, aboriginal fishery, and in the lower river commercial gillnet fishery, were not significantly different (Kolmogorov-Smirnov: d_{max} = 0.312; n = 16, 176; P = 0.094), which is likely the result of size selectivity during the first event that the C versus R was not powerful enough to detect. These tests indicate there was no size selectivity during the second event but there was during the first (Appendix B1, Case III).

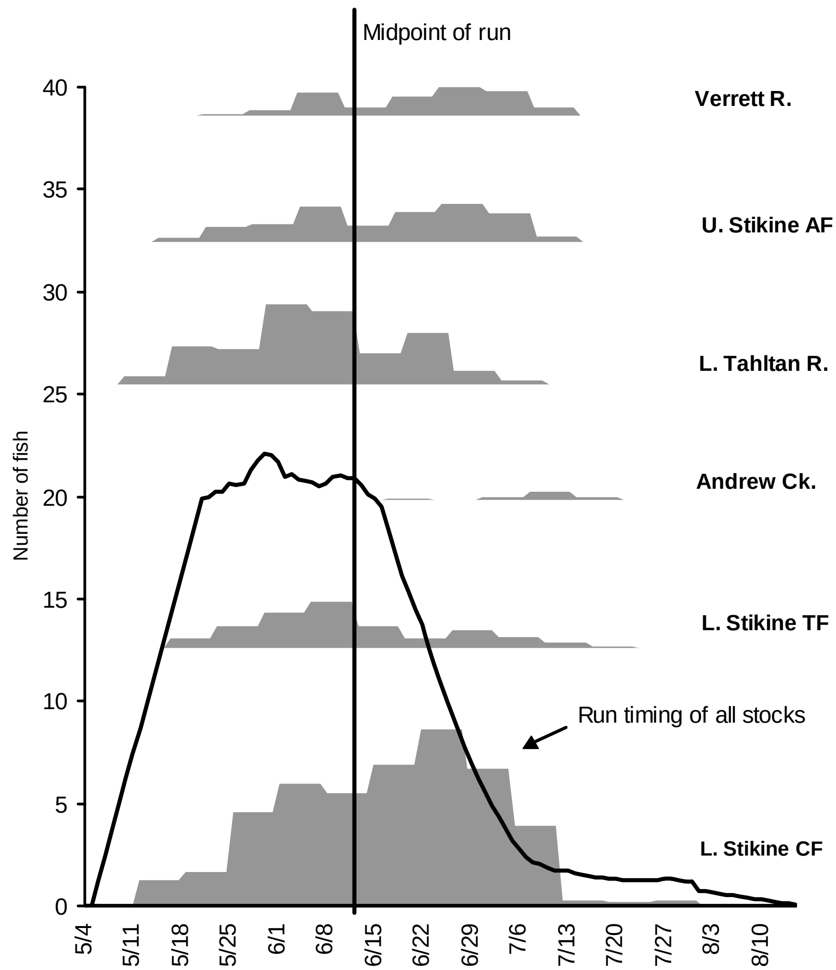


Figure 6.–Weekly numbers of recaptured Chinook salmon sampled at six locations (bar graphs) and associated time of marking, set against the average daily drift gillnet catches in the lower Stikine River (line graph), 1996–2005. X-axis pertains to time of marking.

AGE, SEX, AND LENGTH COMPOSITION

Age-1.3 Chinook salmon dominated all samples, constituting an estimated 62% of fish captured at Kakwan Point, 62% in the lower river commercial fishery, 73% at Verrett River, 63% at the Little Tahltan River weir, and 64% at Andrew Creek (Appendices A3-A7).

Estimated age compositions from the Little Tahltan River weir and Verrett River samples were compared to determine if they could be pooled and used to estimate spawning population proportions. No comparison was possible within the medium size category, but comparisons within the large category were not significantly different (χ^2 = 3.15, df = 1, P = 0.08). Consequently, the Little Tahltan River weir and Verrett River samples were pooled to estimate spawning population proportions.

The estimated spawning escapement of 41,280 (SE = 2,775; 95% CI: 35,841 to 46,719) was composed of 3.7% age-1.2 fish, 65.4% age-1.3 fish, and 29.5% age-1.4 fish, and included 23,953 females (Table 5).

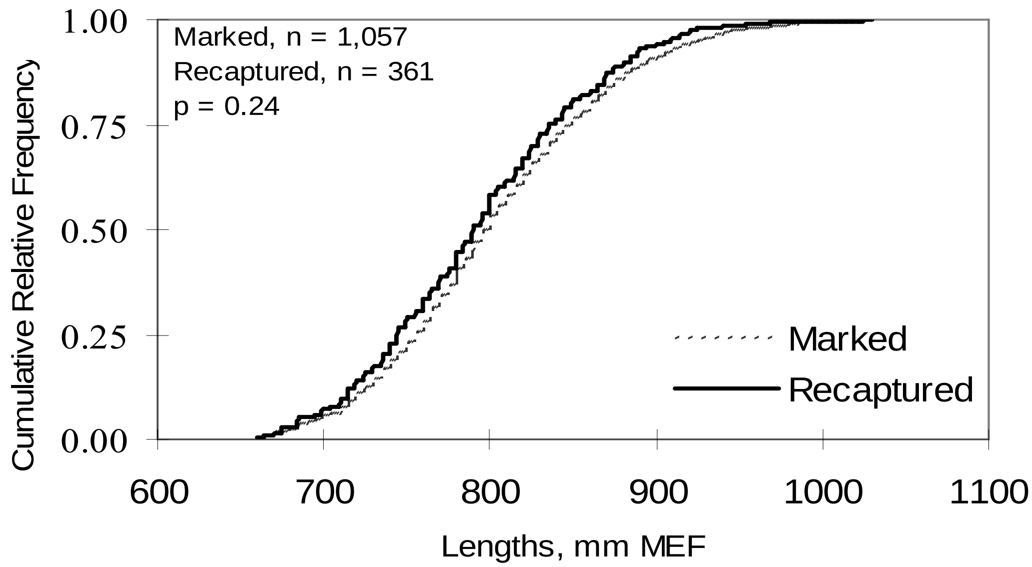


Figure 7.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and recaptured at the weir on the Little Tahltan River, in the Verrett River, in the lower river commercial fishery, and in the aboriginal fishery, lower Stikine River, 2005.

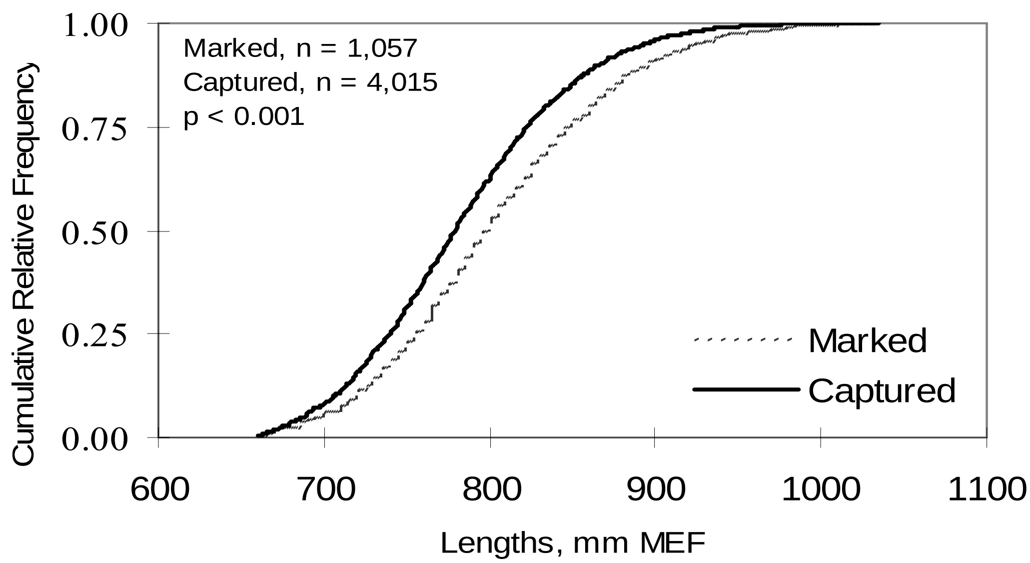


Figure 8.–Cumulative relative frequency of large Chinook salmon (≥660 mm MEF) marked at Kakwan Point and captured at the weir on the Little Tahltan River, in the Verrett River, in the lower river commercial fishery, and in the aboriginal fishery, Stikine River, 2005.

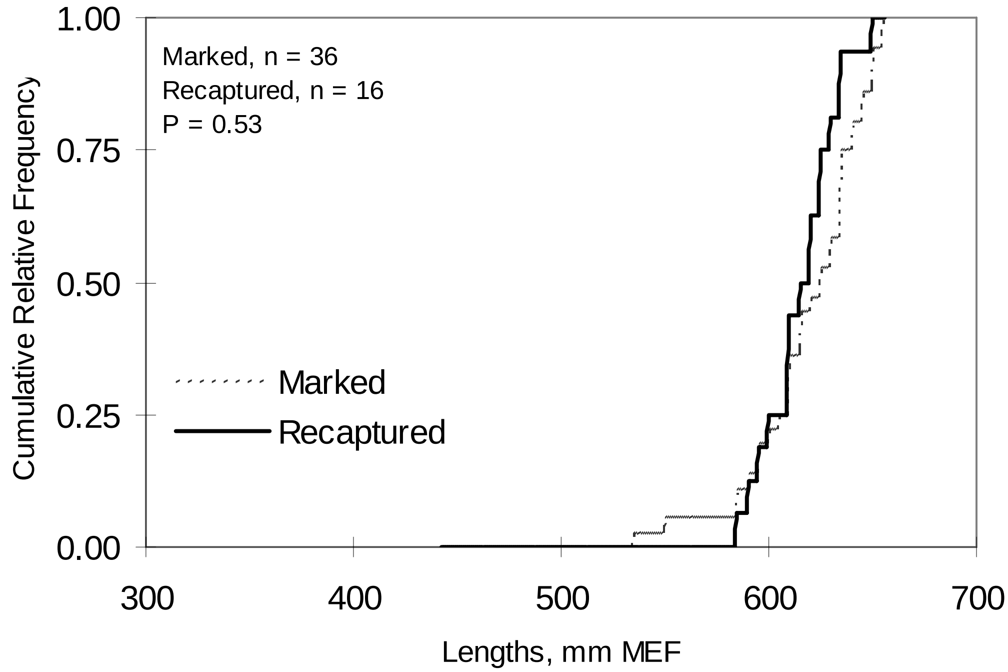


Figure 9.–Cumulative relative frequency of medium Chinook salmon (440-659 mm MEF) marked at Kakwan Point, and recaptured at the weir on the Little Tahltan River, in the Verrett River, and in the lower river commercial fishery, Stikine River, 2005.

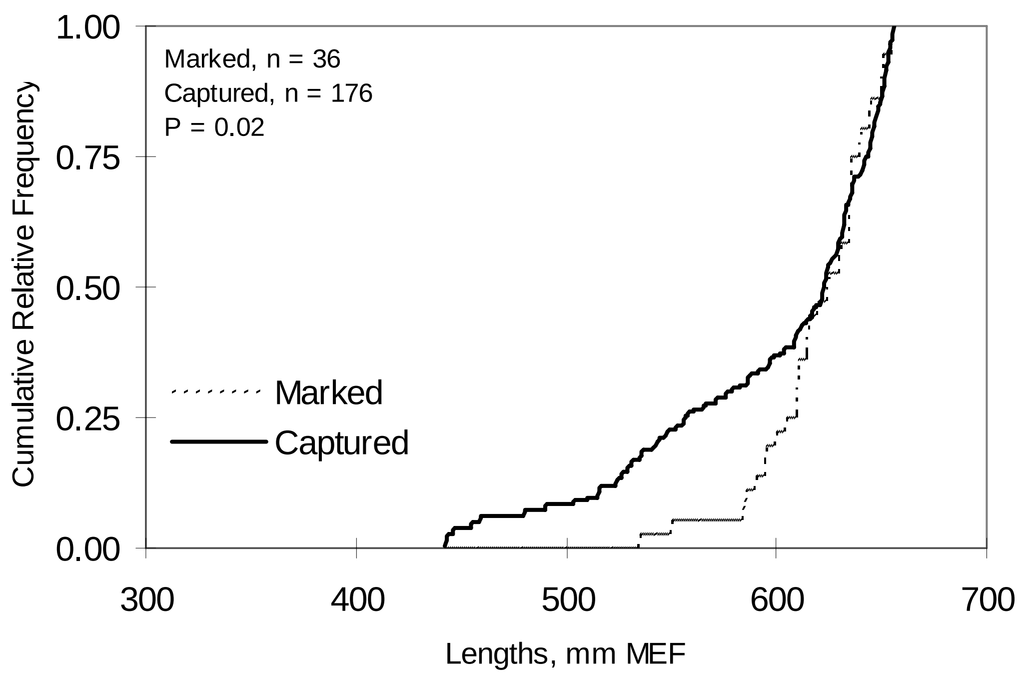


Figure 10.–Cumulative relative frequency of medium Chinook salmon (440-659 mm MEF) marked at Kakwan Point, and captured at the weir on the Little Tahltan River, in the aboriginal fishery, and in the lower river commercial fishery, Stikine River, 2005.

DISTRIBUTION OF SPAWNERS

A total of 259 radio tags were available to deploy in Chinook salmon. After those were all deployed an additional 104 tags recovered in fisheries were redeployed a second time and 6 tags were redeployed a third time for a total of 369 radio-tagged Chinook.

Of the 369 fish marked with radio transmitters, 357 (97%) were successfully tracked to spawning areas or were captured in fisheries. The remaining 12 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 C1). Nine radio-tagged fish moved downriver and were captured in the U.S. District 8 gillnet fishery, 1 was captured in the marine sport fishery and 1 went downstream to Andrew Creek. The lower Stikine commercial gillnet fishery captured 139 radio-tagged fish, 4 were caught in the upper Stikine gillnet fishery, and 3 were recovered from the Tahltan River sport fishery. The remaining 203 moved upriver to spawn in Canada.

Spawning radio-tagged fish were assigned to 1 of the following 8 areas: 1) U.S.: included Andrew Creek and Kikahe River; 2) Iskut River: included all fish recorded at Iskut or Snip Towers, or tracked to Verrett or Craig rivers; 3) Chutine River: fish tracked to Chutine or recorded at Chutine tower; 4) Christina Creek: fish tracked to Christina Creek; 5) Tahltan River: included fish tracked to the mainstem Tahltan River above and below the confluence of the Little Tahltan River, Beatty Creek and Tashoots Creek; 6) Little Tahltan River: any fish above the Little Tahltan River weir; 7) Upper Stikine River: included fish recorded at either the Butterfly Creek or Shakes Creek towers and not in the Tahltan, Little Tahltan or Chutine rivers, and included Tuya River, Shakes and Telegraph creeks and the upriver gillnet fisheries; 8) Lower Stikine River: all fish recorded at Border tower and never found again. Based on the radiotelemetry results, estimated proportions of large Chinook spawning in each area of the Stikine River were: U.S. 0.7%, Iskut River 12.8%, Chutine River 2.9%, Christina River 5.1%, Tahltan River 45.8%, Little Tahltan River 17.2%, Upper Stikine River 12.1%, and Lower Stikine River 3.5%. The distributions were similar to those estimated in 1997 (Figure 11). Bootstrap confidence intervals for the proportions spawning in each area were asymmetric for the areas with small contributions (Table 6). Weighting distribution estimates to account for the radio-tagged fish captured in the lower river gillnet fishery did not change the estimates significantly.

The median time for radio-tagged fish to travel the 20 km from Kakwan Point to the tracking station near the Border was 13 d (range 1–34 d) for an average swimming speed of 1.5 km/d, and the median travel time for fish marked only with spaghetti tags that were recaptured in the Canadian lower river fishery was 11 d (range 1–31 d). The median time for radio-tagged fish to travel the 85 km from Kakwan Point to the Flood River tower was 22 days (range 9–42 d, average 3.8 km/d), and the median time to travel 215 km to the Tahltan River tower was 35 d (range 18–90 d) for an average swimming speed of 5.7 km/d.

Fish migrating to Verrett River and other Iskut River tributaries in general migrated by the Kakwan Point tagging site later in the year than fish heading to the Tahltan River and other upriver spawning areas, a trend also noted in 1997 (Figure 12).

Five radio-tagged fish were recorded at the Tuya River tower, but all 5 eventually went up the Tahltan River.

