Fishery Data Series No. 99-34

Production of Coho Salmon from the Taku River, 1997–1998

by

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

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

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

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

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

General

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

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

Recovery of coded wire tags from adults in 1998 tagged as smolts in 1996 and 1997 and an inriver abundance program were used to estimate smolt abundance, harvest, exploitation rate, and production of coho salmon *Oncorhynchus kisutch* from the Taku River, near Juneau, Alaska. From 15 April through 23 June 1997, 23–200 baited G-40 minnow traps were fished daily near Canyon Island on the Taku River. During this period, 15,364 coho salmon smolt ≥70 mm fork length were marked with an adipose fin clip and a coded wire tag of code 04-46-40 or 04-46-41, and released alive. Smolt averaged 86 mm in fork length (SE = 0.52) and 6.6 g (SE = 0.14) in weight. In 1998, 232 adult coho salmon bearing coded wire tags of Taku River origin were recovered in random sampling of marine fisheries, and correspond to an estimated harvest of 53,368 (SE = 7,435) in U. S. marine waters. Of this harvest, the troll fishery took an estimated 54%, drift gillnet fisheries took 36%, recreational fisheries 8%, and seine fisheries 1%. An estimated 66,472 (SE = 5,394) adults passed by Canyon Island, as determined by a separate mark-recapture experiment. Of this inriver run, 5,090 were harvested by inriver fishers above the U.S./Canada border, leaving an estimated escapement past all fisheries of 61,382 (SE = 5,394). The estimated run (escapement plus harvest) in 1998 for coho salmon originating above Canyon Island was 119,840 (SE = 9,186); marine exploitation rate on this run was an estimated 44.5% (SE = 4.0%). The estimated run in 1998 for coho salmon from the entire Taku River drainage was 153,641 (SE ≅11,776), accounting for those fish originating below Canyon Island. The contribution of all Taku River coho salmon to the Juneau marine sport fishery was estimated at 5,108 fish (SE = 1,390), or 32% of the estimated harvest in that fishery. Estimated smolt abundance in 1997 from above Canyon Island was 853,662 (SE = 147,260), obtained by using a modified Petersen estimator, and marine survival rate of coho salmon smolt from above Canyon Island was estimated at 14% (SE = 2.6%).

Key words: coho salmon, *Oncorhynchus kisutch*, Taku River, harvest, troll fishery, drift gillnet fishery, recreational fishery, seine fishery, escapement, migratory timing, production, return, exploitation rate, marine survival, coded wire tag, mark-recapture experiment

INTRODUCTION

The Taku River produces an estimated 100,000–450,000 adult coho salmon *Oncorhynchus kisutch* annually, 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).

Run sizes vary depending on escapements and on freshwater and marine survival rates. Coho salmon returning to the Taku River pass through an offshore troll fishery before entering inside waters through Icy Strait (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), the Canadian Department of Fisheries and Oceans (DFO), and the Taku River Tlinglit First Nation (TRTFN) operate a cooperative program of stock assessment and management. Past studies of Taku River coho salmon stocks are listed in Appendix A1. Taku River coho salmon are managed as a single stock, and the stock assessment program has mirrored that emphasis since 1991 (McPherson and Bernard 1996; PSC 1996).

Objectives of this year's study were to estimate (1) abundance and mean length and weight of coho salmon smolt leaving the Taku River in 1997, (2) harvest of adults returning to the Taku River in 1998, and (3) escapement and age composition of returning adults in 1998. These objectives were accomplished by tagging and sampling smolt in 1996 and 1997 in the lower Taku River and operating a cooperative inriver

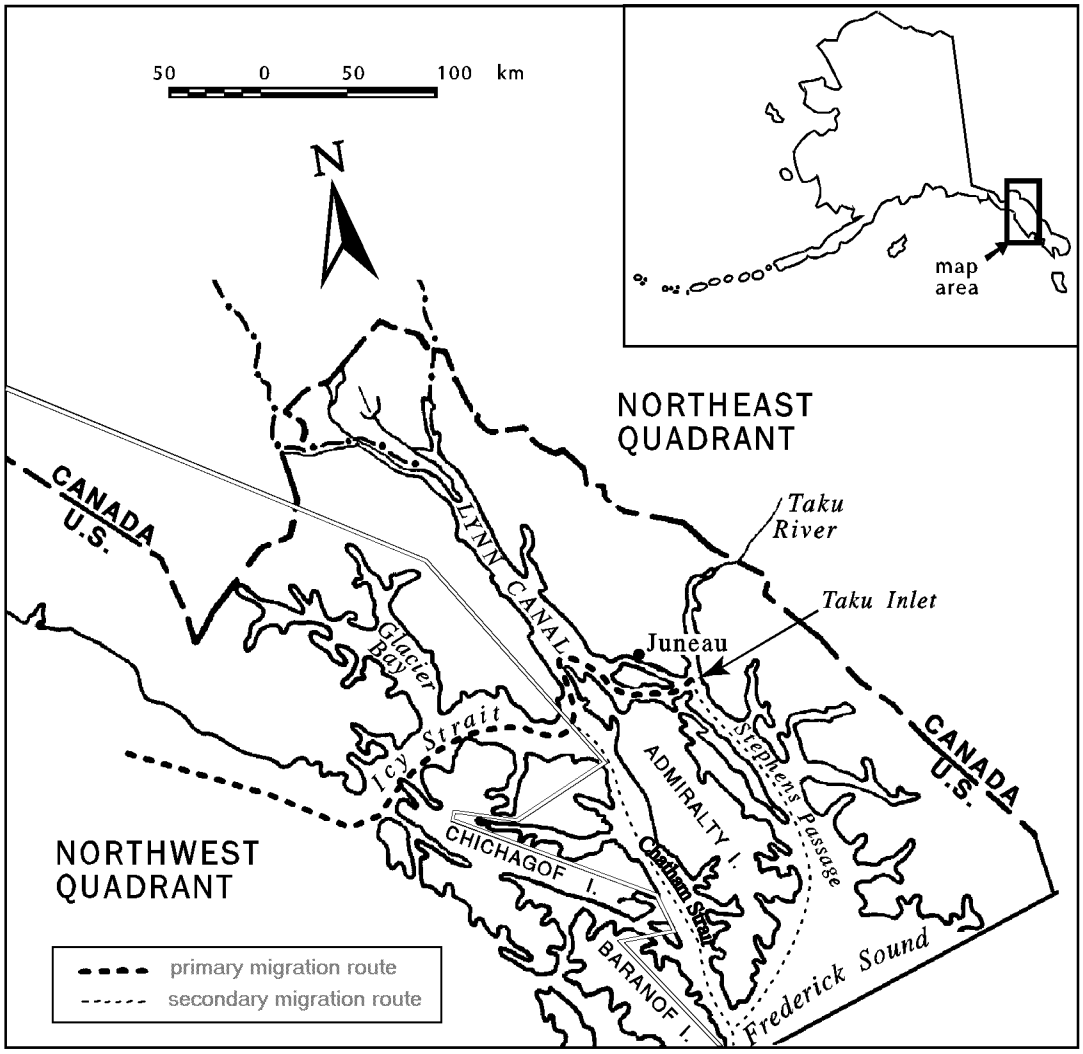


Figure 1.–Migration routes through northern Southeast Alaska of coho salmon bound for the Taku River.

abundance program for adult coho salmon in 1998. Other projects in our agency or in Canada supplied additional data on returning adults which were harvested or escaped in 1998.

METHODS

SMOLT CAPTURE, CODED WIRE TAGGING, AND SAMPLING

Between 23 and 200 G-40 minnow traps baited with salmon roe were fished daily for 24 h/d from 15 April to 23 June 1997 along both sides of the Taku River for about 6 km above and below Canyon Island. Traps were located along mainstem banks and in some backwater areas, depending on river stage. Minnow traps were checked daily when the river stage was stable and more frequently when the stage was unstable. See McPherson et al. (1998) for the description of coho smolt tagging in 1996.

Salmonid smolt and fry were removed from minnow traps during each visit, 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, and species were separated using a combination of external

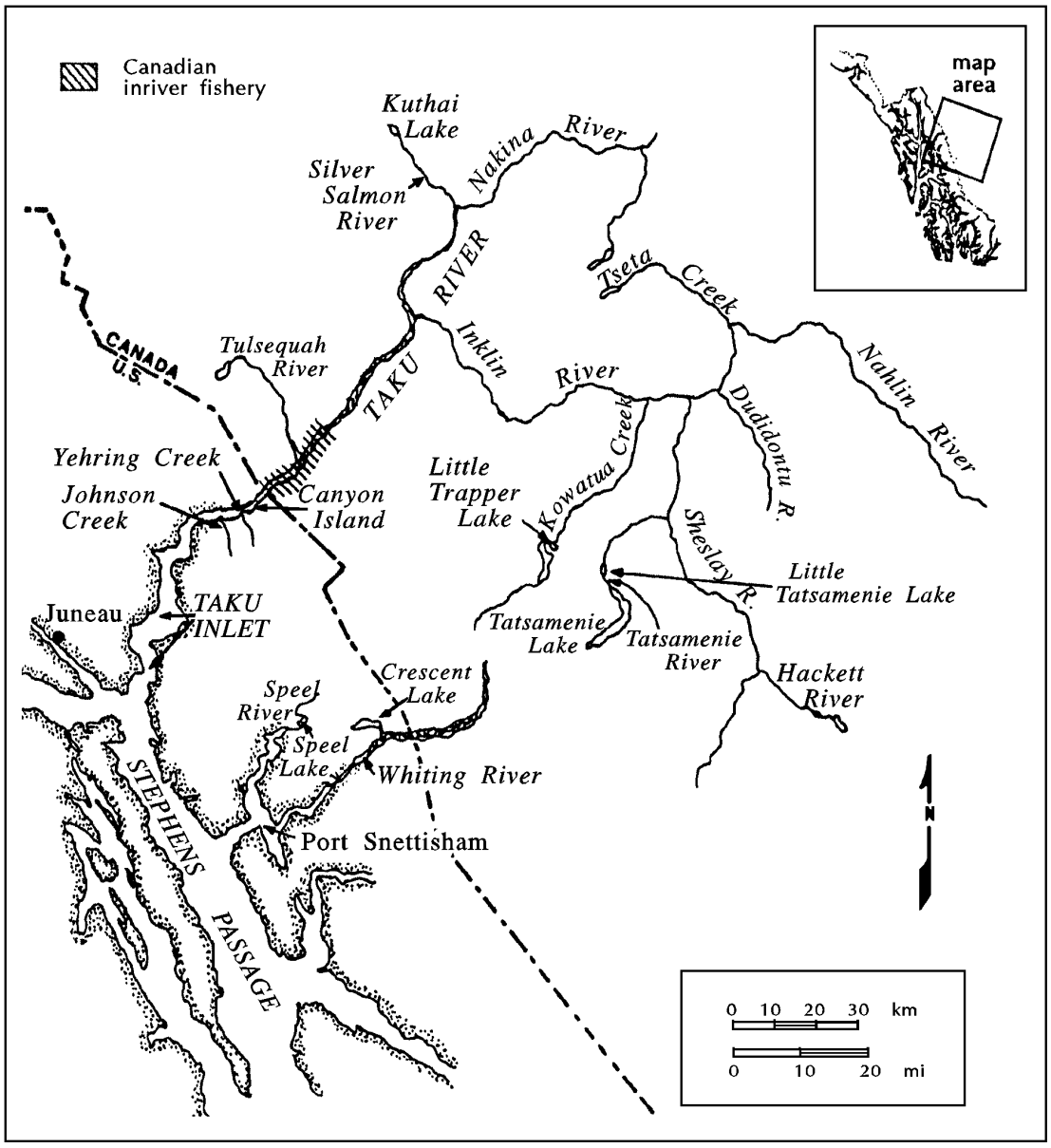


Figure 2.–Taku River drainage, northwestern British Columbia and Southeast Alaska.

morphological characteristics. A clear 'window' in the pigmentation of the adipose fin (Meehan and Vania 1961; McConnell and Snyder 1972) 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 ≥ 70 mm fork length (FL) were tranquilized in a buffered solution of tricain-methane sulfonate (MS 222). The solution was buffered with sodium bicarbonate until the pH was neutral, as measured with a Hach kit. The MS 222 solution was maintained at a constant 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), and released. In 1996 only, all live coho salmon fingerlings 50–69 mm FL were tagged also, but with a separate tag code. These fingerlings spent an additional year in the Taku River before smolting in 1997. All chinook salmon smolt >50 mm FL were also tagged with separate tag codes.

