Fishery Data Series No. 12-12

Production of Coho Salmon from the Taku River, 2003–2007

by

Edgar L. Jones III

Daniel J. Reed

and

Albert D. Brandenburger

March 2012

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. 12–12

PRODUCTION OF COHO SALMON FROM THE TAKU RIVER, 2003–2007

by

Edgar L. Jones III and Albert D. Brandenburger
Division of Sport Fish, Douglas

and

Daniel J. Reed
Division of Sport Fish, Nome

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

March 2012

The report was prepared by Edgar Jones, Daniel Reed, Albert Brandenburger, Scott McPherson, and Ian Boyce under award NA04NMF4380162 (Alaska Sustainable Salmon Fund project 45023) from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, administered by the Alaska Department of Fish and Game. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, the U.S. Department of Commerce, or the Alaska Department of Fish and Game.

Development and publication of this manuscript were also partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C.777-777K) under Projects F-10-14, F-10-15, F-10-16, F-10-17, and F-10-18.

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.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

Edgar L. Jones III [a] *and Albert D. Brandenburger*
Alaska Department of Fish and Game, Division of Sport Fish, Region 1
P. O. Box 240020, Douglas, AK 99824-0020, USA

Daniel J. Reed,
Alaska Department of Fish and Game, Division of Sport Fish, Biometrics
P.O. Box 1148, Nome, A 99762-1148, USA

[a] *Author to whom all correspondence should be addressed: e-mail: ed.jones@alaska.gov*

This document should be cited as:
Jones III, E. L., D. J. Reed, and A. D. Brandenburger. 2012. Production of coho salmon from the Taku River, 2003–2007. Alaska Department of Fish and Game, Fishery Data Series No.12-12, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Coho salmon *Oncorhynchus kisutch* smolt abundance in 2003, 2004, 2005 and 2006 and adult production in 2004, 2005, 2006, and 2007 were estimated from the Taku River, above Canyon Island, near Juneau, Alaska using coded wire tags implanted in smolt, harvest sampling, and an inriver adult mark-recapture experiment. An estimated 22% of Taku River coho salmon spawn below Canyon Island and this report is germane to the population of coho salmon that spawn above Canyon Island. A modified Petersen estimator was used to estimate the smolt emigration each year from 2003 through 2006. On average, 3,004,691 smolt emigrated from the Taku River each year and marine survival averaged 7.3%. Marine harvest in 2004, 2005, 2006, and 2007 was estimated at 112,404 (SE = 12,967), 79,045 (SE = 11,908), 92,508 (SE = 7,812), and 50,921 (SE = 5,529) fish, respectively. Total exploitation rates (marine and inriver harvest) averaged 45% over this time period. Mark-recapture studies were used to estimate inriver runs of 139,011 (SE = 12,301) in 2004, 143,817 (SE = 30,685) in 2005, 134,053 (SE = 8,643) in 2006, and 82,319 (SE = 13,608) in 2007. Accounting for inriver harvests resulted in escapement estimates of 129,327 in 2004, 135,558 in 2005, 121,778 in 2006, and 74,326 in 2007. From 2004 to 2007, the total run of coho salmon originating from above Canyon Island was 208,630, on average. Scale samples were used for age analysis to estimate annual age compositions. On average, 84% of the fish were age-1.1 fish.

Key words: coho salmon, adult production, coded wire tag, Petersen estimator, marine survival, exploitation, mark-recapture, inriver run, escapement, total run, age composition.

INTRODUCTION

The Taku River annually produces an estimated 100,000–450,000 adult coho salmon *Oncorhynchus kisutch*, many of which are caught in commercial and recreational fisheries in northern Southeast Alaska (Elliott and Bernard 1994; McPherson and Bernard 1995, 1996; PSC 1996; McPherson et al. 1997; 1998; Yanusz et al. 1999; Jones et al. 2006). Coho salmon returning to the Taku River pass through an offshore troll fishery before entering inside waters (Figure 1), then through a seine fishery in Icy and Chatham straits and a drift gillnet fishery in lower Lynn Canal. They next transit the recreational fishery near Juneau and the drift gillnet fishery in Taku Inlet/Stephens Passage before ascending the Taku River (Figure 2). After entering the river, the remaining coho salmon are exposed to a drift/set gillnet fishery just inside Canada (Figure 2). Because of the large production of coho salmon from the Taku River, and because of the many fisheries that utilize this production, the Alaska Department of Fish and Game (ADF&G), Fisheries and Oceans Canada (DFO), and the Taku River Tlingit First Nation (TRTFN) operate a cooperative program of stock assessment and management in regards to this stock (Appendix A1 contains references for past studies). Coho salmon spawning in the Taku River are managed as a single stock, and the stock assessment program has mirrored that emphasis since 1991 (McPherson and Bernard 1996; PSC 1996; Jones et al. 2006).

High quality stock assessment for the Taku River stock of coho salmon is essential in order to develop and implement abundance-based management and to develop a revised MSY escapement goal as mandated in the Pacific Salmon Treaty, Annex IV, amended January 1, 2009 (p. 11, paragraph 2(i)). This manuscript provides details of smolt production from 2003 through 2006 and adult production from 2004 through 2007, representing 16 consecutive years these parameters have been estimated for this population. Escapements and inriver run sizes have been estimated by ADF&G and DFO since 1987. Methods have been developed to forecast smolt abundance and run strength since 1999. This information, along with inseason assessment of catch, escapement, and total run (see McPherson et al. 1998; Jones et al. 2006), have provided the tools necessary for abundance-based management and future escapement goal development.

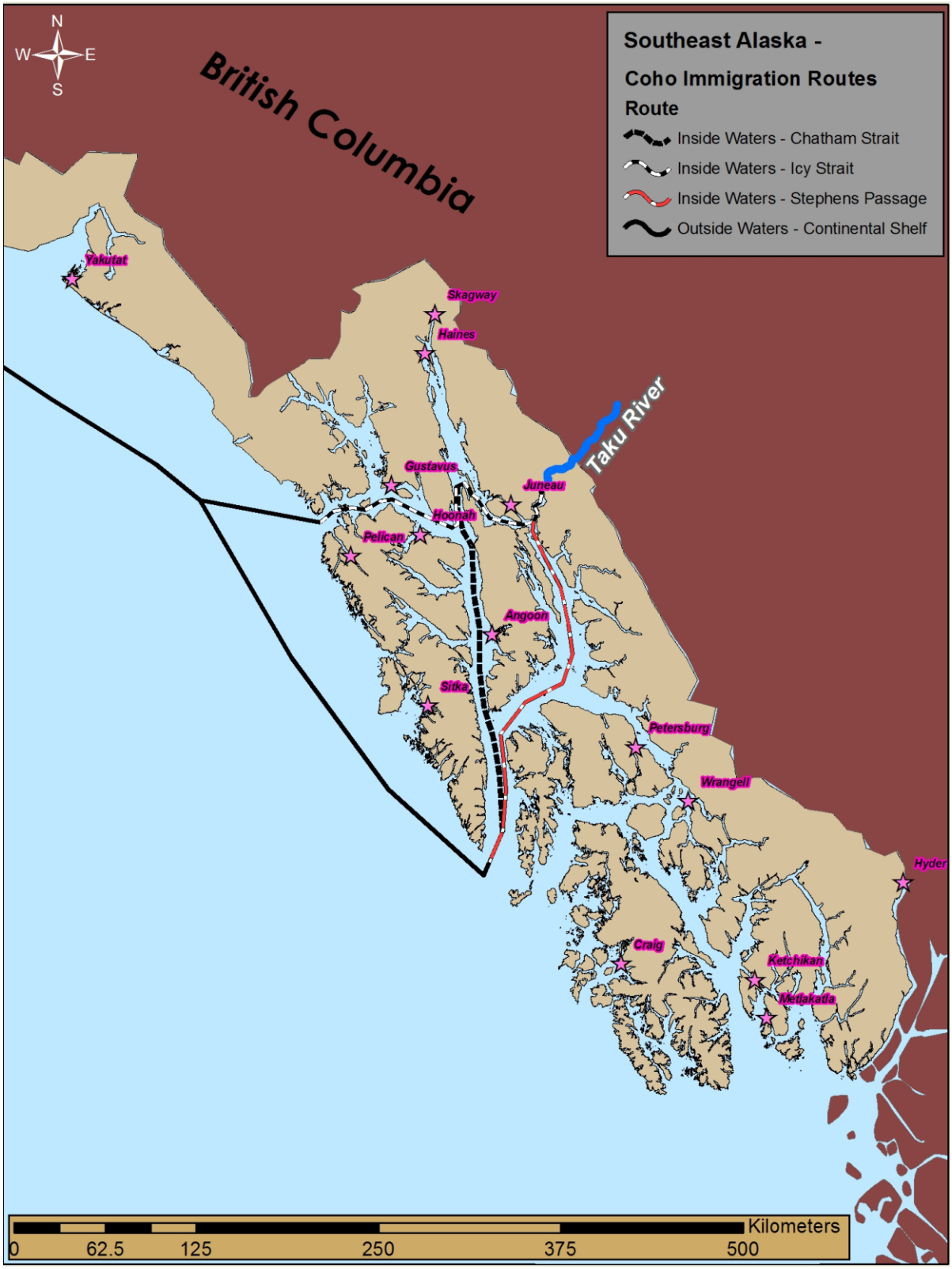

Figure 1.–Migration routes of coho salmon bound for the Taku River through northern Southeast Alaska.

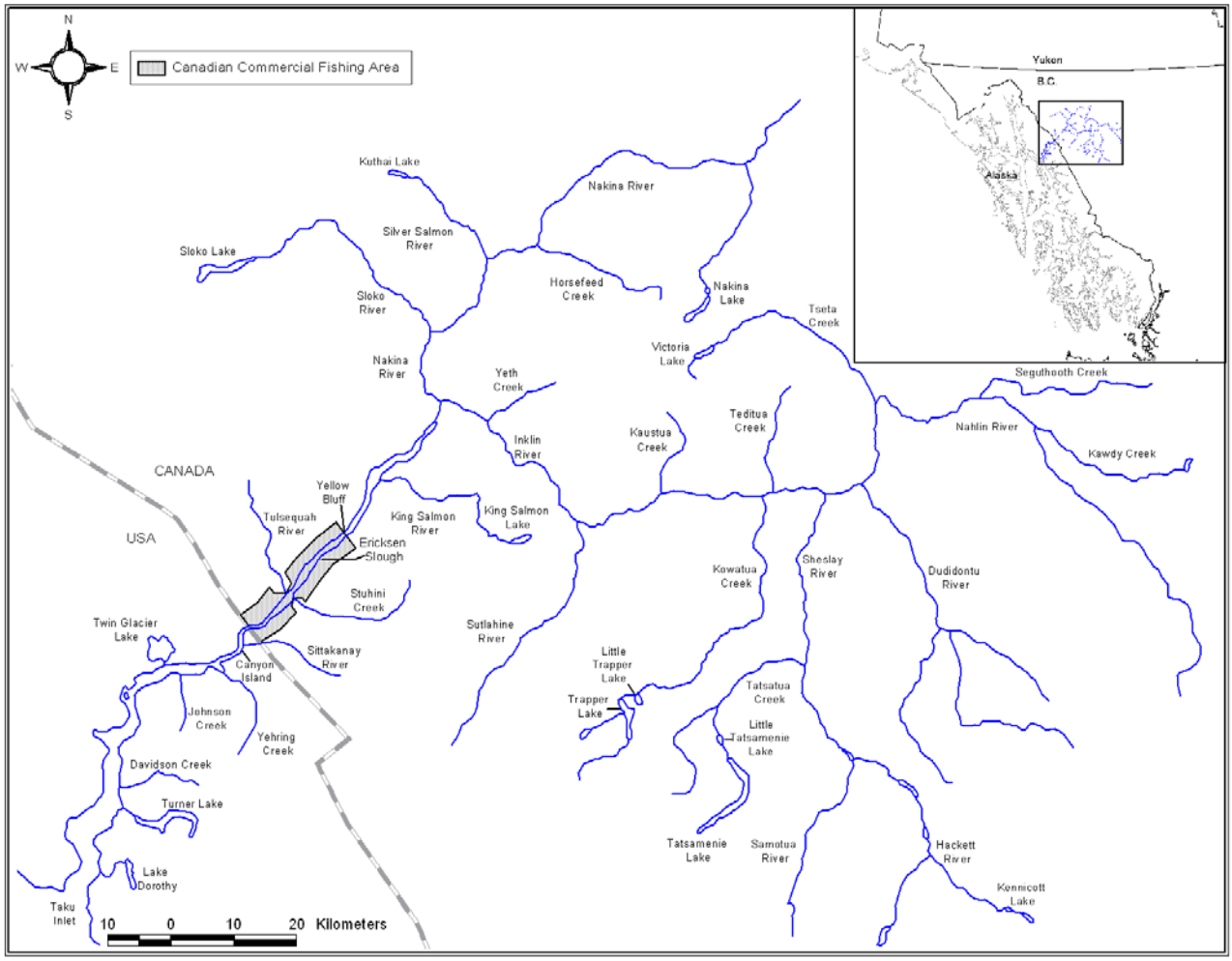

Figure 2.–The Taku River drainage located in northwestern British Columbia and Southeast Alaska.

OBJECTIVES

Objectives of this study were to estimate abundance of coho salmon smolt leaving the Taku River in 2003–2006, harvests in 2004–2007, and the escapement and age composition of adults returning to the Taku River above Canyon Island in 2004–2007. These objectives were accomplished by tagging and sampling smolt each spring in the lower Taku River and operating cooperative, inriver mark-recapture experiments each summer and early fall to estimate abundance of adult coho salmon.

METHODS

SMOLT CAPTURE, CODED WIRE TAGGING, AND SAMPLING

Minnow traps (style G-40) baited with salmon roe were fished daily for 24 h/d each spring, 2003–2006. Traps were distributed along mainstem banks and in some backwater areas along both sides of the Taku River stretching from about 6 km above to 6 km below Canyon Island (Figure 2). All traps were placed upriver from Yehring Creek, an area addressed in other studies (Elliott and Sterritt 1991; Eiler et al. 1993). Traps were checked daily when the river

stage was stable, and more frequently when the stage was rising or falling. Captured salmonid smolt and fry were transported to holding boxes at camp, and processed each afternoon. Coho and Chinook salmon *O. tshawytscha* smolt were separated by inspection from other species of salmon and Dolly Varden *Salvelinus malma*. Coho and Chinook salmon smolt were carefully examined to distinguish species. A clear 'window' in the pigmentation of the adipose fin (Meehan and Vania 1961; Pollard et al. 1997) and a more 'silver' sheen from a side view indicated a Chinook salmon smolt. Coho salmon smolt had more narrow parr marks, showed a greater number of small, darkly pigmented spots from a dorsal view, had pigmentation throughout the adipose fin, and had longer anterior rays on the anal fin.

All live coho salmon smolt ≥75 mm FL were tranquilized in a solution of tricaine-methane sulfonate (MS 222). The solution was buffered with sodium bicarbonate until the pH was neutral, as measured with a water sampling kit. The MS 222 solution was maintained at river temperature by circulating it through a coil of aluminum tubing submerged in the river. All fish were tagged with a coded wire tag (CWT) and marked by excision of the adipose fin, following methods in Koerner (1977). Small coho salmon (75-85 mm FL) were tagged with a different set of codes than were larger smolt (>85 mm FL). All tagged fish were held for 24 hours and inspected for mortalities prior to release; 100 fish were checked daily to determine if their tag had been retained.

When fewer than 100 fish of a species were caught in a day, all of the catch was checked. The number of fish tagged, number of tagging-related mortalities, and number of fish that had shed their tags were compiled and recorded on *ADF&G CWT Tagging Summary and Release Information Forms*, which were submitted to the ADF&G Mark, Tag, and Age Laboratory (Tag Lab) in Juneau when field work ended.

One day per week, 1 out of every 40 smolt was measured to the nearest 1 mm FL and weighed to the nearest 0.1 g. In addition, 1 out of 80 coho smolt had 12-15 scales removed from the preferred area for later determination of age (Scarnecchia 1979). Scales were sandwiched between two 1X3" microscope slides and the slides were taped together with frosted scotch tape. Scales were numbered consecutively for each sampled smolt and the number was written on the frosted portion of the bottom slide along with the location, date, species and slide number. Ages of each sampled smolt were later determined from interpretation of circuli patterns (70X magnification). Every coho salmon smolt that was recaptured in a minnow trap, i.e. already missing its adipose fin, was tested for the presence of a CWT, and its fork length was recorded.

SMOLT ABUNDANCE

Abundance of coho salmon smolt (N_S) in 2003, 2004, 2005, and 2006 was estimated using a modified Petersen-type estimator for closed populations. A sample of smolt was marked and tagged in each of the above years. A sample of adults was inspected for marks in the following year by ADF&G port samplers stationed at cold storages, ADF&G creel technicians inspecting catches of the sport fishing fleet at various docks, and by ADF&G technicians working at the Canyon Island fish wheels. During the year at sea the population was open to mortality, but because of their life history, was closed to recruitment (Groot and Margolis 1991). Because smaller smolt have a lower probability of being caught in minnow traps and of surviving to adulthood (Holtby et al.1990; Lum 2003), Chapman's modification of Petersen's estimator (Seber 1982) was altered to produce relatively unbiased estimates of smolt abundance. From Appendix A2, the corrected estimator is:

$$\hat{N}_S = \frac{(\hat{\lambda}M_1 + M_2 + 1)(C+1)}{\hat{\lambda}(R_1 + \hat{\pi}R_3) + R_2 + (1-\hat{\pi})R_3 + 1} - 1 \qquad (1)$$

where M_1 is the number of smaller smolt (75–85 mm FL) marked and released in a year, M_2 is the number of larger smolt (>85 mm FL) marked in the same year, C the number of adults inspected for marks a year later, R_1 the subset of C with marks representing adults tagged as smaller smolt, R_2 the subset of C representing adults tagged as larger smolt, and R_3 the subset of C comprised of marked fish that had lost their tag (size at tagging unknown). The adjustment λ is the ratio of the catchability coefficients for larger to smaller smolt; π is the fraction of adults that were tagged as smaller smolt. Note that if there is no difference in catchability by smolt group (λ = 1), equation (1) becomes Chapman's modification regardless of size of marked smolt. Estimates of π and λ were obtained as (Appendices A2 and A3):

$$\hat{\pi} = \frac{\hat{T}_1}{\hat{T}_1 + \hat{T}_2} \qquad (2)$$

$$\hat{\lambda} = \frac{\hat{T}_2(\hat{\phi}_2 - \hat{p})}{\hat{T}_1(\hat{p} - \hat{\phi}_1)} \qquad (3)$$

where $\hat{T}_i$ (i = 1, 2) is the number of all tags representing smolt (smaller or larger) recaptured from adult salmon regardless of how or where recaptured, ϕ_i is the fraction of smolt (smaller or larger) that were age 1-freshwater (age-1.) when tagged, and p is the fraction of all adults that are freshwater age-1 a year later.

Variance and relative statistical bias in the estimator (equation 1) were estimated with bootstrap procedures described in general by Buckland and Garthwaite (1991). Each bootstrap sample was drawn randomly with replacement from the capture histories of the $\hat{N}_S$ smolt in the "virtual" population (Table 1). From the bootstrap sample a new estimate of smolt abundance $\hat{N}'_S$ was calculated. Then the process was repeated 10,000 times to create the frequency distribution $\hat{F}'(\hat{N}'_S)$. At the end of the iterations, the following statistics were calculated:

$$\overline{N}'_S = \frac{\sum_{b=1}^{10000} \hat{N}'_{S(b)}}{10000} \qquad (4a)$$

$$var(\hat{N}_S) = \frac{\sum_{b=1}^{10000} (\hat{N}'_{S(b)} - \overline{N}'_S)^2}{10000 - 1} \qquad (4b)$$

$$\text{Estimated Relative Bias} = \frac{\overline{N}'_S - \hat{N}_S}{\hat{N}_S}(100) \qquad (4c)$$

The relationships among program variables, capture histories, and model variables in bootstrap simulations to estimate the variance of smolt abundance estimates are provided in Table 1. Bootstrap estimates $\hat{\phi}'_1$, $\hat{\phi}'_2$, and $\hat{p}'$ were obtained from binomial distributions based on observed values of the estimates $\hat{\phi}_1$, $\hat{\phi}_2$, and $\hat{p}$. The estimated variance of $\hat{\lambda}$ was calculated using methods similar to equations (4a) and (4b). A BASIC program SMLTTAKU.BAS (Appendix A4) was used to conduct the simulations.

Table 1.–Relationships among program variables, capture histories, and model variables in bootstrap simulations to estimate the variance of smolt abundance estimates.

Program variable	Capture history	Model variables
(1)	Not marked, not seen	$\hat{\mathrm{N}} - M_1 - M_2 - C + R_1 + R_2 + R_3$
(2)	Marked, not seen – Smaller smolt	$M_1 - \hat{T}_1$
(3)	" " – Larger smolt	$M_2 - \hat{T}_2$
(4)	Marked, recaptured – Smaller smolt w/ CWT	R_1
(5)	" " – Larger smolt w/ CWT	R_2
(6)	" " – Smaller smolt w/o CWT	$\hat{\pi} R_3$
(7)	" " – Larger smolt w/o CWT	$(1-\hat{\pi}) R_3$
(8)	Marked, recovered – Smaller smolt	$\hat{T}_1 - R_1 - \hat{\pi} R_3$
(9)	" " – Larger smolt	$\hat{T}_2 - R_2 - (1-\hat{\pi}) R_3$
(10)	Not marked, captured	$C - R_1 - R_2 - R_3$

HARVESTS

Harvest estimates were obtained from ADF&G reports (e.g., Wendt and Jaenicke 2011, *in prep a-c*) and ADF&G computer summaries. In the reports, methods described in Bernard and Clark (1996, Table 2) were used to estimate the marine harvests of coho salmon from the portion of the Taku River above Canyon Island using information from stratified catch sampling of marine commercial fisheries and recreational fisheries. Commercial catch data for the analysis were summarized by ADF&G statistical week (SW) and district (for gillnet and seine fisheries), or by troll period and quadrant for troll fisheries. Data on recovery of tags from recreational fisheries was obtained from reports provided by the Tag Lab and summarized by bi-week and fishery (e.g., bi-week 16 during the Juneau Marine Creel Survey). Assuming that the harvests of fish with CWTs of interest were independent of sampling strata within fishery bi-weeks, harvests and sampling information were totaled over the fishery bi-week to estimate contributions. This procedure allowed comparisons between published biweekly harvests and the CWT data.

The harvest estimates are based on the:

1) number of coho salmon harvested;
2) fraction of the harvest inspected;
3) number of coho salmon in the sample without adipose fins;
4) number of fish whose heads reached the Tag Lab;
5) number of these heads that contained a CWT;
6) number of CWTs that were decoded; and
7) number of decoded CWTs with the appropriate code (i.e., originally released in the Taku River).

Total harvest over all marine and freshwater fisheries (H) was estimated as the sum of harvests estimated for each fishery. Because harvest was estimated for each fishery independently, estimated variance for harvest over all fisheries was the sum of all variances estimated for each fishery.

Table 2.–Model variables and their values for capture histories used to estimate abundance of coho salmon smolt emigrating from the Taku River each year, 2003 through 2006.

Model variables		2003	2004	2005	2006
$\hat{N} - M_1 - M_2 - C + R_1 + R_2 + R_3$		= 2,925,676	= 3,734,578	= 2,112,487	= 3,113,250
$M_1 - \hat{T}_1$		16,034 – 91 = 15,943	9,019 – 71 = 8,948	16,757 – 192 = 16,565	17,458 – 77 = 17,381
$M_2 - \hat{T}_2$		16,505 – 163 = 16,342	7,097 – 61 = 7,036	15,763 – 245 = 15,518	16,659 – 131 = 16,528
R_1		16	10	15	30
R_2		15	9	37	24
$\hat{\pi} R_3$		0.358(3) = 1.1	0.538(0) = 0	0.439(0) = 0	0.370(3) =1.1
$(1-\hat{\pi}) R_3$		(1 – 0.358)3 = 1.9	(1 – 0.538)0 = 0	(1 – 0.439)0 = 0	(1 – 0.370)3 = 1.9
$\hat{T}_1 - R_1 - \hat{\pi} R_3$		91 – 16 – 1.1 = 73	71 – 10 – 0 = 61	192 – 15 – 0 = 177	77 – 30 – 1.1 = 46
$\hat{T}_2 - R_2 - (1-\hat{\pi}) R_3$		163 – 15 – 1.9 = 146	61 – 9 – 0 = 52	245 – 37 – 0 = 208	131 –24 – 1.9 = 105
$C - R_1 - R_2 - R_3$		3,163 – 16 – 15 – 3 = 3,129	4,599 – 10 – 9 – 0 = 4,580	4,718 – 15 – 37 – 0 = 4,666	5,161 – 30 – 24 – 3 = 5,104
Final abundance	$\overline{N}'_S$	= 2,961,344	= 3,755,274	= 2,149,673	= 3,152,471
	SE ($\hat{N}_S$)	= 708,526	= 1,014,210	= 442,136	= 797,296

ESCAPEMENTS

Estimates of the escapement N_E of adult coho salmon passing by Canyon Island in 2004, 2005, 2006, and 2007 were based on 2-event, closed-population, mark-recapture experiments conducted by ADF&G Division of Sport Fish (DSF) and Division of Commercial Fisheries (DCF), TRTFN, and DFO. During the first sampling event, coho salmon were captured using fish wheels operated at Canyon Island, tagged with a uniquely numbered solid-core spaghetti tag sewn through the back of the fish just posterior and below the dorsal fin, measured to the nearest 5 mm MEF, sampled for scales, and released. A set gillnet (127 mm stretch mesh) was also used at Canyon Island to capture coho salmon when low water impaired operation of the fish wheels.

Scale samples consisted of 4 scales from the "preferred area" from each sampled fish - i.e. the left side of the fish 2 scales above the lateral line and on an imaginary line from the posterior dorsal fin to the anterior anal fin (Scarnecchia 1979). The scales were applied to a gum card in the field and later pressed into acetate cards. Ages were determined by examining the impressions under 70 × magnification. Criteria used to assign ages were similar to those of Mosher (1968) and were supplemented with results from recent studies on validating age as determined from scales (C. Farrington, DCF, Douglas, AK, unpublished data). Ages are reported in European notation (Koo 1962).

During the second sampling event, coho salmon were caught in the Canadian commercial gillnet fishery and in the test gillnet fisheries, both fished between 3–20 km upstream of Canyon Island. See Kelley and Milligan (1999) for a detailed description of the field methods. A test fishery was used each year to extend sampling during the second event because the commercial fishery ended before all adults had reached Canyon Island. Mark-recapture data were grouped by SW for analysis to avoid the variability associated with day-to-day statistics and to reflect the weekly periods used to manage U.S. and Canadian fisheries.

Adult abundance N_E past Canyon Island was estimated each year according to stratified models first developed by Darroch (1961) for circumstances where temporal or spatial distributions of fish affect their probabilities of capture. In order to get a consistent abundance estimate, there must be no temporal changes in the probability of capture during at least one of the sampling events. Probabilities of capture of coho salmon during the first event often change as their annual migration progresses because of fluctuation in water levels at Canyon Island (Yanusz et al. 1999). Also, the change in sampling technique from a commercial fishery to a test fishery halfway through the migration has affected probabilities of capture because of run timing during the second sampling event (Eiler et al. 1993). In each annual experiment statistics were pooled across statistical weeks into strata based upon estimated fish catchability and fishing methods. To allow for travel time from Canyon Island upstream to the fisheries, recovery strata were lagged 1 SW from the release strata. A matrix of fish released and recaptured in each stratum was entered into the computer program SPAS (Arnason et al. 1996) to perform the abundance and variance calculations.