The tower at the confluence of the Little Tahltan and Tahltan rivers was designed to record fish going up the Tahltan River with one antenna and up the Little Tahltan with another antenna, such that the signal strength could be used to determine which river the fish ended up in. Many fish appeared to nose into the mouth of the Little Tahltan River and then proceed on up the Tahltan River, and it was difficult to confidently decide which river to place some fish in. If they were tracked from the air several km up either river, destination could be determined with confidence. If we were unsure, we assigned the fish simply to the Tahltan River.

Five radio-tagged Chinook were tracked up the lower end of Johnny Tashoots Creek, which is the outlet of Tahltan Lake, but no Chinook salmon were recorded at the Tahltan Lake tower.

Table 5.–Estimated age and sex composition by size category of the spawning escapement of Chinook salmon in the Stikine River, 2005.

		Brood year and age class									
		2002	2001	2001	2000	2000	1999	1999	1998	1998	
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Panel A. Medium Chinook salmon (<660 mm MEF)											
Females	*n*				4						4
	%				9.3						9.3
	SE of %				4.5						4.5
	Escapement				135						135
	SE of esc.				78						78
Males	*n*	1	11		26	1					39
	%	2.3	25.6		60.5	2.3					90.7
	SE of %	2.3	6.7		7.5	2.3					4.5
	Escapement	34	370		875	34					1,312
	SE of esc.	34	163		337	34					486
Combined	*n*	1	11		30	1					43
	%	2.3	25.6		69.8	2.3					100.0
	SE of %	2.3	6.7		7.1	2.3					0
	Escapement	34	370		1,010	34					1,447.0
	SE of esc.	34	163		383	34					532
Panel B. Large Chinook salmon (≥660 MEF)											
Females	*n*		6		360		212	7	1		586
	%		0.6		36.7		21.6	0.7	0.1		59.8
	SE of %		0.2		1.5		1.3	0.3	0.1		1.6
	Escapement		244		14,633		8,617	285	41		23,819
	SE of esc.		100		1,173		788	109	41		1,744
Males	*n*		22		279		88	3	1	1	394
	%		2.2		28.5		9.0	0.3	0.1	0.1	40.2
	SE of %		0.5		1.4		0.9	0.2	0.1	0.1	1.6
	Escapement		894		11,340		3,577	122	41	41	16,014
	SE of esc.		198		964		438	71	41	41	1,260
Combined	*n*		28		639		300	10	2	1	980
	%		2.9		65.2		30.6	1.0	0.2	0.1	100.0
	SE of %		0.5		1.5		1.5	0.3	0.1	0.1	0.0
	Escapement		1,138		25,973		12,194	406	81	41	39,833
	SE of esc.		225		1,876		1,019	131	58	41	2,724
Panel C. Medium and large Chinook salmon											
Females	*n*		6		364		212	7	1		590
	%		0.6		35.8		20.9	0.7	0.1		58.0
	SE of %		0.2		1.5		1.3	0.3	0.1		1.6
	Escapement		244		14,767		8,617	285	41		23,953
	SE of esc.		100		1,176		788	109	41		1,746
Males	*n*	1	33		305	1	88	3	1	1	433
	%	0.1	3.1		29.6	0.1	8.7	0.3	0.1	0.1	42.0
	SE of %	0.1	0.6		1.5	0.1	0.9	0.2	0.1	0.1	1.6
	Escapement	34	1,264		12,215	34	3,577	122	41	41	17,327
	SE of esc.	34	257		1,022	34	438	71	41	41	1,350
Combined	*n*	1	39		669	1	300	10	2	1	1,023
	%	0.1	3.7		65.4	0.1	29.5	1.0	0.2	0.1	100.0
	SE of %	0.1	0.6		1.5	0.1	1.5	0.3	0.1	0.1	0.0
	Escapement	34	1,508		26,982	34	12,194	406	81	41	41,280
	SE of esc.	34	278		1,915	34	1,019	131	58	41	2,775

Table 6.–Summary of fates assigned to radio transmitters applied to Chinook salmon on the Stikine River, 1997 and 2005. Number of tags assigned to fates with estimated proportions spawning in each tributary, with SE and upper and lower 95% confidence intervals for estimates.

	1997					2005				
Tributary	Tags	Proportion	SE	LCI	UCI	Tags	Proportion	SE	LCI	UCI
U.S.	4	1.8	0.8	0.3	3.6	1	0.7	0.7	0.0	2.2
Lower	15	7.2	1.7	4.2	10.8	6	3.5	1.3	1.1	6.3
Christina	6	3.5	1.3	1.0	6.2	14	5.1	1.3	2.7	7.7
Iskut	40	17.5	2.4	13.1	22.9	24	12.8	2.6	8.1	17.8
Chutine	8	4.7	1.6	1.9	7.9	8	2.9	1.0	1.1	5.1
Tahltan	50	25.8	2.9	19.9	31.3	95[a]	45.8	3.7	38.6	52.8
Little Tahltan	33	17.7	2.6	12.5	22.6	37	17.2	2.7	12.0	22.7
Upper[b]	44	21.8	2.8	16.6	27.6	23	12.1	2.5	7.4	17.2
Combined Upper[c]	127	65.3				155	75.1			
Subtotal	200	100.0				208	100.0			
Mortality/unknown	26					12				
U. S. gillnet/sport	1					10				
Lower river gillnet	28					139				
Subtotal	55					160				
Total tags deployed	255					369				

[a] Tahltan includes 3 Tahltan sport fish recoveries.

[b] Includes upriver gillnet catches in Upper Stikine.

[c] Combined Upper includes Tahltan, Little Tahltan and Upper Stikine.

The remote tracking stations were very effective at recording every radio-tagged fish that passed them. The Border station recorded 336 (97%) of 346 radio tagged Chinook tracked upriver, recorded at other stations, or recovered in Canadian fisheries or spawning ground samples in 2005. This compares with about 76% recorded by the Border station in the 1997 study. In 2005, a smaller proportion of fish were assigned to the lower and upper categories than in 1997, because the improved technology was able to assign more fish to specific spawning areas.

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 estimated proportion of the escapement spawning in the Little Tahltan River in 2005 (17.2%) was nearly identical to the estimate in 1997 (17.7%). The estimates of distribution to the combined upper river areas (Tahltan and Little Tahltan rivers, and Upper Stikine River) in 1997 and 2005 were about 65% and 75%, respectively.

Beginning June 22, an attempt was made to locate each radio transmitter periodically by helicopter. Aerial surveys were important in supplementing the data from the remote tracking stations, but not as efficient in tracking all the tags. For example, the Iskut River tower recorded 23 radio-tagged fish, and 22 were recorded during 4 aerial surveys; the Chutine tower recorded 8 radio-tagged fish and only 6 were recorded during a single survey flight.

A single transmitter appeared to have failed. It was not recorded at any tower or survey but the spaghetti tag was recovered at the Tahltan River sport fishery.

Production and Harvest, Brood Year 1998

Smolt Capture and Coded Wire Tagging

Smolt trapping commenced on April 13, 2000, tagging began on April 14, and both activities ceased on June 12. CPUE increased as water temperatures approached and exceeded 4°C (Figure 13).

A total of 14,717 Chinook salmon smolt were captured and tagged (Table 7). Of these, 138 died overnight and an estimated 19 fish lost their tags within 24 hours, leaving 14,560 smolt that were released with valid CWTs. Tagged smolt averaged 74 mm FL and 5.2 g (Table 8).

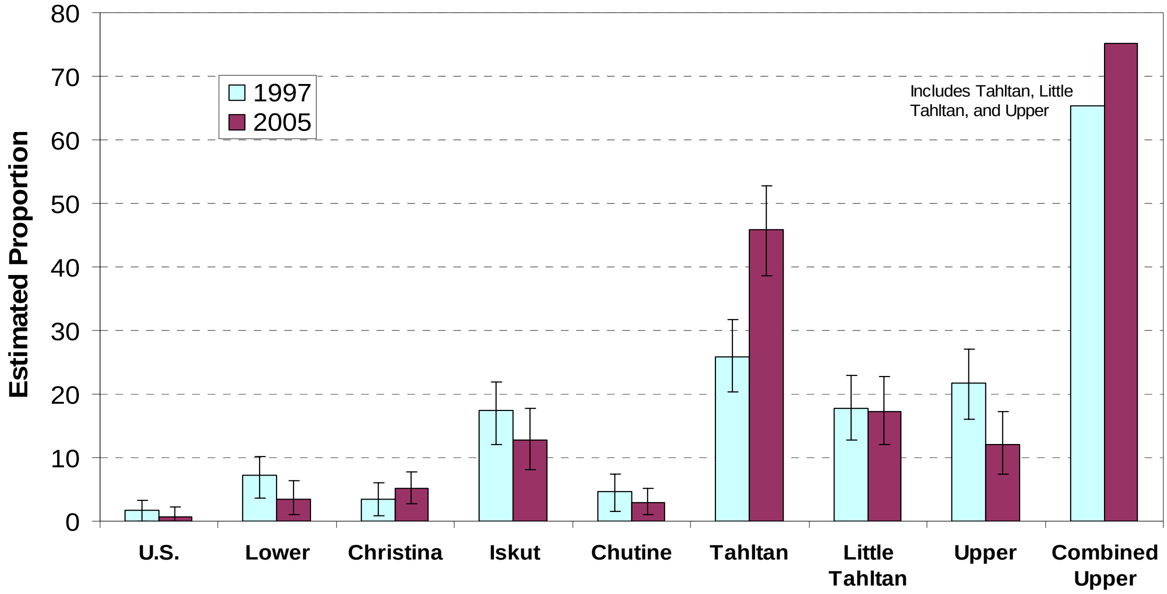


Figure 11.–Estimated spawning proportions by tributary for Chinook salmon in the Stikine River, 1997 and 2005, with 95% CI.

Smolt Abundance

The estimated abundance $\hat{N}_s$ of Chinook salmon smolt that emigrated from the Stikine River in 2000 was 5,957,528 (SE = 2,652,978). Of the 14,560 smolt released with tags, 13 (expanded to 14 accounting for unsacrificed clips) were recovered inriver from an estimated 5,727 adults examined for missing adipose fins from brood year 1998 (Tables 9 and 10). Because the number of inriver recoveries in any given year was small, temporal changes in the fraction of adults with valid CWTs were tested against a χ^2 distribution incorporating Yate's correction for continuity. Marked fractions in 2002 and 2003 were not significantly different ($\chi^2 < 0.01$, df = 1, P= 0.97), as were the pooled 2002/2003 versus 2004 fractions ($\chi^2 = 0.38$, df = 1, P = 0.54). Hence, at least one of the conditions in assumption (a) was considered satisfied. Pooling all 3 years yielded an estimate of θ= 0.245% (Table 9).

Marine Harvest

Between 2001 and 2005, 15 Chinook salmon with CWTs released in the Stikine River in 2000 were randomly recovered in marine fisheries, and an estimated 18,856 (SE = 9,364) Chinook salmon from the 1998 brood year (age-.3 and -.4) were harvested. (Tables 10 and 11). Data were pooled to estimate harvest because contributions in some strata (notably sport fishery strata) exceeded the stratum harvest.

Return, Exploitation, and Marine Survival

The total return of brood year 1998 Chinook salmon (age-.2 to -.5) was an estimated 77,027 (SE = 10,433), exploitation was 24.5% (SE = 9.3%), and marine survival was 1.3% (SE = 0.6%).

DISCUSSION

To estimate the spawning escapement of large Chinook salmon that passed by Kakwan Point, inriver harvests in the commercial, aboriginal, U.S. subsistence, and Tahltan River sport fisheries were subtracted from the inriver run abundance estimate. The final estimate of the spawning escapement for large Chinook salmon above Kakwan Point in 2005 is 39,833 (= 59,885-20,052).

Historically, spawning escapement to the Stikine River was estimated by multiplying the Little Tahltan River weir count by an expansion factor (4.0) thought to represent the proportion of the spawning escapement represented by that

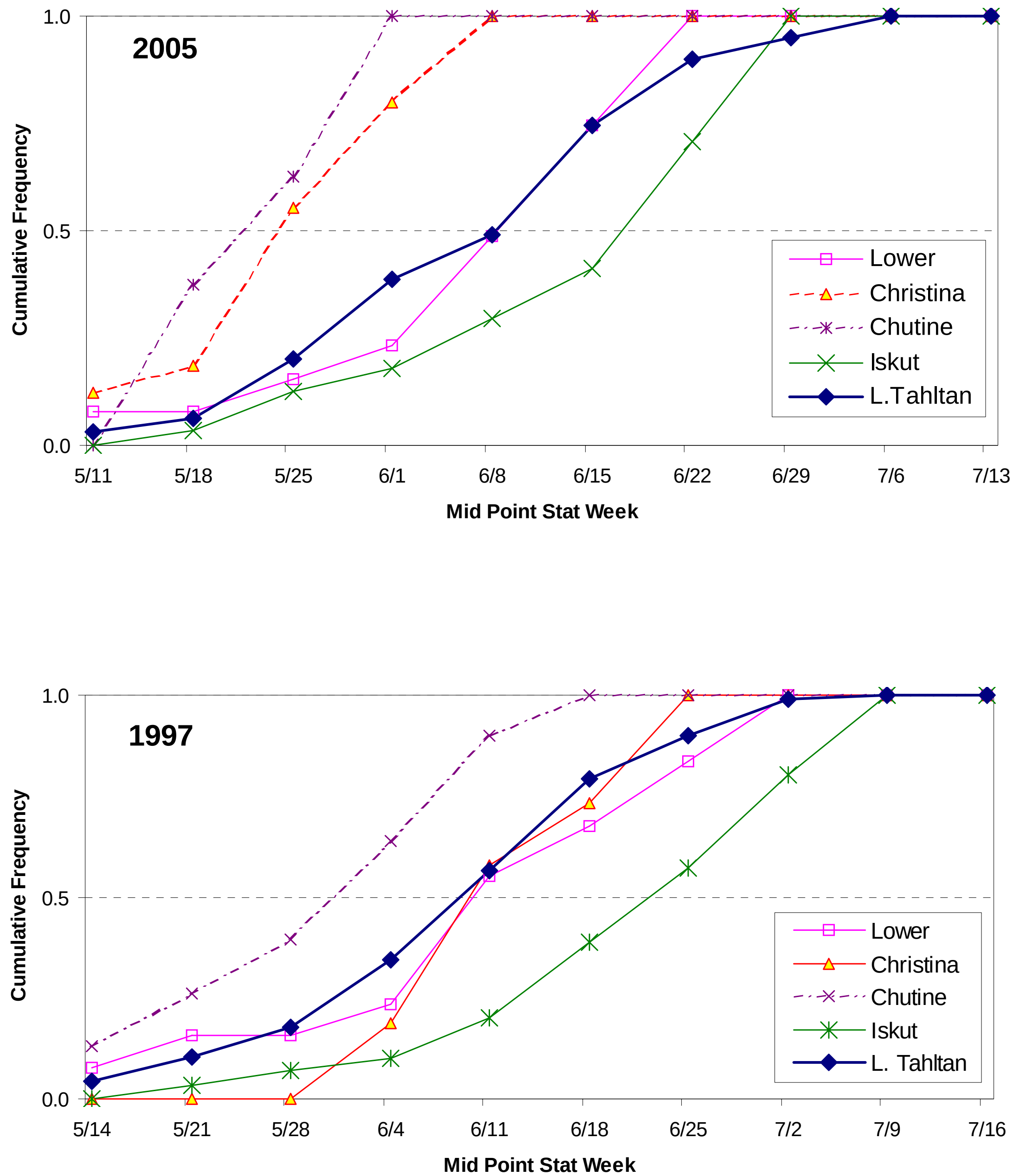


Figure 12.–Chinook Salmon migratory timing by the U.S./Canada border, by stock, Stikine River, 2005 and 1997.

tributary (Pahlke 1996). The original expansion factor was based on professional judgment rather than empirical data, and in 1991 the TTC of the PSC decided to use only the actual counts of escapement to the Little Tahltan River to assess rebuilding (PSC 1991). The relationship between weir counts and the spawning escapement for the watershed is being refined through weir operations and this mark–recapture experiment.