All tagged fish were held for 24 h and inspected for mortalities prior to release. Fifty (50) representative coho salmon from each day's catch were checked 24 h later for retention of CWTs. When fewer than 50 fish of a species were caught in a day, half the catch was tested. 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 Commercial Fisheries Division (CF) Tag Lab in Juneau when field work ended. About once every ten days, 50–100 coho salmon smolt were measured for FL to the nearest 1 mm and weighed to the nearest 0.1 g.

ESTIMATE OF SMOLT ABUNDANCE

Abundance of smolt originating above Canyon Island in 1997 was estimated in a two-sample, mark-recapture experiment with Petersen's estimator as modified by Bailey (1951, 1952).

$$\hat{N}_s = \frac{n_c\,(n_e + 1)}{m_a + 1} \tag{1a}$$

$$v\left[\hat{N}_s\right] = \frac{n_c^2\,(n_e + 1)(n_e - m_a)}{(m_a + 1)^2\,(m_a + 2)} \tag{1b}$$

See Table 1 for definitions of all notation.

ESTIMATE OF HARVEST

Harvest in 1998 of coho salmon originating from the Taku River above Canyon Island was estimated from fish sampled from catches in commercial and recreational fisheries and from the escapement past Canyon Island. Because several fisheries exploited coho salmon over several months in 1998, harvest was estimated over several strata, each a combination of time, area, and type of fishery. Statistics from the commercial troll fishery were stratified by fishing period and by fishing quadrant. Statistics from drift gillnet fisheries were stratified by week and by fishing district. Statistics from the recreational fishery were stratified by fortnight. Estimates of harvest $\hat{r}_i$ were calculated for each stratum, then summed across strata and across fisheries to obtain an estimate of the total $\hat{T}$:

$$\hat{T} = \sum_i \hat{r}_i \tag{2a}$$

$$v\left[\hat{T}\right] = \sum_i v\left[\hat{r}_i\right] \tag{2b}$$

Variance of the sum of estimates was estimated as the sum of variances across strata, because sampling was independent across strata and across fisheries.

A subset n_i of the catch in each stratum was counted and inspected to find recaptured fish. Of those a_i salmon in this sample without the adipose fin, heads were retrieved from a subset, marked, and sent to Juneau for dissection. Of the a_i' heads that arrived in Juneau, all were passed through a magnetometer to detect a CWT. Of the t_i tags detected, t_i' were successfully dissected and decoded with a microscope, of which m_{ci} had come from the Taku River. Oliver (1990) and Hubartt et al. (1997) present details of sampling commercial and recreational fisheries, respectively. The fraction of the return to the Taku River with tags was estimated as the fraction of the escapement sample of adults with valid, decoded CWTs $(\theta_h = m_e / n_e)$. The escapement was sampled in fish wheels located at Canyon Island, as described by Kelley and Milligan (1999).

Information from catch and field sampling programs was expanded to estimate harvest of coho salmon bound for the Taku River for each stratum. From Bernard and Clark (1996), estimated harvest and an estimate of its variance for a stratum were calculated as

Table 1.—Notation used to describe parameters involved in estimators of harvest, escapement and smolt abundance of coho salmon from the Taku River. (Coded wire tags abbreviated as CWTs.)

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
E	=	exploitation rate of adults in commercial and sport fisheries in 1998
H_i	=	number of adults caught in a stratum in 1998
λ_i	=	decoding rate [$=(a_i' t_i')/(a_i t_i)$]
m_{ci}	=	number of CWTs with the appropriate code(s) (subset of t_i') in a stratum
m_a	=	number of adults sampled at Canyon Island in 1998 with missing adipose fins
m_e	=	number of adults sampled at Canyon Island in 1998 with detected tags (a subset of m_a)
n_i	=	number of adults caught in a stratum inspected for missing adipose fins
n_c	=	number of smolt marked in 1997
n_e	=	number of adults sampled in 1998 to estimate θ
N_D	=	number of adults in escapement prior to 23 September 1998
N_e	=	number of adults in escapement to Taku River past Canyon Island in 1998
N_R	=	number of adults returning to the Taku River past Canyon Island in 1998
N_s	=	number of smolts emigrating from the Taku River past Canyon Island in 1997
q_i	=	fraction of smolt with freshwater age i in 1997
p_i	=	fraction of catch with a CWT from a stratum in 1998
P_d	=	fraction of catch in fishery made on day d
π	=	fraction of migration past Canyon Island prior to 23 September 1998
ϕ_i	=	fraction of catch sampled in a stratum in 1998
r_i	=	harvest in 1998 of coho salmon originating above Canyon Island in a stratum
S	=	survival rate from smolts in 1997 to adults in 1998
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
T	=	number of adults harvested in all strata and all fisheries in 1998
θ_h	=	fraction of the stock tagged with valid CWTs, for estimating adult salmon harvest
θ_s	=	fraction of the stock marked as smolt in 1997, for estimating salmon smolt abundance
θ_e	=	fraction of the stock tagged with spaghetti tags, for estimating adult salmon abundance above Canyon Island

$$\hat{r}_i = \hat{H}_i \hat{p}_i \hat{\theta}^{-1} \tag{3a}$$

$$\begin{aligned} v[\hat{r}_i] = \hat{r}_i^2 \,(& G[\hat{H}_i] + G[\hat{p}_i] + G[\hat{\theta}^{-1}] \\ & - G[\hat{H}_i] G[\hat{p}_i] - G[\hat{H}_i] G[\hat{\theta}^{-1}] \\ & - G[\hat{p}_i] G[\hat{\theta}^{-1}] + G[\hat{H}_i] G[\hat{p}_i] G[\hat{\theta}^{-1}]) \end{aligned} \tag{3b}$$

where $G(\,)$ is the squared coefficient of variation for the specified variable and $\hat{H}_i$ the estimated catch for a stratum. Note that $G[\hat{H}_i] = 0$ for commercial and inriver fisheries. Estimated fraction of catch composed of recovered, tagged fish $\hat{p}_i$ and $G[\hat{p}_i]$ were calculated per Table 2 in Bernard and Clark (1996):

$$\hat{p}_i = \frac{m_i}{\lambda_i n_i} \tag{4a}$$

$$G[\hat{p}_i] = \frac{1 - \lambda_i \hat{\phi}_i \hat{\theta}}{m_i} \tag{4b}$$

where $\hat{\phi}_i$ is the fraction of catch sampled ($= n_i / H_i$) and $\lambda_i = (a_i' t_i') / (a_i t_i)$. Monte Carlo simulation was used to estimate precision from field sampling programs (see Geiger 1990). Because sampling with fish wheels at Canyon Island was continuous with equal sampling effort expended throughout the passage of the escapement, the binomial probability distribution was considered an adequate model for the recovery of tagged fish. A vector of B simulated statistics $\{\theta_1^*, \theta_2^*, \ldots \theta_B^*\}$ was generated by drawing B samples each of size n_e from Binom $(\hat{\theta}, n_e)$ where $\theta_b^* = m_e^* / n_e$. Calculations followed as

$$\{\theta_1^{*-1}, \theta_2^{*-1}, \ldots, \theta_B^{*-1}\} = \{y_1^*, y_2^*, \ldots, y_B^*\}$$

$$\hat{v}[\theta^{-1}]) = \frac{\sum_{b=1}^{B} (y_b^* - \bar{y}^*)^2}{B-1} \tag{5}$$

$$\hat{G}[\theta^{-1}] = \hat{v}[\theta^{-1}])\, \hat{\theta}^2$$

ESTIMATE OF ESCAPEMENT

The escapement of coho salmon above Canyon Island in 1998 was estimated with a mark-recapture experiment co-conducted by ADF&G Sport Fish Division, CF, TRTFN, and DFO. Coho salmon were captured in two fish wheels at Canyon Island, tagged with individually numbered plastic spaghetti tags, given a dorsal fin punch as a secondary mark, measured for length to the nearest 5 mm from mid eye to tail fork (MEF), sampled for scales, and released at the fish wheels. A set gillnet (127 mm stretch mesh) was also used at Canyon Island to capture coho salmon when warranted by water conditions.

Coho salmon were examined for tags and secondary marks in the Canadian commercial gillnet and test fisheries 3–20 km upstream. See Kelley and Milligan (1999) for a detailed description of the field methods. Mark-recapture data were grouped into statistical weeks (SW) for analysis to avoid the variability associated with day-to-day statistics and to reflect the weekly periods that are used to manage U.S. and Canadian fisheries. Bailey's modification of the Petersen model (equations 1a and 1b) was used to estimate migration past Canyon Island. Since the coho salmon run usually continues beyond the end of field sampling, the direct estimate was expanded by dividing it by the estimated fraction of the migration that had passed Canyon Island by the end of field operations in 1998 (Appendix A2).

The scale sample consisted of four scales from near the "preferred area"—i.e. the left side of the fish two scales above the lateral line and on an imaginary line from the posterior dorsal fin to the anterior anal fin (Scarneccia 1979). The scales were glued to a gum card in the field and later impressed onto acetate cards. Ages were determined by examining the impressions under 70× magnification. Criteria used to assign ages were similar to those of Moser (1968) and were supplemented with results from recent coho salmon age validation studies (unpublished data). Ages are reported in European notation (Koo 1962).

ESTIMATES OF RUN SIZE, RATE OF EXPLOITATION, AND MARINE SURVIVAL

Estimates of total run size (harvest plus escapement) of coho salmon returning to the Taku River above Canyon Island in 1998 and the associated exploitation rate in commercial and sport fisheries are based on the sum of estimated harvest and estimated escapement

$$\hat{N}_R = \hat{T} + \hat{N}_e \tag{6a}$$

The variance of the estimated run was calculated as the sum of the variances for estimated escapement and estimated harvest

$$v[\hat{N}_R] = v[\hat{T}] + v[\hat{N}_e] \tag{6b}$$

The estimate of exploitation rate was calculated as

$$\hat{E} = \frac{\hat{T}}{\hat{N}_R} \tag{7a}$$

$$v[\hat{E}] \approx \hat{E}^2 \left[\frac{v[\hat{T}]\hat{N}_e^2}{\hat{N}_R^4} + \frac{v[\hat{N}_e]\hat{T}^2}{\hat{N}_R^4} \right] \tag{7b}$$

The variance in equation (7b) was approximated by the delta method (Seber 1982). The estimated survival rate of smolts to adults was calculated as

$$\hat{S} = \frac{\hat{N}_R}{\hat{N}_s} \tag{8a}$$

$$v[\hat{S}] \approx \hat{S}^2 \left[\frac{v[\hat{N}_R]}{\hat{N}_R^2} + \frac{v[\hat{N}_s]}{\hat{N}_s^2} \right] \tag{8b}$$

The variance in equation (8a) was approximated by the delta method (Seber 1982).