Other conditions for obtaining a consistent estimate from a 2-event mark-recapture experiment are:

1. all adults have an equal probability of being marked regardless of their size; or
2. all adults have an equal probability of being inspected for marks regardless of their size; and
3. there is no recruitment to the population between Canyon Island and the fisheries upstream; and
4. capture during the first event did not affect capture probability during the second event; and
5. fish do not lose their marks and all marks are recognizable.

Size distributions and recapture rates by size groups were compared to detect heterogeneity in probabilities of capture. Considering the short distance between Canyon Island and the inriver fisheries just 3 km upstream, and considering the life history of the species, no recruitment could have occurred (Groot and Margolis 1991) between sampling events. Different sampling gears in different sampling events prevented trap-induced behavior. The short duration between sampling events should have left a scar as a secondary mark for any fish that had lost its tag in transit. Coho salmon were expected to survive handling, because similar techniques were used during a radio telemetry study (Eiler et al. 1993) when all tagged fish survived and moved upstream to spawning grounds. In work performed by Eiler et al. (1993), as much as 22% of the escapement in the Taku River was found to occur below the Canadian border. Escapements above Canyon Island were expanded to estimates of the total drainage escapement using this relationship.

RUN SIZE, EXPLOITATION, AND MARINE SURVIVAL

Estimates of run size N_A of coho salmon returning to the Taku River above Canyon Island in 2004, 2005, 2006, and 2007 and the associated exploitation rates U in commercial and sport fisheries are based on the sum of estimates of harvest H and escapement E:

$$\hat{N}_A = \hat{H} + \hat{E} \qquad (5a)$$

$$\mathrm{var}(\hat{N}_A) = \mathrm{var}(\hat{H}) + \mathrm{var}(\hat{E}) \qquad (5b)$$

$$\hat{U} = \frac{\hat{H}}{\hat{H} + \hat{E}} \qquad (6a)$$

Variance for equation (6a) was approximated with the delta method (Seber 1982) to be:

$$\mathrm{var}(\hat{U}) \cong \frac{\mathrm{var}(\hat{H})\hat{E}^2}{\hat{N}_A^4} + \frac{\mathrm{var}(\hat{E})\hat{H}^2}{\hat{N}_A^4} \qquad (6b)$$

Survival rate S of smolt to adults was estimated as:

$$\hat{S} = \frac{\hat{N}_A}{\hat{N}_S} \qquad (7a)$$

Variance for equation (7a) was approximated with the delta method to be:

$$\mathrm{var}(\hat{S}) \cong \hat{S}^2 \left[\frac{\mathrm{var}(\hat{N}_A)}{\hat{N}_A^2} + \frac{\mathrm{var}(\hat{N}_S)}{\hat{N}_S^2} \right] \qquad (7b)$$

RESULTS

PRODUCTION OF COHO SALMON 2003-2004

From 17 April through 7 June, 2003, 32,539 coho salmon smolt were captured, tagged, and released with the following codes:

Tag code	Size[a]	Number tagged	Overnight mortality	Tag retention	Final release
040831	small	9,863	19	0.996	9,800
040832	small	6,234	0	1.000	6,234
040834	large	9,018	17	0.996	8,964
040835	large	7,543	2	1.000	7,541
Sub total	small	16,097	19	0.997	16,034
Sub total	large	16,561	19	0.998	16,505
Grand total		32,658	38	0.998	32,539

[a] Small coho salmon smolt were fish measured between 75-85 mm FL; large fish > 85 mm FL.

Ninety percent of coho salmon smolt were captured between 17 April and 29 May. Peak catches occurred on 17 and 24 April, and 50% of the catch occurred by 6 May (Figure 3; Appendix B1). The average fork length of coho salmon smolt was 88 mm (SD = 10.80; Figure 4) and average weight was 7.3 g (SD = 2.68).

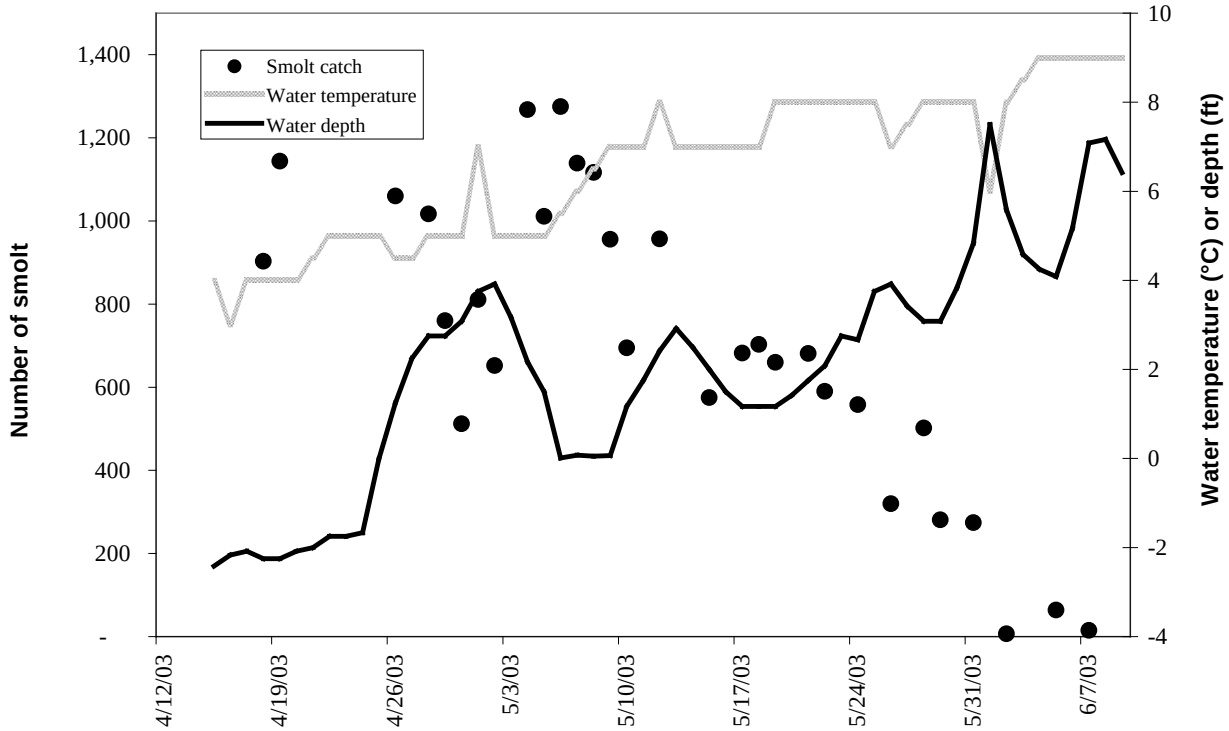

Figure 3.–Daily catch of coho salmon smolt ≥75 mm FL and daily water temperature and depth near Canyon Island, Taku River, during 2003.

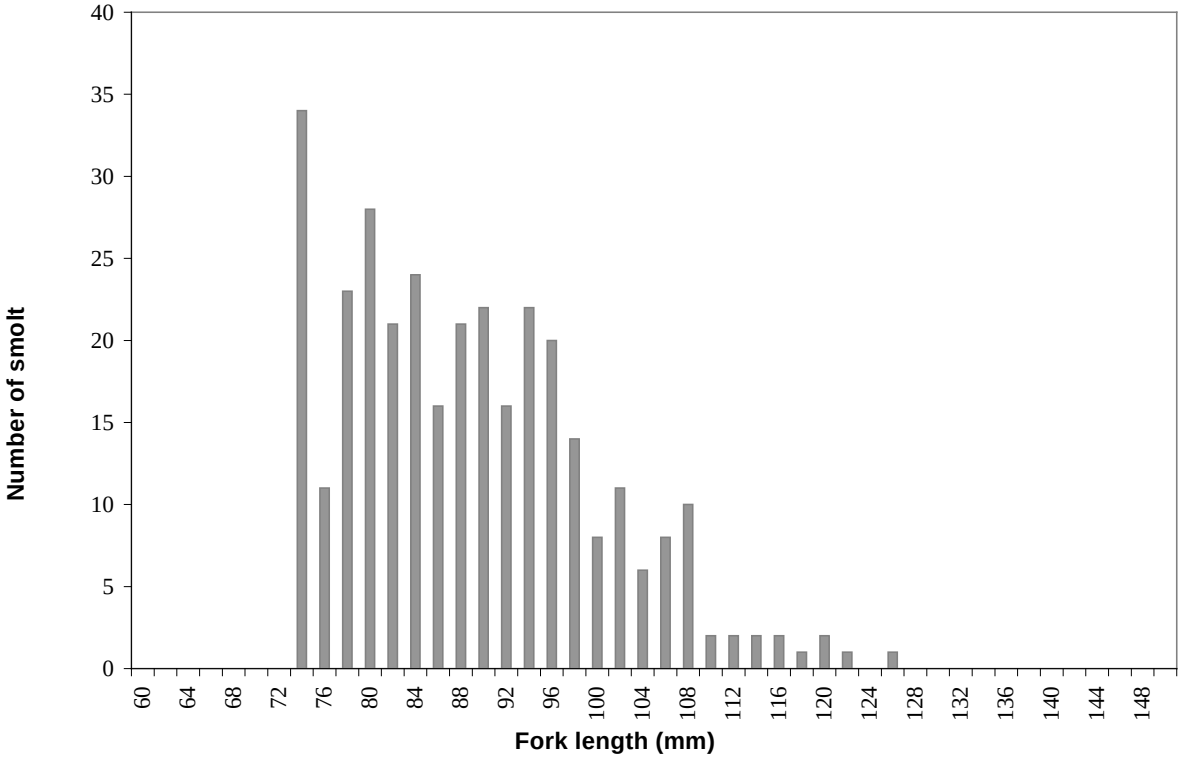

Figure 4.–Length frequency of 328 coho salmon smolt ≥ 75 mm FL captured and measured at Canyon Island, Taku River, during 2003.

Based on the recovery of tags (CWTs) and sampling a year later in 2004, an estimated 2,961,344 coho salmon smolt (SE = 708,526) had emigrated to sea in 2003 (Table 2). CWTs were recovered at significantly greater rates (χ^2 = 18.53, df = 1, P < 0.0001) for larger smolt (0.99%; 163 of 16,505) than for smaller smolt (0.57%; 91 of 16,034). From sampling smolt in 2003, estimated fractions of smaller and larger smolt comprised of age-1.0 fish ($\hat{\phi}_1$ and $\hat{\phi}_2$) were 1.00 (SE = 0.00) and 0.60 (SE = 0.036), respectively. From sampling adults at Canyon Island in 2004, the estimated fraction $\hat{p}$ of age-1.1 adults was 0.90 (SE = 0.011). The estimated ratio of catchability $\hat{\lambda}$ was 5.13 (SE = 1.22), indicating that larger smolt were more likely to be captured in minnow traps. All of the bootstrap estimates had values larger than 1.0, indicating that $\hat{\lambda}$ was significantly greater than 1.0. Estimates of abundance and catchability from bootstrap compared to estimates from Equations 1 and 3 showed bias in abundance to be low at 4.5% and in $\hat{\lambda}$ to be low 2.5%.

An estimated 122,208 (SE= 12,967) coho salmon originating upriver from Canyon Island were harvested in various marine and inriver fisheries in 2004 (Table 3; Appendix B2). In 2004, during random sampling of marine catches, 223 adult coho salmon were found possessing CWTs germane to the Taku River above Canyon Island (Appendix B2). The greatest number of CWTs (129) was recovered from the commercial troll fishery, nearly all of which were from the Northwest Quadrant (99%) on the outside coast, followed by the marine gillnet fisheries (56) with nearly equal numbers from District 111 (Taku Inlet/Stephens Passage) and District 115 (southern Lynn Canal). Twenty-one (21) CWTs were recovered in the marine recreational fishery near Juneau from July through early September. Twelve (12) CWTs were recovered in the seine fishery in Chatham Strait and Frederick Sound.

Table 3.–Estimated smolt abundance in 2003 and adult harvest, escapement and run size in 2004 for the Taku River stock of coho salmon.

	Estimate	SE	Exploitation rate	SE	Removal rate	SE
Smolt abundance (2003)	2,961,344	708,526				
Marine survival	0.085	0.021				
Adult run (2004)	251, 535	18,454				
Total harvest (2004)	122,208	12,967	48.6%	3.6%		
Total marine harvest (2004)	112,404	12,967	44.7%	3.4%	44.7%	3.4%
Troll fishery subtotal	62,002	11,270	24.6%	2.6%	24.6%	2.6%
NW Quadrant	60,829	11,238	24.2%	2.6%		
NE Quadrant	1,173	838	0.5%	0.2%		
Seine fishery subtotal	5,334	1,681	2.1%	0.4%	2.8%	0.4%
District 109	258	257	0.1%	0.1%		
District 110	782	781	0.3%	0.2%		
District 112	3,678	1,397	1.5%	0.3%		
District 114	617	444	0.2%	0.1%		
Recreational fishery subtotal	14,107	3,590	5.6%	0.8%	7.7%	0.8%
Sitka	431	431	0.2%	0.1%		
Gustavus/Elfin Cove	957	506	0.4%	0.1%		
Juneau	12,720	3,528	5.1%	0.8%		
Drift gillnet subtotal	30,961	5,041	12.3%	1.2%	18.2%	1.2%
District 111	13,058	2,937	5.2%	0.7%		
District 115	17,903	4,097	7.1%	0.9%		
U.S. personal use harvest (2004)[a]	120					
Total Canadian harvest (2004)[b]	9,684		3.8%	0.2%	5.5%	0.4%
Passage past Canyon Island (2004)[c]	139,011	12,301				
Escapement past all fisheries (2004)[d]	129,327	12,301				

[a] U.S. personal use harvest mostly occurs downriver of the mark and recapture locations.

[b] Total Canadian harvest includes the inriver commercial, test, and aboriginal fisheries.

[c] Inriver run is the estimated number of coho salmon above Canyon Island.

[d] Escapement past all fisheries is the inriver run minus the total Canadian harvest.

Harvests in marine fisheries were estimated based on 0.98% of returning adults carrying a CWT. Thirty-four of 3,163 adults sampled at Canyon Island were missing their adipose fin, of which 31 had CWTs. Marked fractions of these sampled adults were marginally different throughout the season (Table 4; $\chi^2 = 10.67$, df = 4, $P = 0.03$).

Table 4.–Numbers of adult coho salmon examined for coded wire tags at Canyon Island in 2004.

	Number			
Date	Examined	Adipose clips	Valid marked	% adipose clips
July 25–Aug 7	499	2	2	0.40%
Aug 8–Aug 21	689	4	4	0.58%
Aug 22–Sept 4	583	4	4	0.69%
Sept 5–Sept 18	481	10	9	2.08%
Sept 19–Oct 4	911	14	12	1.54%
Total	3,163	34	31	1.07%

Details on the numbers examined by day at Canyon Island along with the numbers of fish missing adipose fins, valid CWTs, and their respective codes are listed in Appendix B3. Table 3 contains estimated fractions of harvest by fishery and estimated exploitation rates, and Figure 5 shows the weekly harvests by fishery. Estimated mean date of harvest, using techniques detailed in Mundy (1984), was 20 August for the troll fishery compared to 6 September for the gillnet fishery (Appendix B4). Mean date of estimated harvest in all marine fisheries was 24 August. Estimated harvest of coho salmon bound for the Taku River above Canyon Island in the Juneau marine recreational fishery was 12,720 fish, or 10.4% of all estimated marine and inriver harvests (122,208). Expanding for the estimated 22% of the Taku River coho salmon run that spawns below Canyon Island, the recreational harvest was 16,307 (12,720/0.78) representing 79% of the estimated 20,543 coho salmon caught in the Juneau area marine fishery (Wendt and Jaenicke 2011). The inriver harvest of coho salmon in the Taku River was 9,804 (i.e., 9,684 inriver test, Canadian commercial, and aboriginal, and 120 U.S. personal use fisheries) in 2004.

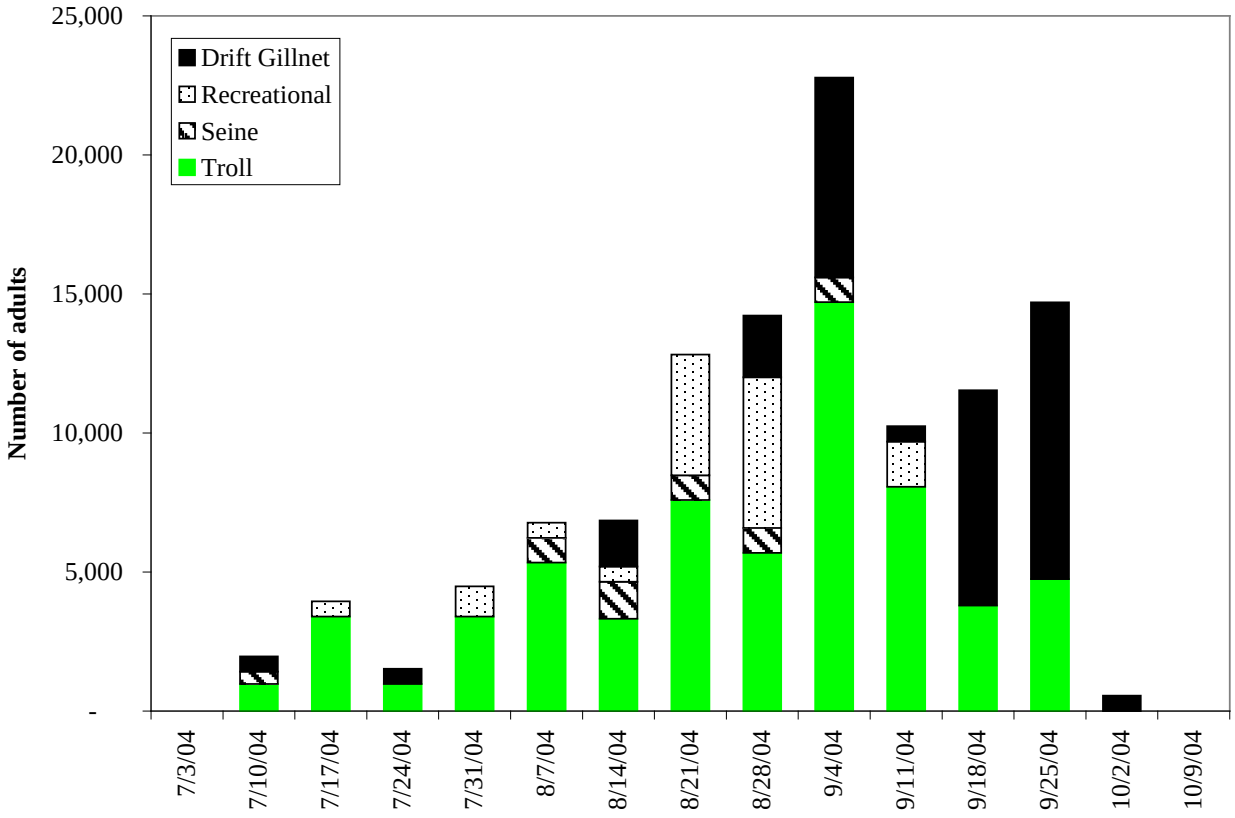

Figure 5.– Estimated harvests of coho salmon bound for Taku River in 2004, assigned to the marine commercial fishery and the recreational fishery by statistical week (weekly estimates of harvest in the troll fishery approximated).

An estimated 139,011 (SE = 12,301) adults passed upstream of Canyon Island in 2004. Between 4 July and 9 October, 3,163 coho salmon were captured at Canyon Island of which 2,765 were marked and released. From 27 June through 4 September 5,966 coho salmon, 148 of which had spaghetti tags, were examined in the upstream commercial fishery. From 29 August through 9 October, 3,268 fish were caught in the inriver test fishery, of which 61 carried tags;

another 450 fish were harvested in the aboriginal fishery but were not examined for spaghetti tags. The mark-recapture data were stratified by week and tests for consistency were conducted in SPAS (Arnason et al. 1996). The ratio of marked to unmarked fish in the commercial and test fisheries samples was not uniform across time (χ^2 = 30.94, df = 8, P < 0.01), indicating the probability of capture during the marking event varied significantly. Similarly, the marked fractions in the two fisheries were not similar (χ^2 = 4.41, df = 1, P = 0.04). The probability that a marked fish was recovered during the second event was not independent of the week that the fish was marked (χ^2 = 110.94, df = 8, P < 0.01), indicating the probability of capture during the second event varied significantly. Results of these tests were evidence that supported stratifying the mark-recapture experiment by time and using Darroch's (1961) method to estimate the escapement of coho salmon in 2004 (Seber 1982).

The mark-recapture data were initially stratified by 9 first event and 9 second event periods (Appendix B5). Some pooling of adjacent first and second event time strata were allowable, while maintaining the capture heterogeneity observed in the original model. A model with 6 first event and 6 second event strata was selected to estimate abundance. Using SPAS (Arnason et al. 1996), the estimated number of adult coho salmon past Canyon Island in 2004 was 139,011 (SE = 12,301). Given that 9,804 coho salmon were harvested above Canyon Island, the estimated spawning escapement of coho salmon past all fisheries in 2004 was 129,327 (SE = 12,301) (Table 3).

PRODUCTION OF COHO SALMON 2004-2005

From 13 April through 5 June 2004, 16,116 coho salmon smolt were captured, tagged, and released with the following codes:

Tag code	Size[a]	Number tagged	Overnight mortality	Tag retention	Final release
041007	small	9,055	6	0.997	9,019
041010	large	7,119	4	0.999	7,097
Grand total		16,174	10	0.997	16,116

[a] Small coho salmon smolt were fish measured between 75-85 mm FL; large fish were >85 mm FL.

Ninety percent (90%) of coho smolt were captured between 13 April and 12 May. Peak catches occurred on 20 and 29 April, and 50% of the catch occurred by 25 April (Figure 6; Appendix C1). The average fork length of coho salmon smolt was 91 mm (SD = 12.32; Figure 7) and average weight was 7.3 g (SD = 3.17). An additional 23,165 Chinook salmon smolt were captured and tagged with codes 04-10-22 and 04-10-23; 87 died within 24 h of tagging and tag retention was 100% leaving a release of 23,078 marked Chinook salmon smolt. Analyses of data on tagged Chinook salmon will be published after returns from that brood (2002) are completed in calendar year 2009.

Based the recovery of CWTs and sampling a year later in 2005, an estimated 3,755,274 coho salmon smolt (SE = 1,014,210) emigrated to sea in 2004. Values for capture histories are shown in Table 2. Coded wire tags were recovered from approximately 0.79% (71 of 9,019) smaller smolt and 0.86% (61 of 7,097) from larger smolt. These rates indicate equal odds (1.09) for recovery and implied survival of larger smolt (χ^2 = 0.26, df = 1, P = 0.61). From sampling smolt in 2004, estimated fractions of smaller and larger smolt comprised of age-1.0 fish ($\hat{\phi}_1$ and $\hat{\phi}_2$)

were 1.000 (SE = 0.000) and 0.596 (SE = 0.047), respectively. From sampling adults at Canyon Island in 2005, the estimated fraction $\hat{p}$ of age-1.1 adults was 0.84 (SE = 0.011). The estimated ratio of catchability $\hat{\lambda}$ was 1.31 (SE = 0.37), indicating that larger smolt were slightly more likely to be captured in minnow traps. More than 25% of the bootstrap estimates had values smaller than 1.0, indicating that $\hat{\lambda}$ was not significantly greater than 1.0. Estimates of abundance and catchability from bootstrap compared to estimates from Equations 1 and 3 showed bias in abundance to be low at 5.9% and in $\hat{\lambda}$ to be low 1.5%.Consistent with the indication of small differences in survival rates and in catchability during marking between large and small smolt reported above, abundance as estimated with Chapman's modification of Petersen's estimator (3,706,909) was about 1% less than the estimate from equation (1).

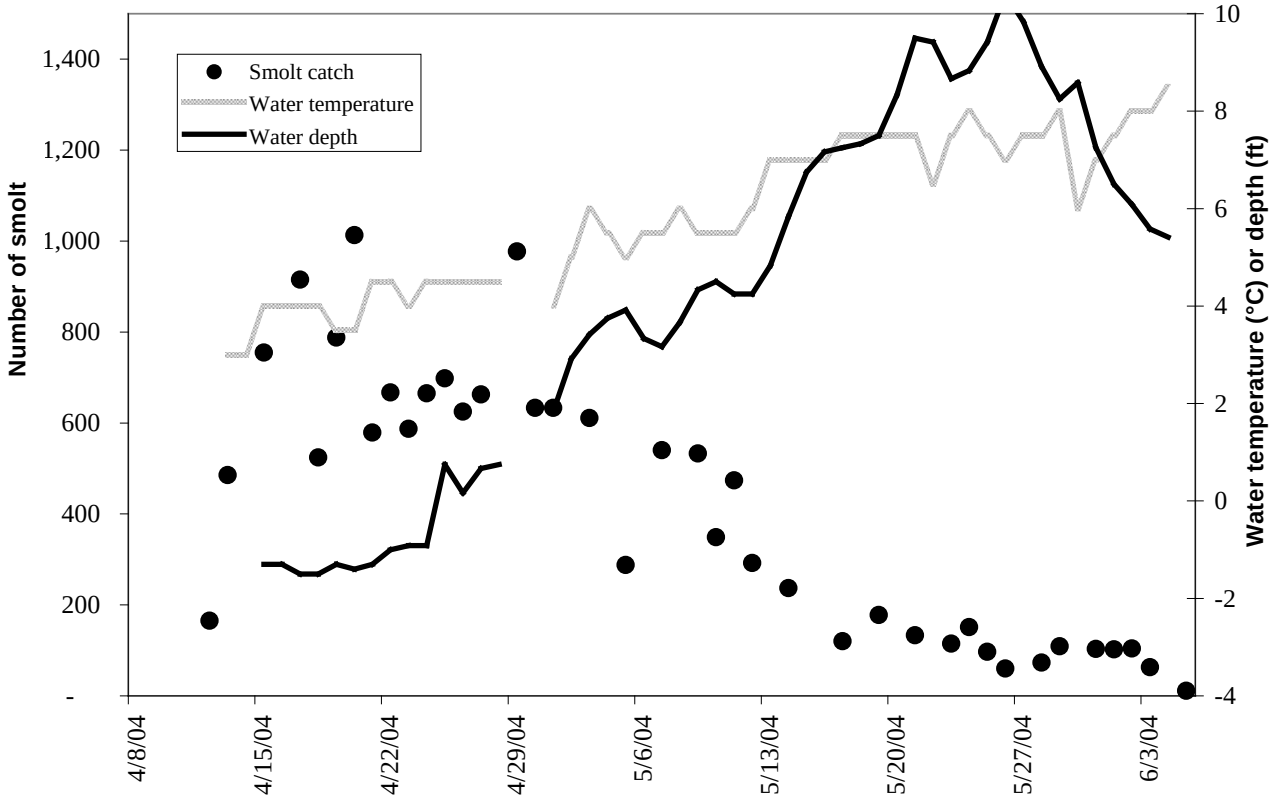

Figure 6.–Daily catch of coho salmon smolt ≥75 mm FL and daily water temperature and depth near Canyon Island, Taku River, during 2004.