The total weir count in 2005 of 7,253 large fish in the Little Tahltan River was 18% of the estimated spawning escapement. The estimated expansion

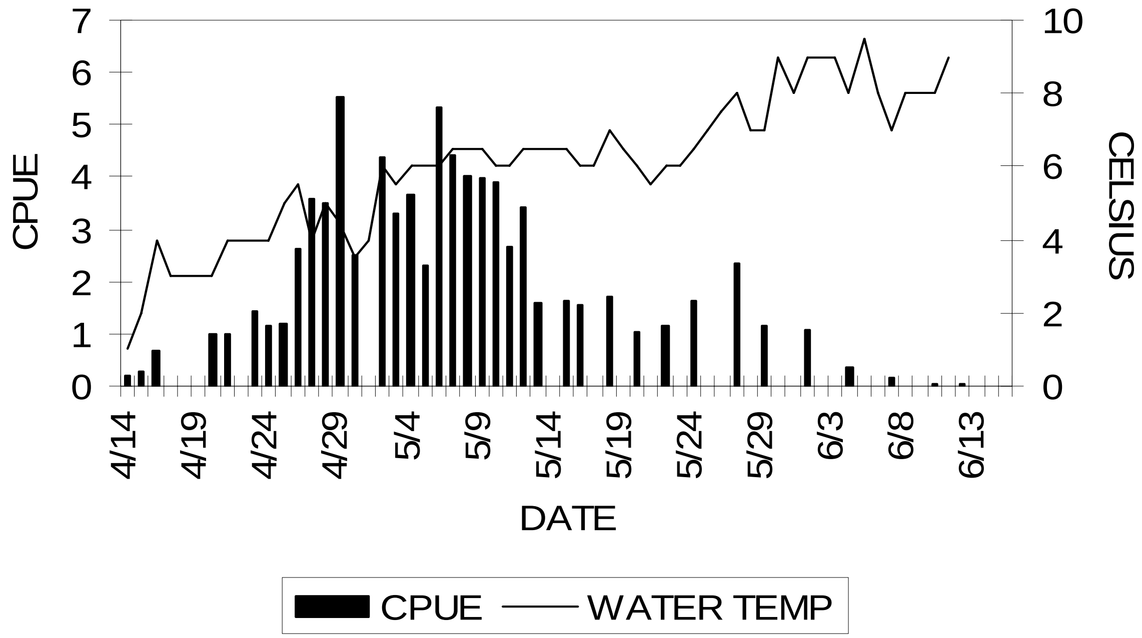


Figure 13.–Catch-per-unit effort (CPUE) of Stikine River Chinook salmon smolt ≥50 mm FL versus water temperature, 2000.

factor for weir counts to escapement was 5.58 (39,833/7,253; Table 12). The average expansion factor of 5.36 (SE = 0.46), or 20% of the spawning population, is greater than the factor of 4.0 (25% of the spawning escapement) that was formerly used to expand weir counts in the Little Tahltan River.

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 2005. Towards that end, we have analyzed sibling relationships in which previous-year inriver run abundance estimates of age-1.2, age-1.3, and age-1.4 fish were used to predict current-year abundance of age-1.3 (R^2 = 0.88, $P < 0.01$), age-1.4 (R^2 = 0.85, $P < 0.01$), and age-1.5 fish (R^2 = 0.52, P = 0.04). The sum of these predictions, compared to corresponding postseason inriver run abundance estimates from 1996–2004, had an average absolute forecast error of 14%.

Prior to 2005, the harvest of Stikine-bound Chinook salmon in D108 was not included in the forecast because the D108 harvest was consistent and minimal, and forecasting the inriver run was considered suitable for planning purposes. However, in 2005 a terminal run forecast was required because of the new directed terminal fishery. The preseason inriver run forecast was 76,900 large Chinook salmon, to which the base catch of 3,400 was added for a preseason terminal run estimate of 80,300. This translated into a U.S. total allowable catch (TAC) of 31,900 large Chinook salmon per the February 2005 harvest sharing agreement (a terminal run forecast, including all Stikine River-origin fish harvested in D108, will be used henceforth).

In 2005, we used models that described linear relationships between the inriver run abundance of large Chinook salmon and cumulative CPUE at Kakwan Point on May 15 (R^2 = 0.70, $P < 0.04$) and 31 (R^2 = 0.79, $P < 0.002$). These models provided inseason estimates of 36,620 on the 15th and 45,110 on the 31st, which compared reasonably well with the preseason terminal forecast after the U.S. harvest was added. The absolute error in the preseason estimate was 12% ([preseason forecast – postseason estimate] /postseason estimate = [80,300 – (59,900 + 30,900)] / 90,800).

The 1999 PST Agreement states that Southeast Alaska fisheries will be managed to achieve escapement objectives for Southeast Alaska and

Table 7.–Number of Chinook salmon smolt ≥50 mm FL captured and coded wire tagged, by gear type, in the Stikine River, brood years 1998–2003.

Tag year	Tag code	Trap sets	Seine sets	Tagged, traps	Tagged, seines	24 h morts	Marked	Shed tags	Valid CWTs
2000	040357	3,787		9,824		99	9,725	10	9,715
2000	040358	1,154		1,848		6	1,842	0	1,842
2000	040359	2,918		3,045		33	3,012	9	3,003
1998 brood year total		7,859		14,717		138	14,579	19	**14,560**
2001	040459	9,055		5,821		30	5,791	17	5,774
1999 brood year total		9,055		5,821		30	5,791	17	**5,774**
2002[a]	040533	3,628	261	2,569	8,647	219	10,997	44	10,953
2002	040234	0	347	0	6,592	121	6,471	13	6,458
2000 brood year total		3,628	608	2,569	15,239	340	17,468	57	**17,411**
2003	040802	2,411	255	3,577	7,871	145	11,303	34	11,269
2003	040803	194	419	0	8,726	51	8,675	17	8,658
2001 brood year total		3,605	674	3,577	16,597	196	19,978	51	**19,927**
2004	040804	2,542	261	3,780	7,691	74	11,397	46	11,351
2004	040956	158	264	68	11,494	129	11,433	46	11,387
2004	040957	0	182	0	3,975	83	3,892	0	3,892
2002 brood year total		2,700	707	3,848	23,160	286	26,722	91[b]	**26,631**[b]
2005	041130	3,642	283	1,131	9,936	191	10,876	54	10,822
2005	041131	686	662	0	11,100	238	10,862	0	10,862
2003 brood year total		4,328	945	1,131	21,036	429	21,738	54	**21,684**

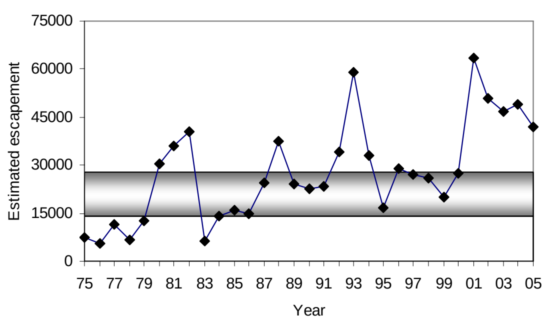
[a] Use of seines initiated in 2002.

[b] Rounding error.

Table 8.–Mean length and weight of Chinook salmon smolt ≥50 mm FL coded wire tagged in the Stikine River, brood years 1998–2003.

			Length, mm FL			Weight, g		
Sample year	Sample dates	n	Range	Mean	SD	Range	Mean	SD
2000	4/20–6/12	217	53–96	74	8	1.2–11.2	5.2	1.8
2001	4/9–5/29	242	60–119	75	8	2.5–14.0	5.5	1.6
2002	4/25–6/11	302	54–116	77	11	2.3–17.5	6.3	2.3
2003	4/22–6/6	310	52–112	72	8	1.4–16.3	4.9	1.2
2004	4/19–5/29	509	50–105	71	8	1.6–12.3	4.4	1.5
2005	4/13–5/30	480	50–129	72	10	1.6–22.5	4.5	1.7

transboundary river Chinook stocks (Chapter 3, Attachment 1, footnote 5). Estimated escapements have met or exceeded the escapement goal range (established in 2000) of 14,000 to 28,000 adult spawners since 1985. As coded wire tag data accumulate on marine harvests of Stikine River Chinook salmon, the escapement goal will be formally reviewed. 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).



Shaded area = escapement goal range

CONCLUSIONS AND RECOMMENDATION

This was the 10th year of estimating the spawning escapement of Chinook salmon to the Stikine River and drift gillnets have proven to be an effective method of capturing enough large Chinook salmon for a postseason estimate. The use of a set gillnet at Rock Island provided a larger marked release group of Chinook salmon <660 mm MEF that has, in some years, been sufficient for a mark–recapture estimate. However, fish tagged at Rock Island were removed from the mark–recapture experiment in 2005. Tagging commenced June 16, after approximately 50% of the run passed Rock Island, therefore violating assumption (a). The results of 10 years of study confirm that counts of salmon through the Little Tahltan River weir are a useful index (i.e., the counts represent a relatively constant percentage of the escapement) of Chinook salmon escapement to the Stikine River. However, the weir counts do not serve as a timely indicator for inseason abundance-based management per the 1999 PST. Models that predict inriver abundance from CPUE data are encouraging, and although CPUE varies with changing river conditions, it is a promising inseason indicator of run strength. Preseason forecast models using sibling information have proved to be very useful for fishery managers. The large return forecast in 2005 allowed managers to open directed fisheries on Chinook salmon for the first time in 20 years, and resulted in the largest harvest in over 50 years.

The weir count of 7,253 large fish is 17.9% of the estimated escapement, which is almost identical to the 17.2% (including U.S.) estimated from the telemetry study and provides assurance that radio tagging Chinook salmon did not affect their final spawning destination.

The lower river gillnet fishery captured 139 radio-tagged fish. Based on tagging rates (period 1 = 1 out of every 2 large fish tagged, period 2 = 1 of 5), a catch of about 364 large tagged fish was expected in the lower river fishery; however only 321 spaghetti tags were recovered from that fishery. Using 321 as observed tags yields a P-value of 0.02 for a test of the hypothesis that the distribution was binomial (trials = 19,070, probability = 364 / 19,070). This difference may cast some doubt on abundance assumption (e) that all recaptured fish are reported and/or distribution assumption (b) that radio-tagged fish are captured

Table 9.–Marked fractions (θ), of Chinook salmon from brood years 1998–2002, estimated from recoveries of coded wire tagged fish in the Stikine River, 2001–2005**.**

Brood year	Age class[a]	Year examined	Estimated number examined	Adipose clips[c]	Number sacrificed	Total valid tags	Valid marked fraction θ
1998	1.1	2001	204	2	2	0	0.000%
1998	1.2	2002	547	2	1	1	0.366%
1998	1.3	2003	3,013	10	10	9	0.299%
1998	1.4	2004	1,926	19	18	3	0.164%
1998	1.5	2005	37	36	33	0	0.000%
1998 brood year total			5,727			14[b]	0.245%
1999	1.1	2002	164	2	1	0	0.000%
1999	1.2	2003	1,531	10	10	0	0.000%
1999	1.3	2004	2,497	19	18	4	0.169%
1999	1.4	2005	1,805	36	33	1	0.060%
1999	1.5	2006					
1999 brood year total			5,997			5	0.090%
2000	1.1	2003	249	10	10	0	0.000%
2000	1.2	2004	1,499	19	18	1	0.070%
2000	1.3	2005	3,439	36	33	16	0.508%
2000	1.4	2006					
2000	1.5	2007					
2000 brood year total			5,187			17	0.349%
2001	1.1	2004	36	19	18	0	0.000%
2001	1.2	2005	123	36	33	1	0.887%
2001	1.3	2006					
2001	1.4	2007					
2001	1.5	2008					
2001 brood year total			159			1	0.678%
2002	1.1	2005	45	36	33	0	0.000%
2002	1.2	2006					
2002	1.3	2007					
2002	1.4	2008					
2002	1.5	2009					
2002 brood year total			45			0	0.000%

[a] Age-0. and -.2 grouped with appropriate age class.

[b] Expanded to 14 total tags to account for unsacrificed clips.

[c] Total adipose clips observed in year expanded.

at the same rate as untagged fish. If radio-tagged fish were captured at a higher rate than fish marked only with spaghetti tags, then a higher proportion of spaghetti-tagged fish would have been expected to pass the fishery and be recovered on the spawning grounds. This was not the case; 37 radio-tagged fish were estimated to enter the Little Tahltan River, and based on the radio-tagging rates, the expected number of large, spaghetti-tagged fish observed at the weir would have been about 127. Actual numbers were less: 91 observed plus 23 sampled for a total of 114, 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. If there was significant under-reporting of spaghetti tags in the lower river commercial fishery, then a higher rate of tags recovered on the spawning grounds than in the commercial fishery would have been expected, and that was not the case (Table 4).

Radiotelemetry provided another method of verifying some of the assumptions of the mark–recapture experiment. Less than 3% of the radio-tagged fish were estimated to have died as a result of tagging, verifying assumption (c). Average transit time (13 days) for radio-tagged fish to reach the Canadian border is the result of handling-induced delay. Delay and downstream movement of Chinook salmon fitted with radio transmitters have been common in other studies in

Table 10.–Random and select recoveries of Chinook salmon from the 1998 brood year that were coded wire tagged in the Stikine River in 2000**.**

Head number	Tag code	Sampling Site	Gear	Recovery date	Statistical Week	Quadrant	District	Sub-District
RANDOM FISHERY RECOVERIES								
513316	40357	Ketchikan	Troll	06/02/2003	23	SE	101	29
255163	40357	Ketchikan	Troll	05/07/2004	19	NE	109	62
257394	40357	Ketchikan	Troll	06/16/2004	25	SE	101	29
241092	40358	Petersburg	Troll	04/12/2004	16	NE	109	61
255877	40357	Petersburg	Troll	05/19/2004	21	SE	105	41
240671	40357	Sitka	Troll	05/06/2003	19	NW	113	31
180570	40357	Sitka	Troll	07/27/2003	31	NW	113	45
217569	40357	Sitka	Troll	05/18/2004	21	NW	113	31
217564	40358	Sitka	Troll	05/18/2004	21	NW	113	31
263069	40357	Sitka	Troll	06/16/2004	25	NE	109	51
520706	40357	Wrangell	Troll	05/28/2003	22	SE	108	30
517672	40357	Wrangell	Troll	06/03/2004	23	SE	108	10
242014	40357	Petersburg	Sport	05/26/2003	22	SE	108	30
269503	40358	Petersburg	Sport	05/28/2004	22	SE	106	44
242413	40357	Sitka	Sport	05/25/2003	22	NW	113	31
SELECT FISHERY RECOVERIES								
98184	40357	Sitka	Sport	06/06/2004	24	NW	113	62
269420	40359	Wrangell	Sport	05/10/2004	20	SE	108	40
269421	40357	Wrangell	Sport	05/31/2004	23	SE	108	40
RANDOM ESCAPEMENT RECOVERIES								
14490	40357	Little Tahltan	Escapement	07/06/2003	27	SE	108	80
14491	40357	Little Tahltan	Escapement	08/06/2003	32	SE	108	80
14492	40357	Little Tahltan	Escapement	08/07/2003	32	SE	108	80
002434E	40357	Little Tahltan	Escapement	07/23/2004	30	SE	108	80
65930	40359	Stikine	Escapement	06/27/2002	26	SE	108	40
65942	40359	Stikine	Escapement	05/27/2003	22	SE	108	40
003171E	40358	Stikine	Escapement	06/15/2003	24	SE	108	70
72740	40357	Stikine	Escapement	06/18/2003	25	SE	108	40
3173	40358	Stikine	Escapement	06/22/2003	25	SE	108	70
65949	40358	Stikine	Escapement	07/04/2003	27	SE	108	70
12475	40357	Stikine	Escapement	06/24/2004	26	SE	108	70
12387	40357	Stikine	Escapement	06/29/2004	26	SE	108	70
003174E	40359	Verrett	Escapement	08/04/2003	32	SE	108	70

Alaska (Bernard et al. 1999). Matter and Sandford (2003) found that over a distance of 460 river km there was no evidence that radio tagging negatively affected Chinook salmon behavior in the Columbia River. Once the fish recover from the handling induced delay, they resume their migration and behave similar to untagged fish, which is an important assumption in any tagging study. Ramstad and Woody (2003) found no difference in mortality between radio-tagged sockeye salmon and untagged controls over a period of 33 d.

Regurgitation of radio tags was also estimated to be less than 3% in 2005, compared to a maximum estimate of about 10% in 1997. Numerous studies have shown similar rates of mortality and regurgitation (Eiler et al. 2006; Ramstad and Woody. 2003).

No significant unknown spawning areas were identified, but 6 tags were tracked to a previously unknown spawning area a few km upriver from Verrett Creek on the Iskut River.