Estimates of Mean Date of Harvest

Estimates of the mean dates of harvest for commercial and sport fisheries were calculated from the time series of estimated proportions of catches by strata within a fishery following the methods of Mundy (1982):

$$\hat{P}_d = \frac{\hat{H}_d}{\sum_i H_i} \tag{9}$$

where P_d is the fraction of Taku River coho salmon in a fishery on day *d*. The mean date of harvest $\bar{d}$ in each fishery was calculated as:

$$\hat{\bar{d}} = \sum_d d\hat{P}_d \tag{10}$$

RESULTS

Smolt Tagging, Length, and Weight in 1997

From 15 April through 23 June 1997, 15,375 coho salmon smolt ≥70 mm FL were captured and tagged (Table 2). Eleven died within 24 h of tagging, leaving a total release of 15,364 marked smolts, composed of 10,714 coho salmon smolt bearing code 04-46-40 and 4,650 bearing code 04-46-41. Five smolt were estimated to have shed their tags within 24 h.

Ninety percent (90%) of coho smolt were captured between 21 April and 12 June (Figure 3; Table 2). Peak catches occurred from 30 April to 23 May, and 50% of the catch occurred by 7 May. Coho salmon smolt averaged 86 mm in FL (SE = 0.52) and 6.6 g (SE = 0.14) in weight in 1997 (Figure 4).

Of 38,084 chinook salmon smolt captured and tagged, 135 died within 24 h of tagging, leaving a total release of 37,949 marked smolts, composed of 10,774 chinook salmon smolts bearing code 04-46-32, 10,084 bearing code 04-46-33, 9,230 bearing code 04-46-34, and 7,861 bearing code 04-46-35 (Table 2). Seventy-six (76) smolts were estimated to have shed their tags within 24 h. Analyses of chinook salmon tagging data will be published when catches from that brood (1995) are completed after calendar year 2002.

Coded Wire Tag Recovery

In 1998, 232 CWTs with codes from Canyon Island were recovered from coho salmon in the various fisheries during random sampling of catches (Appendix A3). The greatest number of tags (120) were recovered from the commercial troll fishery, nearly all from the Northwest Quadrant on the outside coast (see Figure 1). In the marine gillnet fisheries, 83 tags were recovered, most of them from District 111 (Taku Inlet/Stephens Passage), and the others from District 115. Twenty-six (26) tags were recovered in the marine recreational fishery around Juneau in July and August. Three CWTs were recovered in the seine fishery in Chatham Strait and Frederick Sound.

Coho salmon bearing Canyon Island tags were recovered at slightly higher frequencies late in the season over the course of the District 111 gillnet fishery (Table 3). In the Northwest Quadrant of the troll fishery, recoveries appeared to be uniform throughout the season.

Table 2.–Number of salmon smolt caught and tagged in minnow traps near Canyon Island on the Taku River during 1997. Coho salmon ≥70 mm FL total includes 11 overnight tagging mortalities and 5 shed tags. Chinook salmon total includes 135 overnight tagging mortalities and 76 shed tags.

	Trap	Daily catch		Catch per trap		Air temperature (°C)		Precipitation	Water	
Date	sets	Coho	Chinook	Coho	Chinook	Min.	Max.	(inches)	Temp. (°C)	Depth (ft)
4/15/97	40	29	96	0.7	2.4					
4/16/97	54	29	96	0.5	1.8	-1	8	0.35	2.5	
4/17/97	62	58	85	0.9	1.4	0	8	0.21	2	
4/18/97	83	78	113	0.9	1.4	-2	9	0.28	3	-1.9
4/19/97	106	100	145	0.9	1.4	-7	10	0	3	-2.1
4/20/97	111	216	280	1.9	2.5	-4	12	0	2.5	-1.9
4/21/97	106	207	268	1.9	2.5	0	14	0.21	2.5	-1.9
4/22/97	115	114	300	1.0	2.6	-1	6	0.41	2.5	-1.6
4/23/97	156	155	408	1.0	2.6	-5	19	0	3	-1.3
4/24/97	153	184	330	1.2	2.2	-6	18	0	4	-0.9
4/25/97	162	195	350	1.2	2.2	-5	20	0	3	-0.8
4/26/97	152	183	328	1.2	2.2	-2	15	0.01	3	-0.3
4/27/97	162	296	250	1.8	1.5	1	12	0.19	2.5	-0.1
4/28/97	155	283	239	1.8	1.5	-2	13	0.01	3	0.3
4/29/97	168	307	259	1.8	1.5	-4	12	0	4	0.2
4/30/97	175	622	637	3.6	3.6	-4	15	0	4	-0.1
5/1/97	171	883	1,054	5.2	6.2	-4	13	0		
5/2/97	178	856	1,115	4.8	6.3	-5	18	0	4	0.1
5/3/97	174	853	1,394	4.9	8.0	-4	20	0	4	0.2
5/4/97	173	680	1,019	3.9	5.9	0	23	0	6	0.7
5/5/97	167	656	819	3.9	4.9	-4	17	0	5	1.0
5/6/97	170	520	724	3.1	4.3	0	19	0	5	1.3
5/7/97	151	577	738	3.8	4.9	4	17	0.15	4	1.9
5/8/97	148	414	552	2.8	3.7	1	13	0.17	4.5	2.0
5/9/97	165	461	616	2.8	3.7	2	18	0.19	4.5	1.8
5/10/97	162	709	1,237	4.4	7.6	2	15	0.8	5	1.8
5/11/97	200	609	1,737	3.0	8.7	4	17	0.5	4.5	1.7
5/12/97	0					0	10	0.9	5	3.8
5/13/97	50	368	898	7.4	18.0	2	17	0	6	4.0
5/14/97	24	76	88	3.2	3.7	6	21	0.4	7	6.0
5/15/97	0					6	18	0.03	6	6.2
5/16/97	38	28	110	0.7	2.9	2	15	0.06	6	6.2
5/17/97	71	52	206	0.7	2.9	1	19	0	6	5.0
5/18/97	95	70	275	0.7	2.9	6	19	0.01	6	3.7
5/19/97	116	196	870	1.7	7.5	4	20	0	6	4.1
5/20/97	82	305	2,047	3.7	25.0	0	25	0	7	4.3
5/21/97	143	273	1,758	1.9	12.3	1	25	0	7	5.0
5/22/97	125	225	1,164	1.8	9.3	3	25	0	7.5	5.9
5/23/97	79	208	724	2.6	9.2	4	25	0	8	7.4
5/24/97	38	16	97	0.4	2.6	2	25	0	8	8.5
5/25/97	23	10	59	0.4	2.6	3	27	0	8	8.0
5/26/97	42	18	107	0.4	2.6	6	20	0	7.5	6.8
5/27/97	93	79	637	0.9	6.8	10	24	0	9	5.3
5/28/97	102	87	698	0.9	6.8	7	21	0.05	11	4.3
5/29/97	113	232	1,317	2.1	11.7	11	23	0.05	10.55	4.9
5/30/97	107	151	1,176	1.4	11.0	7	21	0.01	10	

-continued-

Table 2.–(Page 2 of 2).

Date	Trap sets	Daily catch		Catch per trap		Air temperature (°C)		Precipitation	Water	
		Coho	Chinook	Coho	Chinook	Min.	Max.	(inches)	Temp. (°C)	Depth (ft)
5/31/97	124	284	835	2.3	6.7	1	21	0	10	5.8
6/1/97	116	173	804	1.5	6.9	7	18	0.08	10	5.0
6/2/97	129	216	1,158	1.7	9.0	5	13	0.04	11	4.9
6/3/97	125	209	1,214	1.7	9.7	3	23	0	10	5.0
6/4/97	124	163	1,123	1.3	9.1	7	28	0	9.5	5.3
6/5/97	86	153	573	1.8	6.7	7	21	0.08	9.5	6.4
6/6/97	10	18	67	1.8	6.7	2	13	0.15	9.5	8.6
6/7/97	58	69	82	1.2	1.4	5	20	0	9	7.6
6/8/97	78	93	111	1.2	1.4	7	19	0	10	6.2
6/9/97	106	126	150	1.2	1.4	6	15	0.26	9	5.6
6/10/97	135	135	414	1.0	3.1	0	12	0.11	9	5.0
6/11/97	137	125	638	0.9	4.7	4	20	0	9	4.8
6/12/97	135	118	595	0.9	4.4	9	23	0.04	9	4.9
6/13/97	98	85	309	0.9	3.2	9	17	0.05	10	5.6
6/14/97	118	102	372	0.9	3.2	8	15	0.08	10	5.9
6/15/97	119	72	420	0.6	3.5	6	16	0.06	10	5.8
6/16/97	117	71	413	0.6	3.5	6	15	0.14	9	5.8
6/17/97	112	44	174	0.4	1.6	2	21	0.01	9	5.5
6/18/97	108	42	167	0.4	1.6	6	20	0.1	9	4.8
6/19/97	109	42	169	0.4	1.6	8	17	0.01	10	4.8
6/20/97	107	164	535	1.5	5.0	6	21	0.01	9	4.9
6/21/97	103	130	219	1.3	2.1	5	24	0	9	4.8
6/22/97	58	73	123	1.3	2.1	10	29	0.03	9	5.8
6/23/97	0					8	30	0	10	6.4
Total	7,572	15,375	38,084					6.24		
Mean				2.0	5.0					

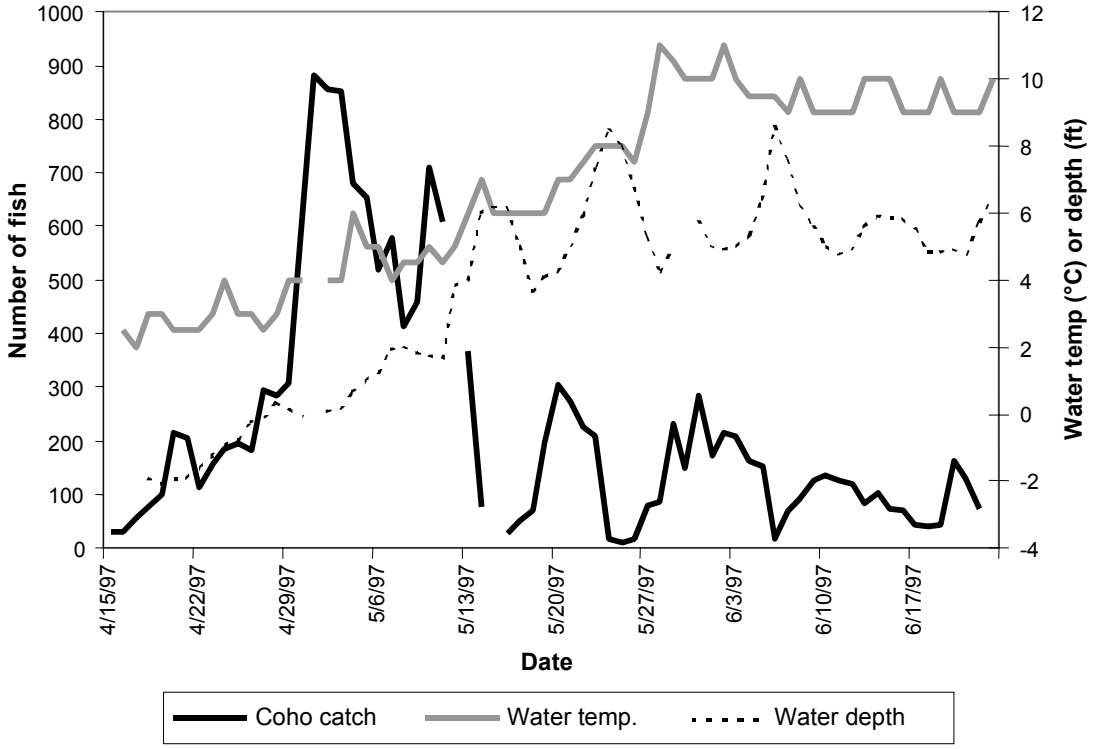


Figure 3.–Daily catch of coho salmon smolt ≥70 mm FL and daily water temperature and depth near Canyon Island, Taku River, during 1997.