In 2005, during random sampling of marine catches, 94 adult coho salmon were found possessing CWTs germane to the Taku River (Appendix C2). The greatest number of CWTs (58) was recovered from the commercial troll fishery, all of which came from the Northwest Quadrant. Other CWTs were recovered in marine gillnet fisheries (26), most (65%) of them from District 111 (Taku Inlet/Stephens Passage), 6 CWTs were recovered in the marine recreational fishery near Juneau from July through August, and 1 CWT was sampled in the marine recreational fishery near Elfin Cove in early August. Three (3) CWTs were recovered in the seine fishery in Chatham Strait and lower Lynn Canal.

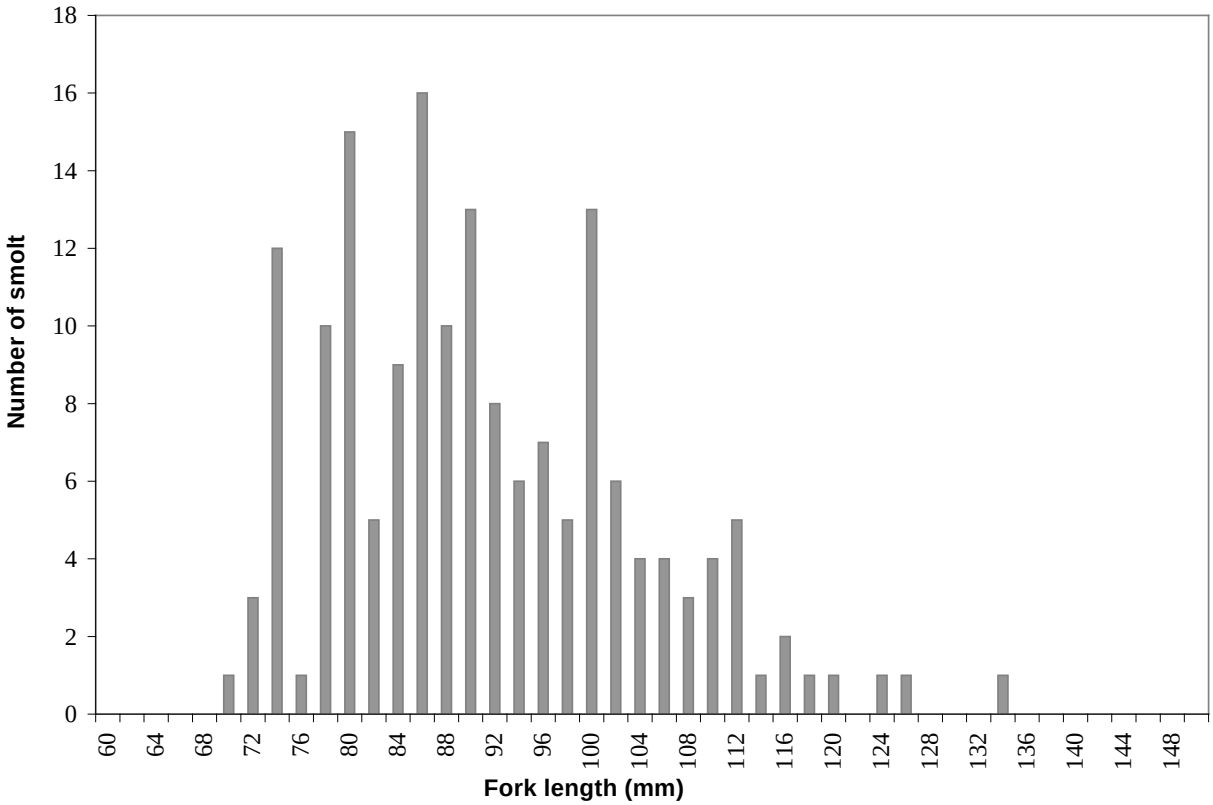

Figure 7.–Length frequency of 168 coho salmon smolt ≥ 75 mm FL captured and measured at Canyon Island, Taku River, during 2004.

An estimated 87,438 (SE = 11,908) coho salmon originating upriver from Canyon Island were harvested in various marine and inriver fisheries in 2005 (Table 5; Appendix C2). Harvests in marine fisheries were estimated based on 0.46% of returning adults carrying a CWT. Six (6) of 1,476 adults sampled at Canyon Island were missing their adipose fin, 5 of which had tags.

Twenty-two (22) of 3,123 adults sampled in the inriver test and Canadian commercial fisheries were missing their adipose fin, 15 of which had tags. Combined, 28 of 4,599 adults sampled were missing their adipose fin, 20 of which had tags. Marked fractions seen at Canyon Island and in the inriver test and Canadian commercial fisheries were not different (χ^2 = 1.45, df = 1, P = 0.23). Details on the numbers examined by day at Canyon Island and in the inriver fisheries along with the numbers of adipose clips, valid CWTs, and their respective codes can be found in Appendix C3. Table 6 contains estimated fractions of harvest by fishery and estimated exploitation rates, and Figure 8 has the weekly harvests by fishery. Estimated mean date of harvest, using techniques detailed in Mundy (1984), was 20 August for the troll fishery compared to 5 September for the gillnet fishery (Appendix C4). Mean date of estimated harvest in all marine fisheries was 26 August, same as the mean date observed in 2004. Estimated harvest of coho salmon bound for the Taku River above Canyon Island in the Juneau marine recreational fishery was 3,573 fish or 4.1% of all estimated marine and inriver harvests (87,438). Expanded to 4,581 (3,573/0.78) for the entire Taku River drainage, this was 18% of the estimated 24,858 coho salmon caught in the Juneau area marine fishery (Wendt and Jaenicke *in prep a*). The inriver harvest of coho salmon in the Taku River was 8,393 (i.e., 8,259 inriver test and Canadian commercial and 134 U.S. personal use fisheries) in 2005.

Table 5.–Estimates of smolt abundance in 2004, of adult harvest, escapement and run size in 2005 for the Taku River stock of coho salmon.

	Estimate	SE	Exploitation rate	SE	Removal rate	SE
Smolt abundance (2004)	3,755,274	1,014,210				
Marine survival	0.059	0.018				
Adult run (2005)	222,996	32,915				
Total harvest (2005)	87,438	11,908	39.2%	6.3%		
Total marine harvest (2005)	79,045	11,908	35.4%	5.9%	35.4%	5.9%
Troll fishery subtotal	46,521	9,559	20.9%	3.9%	20.9%	3.9%
NW Quadrant Period 3	13,415	4,750	6.0%	1.5%		
NW Quadrant Period 4	22,487	7,339	10.1%	2.4%		
NW Quadrant Period 5	10,619	3,868	4.8%	1.2%		
Seine fishery subtotal	4,324	2,914	1.9%	0.8%	2.5%	0.8%
District 114	1,118	1,117	0.5%	0.3%		
District 112	3,207	2,691	1.4%	0.8%		
Recreational fishery subtotal	4,653	2,125	2.1%	0.6%	2.7%	0.6%
Elfin Cove	1,081	1,080	0.5%	0.3%		
Juneau	3,573	1,830	1.6%	0.5%		
Drift gillnet subtotal	23,546	6,117	10.6%	2.2%	14.1%	2.2%
District 111	18,011	5,679	8.1%	1.9%		
District 115	5,535	2,274	2.5%	0.7%		
U.S. personal use harvest (2005)[a]	134					
Total Canadian harvest (2005)[b]	8,259		3.7%	0.5%	5.7%	1.2%
Passage past Canyon Island (2005)[c]	143,817	30,685				
Escapement past all fisheries (2005)[d]	135,558	30,685				

[a] U.S. personal use harvest mostly occurs downriver of the mark and recapture locations.

[b] Total Canadian harvest includes the inriver commercial, test, and aboriginal fisheries.

[c] Inriver run is the estimated number of coho salmon above Canyon Island.

[d] Escapement past all fisheries is the inriver run minus the total Canadian harvest.

Table 6.–Numbers of adult coho salmon examined for coded wire tags at Canyon Island and in the inriver test and Canadian commercial fisheries in 2005.

	Number			
Date	Examined	Adipose clips	Valid marked	% adipose clips
Canyon Island				
July 1–Aug 15	206	1	1	0.49%
Aug 16–Aug 31	249			
Sept 1–Sept 15	426	2	2	0.47%
Sept 16–Sept 30	451	3	2	0.67%
Oct 1–Oct 8	144			
Total	1,476	6	5	0.41%
Inriver test and Canadian commercial fisheries				
July 1–Aug 15	350	2	0	0.57%
Aug 16–Aug 31	250	1	1	0.40%
Sept 1–Sept 15	790	7	6	0.89%
Sept 16–Sept 30	1,325	8	4	0.60%
Oct 1–Oct 8	408	4	4	0.98%
Total	3,123	22	15	0.70%
Combined				
July 1–Aug 15	556	3	1	0.54%
Aug 16–Aug 31	493	1	1	0.20%
Sept 1–Sept 15	1,214	9	8	0.74%
Sept 16–Sept 30	1,776	11	6	0.62%
Oct 1–Oct 8	552	4	4	0.72%
Grand total	4,599	28	20	0.61%

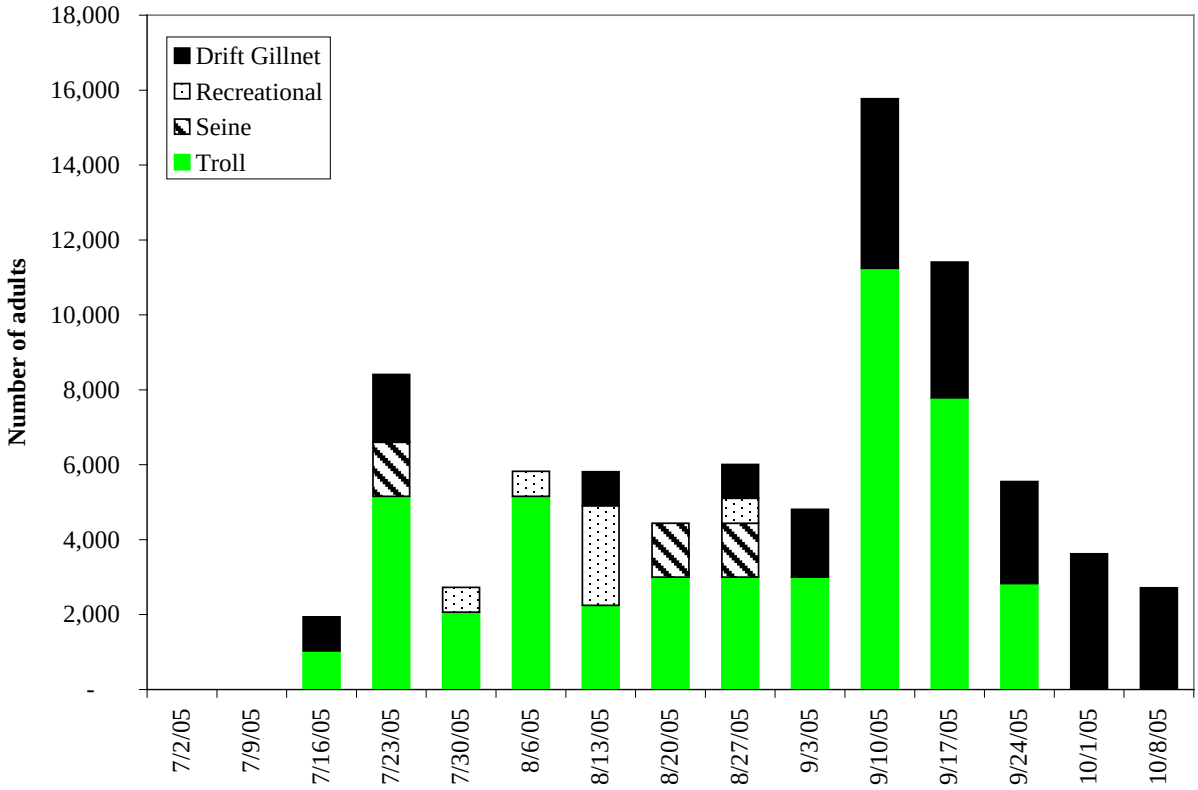

Figure 8.–Estimated harvests of coho salmon bound for Taku River in 2005, assigned to marine commercial and recreational fishery by statistical week (weekly estimates of harvest in the troll fishery approximated).

An estimated 143,817 (SE = 30,685) adults passed upstream of Canyon Island in 2005. Between 2 July and 5 October, 1,476 coho salmon were captured at Canyon Island of which 1,337 were marked and released. From 3 July through 10 September, 4,809 coho salmon, 75 with spaghetti tags, were examined in the inriver Canadian commercial fishery. After 28 August through 8 October, 3,172 coho salmon, 30 with spaghetti tags, were examined in the inriver test fishery.

An additional 116 and 162 fish were harvested in the inriver Canadian commercial and Aboriginal fisheries, respectively. The mark-recapture data were stratified by week (Appendix C5) and tests for consistency were conducted in SPAS (Arnason et al. 1996). The ratio of marked to unmarked fish in the commercial and test fisheries samples was not uniform across time (χ^2 = 19.68, df = 13, P = 0.10), indicating the probability of capture during the marking event varied significantly. The marked fractions in the 2 fisheries were not similar (χ^2 = 5.01, df = 1, P = 0.02) indicating the probability of capture during the marking event varied significantly. The probability that a marked fish was recovered during the second event was not independent of the week that the fish was marked (χ^2 = 146.06, df = 8, P < 0.01), indicating the probability of capture during the second event varied significantly. Results of these tests were evidence that supported stratifying the mark-recapture experiment by time and using Darroch's (1961) method to estimate the escapement of coho salmon in 2005 (Seber 1982).

The mark-recapture data were initially stratified by 14 first event and 14 second event periods (Appendix C5). Some pooling of adjacent first and second event time strata was allowable, while maintaining the capture heterogeneity observed in the original model. A model with 3 first event and 3 second event strata was selected to estimate abundance. Using SPAS (Arnason et al. 1996),

the estimated number of adult coho salmon past Canyon Island in 2005 was 143,817 (SE = 30,685). Given that 8,259 coho salmon were harvested above Canyon Island, the estimated spawning escapement of coho salmon past all fisheries in 2005 was 135,558 (SE = 30,685; Table 5).

PRODUCTION OF COHO SALMON 2005–2006

From 7 April through 2 June 2005, 32,520 coho salmon smolt were captured, tagged, and released with the following codes:

Tag code	Size[a]	Number tagged	Overnight mortality	Tag retention	Final release
040833	small	11,172	4	0.999	11,155
041008	small	5,609	7	1.000	5,602
040836	large	10,930	2	0.999	10,915
041011	large	4,859	11	1.000	4,848
Sub total	small	16,781	11	0.999	16,757
Sub total	large	15,789	13	0.999	15,763
Grand total		32,570	24	0.999	32,520

[a] Small coho salmon smolt were fish measured between 75-85 mm FL; large fish >85 mm FL.

Ninety percent (90%) of coho smolt were captured between 7 April and 10 May. Peak catches occurred during this same period, and 50% of the catch occurred by 21 April (Figure 9; Appendix D1). The average fork length of coho salmon smolt was 88 mm (SD = 9.8; Figure 10) and average weight was 6.2 g (SD = 2.3). An additional 27,341 Chinook salmon smolt were captured and tagged with codes 04-10-09 and 04-10-08; 90 died within 24 h of tagging and tag retention was 100% leaving a release of 27,251 marked smolt. Analyses of data on tagged Chinook salmon will be published after returns from that brood (2003) are completed in calendar year 2010.

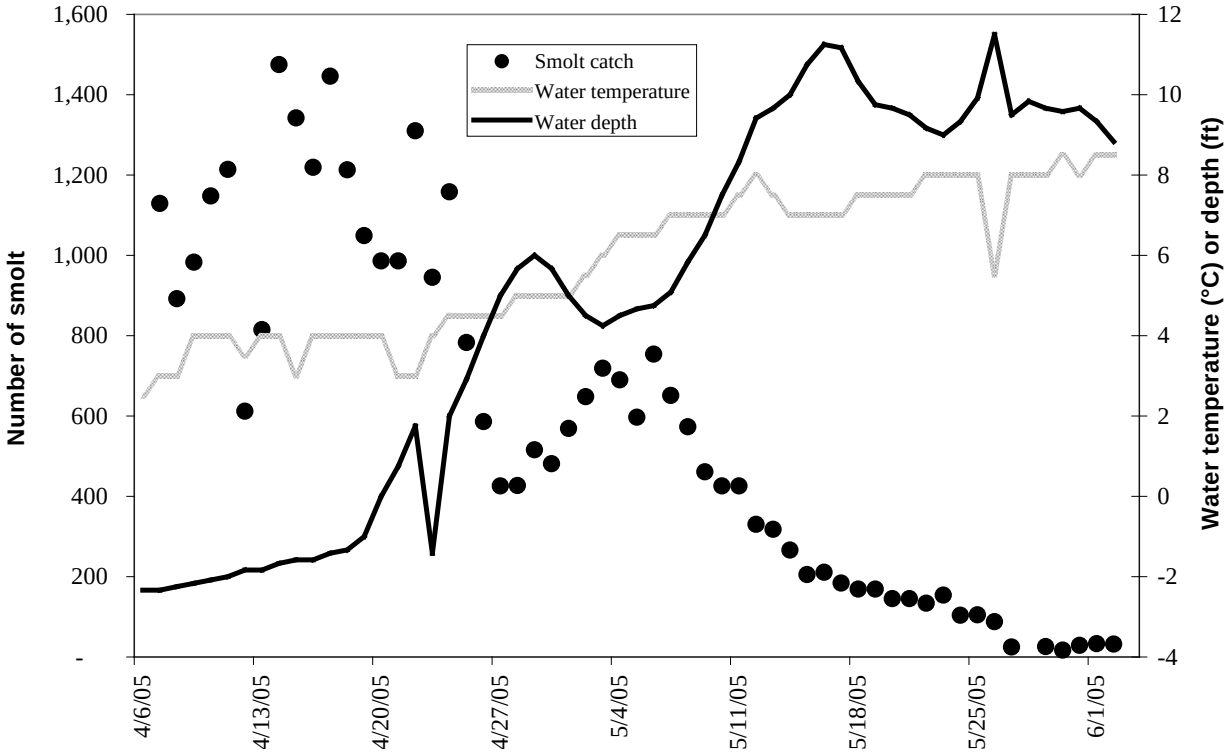

Figure 9.–Daily catch of coho salmon smolt ≥75mm FL and daily water temperature and depth near Canyon Island, Taku River, during 2005.

Based the recovery of CWTs and sampling a year later in 2006, an estimated 2,149,673 coho salmon smolt (SE = 442,136) emigrated to sea in 2005. Values for capture histories are shown in Table 2. Coded wire tags were recovered from approximately 1.15% (192 of 16,757) smaller smolt and 1.55% (245 of 15,763) from larger smolt. These rates indicate better odds (1.36) for recovery and implied survival of larger smolt (χ^2 = 10.22, df = 1, P = 0.0014). From sampling smolt in 2005, estimated fractions of smaller and larger smolt comprised of age-1.0 fish ($\hat{\phi}_1$ and $\hat{\phi}_2$) were 0.993 (SE = 0.007) and 0.778 (SE = 0.031), respectively. From sampling adults at Canyon Island in 2006, estimated fraction $\hat{p}$ of age-1.1 adults was 0.81 (SE = 0.014). The estimated ratio of catchability $\hat{\lambda}$ was 0.22 (SE = 0.24), indicating that larger smolt were less likely than smaller smolt to be captured in minnow traps. Less than 1% of the bootstrap estimates had values greater than 1.0, indicating that $\hat{\lambda}$ was significantly smaller than 1.0. Estimates of abundance and catchability from bootstrap compared to estimates from Equations 1 and 3 showed bias in abundance to be low at 1.7% and in $\hat{\lambda}$ to be low 4.9%.

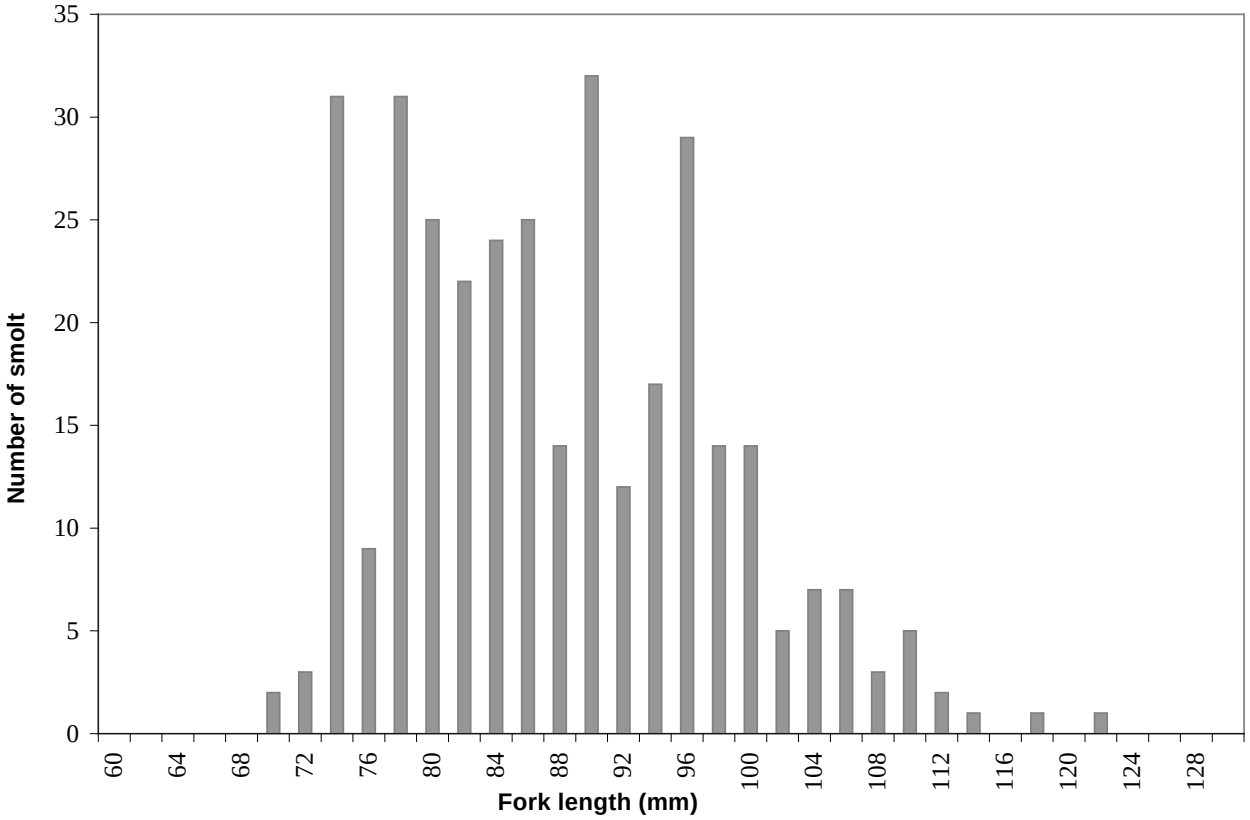

Figure 10.–Length frequency of 336 coho salmon smolt ≥ 75 mm FL captured and measured at Canyon Island, Taku River, during 2005.

In 2006, during random sampling of marine catches, 318 adult coho salmon were found possessing CWTs germane to the Taku River (Appendix D2). The greatest number of CWTs (145) was recovered from the commercial gillnet fishery, the majority of which (87%) came

from District 111 (Taku Inlet/Stephens Passage). Another 142 CWTs were recovered in the commercial troll fishery, nearly all of which were from the Northwest Quadrant (92%) on the outer coast. Other CWTs (24) were recovered in the marine recreational fishery near Juneau from July through early September. Three (3) CWTs were recovered in the seine fishery in Chatham Strait and Frederick Sound.

An estimated 104,916 (SE = 7,812) coho salmon originating upriver from Canyon Island were harvested in various marine and inriver fisheries in 2006 (Table 7; Appendix D2). Harvests in marine fisheries were estimated based on 1.16% of returning adults carrying a CWT. Fifty-nine (59) of 4,718 adults sampled at Canyon Island and in the test fishery were missing their adipose fin, 54 of which were considered valid tags (3 heads were lost during shipping and were assumed valid). Marked fractions of these sampled adults varied through the season ($\chi^2 = 10.99$, df = 3, P = 0.01) and increased over time (Table 8). Details on the numbers examined by day at Canyon Island and in the test fishery along with the numbers of fish missing adipose fins, and numbers of valid CWTs and their respective codes are detailed in Appendix D3. Table 7 contains estimated fractions of harvest by fishery and estimated exploitation rates, and Figure 11 shows the weekly harvests by fishery. Estimated mean date of harvest, using techniques detailed in Mundy (1984), was 21 August for the troll fishery compared to 6 September for the gillnet fishery (Appendix D4).

Table 7.–Estimated smolt abundance in 2005 and adult harvest, escapement and run size in 2006 for the Taku River stock of coho salmon.

	Estimate	SE	Exploitation rate	SE	Removal rate	SE
Smolt abundance (2005)	2,149,673	442,136				
Marine survival	0.105	0.022				
Adult run (2006)	226,694	11,651				
Total harvest (2006)	104,916	7,812	46.3%	2.6%		
Total marine harvest (2006)	92,508	7,812	40.8%	2.4%	40.8%	2.4%
Troll fishery subtotal	49,393	6,379	21.8%	1.7%	21.8%	1.7%
NW Quadrant	45,456	6,261	20.1%	1.7%		
NE Quadrant	3,659	1,190	1.6%	0.3%		
SE Quadrant	279	278	0.1%	0.1%		
Seine fishery subtotal	614	355	0.3%	0.1%	0.3%	0.1%
District 114	217	217	0.1%	0.1%		
District 110	396	281	0.2%	0.1%		
Recreational fishery subtotal	4,621	1,075	2.0%	0.3%	2.6%	0.3%
Yakutat	181	128	0.1%	0.0%		
Sitka	455	326	0.2%	0.1%		
Juneau	3,985	1,017	1.8%	0.3%		
Drift gillnet subtotal	37,879	4,365	16.7%	1.2%	22.0%	1.2%
District 111	32,051	4,020	14.1%	1.1%		
District 115	5,828	1,701	2.6%	0.4%		
U.S. personal use harvest (2006)[a]	133					
Total Canadian harvest (2006)[b]	12,275		5.4%	0.2%	9.1%	0.6%
Passage past Canyon Island (2006)[c]	134,053	8,643				
Escapement past all fisheries (2006)[d]	121,778	8,643				

[a] U.S. personal use harvest mostly occurs downriver of the mark and recapture locations.

[b] Total Canadian harvest includes the inriver commercial, test, and aboriginal fisheries.

[c] Inriver run is the estimated number of coho salmon above Canyon Island.

[d] Escapement past all fisheries is the inriver run minus the total Canadian harvest.

Table 8.–Numbers of adult coho salmon examined for coded wire tags at Canyon Island and in the inriver test fishery in 2006.