The estimated swimming speed of large Chinook salmon bound for the upper Stikine averaged 5.7 km/d, with fish tagged in period 1 swimming about 5.1 km/day compared to 6.2 km/d for fish tagged in period 2. Estimated swimming speed (5

Table 11.–Harvest of Stikine River Chinook salmon from the 1998 brood year in U.S. marine fisheries. Bold harvest estimates are contributions greater than the total stratum catch. Abbreviations: PSG = Petersburg, SIT = Sitka, BW = biweek, DE = derby.

Description	Age	Return year	Quadrant/ district	Total harvest H_i	Var $[H_i]$	Sample n_i	Adipose clips a_i	Heads sent a'_i	Tags detected t_i	Tags decoded t'_i	Codes of interest m_i	Harvest of interest r_i	SE$[r_i]$
TROLL FISHERY													
Period 2	1.3	2003	NW	18,866	0	8,314	532	529	457	457	1	947	947
Period 3			NW	187,467	0	53,072	3,010	2,954	2,205	2,201	1	1,496	1,496
Period 2			SE	7,386	0	4,766	330	316	278	278	2	1,343	1,037
Period 2	1.4	2004	NW	32,593	0	13,759	766	757	650	650	2	1,989	1,536
Period 1			NE	4,235	0	1,331	115	115	80	79	1	1,337	1,337
Period 2			NE	10,648	0	3,780	319	317	269	269	2	2,352	1,816
Period 2			SE	10,731	0	5,904	387	383	342	342	3	2,286	1,553
Troll subtotal				271,926		90,926	5,459	5,371	4,281	4,276	12	11,751	3,750
SPORT FISHERY													
PSG BW11 DE	1.3	2003		105	0[a]	100	2	2	1	1	1	**436**	435
SIT BW10 DE				145	0[a]	50	5	5	4	4	1	**1,203**	1,203
PSG BW11 DE	1.4	2004		503	0[a]	503	19	19	15	15	1	415	415
Sport subtotal				753		653	26	26	20	20	3	**2,054**	1,345
Grand total, stratified[b]												13,805	3,984
Grand total, pooled[c]												18,856	9,364

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

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

[c] All ten strata pooled.

Table 12.–Counts at the weir on the Little Tahltan River, mark–recapture estimates of inriver run abundance and spawning escapement, expansion factors, and other statistics for large Chinook salmon in the Stikine River, 1996–2005.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
Weir count	4,821	5,557	4,879	4,738	6,640	9,738	7,490	6,492	16,381	7,253	7,399
M[a]	359	653	405	252	612	1,416	935	1,089	1,509	1,022	825
C	2,006	4,528	3,048	4,030	3,657	5,596	4,375	4,696	5,914	21,249	5,910
R	47	93	43	42	73	118	75	118	169	362	114
Inriver run abundance	31,718[b]	31,509	28,133	23,716	30,301	66,646	53,893	49,881	52,538	59,885	43,932
SE	1,978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078[d]	3,896	2,538	3,937
CV	6.2%	9.4%	14.0%	13.7%	10.5%	8.8%	11.0%	12.2%	7.4%	4.2%	9.74
95% lower C.I.	NA	NA	NA	NA	24,879	56,521	43,798	37,968	45,817	54,392	43,896
95% upper C.I.	NA	NA	NA	NA	38,049	78,982	67,023	61,795	61,217	64,641	61,951
Bias	NA	NA	NA	NA	1.0%	0.76%	0.31%	NA	0.47%	2.55%	1.02
Spawning escapement	28,949	26,996	25,968	19,947	27,531	63,523	50,875	46,824	48,900	39,833	38,001
SE	1,978[c]	2,960	3,931	3,240	3,168	5,853	5,912	6,078[d]	3,896	2,538	3,937
CV	6.8%	11.0%	15.1%	16.2%	11.5%	9.2%	11.6%	13.0%	8.0%	6.4%	10.9%
95% lower C.I.	NA	NA	NA	NA	22,220	53,741	40,675	34,911	42,179	20,052	
95% upper C.I.	NA	NA	NA	NA	34,565	75,718	63,900	58,738	57,579	59,885	
Bias	NA	NA	NA	NA	1.14%	0.79%	0.33%	NA	0.50%	NA	
Expansion factor	6.00[e]	4.86[f]	5.32	4.21	4.15	6.52	6.79	7.21	2.99	5.58	5.36
SE	0.41	0.53	0.81	0.68	0.48	0.60	0.79	0.94	0.24	0.35	0.46

[a] Estimated in 1998 and 2001–05.

[b] An estimated 15,052 large Chinook immigrated to the Stikine River after June 12. This estimate, prorated for differences in sampling effort, was expanded to 31,718 for the entire season (see Pahlke and Etherton 1997).

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

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

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

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

km/d) and distance traveled (190 km) was similar for Chinook salmon in the Alsek River (Pahlke and Waugh 2003). In comparison, Chinook salmon traveling over 500 km up the Columbia River traveled between 25 and 50 km/d (Matter and Sandford 2003), fish traveling less than 400 km up the lower Yukon swam about 31 km/day, while Chinook traveling over 800 km to the upper Yukon averaged over 55 km/d (Eiler et al. 2006).

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).

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.

An insufficient number of coded wire tags were recovered inriver and in marine fisheries to estimate smolt abundance and harvest per objective criteria (%RP = 25% at $\alpha = 0.05$). Although tagged smolt may have behaved differently or experienced greater mortality than untagged fish, results from past studies indicate that CWTs do not affect behavior or increase mortality (Elliott and Sterritt 1990; Northwest Marine Technology 2002; Vander Haegen et al. 2005; Vincent-Lang 1993). Handling-induced mortality is always a concern, but overnight mortality was only 0.9% (Table **7**) and if handling adversely impacted survival, its effects should have been readily apparent.

The small number of CWTs recovered can likely be attributed to an insufficient release of CWT-marked smolt. Indeed, the sampling goal was not achieved (14,560 released versus a goal of 30,000). Further, the sampling goal was based on a theoretical emigration of 1 million smolt and if the estimate of 6 million is realistic, the goal was too low. However, an emigration of that magnitude is unlikely given the average number of smolt that emigrate from the Taku River, a system that supports similar escapements of Chinook salmon, is about 1.7 million (Ed Jones, Alaska Department of Fish and Game, Douglas, personal communication).

ACKNOWLEDGMENTS

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

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 1981. Proposed management plan for Southeast Alaska Chinook salmon runs in 1981. Southeast Region, Alaska Department of Fish and Game Division of Commercial Fisheries. Regional Report 1J81-3, Juneau.

Arnason, A. N., C. W. Kirby, C. J. Schwarz, and J. R. Irvine. 1996. Computer analysis of marking data from stratified populations for estimation of salmonid escapements and the size of other populations. Canadian Technical Report of Fisheries and Aquatic Sciences. 2106. National Research Council, Canada.

Beak Consultants Limited. 1981. Preliminary analysis of the potential impact of hydroelectric development of the Stikine River system on biological resources of the Stikine River estuary. Report for the British Columbia Hydro and Power Authority. Richmond, B. C.

REFERENCES CITED (Continued)

Bernard, D. R., and J. E. Clark. 1996. Estimating salmon harvest based on return of coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences 53:2323-2332.

Bernard, D. R., J. J. Hasbrouck, and S. J. Fleischman. 1999. Handling-induced delay and downstream movement of adult Chinook salmon in rivers. Fisheries 44:37-46.

Bernard, D. R., S. A. McPherson, K. A. Pahlke, and P. Etherton. 2000. Optimal production of Chinook salmon from the Stikine River. Alaska Department of Fish and Game, Fishery Manuscript No. 00-1, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fms00-01.pdf

Bigelow, B. B., B. J. Bailey, M. M. Hiner, M. F. Schellekens, and K. R. Linn. 1995. Water resources data Alaska water year 1994. U. S. Geological Survey Water Data Report AK-94-1, Anchorage.

Buckland, S. T., and P. H. Garthwaite. 1991. Quantifying precision of mark-recapture estimates using the bootstrap and related methods. Biometrics 47:255-268.

Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. International Pacific Salmon Commission, Bulletin 9. Westminster, British Columbia, Canada.

Cochran, W. G. 1977. Sampling techniques, *third edition.* John Wiley and Sons, New York.

Conover, W. J. 1980. Practical nonparametric statistics, *second edition*. John Wiley and Sons, New York.

Darroch, J. N. 1961. The two-sample capture-recapture census when tagging and sampling are stratified. Biometrika 48:241-260.

Der Hovanisian, J. A., P. Etherton, and K. A. Pahlke. 2005. Abundance of the Chinook salmon escapement on the Stikine River, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 05-25, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/Fds05-25.pdf

Der Hovanisian, J. A., and P. Etherton. 2006. Abundance of the Chinook salmon escapement on the Stikine River, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 06-01, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds06-01.pdf

Der Hovanisian, J. A., K. A. Pahlke, and P. Etherton. 2001. Abundance of the Chinook salmon escapement on the Stikine River, 2000. Alaska Department of Fish and Game, Fishery Data Series No. 01-18, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds01-18.pdf

Der Hovanisian, J. A., K. A. Pahlke, and P. Etherton. 2003. Abundance of the Chinook salmon escapement on the Stikine River, 2001. Alaska Department of Fish and Game, Fishery Data Series No. 03-09, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds03-09.pdf

Efron, B., and R. J. Tibshirani. 1993. *First Edition*. An introduction to the bootstrap. Chapman and Hall, New York, NY

Eiler, J. H. 1990. Radio transmitters used to study salmon in glacial rivers. pp 364-369 *in* N. C. Parker et al., *editors.* Symposium 7: Proceedings from the International Symposium and Educational Workshop on Fish-Marking Techniques, held in Seattle, Washington, June 1988. American Fisheries Society, Bethesda, Md.

Eiler, J. H. 1995. A remote satellite-linked tracking system for studying Pacific salmon with radiotelemetry. Transactions of the American Fisheries Society 124:184-193.

Eiler, J. H., T. R. Spencer, J. J. Pella, and M. M. Masuda. 2006. Stock composition, run timing, and movement patterns of Chinook salmon returning to the Yukon River basin in 2003., U. S. Department of Commerce, NOAA Technical Memo. NMFS-AFSC-163.

Elliott, S. T., and D. A. Sterritt. 1990. A study of coho salmon in southeast Alaska, 1989: Chilkoot Lake, Yehring Creek, Auke Lake, and Vallenar Creek. Alaska Department of Fish and Game, Fishery Data Series No. 90-53, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds90-53.pdf

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association 55:708-713.

Johnson, R. E., R. P. Marshall, and S. T. Elliott. 1993. Chilkat River Chinook salmon studies, 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-50, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds93-50.pdf

Kissner, P. D. 1982. A study of Chinook salmon in Southeast Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14(23)AFS-41-1, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/FREDf-9-14(23)AFS41-10.pdf

Magnus, D. L., D. Brandenburger, K. F. Crabtree, K. A. Pahlke, and S. A. McPherson. 2006. Juvenile salmon capture and coded wire tagging manual. Alaska Department of Fish and Game, Special Publication No. 06-31, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp06-31.pdf

Matter, A. L., and B. P. Sandford. 2003. A comparison of migration rates of radio- and PIT-tagged adult Snake River Chinook salmon through the Columbia River hydropower system. North American Journal of Fisheries Management 23: 967-973.

McPherson, S. A., D. R. Bernard, M. S. Kelley, P. A. Milligan, and P. Timpany. 1996. Spawning abundance of Chinook salmon in the Taku River in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-36, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-36.pdf

Olsen, M. A. 1995. Abundance, age, sex, and size of Chinook salmon catches and escapements in Southeast Alaska in 1988. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Technical Fisheries Report 95-02, Juneau.

Pahlke, K. A. 1996. Abundance of the Chinook salmon escapement on the Chickamin River, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-37, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-37.pdf

Pahlke, K. A. 1999. Escapements of Chinook salmon in Southeast Alaska and transboundary rivers in 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-17, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-17.pdf

Pahlke, K. A., and D. R. Bernard. 1996. Abundance of the Chinook salmon escapement into the Taku River, 1989-1990., Alaska Fisheries Research Bulletin 3:9-20.

Pahlke, K. A., and P. Etherton. 1997. Chinook salmon research on the Stikine River, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-37, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-37.pdf

Pahlke, K. A., and P. Etherton. 1999. Abundance and distribution of the Chinook salmon escapement on the Stikine River, 1997. Alaska Department of Fish and Game, Fishery Data Series No. 99-6 , Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-06.pdf

Pahlke, K. A., and P. Etherton. 2000. Abundance of the Chinook salmon escapement on the Stikine River, 1998. Alaska Department of Fish and Game, Fishery Data Series No. 00-24, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-24.pdf

Pahlke, K. A., P. Etherton, and J. A. Der Hovanisian. 2000. Abundance of the Chinook salmon escapement on the Stikine River, 1999. Alaska Department of Fish and Game, Fishery Data Series No. 00-25, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-25.pdf

Pahlke, K. A., and B. Waugh. 2003. Abundance and distribution of the Chinook salmon escapement on the Alsek River, 2002. Alaska Department of Fish and Game, Fishery Data Series No. 03-20, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds03-20.pdf

PSC (Pacific Salmon Commission). 1991. Escapement goals for Chinook salmon in the Alsek, Taku, and Stikine Rivers. Transboundary River Technical Report, TCTR (91)-4. Vancouver, B. C.,

PSC (Pacific Salmon Commission). 1999. Treaty between the government of Canada and the government of the United States of America concerning Pacific salmon. Pacific Salmon Treaty, 1999 Agreement. Pacific Salmon Commission, Vancouver, B.C., Canada.,

PSC (Pacific Salmon Commission). 2000. Estimates of transboundary river salmon production, harvest and escapement and a review of joint enhancement activities in 1998. Transboundary River Technical Report TCTR (2000)-1., Vancouver.

Ramstad, K. M., and C. A. Woody. 2003. Radio tag retention and tag-related mortality among adult sockeye salmon. North American Journal of Fisheries Management 23:979-982.

REFERENCES CITED (Continued)

Seber, G. A. F. 1982. On the estimation of animal abundance and related parameters, *second edition.* Griffin and Company, Ltd. London.

Thompson, D. A., and H. L. Blankenship. 1997. Regeneration of adipose fins given complete and incomplete clips. North American Journal of Fisheries Management 17: 467-469.

Vander Haegen, G. E., H. L. Blankenship, A. Hoffmann, and D. A. Thompson. 2005. The effects of adipose fin clipping and coded wire tagging on the survival and growth of spring Chinook salmon. North American Journal of Fisheries Management 25:1161–1170.

Vincent-Lang, D. 1993. Relative survival of unmarked and fin-clipped coho salmon from Bear Lake, Alaska. The Progressive Fish-Culturist 55(3):141-148.

Washington Department of Fish and Wildlife. 1996. Fish health manual. Hatcheries Program, Fish Health Division. Washington Department of Fish and Wildlife, Olympia.

Welander, A. D. 1940. A study of the development of the scale of Chinook salmon *Oncorhynchus tshawytscha*. Masters Thesis. University of Washington, Seattle.

APPENDIX A

Appendix A1.–Drift gillnet daily effort (minutes fished), catches, and catch per hour near Kakwan Point, Stikine River, 2005.