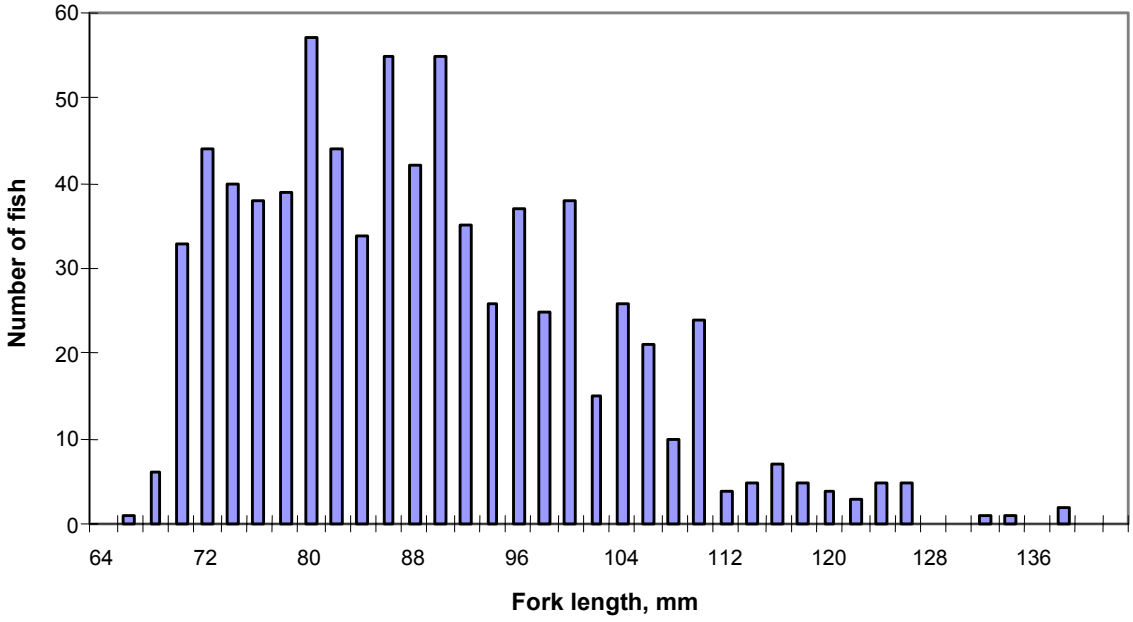


Figure 4.–Length frequency of coho salmon smolt ≥70 mm FL captured and measured at Canyon Island, Taku River, during 1997.

Table 3.–Frequency of CWTs recovered during sampling of coho salmon harvests from the drift gillnet fishery in District 111 and the troll fishery in the Northwest Quadrant in 1998. Recoveries from smolt marked at Canyon Island in 1996 with tag codes 04-42-33 or 04-42-16, and in 1997 with codes 04-46-40 or 04-46-41.

PANEL A:
DISTRICT 111 GILLNET FISHERY

		Tag code						
Stat. week	Dates	04-42-33 and 04-42-16	04-46-40	04-46-41	Sampled harvest	Percent marked	Total harvest	Percent sampled
26	21–27 Jun				1		2	50.0
27	28 Jun–04 Jul				25		32	78.1
28	5–11 Jul			1	42	2.38	131	32.1
29	12–18 Jul				96		285	33.7
30	19–25 Jul				114		517	22.1
31	26 Jul–01 Aug		2	3	897	0.56	1,497	59.9
32	02–08 Aug				460		1,440	31.9
33	09–15 Aug	2	2	2	1,623	0.37	2,431	66.8
34	16–22 Aug	1	8	1	1,059	0.94	1,977	53.6
35	23–29 Aug	1	4	4	1,453	0.62	3,040	47.8
36	30 Aug–5 Sep		1	6	1,182	0.59	3,619	32.7
37	06–12 Sep	1	7	2	1,384	0.72	6,736	20.5
38	13–19 Sep	4	11	3	2,465	0.73	6,524	37.8
39	20–26 Sep		3	1	246	1.63	482	51.0
Total		9	38	23	11,047	0.63	28,713	38.5
26–35	21 Jun–29 Aug	4	16	11	5,770	0.54	11,352	50.8
36–37	30 Aug–12 Sep	1	8	8	2,566	0.66	10,355	24.8
38–39	13–26 Sep	4	14	4	2,711	0.81	7,006	38.7
TOTAL		9	38	23	11,047	0.63	28,713	38.5

PANEL B:
NORTHWEST QUADRANT TROLL FISHERY

		Tag code						
Stat. week	Dates	04-42-33 and 04-42-16	04-46-40	04-46-41	Sampled harvest	Percent marked	Total harvest	Percent sampled
19–33	3 May–15 Aug	4	45	11	232,803	0.026	762,167	30.5
34–41	16 Aug–10 Oct	8	41	7	85,396	0.066	314,676	27.1
TOTAL		12	86	18	318,199	0.036	1,076,843	29.5

ESTIMATES OF θ AND SMOLT ABUNDANCE

Thirty-four (34) of the coho salmon inspected in the escapement were missing the adipose fin and all were sacrificed to search for CWTs; 21 contained Canyon Island tags implanted in 1997, three contained Canyon Island tags implanted in 1996, one tag was lost at the tag lab, one tag was "nonsense" (the smolt was mistakenly tagged as a chinook), and 8 fish had no tags (Appendix A4).

Because of the high incidence of marked fish with no CWTs, separate estimates of θ were used for estimating harvest and smolt abundance. For estimating harvest, we used the 24 decoded tags from 1997 and 1996 releases. We added the lost tag, assuming it was released from Canyon Island in 1997 or 1996, as past sampling at Canyon Island has yielded only tags of Canyon Island origin (McPherson et al. 1994; McPherson and Bernard 1995, 1996; McPherson et al. 1997,

1998). We also added the nonsense tag, because the fish was a Canyon Island release, to arrive at the total of 26 valid tags; thus θ_h = 0.0146 for the harvest estimate (SE = 0.0028).

For estimating coho salmon smolt abundance we used all smolt marked in 1997. Twenty-one (21) of the decoded tags were from the 1997 release. Seven (7) of the fish missing tags, the one lost tag, and the one nonsense tag were age 1.1 and definitely from the 1997 release. The eighth missing tag was age 2.1; it could have been a 1996 release, but we considered it far more likely to be an age two smolt from 1997 that had shed its tag. Thus, 31 recoveries were used to estimate θ_s for the smolt abundance estimate at 0.0174 (SE = 0.0031). Both estimates of θ were based on 1,777 coho salmon adults inspected in 1998 from catches in two fish wheels and the gillnet operated at Canyon Island (Appendix A4). The estimate of smolt abundance above Canyon Island ($\hat{N}_s$) for 1997 is 853,662 (n_c = 15,364, n_e = 1,777, m_a = 31), SE = 147,260.

ESTIMATES OF HARVEST, ESCAPEMENT AND EXPLOITATION IN 1998

An estimated 53,368 (SE = 7,435) coho salmon originating above Canyon Island were harvested in marine commercial and sport fisheries in 1998 (Table 4). The troll fishery in the Northwest Quadrant took 53.1% of the estimated marine harvest, and the drift gillnet fisheries in Taku Inlet/Stephens Passage and Lynn Canal took 24.3% (Table 5). Harvests in these fisheries occurred from July through mid-September. The troll harvest was spread over a long period (July to September), and the peak of the gillnet harvests occurred in late August and continued through September (Figure 5). Estimated mean date of harvest in the troll fishery was 23 August, compared to 9 September for the gillnet fishery (Appendix A5). Coho salmon originating above Canyon Island contributed an estimated 45% (12,972 fish) of the District 111 gillnet catch (28,713 fish). Fifty percent (50%) of the estimated 1998 harvest occurred by 5 September, later than in 1994, 1996, or 1997, but similar to 1995 (McPherson and Bernard 1995, 1996; McPherson et al. 1997, 1998). Estimated harvest in the Juneau marine recreational fishery was 3,984 fish or 7.5% of all estimated harvest and 25% of the estimated 15,730 coho salmon caught in the Juneau marine fishery, according to harvest and sampling data from Hubartt et al. (1999).

Between 5 July and 23 September, 1,642 coho salmon were marked with spaghetti tags and released at Canyon Island (Table 6), consisting of 1,418 fish captured in the fish wheels and 224 in the gillnets (Appendix A6). Six (6) coho salmon were removed from the experiment because they were recovered in other fisheries before they could enter the Canadian commercial fishery upstream, leaving 1,636 tagged fish at large. During the same period, 5,088 coho salmon were examined in the upstream fisheries, and 178 spaghetti tags were recovered. The experiment was discontinued on 23 September, when the majority of the run was over and recovery efforts dwindled.

A break in the mixing of tagged fish and changes in the sampling operations were the criteria used for stratifying the abundance estimate into independent early and late mark-recapture experiments. There was no recovery effort during SW 37 (Table 6), owing to lack of commercial interest, and fish tagged during and prior to SW 37 were not recaptured in later weeks (Table 7). During the early stratum fish were marked in the fish wheels and recaptured in the Canadian commercial fishery, the river stage was relatively constant (Appendix A6), and θ_e was 0.037 and showed no trend over time (Figure 6). During the late stratum fish were marked in gillnets and recaptured in the test fishery, the river stage plunged, and θ_e changed to 0.021 (P = 0.08).

Size-selective sampling was not apparent in either stratum (Figure 7). Thus, the abundance estimate for coho salmon passing Canyon Island prior to 23 September is 49,290 (SE = 4,485), which is the sum of 36,347 (SE = 2,744) during the early stratum and 12,943 (SE = 3,548) during the late stratum. We expanded the direct estimate by dividing it by 0.803 (the estimated fraction of the migration which passed Canyon Island by 23 September—see Appendix A2 for the

Table 4.–Estimated marine harvest of adult coho salmon bound for the Taku River in 1998, where $\hat{\theta} =$ 0.0146 and $G[\hat{\theta}^{-1}] =$ 0.049. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

TROLL FISHERY

Stat. weeks	Dates	Per.	Quad.	H	v[H]	n	a	a'	t	t'	m_c	$\hat{r}$	SE[$\hat{r}$]	RP[$\hat{r}$]
19–33	5/3-8/15	3	NW	762,167	0	232,803	4,712	4,645	3,917	3,913	62	14,083	3,559	49.5%
19–33	5/3-8/15	3	NE	135,976	0	36,893	699	688	575	573	2	514	371	141.7%
34–41	8/16-10/10	4	NW	314,915	0	85,395	2,246	2,230	1,952	1,950	56	14,230	3,642	50.2%
Subtotal troll fishery				1,212,819	0	355,091	7,657	7,563	6,444	6,436	120	28,827	5,106	34.7%

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	8/2-8/8	112	4,752	0	1,873	41	41	37	37	1	173	173	195.5%
33	8/9-8/15	112	10,963	0	2,486	55	55	51	51	1	301	302	195.7%
36	8/30-9/5	109	12,261	0	3,132	53	53	44	44	1	268	264	195.6%
Subtotal seine fishery			27,976	0	7,491	149	149	132	132	3	742	438	115.6%

SPORT FISHERY

Biweek	Dates	Derby	Area	H	v[H]	n	a	a'	t	t'	m_c	$\hat{r}$	SE[$\hat{r}$]	RP[$\hat{r}$]
14	7/6-7/19	no	Juneau	314	5,748	130	1	1	1	1	1	165	165	195.5%
15	7/20-8/2	no	Juneau	1,245	95,289	359	4	4	4	3	2	632	470	145.7%
15	7/20-8/2	no	Sitka	10,640	3,769,918	3,752	94	87	83	83	1	209	209	195.6%
16	8/3-8/16	no	Juneau	2,839	579,924	1,056	21	18	14	14	1	214	214	195.6%
17	8/17-8/30	yes	Juneau	2,808	0	2,808	136	136	118	117	10	689	260	74.0%
17	8/17-8/30	no	Juneau	3,867	2,337,820	1,032	43	39	38	38	3	847	577	133.5%
17	8/17-8/30	no	Sitka	8,088	2,305,807	2,509	87	82	75	75	1	234	233	195.6%
18	8/31-9/13	no	Juneau	2,535	387,705	1,001	51	43	39	39	7	1,437	694	94.6%
Subtotal sport fishery				32,336	9,482,211	12,647	437	410	372	370	26	4,428	1,128	49.9%