Date	Number			% Adipose clips
	Examined	Adipose clips	Valid marked	
		Canyon Island		
June 30–Aug 15	799	2	1	0.25%
Aug 16–Aug 31	747	8	7	1.07%
Sept 1–Sept 15	794	13	13	1.64%
Sept 16–Oct 3	471	12	9	2.55%
Total	2,811	35	30	1.25%
		Inriver test fishery		
June 30–Aug 15				
Aug 16–Aug 31				
Sept 1–Sept 15	1,112	12	9	1.08%
Sept 16–Oct 3	795	12	12	1.51%
Total	1,907	24	21	1.26%
		Combined		
June 30–Aug 15	799	2	1	0.25%
Aug 16–Aug 31	747	8	7	1.07%
Sept 1–Sept 15	1,906	25	22	1.31%
Sept 16–Oct 3	1,266	24	21	1.90%
Grand total	4,718	59	51	1.25%

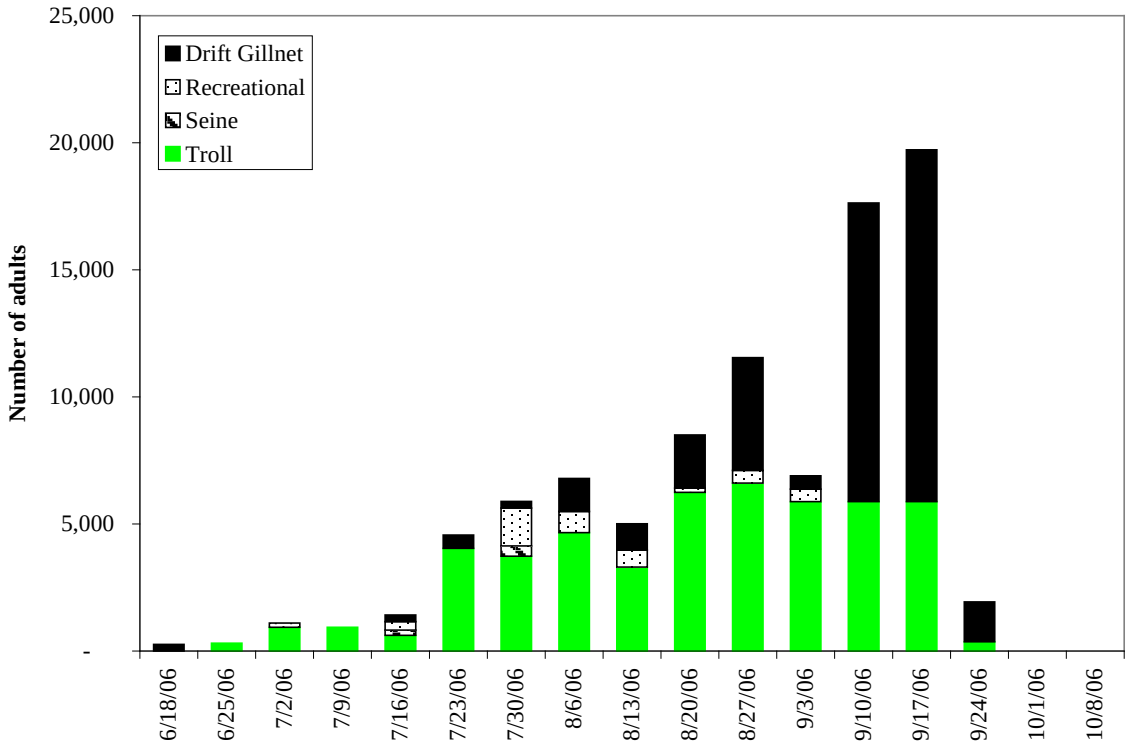

Figure 11.–Estimated harvests of coho salmon bound for Taku River in 2006, assigned to marine commercial and recreational fishery by statistical week (weekly estimates of harvest in the troll fishery approximated).

PRODUCTION OF COHO SALMON 2006–2007

From 13 April through 2 June 2006, 34,117 coho salmon smolt were captured, tagged, and released with the following codes:

Tag code	Size[a]	Number tagged	Overnight mortality	Tag retention	Final release
041013	small	6,614	7	1.000	6,607
041014	small	10,869	7	0.999	10,851
040815	large	5,717	32	1.000	5,685
041012	large	11,010	25	0.999	10,974
Sub total	small	17,483	14	0.999	17,458
Sub total	large	16,727	57	0.999	16,659
Grand total		34,210	71	0.999	34,117

[a] Small coho salmon smolt were fish measured between 75-85 mm FL; large fish >85 mm FL.

Mean date of estimated harvest in all marine fisheries occurred on 28 August, a similar timing to 2004 and 2005. Estimated harvest of coho salmon bound for the Taku River above Canyon Island in the Juneau marine recreational fishery was 3,985 fish or 3.8% of all estimated marine and inriver harvests (104,916 fish; Table 7). Expanded to 5,110 (3,985/0.78) for the entire Taku River drainage, this was 15% of the estimated 26,098 coho salmon caught in the Juneau marine fishery, according to harvest and sampling data from Wendt and Jaenicke (*in prep b*).

An estimated 134,053 (SE = 8,643) adults passed upstream of Canyon Island in 2006 (Table 7). Between 30 June and 3 October, 2,811 coho salmon were captured at Canyon Island of which 2,535 were marked and released. From 2 July through 9 September, 8,552 coho salmon, 163 with spaghetti tags, were examined in the inriver Canadian commercial fishery. After 3 September through 7 October, another 2,812 coho salmon, 51 with spaghetti tags, were examined in the inriver test fishery. An additional 300 fish were harvested in the Canadian Aboriginal fisheries. The mark-recapture data were stratified by week and (Appendix D5) and tests for consistency were conducted in SPAS (Arnason et al. 1996). Similar proportions of tags were recovered over time in the commercial and test fisheries ($\chi^2 = 12.80$, df = 13, P = 0.46). Comparisons of marked fractions in both fisheries were also similar ($\chi^2 = 0.09$, df = 1, P = 0.76). These results provide no indication of significant variability in probability of capture over time during the marking event, so Chapman's (1951) modification of Petersen's estimator (Seber 1982) could be used to estimate abundance. Given that 12,275 coho salmon were harvested above Canyon Island, the estimated spawning escapement of coho salmon past all fisheries in 2006 is 121,778 (SE=8,643; Table 7).

Ninety percent (90%) of the smolt were captured between 14 April and 17 May. Peak catches occurred during this same period, and 50% of the catch occurred by 5 May (Figure 12; Appendix E1). The average FL of coho salmon smolt was 90 mm (SD = 12.9; Figure 13) and average weight was 6.9 g (SD = 3.5) in 2006. An additional 36,792 Chinook salmon smolt were captured and tagged with codes 04-12-18 and 04-11-54; 46 died within 24 h of tagging and tag retention was nearly 100% leaving a release of 36,746 marked smolt. Analyses of data on tagged Chinook salmon will be published after returns from that brood (2004) are completed in calendar year 2011.

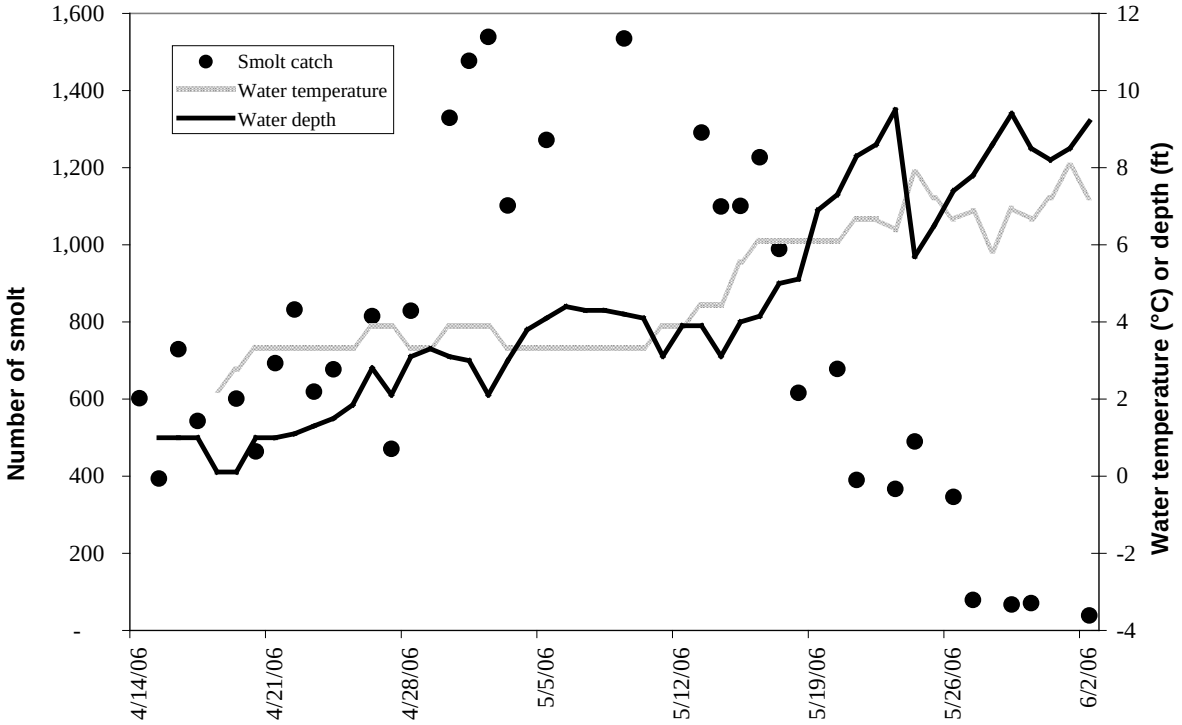

Figure 12.–Daily catch of coho salmon smolt ≥ 75mm FL and daily water temperature and depth near Canyon Island, Taku River, during 2006.

Based the recovery of CWTs and sampling a year later in 2007, an estimated 3,152,471 coho salmon smolt (SE = 797,296) emigrated to sea in 2006. Values for capture histories are shown in Table 2. In addition to the values presented in Table 2, The R_3 parameter was adjusted downward by a ratio of 54/56, as a result of 2 CWT recoveries that did not originate from the 2006 smolt marking event. Coded wire tags were recovered from approximately 0.45% (78 of 17,458) smaller smolt and 0.79% (132 of 16,659) from larger smolt. These rates indicate better odds (1.77) for recovery and implied survival of larger smolt (χ^2 = 16.64, df = 1, P < 0.001). From sampling smolt in 2006, estimated fractions of smaller and larger smolt comprised of age-1.0 fish ($\hat{\phi}_1$ and $\hat{\phi}_2$) were 1.000 (SE = 0.000) and 0.767 (SE = 0.027), respectively. From sampling adults at Canyon Island in 2007, estimated fraction $\hat{p}$ of age-1.1 adults was 0.79 (SE = 0.016). The estimated ratio of catchability $\hat{\lambda}$ was 0.18 (SE = 0.27), indicating that larger smolt were less likely than small smolt to be captured in minnow traps. Less than 1% of the bootstrap estimates had values greater than 1.0, indicating that $\hat{\lambda}$ was significantly smaller than 1.0.

Estimates of abundance and catchability from bootstrap compared to estimates from Equations 1 and 3 showed bias in abundance to be low at 4.0% and in $\hat{\lambda}$ to below -6.6%.

In 2007, during random sampling of marine catches, 154 adult coho salmon were found possessing CWTs germane to the Taku River (Appendix E2). The greatest number of CWTs (69) was recovered from the commercial gillnet fishery, the majority of which (80%) came from District 111 (Taku Inlet/Stephens Passage). Another 67 CWTs were recovered in the commercial troll fishery, nearly all which were from the Northwest Quadrant (96%) on the outer coast. Other CWTs (5) were recovered in the marine recreational fishery near Juneau in August. Six (6) CWTs were recovered in the seine fishery in Chatham Strait and Frederick Sound.

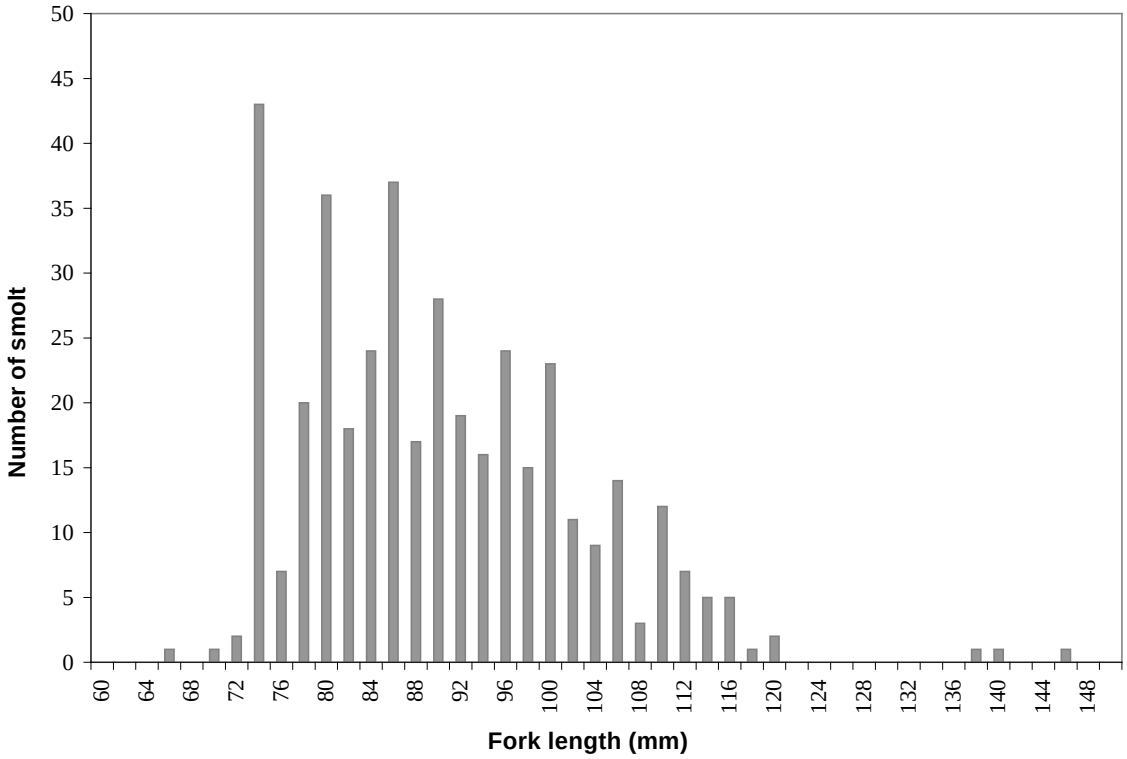

Figure 13.–Length frequency of 404 coho salmon smolt ≥ 75 mm FL captured and measured at Canyon Island, Taku River, during 2006.

An estimated 58,968 (SE = 5,529) coho salmon originating upriver from Canyon Island were harvested in various marine and inriver fisheries in 2007 (Table 9; Appendix E2). Harvests in marine fisheries were estimated based on 1.15% of returning adults carrying a CWT. Sixty-nine (69) of 5,161 adults sampled at Canyon Island and in the test fishery were missing their adipose fin, 61 of which were considered valid tags. Six of these heads were lost during shipping; thus, 63 heads were tested for the presence of valid wire of which 56 had valid coded wire released in the Taku River. However, 2 of these heads possessed coded wire released in 2005, not 2006 and therefore were excluded from harvest calculations and the valid wire release group was reduced to 54. For smolt abundance calculations, these fish were still part of the overall smolt outmigration in 2006 and thus remained part of the tag release group. For the 6 heads lost during shipping, these fish were added back into the total valid sample after multiplying by the ratio of the number valid to the number tested. This yielded a total of 59 valid coded wire samples out of the total of 69 adipose-finclipped fish originally sampled.

Marked fractions of sampled adults varied throughout the season ($\chi^2 = 13.42$, df = 3, $P = 0.004$) and increased over time (Table 10). Details on the numbers examined by day at Canyon Island and in the test fishery along with the numbers of fish missing adipose fins, and numbers of valid CWTs and their respective codes are detailed in Appendix E3. Table 9 contains estimated fractions of harvest by fishery and estimated exploitation rates, and Figure 14 shows the weekly harvests by fishery. Estimated mean date of harvest, using techniques detailed in Mundy (1984), was 20 August for the troll fishery compared to 2 September for the gillnet fishery (Appendix E4). Mean date of estimated harvest in all marine fisheries occurred on 25 August, similar to prior 3 years.

Table 9.–Estimated smolt abundance in 2006 and adult harvest, escapement and run size in 2007 for the Taku River stock of coho salmon.

	Estimate	SE	Exploitation	SE	Removal	SE
Smolt abundance (2006)	3,152,471	797,296				
Marine survival	0.042	0.012				
Adult run (2007)	133,294	14,677				
Total harvest (2007)	58,968	5,529	44.2%	5.1%		
Total marine harvest (2007)	50,921	5,529	38.2%	4.5%	38.2%	4.5%
Troll fishery subtotal	23,519	3,625	17.6%	2.4%	17.6%	2.4%
NW Quadrant	22,540	3,580	16.9%	2.3%		
NE Quadrant	979	567	0.7%	0.2%		
Seine fishery subtotal	6,484	3,194	4.9%	1.4%	5.9%	1.4%
District 112	5,946	3,149	4.5%	1.4%		
District 113	538	537	0.4%	0.2%		
Recreational fishery subtotal	2,123	824	1.6%	0.4%	2.1%	0.4%
Yakutat	189	133	0.1%	0.1%		
Elfin Cove	96	95	0.1%	0.0%		
Gustavus	183	129	0.1%	0.1%		
Sitka	852	631	0.6%	0.3%		
Juneau	804	488	0.6%	0.2%		
Drift gillnet subtotal	18,795	2,559	14.1%	1.8%	18.6%	1.8%
District 111	15,753	2,416	11.8%	1.6%		
District 115	3,042	845	2.3%	0.4%		
U.S. personal use harvest (2007)[a]	54					
Total Canadian harvest (2007)[b]	7,993		6.0%	0.6%	9.7%	1.6%
Passage past Canyon Island (2007)[c]	82,319	13,608				
Escapement past all fisheries (2007)[d]	74,326	13,608				

[a] U.S. personal use harvest mostly occurs downriver of the mark and recapture locations.

[b] Total Canadian harvest includes the inriver commercial, test, and aboriginal fisheries.

[c] Inriver run is the estimated number of coho salmon above Canyon Island.

[d] Escapement past all fisheries is the inriver run minus the total Canadian harvest.

Table 10.–Numbers of adult coho salmon sampled for coded wire tags at Canyon Island and in the inriver test and commercial fisheries in 2007.

	Number			
Date	Examined	Adipose clips	Valid marked	% adipose clips
		Canyon Island		
July 1–Aug 15	868	2	2	0.23%
Aug 16–Aug 31	473	9	7	1.90%
Sept 1–Sept 15	382	3	2	0.79%
Sept 16–Oct 5	393	4	4	1.02%
Total	2,116	18	15	0.85%
		Inriver test and commercial fisheries		
July 1–Aug 15 Aug 16–Aug 31 Sept 1–Sept 15	451	2	1	0.44%
Sept 16–Oct 5	2,594	49	38	1.89%
Total	3,045	51	39	1.67%
		Combined		
July 1–Aug 15	868	2	2	0.23%
Aug 16–Aug 31	924	11	8	1.19%
Sept 1–Sept 15	382	3	2	0.79%
Sept 16–Oct 5	2,987	53	42	1.77%
Grand total	5,161	69	54	1.34%

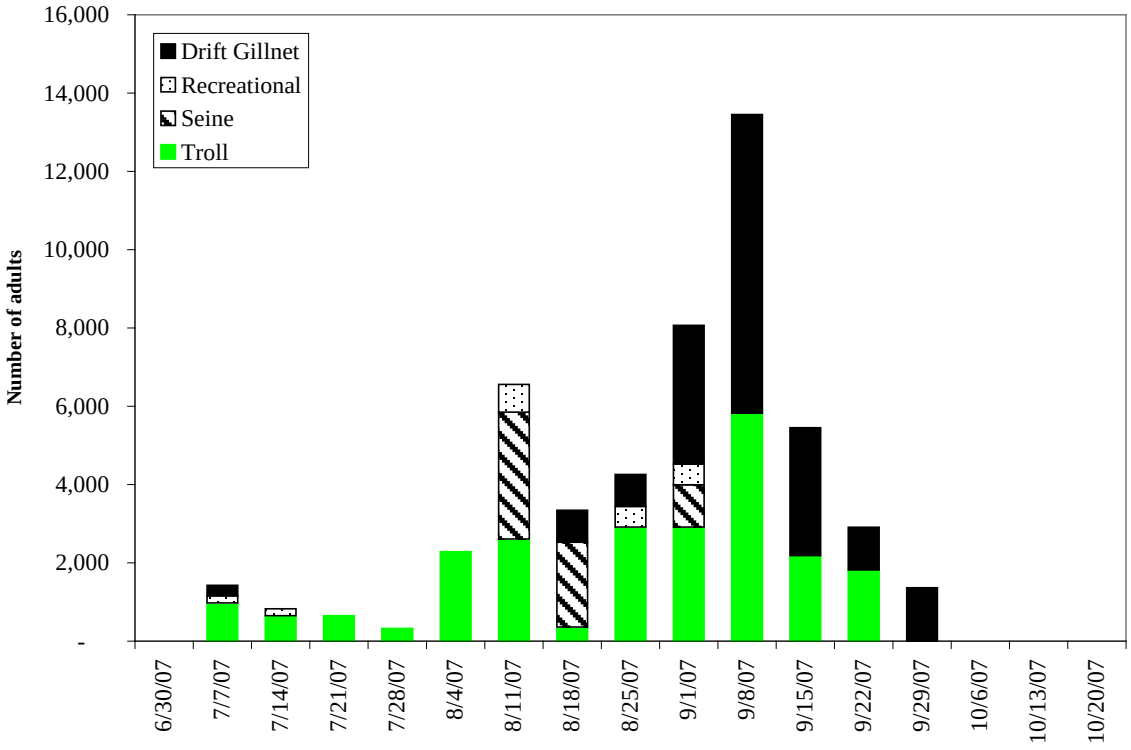

Figure 14.–Estimated harvests of coho salmon bound for Taku River in 2007, assigned to marine commercial and recreational fishery by statistical week (weekly estimates of harvest in the troll fishery approximated).

Estimated harvest of coho salmon bound for the Taku River above Canyon Island in the Juneau marine recreational fishery was 804 fish or 1.4% of all estimated marine and inriver harvests (58,968 fish). Expanded to 1,030 (804/0.78) for the entire Taku River drainage, this was 7% of the estimated 11,202 coho salmon caught in the Juneau marine fishery, according to harvest and sampling data from the Tag Lab online report. This information will be published in an ADF&G Fisheries Data Series report (Wendt and Jaenicke *in prep c*).

An estimated 82,319 (SE = 13,608) adults passed upstream of Canyon Island in 2007 (Table 9). Between 1 July and 3 October, 2,117 coho salmon were captured at Canyon Island of which 1,925 were marked and released. From 1 July through 15 September, 5,162 coho salmon, 220 with spaghetti tags, were examined in the inriver Canadian commercial fishery. After 2 September through 6 October, another 2,676 coho salmon, 32 with spaghetti tags, were examined in the inriver test fishery. An additional 155 fish were harvested in the Canadian Aboriginal fisheries, but were not examined for spaghetti tags. The mark-recapture data were stratified by week and tests for consistency were conducted in SPAS (Arnason et al. 1996). The ratio of marked to unmarked fish in the commercial and test fisheries samples was not uniform across time (χ^2 = 102.93, df = 13, $P < 0.01$), indicating the probability of capture during the marking event varied significantly. Similarly, the marked fractions in the 2 fisheries significantly different (χ^2 = 53.24, df = 1, $P < 0.01$). The probability that a marked fish was recovered during the second event was not independent of the week that the fish was marked

(χ^2 = 88.75, df = 13, P < 0.01), indicating the probability of capture during the second event varied significantly. Results of these tests were evidence that supported stratifying the mark-recapture experiment by time and using Darroch's (1961) method to estimate the escapement of coho salmon in 2007 (Seber 1982). The mark-recapture data were initially stratified by 13 first event and 13 second event periods (Appendix E5). Some pooling of adjacent first and second event time strata were allowable, while maintaining the capture heterogeneity observed in the original model. A model with 11 first event and 10 second event strata was selected to estimate abundance. Using SPAS (Arnason et al. 1996), the estimated number of adult coho salmon past Canyon Island in 2007 was 82,319 (SE = 13,608). Given that 7,993 coho salmon were harvested above Canyon Island, the estimated spawning escapement of coho salmon past all fisheries in 2007 was 74,326 (SE = 13,608);(Table 9).

DISCUSSION

From 1991 to 1996, rotary screw traps were used to capture smolt. In 1997, the screw traps were decommissioned and smolt captured using baited minnow traps. Capture with minnow traps has been shown to be size selective, usually catching less small smolt and more, large smolt. This introduced bias into the smolt abundance estimates, using a simple 2-event Petersen-type estimator, and necessitated the need to generate stratified abundance estimates that began in 1999. This required tagging smolt in 2 size groups (small fish 70/75mm to 85mm; large fish greater than 85mm) and taking scales to estimate age structure of each size group. In 1999, the minnow trapping effort was increased to boost the numbers of smolt released with CWTs thereby increasing the numbers of adults recovered with CWTs for each of these four size and age categories (i.e., small age-1.1 and age-2.1 and large age-1.1 and age-2.1 fish). The results from 1999 to 2002 indicated that the simple pooled Petersen estimate underestimated the true smolt abundance by an average of 11%. From 2003 to 2006 the simple pooled Petersen overestimated the true smolt abundance by an average of 7%. Results from this study suggest that marine survival varies substantially by age as well as size. The rates of recovery were compared for four different groups of smolt, small and large, age 1 and age 2, respectively. Recovery rates were highest for age-1 fish in general and larger age-1 fish within that age group. Recovery rates were lowest for age 2-fish and larger age 2-fish within that group:

Size	Age	Recovery rate
Large	Age 2	0.019%
Small	Age 2	0.025%
Small	Age 1	0.050%
Large	Age 1	0.090%

In general, if smolt are captured using size-selective gear, then stratified estimates must be used to produce an asymptotically unbiased estimate of smolt abundance.

Coho salmon smolt captured and tagged from 2003 to 2006 were larger on average (90.0 mm in length and 7.1 g in weight) than those seen in the prior 4 years (88.1 mm in length and 6.7 g in weight; Figure 15). Smolt sizes in the past 4 years are similar to those seen from 1991 to 1998 (Elliott and Bernard 1994; McPherson et al. 1994; McPherson and Bernard 1995, 1996; McPherson et al. 1998; Yanusz et al. 1999; Jones et al. 2006).

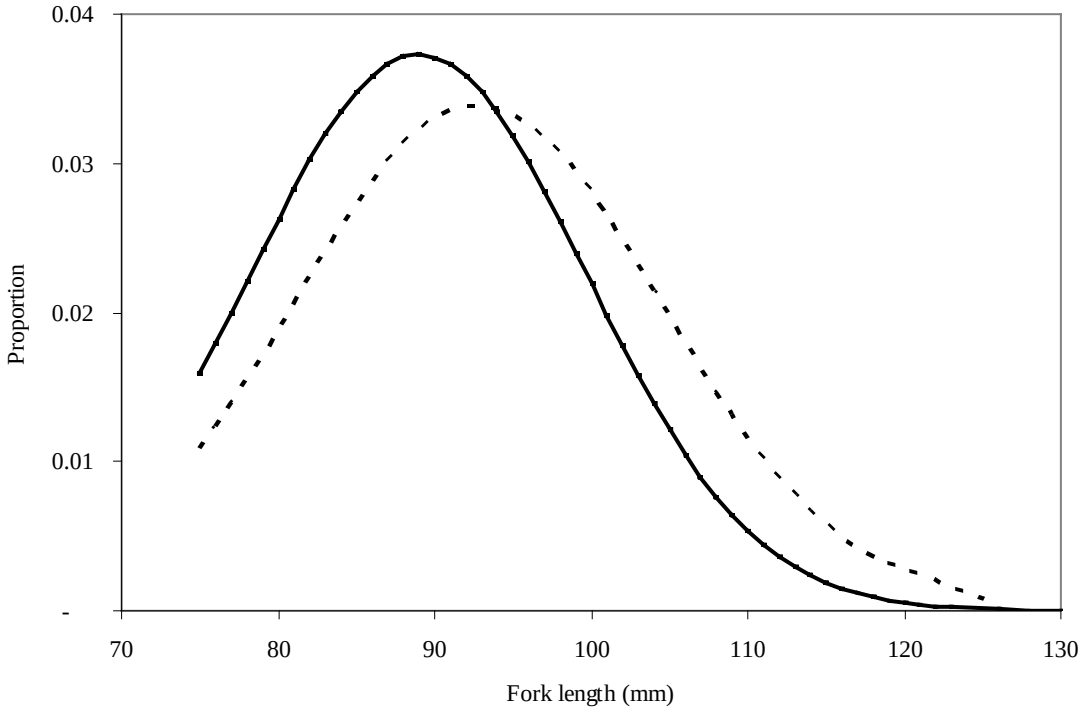

Figure 15–Coho salmon smolt size distributions since 1999. The solid and dotted lines are the averages seen from 1999 to 2002 (88 mm) and 2003 to 2006 (90 mm), respectively.