		Chinook				Large Chinook		Small-medium Chinook	
Date	Minutes	Lg	Sm-med	Sockeye	Depth	Fish/hour	Cum. percent	Fish/hour	Cum. percent
05/07/05	289	3	1	0	13.70	0.62	0.00	0.21	0.03
05/08/05	511	15	0	0	14.29	1.76	0.02	0.00	0.03
05/09/05	493	4	0	0	14.93	0.49	0.02	0.00	0.03
05/10/05	490	3	0	0	15.66	0.37	0.02	0.00	0.03
05/11/05	483	11	0	0	16.52	1.37	0.03	0.00	0.03
05/12/05	485	1	0	0	17.34	0.12	0.03	0.00	0.03
05/13/05	482	6	0	0	17.84	0.75	0.04	0.00	0.03
05/14/05	502	5	0	0	18.37	0.60	0.05	0.00	0.03
05/15/05	491	3	0	0	19.89	0.37	0.05	0.00	0.03
05/16/05	496	6	0	0	20.34	0.73	0.05	0.00	0.03
05/17/05	493	4	0	0	20.00	0.49	0.06	0.00	0.03
05/18/05	486	4	0	0	19.85	0.49	0.06	0.00	0.03
05/19/05	488	16	0	0	19.41	1.97	0.08	0.00	0.03
05/20/05	488	7	0	0	19.52	0.86	0.08	0.00	0.03
05/21/05	482	21	0	0	19.35	2.61	0.10	0.00	0.03
05/22/05	490	15	2	0	18.96	1.84	0.12	0.24	0.08
05/23/05	494	26	1	0	18.71	3.16	0.14	0.12	0.11
05/24/05	484	30	1	0	18.64	3.72	0.17	0.12	0.14
05/25/05	488	28	1	0	19.12	3.44	0.20	0.12	0.17
05/26/05	492	26	0	0	19.28	3.17	0.22	0.00	0.17
05/27/05	490	27	0	0	19.59	3.31	0.25	0.00	0.17
05/28/05	482	33	0	0	20.36	4.11	0.28	0.00	0.17
05/29/05	492	31	0	0	20.81	3.78	0.31	0.00	0.17
05/30/05	487	19	0	0	20.70	2.34	0.32	0.00	0.17
05/31/05	487	22	0	0	21.11	2.71	0.35	0.00	0.17
06/01/05	493	24	1	0	21.26	2.92	0.37	0.12	0.19
06/02/05	494	33	0	0	21.06	4.01	0.40	0.00	0.19
06/03/05	487	12	1	0	20.99	1.48	0.41	0.12	0.22
06/04/05	496	21	1	0	20.85	2.54	0.43	0.12	0.25
06/05/05	493	14	0	0	20.50	1.70	0.44	0.00	0.25
06/06/05	490	39	4	0	20.10	4.78	0.48	0.49	0.36
06/07/05	242	21	0	0	19.91	5.21	0.50	0.00	0.36
06/08/05	473	18	1	0	20.06	2.28	0.52	0.13	0.39
06/09/05	487	14	0	0	21.27	1.72	0.53	0.00	0.39
06/10/05	498	9	0	0	21.24	1.08	0.54	0.00	0.39
06/11/05	488	12	0	0	20.68	1.48	0.55	0.00	0.39
06/12/05	486	13	0	0	20.49	1.60	0.56	0.00	0.39
06/13/05	493	28	0	0	20.06	3.41	0.59	0.00	0.39
06/14/05	498	21	0	0	19.58	2.53	0.61	0.00	0.39
06/15/05	482	22	0	0	20.28	2.74	0.63	0.00	0.39
06/16/05	484	25	2	0	19.83	3.10	0.65	0.25	0.44
06/17/05	490	29	0	0	19.81	3.55	0.68	0.00	0.44
06/18/05	489	17	2	0	20.12	2.09	0.70	0.25	0.50
06/19/05	480	16	1	0	20.96	2.00	0.71	0.13	0.53
06/20/05	493	13	0	0	21.22	1.58	0.72	0.00	0.53
06/21/05	491	14	0	0	20.97	1.71	0.74	0.00	0.53
06/22/05	481	37	0	1	20.44	4.62	0.77	0.00	0.53
06/23/05	495	34	4	0	19.41	4.12	0.80	0.48	0.64
06/24/05	485	43	3	0	18.57	5.32	0.85	0.37	0.72

-continued-

Appendix A1.–Page 2 of 2.

Date	Minutes	Chinook Lg	Chinook Sm-med	Sockeye	Depth	Large Chinook Fish/hour	Large Chinook Cum. percent	Small-medium Chinook Fish/hour	Small-medium Chinook Cum. percent
06/25/05	371	39	5	0	17.95	6.31	0.88	0.81	0.86
06/26/05	483	25	1	0	18.30	3.11	0.91	0.12	0.89
06/27/05	483	28	1	1	18.95	3.48	0.93	0.12	0.92
06/28/05	485	13	0	0	19.52	1.61	0.94	0.00	0.92
06/29/05	483	13	1	0	19.86	1.61	0.96	0.12	0.94
06/30/05	484	12	2	0	19.93	1.49	0.97	0.25	1.00
07/01/05	248	2	0	1	19.57	0.48	0.97	0.00	1.00
07/02/05	483	7	0	0	19.87	0.87	0.98	0.00	1.00
07/03/05	490	6	0	0	19.95	0.73	0.98	0.00	1.00
07/04/05	493	6	0	0	20.29	0.73	0.99	0.00	1.00
07/05/05	480	4	0	0	21.07	0.50	0.99	0.00	1.00
07/06/05	489	5	0	0	21.16	0.61	1.00	0.00	1.00
07/07/05	473	4	0	0	20.24	0.51	1.00	0.00	1.00
Total	491 hrs.	1,059	36	3					

Appendix A2.–Estimated age and sex composition and mean length by age of Chinook salmon passing by Kakwan Point, 2005.

		Small and medium Chinook salmon										
		Age class										
		1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Females	n					3	1					4
	% age comp.					10.3	3.4					13.8
	SE of %					5.8	3.4					6.5
	Avg. length					643	635					641
	SE					4						4
Males	n			7		16		1	1			25
	% age comp.			24.1		55.2		3.4	3.4			86.2
	SE of %			8.1		9.4		3.4	3.4			6.5
	Avg. length.			599		628		615	650			620
	SE			11		5						5
Sexes combined	n			7		19	1	1	1			29
	% age comp.			24.1		65.5	3.4	3.4	3.4			100.0
	SE of %			8.1		9.0	3.4	3.4	3.4			0.0
	Avg. length.			599		630	635	615	650			623
	SE			11		4						5
		Large Chinook salmon										
Females	n					356		208	1	1	2	568
	% age comp.					40.2		23.5	0.1	0.1	0.2	64.1
	SE of %					1.6		1.4	0.1	0.1	0.2	1.6
	Avg. length					773		846	800	945	813	800
	SE					2		3			13	2
Males	n			1		195		114	3	3	1	317
	% age comp.			0.1		22.0		12.9	0.3	0.3	0.1	35.8
	SE of %			0.1		1.4		1.1	0.2	0.2	0.1	1.6
	Avg. length.			670		772		886	703	967	890	814
	SE					4		6	27	51		5
Sexes combined	n			1		551		322	4	4	3	885
	% age comp.			0.1		62.3		36.3	0.5	0.5	0.3	100.0
	SE of %			0.1		1.6		1.6	0.2	0.2	0.2	0.0
	Avg. length.			670		773		860	728	961	838	805
	SE					2		3	31	36	27	2
		Small, medium, and large Chinook salmon										
Females	n					359	1	208	1	1		572
	% age comp.					39.2	0.1	22.7	0.1	0.1		62.5
	SE of %					1.6	0.1	1.4	0.1	0.1		1.6
	Avg. length					772	635	846	800	945		799
	SE					2		3				2
Males	n			8		211		115	4	3	1	342
	% age comp.			0.9		23.1		12.6	0.4	0.3	0.1	37.4
	SE of %			0.3		1.4		1.1	0.2	0.2	0.1	1.6
	Avg. length.			608		761		884	690	967	890	800
	SE			13		5		7	23	51		5
Sexes combined	n			8		570	1	323	5	4	3	914
	% age comp.			0.9		62.4	0.1	35.3	0.5	0.4	0.3	100.0
	SE of %			0.3		1.6	0.1	1.6	0.2	0.2	0.2	0.0
	Avg. length.			608		768	635	860	712	961	838	800
	SE			13		2		3	28	36	27	2

Appendix A3.–Estimated age and sex composition and mean length by age of Chinook salmon harvested in the Canadian commercial gillnet fishery on the Lower Stikine River, 2005.

		Age Class											
		1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon													
Females	n						3						3
	% age comp.						9.4						9.4
	SE of %						5.2						5.2
	Avg. length						651						651
	SE						4						4
Males	n	3		5			20	1					29
	% age comp.	9.4		15.6			62.5	3.1					90.6
	SE of %	5.2		6.5			8.7	3.1					5.2
	Avg. length.	404		542			628	491					585
	SE	37		10			7	0					15
Sexes combined	n	3		5			23	1					32
	% age comp.	9.4		15.6			71.9	3.1					100.0
	SE of %	5.2		6.5			8.1	3.1					0.0
	Avg. length.	404		542			631	491					591
	SE	37		10			6	0					14
Large Chinook salmon													
Females	n		1	1		1	247		174	2	2		428
	% age comp.		0.1	0.1		0.1	30.1		21.2	0.2	0.2		52.1
	SE of %		0.1	0.1		0.1	1.6		1.4	0.2	0.2		1.7
	Avg. length		729	881		813	760		817	785	825		784
	SE			0			2		3	18			2
Males	n			1			257		129	1	5		393
	% age comp.			0.1			31.3		15.7	0.1	0.6		47.9
	SE of %			0.1			1.6		1.3	0.1	0.3		1.7
	Avg. length.			776			764		851	843	906		795
	SE						4		5	0	18		4
Sexes combined	n		1	2		1	504		303	3	7		821
	% age comp.		0.1	0.2		0.1	61.4		36.9	0.4	0.9		100.0
	SE of %		0.1	0.2		0.1	1.7		1.7	0.2	0.3		0.0
	Avg. length.		729	829		813	762		832	804	883		789
	SE			53			2		3	22			2
Small, medium, and large Chinook salmon													
Females	n		1	1		1	250		174	2	2		431
	% age comp.		0.1	0.1		0.1	29.3		20.4	0.2	0.2		50.5
	SE of %		0.1	0.1		0.1	1.6		1.4	0.2	0.2		1.7
	Avg. length		729	881		813	758		817	785	825		783
	SE			0		0	3		3	18	53		2
Males	n	3		6			277	1	129	1	5		422
	% age comp.	0.4		0.7			32.5	0.1	15.1	0.1	0.6		49.5
	SE of %	0.2		0.3			1.6	0.1	1.2	0.1	0.3		1.7
	Avg. length.	404		581			754	491	851	843	906		780
	SE	37		40			4		5	0	18		4
Sexes combined	n	3	1	7		1	527	1	303	3	7		853
	% age comp.	0.4	0.1	0.8		0.1	61.8	0.1	35.5	0.4	0.8		100.0
	SE of %	0.2	0.1	0.3		0.1	1.7	0.1	1.6	0.2	0.3		0.0
	Avg. length.	404	729	624		813	756	491	832	804	883		782
	SE	37	0	55		0	2	0	3	22	23		2

Appendix A4.–Estimated age and sex composition and mean length by age of Chinook salmon at Little Tahltan River weir, 2005.

		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										0
	% age comp.										
	SE of %										
	Avg. length										
	SE										
Males	n	1	10		18	1					30
	% age comp.	3.3	33.3		60.0	3.3					100.0
	SE of %	3.3	8.8		9.1	3.3					0.0
	Avg. length.	442	586		627	609					606
	SE		16		7						9
Sexes combined	n	1	10		18	1					30
	% age comp.	3.3	33.3		60.0	3.3					100.0
	SE of %	3.3	8.8		9.1	3.3					0.0
	Avg. length.	442	586		627	609					606
	SE		16		7						9
Large Chinook salmon											
Females	n		6		274		171	7	1		459
	% age comp.		0.8		35.4		22.1	0.9	0.1		59.2
	SE of %		0.3		1.7		1.5	0.3	0.1		1.8
	Avg. length		738		771		818	798	877		789
	SE		11		3		3	5			2
Males	n		21		218		74	2		1	316
	% age comp.		2.7		28.1		9.5	0.3		0.1	40.8
	SE of %		0.6		1.6		1.1	0.2		0.1	1.8
	Avg. length.		735		775		849	809		832	790
	SE		13		5		7	15			4
Sexes combined	n		27		492		245	9	1	1	775
	% age comp.		3.5		63.5		31.6	1.2	0.1	0.1	100.0
	SE of %		0.7		1.7		1.7	0.4	0.1	0.1	0.0
	Avg. length.		736		773		828	800	877	832	789
	SE		10		3		3	5	0		2
Small, medium, and large Chinook salmon											
Females	n		6		274		171	7	1		459
	% age comp.		0.7		34.0		21.2	0.9	0.1		57.0
	SE of %		0.3		1.7		1.4	0.3	0.1		1.7
	Avg. length		738		771		818	798	877		789
	SE		11		3		3	5			2
Males	n	1	31		236	1	74	2		1	346
	% age comp.	0.1	3.9		29.3	0.1	9.2	0.2		0.1	43.0
	SE of %	0.1	0.7		1.6	0.1	1.0	0.2		0.1	1.7
	Avg. length.	442	687		763	609	849	809		832	774
	SE		16		5		7	15			5
Sexes combined	n	1	37		510	1	245	9	1		805
	% age comp.	0.1	4.6		63.4	0.1	30.4	1.1	0.1		100.0
	SE of %	0.1	0.7		1.7	0.1	1.6	0.4	0.1		0.0
	Avg. length.	442	695		768	609	828	800	877		782
	SE		14		3		3	5			2

Appendix A5.–Estimated age and sex composition and mean length by age of moribund and recently expired Chinook salmon in Verrett River, 2005.

		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				4						4
	% age comp.				30.8						30.8
	SE of %				13.3						13.3
	Avg. length				631						631
	SE				8						8
Males	n		1		8						9
	% age comp.		7.7		61.5						69.2
	SE of %		7.7		14.0						13.3
	Avg. length.		635		623						624
	SE				10						10
Sexes combined	n		1		12						13
	% age comp.		7.7		92.3						100.0
	SE of %		7.7		7.7						0.0
	Avg. length.		635		625						626
	SE				8						7
		Large Chinook salmon									
Females	n				86		41				127
	% age comp.				42.0		20.0				62.0
	SE of %				3.5		2.8				3.4
	Avg. length				742		796				759
	SE				5		7				4
Males	n		1		61		14	1	1		78
	% age comp.		0.5		29.8		6.8	0.5	0.5		38.0
	SE of %		0.5		3.2		1.8	0.5	0.5		3.4
	Avg. length.		680		753		818	680	1,020		766
	SE				6		14				7
Sexes combined	n		1		147		55	1	1		205
	% age comp.		0.5		71.7		26.8	0.5	0.5		100.0
	SE of %		0.5		3.2		3.1	0.5	0.5		0.0
	Avg. length.		680		746		802	680	1,020		762
	SE				4		7				4
		Small, medium, and large Chinook salmon									
Females	n				90		41				131
	% age comp.				41.3		18.8				60.1
	SE of %				3.3		2.7				3.3
	Avg. length				737		796				755
	SE				5		7				5
Males	n		2		69		14	1	1		87
	% age comp.		0.9		31.7		6.4		0.5		39.9
	SE of %		0.6		3.2		1.7		0.5		3.3
	Avg. length.		658		738		818	680	1,020		751
	SE		23		7		14				8
Sexes combined	n		2		159		55	1	1		218
	% age comp.		0.9		72.9		25.2		0.5		100.0
	SE of %		0.6		3.0		2.9		0.5		0.0
	Avg. length.		658		737		802	680	1,020		754
	SE		23		4		7				4

Appendix A6.–Estimated age and sex composition and mean length by age of Chinook salmon in Andrew Creek, 2005.

					Age class						
		1.1	1.2	2.1	1.3	2.2	1.4	2.3	1.5	2.4	Total
Small and medium Chinook salmon											
Females	n				1						1
	% age comp.				4.0						4.0
	SE of %				4.0						4.0
	Avg. length				640						0
	SE										0
Males	n		11		12	1					24
	% age comp.		44.0		48.0	4.0					96.0
	SE of %		10.1		10.2	4.0					4.0
	Avg. length.		565		630	610					600
	SE		25		7						13
Sexes combined	n		11		13	1					25
	% age comp.		44.0		52.0	4.0					100.0
	SE of %		10.1		10.2	4.0					0.0
	Avg. length.		565		631	610					601
	SE		25		6						13
Large Chinook salmon											
Females	n				39		40				79
	% age comp.				20.0		20.5				40.5
	SE of %				2.9		2.9				3.5
	Avg. length				746		811				779
	SE				6		6				6
Males	n		4		88		24				116
	% age comp.		2.1		45.1		12.3				59.5
	SE of %		1.0		3.6		2.4				3.5
	Avg. length.		689		744		818				758
	SE		15		6		17				6
Sexes combined	n		4		127		64				195
	% age comp.		2.1		65.1		32.8				100.0
	SE of %		1.0		3.4		3.4				0.0
	Avg. length.		689		745		814				766
	SE		15		4		8				4
Small, medium, and large Chinook salmon											
Females	n				40		40				80
	% age comp.				18.2		18.2				36.4
	SE of %				2.6		2.6				3.3
	Avg. length				744		811				777
	SE				6		6				6
Males	n		15		100	1	24				140
	% age comp.		6.8		45.5	0.5	10.9				63.6
	SE of %		1.7		3.4		2.1				3.3
	Avg. length.		598		731	610	818				731
	SE		24		6		17				8
Sexes combined	n		15		140	1	64				220
	% age comp.		6.8		63.6	0.5	29.1				100.0
	SE of %		1.7		3.3		3.1				0.0
	Avg. length.		598		734	610	814				748
	SE		24		5		8				6

APPENDIX B

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

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

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

M vs. R	C vs. R	M vs. C
Case I:		
Fail to reject H_o	Fail to reject H_o	Fail to reject H_o

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

Case II:		
Reject H_o	Fail to reject H_o	Reject H_o

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

Case III:		
Fail to reject H_o	Reject H_o	Reject H_o

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

Case IV:		
Reject H_o	Reject H_o	Reject H_o

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

Evaluation Required:		
Fail to reject H_o	Fail to reject H_o	Reject H_o

Sample sizes and powers of tests must be considered:

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

-continued-

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

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

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

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

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

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

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

APPENDIX C

AppendixC1.–Stikine River Chinook salmon radio tagging application data, with remote tracking site and aerial survey records and final assigned grouping, 2005. Site #1:Border, #2:Iskut water gage, #4:Iskut Snip, #5:Flood R., #6:Butterfly, #7:Chutine R., #8:Shakes Cr., #9:Tahltan R., #11: Tuya R., #12: Little Tahltan R.