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	7/5-7/11	111	131	0	42	1	1	1	1	1	213	213	195.6%
31	7/26-8/1	111	1,499	0	897	10	9	7	7	5	635	309	95.6%
33	8/9-8/15	111	2,431	0	1,623	25	22	19	19	6	698	317	89.1%
34	8/16-8/22	111	1,977	0	1,059	24	24	23	23	10	1,276	482	74.3%
35	8/23-8/29	111	3,040	0	1,453	32	31	31	31	9	1,328	521	77.0%
35	8/23-8/29	115	3,112	0	44	2	2	1	1	1	4,834	4,833	196.0%
36	8/30-9/5	111	3,619	0	1,182	35	34	31	31	7	1,508	647	84.2%
36	8/30-9/5	115	3,830	0	949	25	25	22	22	1	276	275	195.7%
37	9/6-9/12	111	6,736	0	1,384	62	62	59	59	10	3,326	1,260	74.4%
37	9/6-9/12	115	6,006	0	1,075	26	26	24	24	1	382	381	195.8%
38	9/13-9/19	111	6,524	0	2,465	108	103	91	90	18	3,452	1,098	62.6%
39	9/20-9/26	111	482	0	246	11	11	8	8	4	536	286	104.7%
39	9/20-9/26	115	5,832	0	4,414	223	222	214	214	10	907	343	74.2%
Subtotal gillnet fishery			45,219	0	16,833	584	572	531	530	83	19,371	5,267	53.3%
TOTAL			1,318,350	9,482,211	392,062	8,827	8,694	7,479	7,468	232	53,368	7,435	27.3%

Table 5.–Estimated harvest, exploitation, and total run of Taku River coho salmon from above Canyon Island in 1998.

Fishery	Area	Estimated harvest	SE	Percent of marine harvest	Percent of total run	Removal rate[a]
U.S. troll fishery	NW Quad	28,313	5,093	53.1	23.6	
	NE Quad	514	371	1.0	0.4	
	Subtotal	28,827	5,106	54.0	24.1	24.1%
Seine fishery	Dist. 109	268	264	0.5	0.2	
	Dist. 112	474	348	0.9	0.4	
	Subtotal	742	437	1.4	0.6	1.0%
Recreational	Juneau	3,984	1,084	7.5	3.3	
	Sitka	443	313	0.8	0.4	
	Subtotal	4,428	1,173	8.3	3.7	6.1%
Drift gillnet	Dist. 111	12,972	2,015	24.3	10.8	
	Dist. 115	6,399	4,856	12.0	5.3	
	Subtotal	19,371	5,258	36.3	16.2	22.6%
Total marine harvest		53,368	7,435	100.0	44.5	44.5%
Escapement		61,382	5,394		43.1	
Canadian catch		5,090			5.0	10.3%
Inriver run		66,472	5,394			
TOTAL RUN		119,840	9,186			

[a] Percent of available population harvested by a fishery.

Table 6.–Number of adult coho salmon tagged and recovered and recovery effort to estimate abundance at Canyon Island during 1998. Number tagged does not include 6 tagged coho salmon caught in other fisheries prior to reaching the recovery area.

Statistical week	Dates	Number tagged	Fishery openings		Number examined	Tags recovered
			Days	Permits		
28	5–11 Jul	1	3	10.67	11	0
29	12–18 Jul	30	2	11	46	0
30	19–25 Jul	105	2	11.5	281	4
31	26 Jul–1 Aug	114	2	10	364	19
32	2–8 Aug	125	3.5	10.86	1233	36
33	9–15 Aug	166	2	10	511	21
34	16–22 Aug	349	2.5	11.6	797	32
35	23–29 Aug	129	3	7	783	37
36	30 Aug–5 Sep	182	4	4	547	18
37	6–12 Sep	134	0	0	0	0
Subtotal, early		1,335			4,573	167
38	13–19 Sep	218	7	1[a]	285	3
39	20–26 Sep	83	3	1[a]	164	7
40	27 Sep–3 Oct	0	1	1[a]	66	1
Subtotal, late		301	11	3	515	11
TOTAL		1,636			5,088	178

[a] Test fishery.

Table 7.–Relationship between the release week and recovery week of tagged fish in the mark-recapture experiment to estimate the coho salmon escapement at Canyon Island in 1998.

Release week	Dates	Recovery week													All
		28	29	30	31	32	33	34	35	36	37	38	39	40	
		Number of tags recovered													
28	5–11 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	12–18 Jul		0	2	2	0	0	0	0	0	0	0	0	0	4
30	19–25 Jul			2	17	5	0	0	0	0	0	0	0	0	24
31	26 Jul–1 Aug				0	25	0	0	0	0	0	0	0	0	25
32	2–8 Aug					6	13	1	0	0	0	0	0	0	20
33	9–15 Aug						8	17	6	0	0	0	0	0	31
34	16–22 Aug							14	28	4	0	0	0	0	46
35	23–29 Aug								3	6	0	0	0	0	9
36	30 Aug–5 Sep									8	0	0	0	0	8
37	6–12 Sep										0	0	0	0	0
38	13–19 Sep											3	0	0	3
39	20–26 Sep												7	1	8
40	27 Sep–3 Oct													0	0
All		0	0	4	19	36	21	32	37	18	0	3	7	1	178

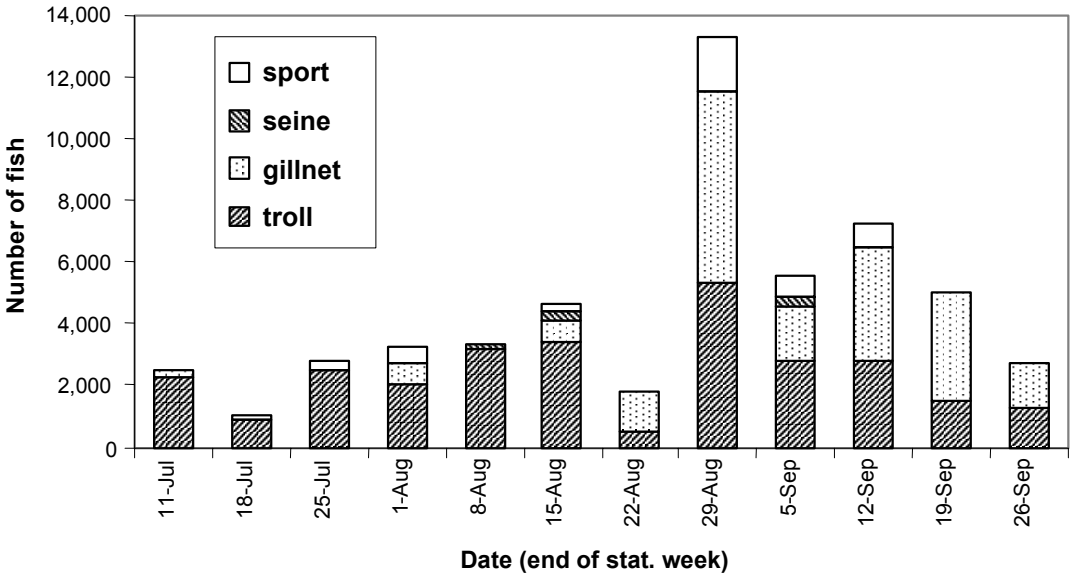


Figure 5.–Estimated harvests of coho salmon bound for Taku River in 1998, assigned to marine commercial and recreational fishery by statistical week (weekly estimates of harvest in the troll fishery approximated).

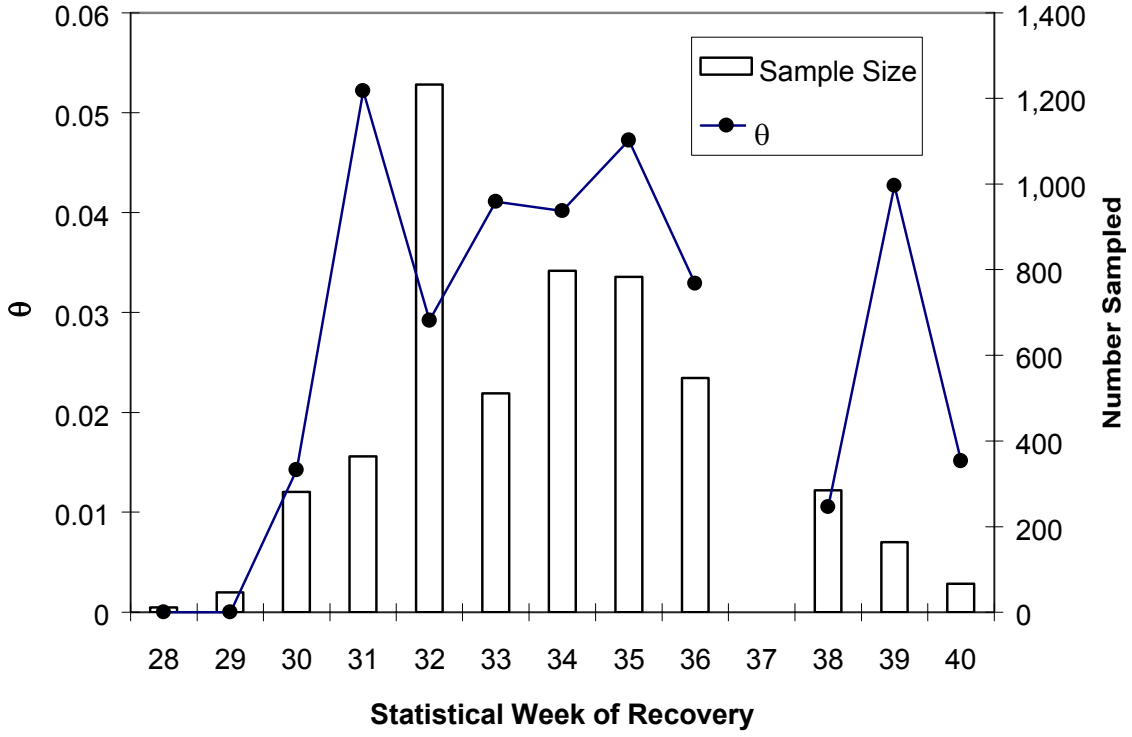
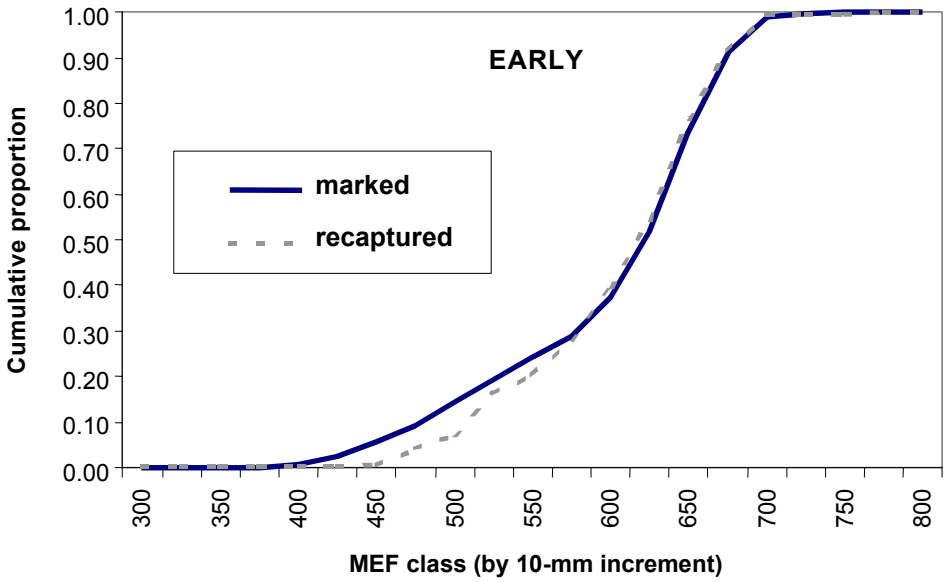


Figure 6.–Marked fraction (θ) and number examined of adult coho salmon during recovery in the mark-recapture experiment at Canyon Island during 1998.