However, large size did not appear to aid fish. On average, marine survivals from 2003 to 2006 were the lowest seen since 1992 (Appendix F1). Moreover, the length and weight of smolt measured from 1999 to 2006 appeared to have a negligible relationship to marine survival. A condition factor was applied using methods described in Ricker (1975) to compare size of smolt to marine survival and smolt abundance (Figure 16). Health of smolt using a condition factor does not appear to be correlated to either variable, suggesting density-independent survival.

From 1987 to 2000, fish wheels were used to capture adult coho salmon at Canyon Island. During most of these years, budget restrictions and/or water levels resulted in ADF&G operating the fish wheels for only part of September and as a result, inriver run estimates were expanded by using information on fishery performance to estimate the remainder of the escapement through the first week of October. Beginning in 2001, to augment budget shortfalls and improve stock assessment, additional funding from the Alaska Sustainable Salmon Fund (formerly called Southeast Sustainable Salmon Fund) and the Northern Fund was granted to extend the project through the first week of October and to also boost smolt tagging efforts each spring.

When fish wheels were not operable, set gillnets were used to capture adult coho salmon for tagging requirements. These efforts enabled estimation of the inriver run size through the duration of the run, vital to inseason management and necessary for escapement goal analyses.

During periods of low water, the fish wheels do not spin or spin at less than optimal rates; therefore, set gillnets are used to entangle fish for tagging. Low water levels can be generalized as water depths 4 ft or less as measured on the ADF&G water gauge located at Canyon Island.

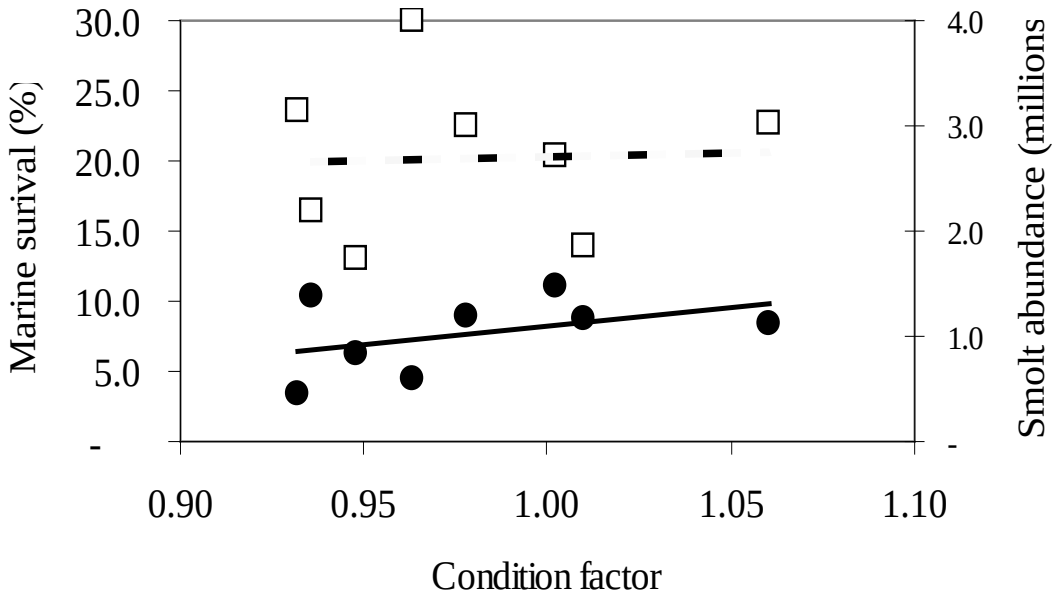

Figure 16.–The condition factor for coho salmon smolt released from 1999 to 2006 compared to marine survival (black dots) and smolt abundance (open boxes). Linear trend lines are fit for each series.

Such levels result in fish wheel revolutions of 2 per minute or less. At higher water levels, generalized as water depths of 6.5 ft or more, fish wheels spin at greater than optimal rates decreasing efficiency. Gillnets are not used at these levels as too much drag occurs on the net, which can increase mortality rates on fish. Equal capture probabilities in the inriver test and Canadian commercial fisheries were attempted by standardizing fishing times each week. However, this was not always possible in the commercial fishery as in some weeks weak run sizes dictated less fishing time, and vice versa.

The estimates of escapement generated by this study were minimum estimates as many fish spawn downstream of Canyon Island. In work performed by Eiler et al. (1993), as much as 22% of the escapement in the Taku River was found to occur below the Canadian border. Using that expansion, coho salmon escapement, marine harvest, and total run were estimated from 2004 through 2007 (Appendix F1). Exploitation rates and marine survival rates for populations spawning downstream of Canyon Island were assumed to be the same as rates for fish spawning above Canyon Island. Studies on downstream tributaries such as Yehring Creek indicated fish that spawn in these tributaries rear in these tributaries (Elliott and Sterritt 1990), making estimates of smolt abundance at Canyon Island germane to populations spawning upstream.

RECOMMENDATIONS

Recent proposed activities in the lower Taku River have highlighted the need to more accurately document fish catches by time and location. Since 1991, juvenile trapping efforts have shown that the lower Taku River provides overwintering habitat for coho and Chinook salmon. Since 1991, 468,893 coho and 561,061 Chinook salmon juveniles have been tagged and released with CWTs in the Taku River. The bulk of the coho and all of the Chinook

salmon juveniles were caught in the mainstem portion of the Taku River from April through June. Because juvenile Chinook salmon are found primarily in this portion of the Taku River each spring, the mainstem was trapped exclusively to maximize the catch of Chinook salmon. It is known that many side channels and tributaries also provide essential habitat for juvenile coho salmon. In addition, some Chinook salmon fry are caught in late May and early June. These are juvenile Chinook salmon that hatched-out earlier in the year in the upriver tributaries and made the inriver migration to the lower river rearing habitat. These fish do not leave fresh water immediately as scale pattern analysis has revealed that over 99% of Taku River Chinook salmon are at least age-1 fish indicating that these fry spend another year in the river. It is also doubtful these small fish swim back upriver. Side channel and tributary sampling efforts have shown that Chinook salmon juveniles are present but in very low numbers. Other fish caught during these minnow trapping efforts include Dolly Varden, sockeye salmon (*O. nerka*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), Eulachon (*Thaleichthys pacificus*), mountain whitefish (*Prosopium williamsoni*), grayling (*Thymallus arcticus*), western brook lamprey (*Lampetra richardsoni*), threespine stickleback (*Gasterosteus aculeatus*), and sculpin (*Cottus* ssp).

We recommend that the minnow trapping effort include the documentation of catches by time and location. Global positioning systems should be used to document the placement of each trap and fish catches by species should be recorded by date and time for each trap. We also recommend that trap placements be identified by habitat category (i.e., Macro and Meso). In time, these data will provide baseline information necessary to adequately address planned activities in the lower Taku River.

Continued efforts to maximize the numbers of smolt tagged with CWTs are recommended to achieve high levels of precision in smolt abundance and adult harvest and exploitation rate estimates. Tagging smolt early each spring covers a greater proportion of smolt emigration and the use of a third minnow trap line substantially increases overall catch. Minnow traps have proven to be size-selective, thus future studies should continue to tag smolt by size and continue to sample scales for age composition analyses. Sampling of adults at Canyon Island using gillnets and fish wheels should also be maximized with catchability rates held nearly consistent throughout the run to increase the precision in estimates of marked fractions. The inriver mark-recapture should continue to be funded to produce escapement estimates from the beginning of the run through the first week of October. Set gillnets have worked well in the absence of fish wheels during low water flows and use should continue when necessary.

ACKNOWLEDGMENTS

We thank the many individuals who participated in this study. We thank Clyde Andrews, Al DeMartini, Jarbo Crete, Dave Dreyer, Shane Rear, Krista Kissner, Jaime Kissner, Bradley Russell, Scott Duffy, John Barton, and Kent Crabtree (ADF&G); Patrick Jackson, Kirstie Falkevitch, Lars Jessup, Sean Stark, Scott Herron, Zack Dixon, and James Grier (DFO) for smolt trapping and tagging; Mike LaFollette, Jerry Owens and Britt Lobdell (ADF&G); Rick Ferguson, Brian Mercer, Marty Strachan, Shawn Hughes, and Ryan Drummond (DFO); and Mike Smarch, Jason Williams, Mark Connor, and Trevor Mitchell (TRTFN) for adult tagging and inriver test and Canadian commercial fishery operations; and the Canadian commercial and aboriginal fishermen for adult tag recoveries; Sandy Johnston and Ian Boyce (DFO) for project oversight and planning. We also thank additional ADF&G staff: Glen Oliver and

Anne Reynolds and their port sampling crews for commercial fisheries CWT recoveries; Mike Jaenicke and Diana Tersteeg and their creel sampling crews for CWT recoveries from the Juneau and Sitka area recreational fisheries; Ron Josephson, Detlef Buettner, Anna Sharp, and the Tag Lab in Juneau for dissecting heads and decoding CWTs and providing sampling supplies and data on CWT recoveries; Sue Millard for aging adult and smolt scales; David Bernard and Randy Mullen for their biometric support; and Stacey Poulson for editing the final manuscript.

REFERENCES CITED

Arnason, A. N., C. W. Kirby, C. J. Schwarz, and J. R. Irvine. 1996. Computer analysis of data from stratified mark-recovery experiments for estimation of salmon escapements and other populations. Canadian Technical Report of Fisheries and Aquatic Sciences 2106:36.

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.

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

Chapman, D. G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. University of California Publication Station 1:131-160.

Darroch, J.N. 1961. Two-sample capture-recapture census when tagging and sampling are stratified. Biometrika 48: 241-60.

Eiler, J. H., M. M. Masuda, and H. R. Carlson. 1993. Stock composition, timing and movement patterns of adult coho salmon in the Taku River drainage, 1992. National Marine Fisheries Service Technical Report, Juneau.

Elliott, S. T. 1992. A Trough Trap for Catching Coho Salmon Smolts Emigrating from Beaver Ponds. North American Journal of Fisheries Management: Vol. 12, No. 4, pp. 837-840.

Elliott, S. T., and D. R. Bernard. 1994. Production of Taku River coho salmon, 1991-1992. Alaska Department of Fish and Game, Fishery Data Series No. 94-1, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-01.pdf

Elliott, S. T., and K. J. Kuntz. 1988. A study of coho salmon in southeast Alaska: Chilkat Lake, Chilkoot Lake, Yehring Creek, and Vallenar Creek. Alaska Department of Fish and Game, Fishery Data Series No. 62, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-062.pdf

Elliott, S. T., A. E. Schmidt, and D. A. Sterritt. 1989. A study of coho salmon in southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 113, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-113.pdf

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

Elliott, S. T., and D. A. Sterritt. 1991. Coho salmon studies in Southeast Alaska, 1990: Auke Lake, Chilkoot Lake, Nahlin River, and Yehring Creek. Alaska Department of Fish and Game, Fishery Data Series No. 91-43, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds91-43.pdf

Gray, P. L., K. R. Florey, J. F. Koerner, and R. A. Marriott. 1978. Coho salmon (*Oncorhynchus kisutch*) fluorescent pigment mark-recovery program for the Taku, Berners, and Chilkat rivers in Southeastern Alaska (1972-1974). Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet 176, Juneau.

Groot, C., and L. Margolis. 1991. Pacific Salmon Life Histories. University of British Columbia Press. Vancouver, B.C.

REFERENCES CITED (Continued)

Holtby, L. B., B. C. Andersen and R. K. Kadowaki. 1990. Importance of smolt size and early ocean growth to interannual variability in marine survival of coho slamon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences, 47: 2181-2194.

Jones III, E. L., S. A. McPherson, D. R. Bernard and I. M. Boyce. 2006. Production of coho salmon from the Taku River, 1999–2003. Alaska Department of Fish and Game, Fishery Data Series No.06-02, Anchorage.

Kelley, M. S., and P. A. Milligan. 1999. Mark-recapture studies of Taku River adult salmon stocks in 1998. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 1J99-21, Douglas.

Koerner, J. F. 1977. The use of coded wire tag injector under remote field conditions. Alaska Department of fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 172, Juneau.

Koo, T. S. Y. 1962. Age designation in salmon. Pages 37-48 [*in*] Studies of Alaska red salmon. University of Washington, Publications in Fisheries, New Series Volume I., Seattle.

Lum, J. L. 2003. Effects of smolt length and emigration timing on marine survival and age at maturity of wild coho salmon (*Oncorhynchus kisutch*) at Auke Creek, Juneau, Alaska. Master of Science Thesis, University of Alaska, Fairbanks, Alaska.

McGregor, A. J., and J. E. Clark. 1988. Migratory timing and escapement of Taku River salmon stocks in 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J88-26, Juneau.

McGregor, A. J., and J. E. Clark. 1989. Migratory timing and escapement of Taku River salmon stocks in 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J89-40, Juneau.

McGregor, A. J., P. A. Milligan, and J. E. Clark. 1991. Adult mark-recapture studies of Taku River salmon stocks in 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 91-05, Juneau.

McPherson, S. A., and D. R. Bernard. 1995. Production of coho salmon from the Taku River, 1993-1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-29, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds95-29.pdf

McPherson, S. A., and D. R. Bernard. 1996. Production of coho salmon from the Taku River, 1994–1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-25, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-25.pdf

McPherson, S. A., D. R. Bernard, and S. T. Elliott. 1994. Production of coho salmon from the Taku River, 1992-1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-38, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-38.pdf

McPherson, S. A., D. R. Bernard, and M. S. Kelley. 1997. Production of coho salmon from the Taku River, 1995-1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-24, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-24.pdf

McPherson, S. A., R. J. Yanusz, D. R. Bernard, and M. S. Kelley. 1998. Production of coho salmon from the Taku River, 1996-1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-18, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-18.pdf

Meehan, W. R., and J. S. Vania. 1961. An external characteristic to differentiate between king and silver salmon juveniles in Alaska. Alaska Dept. of Fish and Game, Division of Biological Research, Informational Leaflet No.1, Juneau.

Mosher, K. H. 1968. Photographic atlas of sockeye salmon scales. U.S. Fish and Wildlife Service, Fishery Bulletin 67:243-280.

REFERENCES CITED (Continued)

Mundy, P. R. 1984. Migratory timing of salmon in Alaska with an annotated bibliography on migratory behavior of relevance to fisheries research. Alaska Department of Fish and Game, Informational Leaflet No. 234, Juneau.

Murphy, M. L., K. V. Koski, J. M. Lorenz, and J. F. Thedinga. 1988. Migrations of juvenile salmon in the Taku River, Southeast Alaska. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Auke Bay Laboratory, NWAFC Processed Report 88-91.

Pollard, W. R., G. F. Hartman, C. Groot, and P. Edgell. 1997. Field identification of coastal juvenile salmonids. Harbour Publishing for the Federal Department of Fisheries and Oceans and Weyerhaeuser Ltd., Madeira Park, BC Canada.

PSC (Pacific Salmon Commission). 1993. Transboundary river salmon production, harvest, and escapement estimates. 1992 Transboundary Technical Committee Report (93-1).

PSC (Pacific Salmon Commission). 1996. Trans-boundary river salmon production, harvest, and escapement estimates, 1995. Transboundary Technical Committee Report (96-1).

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 191: 1-382.

Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. Progressive Fish Culturist 41(3):132-135.

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

Shaul, L. D. 1987. Taku and Stikine River coho salmon (*Oncorhynchus kisutch*) adult escapement and juvenile tagging investigations, 1986. Alaska Department of Fish and Game, Division of Commercial Fisheries, Completion Report for National Marine Fisheries Service Cooperative Agreement No. NA-85-ABH-00050, Juneau.

Shaul, L. D. 1988. Taku River coho salmon (*Oncorhynchus kisutch*) adult escapement and juvenile tagging investigations, 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Completion Report for National Marine Fisheries Service Cooperative Agreement No. NA-87-ABH-00025, Juneau.

Shaul, L. D. 1989. Taku River Coho Salmon Investigations, 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J89-33, Juneau.

Shaul, L. D. 1990. Taku River Coho Salmon Investigations, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 1J90-19, Juneau.

Wendt, K. L., and M. J. Jaenicke. 2011. Harvest estimates for selected marine sport fisheries in Southeast Alaska during 2004. Alaska Department of Fish and Game, Fishery Data Series No. 11-62, Anchorage.

Wendt, K. L., and M. J. Jaenicke. *In prep a*. Harvest estimates for selected marine sport fisheries in Southeast Alaska during 2005. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Wendt, K. L., and M. J. Jaenicke. *In prep b.* Harvest estimates for selected marine sport fisheries in Southeast Alaska during 2006. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Wendt, K. L., and M. J. Jaenicke. *In prep c*. Harvest estimates for selected marine sport fisheries in Southeast Alaska during 2007. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Yanusz, R. J., S. A. McPherson, and D. R. Bernard. 1999. Production of coho salmon from the Taku River, 1997-1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-34, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-34.pdf

Yanusz, R. J., S. A. McPherson, D. R. Bernard, and I. M. Boyce. 2000. Production of coho salmon from the Taku River, 1998/1999. Alaska Department of Fish and Game, Fishery Data Series No.00-31, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-31.pdf

APPENDIX A

Appendix A1.–Bibliography of historical coho salmon stock assessment studies conducted on the Taku River.

Citation	Location	Objective(s)
Eiler et al. 1993	Taku River	Spawning distribution
Elliott and Kuntz 1988	Yehring Creek	1987 smolt samples
		1987 escapement
Elliott et al. 1989	Yehring Creek	1988 harvest and escapement
		1987 smolt abundance and survival
		1988 smolt abundance
	Nahlin River	1988 harvest and escapement
		1988 juvenile tagging
Elliott and Sterritt 1990, 1991	Yehring Creek	1989, 1990 harvest and escapement
		1988, 1989 smolt abundance and survival
		1989, 1990 smolt abundance
Elliott 1992	Yehring Creek	Smolt capture methods
Elliott and Bernard 1994	Taku River	1991 smolt abundance and 1992 adult harvest and escapement
Gray et al. 1978	Moose Creek	Harvest estimate
	Johnson Creek	Harvest estimate
	Yehring Creek	Harvest estimate
	Other tribs.	Harvest estimate
Jones et al. 2006	Taku River	1999-2002 smolt abundance and survival
		2000-2003 harvest and escapement
McGregor and Clark 1988, 1989	Taku River	1987, 1988 escapement
McGregor et al. 1991	Taku River	1989 escapement
McPherson et al. 1994	Taku River	1992 smolt abundance and survival
		1993 harvest and escapement
McPherson and Bernard 1995, 1996	Taku River	1993, 1994 smolt abundance and survival
		1994, 1995 harvest and escapement
McPherson et al. 1997, 1998	Taku River	1995, 1996 smolt abundance and survival
		1996, 1997 harvest and escapement
Murphy et al. 1988	Taku River	1987 smolt tagging
PSC 1993	Taku River	1992 escapement
Shaul 1987	Nahlin River	1986 escapement
		1986 juvenile tagging
	Tatsamenie L.	1986 escapement
Shaul 1987	Tatsamenie L.	1986 juvenile tagging
	Dudidontu R.	1986 escapement
Shaul 1988	Tatsamenie L.	1987 juvenile tagging
Shaul 1989	Nahlin River	1988 harvest
	Mainstem	1988 harvest
	Tatsamenie L.	1988 harvest
	Sheslay R.	1988 harvest
	Yehring Creek	1988 harvest
	U.S. tribs.	1988 escapement
Shaul 1990	Nahlin River	1989 harvest
	Mainstem	1989 harvest
	Tatsamenie L.	1989 harvest
	Yehring Creek	1989 harvest
	U.S. tribs.	1989 escapement
Yanusz et al. 1999	Taku River	1997 smolt abundance and survival
		1998 harvest and escapement
Yanusz et al. 2000	Taku River	1998 smolt abundance and survival
		1999 harvest and escapement

Appendix A2.–Estimating abundance with group-specific rates of being marked and of surviving.

When a population is divided into 2 groups labeled (1) and (2), Petersen's model of a mark-recapture experiment can be expressed as:

$$N_1 + N_2 = (N_1\alpha_1 + N_2\alpha_2)\frac{N_1\alpha_1 S_1\beta_1 + N_2\alpha_2 S_2\beta_2 + N_1(1-\alpha_1)S_1\beta_1 + N_2(1-\alpha_2)S_2\beta_2}{N_1\alpha_1 S_1\beta_1 + N_2\alpha_2 S_2\beta_2}$$

where N is abundance, α is the rate at which members of the group are marked (tagged), S the rate at which members survive to return as adults, and β the rate at which surviving members are captured. If all adults have an equal probability of being captured in the experiment regardless of group membership, and of their having or not having a mark, then $\beta_1 = \beta_2 = \beta$, and the equation above reduces to:

$$N_1 + N_2 = (N_1\alpha_1 + N_2\alpha_2)\frac{N_1\alpha_1 S_1 + N_2\alpha_2 S_2 + N_1(1-\alpha_1)S_1 + N_2(1-\alpha_2)S_2}{N_1\alpha_1 S_1 + N_2\alpha_2 S_2}$$

Relationships between capture rates and between survival rates by group can be expressed as $\alpha_2 = \alpha_1\lambda$ and $S_2 = S_1\delta$, respectively. Plugging these relationships into the equation immediately above and simplifying produces:

$$N_1 + N_2 = \frac{(N_1 + \lambda N_2)(N_1 + \delta N_2)}{N_1 + \lambda\delta N_2}$$

Note that this result is false only when $\lambda \neq 1$ (i.e., $\alpha_1 \neq \alpha_2$) and $\delta \neq 1$ (i.e., $S_1 \neq S_2$), that is, when groups of smolt are tagged at different rates and survive at different rates.

Note that for an estimate using Chapman's modification of Petersen's model, $\hat{N} = (M_1 + M_2 + 1)(C + 1)/(R_1 + R_2 + 1)$ where M is the number marked by group, C the number inspected for marks, and R the number of marks recovered by group. Since $\lambda > 1$ and $\delta > 1$, $N > \hat{N}$. However, if group (1) had had the same marking rate as group (2), λM_1 smolt would have been marked and λR_1 would have been recaptured as adults. Plugging an estimate for λ into the model produces a rescaled estimate of abundance:

$$\hat{N} = \frac{(\hat{\lambda}M_1 + M_2 + 1)(C + 1)}{\hat{\lambda}R_1 + R_2 + 1} - 1$$

The expected value of $\hat{N}$ is N because in the rescaled situation the two groups have the same effective marking rate. Unfortunately, values for R must often be estimated because not all recaptured adults can be assigned to a smolt group; tags are shed or heads are lost before tags can be retrieved and decoded. If there are R_3 of such recaptured fish of unknown origin, a naïve adjustment to the estimator would be:

$$\hat{N} = \frac{(\hat{\lambda}M_1 + M_2 + 1)(C + 1)}{\hat{\lambda}(R_1 + \pi R_3) + R_2 + (1-\pi)R_3 + 1} - 1$$

where π is the fraction of recaptured fish from group (1) recaptured as adults. Tags summed by group no matter how recovered from adults can be used to estimate π.

Appendix A3.–Estimation of the ratio of catchabilities between large and small smolt.

The fraction p of adults with 1-freshwater age (age-1.) can be expressed as:

$$p = \frac{N_1\phi_1 S_1 + N_2\phi_2 S_2}{N_1 S_1 + N_2 S_2} = \frac{N_1\phi_1 S_1 + N_2\phi_2\delta S_1}{N_1 S_1 + N_2\delta S_1} = \frac{N_1\phi_1 + N_2\phi_2\delta}{N_1 + N_2\delta}$$

where N is smolt number by smolt size group, S their survival rate, ϕ the fraction of the smolt group comprised of age-1. smolt, and δ is the ratio of survival rates S_2/S_1. This relationship simplifies to:

$$\frac{N_1}{N_2} = \frac{\delta(\phi_2 - p)}{(p - \phi_1)}$$

If α is the capture rate of smolt, then $M_1 = \alpha_1 N_1$ and $M_2 = \alpha_2 N_2$, and:

$$\frac{N_1}{N_2} = \frac{M_1}{M_2}\frac{\alpha_2}{\alpha_1} = \frac{\delta(\phi_2 - p)}{(p - \phi_1)}$$

If λ is the ratio of catchability for the 2 groups of smolt, then $\lambda = \alpha_2/\alpha_1$ since fishing effort by definition is equal for both groups. Substitution creates:

$$\lambda = \frac{M_2\delta(\phi_2 - p)}{M_1(p - \phi_1)}$$

A naïve estimate of $\hat{\lambda}$ is therefore:

$$\hat{\lambda} = \frac{M_2\hat{\delta}(\hat{\phi}_2 - \hat{p})}{M_1(\hat{p} - \hat{\phi}_1)}$$

Noting that the estimate for the ratio of survival rates is:

$$\hat{\delta} = \frac{\hat{T}_2}{M_2}\frac{M_1}{\hat{T}_1}$$

A simpler estimate for λ is:

$$\hat{\lambda} = \frac{\hat{T}_2(\hat{\phi}_2 - \hat{p})}{\hat{T}_1(\hat{p} - \hat{\phi}_1)}$$

Appendix A4.–Listing of QuickBASIC program SMLTTAKU.BAS.