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.380	1-21	5/7	20	6/11	6/30																				D8 Gillnet	
148.380	2-21	5/8	20	5/21				5/27	6/2		6/7	6/20		6/25	22	Tahltan					17	L. Tahltan	16	L. Tahltan	Little Tahltan	
148.380	3-21	5/9	20	5/24																					LR Gillnet	
148.380	4-21	5/9	20	5/21	6/25																				LR Gillnet	
148.380	5-21	5/9	20	6/9				6/15	6/19		6/22	6/30					22	Tahltan					18	Tahltan	Tahltan	
148.380	6-21	5/9	20	6/4	6/25																				LR Gillnet	
148.380	7-21	5/10	20	5/24																					LR Gillnet	
148.380	8-21	5/10	20																		11	Stikine	10	Stikine	LR Gillnet	regurgitated
148.380	9-21	5/11	20	6/9	7/2																				LR Gillnet	
148.380	10-21	5/11	20																						D8 Gillnet	
148.380	11-21	5/11	20	5/30																					LR Gillnet	
148.380	12-21	5/11	20	6/6	7/1																				LR Gillnet	
148.380	13-21	5/11	20	5/31				6/7	6/9		6/14	6/23		7/1	3	Tahltan					3	L. Tahltan	2	L. Tahltan	Little Tahltan	
148.380	14-21	5/11	20	6/8																					LR Gillnet	
148.380	15-21	5/12	20	5/29																					LR Gillnet	
148.380	16-21	5/13	20	6/13	7/7																				LR Gillnet	
148.380	17-21	5/13	20	5/15															12	Stikine	12	Stikine			LR Gillnet	regurgitated?
148.380	18-21	5/13	20	5/25	6/29																				LR Gillnet	
148.380	19-21	5/13	20	5/23																					Lower Stikine	
148.380	20-21	5/13	20	5/30				6/23	6/26		6/29	7/5			87	Stikine							20	Tahltan	Tahltan	
148.380	21-21	5/14	20	5/29				6/12	6/18	6/22									110	Stikine			112	Stikine	Christina	
148.380	22-21	5/14	20	5/29	7/7																				LR Gillnet	
148.380	23-21	5/14	20	5/27	6/26																				LR Gillnet	
148.380	24-21	5/14	20	5/24				6/6							111	Stikine	112	Stikine	110	Stikine			112	Stikine	Christina	
148.380	25-21	never deployed																							Never Deployed	
148.380	26-21	5/15	21	5/23	7/2																				LR Gillnet	
148.380	27-21	5/15	21	5/25				6/5															112	Stikine	Christina	
148.380	28-21	5/16	21	7/4																					D8 Gillnet	
148.380	29-21	5/16	21	6/5	7/14																				LR Gillnet	
148.380	30-21	5/16	21	5/28	7/8																				LR Gillnet	
148.380	31-21	5/17	21	5/27				6/2	6/5		6/7	6/12		6/19											Tahltan	

-continued-

Appendix C1.–Page 2 of 12.

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.380	32-21	5/17	21	5/22				5/28	6/5		6/7	6/11		6/19	28	Tahltan									Little Tahltan	148.380
148.380	33-21	5/18	21	6/1				6/10	6/19	6/21									42	Chutine					Chutine	
148.400	1-22	5/18	21	5/23	6/25																				LR Gillnet	
148.400	2-22	5/18	21									8/14								LT weir					Tahltan	questions
148.400	3-22	5/19	21	6/6				6/14	6/17		6/18						204	Stikine	204	Stikine					Upper Stikine	
148.400	4-22	5/19	21	6/8	6/23																				LR Gillnet	
148.400	5-22	5/19	21	5/29	7/6																				LR Gillnet	
148.400	6-22	5/19	21	5/31		6/5	6/11																		Iskut	above Verrett
148.400	7-22	5/19	21	5/31				6/9	6/13		6/18	6/29		7/8			26	Tahltan					28	Tahltan	Tahltan	
148.400	8-22	5/19	21	6/5				6/10	6/13		6/17	6/20		6/27	9	Tahltan	51	Tahltan	50	Tahltan			50	Tahltan	Tahltan	
148.400	9-22	5/19	21	5/23	6/24																				LR Gillnet	
148.400	10-22	5/19	21	5/23				6/8	6/10		6/13	6/19		6/27	9	Tahltan	38	Tahltan	38	Tahltan			36	Tahltan	Tahltan	
148.400	11-22	5/20	21	5/23				6/18	6/21		6/24	7/1		7/10							6	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.400	12-22	5/20	21	5/20				6/4	6/6	6/11									43	Chutine					Chutine	
148.400	13-22	5/20	21	6/4	6/26																				LR Gillnet	
148.400	14-22	5/20	21	5/31	7/5																				LR Gillnet	
148.400	15-22	5/21	21	6/4																					LR Gillnet	
148.400	16-22	5/21	21	6/5																					LR Gillnet	
148.400	17-22	5/21	21	6/1	7/5																				LR Gillnet	
148.400	18-22	5/21	21	6/10				7/1																	LR Gillnet	
148.400	19-22	5/21	21	6/7	6/27																				LR Gillnet	
148.400	20-22	5/21	21	6/4				6/11	6/14	6/28									43	Chutine					Chutine	
148.400	21-22	5/21	21	6/3		6/8	6/26								34	Iskut	50	Iskut							Iskut	Verrett
148.400	22-22	5/21	21	5/31	6/22										41	Stikine									LR Gillnet	
148.400	23-22	5/21	21	5/29				6/11	6/14		6/18	6/22		6/28			50	Tahltan	50	Tahltan			50	Tahltan	Tahltan	Tashoots
148.400	24-22	5/21	21	6/8				6/16	6/19		6/25	8/10											6	Tahltan	Tahltan	
148.400	25-22	5/22	22	5/28	7/3																				LR Gillnet	
148.400	26-22	5/22	22	6/6				6/12	6/18		6/20	6/25		7/3			25	Tahltan					23	Tahltan	Tahltan	L. Tahltan?
148.400	27-22	5/22	22	6/3	7/2																				LR Gillnet	
148.400	28-22	5/22	22	6/11	6/28																				LR Gillnet	
148.400	29-22	5/22	22	5/26				6/3	6/7		6/16	6/23		7/1	2	Tahltan					9	L. Tahltan	7	L. Tahltan	Little Tahltan	
148.400	30-22	5/22	22																	mort	12	Stikine			Mort	
148.400	31-22	5/22	22	6/11				6/27	6/30		7/8	7/13		8/2	60	Stikine	18	Tahltan					22	Tahltan	Tahltan	L. Tahltan?
148.400	32-22	5/23	22	6/8	7/2																				LR Gillnet	
148.400	33-22	5/23	22	6/14	6/29																				LR Gillnet	

-continued-

Appendix C1.–Page 3 of 12.

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.440	1-23	5/23	22	6/10	6/29																				US sport	
148.440	2-23	5/23	22	6/4				6/12	6/15		6/19	7/23			191	Stikine	190	Stikine					190	Stikine	Tahltan	
148.440	3-23	5/23	22	6/4				6/10							112	Stikine	112	Stikine	110	Stikine			110	Stikine	Christina	
148.440	4-23	5/23	22	5/24				7/4	7/7		7/12														LR Gillnet	
148.440	5-23	5/23	22	6/2				6/10	6/13		6/17														UR Gillnet	
148.440	6-23	5/23	22	6/6				6/14	6/19		6/24	7/15					20	Tahltan							Tahltan	
148.440	7-23	5/23	22	6/6	6/30																				LR Gillnet	
148.440	8-23	5/23	22	6/16				6/26	6/29		7/5	7/10		7/17			28	Tahltan			3	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.440	9-23	5/23	22	5/24				6/8	6/18		6/22	6/26		7/5			28	Tahltan			7	L. Tahltan	6	L. Tahltan	Little Tahltan	
148.440	10-23	5/23	22	6/10				6/17	6/19		6/22				191	Stikine									UR Gillnet	
148.440	11-23	5/23	22	6/5		6/12													37	Iskut					Iskut	Craig
148.440	12-23	5/24	22	6/7				6/18	6/20		6/24	7/12		7/16					50	Tahltan			50	Tahltan	Tahltan	Tashoots
148.440	13-23	5/24	22	6/17	7/9																				LR Gillnet	
148.440	14-23	5/24	22	6/2	7/16																				LR Gillnet	
148.440	15-23	5/24	22	6/5																					LR Gillnet	
148.440	16-23	5/24	22	6/10	7/7																				LR Gillnet	
148.440	17-23	5/24	22	6/5	7/1																				LR Gillnet	
148.440	18-23	5/24	22																-10	inlet	-10	Stikine			Mort	
148.440	19-23	5/24	22	7/1																					D8 Gillnet	
148.440	20-23	5/24	22	6/4				6/11	6/14		6/18	6/25		6/30	2	Tahltan			48	Tahltan	45	Tahltan	46	Tahltan	Tahltan	
148.440	21-23	5/24	22	5/28				6/10	6/13		6/18	6/22		6/29	4	Tahltan					8	L. Tahltan	5	L. Tahltan	Little Tahltan	
148.440	22-23	5/24	22	6/5																					D8 Gillnet	
148.440	23-23	5/24	22	6/4				6/18									112	Stikine					110	Stikine	Christina	
148.440	24-23	5/24	22	6/11				6/16	6/20		6/24	7/3					26	Tahltan					25	Tahltan	Tahltan	
148.440	25-23	5/24	22	6/9	7/2																				LR Gillnet	
148.440	26-23	5/25	22	6/17	7/14																				LR Gillnet	
148.440	27-23	5/25	22					6/17	6/20		6/23	6/27		7/2	170	Stikine	52	Tahltan					50	Tahltan	Tahltan	
148.440	28-23	5/25	22	6/7	7/8																				LR Gillnet	
148.440	29-23	5/25	22	6/2	7/17																				LR Gillnet	
148.440	30-23	5/25	22	6/10				6/18	6/22		6/24	6/26		7/1	156	Stikine	31	Tahltan	30	Tahltan			23	Tahltan	Tahltan	
148.440	31-23	5/25	22	6/6	6/27																				LR Gillnet	
148.440	32-23	5/25	22	6/13	6/29																				LR Gillnet	
148.440	33-23	5/25	22	6/8				6/23	6/25		6/28	7/7	7/5		87	Stikine			20	Tahltan			20	Tahltan	Tahltan	
148.460	1-24	5/25	22	6/11	7/3			6/20	6/23		6/25	6/25			138	Stikine									Tahltan	
148.460	2-24	5/25	22	5/31				6/22	6/24		6/26	7/1			105	Stikine	20	Tahltan	10	Beatty Creek			4	Beatty Creek	Tahltan	Beatty Cr
148.460	3-24	5/25	22	6/10	7/9																				LR Gillnet	

-continued-

Appendix C1.–Page 4 of 12.

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.460	4-24	5/25	22	6/13				6/25	6/27	7/9									46	Chutine					Chutine	
148.460	5-24	5/25	22	6/6																					LR Gillnet	
148.460	6-24	5/25	22	6/4				6/18							111	Stikine	112	Stikine	110	Stikine			110	Stikine	Christina	
148.460	7-24	5/26	22	6/10				6/17	6/20		6/23	6/28		7/2	167	Stikine	28	Tahltan			3	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.460	8-24	5/26	22	6/6	7/6																				LR Gillnet	
148.460	9-24	5/26	22																-11	inlet					Mort	
148.460	10-24	5/26	22	6/10				6/19							111	Stikine	26	Tahltan	110	Stikine			110	Stikine	Christina	
148.460	11-24	5/26	22	6/11				6/18	6/22		6/25	7/1			147	Stikine							10	Tahltan	Tahltan	
148.460	12-24	5/26	22	6/24				6/30	7/4		7/9						1	Tahltan							Tahltan	Caught
148.460	13-24	5/26	22	6/19				6/26											110	Stikine			110	Stikine	Christina	
148.460	14-24	5/26	22	6/9	7/4																				LR Gillnet	
148.460	15-24	5/26	22	6/20	6/22	6/25	7/4										52	Iskut	49	Iskut					Iskut	Verrett
148.460	16-24	5/26	22	6/14			8/1	6/21	6/23	6/26				8/4	120	Stikine			47	Chutine					Chutine	questions
148.460	17-24	5/26	22	6/1	7/10			6/27	6/30		7/3	7/7		8/11	45	Stikine	19	Tahltan					23	Tahltan	Tahltan	L. Tahltan?
148.460	18-24	5/26	22					7/3	7/24		7/27	8/2		8/4									4	Tahltan	Tahltan	
148.460	19-24	5/26	22	6/13				6/22																	LR Gillnet	
148.460	20-24	5/26	22	6/10				6/17	6/19		6/22	6/25		7/1	196	Stikine					9	L. Tahltan	6	L. Tahltan	Little Tahltan	
148.460	21-24	5/26	22	5/31	7/4																				LR Gillnet	
148.460	22-24	5/27	22	6/5	8/12																				LR Gillnet	
148.460	23-24	5/27	22	7/10																					D8 Gillnet	
148.460	24-24	5/27	22	6/1				6/13	6/16		6/18	6/24		6/30	229	Stikine							33	Tahltan	Tahltan	
148.460	25-24	5/27	22	6/10	6/27																				LR Gillnet	
148.460	26-24	5/27	22	6/13				6/25	6/28		7/5	8/3			34	Stikine			3	Tahltan			4	Tahltan	Tahltan	
148.460	27-24	5/27	22	6/11				6/19																	LR Gillnet	
148.460	28-24	5/27	22	6/6				6/19									112	Stikine			112	Stikine	110	Stikine	Christina	
148.460	29-24	5/27	22	5/30		6/7																			Iskut	
148.460	30-24	5/27	22	6/13	7/9																				LR Gillnet	
148.460	31-24	5/27	22	5/31	7/2																				LR Gillnet	
148.460	32-24	5/27	22	6/14	7/7																				LR Gillnet	
148.460	33-24	5/27	22	6/8	7/2																				LR Gillnet	
148.480	1-25	5/27	22	6/11	6/26																				LR Gillnet	
148.480	2-25	5/27	22	6/20	6/22			6/27	6/29		7/5			7/21			207	Stikine					193	Stikine	Upper Stikine	
148.480	3-25	5/28	22	6/12	7/7	6/22									10	Iskut	51	Iskut	51	Iskut			50	Iskut	Iskut	Verrett
148.480	4-25	5/28	22	6/4	6/23																				LR Gillnet	
148.480	5-25	5/28	22	6/8				6/19	6/22		6/26	7/5		7/17	140	Stikine				weir	1	L. Tahltan			Little Tahltan	

-continued-

Appendix C1.–Page 5 of 12.