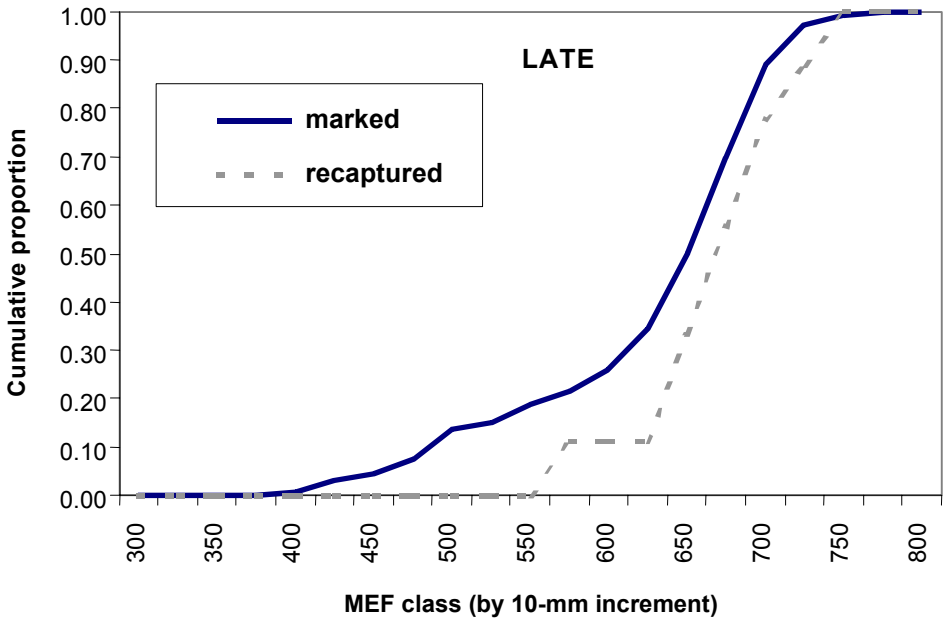


Figure 7.–Length distributions of marked and recaptured adult coho salmon in the mark-recapture experiment at Canyon Island during 1998. Length distributions were not different within early stratum ($P_{2\text{-tail}} = 0.38$; $D_{max} = 0.458$; $n_{(marked)} = 1{,}367$; $n_{(recaptured)} = 167$, K-S test) or late stratum ($P_{2\text{-tail}} = 0.28$; $D_{max} = 0.3225$; $n_{(marked)} = 309$; $n_{(recaptured)} = 9$, K-S test).

the derivation) to arrive at an estimate of 66,472 (SE = 5,394) for the entire migration past Canyon Island.

On the basis of an estimated return in 1998 of 119,840 (SE = 9,186) coho salmon bound for above Canyon Island, we estimated the marine survival rate at 14.0% (SE = 2.6%) and the exploitation rate in marine commercial and sport fisheries at 44.5% (SE = 4.0%; Appendix A7). Inriver harvest above Canyon Island was 5,090 coho salmon in 1998 (Pat Milligan, Department of Fisheries and Oceans Canada, Whitehorse, personal communication), from which we estimate an escapement of 61,382 (SE = 5,394) coho salmon above Canyon Island for the year.

Age composition of adult coho salmon sampled from catches in Canyon Island fish wheels was 67.7% (SE = 1.9%) age 1.1 and 32.3% (SE = 1.9%) age 2.1 (Mark Olson, Alaska Department of Fish and Game, Douglas, personal communication; Appendix A9), and the mean MEF length of adults at Canyon Island was 605 mm (SE = 3.1).

DISCUSSION

Smolt captured and tagged in 1997 were shorter compared to smolt captured and tagged from 1991–1996 on the Taku River. In 1997, smolt captured at Canyon Island averaged 86 mm FL, compared to 89 mm in 1996 (McPherson et al. 1998), 94 mm FL in 1995 (McPherson et al. 1997), 101 mm FL in 1994 (McPherson and Bernard 1996), 98 mm in 1993 (McPherson and Bernard 1995), 105 mm at Barrel Point in 1992 (McPherson et al. 1994) and 100 mm at Barrel Point in 1991 (Elliott and Bernard 1994). Only G-40 minnow traps were used to capture smolt in 1997, whereas rotary traps were used partly or wholly in previous years. The size selectivity of these gear types is unknown. The same tagging strategy (fish $\geq$70 mm FL) was used each year. Smolt emigration timing in 1997 was similar to that observed by Meehan and Siniff (1962), when a modified scoop trap was operated in the narrows of Canyon Island from 12 April through 15 June.

Our estimated marine survival rate (14%) is similar to or lower than estimates for other wild and hatchery stocks in Southeast Alaska for 1997; estimated marine survivals were 23% for Auke Lake, 17% for Berners River and 12% for Hugh Smith Lake (L. Shaul, Alaska Department of Fish and Game, Douglas, personal communication). The 1997 rate is moderate, compared to historical survival rates for Taku River smolt (Appendix A7). Circumstances and results indicate that conditions for obtaining an accurate estimate of smolt abundance with the mark-recapture experiment were met. Bailey's modification of the Petersen estimate was used because of the systematic nature of sampling smolts and adults (see below). While the population in this experiment was not closed to losses from mortality, it was closed to recruitment, because salmon return to their natal stream to spawn. The models we used to estimate harvest of coho salmon from the Taku River are based on sampling as a random process, yet our capture of smolts at Canyon Island and catch sampling of harvests were not random, but systematic. Representative samples can be drawn with a systematic process only if (1) every smolt has an equal chance of being marked, (2) every adult has an equal chance of being sampled, or (3) marked and unmarked fish mix completely between sampling events. Our fishing effort near Canyon Island for smolt was relatively constant, and it is unlikely that much of the migration occurred prior to 15 April. Also, the drawn-out recovery of CWTs indicated considerable mixing of marked and unmarked coho salmon during their 14 to 16 months at sea (Table 3, Appendix A4). Recoveries of CWTs in the troll and District 111 gillnet fisheries from coho salmon tagged at Canyon Island were spread throughout this fishery in rough proportion to harvests.

Tagging a representative sample of smolts or having tagged and untagged fish mix completely is also crucial for an accurate estimate of adult coho salmon harvests. In catches at the Canyon Island fish wheels, the fraction of adult coho salmon with marks (a missing adipose fin) did not vary over time; this indicates that one or both of these conditions was satisfied (P = 0.72, X2 = 0.646, df = 2). As shown in Appendix A4, 1.72% (10/582) of coho salmon caught during 1 July–15 August lacked an adipose fin, 2.28% (14/614) during 16–31 August, and 1.72% (10/581) during 1–23 September.

Different estimates of θ were necessary to estimate harvest and smolt abundance, because there was a high incidence of marked fish without CWTs (24%). While values of θ differ, each estimate is unbiased for its particular use. The secondary mark (missing adipose fin) was used for the smolt abundance estimate to avoid bias due to tag loss and to improve precision by means of a larger sample size (Seber 1982). Because past instances of naturally missing adipose fins are rare, and only coho salmon of Taku River origin are captured at Canyon Island, the heads with no tags are likely to be Taku River coho that shed their CWTs (McPherson et al. 1994; McPherson and Bernard 1995, 1996; McPherson et al. 1997, 1998). We excluded the three CWTs released in 1996 from the smolt abundance estimate because they experienced an additional year of mortality than did the 1997 release, thereby failing the necessary condition of similar survival for all fish. Only valid tags (present and decoded) were used to estimate harvest, because fisheries comprise mixed stocks—as do fish missing the adipose fin in those fisheries. The reason for 24% loss of CWTs during the smolt to adult period is not obvious; an experienced field crew used tagging procedures that were identical to previous years, and 24-h tag loss was very low (<1%).

Necessary assumptions were likely met, also, for the mark-recapture experiment on adult coho salmon abundance. Marking effects on the catchability of fish were extremely unlikely, because active capture methods were used in mark and recapture events, and gear types were usually different. Mortality of marked fish was minimized by tagging only healthy fish and recapturing them soon (1–3 weeks). No fish with only a secondary mark were noted when examining for tags, so tag loss was inconsequential. One tagged coho salmon was recovered downstream in the marine commercial gillnet fishery in Taku Inlet and Stephens Passage, indicating some emigration of tagged fish, but no adjustment was made to the number of tags released, other than removing that particular tag from the experiment. Mortality and downstream movement were very infrequent (<3%) for coho salmon marked with spaghetti tags and radio transmitters at Canyon Island in a 1992 study (John Eiler, National Marine Fisheries Service, Auke Bay, personal communication), demonstrating that those particular handling effects on coho salmon were unlikely. Recruitment of coho salmon to the population above Canyon Island was impossible, because the river is constricted to a single channel at Canyon Island where all coho salmon must pass to reach the recapture site.

The experimental design precluded equal temporal mixing of marked and unmarked fish, as they passed through the mark and recapture sites on their upstream migration and were out of the experiment in a few weeks. We assumed the distance between mark and recapture sites to be sufficient for spatial mixing of marked and unmarked fish, but this assumption cannot be directly tested, because upsteam fisheries occur over a small stretch of the river.

We attempted to establish equal probability of marking each fish by operating both fish wheels continuously for most of the season, but a freshet during 1–3 August and low water during 16–23 September interrupted fish wheel operation (Appendix A6), and the marking gear switched from fish wheels to gillnet on 16 September. Equal probability of recapture was attempted by weekly openings of the Canadian commercial fishery throughout the run, but this fishery ceased by 5 September and a test fishery operated by TRTFN did not begin until 13 September (Table 6). Whereas θ_e did not change significantly between early and late strata we chose ($P = 0.08$, $X^2 = 2.97$, $df = 1$), the P-value is marginal and the power of the test is low. To account for the shift in conditions and possibly catchability, we modeled the total abundance as the sum of early and late strata. We felt the Petersen model, not the Darroch, was the most appropriate within a stratum. No need for further stratification was apparent within the early stratum, as catchability (evidenced by θ_e) lacked a trend, and the methods and river stage were relatively constant. Sample sizes in the late stratum were too small to allow further stratification.

We included tags released during SW 37 in the early stratum, as gear type and river stage then

were more similar to the early conditions than to the late conditions (Appendix A6). We believe this similarity can be extended to catchability, which allows the tags released in SW 37 to be used in the early stratum abundance estimate. If SW 37 tags were not used, there would be no abundance estimate for SW 37 and another method would be needed to obtain abundance for SW 37.

Our estimates of escapement (61,382), catch (53,368 + 5,090) and total run (119,840) are minimum estimates of those parameters for the entire Taku River, because many fish spawn downstream of Canyon Island. As much as 22% of the spawning occurs below the Canadian border (Eiler et al. *In press*), and only a small portion of the U.S. population is believed to spawn above Canyon Island. Using that expansion, we estimated escapement in the entire Taku River in 1998 at 80,131 ([61,382 + 5,090]/0.78 – 5,090), marine harvest at 68,421 (53,368/0.78), and run at 153,641. Exploitation rate (44.5%) and marine survival (14.0%) remain the same as estimates for fish from above Canyon Island. Estimated harvest for all Taku River coho salmon in the Juneau-area marine boat sport fishery is 5,108 (3,984/0.78), or 32% of the sport harvest of 15,730 coho salmon, similar to recent years (McPherson and Bernard 1995, 1996; McPherson et al. 1997, 1998).