Program is initialized to bootstrap the estimate of abundance for the stock of Taku River coho salmon smolt outmigrating in 2003.

```
10 CLS
60 OPEN "0", #1, "TakCoh03.TXT"
100 DIM CDF(10), N(10), PHI(2), PHIP(2)
150 RANDOMIZE
190 REM ----------------------------------------------Inputs
195 NITER = 10000
196 PI = 91 / (91 + 163)
197 N(2) = 16034 - 91
200 N(3) = 16505 - 163
210 N(4) = 16
220 N(5) = 15
230 N(6) = 3 * PI
251 N(7) = 3 * (1 - PI)
261 N(8) = 91 - 16 - PI * 3
265 N(9) = 163 - 15 - (1 - PI) * 3
266 N(10) = 3163 - 16 - 15 - 3
275 PHI(1) = 141 / 141
276 PHI1R = 141
280 PHI(2) = 112 / 187
281 PHI2R = 187
283 P = 708 / 790
284 ASMPLS = 790
285 REM ---------------------------------------Notation
286 REM N(1-10), phi, pi, R, M, T, C, LAMBDA as defined in report
288 REM ASMPLS is the number of adults sampled to determine age composition
290 REM ---------------------------------------Estimate Abundance
292 R1 = N(4): R2 = N(5): R3 = N(6) + N(7)
297 T1 = N(8) + R1 + N(6): T2 = N(9) + R2 + N(7)
303 C = N(10) + R1 + R2 + R3
305 M1 = N(2) + T1: M2 = N(3) + T2
307 PI = T1 / (T1 + T2)
312 A = (PHI(2) - P) * T2 / (P - PHI(1)) / T1
320 NS = (A * M1 + M2 + 1) * (C + 1) / (A * (R1 + PI * R3) + R2 + (1 - PI) * R3 + 1)
```

```
325 PRINT X; R1; R2; R3; T1; T2; M1; M2; C; PI; PHI(1); PHI(2); P; A; NS
326 PRINT #1, X; R1; R2; R3; T1; T2; M1; M2; C; PI; PHI(1); PHI(2); P; A; NS
330 REM ----------Set up CDF
332 N(1) = NS - M1 - M2 - C + R1 + R2 + R3
335 CDF(1) = N(1) / NS
340 FOR I = 2 TO 10
350 CDF(I) = N(I) / NS + CDF(I - 1)
352 NEXT I
460 REM ----------Iterate ===== START HERE
465 NPSQ = NPSUM = NCSQ = NCSUM = LASQ = LASUM =0
470 FOR I = 1 TO NITER
480 FOR J = 1 TO 10: N(J) = 0: NEXT J
490 FOR J = 1 TO NS
500 X = RND
510 FOR K = 1 TO 9
520 IF X < CDF(K) THEN N(K) = N(K) + 1: GOTO 540
530 NEXT K
535 N(10) = N(10) + 1
540 NEXT J
550 REM ----------Recalculate statistics
555 R1 = N(4): R2 = N(5): R3 = N(6) + N(7)
560 T1 = N(8) + R1 + N(6): T2 = N(9) + R2 + N(7)
565 C = N(10) + R1 + R2 + R3
570 M1 = N(2) + T1: M2 = N(3) + T2
575 PI = T1 / (T1 + T2)
576 REM ----------Simulate phi's and p
578 SN = PHI1R : SS = 0
579 FOR J = 1 TO SN: IF RND < PHI(1) THEN SS = SS + 1
580 NEXT J: PHIP(1) = SS / SN
581 SN = PHI2R : SS = 0
583 FOR J = 1 TO SN: IF RND < PHI(2) THEN SS = SS + 1
584 NEXT J: PHIP(2) = SS / SN
588 SS = 0
```

-continued-

```
590 FOR J = 1 TO ASMPLS: IF RND < P THEN SS = SS + 1
592 NEXT J: PP = SS / ASMPLS
605 LAMBDA = (PHIP(2) - PP) * T2 / (PP - PHIP(1)) / T1
610 NP = (LAMBDA * M1 + M2 + 1) * (C + 1) / (LAMBDA * (R1 + PI * R3) + R2 + (1 - PI) * R3 + 1)
611 NC = (M1 + M2 + 1) * (C + 1) / (R1 + R2 + R3 + 1) - 1
710 REM ------------Tally statistics
720 NPSQ = NP * NP + NPSQ: NPSUM = NP + NPSUM
721 NCSQ = NC * NC + NCSQ: NCSUM = NC + NCSUM
722 LASQ = LAMBDA * LAMBDA + LASQ: LASUM = LAMBDA + LASUM
725 PRINT #1, I; R1; R2; R3; T1; T2; M1; M2; C; PI; PHIP(1); PHIP(2); PP; LAMBDA; NP; NC
726 PRINT I; R1; R2; R3; T1; T2; M1; M2; C; PI; PHIP(1); PHIP(2); PP; LAMBDA; NP; NC
730 NEXT I
740 REM ------------------------------------Output statistics
750 NPB = NPSUM / NITER: SENB = SQR((NPSQ - NPSUM * NPSUM / NITER) / (NITER - 1))
751 NCB = NCSUM / NITER: SENC = SQR((NCSQ - NCSUM * NCSUM / NITER) / (NITER - 1))
752 LAB = LASUM / NITER: SELA = SQR((LASQ - LASUM * LASUM / NITER) / (NITER - 1))
760 PRINT NPB; SENB
761 PRINT NCB; SENC
762 PRINT LAB; SELA
770 END
```

APPENDIX B

Appendix B1.–Number of salmon smolt caught in minnow traps near Canyon Island on the Taku River during 2003. Days with trap sets but no catches indicate that fish caught were held 1, 2, or 3 days until enough were accumulated for tagging.

		Daily catch		Catch per trap		Air temperature (°C)			Water	
Date	Trap sets	Coho	Chinook	Coho	Chinook	Min.	Max.	Precipitation (inches)	Temp. (°C)	Stage (ft.)
12-Apr						-2.8				
13-Apr						-2.2				
14-Apr	20					-2.2				
15-Apr	65					1.1	10.6		4.0	-2.4
16-Apr	90					1.7	8.3		3.0	-2.2
17-Apr	109	2,023	1,070	7	4	-0.6	10.6	4.0	4.0	-2.1
18-Apr	108	903	490	8	5	0.0	7.2		4.0	-2.3
19-Apr	142	1,144	725	8	5	1.1	11.7	0.1	4.0	-2.3
20-Apr	173	1,381	886	8	5	-2.2	13.3		4.0	-2.1
21-Apr	168	1,522	1,139	9	7	-1.7	13.3		4.5	-2.0
22-Apr	169	1,651	1,045	10	6	1.1	11.1	1.0	5.0	-1.8
23-Apr	170	1,617	941	10	6	2.2	18.9		5.0	-1.8
24-Apr	177	1,672	1,094	9	6	0.0	19.4		5.0	-1.7
25-Apr	181	1,603	644	9	4	6.7	21.7		5.0	0.0
26-Apr	143	1,060	241	7	2	1.7			4.5	1.3
27-Apr	128					3.9			4.5	2.3
28-Apr	127	1,017	258	4	1	-0.6			5.0	2.8
29-Apr	149	760	188	5	1	-0.6			5.0	2.8
30-Apr	166	512	190	3	1	0.0			5.0	3.1
1-May	191	811	266	4	1	5.6			7.0	3.8
2-May	183	652	271	4	1	-2.8			5.0	3.9
3-May	186					2.8		2.0	5.0	3.2
4-May	192	1,268	779	3	2	1.7			5.0	2.2
5-May	192	1,011	1,045	5	5	-3.9			5.0	1.5
6-May	195	1,275	1,289	7	7	4.4			5.5	0.0
7-May	214	1,139	1,333	5	6	-2.2			6.0	0.1
8-May	222	1,117	1,621	5	7	-1.7			6.5	0.1
9-May	227	956	1,485	4	7	-0.6			7.0	0.1
10-May	226	695	1,230	3	5	1.7			7.0	1.2
11-May	226					8.3			7.0	1.8
12-May	205	957	976	2	2	6.1		1.2	8.0	2.4
13-May	137					4.4		0.5	7.0	2.9
14-May	146					2.2		0.2	7.0	2.5
15-May	162	575	212	1	0	2.8		0.1	7.0	2.0
16-May	167					0.0		1.0	7.0	1.5
17-May	164	682	350	2	1	-1.7			7.0	1.2
18-May	169	703	1,057	4	6	-0.6			7.0	1.2
19-May	199	660	995	3	5	0.6			8.0	1.2
20-May	200					0.6			8.0	1.4
21-May	203	681	708	2	2	0.6			8.0	1.8
22-May	194	590	999	3	5	6.7		4.0	8.0	2.1
23-May	200					7.8		5.0	8.0	2.8
24-May	139	558	1,462	2	4	8.3		0.3	8.0	2.7
25-May	135					6.1		0.5	8.0	3.8
26-May	104	320	470	1	2	6.7		0.2	7.0	3.9
27-May	106					5.6		0.2	7.5	3.4

-continued-

Appendix B1.–Page 2 of 2.

Date	Trap sets	Daily catch		Catch per trap		Air temperature (°C)		Precipitation (inches)	Water	
		Coho	Chinook	Coho	Chinook	Min.	Max.		Temp. (°C)	Stage (ft)
28-May	105	502	851	2	4	4.4			8.0	3.1
29-May	105	281	718	3	7	10.0		0.3	8.0	3.1
30-May	147					7.2		0.1	8.0	3.8
31-May	143	274	815	1	3	8.3			8.0	4.8
1-Jun	97					7.8		6.0	6.0	7.5
2-Jun	-	7	24	0	0	7.2		0.2	8.0	5.6
3-Jun	36					7.8		4.0	8.5	4.6
4-Jun	81					3.9			9.0	4.3
5-Jun	101	64	138	0	1	10.0			9.0	4.1
6-Jun	78					12.2		0.2	9.0	5.2
7-Jun	48	15	101	0	1	8.9		2.0	9.0	7.1
8-Jun						6.7			9.0	7.2
9-Jun						5.6			9.0	6.4

Appendix B2.–Estimated marine harvest of adult coho salmon bound for the Taku River above Canyon Island in 2004. Calculations follow equations in Table 2 of Bernard and Clark (1996) with 0.010 used as an estimate of θ and 0.048 for $G(\theta^{-1})$. Definitions of notation used to label these and other statistics are immediately below. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

a_i = number of adults missing adipose fins in a sample from catch in a stratum

a_i' = number of heads that arrive at Juneau for dissection (subset of a_i) in a stratum

r_i = number of adults from the stock harvested in a stratum in year j

m_{ci} = number of CWTs with the appropriate code(s) (subset of t_i') in a stratum

n_i = number of adults caught in a stratum inspected for missing adipose fins

t_i = number of heads with tags detected magnetically (subset of a_i') in a stratum

t_i' = number of CWTs found through dissection and decoded (subset of t_i) in a stratum

θ = fraction of the stock with CWTs

$G(\theta^{-1})$ = squared coefficient of variation for the estimate of $1/\theta$

TROLL FISHERY

Stat. weeks	Dates	Per.	Quad.	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
28-32	7/4-8/7	3	NW	547,304		118,686	1,587	1,560	1,230	1,229	28	13,413	3,667	54%
33-39	8/8-9/25	4	NW	690,256		149,828	2,760	2,710	2,229	2,228	99	47,416	10,624	44%
28-32	7/4-8/7	3	NE	97,303		15,163	195	190	145	145	1	672	672	196%
33-39	8/8-9/25	4	NE	131,422		27,257	443	436	333	332	1	501	501	196%
Subtotal troll fishery				1,466,285		310,934	4,985	4,896	3,937	3,934	129	62,002	11,270	35.6%

SEINE FISHERY

Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
33	8/8-8/14	109	5,926		2,348	20	20	17	17	1	258	257	196%
34	8/15-8/21	110	2,344		306	3	3	2	2	1	782	781	196%
28	7/4-7/10	112	2,192		348	5	5	3	3	1	643	642	196%
33	8/8-8/14	112	10,916		3,616	43	43	38	38	2	616	444	141%
34	8/15-8/21	112	22,598		5,207	52	52	44	44	1	443	442	196%
35	8/22-8/28	112	25,332		3,839	70	70	61	61	2	1,347	971	141%
36	8/29-9/4	112	1,469		476	8	8	7	7	2	630	454	141%
32	8/1-8/7	114	1,478		489	6	6	4	4	2	617	444	141%
Subtotal seine fishery			72,255		16,629	207	207	176	176	12	5,334	1,681	61.8%

SPORT FISHERY

Biweek	Dates	Derby	Area	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
17	8/16-8/29	No	Sitka	14,453	9,473,235	3,488	52	51	48	48	1	431	431	196%
14-18	7/5-9/12	No	Gust./Elfin[a]	9,554		4,076	55	55	48	48	4	957	506	196%
15	7/19-8/1	No	Juneau	1,970	288,362	424	2	2	2	1	1	948	948	196%
16	8/2-8/15	No	Juneau	4,989	666,471	967	7	7	6	6	1	526	526	141%
17	8/16-8/29	No	Juneau	3,055	511,162	4,019	88	87	73	73	1	78	78	195%
17	8/16-8/29	Yes	Juneau[a]	4,019		654	11	11	8	8	17	10,659	3,318	61%
18	8/30-9/12	No	Juneau	2,063	340,915	507	22	18	16	16	1	507	507	196%
Subtotal sport fishery				40,103	11,280,145	14,135	237	231	201	200	26	14,107	3,590	49.9%

-continued-

Appendix B2.–Page 2 of 2.

GILLNET FISHERY													
Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
28	6/29-7/5	115	120		181	1	1	1	1	1	68	67	195%
30	8/3-8/9	111	1,099		485	2	2	1	1	1	231	231	196%
33	8/10-8/16	111	2,873		840	6	6	3	3	3	1,047	628	118%
35	8/24-8/30	111	4,935		818	17	17	12	12	4	2,462	1,303	104%
36	8/31-9/6	111	8,160		1,756	22	21	18	18	13	6,457	2,182	66%
37	8/31-9/6	115	8,054		1,027	52	52	50	50	1	800	800	196%
38	9/7-9/13	115	20,314		3,071	142	142	135	135	12	8,099	2,810	68%
38	9/7-9/13	111	10,901		1,618	28	25	22	22	2	1,540	1,110	141%
39	9/14-9/20	115	12,126		2,000	92	92	87	87	14	8,661	2,859	67%
39	9/14-9/20	111	4,097		1,305	34	33	26	26	4	1,320	698	104%
40	9/28-10/4	115	954		353	26	26	24	24	1	276	275	196%
Subtotal gillnet fishery			73,633		13,454	422	417	379	379	56	30,961	5,041	31.9%
TOTAL			1,652,276	11,280,145	355,152	5,851	5,751	4,693	4,689	223	112,404	12,967	24.0%

[a] Catch sampling program; variance of harvest not available.

[b] All of the Juneau derby harvest is sampled, thus the variance is zero.

Appendix B3.–Number of coho salmon examined along with adipose fin clips and valid coded wire tags sampled at Canyon Island and in the test fishery in 2004.

		Canyon Island[a]				Test fishery[b]			
Date	Stat week	Number examined	Adipose clips	Number valid	Tag codes	Number examined	Adipose clips	Number valid	Tag codes
7/4	28	1							
7/5	28	1							
7/6	28	1							
7/7	28	2							
7/8	28	0							
7/9	28	4							
7/10	28	1							
7/11	29	3							
7/12	29	5							
7/13	29	9							
7/14	29	3							
7/15	29	15							
7/16	29	15							
7/17	29	20							
7/18	30	20							
7/19	30	14							
7/20	30	19							
7/21	30	21							
7/22	30	14							
7/23	30	5							
7/24	30	9							
7/25	31	21							
7/26	31	38							
7/27	31	13							
7/28	31	5							
7/29	31	9							
7/30	31	30							
7/31	31	64	1	1	40835				
8/1	32	11							
8/2	32	10							
8/3	32	9							
8/4	32	29	1	1	40835				
8/5	32	22							
8/6	32	23							
8/7	32	33							
8/8	33	40							
8/9	33	28							
8/10	33	19							
8/11	33	18							
8/12	33	30	1	1	40832				
8/13	33	43							

-continued-

Appendix B3.–Page 2 of 3.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[b] Number examined	Adipose clips	Number valid	Tag codes
8/14	33	36	1	1	40835				
8/15	34	32							
8/16	34	41	1	1	40835				
8/17	34	17							
8/18	34	67							
8/19	34	145	1	1	40834				
8/20	34	120							
8/21	34	53							
8/22	35	34	1	1	40835				
8/23	35	38							
8/24	35	80							
8/25	35	33							
8/26	35	38							
8/27	35	5							
8/28	35	8							
8/29	36	25							
8/30	36	51	1	1	40834				
8/31	36	30	1	1	40831				
9/1	36	41							
9/2	36	38							
9/3	36	36							
9/4	36	126	1	1	40834				
9/5	37	55	2	1	40835				
					No tag				
9/6	37	31	1	1	40832				
9/7	37	19							
9/8	37	29							
9/9	37	5	1	1	40834				
9/10	37	6	1	1	40831				
9/11	37	0							
9/12	38								
9/13	38								
9/14	38	60	1	1	40832				
9/15	38	67	1	1	40831				
9/16	38	70	1	1	40835				
9/17	38	47							
9/18	38	92	2	2	40831				
					40835				
9/19	39								
9/20	39	50							
9/21	39	6							
9/22	39	63	1	1	40832				

-continued-

Appendix B3.–Page 3 of 3.

		Canyon Island[a]				Test fishery[b]			
Date	Stat week	Number examined	Adipose clips	Number valid	Tag codes	Number examined	Adipose clips	Number valid	Tag codes
9/23	39	151	2	2	40831				
					40835				
9/24	39	76							
9/25	39	59	1	1	40831				
9/26	40	59	1	1	40834				
9/27	40	36							
9/28	40	38							
9/29	40	70	1	1	40831				
9/30	40	67	3	2	40831				
					40832				
					No tag				
10/1	40	60	2	1	40834				
					No tag				
10/2	40	28	1	1	40831				
10/3	41	107							
10/4	41	41	2	2	40831				
					40832				
Total		3,163	34	31					

[a] At Canyon, all adipose-finclipped coho salmon were sacrificed for CWT sampling.

[b] In the test fishery, fish were not sampled for adipose fin clips in 2004.

Appendix B4.–Estimated harvests of coho salmon bound for the Taku River above Canyon Island in 2004 in the marine commercial troll and gillnet fisheries by statistical week. Harvest in the troll fishery was approximated by weighting period catches by the number of coded wire tags recovered in a statistical week

		Troll		Gillnet		Total		Weekly proportion of harvest			Weekly proportion of harvest times statistical week		
Statistical week	Ending date	Tags	Harvest	Tags	Harvest	Tags	Harvest	Troll	Gillnet	Total	Troll	Gillnet	Total
27	7/3												
28	7/10	2	971	1	553	3	1,524	0.02	0.02	0.02	0.44	0.50	0.46
29	7/17	7	3,400			7	3,400	0.05		0.04	1.59		1.06
30	7/24	2	971	1	553	3	1,524	0.02	0.02	0.02	0.47	0.54	0.49
31	7/31	7	3,400			7	3,400	0.05		0.04	1.70		1.13
32	8/7	11	5,343			11	5,343	0.09		0.06	2.76		1.84
33	8/14	7	3,321	3	1,659	10	4,980	0.05	0.05	0.05	1.77	1.77	1.77
34	8/21	16	7,591			16	7,591	0.12		0.08	4.16		2.78
35	8/28	12	5,693	4	2,211	16	7,905	0.09	0.07	0.09	3.21	2.50	2.98
36	9/4	31	14,707	13	7,187	44	21,895	0.24	0.23	0.24	8.54	8.36	8.48
37	9/11	17	8,065	1	553	18	8,618	0.13	0.02	0.09	4.81	0.66	3.43
38	9/18	8	3,795	14	7,740	22	11,536	0.06	0.25	0.12	2.33	9.50	4.72
39	9/25	10	4,744	18	9,952	28	14,696	0.08	0.32	0.16	2.98	12.54	6.17
40	10/2			1	553	1	553		0.02	0.01		0.71	0.24
41	10/9												
	Total	130	62,002	56	30,961	186	92,963	1.00	1.00	1.00	34.76	37.07	35.53
								Estimated mean date of harvest			8/20/04	9/6/04	8/26/04

Appendix B5.–Number of marked coho salmon released at Canyon Island and recaptured and examined for marks in the inriver test and Canadian commercial fisheries by statistical week in 2004.

Release statistical week	Date	Number of fish released	Recovery statistical week								
			27-30	31	32	33	34	35	36	37	38-41
28-29	7/4–7/17	76	17	2							
30	7/18–7/24	89	1	8							
31	7/25–7/31	161			28	3	1				
32	8/1–8/7	118				11	4				
33	8/8–8/14	183				4	6	6			
34	8/15–8/21	405						36	4	1	
35	8/22–8/28	208						9	7		
36	8/29–9/4	303							10	11	1
37-41	9/5–10/9	1,222								1	38
Total		2,765	18	10	28	18	11	51	21	13	39
Marked percent			3.0	1.9	5.3	2.4	1.5	2.5	1.6	2.1	1.8
Number of fish examined			593	523	528	743	712	2,036	1,303	629	2,167

APPENDIX C

Appendix C1.–Number of salmon smolt caught in minnow traps near Canyon Island on the Taku River during 2004. Days with trap sets but no catches indicate that fish caught were held 1, 2, or 3 days until enough were accumulated for tagging.

		Daily catch		Catch per trap		Air temperature (°C)			Water	
Date	Trap sets	Coho	Chinook	Coho	Chinook	Min.	Max.	Precipitation(inches)	Temp. (°C)	Stage (ft.)
8-Apr						3.3	12.8			
9-Apr						-2.8	7.2			
10-Apr						1.7	7.8			
11-Apr						-0.6	11.1			
12-Apr	21	165	238	8	11	1.1	8.9			
13-Apr	79	486	698	6	9	1.1			3.0	
14-Apr	124					3.3			3.0	
15-Apr	118	755	1,085	6	9	0.6			4.0	-1.3
16-Apr	145					-4.4			4.0	-1.3
17-Apr	178	915	1,314	5	7	1.1		0.0	4.0	-1.5
18-Apr	191	524	753	3	4	1.1		0.1	4.0	-1.5
19-Apr	191	788	1,132	4	6	0.0			3.5	-1.3
20-Apr	190	1,013	1,455	5	8	-3.9			3.5	-1.4
21-Apr	194	579	832	3	4	-1.1			4.5	-1.3
22-Apr	194	667	958	3	5	0.0			4.5	-1.0
23-Apr	198	587	843	3	4	0.0		0.4	4.0	-0.9
24-Apr	198	665	955	3	5	1.7		0.2	4.5	-0.9
25-Apr	193	698	1,003	4	5	1.7		0.6	4.5	0.8
26-Apr	203	625	898	3	4	1.7		1.2	4.5	0.2
27-Apr	194	663	952	3	5	1.7		0.2	4.5	0.7
28-Apr	198					4.4		0.0	4.5	0.8
29-Apr	197	977	1,403	5	7					
30-Apr	205	633	909	3	4					
1-May	201	633	909	3	5	1.7			4.0	1.8
2-May	202					5.0		0.0	5.0	2.9
3-May	196	611	878	3	4	2.8		0.0	6.0	3.4
4-May	191					2.8			5.5	3.8
5-May	191	288	414	2	2	-0.6			5.0	3.9
6-May	198					1.7			5.5	3.3
7-May	197	540	776	3	4	3.9			5.5	3.2
8-May	204					4.4			6.0	3.7
9-May	207	533	766	3	4	8.3			5.5	4.3
10-May	207	349	501	2	2	3.3		0.0	5.5	4.5
11-May	208	474	681	2	3	1.7			5.5	4.3
12-May	205	292	419	1	2	1.7			6.0	4.3
13-May	208					1.7			7.0	4.8
14-May	200	237	340	1	2	3.9			7.0	5.8
15-May	162					1.7			7.0	6.8
16-May	142					5.0			7.0	7.2
17-May	147	120	172	1	1	7.2			7.5	7.3
18-May	147					7.2			7.5	7.3
19-May	168	178	256	1	2	7.2			7.5	7.5
20-May	175					3.3			7.5	8.3
21-May	94	133	191	1	2	3.9			7.5	9.5
22-May	64					3.9			6.5	9.4
23-May	106	115	165	1	2	2.8			7.5	8.7

-continued-

Appendix C1.–Page 2 of 2.

Date	Trap sets	Daily catch		Catch per trap		Air temperature (°C)		Precipitation (inches)	Water	
		Coho	Chinook	Coho	Chinook	Min.	Max.		Temp. (°C)	Stage (ft)
24-May	145	151	217	1	1	4.4			8.0	8.8
25-May	173	97	139	1	1	10.0		0.3	7.5	9.4
26-May	150	60	86	0	1	9.4		0.2	7.0	10.4
27-May	122					8.3		0.0	7.5	9.8
28-May	133	73	105	1	1			0.0	7.5	8.9
29-May	149	109	157	1	1				8.0	8.3
30-May	158								6.0	8.6
31-May	154	103	148	1	1			0.0	7.0	7.3
1-Jun	119	102	147	1	1				7.5	6.5
2-Jun	133	104	149	1	1			0.0	8.0	6.1
3-Jun	148	63	90	0	0			0.1	8.0	5.6
4-Jun	151								8.5	5.4
5-Jun	108	11		0						
Total	9,074	23,078	16,116					3.33		
Mean				1.8	2.6					

Appendix C2.–Estimated marine harvest of adult coho salmon bound for the Taku River above Canyon Island in 2005. Calculations follow equations in Table 2 of Bernard and Clark (1996) with 0.0046 used as an estimate of θ and 0.0708 for G(θ^{-1}). Definitions of notation used to label these and other statistics are immediately below. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

a_i	=	number of adults missing adipose fins in a sample from catch in a stratum
a_i'	=	number of heads that arrive at Juneau for dissection (subset of a_i) in a stratum
r_i	=	number of adults from the stock harvested in a stratum in year *j*
m_{ci}	=	number of CWTs with the appropriate code(s) (subset of t_i') in a stratum
n_i	=	number of adults caught in a stratum inspected for missing adipose fins
t_i	=	number of heads with tags detected magnetically (subset of a_i') in a stratum
t_i'	=	number of CWTs found through dissection and decoded (subset of t_i) in a stratum
θ	=	fraction of the stock with CWTs
$G(\theta^{-1})$	=	squared coefficient of variation for the estimate of $1/\theta$

TROLL FISHERY

Stat. weeks	Dates	Per.	Quad.	H	v(H)	n	A	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
29-33	7/10-8/13	3	NW	646,267		181,111	2,238	2,194	1,614	1,609	17	13,415	4,750	69%
34-37	8/14-9/10	4	NW	405,055		102,640	1,420	1,404	1,131	1,128	26	22,487	7,339	64%
38-39	9/11-9/24	5	NW	127,713		39,415	737	729	571	571	15	10,619	3,868	71%
Subtotal troll fishery				1,179,035		323,166	4,395	4,327	3,316	3,308	58	46,521	9,559	40%

SEINE FISHERY

Stat.week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
30	8/8-8/14	114	3,584		693	11	11	8	8	1	1,118	1,117	196%
34	8/15-8/21	112	10,139		3,887	54	54	42	41	1	577	577	196%
35	8/1-8/7	112	27,566		2,266	47	47	39	39	1	2,629	2,629	196%
Subtotal seine fishery			41,289		6,846	112	112	89	88	3	4,324	2,913	132%

SPORT FISHERY

Biweek	Dates	Derby	Area	H	v(H)	n	A	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
16	8/1-8/14	No	Elfin Cove[a]	3,485		697	15	15	10	10	1	1,081	1,080	196%
15	7/18-7/31	No	Juneau	5,019	697,418	1,250	9	9	8	8	1	868	867	196%
16	8/1-8/14	Yes	Juneau[b]	4,841		4,841	39	39	22	22	3	648	399	121%
16	8/1-8/14	No	Juneau	4,418	1,176,433	734	11	10	9	9	1	1,431	1,430	196%
17	8/15-8/28	No	Juneau	3,679	649,410	1,341	19	18	17	17	1	626	625	196%
Subtotal sport fishery				21,442	2,523,261	8,863	93	91	66	66	7	4,653	2,125	90%

-continued-

Appendix C2.–Page 2 of 2.