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.480	6-25	5/28	22	6/13																					LR Gillnet	
148.480	7-25	5/28	22	6/25				6/28	6/30		7/8												190	Stikine	Upper Stikine	
148.480	8-25	5/28	22	6/17				6/24	6/26		6/27	7/1		7/28											Little Tahltan	
148.480	9-25	5/28	22	6/12				6/19	6/24		6/27	7/9		7/17					0	L. Tahltan			25	Tahltan	Tahltan	L. Tahltan?
148.480	10-25	5/28	22	6/8		6/13									29	Iskut	35	Iskut	32	Iskut			35	Iskut	Iskut	Craig
148.480	11-25	5/28	22																						D8 Gillnet	
148.480	12-25	5/28	22	6/18																					Lower Stikine	
148.480	13-25	5/28	22	6/6	6/26																				LR Gillnet	
148.480	14-25	5/28	22	6/8																					LR Gillnet	
148.480	15-25	5/28	22	6/12				5/12	6/19		6/22	6/27		7/6	186	Stikine	28	Tahltan			3	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.480	16-25	5/28	22	6/14				6/22	6/25		6/27	7/2		7/28					0	L. Tahltan			26	Tahltan	Tahltan	L. Tahltan?
148.480	17-25	5/28	22	6/1	6/23																				LR Gillnet	
148.480	18-25	5/28	22	6/5																					LR Gillnet	
148.480	19-25	5/29	23	6/5	6/22																				LR Gillnet	
148.480	20-25	5/29	23	6/13				6/23	6/25		6/27	7/2											24	Tahltan	Tahltan	
148.480	21-25	5/29	23	6/17				6/23	6/26		6/30	7/7		7/17							1	L. Tahltan	28	Tahltan	Little Tahltan	
148.480	22-25	5/29	23	6/5				6/24							88	Stikine	112	Stikine	110	Stikine	110	Stikine	110	Stikine	Christina	
148.480	23-25	5/29	23	5/31	6/23																				LR Gillnet	
148.480	24-25	5/29	23	6/8													73	Stikine			73	Stikine	72	Stikine	Lower Stikine	
148.480	25-25	5/29	23	6/14				6/23	6/25		6/27	7/3		7/10							4	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.480	26-25	5/29	23	6/9				6/21	6/24		6/27	7/7		7/16					44	Tahltan	39	Tahltan	36	Tahltan	Tahltan	
148.480	27-25	5/29	23														15	Stikine	13	Stikine	14	Stikine	15	Stikine	Mort	
148.480	28-25	5/29	23	6/23				6/29	7/2		7/6	7/12		7/20							0	L. Tahltan			Tahltan	L. Tahltan?
148.480	29-25	5/29	23																-17	inlet					Mort	
148.480	30-25	5/29	23	6/18				6/23	6/25		6/27	7/3		7/22			28	Tahltan					26	Tahltan	Tahltan	
148.480	31-25	5/29	23	6/3				6/23	6/25	7/8									46	Chutine					Chutine	
148.480	32-25	5/29	23	6/8																					LR Gillnet	
148.480	33-25	5/29	23	6/7	7/7																				LR Gillnet	
148.500	1-26	5/29	23	6/16	6/29			6/24	6/26		6/28	6/25		7/29			21	Tahltan					26	Tahltan	Tahltan	L. Tahltan?

-continued-

Appendix C1.–**page 6 of 12.**

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.500	2-26	5/29	23	6/23				6/26	6/27		6/29	6/25		7/9			50	Tahltan	50	Tahltan	49	Tahltan			Tahltan	Tashoots
148.500	3-26	5/29	23	6/12				6/20	6/22		6/25	7/1		7/12	146	Stikine	27	Tahltan			1	L. Tahltan	28	Tahltan	Tahltan	L. Tahltan?
148.500	4-26	5/29	23	6/8	7/17																				LR Gillnet	
148.500	5-26	5/30	23	6/13	7/7																				LR Gillnet	
148.500	6-26	5/30	23	6/10				6/22																	LR Gillnet	
148.500	7-26	5/30	23	6/24				6/27	6/29		7/2	8/27	8/24										8	Tahltan	Tahltan	
148.500	8-26	5/30	23	6/23				6/26	6/28		6/30														UR Gillnet	
148.500	9-26	5/30	23	6/9				6/16	6/19		6/23				170	Stikine	0	Tahltan	212	Stikine					UR Gillnet	
148.500	10-26	5/30	23	6/12				6/18	6/21		6/24	7/6		7/9							6	L. Tahltan	5	L. Tahltan	Little Tahltan	
148.500	11-26	5/30	23	6/6	7/2																				LR Gillnet	
148.500	12-26	5/31	23	6/12	6/30																				LR Gillnet	
148.500	13-26	5/31	23	6/16				6/25	6/27		6/29	7/2		7/9			51	Tahltan	50	Tahltan	51	Tahltan	51	Tahltan	Tahltan	Tashoots
148.500	14-26	5/31	23	6/6				6/21	6/24	7/5									45	Chutine					Chutine	
148.500	15-26	5/31	23	6/12	7/7																				LR Gillnet	
148.500	16-26	5/31	23	6/13	6/29																				LR Gillnet	
148.500	17-26	5/31	23	6/1	7/10																				LR Gillnet	
148.500	18-26	5/31	23	6/9	7/11																				LR Gillnet	
148.500	19-26	5/31	23	6/5	7/8																				LR Gillnet	
148.500	20-26	5/31	23	6/18	7/10																				LR Gillnet	
148.500	21-26	5/31	23	6/9																					LR Gillnet	
148.500	22-26	6/1	23	6/18	6/25																				LR Gillnet	
148.500	23-26	6/1	23	6/12				6/20	6/23		6/25	6/29		7/3	134	Stikine	203	Stikine			3	L. Tahltan	3	L. Tahltan	Little Tahltan	recovered
148.500	24-26	6/1	23	6/25				7/4	7/8		7/13	7/18											18	Tahltan	Tahltan	
148.500	25-26	6/1	23					6/19	6/22		6/24	6/27		7/3							9	L. Tahltan	7	L. Tahltan	Little Tahltan	
148.500	26-26	6/1	23	6/4	6/22																				LR Gillnet	
148.500	27-26	6/1	23	6/15				6/22	6/25		6/27	6/30		7/8	103	Stikine									Little Tahltan	
148.500	28-26	6/1	23	6/11	6/27																				LR Gillnet	
148.500	29-26	6/1	23	6/23				6/27	7/1		7/5	7/11		7/23			25	Tahltan			2	L. Tahltan	1	L. Tahltan	Little Tahltan	
148.500	30-26	6/1	23	6/14				6/24	6/26		6/29	7/9		7/23									27	Tahltan	Tahltan	L. Tahltan?
148.500	31-26	6/1	23	6/18	6/29																				LR Gillnet	
148.500	32-26	6/1	23	6/24				6/27	6/29		7/3	7/9		7/14			37	Tahltan			42	Tahltan	39	Tahltan	Tahltan	
148.500	33-26	6/1	23	6/15				6/20	6/22	6/24					143	Stikine									Chutine	
148.520	1-27	6/1	23	6/10	8/1			6/18	6/25		6/27	7/6	7/5	7/28											Tahltan	questions

-continued-

Appendix C1.–**page 7 of 12.**

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.520	2-27	6/2	23	6/9				6/18	6/21		6/23	6/26		6/30			52	Tahltan	50	Tahltan	49	Tahltan	48	Tahltan	Tahltan	Tashoots
148.520	3-27	6/2	23	6/14																					LR Gillnet	
148.520	4-27	6/2	23	6/13	6/26																				LR Gillnet	
148.520	5-27	6/2	23	6/12				6/23	6/25		6/28	7/6		7/24	93	Stikine							24	Tahltan	Tahltan	L. Tahltan?
148.520	6-27	6/2	23	6/12				6/18	6/22		6/25	7/18		7/25	140	Stikine							14	Tahltan	Tahltan	
148.520	7-27	6/2	23	6/25				6/28																	LR Gillnet	
148.520	8-27	6/2	23	6/23				6/28	7/4		7/7	7/13					13	Tahltan					20	Tahltan	Tahltan	
148.520	9-27	6/2	23	6/14	7/8																				LR Gillnet	
148.520	10-27	6/2	23	6/9	6/26																				LR Gillnet	
148.520	11-27	6/2	23	6/11				6/20	6/23		6/26	7/1		7/24			19	Tahltan	0	L. Tahltan			28	Tahltan	Tahltan	L. Tahltan?
148.520	12-27	6/2	23	6/18											42	Stikine									LR Gillnet	
148.520	13-27	6/2	23	6/24				6/29	7/3		7/8	7/16											8	Tahltan	Tahltan	
148.520	14-27	6/2	23	6/9		6/21	6/26								18	Iskut			51	Iskut			19	Iskut	Iskut	Verrett
148.520	15-27	6/2	23	6/14				6/22	6/24		6/27	7/4		7/15			27	Tahltan			10	L. Tahltan	8	L. Tahltan	Little Tahltan	
148.520	16-27	6/2	23	6/15				6/24	6/26		6/29								190	Stikine					Upper Stikine	
148.520	17-27	6/2	23	6/14	7/10			6/25	6/28		7/3	7/13		7/25									23	Tahltan	Tahltan	L. Tahltan?
148.520	18-27	6/2	23	6/13	7/10																				LR Gillnet	
148.520	19-27	6/2	23	6/5				7/3							64	Stikine	112	Stikine	110	Stikine			111	Stikine	Christina	
148.520	20-27	6/3	23	6/19	6/23			7/2							38	Stikine	112	Stikine	110	Stikine	111	Stikine	115	Stikine	Christina	
148.520	21-27	6/3	23	6/15	7/11																				LR Gillnet	
148.520	22-27	6/3	23	6/5	6/24			6/26	6/28		6/30	7/5		7/13							2	L. Tahltan	1	L. Tahltan	Little Tahltan	
148.520	23-27	6/3	23	6/15	6/23																				LR Gillnet	
148.520	24-27	6/3	23	6/13	7/4																				LR Gillnet	
148.520	25-27	6/3	23	6/14																					LR Gillnet	
148.520	26-27	6/4	23	6/23				6/26	6/28		7/1	7/6		7/12			46	Tahltan	50	Tahltan	48	Tahltan	51	Tahltan	Tahltan	Tashoots
148.520	27-27	6/4	23	6/18				6/25	6/27		6/29	7/6		7/17	43	Stikine									Tahltan	L. Tahltan?
148.520	28-27	6/4	23	6/18																					LR Gillnet	
148.520	29-27	6/4	23	6/11																					LR Gillnet	
148.520	30-27	6/4	23	6/16				6/20	6/23		6/25	6/28		7/5							4	L. Tahltan	2	L. Tahltan	Little Tahltan	
148.520	31-27	6/4	23	6/12																					LR Gillnet	
148.520	32-27	6/4	23	6/15				6/23							97	Stikine	112	Stikine	110	Stikine			112	Stikine	Christina	
148.520	33-27	6/4	23	6/25				6/28	7/3		7/8						190	Stikine					192	Stikine	Upper Stikine	
148.540	1-28	6/4	23	6/14	6/24			6/29	7/3		7/7	7/20							7	Tahltan			6	Tahltan	Tahltan	

-continued-

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.540	2-28	6/4	23																-7	inlet	-7	Stikine			Mort	
148.540	3-28	6/5	23.5	6/13	7/4																				LR Gillnet	
148.540	4-28	6/5	23.5	6/16				6/21	6/24		6/26	7/3		7/17	118	Stikine					1	L. Tahltan	28	Tahltan	Little Tahltan	recovered
148.540	5-28	6/5	23.5	6/23				6/27																	LR Gillnet	
148.540	6-28	6/5	23.5	6/23	6/23			6/27	6/30		7/4	8/6					194	Stikine					9	Tahltan	Tahltan	
148.540	7-28	6/5	23.5	6/25				7/4	7/8		7/11	7/16					10	Tahltan					18	Tahltan	Tahltan	
148.540	8-28	6/5	23.5	6/8	6/28																				LR Gillnet	
148.540	9-28	6/5	23.5	6/15				6/25	6/27		7/1	7/15		7/27					17	Tahltan			13	Tahltan	Tahltan	L. Tahltan?
148.540	10-28	6/6	23.5	6/26				6/30	7/3		7/7						1	Tahltan							Tahltan	caught
148.540	11-28	6/6	23.5	6/15		7/3	7/10												50	Iskut			50	Iskut	Iskut	Verrett
148.540	12-28	6/6	23.5	6/19				7/6									112	Stikine	110	Stikine	113	Stikine	112	Stikine	Christina	
148.540	13-28	6/6	23.5	6/14	7/9																				LR Gillnet	
148.540	14-28	6/6	23.5	6/9		6/25	7/2										54	Iskut	60	Iskut			58	Iskut	Iskut	above Verrett
148.540	15-28	6/6	23.5	6/17	7/9																				LR Gillnet	
148.540	16-28	6/6	23.5	6/13				6/23	7/6						92	Stikine	186	Stikine					186	Stikine	Upper Stikine	
148.540	17-28	6/6	23.5	6/1				6/21							103	Stikine	103	Stikine			103	Stikine	53	Stikine	Lower Stikine	close Christina
148.540	18-28	6/6	23.5	6/19	7/14																				LR Gillnet	
148.540	19-28	6/6	23.5	6/10				6/17	6/19		6/23						230	Stikine					0	Tahltan	Upper Stikine	
148.540	20-28	6/6	23.5			6/23									2	Iskut	4	Iskut	4	Iskut			4	Iskut	Iskut	
148.540	21-28	6/6	23.5	6/23				7/1	7/5		7/11	7/17		7/22							2	L. Tahltan	1	L. Tahltan	Little Tahltan	
148.540	22-28	6/6	23.5	6/14																					LR Gillnet	
148.540	23-28	6/6	23.5	6/11	7/8																				LR Gillnet	
148.540	24-28	6/6	23.5	6/13	6/25																				LR Gillnet	
148.540	25-28	6/6	23.5	6/12				6/24	6/26		7/6	7/13		7/23	91	Stikine							28	Tahltan	Tahltan	L. Tahltan?
148.540	26-28	6/6	23.5	6/13	7/14																				LR Gillnet	
148.540	27-28	6/6	23.5	6/23				6/26	6/28		7/6	7/27	7/13										22	Tahltan	Tahltan	
148.540	28-28	6/6	23.5	6/14				6/23	6/25		6/30	7/10							18	Tahltan			25	Tahltan	Tahltan	
148.540	29-28	6/7	24	6/27		7/8	7/11										54	Iskut					58	Iskut	Iskut	above Verrett
148.380	1-21	6/9	24	6/11	6/30			6/19	6/23		6/25	7/23	7/29	6/25									2	Tahltan	Tahltan	
148.380	3-21	6/13	25	5/24		6/29	7/7								44	Stikine			51	Iskut			51	Iskut	Iskut	Verrett
148.380	4-21	6/14	25	5/21	6/25			7/1	7/4		7/9												190	Stikine	Upper Stikine	

-continued-

Appendix C1.–**page 9 of 12.**

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.380	6-21	6/15	25	6/4	6/25			7/3	7/8		7/15	7/30											1	Tahltan	Tahltan	
148.380	7-21	6/12	25	5/24				6/26	6/28		7/2	7/10							11	Tahltan			10	Tahltan	Tahltan	
148.380	9-21	6/24	26	6/9	7/2	7/7		6/15									50	Iskut	50	Iskut			50	Iskut	Iskut	Verrett
148.380	11-21	6/8	24	5/30				6/26	6/28		7/5														Upper Stikine	
148.380	12-21	6/16	25	6/6	7/1			7/8	7/12		7/14	7/21		7/29							1	L. Tahltan	2	L. Tahltan	Little Tahltan	recovered
148.380	14-21	6/10	24	6/8																					Tahltan	caught
148.380	16-21	6/26	27	6/13	7/7			7/14	7/16		7/19	7/23		7/29							2	L. Tahltan	2	L. Tahltan	Little Tahltan	
148.380	18-21	6/9	24	5/25	6/29			7/8				7/21		8/10											LR Gillnet	
148.380	22-21	6/9	24	5/29	7/7	6/24																			Lower Stikine	questions
148.380	23-21	6/11	24	5/27	6/26			7/7	7/10		7/14	7/18		8/2			5	Tahltan					20	Tahltan	Tahltan	L. Tahltan?
148.380	26-21	6/19	26	5/23	7/2			6/6																	LR Gillnet	
148.380	28-21	6/14	25	7/4																					LR Gillnet	
148.380	29-21	6/26	27	6/5	7/14			6/13	7/20		7/24						123	Stikine					95	Stikine	Upper Stikine	
148.380	30-21	6/17	25	5/28	7/8			6/7	7/15		7/17	7/25											20	Tahltan	Tahltan	
148.400	1-22	6/16	25	5/17	6/25			7/2	7/5		7/9	8/5											1	Tahltan	Tahltan	
148.400	4-22	6/20	26	6/8	6/23																				LR Gillnet	
148.400	5-22	6/15	25	5/29	7/6			7/11	7/14		7/18						196	Stikine	180	Stikine					Upper Stikine	
148.400	9-22	6/10	24	5/23	6/24			6/27	6/29		7/4	7/9		7/14			28	Tahltan			3	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.400	13-22	6/16	25	6/4	6/26			7/12	7/14		7/19								205	Stikine			136	Stikine	Upper Stikine	
148.400	14-22	6/13	25	5/31	7/5			7/9	7/11		7/14	8/3		8/6							3	L. Tahltan	3	L. Tahltan	Little Tahltan	
148.400	15-22	6/11	24	6/4																					Mort? Never seen again	
148.400	16-22	6/12	25	5/22				6/25	6/27		6/29	7/4		7/11			28	Tahltan			2	L. Tahltan	2	L. Tahltan	Little Tahltan	
148.400	17-22	6/19	26	6/1	7/5			7/10																	LR Gillnet	
148.400	19-22	6/17	25	6/7	6/27			6/30	7/5		7/7	7/10		7/18			28	Tahltan			4	L. Tahltan	4	L. Tahltan	Little Tahltan	
148.400	25-22	6/25	26	5/28	7/3	7/9											44	Iskut	42	Iskut			43	Iskut	Iskut	Verrett
148.400	27-22	6/14	25	6/3	7/2																				LR Gillnet	
148.400	28-22	6/24	26	6/11	6/28			7/4																	LR Gillnet	

-continued-

Appendix C1.–**page 10 of 12.**

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.400	32-22	6/23	26	6/8	7/2			7/11	7/16		7/21	8/1											7	Tahltan	Tahltan	
148.400	33-22	6/23	26	6/14	6/29			7/5	7/8		7/11	7/17		7/21									23	Tahltan	Tahltan	L. Tahltan?
148.440	1-23	6/22	26	5/11	6/29																				LR Gillnet	
148.440	7-23	6/18	25	6/6	6/30			7/3									5	Tahltan							LR Gillnet	
148.440	13-23	6/27	27	6/17	7/9			6/22	7/21		7/25	8/8											26	Tahltan	Tahltan	
148.440	14-23	6/13	25	6/2	7/16	6/24																			Lower Stikine	questions
148.440	15-23	6/13	25	6/5				6/30	7/8		7/15	7/21			47	Stikine			19	Tahltan			15	Tahltan	LR Gillnet	
148.440	16-23	6/23	26	6/10	7/7			7/12	7/15		7/19	7/26					179	Stikine	10	Tahltan			10	Tahltan	Tahltan	
148.440	17-23	6/13	25	5/17	7/1																				LR Gillnet	
148.440	19-23	6/21	26	7/1				7/9	7/12		7/15	7/26					231	Stikine					22	Tahltan	Tahltan	
148.440	22-23	6/18	25	6/5	6/23			6/27	6/30		7/3	7/10		8/4			22	Tahltan					19	Tahltan	Tahltan	L. Tahltan?
148.440	25-23	6/17	25	6/9	7/2			7/10	7/14		7/25								190	Stikine			178	Stikine	Upper Stikine	
148.440	26-23	7/2	27	6/17	7/14				7/21								102	Stikine							LR Gillnet	
148.440	28-23	6/23	26	6/7	7/8			7/12	7/15		7/19	7/26					185	Stikine							Tahltan	
148.440	29-23	6/29	27	6/2	7/17			6/21	7/30		8/3	8/11			25	Iskut	68	Stikine							Tahltan	
148.440	31-23	6/19	26	6/6	6/27			7/1	7/5		7/8						189	Stikine					190	Stikine	Upper Stikine	
148.440	32-23	6/22	26	6/13	6/29			7/4																	LR Gillnet	
148.460	3-24	6/23	26	6/10	7/9	7/12	7/16										50	Iskut	66	Iskut			58	Iskut	Iskut	above Verrett
148.460	5-24	6/20	26	6/6				7/5	7/8		7/10	7/24		7/27							6	L. Tahltan	5	L. Tahltan	Little Tahltan	
148.460	8-24	6/25	26	6/6	7/6			6/14	7/13		7/15	7/20		7/23									23	Tahltan	Little Tahltan	recovered
148.460	14-24	6/24	26	6/9	7/4																				LR Gillnet	
148.460	21-24	6/25	26	5/31	7/4																				LR Gillnet	
148.460	22-24	6/19	26	6/5	8/12			7/13	7/15		7/20	7/28					174	Stikine	6	Tahltan					Tahltan	
148.460	23-24	6/21	26	7/10				7/14	7/16		7/20	8/2		8/5			172	Stikine							Little Tahltan	recovered
148.460	25-24	6/22	26	6/10	6/27			7/11	7/13		7/16	7/20		7/27			112	Stikine		weir			12	Tahltan	Tahltan	L. Tahltan?
148.460	30-24	6/27	27	6/13	7/9			7/12						8/4											LR Gillnet	
148.460	31-24	6/18	25	5/31	7/2			7/9	7/12		7/17	7/27							13	Tahltan			13	Tahltan	Tahltan	
148.460	32-24	6/27	27	6/14	7/7																				LR Gillnet	
148.460	33-24	6/18	25	6/8	7/2																				LR Gillnet	
148.480	1-25	6/23	26	6/11	6/26			7/9	7/16					7/28					0	L. Tahltan			174	Stikine	Upper Stikine	questions

-continued-

Appendix C1.–**page 11 of 12.**

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.480	4-25	6/15	25	6/4	6/23			6/28	7/1		7/5	7/9		7/14						weir	3	L. Tahltan	2	L. Tahltan	Little Tahltan	
148.480	6-25	6/24	26	6/13				7/7	7/10		7/15	7/20		7/25					36	Tahltan			35	Tahltan	Tahltan	
148.480	11-25	6/21	26														7	Stikine			8	South Fork	7	Andrew Creek	Andrew Cr	
148.480	13-25	6/17	25	6/6	6/26	7/1	7/9												50	Iskut					Iskut	Verrett
148.480	14-25	6/22	26	6/8																					D8 Gillnet	
148.480	17-25	6/17	25	6/1	6/23			7/6	7/8		7/10	7/15		8/3									18	Tahltan	Tahltan	L. Tahltan?
148.480	18-25	6/22	26	6/5				6/13	6/17		6/20	6/26		7/5	205	Stikine			47	Tahltan	43	Tahltan	42	Tahltan	Tahltan	
148.480	19-25	6/14	25	5/24	6/22																				LR Gillnet	
148.480	23-25	6/15	25	5/31	6/23			6/26	6/30		7/5	7/18		7/27									14	Tahltan	Tahltan	L. Tahltan?
148.480	32-25	6/16	25	6/8																					LR Gillnet	
148.480	33-25	6/16	25	6/7	7/7			7/13	7/16		7/19	7/27					171	Stikine	10	Tahltan			7	Tahltan	Tahltan	
148.500	4-26	7/7	28	6/8	7/17			6/22	7/24		7/27	8/2			104	Stikine							19	Tahltan	Tahltan	
148.500	5-26	6/29	27	6/13	7/7			7/14	7/17		7/25												174	Stikine	Upper Stikine	
148.500	11-26	6/25	26	6/6	7/2	7/9	7/16	6/14											60	Iskut					Iskut	above Verrett
148.500	12-26	6/26	27	6/12	6/30	7/7	7/13												49	Iskut					Iskut	Verrett
148.500	15-26	6/28	27	6/12	7/7	7/10	7/22												59	Iskut			58	Iskut	Iskut	above Verrett
148.500	16-26	6/25	26	6/13	6/29			7/8	7/11		7/15	7/25		7/5			222	Stikine	10	Tahltan			28	Tahltan	Tahltan	L. Tahltan?
148.500	17-26	7/3	28	6/1	7/10			6/23																	LR Gillnet	
148.500	18-26	7/1	27	6/9	7/11	7/13	7/20												44	Iskut					Iskut	Verrett
148.500	19-26	6/30	27	6/5	7/8	7/11	7/18																45	Iskut	Iskut	Verrett
148.500	20-26	6/26	27	6/18	7/10			7/14	7/16		7/20	7/26							16	Tahltan			15	Tahltan	Tahltan	
148.500	21-26	6/22	26	6/9				7/9	7/11		7/13						203	Stikine	202	Stikine			202	Stikine	Upper Stikine	
148.500	22-26	6/13	25	5/17	6/25			7/7																	LR Gillnet	
148.500	26-26	6/8	24	6/4	6/22			6/26	6/28		7/2	7/7		7/12							4	L. Tahltan	4	L. Tahltan	Little Tahltan	
148.500	28-26	6/30	27	6/11	6/27			6/26																	Mort? Never seen again	
148.500	31-26	6/25	26	6/18	6/29	7/7											50	Iskut	50	Iskut			50	Iskut	LR Gillnet	
148.520	4-27	6/22	26	6/13	6/26			7/14	7/18		7/22	7/28							5	Tahltan			16	Tahltan	Tahltan	
148.520	9-27	6/27	27	6/14	7/8			7/11	7/13		7/15	7/19		7/26					35	Tahltan			31	Tahltan	Tahltan	
148.520	10-27	6/20	26	6/9	6/26			7/3	7/7														173	Stikine	Upper Stikine	just below Shakes

-continued-

				Tower recoveries											Aerial survey records											
				#1	#1 reapp	#2	#4	#5	#6	#7	#8	#9	#11	#12	Survey date 6/22/05		Survey date 7/18/05		Survey date 7/24/05		Survey date 8/15/05		Survey date 8/29/05			
Tag freq	Code-freq	Date applied	Stat wk	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	River km.	River	River km.	River	River km	River	River km	River	River km	River	Grouping (fate)	Sub fate
148.520	18-27	6/26	27	6/13	7/10																				LR Gillnet	
148.520	21-27	6/28	27	6/15	7/11			6/23	7/17		7/21	7/27			97	Stikine							3	Tahltan	Tahltan	
148.520	24-27	6/25	26	6/13	7/4			7/8	7/11		7/14	7/18											26	Tahltan	Tahltan	
148.520	25-27	6/25	26	6/14				7/8	7/11		7/14	7/27							8	Tahltan			11	Tahltan	Tahltan	
148.520	29-27	6/23	26	6/11				7/3	7/5		7/8	7/13		7/20									20	Tahltan	Tahltan	L. Tahltan?
148.520	31-27	6/25	26	6/12																					LR Gillnet	
148.540	3-28	6/27	27	5/15	7/4			7/11	7/14		7/16						197	Stikine			147	Stikine	150	Stikine	Upper Stikine	
148.540	8-28	6/24	26	6/8	6/28	7/3	7/11										50	Iskut	51	Iskut			50	Iskut	Iskut	Verrett
148.540	13-28	7/4	28	6/5	7/9			7/13	7/16		7/18	7/22		7/28	105	Stikine					5	L. Tahltan	4	L. Tahltan	Little Tahltan	
148.540	15-28	6/28	27	5/30	7/9			6/23																	LR Gillnet	
148.540	18-28	6/24	26	5/22	7/14				7/28		5/23	8/7		7/26											Tahltan	L. Tahltan?
148.540	22-28	6/26	27	6/5																					D8 Gillnet	
148.540	23-28	6/22	26	6/11	7/8			7/12	7/14		7/17	7/26		7/28					29	Tahltan	53	Tahltan	53	Tahltan	Tahltan	Tashoots
148.540	24-28	6/17	25	5/24	6/25			6/30	7/4		7/6	7/9		7/16									40	Tahltan	Tahltan	
148.540	26-28	6/27	27	6/13	7/14	7/15	7/19										45	Iskut	30	Iskut			30	Iskut	Iskut	Craig
148.440	17-23	6/24	26	5/17	7/1			7/7	7/10		7/13	7/19		7/27									0	L. Tahltan	Tahltan	L. Tahltan?
148.400	27-22	6/24	26	6/3	7/2			7/9																	LR Gillnet	
148.400	4-22	6/27	27	6/8	6/23																				LR Gillnet	
148.440	1-23	6/30	27	5/11	6/29			7/15																	LR Gillnet	
148.480	32-25	7/5	28	6/8																					Mort? Never seen again	
148.480	19-25	7/6	28	5/24	6/22																		4	Katete	Lower Stikine	Katete

APPENDIX D

Appendix D1.–Origin of coded wire tags recovered from Chinook salmon collected in the Stikine River, 2005.

Tag code	# recovered	State	Agency	Location (facility or wild stock)	Year brood	Stock	Stage	Weight	Length	Year released	Clipped and tagged
40459	1	AK	ADFG	(W) STIKINE R 108-40	1999	STIKINE R 108-40	SMOLT	5.5	75	2001	5,774
40533	12	AK	ADFG	(W) STIKINE R 108-40	2000	STIKINE R 108-40	SMOLT	6.3	77	2002	10,953
40534	9	AK	ADFG	(W) STIKINE R 108-40	2000	STIKINE R 108-40	SMOLT	6.3	77	2002	6,458
40549	1	AK	ADFG	(W) TAKU R 111-32	2000	TAKU R 111-32	SMOLT			2002	22,985
20604	4	BC	CDFO	H-GLENORA PROJECT	2000	S-TAHLTAN R	FED FRY	2		2001	21,172
181740	1	BC	CDFO	H-GLENORA PROJECT	2001	S-TAHLTAN R	FED FRY	1.8		2002	10,922

APPENDIX E

Appendix E1.–**Computer files used to estimate the spawning abundance of Chinook salmon in the Stikine River in 2005.**

File Name	Description
CAPTPROB05.xls	EXCEL spreadsheet with chi-square capture probability tests
STIK05.BAS	QBASIC bootstrap program for estimating abundance (Petersen model) of large and medium Chinook salmon, variance, bias, and confidence intervals
STIK05BOOTSRTAPS.xls	Excel spreadsheet with QBASIC input and output files for large and medium Chinook salmon, including QBASIC bootstrap instructions
POSTSEASON05.xls	EXCEL spreadsheet with Petersen abundance estimates including bootstrap output for variance, confidence interval and bias estimation
PRE-INSEASON05.xls	EXCEL spreadsheet with and preseason sibling forecast and inseason CPUE models.
SIZESELPOST05.xls	EXCEL spreadsheet with Kolmogorov-Smirnov size-selectivity tests including charts.
SMSTIK05.BAS	QBASIC bootstrap program for estimating abundance (Petersen model) of medium Chinook salmon, variance, bias, and confidence intervals
STIKMR-CPUE05.xls	EXCEL spreadsheet with Kakwan Point and Rock Island catch-effort, hydrology, and temperature data including charts.
STIKMR-TAG&ASL05.xls	EXCEL spreadsheet with Kakwan Point, Rock Island, and inriver fishery/spawning ground tag, recovery, and age-sex-size data.
41_STIK_HARV_BY98.xls	Excel spreadsheet containing harvest and smolt abundance estimates for brood year 1998 Chinook salmon
STIK_CHIN_SR_2005.xls	Excel spreadsheet containing Chinook spawner-recruit data through 2005 and brood year 1998 return, exploitation, and marine survival estimates
STIKCWT_AWL00.xls	Excel spreadsheet containing 2000 Chinook/coho smolt length-weight data
STIKCWT_PHY00.xls	Excel spreadsheet containing 2000 Water temperature, stream level, and precipitation data
STIKCWT_TAG00.xls	Excel spreadsheet containing 2000 Chinook/coho smolt catch, effort, and tagging data
STIK_THETA_05.xls	Excel spreadsheet containing estimates of the inriver CWT marked fraction through brood year 2002
THETA8BY98FULL.csv	Input file for THETA11BY98.r that contains the number of fully aged fish by year, sampling location and length

-continued-

Appendix E1.–**Page 2 of 2.**

File Name	Description
THETA8BY98MARINE.csv	Input file for THETA11BY98.r that contains the number of fish with marine ages only (total number and the number that belong to BY98) by year and sampling location
THETA8BY98TAG.csv	Input file for THETA11BY98.r that contains the number of number of BY98 Chinook salmon inspected inriver for missing adipose fins, the number of fish observed with missing adipose fins, the number sacrificed, and the number of valid CWTs recovered.
THETA8BY98UNAGED.csv	Input file for THETA11BY98.r that contains the number of unaged fish by year, sampling location and length
THETA11BY98.r	R program that estimates SE$\left[1/\hat{\theta}\right]$
THETA_STIKINE 1998.out	Output file from THETA11BY98.r containing the estimated SE$\left[1/\hat{\theta}\right]$
2005 Stikine Tower DataFinal.xls	EXCEL spreadsheet with telemetry data used in the 2005 analysis