GILLNET FISHERY													
Stat. week	**Dates**	**District**	***H***	**v(H)**	**n**	**A**	**a'**	**t**	**t'**	m_c	$\hat{r}$	**SE($\hat{r}$)**	**RP($\hat{r}$)**
29	7/10-7/16	115	105		168	1	1	1	1	1	135	135	195%
30	7/17-7/23	115	34		94	2	2	2	2	2	156	114	143%
33	8/7-8/13	111	1,797		285	1	1	1	1	1	1,363	1,362	196%
35	8/21-8/27	111	1,733		91	1	1	1	1	1	4,116	4,115	196%
36	8/28-9/3	111	3,010		514	2	2	2	2	2	2,531	1,851	143%
37	9/4-9/10	111	3,682		962	10	9	9	9	5	4,595	2,327	99%
38	9/11-9/17	111	2,850		917	16	14	14	14	4	3,071	1,690	108%
39	9/18-9/24	115	6,561		1,501	75	75	74	73	3	2,873	1,771	121%
40	9/25-10/1	115	5,459		1,850	57	55	52	52	1	661	660	196%
40	9/25-10/1	111	1,318		402	4	4	4	4	3	2,126	1,311	121%
41	10/2-10/8	115	1,733		438	8	8	8	8	2	1,710	1,251	143%
Subtotal gillnet fishery			28,894		7,854	178	173	169	168	26	23,545	6,117	51%
TOTAL			,270,660	2,523,261	346,729	4,778	4,703	3,640	3,630	94	79,045	11,908	29.5%

[a] Catch sampling program; variance of harvest not available.

[b] All of the Juneau derby harvest is sampled thus the variance is zero.

Appendix C3.–Number of coho salmon examined along with adipose fin clips and valid coded wire tags sampled at Canyon Island and in the test fishery in 2005.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[b] Number examined	Adipose clips	Number valid	Tag codes
7/2	27	1							
7/3	28	3							
7/4	28	2							
7/5	28	1							
7/6	28	0							
7/7	28	1							
7/8	28	3							
7/9	28	2							
7/10	29	1							
7/11	29	0							
7/12	29	2							
7/13	29	6							
7/14	29	4							
7/15	29	3							
7/16	29	2							
7/17	30	1							
7/18	30	1							
7/19	30	1							
7/20	30	8							
7/21	30	5							
7/22	30	11							
7/23	30	2							
7/24	31	4							
7/25	31	7							
7/26	31	3							
7/27	31	0							
7/28	31	4							
7/29	31	7							
7/30	31	6							
7/31	32	13							
8/1	32	4							
8/2	32	7				150	1		HEAD LOST
8/3	32	4							
8/4	32	1							
8/5	32	0							
8/6	32	3							
8/7	33	14							
8/8	33	8							
8/9	33	6				150	0		
8/10	33	12							
8/11	33	13							

-continued-

Appendix C3.–Page 2 of 3.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[b] Number examined	Adipose clips	Number valid	Tag codes
8/12	33	13	1	1	41010				
8/13	33	14							
8/14	34	2							
									HEAD
8/15	34	1				50	1		LOST
8/16	34	2				50	0		
8/17	34	14							
8/18	34	3							
8/19	34	4							
8/20	34	9							
8/21	35	20							
8/22	35	7				50	0		
8/23	35	16				50	0		
8/24	35	15							
8/25	35	6							
8/26	35	16							
8/27	35	40							
8/28	36	46							
8/29	36	20				30	1	1	41007
8/30	36	8				70	0		
8/31	36	23							
9/1	36	12							
9/2	36	26							
9/3	36	14							
9/4	37	8							
9/5	37	31							
9/6	37	22							
9/7	37	12	1	1	41007				
9/8	37	43							
9/9	37	81				184	1	1	41010
9/10	37	55				81	1	1	41007
9/11	38	27	1	1	41007	130	0		
9/12	38	26				70	1	1	41007
9/13	38	21				156	0		
9/14	38	29				88	3	3	41007
									41010
									41010
9/15	38	19				81	1		NO TAG
9/16	38	41				81			
9/17	38	26				97	1		41010
9/18	39	12				85	3	1	41007
									NO TAG

-continued-

Appendix C3.–Page 3 of 3.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Inriver fisheries[b] Number examined	Adipose clips	Number valid	Tag codes
									NO TAG
9/19	39	28							
9/20	39	45	1	1	41010	143	2	1	41010 HEAD LOST
9/21	39	32				159	0		
9/22	39	13				115	1	1	NO TAG
9/23	39	11							
9/24	39	19	1	1	41007	148	1	1	NO TAG
9/25	40	44							
9/26	40	42				128	0		
9/27	40	32				131	0		
9/28	40	24				143	0		
9/29	40	26	1		No tag	95	0		
9/30	40	56							
10/1	40	58							
10/2	41	36							
10/3	41					90	2	2	41007 41010
10/4	41	26				72	0		
10/5	41	24				102	0		
10/6	41								
10/7	41					86	1	1	41007
10/8	41					58	1	1	41010
10/9	42								
Total		1,476	6	5		3,123	22	15	

[a] At Canyon Island all adipose-finclipped coho salmon were sacrificed.

[b] Includes the test and Canadian commercial fisheries; all adipose-finclipped coho salmon had their heads removed for sampling, 3 of which were lost during shipping.

Appendix C4.–Estimated harvests of coho salmon bound for Taku River above Canyon Island in 2005 in marine commercial troll and gillnet fisheries by statistical week. Harvest in the troll fishery was approximated by weighting period catches by the number of coded wire tags recovered in a statistical week

Statistical week	Ending date	Troll		Gillnet		Total		Weekly proportion of harvest			Weekly proportion of harvest times statistical week		
		Tags	Harvest	Tags	Harvest	Tags	Harvest	Troll	Gillnet	Total	Troll	Gillnet	Total
27	7/2												
28	7/9												
29	7/16	1	1,032	1	906	2	1,938	0.02	0.04	0.03	0.64	1.12	0.80
30	7/23	5	5,159	2	1,811	7	6,971	0.11	0.08	0.10	3.33	2.31	2.98
31	7/30	2	2,064			2	2,064	0.04		0.03	1.38		0.91
32	8/6	5	5,159			5	5,159	0.11		0.07	3.55		2.36
33	8/13	3	2,249	1	906	4	3,154	0.05	0.04	0.05	1.60	1.27	1.49
34	8/20	4	2,998			4	2,998	0.06		0.04	2.19		1.45
35	8/27	4	2,998	1	906	5	3,904	0.06	0.04	0.06	2.26	1.35	1.95
36	9/3	4	2,998	2	1,811	6	4,810	0.06	0.08	0.07	2.32	2.77	2.47
37	9/10	15	11,244	5	4,528	20	15,772	0.24	0.19	0.23	8.94	7.12	8.33
38	9/17	11	7,787	4	3,622	15	11,410	0.17	0.15	0.16	6.36	5.85	6.19
39	9/24	4	2,832	3	2,717	7	5,549	0.06	0.12	0.08	2.37	4.50	3.09
40	10/1			4	3,622	4	3,622		0.15	0.05		6.15	2.07
41	10/8			3	2,717	3	2,717		0.12	0.04		4.73	1.59
	Total	58	46,521	26	23,546	84	70,067	1.00	1.00	1.00	34.93	37.15	35.68
								Estimated mean date of harvest			8/20/05	9/5/05	8/26/05

Appendix C5.–Number of marked coho salmon released at Canyon Island and recaptured and examined for marks in the inriver test and Canadian commercial fisheries by statistical week in 2005.

Release statistical week	Date	Number of fish released	Recovery statistical week													
			28	29	30	31	32	33	34	35	36	37	38	39	40	41
28	7/3–7/9	11	1													
29	7/10–7/16	16			2											
30	7/17–7/23	25				5										
31	7/24–7/30	27				1	7									
32	7/31–8/6	31					5	5								
33	8/7–8/13	70						6	13	1						
34	8/14–8/20	33								10						
35	8/21–8/27	105								2	10					
36	8/28–9/3	128									4	4	1	1		
37	9/4–9/10	231										3	6			
38	9/11–9/17	168											6	4	1	
39	9/18–9/24	145													2	
40	9/25–10/1	271													1	5
41	10/2–10/8	76														
	Total	1,337	1	0	2	6	12	11	13	13	14	7	13	5	4	5
		Marked percent	2.9	0.0	1.8	1.9	2.8	2.2	1.3	1.3	1.1	0.9	1.9	0.8	0.8	0.7
		Number of fish examined	35	44	114	308	424	502	1013	990	1286	776	700	600	497	692

APPENDIX D

Appendix D1.–Number of salmon smolt caught in minnow traps near Canyon Island on the Taku River during 2005. Days with trap sets but no catches indicate that fish caught were held 1, 2, or 3 days until enough were accumulated for tagging.

		Daily catch		Catch per trap		Air temperature (°C)			Water	
Date	Trap sets	Coho	Chinook	Coho	Chinook	Min.	Max.	Precipitation(inches)	Temp. (°C)	Stage (ft.)
5-Apr									2.5	-28
6-Apr	118							0.14	2.5	-28
7-Apr	139	1,129	893	8	6				3	-28
8-Apr	143	892	561	6	4				3	-27
9-Apr	144	983	610	7	4	-1.7	10.0		4	-26
10-Apr	162	1,148	668	7	4	-0.6	13.3	0.12	4	-25
11-Apr	190	1,214	572	6	3	1.1	8.9		4.0	-24.0
12-Apr	193	612	357	3	2	1.1	10.6	0.03	3.5	-22.0
13-Apr	211	815	345	4	2	1.7	10.0	0.02	4.0	-22.0
14-Apr	210	1,475	784	7	4	1.1	11.1	0.01	4.0	-20.0
15-Apr	205	1,342	622	7	3	-3.3	10.6		3.0	-19.0
16-Apr	209	1,219	422	6	2	-17.8	11.7		4.0	-19.0
17-Apr	213	1,446	506	7	2	2.2	13.3		4.0	-17.0
18-Apr	217	1,213	372	6	2	0.0	10.6		4.0	-16.0
19-Apr	222	1,049	318	5	1	1.7	7.8	0.94	4.0	-12.0
20-Apr	218	986	179	5	1	4.4	13.9	0.38	4.0	0.0
21-Apr	210	986	179	5	1	3.3	12.2	0.93	3.0	9.0
22-Apr	193	1,310	185	7	1	0.0	13.9	0.16	3.0	21.0
23-Apr	200	945	105	5	1	0.6	22.2		4.0	-17.0
24-Apr	211	1,158	208	5	1	0.0	21.7		4.5	24.0
25-Apr	215	783	142	4	1	0.0	20.0		4.5	35.0
26-Apr	206	586	104	3	1	1.7	21.1		4.5	48.0
27-Apr	205	426	135	2	1	4.4	18.3		4.5	60.0
28-Apr	198	427	135	2	1	12.2	21.1		5.0	68.0
29-Apr	202	516	264	3	1	9.4	20.0		5.0	72.0
30-Apr	203	481	370	2	2	6.1	17.2		5.0	68.0
1-May	208	569	418	3	2	7.2	19.4		5.0	60.0
2-May	212	648	395	3	2	0.0	18.9		5.5	54.0
3-May	211	719	585	3	3	3.3	14.4		6.0	51.0
4-May	209	690	784	3	4	6.1	15.0	0.01	6.5	54.0
5-May	216	597	775	3	4	3.3	21.1	0.02	6.5	56.0
6-May	216	754	963	3	4	0.0	25.6		6.5	57.0
7-May	220	651	1,019	3	5	0.6	23.3		7.0	61.0
8-May	216	573	822	3	4	0.0	22.8		7.0	70.0
9-May	212	461	684	2	3	1.7	21.1		7.0	78.0
10-May	210	426	636	2	3	1.7	21.1		7.0	90.0
11-May	204	426	683	2	3	2.2	18.3		7.5	100.0
12-May	198	330	761	2	4	6.7	14.4		8.0	113.0
13-May	203	318	734	2	4	6.7	18.3	0.01	7.5	116.0
14-May	211	266	740	1	4	7.2	17.2	0.02	7.0	120.0
15-May	207	205	654	1	3	4.4	14.4	0.15	7.0	129.0
16-May	212	211	559	1	3	6.1	17.8	0.03	7.0	135.0
17-May	155	184	466	1	3	3.3	18.9	0.02	7.0	134.0
18-May	130	169	563	1	4	1.7	25.6		7.5	124.0
19-May	137	169	563	1	4	3.3	16.1		7.5	117.0
20-May	148	145	679	1	5	6.1	18.3	0.11	7.5	116.0

-continued-

Appendix D1.–Page 2 of 2.

Date	Trap Sets	Daily catch		Catch per trap		Air temperature (°C)		Precipitation (inches)	Water	
		Coho	Chinook	Coho	Chinook	Min.	Max.		Temp. (°C)	Stage (ft)
21-May	149	145	679	1	5	5.6	18.3	0.10	7.5	114.0
22-May	163	134	841	1	5	1.7	24.4	0.03	8.0	110.0
23-May	159	154	820	1	5	3.3	19.4	0.21	8.0	108.0
24-May	165	104	696	1	4	8.9	13.3	0.03	8.0	112.0
25-May	162	105	697	1	4	6.1	17.8	0.01	8.0	119.0
26-May	42	88	534	2	13	7.2	20.6		5.5	138.0
27-May	47	25	68	1	1	10.0	18.9	0.04	8.0	114.0
28-May						3.3	22.2		8.0	118.0
29-May	103	26	68	0.3	1	7.8	13.3		8.0	116.0
30-May	124	17	81	0.1	1	9.4	13.3	0.01	8.5	115.0
31-May	122	29	87	0.2	1	2.2	17.8	0.03	8.0	116.0
1-Jun	123	33	138	0.3	1	5.6	21.1		8.5	112.0
2-Jun	111	32	113	0.3	1	4.4	20.6		8.5	106.0
Total	10,242	32,544	27,341					3.56		
Mean				3.2	2.7					

Appendix D2.–Estimated marine harvest of adult coho salmon bound for the Taku River above Canyon Island in 2006. Calculations follow equations in Table 2 of Bernard and Clark (1996) with 0.0116 used as an estimate of θ and 0.0203 for $G(\theta^{-1})$. Definitions of notation used to label these and other statistics are immediately below. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

a_i	=	number of adults missing adipose fins in a sample from catch in a stratum
a_i'	=	number of heads that arrive at Juneau for dissection (subset of a_i) in a stratum
r_i	=	number of adults from the stock harvested in a stratum in year *j*
m_{ci}	=	number of CWTs with the appropriate code(s) (subset of t_i') in a stratum
n_i	=	number of adults caught in a stratum inspected for missing adipose fins
t_i	=	number of heads with tags detected magnetically (subset of a_i') in a stratum
t_i'	=	number of CWTs found through dissection and decoded (subset of t_i) in a stratum
θ	=	fraction of the stock with CWTs
$G(\theta^{-1})$	=	squared coefficient of variation for the estimate of $1/\theta$

TROLL FISHERY

Stat. week	Dates	Per.	Quad.	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
26	6/25–7/1	3	NW[a]	1,239		853	10	10	8	8	1	125	125	195%
27–32	7/2–8/12	3	NW	472,611		134,965	1,476	1,413	1,033	1,033	46	14,503	2,955	40%
33-38	8/13–9/23	4	NW	402,885		96,590	1,568	1,519	1,270	1,269	83	30,827	5,519	35%
32	8/6–8/12	3	NE	104,298		28,143	312	308	205	205	1	324	323	196%
33-39	8/13–9/30	4	NE	105,822		27,849	333	327	244	244	10	3,335	1,146	67%
30	7/23–7/29	3	SE	74,432		24,050	211	202	124	124	1	279	278	196%
Subtotal troll fishery				1,161,287		312,450	3,910	3,779	2,884	2,883	142	49,393	6,379	25%

SEINE FISHERY

Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
31	7/30–8/5	114	1,639		650	3	3	1	1	1	217	217	196%
29	7/16–7/22	110	733		290	1	1	1	1	1	218	217	196%
31	7/30–8/5	110	1,955		944	3	3	2	2	1	179	178	195%
Subtotal seine fishery			4,327		1,884	7	7	4	4	3	614	355	113%

-continued-

SPORT FISHERY

Bi-week	Dates	Derby	Area	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
18	8/28-9/10	No	Yakutat[b]	419		400	4	4	4	4	2	181	128	139%
15	7/17-7/30	No	Sitka	10,000	235,158	3,250	32	32	23	23	1	265	265	196%
17	8/14-8/27	No	Sitka	10,590	151,830	4,805	44	44	38	38	1	190	189	195%
14	7/3-7/16	No	Juneau	1,032	2,337	310	1	1	1	1	1	287	286	196%
15	7/17-7/30	No	Juneau	4,735	2,386	1,300	6	5	3	3	1	377	376	196%
16	7/31-8/13	Yes	Juneau[c]	4,068		4,068	40	40	30	30	13	1,121	345	60%
16	7/31-8/13	No	Juneau	1,000	1,371	567	3	3	1	1	1	152	152	195%
16	7/31-8/13	Yes	Juneau	1,250	1,745	184	6	6	6	6	1	586	585	196%
17	8/14-8/27	No	Juneau	2,905	5,161	1,497	22	16	15	15	4	920	473	101%
18	8/28-9/10	No	Juneau	1,310	3,568	623	19	19	16	16	3	544	320	115%
Subtotal sport fishery				37,309	403,556	17,004	177	170	137	137	28	4,621	1,075	46%

GILLNET FISHERY

Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
25	6/18-6/24	115	28		107	1	1	1	1	1	23	22	192%
29	7/16-7/22	115	165		161	1	1	1	1	1	88	88	195%
30	7/23-7/29	115	120		119	2	2	2	2	2	174	123	139%
31	7/30-8/5	115	23		36	1	1	1	1	1	55	55	194%
36	9/3-9/9	115	9,571		733	23	23	22	22	1	1,125	1,125	196%
37	9/10-9/16	115	11,920		2,630	114	114	108	108	4	1,563	804	101%
38	9/17-9/23	115	20,270		5,886	328	327	318	318	7	2,084	833	78%
39	9/24-9/30	115	4,930		1,187	46	46	46	46	2	716	511	140%
32	8/6-8/12	111	3,103		1,157	7	7	7	7	5	1,156	536	91%
33	8/13-8/19	111	1,377		322	4	4	4	4	4	1,474	758	101%
34	8/20-8/26	111	5,450		1,427	9	9	9	9	8	2,634	994	74%
35	8/27-9/2	111	8,330		3,263	30	30	24	24	17	3,741	1,042	55%
36	9/3-9/9	111	11,095		460	3	3	3	3	1	2,079	2,078	196%
37	9/10-9/16	111	14,024		5,322	114	113	101	101	41	9,395	1,972	41%
38	9/17-9/23	111	10,864		3,974	116	116	110	110	46	10,839	2,208	40%
39	9/24-9/30	111	760		357	11	11	9	9	4	734	377	101%
Subtotal gillnet fishery			102,030		27,141	810	808	766	766	145	37,879	4,365	23%
TOTAL			1,304,953	403,556	358,479	4,904	4,764	3,791	3,790	318	92,508	7,812	16%

[a] Experimental troll opening in Northwest Quadrant.

[b] Catch sampling program; variance of harvest not available.

[c] All of the Juneau derby harvest is sampled thus the variance is zero.

Appendix D3.–Number of coho salmon examined along with adipose fin clips and valid coded wire tags sampled at Canyon Island and in the test fishery in 2006.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[a] Number examined	Adipose clips	Number valid	Tag codes
6/30	26	2							
7/1	26	0							
7/2	27	0							
7/3	27	0							
7/4	27	0							
7/5	27	0							
7/6	27	1							
7/7	27	6							
7/8	27	0							
7/9	28	1							
7/10	28	8							
7/11	28	3							
7/12	28	4							
7/13	28	5							
7/14	28	6							
7/15	28	8							
7/16	29	8							
7/17	29	7							
7/18	29	6							
7/19	29	9							
7/20	29	10							
7/21	29	11							
7/22	29	0							
7/23	30	12							
7/24	30	13							
7/25	30	13							
7/26	30	14							
7/27	30	9							
7/28	30	41							
7/29	30	31							
7/30	31	25							
7/31	31	36							
8/1	31	29							
8/2	31	43							
8/3	31	32							
8/4	31	33							
8/5	31	16							
8/6	32	20							
8/7	32	20	1		NO TAG				
8/8	32	32							
8/9	32	52	1	1	40836				

-continued-

Appendix D3.–Page 2 of 4.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[a] Number examined	Adipose clips	Number valid	Tag codes
8/11	32	6							
8/12	32	27							
8/13	33	55							
8/14	33	64							
8/15	33	60							
8/16	33	40	1	1	41008				
8/17	33	41							
8/18	33	24							
8/19	33	21							
8/20	34	48	1	1	41008				
8/21	34	100							
8/22	34	57							
8/23	34	21							
8/24	34	46							
8/25	34	66	2	2	41011				
					41011				
8/26	34	40	1		NO TAG				
8/27	35	42							
8/28	35	86	2	2	40833				
					40836				
8/29	35	46							
8/30	35	26							
8/31	35	43	1	1	40836				
9/1	35	3							
9/2	35								
9/3	36	0							
9/4	36	86							
9/5	36	85				555	8	6	40836
									40836
									41008
									41008
									41011
									41011
									HEAD LOST
									HEAD LOST
9/6	36	144	2	2	40833				
					40836				
9/7	36	52	2	2	40833				
					41008				
9/8	36	42							
9/9	36	44	2	2	40833				

-continued-

Appendix D3.–Page 3 of 4.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Inriver fisheries[a] Number examined	Adipose clips	Number valid	Tag codes
					41008				
9/10	37	51	1	1	41011				
9/11	37	69	1	1	40833	557	4	3	40833
									40836
									41011
									NO TAG
9/12	37	79	2	2	40833				
					41008				
9/13	37	44	1	1	40833				
9/14	37	54	2	2	40833				
					40836				
9/15	37	41							
9/16	37	35	2	1	40836				
					NO TAG				
9/17	38	31							
9/18	38	12				413	5	5	40836
									40836
									40836
									41011
									41011
9/19	38								
9/20	38	22							
9/21	38	33							
9/22	38	21							
9/23	38	45							
9/24	39	18				382	7	7	40833
									40833
									40833
									40836
									40836
									41008
									41011
9/25	39	12							
9/26	39	32	2	2	40833				
					41008				
9/27	39	45	4	2	40833				
					41008				
					NO TAG				
					HEAD LOST				
9/28	39	21							
9/29	39	20	2	2	40836				

-continued-

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Inriver fisheries[a] Number examined	Adipose clips	Number valid	Tag codes
					41008				
9/30	39	25	1	1	40833				
10/1	40	32							
10/2	40	30							
10/3	40	37	1	1	40836				
Total		2,811	35	30		1,907	24	21	

[a] At Canyon Island and in the test fishery, all adipose-finclipped coho salmon were sacrificed. During shipping, 1 head from Canyon Island and 2 heads from the test fishery were lost during shipping.

Appendix D4.–Estimated harvests of coho salmon bound for Taku River above Canyon Island in 2006 in marine commercial troll and gillnet fisheries by statistical week. Harvest in the troll fishery was approximated by weighting period catches by the number of coded wire tags recovered in a statistical week.

Statistical week	Ending date	Troll		Gillnet		Total		Weekly proportion of harvest			Weekly proportion of harvest times Statistical week		
		Tags	Harvest	Tags	Harvest	Tags	Harvest	Troll	Gillnet	Total	Troll	Gillnet	Total
25	6/18			1	261	1	261		0.01	0.00		0.17	0.07
26	6/25	1	311			1	311	0.01		0.00	0.16		0.09
27	7/2	3	932			3	932	0.02		0.01	0.51		0.29
28	7/9	3	932			3	932	0.02		0.01	0.53		0.30
29	7/16	2	622	1	261	3	883	0.01	0.01	0.01	0.36	0.20	0.29
30	7/23	13	4,041	2	522	15	4,563	0.08	0.01	0.05	2.45	0.41	1.57
31	7/30	12	3,730	1	261	13	3,991	0.08	0.01	0.05	2.34	0.21	1.42
32	8/6	15	4,662	5	1,306	20	5,969	0.09	0.03	0.07	3.02	1.10	2.19
33	8/13	9	3,306	4	1,045	13	4,351	0.07	0.03	0.05	2.21	0.91	1.65
34	8/20	17	6,245	8	2,090	25	8,335	0.13	0.06	0.10	4.30	1.88	3.25
35	8/27	18	6,612	17	4,441	35	11,053	0.13	0.12	0.13	4.69	4.10	4.43
36	9/3	16	5,877	2	522	18	6,400	0.12	0.01	0.07	4.28	0.50	2.64
37	9/10	16	5,877	45	11,756	61	17,633	0.12	0.31	0.20	4.40	11.48	7.48
38	9/17	16	5,877	53	13,846	69	19,723	0.12	0.37	0.23	4.52	13.89	8.59
39	9/24	1	367	6	1,567	7	1,935	0.01	0.04	0.02	0.29	1.61	0.86
40	10/1												
41	10/8												
Total		142	49,393	145	37,879	287	87,273	1.00	1.00	1.00	34.07	36.48	35.12
								Estimated mean date of harvest			8/21/06	9/06/06	8/28/06

Appendix D5.–Number of marked coho salmon released at Canyon Island and recaptured and examined for marks in the inriver test and Canadian commercial fisheries by statistical week in 2006.

Release statistical week	Date	Number of fish released	Recovery statistical week													
			27	28	29	30	31	32	33	34	35	36	37	38	39	40
26	6/25-7/1	1														
27	7/2-7/8	6		1												
28	7/9-7/15	34			4											
29	7/16-7/22	43			3	1		1								
30	7/23-7/29	108					21	1								
31	7/30-8/5	198					12	9	2							
32	8/6-8/12	163						1	19	2						
33	8/13-8/19	271							23	18	1	1				
34	8/20-8/26	345								24	18	3				
35	8/27-9/2	229									2	2	1			
36	9/3-9/9	414										5	11	1	1	
37	9/10-9/16	329											5	4	1	1
38	9/17-9/23	158												1		2
39	9/24-9/30	144													2	6
40	10/1-10/7	92														4
Total		2,535	0	1	7	1	33	12	44	44	21	11	17	6	4	13
	Marked percent		0.0%	1.1%	2.3%	0.4%	1.9%	2.4%	2.2%	1.7%	2.0%	1.8%	2.4%	1.0%	1.0%	2.5%
	Number of fish examined		54	89	298	246	1,745	506	2,004	2,535	1,059	609	706	607	382	524

APPENDIX E

Appendix E1.–Number of salmon smolt caught in minnow traps near Canyon Island on the Taku River during 2006. Days with trap sets but no catches indicate that fish caught were held 1, 2, or 3 days until enough were accumulated for tagging.

		Daily catch		Catch per trap		Air temp (°C)[a]			Water[a]	
Date	Trap sets	Coho	Chinook	Coho	Chinook	Min	Max	Precip (in)[a]	Temp. (°C)	Stage (ft.)
14-Apr	73	602	902	4	6	-1	2			
15-Apr	91	394	905	4	10	-3	0			1.00
16-Apr	137	729	1,239	5	9	-4	2			1.00
17-Apr	140	543	933	4	7	-2	2			1.00
18-Apr	138					-3	5		2	0.11
19-Apr	140	601	929	2	3	-4	6	0.3	3	0.11
20-Apr	147	464	1,016	3	7	-4	4		3	1.00
21-Apr	167	693	1,224	4	7	-2	3	0.4	3	1.00
22-Apr	176	832	1,315	5	7	0	3	0.7	3	1.10
23-Apr	146	619	1,003	4	7	1	4	0.2	3	1.30
24-Apr	145	677	1,056	5	7	0	4	0.6	3	1.50
25-Apr	170					0	7		3	1.85
26-Apr	176	815	981	2	3	-1	8	0.1	4	2.80
27-Apr	191	471	377	2	2	-2	6	0.5	4	2.11
28-Apr	189	829	484	4	3	0	7	0.4	3	3.10
29-Apr	193	1,624	1,247	8	6	-1	5	0.2	3	3.30
30-Apr	189	1,329	786	7	4	0	6		4	3.10
1-May	191	1,477	911	8	5	-2	7		4	3.00
2-May	189	1,539	1,578	8	8	1	7		4	2.11
3-May	189	1,102	572	6	3	1	4	0.3	3	3.00
4-May	185					0	7	1.3	3	3.80
5-May	182	1,272	597	3	2	3	7	0.7	3	4.10
6-May	182					3	8	0.2	3	4.40
7-May	176					3	8	0.3	3	4.30
8-May	182	1,906	638	4	1	3	8	0.7	3	4.30
9-May	185	1,535	701	8	4	3	10	0.2	3	4.20
10-May	192	1,693	1,064	9	6	-1	10	0.5	3	4.10
11-May	194	1,852	1,647	10	8	0	11	0.1	4	3.11
12-May	200	1,763	1,912	9	10	2	12		4	3.90
13-May	209	1,291	1,279	6	6	4	12		4	3.90
14-May	206	1,099	1,088	5	5	0	13		4	3.11
15-May	204	1,101	1,146	5	6	-2	16		6	4.00
16-May	204	1,227	1,711	6	8	2	14	0.4	6	4.15
17-May	212	989	1,948	5	9	0	9	0.4	6	5.00
18-May	206	616	1,074	3	5	4	14	0.1	6	5.11
19-May	201					4	16		6	6.90
20-May	188	678	889	2	2	4	16		6	7.30
21-May	194	390	622	2	3	5	17		7	8.30
22-May	201					7	24		7	8.60
23-May	199	367	654	1	2	7	17	0.1	6	9.50
24-May	189	490	762	3	4	4	19		8	5.70
25-May	175					4	22		7	6.50
26-May	186	346	618	1	2	3	23		7	7.40
27-May	188	79	312	0	2	7	22		7	7.80
28-May	177					7	14	0.2	6	8.60
29-May	109	67	265	0	1	8	17	0.0	7	9.40
30-May	141	71	270	1	2	8	17		7	8.50
31-May	136					8	14		7	8.20
1-Jun	129					6	19		8	8.50
2-Jun	74	39	137	0	0	6	18		7	9.20
Total	8,649	34,211	36,792					8 .84		
Mean				4 .0	4 .3					

[a] Air temperature (max/min), precipitation, water temperature and stage were recorded daily around 8 a.m.

Appendix E2.–Estimated marine harvest of adult coho salmon bound for the Taku River above Canyon Island in 2007. Calculations follow equations in Table 2 of Bernard and Clark (1996) with 0.0119 used as an estimate of θ and 0.0184 for $G(\theta^{-1})$. Definitions of notation used to label these and other statistics are immediately below. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

a_i = number of adults missing adipose fins in a sample from catch in a stratum

a_i' = number of heads that arrive at Juneau for dissection (subset of a_i) in a stratum

r_i = number of adults from the stock harvested in a stratum in year *j*

m_{ci} = number of CWTs with the appropriate code(s) (subset of t_i') in a stratum

n_i = number of adults caught in a stratum inspected for missing adipose fins

t_i = number of heads with tags detected magnetically (subset of a_i') in a stratum

t_i' = number of CWTs found through dissection and decoded (subset of t_i) in a stratum

θ = fraction of the stock with CWTs

$G(\theta^{-1})$ = squared coefficient of variation for the estimate of $1/\theta$

TROLL FISHERY

Stat. weeks	Dates	Per.	Quad.	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
27-32	7/3 - 8/11	3	NW	445,701		124,308	1,944	1,865	1,404	1,401	21	6,863	1,734	50%
33-38	8/18 - 9/21	4	NW	494,448		122,908	2,800	2,700	2,110	2,107	43	15,677	3,133	39%
30-32	7/25 - 8/6	3	NE	54,341		15,166	203	199	151	151	2	638	454	140%
36	9/4	4	NE	42,451		11,111	234	229	161	161	1	341	340	196%
Subtotal troll fishery				1,036,941	++	273,493	5,181	4,993	3,826	3,820	67	23,519	3,625	30.2%

SEINE FISHERY

Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
32	8/5 - 8/11	112	15,431		749	10	10	9	9	2	3,596	2,563	140%
33	8/12 - 8/18	112	3,969		1,017	23	23	20	20	2	681	485	140%
35	8/26 - 9/1	112	5,969		312	4	4	4	4	1	1,669	1,669	196%
32	8/5 - 8/11	113	2,908		472	5	5	4	4	1	538	537	196%
Subtotal seine fishery			28,277		2,550	42	42	37	37	6	6,484	3,143	95.0%

SPORT FISHERY

Bi-week	Dates	Derby	Area	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
17	8/24	No	Yakutat[a]	715		704	6	6	5	5	1	89	88	195%
18	9/1	No	Yakutat[a]	1,100		960	8	8	4	4	1	100	99	195%
14	7/2	No	Elfin Cove[a]	172		157	2	2	2	2	1	96	95	195%
17	8/21	No	Gustavus[a]	503		491	10	10	10	10	1	89	89	195%
18	8/31	No	Gustavus[a]	256		238	3	3	3	3	1	94	93	195%
14	7/9	No	Sitka	5,814	1,038,128	1,727	32	32	25	25	1	294	293	196%
18	8/28	No	Sitka	6,152	2,702,575	961	15	15	14	14	1	559	558	196%
16	8/5 - 8/6	Yes	Juneau[b]	1,779		1,779	15	15	11	11	4	349	178	100%
17	8/23	No	Juneau	1,854	268,117	356	3	3	3	3	1	454	454	196%
Subtotal sport fishery				18,345	4,008,820	7,373	94	94	77	77	12	2,123	824	76.0%

-continued-

Appendix E2.–Page 2 of 2.

GILLNET FISHERY													
Stat. week	Dates	District	H	v(H)	n	a	a'	t	t'	m_c	$\hat{r}$	SE($\hat{r}$)	RP($\hat{r}$)
33	8/12 - 8/18	111	2,768		463	3	3	3	3	3	1,565	918	115%
34	8/19 - 8/25	111	2,138		487	3	3	3	3	3	1,149	674	115%
35	8/26 - 9/1	111	6,590		1,678	15	15	13	13	12	4,113	1,293	62%
36	9/2 - 9/8	111	4,442		1,587	31	31	29	29	24	5,862	1,411	47%
37	9/9 - 9/15	111	2,117		689	16	16	15	15	10	2,681	909	66%
39	9/23 - 9/29	111	259		177	3	3	3	3	3	383	224	115%
27	7/1 - 7/7	115	33		30	1	1	1	1	1	96	95	195%
35	8/26 - 9/1	115	1,102		487	21	20	18	18	1	207	207	196%
36	9/2 - 9/8	115	2,549		1,040	34	34	33	33	4	856	438	100%
37	9/9 - 9/15	115	3,163		1,450	47	47	46	46	2	381	271	139%
39	9/23 - 9/29	115	3,651		1,099	43	41	38	38	2	608	433	140%
38	9/16 - 9/22	NE[c]	5,613		2,190	74	74	72	72	4	895	458	100%
Subtotal gillnet fishery			34,425		11,377	291	288	274	274	69	18,795	2,559	26.7%
TOTAL			1,117,988	4,008,820	294,793	5,608	5,417	4,214	4,208	154	50,921	5,500	21.2%

[a] Catch sampling program; variance of harvest not available.

[b] All of the Juneau derby harvest is sampled thus the variance is zero.

[c] NE refers to northeast quadrant.

Appendix E3.–Number of coho salmon examined along with adipose fin clips and valid coded wire tags sampled at Canyon Island and in the test fishery in 2007.

Date	Stat week	Canyon Island[a]				Test fishery[a]			
		Number examined	Adipose clips	Number valid	Tag codes	Number examined	Adipose clips	Number valid	Tag codes
7/1	27	1							
7/2	27	0							
7/3	27	1							
7/4	27	3							
7/5	27	0							
7/6	27	2							
7/7	27	2							
7/8	28	0							
7/9	28	1							
7/10	28	1							
7/11	28								
7/12	28	1							
7/13	28	0							
7/14	28	2							
7/15	29	1							
7/16	29	3							
7/17	29	0							
7/18	29	9							
7/19	29	17							
7/20	29	9							
7/21	29								
7/22	30								
7/23	30	3							
7/24	30	28							
7/25	30	20							
7/26	30	24							
7/27	30	28							
7/28	30	24							
7/29	31	29							
7/30	31	8							
7/31	31	8							
8/1	31	20							
8/2	31	36							
8/3	31	54							
8/4	31	64	1	1	40815				
8/5	32	80							
8/6	32	32							
8/7	32	14							
8/8	32	19							
8/9	32	41							
8/10	32	43							

-continued-

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Test fishery[a] Number examined	Adipose clips	Number valid	Tag codes
8/11	32	50							
8/12	33	60	1	1	40815				
8/13	33	56							
8/14	33	32							
8/15	33	42							
8/16	33	65	1	1	41013				
8/17	33	26	2	1	40815				
	33				NO TAG				
8/18	33	25							
8/19	34	35							
8/20	34	41							
8/21	34	33							
8/22	34	48	3	3	40815				
	34				41013				
	34				41014				
8/23	34	27							
8/24	34	12							
8/25	34	40	1	1	41012				
8/26	35	18							
8/27	35	24							
8/28	35	19	1		NO TAG	451	2	1	40815
	35								HEAD LOST
8/29	35	14							
8/30	35	23							
8/31	35	23	1	1	41013				
9/1	35	23							
9/2	36	21							
9/3	36	22							
9/4	36	13							
9/5	36	18							
9/6	36	25							
9/7	36	29							
9/8	36	28							
9/9	37	21							
9/10	37	19							
9/11	37	16							
9/12	37	48	2	2	41012				
	37				41013				
9/13	37	58	1		NO TAG				
9/14	37	25							
9/15	37	16							

-continued-

Appendix E3.–Page 3 of 4.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Inriver fisheries[a] Number examined	Adipose clips	Number valid	Tag codes
9/16	38	12	1	1	41014				
9/17	38	12							
9/18	38	27	1	1	40833[b]				
9/19	38	42	1	1	41014	1397	16	10	40815
	38								40836[b]
	38								41012
	38								41012
	38								41012
	38								41012
	38								41012
	38								41012
	38								41014
	38								41014
	38								41014
	38								NO TAG
	38								HEAD LOST
	38								HEAD LOST
	38								HEAD LOST
	38								HEAD LOST
9/20	38	27							
9/21	38	20							
9/22	38	52							
9/23	39	32	1	1	41012				
9/24	39	5				443	14	13	40815
	39								40815
	39								41012
	39								41013
	39								41013
	39								41013
	39								41013
	39								41014
	39								41014
	39								41014
	39								41014
	39								41014
	39								41014
	39								NO TAG
9/25	39	15							
9/26	39	24							
9/27	39	26							
9/28	39	53							

-continued-

Appendix E3.–Page 4 of 4.

Date	Stat week	Canyon Island[a] Number examined	Adipose clips	Number valid	Tag codes	Inriver fisheries[a] Number examined	Adipose clips	Number valid	Tag codes
9/29	39	4							
9/30	40	24				434	9	7	40815
	40								41012
	40								41012
	40								41014
	40								41014
	40								41014
	40								41014
	40								NO TAG
	40								NO TAG
10/1	40								
10/2	40	8							
10/3	40	10							
10/4	40								
10/5	40					320	10	9	40815
	40								41012
	40								41012
	40								41013
	40								41013
	40								41014
	40								41014
	40								41014
	40								41014
	40								HEAD LOST
	40								
	40								
Total		2,116	18	15		3,045	51	41	

[a] At Canyon Island and in the test fishery, all adipose-finclipped coho salmon were sacrificed. During shipping, 6 heads from the test fishery were lost during shipping.

[b] These fish were tagged in 2005 as smolt but were fry that overwintered for an additional year prior to smolting. These fish are used in the 2006 smolt abundance calculations as valid adipose-finclip recoveries; however, they are not included in the estimate of theta for valid CWTs released in 2006 and thus are discounted in all harvest calculations.

Appendix E4.–Estimated harvests of coho salmon bound for Taku River above Canyon Island in 2007 in marine commercial troll and gillnet fisheries by statistical week. Harvest in the troll fishery was approximated by weighting period catches by the number of coded wire tags recovered in a statistical week.

Statistical	Ending	Troll		Gillnet		Total		Weekly proportion of harvest			Weekly proportion of harvest times Statistical week		
week	date	Tags	Harvest	Tags	Harvest	Tags	Harvest	Troll	Gillnet	Total	Troll	Gillnet	Total
26	6/30												
27	7/7	3	943	1	263	4	1,206	0.04	0.01	0.03	1.12	0.39	0.80
28	7/14	2	629	0		2	629	0.03		0.02	0.78		0.43
29	7/21	2	629	0		2	629	0.03		0.02	0.80		0.45
30	7/28	1	314	0		1	314	0.01		0.01	0.42		0.23
31	8/4	7	2,201	0		7	2,201	0.10		0.05	3.01		1.67
32	8/11	8	2,516	0		8	2,516	0.11		0.06	3.55		1.97
33	8/18	1	351	3	788	4	1,139	0.02	0.04	0.03	0.51	1.43	0.92
34	8/25	8	2,808	3	788	11	3,596	0.12	0.04	0.09	4.21	1.48	3.00
35	9/1	8	2,808	13	3,415	21	6,223	0.12	0.19	0.15	4.33	6.59	5.34
36	9/8	16	5,616	28	7,355	44	12,971	0.25	0.41	0.32	8.92	14.61	11.44
37	9/15	6	2,106	12	3,152	18	5,258	0.09	0.17	0.13	3.44	6.43	4.77
38	9/22	5	1,755	4	1,051	9	2,806	0.08	0.06	0.07	2.94	2.20	2.61
39	9/29			5	1,313	5	1,313		0.07	0.03		2.83	1.26
40	10/6												
Total		67	22,679	69	18,124	136	40,803	1.00	1.00	1.00	34.03	35.97	34.89
								Estimated mean date of harvest			8/20/07	9/02/07	8/25/07

Appendix E5.–Number of marked coho salmon released at Canyon Island and recaptured and examined for marks in the inriver test and Canadian commercial fisheries by statistical week in 2007.

Release statistical week	Date	Number of fish released	Recovery statistical week													
			27	28	29	30	31	32	33	34	35	36	37	38	39	40
26	6/24-6/30															
27	7/1–7/7	8		3												
28	7/8–7/14	5														
29	7/15–7/21	34				6										
30	7/22–7/28	105				2	10	3								
31	7/29–8/4	195					4	22	4							
32	8/5–8/11	264						18	38	6	1	3		1		
33	8/12–8/18	283							15	34	3	1				2
34	8/19–8/25	221								5	27	2				
35	8/26–9/1	130									4	9	2	1		
36	9/2–9/8	143										4	3			
37	9/9–9/15	180											4	9		
38	9/16–9/22	171												7	1	1
39	9/23–9/29	142													3	2
40	9/30–10/6	44														1
Total		1,925		3		8	10	21	53	45	35	19	9	18	4	6
	Marked percent		0.0%	16.7%	0.0%	6.6%	3.2%	3.6%	4.5%	4.5%	4.1%	1.2%	1.7%	2.6%	0.8%	1.5%
	Number of fish examined		3	18	31	122	315	583	1191	990	850	1628	521	686	500	400

APPENDIX F

Appendix F1.–Population parameters estimated from coho salmon stock assessment studies, 1987-2007.

COHO SALMON ABOVE CANYON ISLAND									
Calendar year	Escapement	Canadian harvest	Inriver run	Est. U.S. harvest	Est. total run	Total harv. rate (%)	U.S. harvest rate (%)	Smolt in year (t-1)	Marine survival (%)
1987	55,457	6,519	61,976						
1988	39,450	3,643	43,093						
1989	56,808	4,033	60,841						
1990	72,196	3,685	75,881						
1991	127,484	5,439	132,923						
1992	84,853	5,541	90,394	96,283	186,765	54.5	51.6	743,000	25.1
1993	109,457	4,634	114,091	97,758	211,874	48.3	46.1	1,510,000	14.0
1994	96,343	14,693	111,036	228,607	339,736	71.6	67.3	1,476,000	23.0
1995	55,710	13,738	69,448	111,571	181,116	69.2	61.6	1,525,000	11.9
1996	44,635	5,052	49,687	44,529	94,283	52.6	47.2	986,489	9.6
1997	32,345	2,690	35,035	15,825	50,887	36.4	31.1	759,763	6.7
1998	61,382	5,090	66,472	53,368	119,926	48.7	44.5	853,662	14.0
1999	60,768	5,575	66,343	50,789	117,176	48.1	43.3	1,184,195	9.9
2000	64,700	5,447	70,147	38,971	109,149	40.7	35.7	1,691,411	6.5
2001	104,394	3,099	107,493	55,264	162,778	35.9	34.0	1,811,038	9.0
2002	219,360	3,802	223,162	80,046	303,276	27.6	26.4	2,741,593	11.1
2003	183,038	3,717	186,755	78,277	265,089	30.9	29.5	2,737,851	9.7
2004	129,327	9,684	139,011	112,404	251,535	48.5	44.7	2,961,344	8.5
2005	135,558	8,259	143,817	79,045	222,996	39.2	35.4	3,755,274	5.9
2006	121,778	12,275	134,053	92,508	226,694	46.2	40.8	2,149,673	10.5
2007	74,326	7,993	82,319	50,921	133,294	44.2	38.2	3,152,471	4.2
Standard errors									
1987	3,096		3,096						
1988	7,162		7,162						
1989	11,174		11,174						
1990	21,813		21,813						
1991	19,051		19,051						
1992	10,645		10,645	24,005	30,635	6.6	6.9	247,000	9.3
1993	9,523		9,523	19,256	26,022	5.2	5.3	418,051	4.2
1994	5,800		5,800	36,734	37,310	3.3	3.7	368,411	6.3
1995	2,882		2,882	12,186	12,610	2.3	2.8	339,822	2.8
1996	3,405		3,405	6,494	7,449	3.8	4.0	214,152	2.2
1997	4,160		4,160	2,691	4,921	4.5	4.4	154,051	1.5
1998	4,485		4,485	7,435	9,186	3.7	3.8	147,260	2.7
1999	6,650		6,650	6,097	9,320	3.8	3.8	207,576	1.9
2000	5,667		5,667	3,326	6,571	2.8	2.7	255,147	1.0
2001	9,495		9,495	4,828	10,652	2.8	2.8	276,385	1.5
2002	28,648		28,648	6,389	29,352	3.0	2.9	363,071	1.8
2003	17,724		17,724	10,271	20,485	3.4	3.4	1,008,886	3.6
2004	12,301		12,301	13,756	18,454	3.7	3.7	708,526	2.1
2005	30,685		30,685	11,908	32,915	6.3	6.0	1,014,210	1.8
2006	8,643		8,643	7,812	11,651	2.6	2.6	442,136	2.2
2007	13,608		13,608	5,500	14,677	5.1	4.7	797,296	1.2

-continued-

COHO SALMON FROM ENTIRE TAKU RIVER DRAINAGE									
Calendar year	Escapement	Canadian harvest	Inriver run	Est. U.S. harvest	Est. total run	Total harv. rate (%)	U.S. harvest rate (%)	Smolt in year (t-1)	Marine survival (%)
1987	72,937	6,519	79,456						
1988	51,604	3,643	55,247						
1989	73,968	4,033	78,001						
1990	93,598	3,685	97,283						
1991	164,975	5,439	170,414						
1992	110,349	5,541	115,890	123,440	239,329	53.9	51.6	952,564	25.1
1993	141,637	4,634	146,271	125,331	271,601	47.9	46.1	1,935,897	14.0
1994	127,661	14,693	142,354	293,086	435,440	70.7	67.3	1,892,308	23.0
1995	75,298	13,738	89,036	143,040	232,076	67.6	61.6	1,955,128	11.9
1996	58,649	5,052	63,701	57,088	120,790	51.4	47.3	1,264,729	9.6
1997	42,227	2,690	44,917	20,288	65,205	35.2	31.1	974,055	6.7
1998	80,131	5,090	85,221	68,421	153,641	47.8	44.5	1,094,438	14.0
1999	79,480	5,575	85,055	65,114	150,169	47.1	43.4	1,518,199	9.9
2000	84,485	5,447	89,932	49,962	139,894	39.6	35.7	2,168,475	6.5
2001	134,712	3,099	137,811	70,851	208,662	35.4	34.0	2,321,843	9.0
2002	282,303	3,802	286,105	102,623	388,728	27.4	26.4	3,514,863	11.1
2003	235,713	3,717	239,430	100,355	339,785	30.6	29.5	3,510,065	9.7
2004	168,535	9,684	178,219	144,108	322,327	47.7	44.7	3,796,595	8.5
2005	176,122	8,259	184,381	101,340	285,721	38.4	35.5	4,814,454	5.9
2006	159,588	12,275	171,863	118,600	290,463	45.1	40.8	2,755,991	10.5
2007	97,544	7,993	105,537	65,284	170,821	42.9	38.2	4,041,629	4.2
Standard errors									
1987	3,969		3,969						
1988	9,182		9,182						
1989	14,326		14,326						
1990	27,965		27,965						
1991	24,424		24,424						
1992	13,647		13,647	30,776	39,276			374,000	
1993	12,209		12,209	24,687	33,362			535,963	
1994	7,436		7,436	47,095	47,833			472,321	
1995	3,695		3,695	15,623	16,167			435,669	
1996	4,365		4,365	8,326	9,550			274,554	
1997	5,333		5,333	3,450	6,309			197,501	
1998	5,750		5,750	9,532	11,777			188,795	
1999	8,526		8,526	7,817	11,949			266,123	
2000	7,265		7,265	4,265	8,424			327,112	
2001	12,173		12,173	6,189	13,656			354,340	
2002	36,728		36,728	8,191	37,631			465,476	
2003	22,723		22,723	13,167	26,263			1,293,444	
2004	15,771		15,771	17,636	23,659			908,367	
2005	39,340		39,340	15,267	42,198			1,300,269	
2006	11,081		11,081	10,016	14,937			566,841	
2007	17,446		17,446	7,051	18,817			1,022,174	

Appendix F2.–Weekly estimates of the inriver run of coho salmon above Canyon Island in the Taku River, 1987–2007.

Statistical week	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
28										573	5
29									1,642	959	106
30		548	1,425	1,479	2,517	5,897	1,178	3,769	2,956	1,715	134
31	5,464	1,060	878	2,186	2,209	3,113	4,385	5,657	5,154	2,429	843
32	3,597	1,526	2,693	1,051	4,157	17,951	5,856	4,489	2,362	6,992	738
33	5,154	1,257	300	1,910	4,867	8,716	8,363	4,849	5,961	6,003	1,265
34	6,715	7,412	9,598	11,095	1,740	894	23,450	11,062	9,858	7,412	1,542
35	4,983	8,366	8,385	17,739	27,296	3,880	6,293	16,917	11,884	8,842	2,589
36	5,777	5,583	14,038	17,855	5,924	23,837	36,213	8,897	12,319	8,281	3,028
37	5,466	11,371	10,181	12,563	17,411	26,106	28,354	38,722	8,007	3,262	10,211
38	8,547	1,446	3,351	9,596	4,708			15,289	6,624	1,476	10,236
39	16,273	4,524	8,031	407	9,100			886	2,372	1,742	1,462
40			1,960		33,009			499	307		2,875
41					11,371						
42					8,614						
Total	61,976	43,093	60,841	75,881	132,923	90,394	114,091	111,036	69,448	49,687	35,035

Statistical week	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average (87-07)
28	89	57	147	226	469	393	298	207	619	105	147
29	454	93	514	787	1,634	1,368	1,039	591	2,053	470	870
30	2,654	309	1,492	2,286	4,746	3,972	3,016	1,228	5,228	1,232	2,158
31	3,954	1,266	2,155	3,303	6,857	5,738	4,358	868	7,356	2,193	3,076
32	7,048	1,372	3,109	4,764	9,890	8,277	6,286	1,255	10,611	2,735	4,464
33	5,551	2,614	3,064	4,696	9,749	8,159	6,196	997	10,427	3,179	4,695
34	5,972	3,537	5,715	8,758	18,182	15,216	11,556	3,289	9,125	5,641	8,631
35	8,101	2,229	7,998	12,255	25,443	21,292	16,171	4,675	19,098	5,958	10,841
36	7,428	5,309	8,349	12,795	26,563	22,229	16,883	7,309	11,185	5,958	10,423
37	7,765	11,688	10,870	16,657	34,580	28,939	21,978	9,890	18,160	5,485	14,302
38	4,403	9,241	5,562	8,522	17,693	14,807	11,246	26,384	8,232	5,485	9,084
39	5,912	4,024	3,896	5,971	12,396	10,374	7,879	12,355	5,435	8,893	5,928
40	7,138	11,970	7,045	10,795	22,412	18,756	14,245	20,839	10,533	10,291	10,850
41		12,634	10,231	15,677	32,547	27,237	20,686	9,924	15,990		16,032
42											4,166
Total	66,472	66,343	70,147	107,493	223,162	186,755	142,626	99,811	134,053	58,159	95,211

Appendix F3.–Estimated age and length compositions of coho salmon sampled in Canyon Island fish wheels and gillnets, 1983–2007.

Year	Sample size	Percent by age class		Average length by age class	
		1.1	2.1	1.1	2.1
1983	476	65%	35%	589	610
1984	620	61%	39%	566	608
1985	772	53%	47%	584	616
1986	465	45%	54%	577	598
1987	654	37%	61%	568	592
1988	613	48%	52%	595	612
1989	624	58%	42%	581	601
1990	644	42%	58%	569	623
1991	569	62%	39%	607	623
1992	526	55%	44%	574	606
1993	567	48%	52%	578	592
1994	553	56%	43%	592	611
1995	599	54%	46%	584	588
1996	592	54%	46%	575	602
1997	472	65%	35%	575	603
1998	610	68%	32%	601	616
1999	617	79%	21%	569	594
2000	648	80%	21%	575	603
2001	771	81%	19%	601	616
2002	1,112	85%	15%	569	594
2003	905	90%	10%	614	635
2004	790	90%	10%	628	637
2005	519	82%	18%	598	619
2006	802	80%	20%	615	626
2007	686	79%	21%	595	597
Average (83–89)	603	52%	47%	580	605
Average (90-99)	575	58%	42%	582	606
Average (00-07)	779	83%	17%	599	616
Average (83-07)	648	65%	35%	587	609
SD (83–07)		16%	16%	17.0	13.5
CV (83-07)		24%	44%	0.03	0.02

APPENDIX G

Appendix G1.–Computer data files on Taku River coho salmon, 2003-2007.

File name	Description
SPAS.exe	SPAS program for estimating adult abundance
BootVar.bas	Quickbasic program for bootstrapping variance of adult abundance estimate
KS2.exe	Program for running Kolmogorov-Smirnov Two Sample Test for similarity in smolt length distributions
SMLTTAKU.bas	Program used to estimate smolt abundance and variance, 2003-2006.
1OVERTC.exe	Program for estimating Var (1/θ)
03_Smolt Data.xls	Excel file containing 2003 smolt data
04_Smolt Data.xls	Excel file containing 2004 smolt data
05_Smolt Data.xls	Excel file containing 2005 smolt data
06_Smolt Data.xls	Excel file containing 2006 smolt data
04_Taku_43.xls	Excel file containing 2004 adult data
05_Taku_43.xls	Excel file containing 2005 adult data
06_Taku_43.xls	Excel file containing 2006 adult data
07_Taku_43.xls	Excel file containing 2007 adult data and data presented in Appendix F.