CONCLUSIONS AND RECOMMENDATIONS

Results from this project are contributing to development of a long-term database. We estimated smolt production in 1997 and adult production in 1998, the seventh consecutive year these parameters have been estimated for this population (Appendix A7). Escapements have been estimated since 1987 by CF and DFO (Appendices A7 and A8). This program has already provided valuable management tools, such as inseason assessment of run strength (see McPherson et al. 1998), and in the future will allow evaluation of smolt and adult production and refinement of escapement goals.

Since this project is planned to continue annually, we recommend some strategies to improve the precision of smolt and adult parameter estimates. First, precision of estimates of harvest, particularly in the sport fishery, and smolt abundance can be improved by tagging more smolt with CWTs. This was accomplished in 1997 by starting slightly earlier to cover a greater proportion of smolt emigration and by deploying more trapping gear and improving the trapping methodology. The precision of θ improved also during recovery of adults from inriver fish wheels. Secondly, the escapement estimate can be improved by operating the mark-recapture experiment through the duration of the immigration of adults, though this may not be possible due to lack of inriver commercial fishing effort late in the season and a lack of funding to operate a test fishery. Gillnetting worked well as a means to capture fish when river levels late in the season became too low for fish wheels. We also need to determine if the minnow traps select for a particular size of smolt.

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APPENDIX A

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

Citation	Location	Objective
Eiler et al. *In press*	Taku River	Spawning distribution
Elliott 1987	Yehring Creek	1986 escapement
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	Yehring Creek	1989 harvest and escapement 1988 smolt abundance and survival 1989 smolt abundance
Elliott and Sterritt 1991	Yehring Creek	1990 harvest and escapement 1989 smolt abundance and survival
	Nahlin River	1990 smolt tagging
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
Kelley et al. 1997	Taku River	1995 escapement
Kelley and Milligan 1997	Taku River	1996 escapement
Kelley and Milligan 1998	Taku River	1997 escapement
McGregor and Clark 1988	Taku River	Estimated escapement
McGregor and Clark 1989	Taku River	Estimated escapement
McGregor et al. 1991	Taku River	Estimated escapement
McPherson et al. 1994	Taku River	1992 smolt abundance and survival 1993 harvest and escapement
McPherson and Bernard 1995	Taku River	1993 smolt abundance and survival 1994 harvest and escapement
McPherson and Bernard 1996	Taku River	1994 smolt abundance and survival 1995 harvest and escapement
McPherson et al. 1997	Taku River	1995 smolt abundance and survival 1996 harvest and escapement
McPherson et al. 1998	Taku River	1996 smolt abundance and survival 1996 harvest and escapement
Murphy et al. 1988	Taku River	1987 smolt tagging
PSC 1993	Taku River	Estimated 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

-continued-

Appendix A1.–Page 2 of 2.

Citation	Location	Objective
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
Shaul 1992	Nahlin River	1990 harvest
	Mainstem	1990 harvest
	Tatsamenie L.	1990 harvest
	Yehring Creek	1990 harvest
	U.S. tribs.	1990 escapement

Appendix A2.–Derivation of the expansion factor for run timing of the Taku River coho salmon return.

The estimated escapement past Canyon Island by 23 September was obtained directly from the mark-recapture experiment (see Methods), but coho salmon continued to migrate upstream to spawn after 23 September. This partial estimate was expanded by the estimated fraction of the escapement that had passed Canyon Island by 23 September:

$$\hat{N}_e = \frac{\hat{N}_D}{\pi} \tag{11a}$$

$$v[\hat{N}_e] = \frac{v[\hat{N}_D]}{\pi^2} \tag{11b}$$

where $\hat{N}_e$ is the estimated escapement above Canyon Island for all of 1998 and $\hat{N}_D$ is the estimated escapement above Canyon Island by 23 September 1998. The statistic π is the fraction of the migration estimated to have passed Canyon Island by 23 September 1998. This fraction is based on the timing of fish at Canyon Island through 23 September in relation to the timing of those fish through the commercial troll fishery. The troll fishery was used because, compared to other fisheries, it occurs over the longest period and across the broadest geographic area, and experiences relatively few management actions to affect its performance. In 1998, 23 September occurred one-half way through SW 39 (hence SW 39.5). We estimate, as seen from "fishery shadows" in past Canyon Island fish wheel catches, that coho salmon take three to four days to migrate to Canyon Island from the commercial gillnet fishery in Taku Inlet. This puts the timing for fish on 23 September (at Canyon Island) in the gillnet fishery at SW 39.0 (20 September). It appears that the migration timing from the commercial troll fishery to the Taku Inlet gillnet fishery was approximately 2.5 weeks (Table A1, Figure A1). Note that the gillnet harvest at the end of the 1998 season was abbreviated to low effort levels. Consequently, we estimate the difference in timing between the commercial troll fishery and Canyon Island fish wheel catches to be three weeks in 1998, meaning that fish passing Canyon Island during SW 39.5 were passing through the troll fishery during SW 36. The fraction of the troll fishery catch through SW 36 was about 80.3%, which is the statistic π. Estimated variance ($v[\hat{N}_e]$ = 30,658,779) is a minimum, because the measurement error in π is unknown.

Table A1.–Estimated mean dates of harvest in the commercial troll fishery and the Taku Inlet gillnet fishery, 1993–1998, using harvest estimates generated from recoveries of CWTs. Data from McPherson et al. (1994, 1997, 1998), and McPherson and Bernard (1995 and 1996).

Year	Troll	Gillnet	Difference (days)
1993	18 Aug	11 Sep	24
1994	3 Aug	31 Aug	28
1995	15 Aug	31 Aug	16
1996	10 Aug	24 Aug	14
1997	11 Aug	no estimate	
1998	15 Aug	1 Sep	17
Average	12 Aug	1 Sep	20

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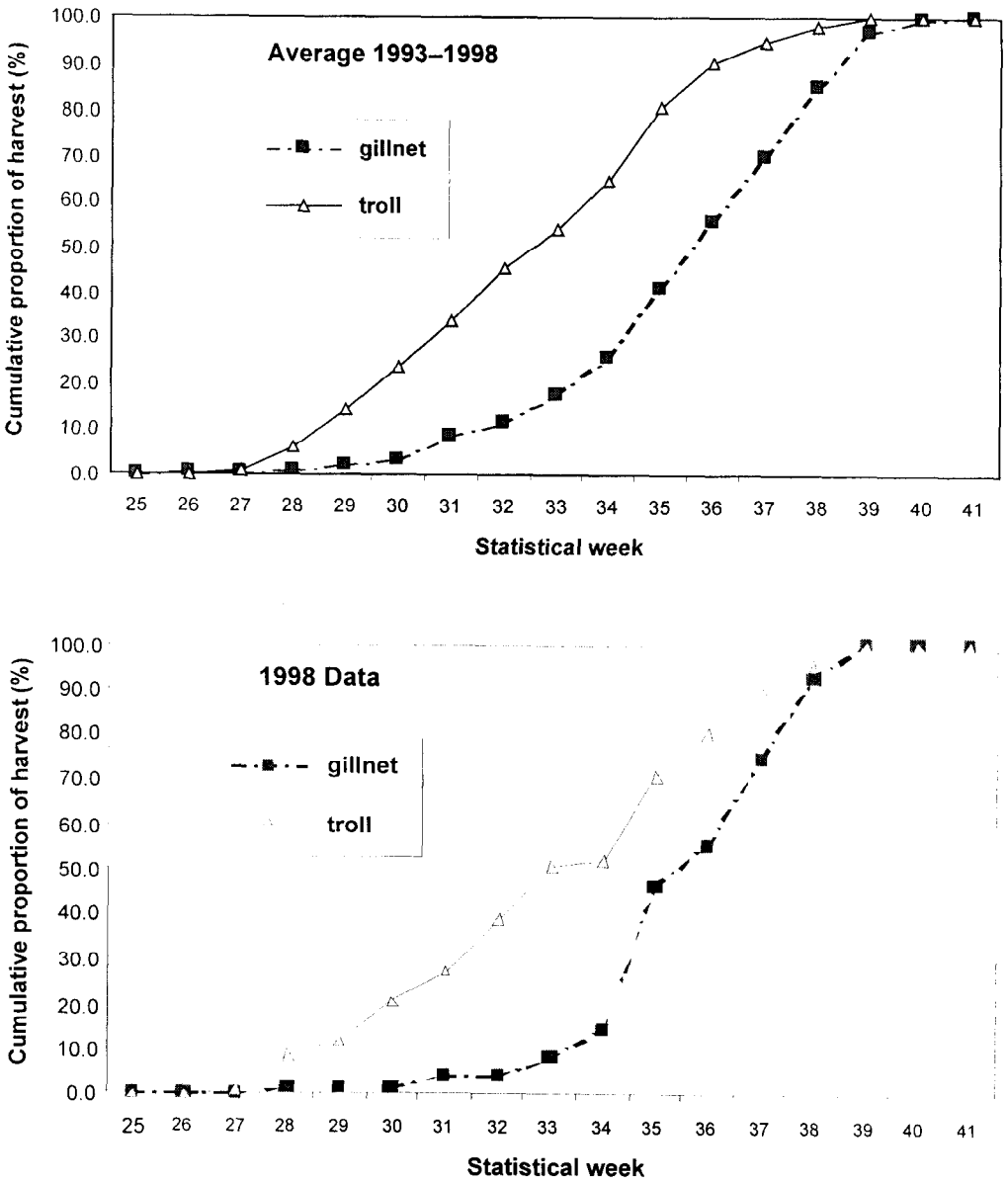

Figure A2.–Cumulative proportions of harvest for the commercial troll fishery versus the commercial gillnet fishery in Taku Inlet, on average for 1993–1998 (top graph) and in 1998 (bottom graph). Data from McPherson et al. (1994, 1997, 1998), and McPherson and Bernard (1995 and 1996).

Appendix A3.–Random and select recoveries of coded wire tagged coho salmon bound for Taku River above Canyon Island in 1998.

Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
RANDOM RECOVERIES														
50522	44640	TROLL	3-Jul-98	27	NW	113	91	695	761,928	232,803	4,712	4,645	3,917	3,913
40147	44641	TROLL	7-Jul-98	28	NW	113	94	685	761,928	232,803	4,712	4,645	3,917	3,913
51711	44640	TROLL	7-Jul-98	28	NW			575	761,928	232,803	4,712	4,645	3,917	3,913
51729	44640	TROLL	7-Jul-98	28	NW			690	761,928	232,803	4,712	4,645	3,917	3,913
65618	44641	TROLL	7-Jul-98	28	NW	113	45	654	761,928	232,803	4,712	4,645	3,917	3,913
51932	44641	TROLL	10-Jul-98	28	NW			565	761,928	232,803	4,712	4,645	3,917	3,913
51944	44640	TROLL	10-Jul-98	28	NW			680	761,928	232,803	4,712	4,645	3,917	3,913
37153	44640	TROLL	11-Jul-98	28	NW	156		594	761,928	232,803	4,712	4,645	3,917	3,913
40352	44640	TROLL	11-Jul-98	28	NW	113	91	700	761,928	232,803	4,712	4,645	3,917	3,913
40355	44640	TROLL	11-Jul-98	28	NW	113	91	635	761,928	232,803	4,712	4,645	3,917	3,913
50587	44640	TROLL	11-Jul-98	28	NW	113	91	615	761,928	232,803	4,712	4,645	3,917	3,913
56595	44640	TROLL	12-Jul-98	29	NW	113	21	708	761,928	232,803	4,712	4,645	3,917	3,913
66419	44640	TROLL	15-Jul-98	29	NW	116	11	630	761,928	232,803	4,712	4,645	3,917	3,913
66048	44640	TROLL	17-Jul-98	29	NW			632	761,928	232,803	4,712	4,645	3,917	3,913
37232	44216	TROLL	18-Jul-98	29	NW	113	91	566	761,928	232,803	4,712	4,645	3,917	3,913
37246	44640	TROLL	19-Jul-98	30	NW	113	91	731	761,928	232,803	4,712	4,645	3,917	3,913
66118	44640	TROLL	20-Jul-98	30	NW	113	11	600	761,928	232,803	4,712	4,645	3,917	3,913
66206	44641	TROLL	21-Jul-98	30	NE	112	17	612	135,976	36,893	699	688	575	573
66269	44640	TROLL	22-Jul-98	30	NW			598	761,928	232,803	4,712	4,645	3,917	3,913
66161	44216	TROLL	23-Jul-98	30	NW	113	91	759	761,928	232,803	4,712	4,645	3,917	3,913
37304	44640	TROLL	25-Jul-98	30	NW			700	761,928	232,803	4,712	4,645	3,917	3,913
37335	44640	TROLL	25-Jul-98	30	NW			684	761,928	232,803	4,712	4,645	3,917	3,913
37359	44641	TROLL	25-Jul-98	30	NW			529	761,928	232,803	4,712	4,645	3,917	3,913
37378	44641	TROLL	25-Jul-98	30	NW			643	761,928	232,803	4,712	4,645	3,917	3,913
45374	44640	TROLL	25-Jul-98	30	NW	181	60	720	761,928	232,803	4,712	4,645	3,917	3,913
57107	44640	TROLL	25-Jul-98	30	NW	116		713	761,928	232,803	4,712	4,645	3,917	3,913
66291	44640	TROLL	27-Jul-98	31	NW	116	11	635	761,928	232,803	4,712	4,645	3,917	3,913
37422	44640	TROLL	29-Jul-98	31	NW	116		707	761,928	232,803	4,712	4,645	3,917	3,913
44835	44216	TROLL	29-Jul-98	31	NE	112		565	135,976	36,893	699	688	575	573
45411	44640	TROLL	29-Jul-98	31	NW	181	60	670	761,928	232,803	4,712	4,645	3,917	3,913
45416	44216	TROLL	30-Jul-98	31	NW	181	60	690	761,928	232,803	4,712	4,645	3,917	3,913
67114	44640	TROLL	30-Jul-98	31				633	761,928	232,803	4,712	4,645	3,917	3,913
37425	44640	TROLL	31-Jul-98	31	NW			667	761,928	232,803	4,712	4,645	3,917	3,913
50678	44640	TROLL	31-Jul-98	31	NW	114	21	730	761,928	232,803	4,712	4,645	3,917	3,913
53566	44641	TROLL	31-Jul-98	31	NW			640	761,928	232,803	4,712	4,645	3,917	3,913
44280	44640	TROLL	2-Aug-98	32	NW	113	91	675	761,928	232,803	4,712	4,645	3,917	3,913
44293	44640	TROLL	3-Aug-98	32	NW			780	761,928	232,803	4,712	4,645	3,917	3,913
45285	44640	TROLL	3-Aug-98	32	NW	113	93	740	761,928	232,803	4,712	4,645	3,917	3,913
50690	44640	TROLL	3-Aug-98	32	NW	114	21	490	761,928	232,803	4,712	4,645	3,917	3,913
53162	44640	TROLL	3-Aug-98	32	NW			720	761,928	232,803	4,712	4,645	3,917	3,913
53177	44640	TROLL	3-Aug-98	32	NW			690	761,928	232,803	4,712	4,645	3,917	3,913
53221	44640	TROLL	3-Aug-98	32	NW			720	761,928	232,803	4,712	4,645	3,917	3,913
67528	44641	TROLL	3-Aug-98	32	NW	116	12	661	761,928	232,803	4,712	4,645	3,917	3,913
45466	44640	TROLL	4-Aug-98	32	NW	181	60	565	761,928	232,803	4,712	4,645	3,917	3,913

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
44644	44641	TROLL	5-Aug-98	32	NW			730	761,928	232,803	4,712	4,645	3,917	3,913
45513	44640	TROLL	5-Aug-98	32	NW			675	761,928	232,803	4,712	4,645	3,917	3,913
50712	44640	TROLL	6-Aug-98	32	NW	114	21	770	761,928	232,803	4,712	4,645	3,917	3,913
37517	44641	TROLL	7-Aug-98	32	NW	113	91	663	761,928	232,803	4,712	4,645	3,917	3,913
50722	44216	TROLL	7-Aug-98	32	NW	114	21	740	761,928	232,803	4,712	4,643	3,915	3,911
37576	44640	TROLL	10-Aug-98	33	NW	113	91	672	761,928	232,803	4,712	4,643	3,915	3,911
44747	44640	TROLL	11-Aug-98	33	NW	113	91	620	761,928	232,803	4,712	4,643	3,915	3,911
50737	44640	TROLL	11-Aug-98	33	NW	114	21	700	761,928	232,803	4,712	4,643	3,915	3,911
10018	44640	TROLL	12-Aug-98	33	NW			735	761,928	232,803	4,712	4,643	3,915	3,911
10092	44640	TROLL	12-Aug-98	33	NW	116		705	761,928	232,803	4,712	4,643	3,915	3,911
37648	44641	TROLL	12-Aug-98	33	NW	113		637	761,928	232,803	4,712	4,643	3,915	3,911
45657	44640	TROLL	12-Aug-98	33	NW	181	60	755	761,928	232,803	4,712	4,643	3,915	3,911
45659	44640	TROLL	12-Aug-98	33	NW	181	60	720	761,928	232,803	4,712	4,643	3,915	3,911
45664	44641	TROLL	12-Aug-98	33	NW	189	30	690	761,928	232,803	4,712	4,643	3,915	3,911
45677	44640	TROLL	12-Aug-98	33	NW	189		745	761,928	232,803	4,712	4,643	3,915	3,911
45769	44640	TROLL	12-Aug-98	33	NW	189	30	580	761,928	232,803	4,712	4,643	3,915	3,911
45774	44640	TROLL	12-Aug-98	33	NW	189	30	630	761,928	232,803	4,712	4,643	3,915	3,911
57557	44640	TROLL	12-Aug-98	33	NW	157		684	761,928	232,803	4,712	4,643	3,915	3,911
68504	44640	TROLL	12-Aug-98	33	NW	116		736	761,928	232,803	4,712	4,643	3,915	3,911
35807	44640	TROLL	13-Aug-98	33	NW			735	761,928	232,803	4,712	4,643	3,915	3,911
50774	44640	TROLL	20-Aug-98	34	NW	114	21	760	314,915	85,395	2,246	2,230	1,952	1,950
50792	44640	TROLL	21-Aug-98	34	NW	114	21	620	314,915	85,395	2,246	2,230	1,952	1,950
37654	44640	TROLL	23-Aug-98	35	NW	113	91	668	314,915	85,395	2,246	2,230	1,952	1,950
68396	44641	TROLL	23-Aug-98	35	NW	113	91	686	314,915	85,395	2,246	2,230	1,952	1,950
37721	44640	TROLL	25-Aug-98	35	NW	113	91	732	314,915	85,395	2,246	2,230	1,952	1,950
37760	44640	TROLL	26-Aug-98	35	NW	181		752	314,915	85,395	2,246	2,230	1,952	1,950
50845	44640	TROLL	26-Aug-98	35	NW	114	21	720	314,915	85,395	2,246	2,230	1,952	1,950
50846	44640	TROLL	26-Aug-98	35	NW	114	21	800	314,915	85,395	2,246	2,230	1,952	1,950
50848	44216	TROLL	26-Aug-98	35	NW	114	21	780	314,915	85,395	2,246	2,230	1,952	1,950
85307	44216	TROLL	26-Aug-98	35	NW	116		695	314,915	85,395	2,246	2,230	1,952	1,950
85315	44640	TROLL	26-Aug-98	35	NW	116		700	314,915	85,395	2,246	2,230	1,952	1,950
45646	44640	TROLL	27-Aug-98	35	NW	189	30	700	314,915	85,395	2,246	2,230	1,952	1,950
85605	44640	TROLL	27-Aug-98	35	NW	114	25	440	314,915	85,395	2,246	2,230	1,952	1,950
85612	44640	TROLL	27-Aug-98	35	NW			750	314,915	85,395	2,246	2,230	1,952	1,950
112914	44640	TROLL	27-Aug-98	35	NW	116	11	700	314,915	85,395	2,246	2,230	1,952	1,950
112929	44233	TROLL	27-Aug-98	35	NW	116	11	706	314,915	85,395	2,246	2,230	1,952	1,950
54776	44640	TROLL	28-Aug-98	35	NW			730	314,915	85,395	2,246	2,230	1,952	1,950
54780	44640	TROLL	28-Aug-98	35	NW			630	314,915	85,395	2,246	2,230	1,952	1,950
54782	44640	TROLL	28-Aug-98	35	NW			760	314,915	85,395	2,246	2,230	1,952	1,950
54795	44640	TROLL	28-Aug-98	35	NW			730	314,915	85,395	2,246	2,230	1,952	1,950
69088	44640	TROLL	28-Aug-98	35	NW			747	314,915	85,395	2,246	2,230	1,952	1,950
69089	44641	TROLL	28-Aug-98	35	NW			548	314,915	85,395	2,246	2,230	1,952	1,950
69378	44640	TROLL	28-Aug-98	35	NW			718	314,915	85,395	2,246	2,230	1,952	1,950
85626	44640	TROLL	30-Aug-98	36	NW	114	25	690	314,915	85,395	2,246	2,230	1,952	1,950
50861	44216	TROLL	1-Sep-98	36	NW	114	21	785	314,915	85,395	2,246	2,230	1,952	1,950
85559	44216	TROLL	1-Sep-98	36	NW	114	25	800	314,915	85,395	2,246	2,230	1,952	1,950
85572	44640	TROLL	2-Sep-98	36	NW	114	25	708	314,915	85,395	2,246	2,230	1,952	1,950

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
50871	44640	TROLL	3-Sep-98	36	NW	114	21	810	314,915	85,395	2,246	2,230	1,952	1,950
50882	44640	TROLL	4-Sep-98	36	NW	114	21	690	314,915	85,395	2,246	2,230	1,952	1,950
50888	44640	TROLL	4-Sep-98	36	NW	114	21	620	314,915	85,395	2,246	2,230	1,952	1,950
50889	44641	TROLL	4-Sep-98	36	NW	114	21	790	314,915	85,395	2,246	2,230	1,952	1,950
54887	44640	TROLL	4-Sep-98	36	NW			795	314,915	85,395	2,246	2,230	1,952	1,950
54888	44640	TROLL	4-Sep-98	36	NW			690	314,915	85,395	2,246	2,230	1,952	1,950
37928	44640	TROLL	5-Sep-98	36	NW	113	91	703	314,915	85,395	2,246	2,230	1,952	1,950
85652	44640	TROLL	7-Sep-98	37	NW	114	25	655	314,915	85,395	2,246	2,230	1,952	1,950
85653	44640	TROLL	7-Sep-98	37	NW	114	25	690	314,915	85,395	2,246	2,230	1,952	1,950
125234	44640	TROLL	7-Sep-98	37	NW			705	314,915	85,395	2,246	2,230	1,952	1,950
35607	44640	TROLL	9-Sep-98	37	NW			770	314,915	85,395	2,246	2,230	1,952	1,950
50897	44640	TROLL	9-Sep-98	37	NW	114	21	780	314,915	85,395	2,246	2,230	1,952	1,950
37995	44640	TROLL	10-Sep-98	37	NW	114	21	677	314,915	85,395	2,246	2,230	1,952	1,950
85683	44641	TROLL	10-Sep-98	37	NW	113	91	650	314,915	85,395	2,246	2,230	1,952	1,950
85696	44640	TROLL	10-Sep-98	37	NW	114	25	715	314,915	85,395	2,246	2,230	1,952	1,950
86023	44640	TROLL	11-Sep-98	37	NW	114	25	810	314,915	85,395	2,246	2,230	1,952	1,950
125142	44216	TROLL	11-Sep-98	37	NW	113	41	725	314,915	85,395	2,246	2,230	1,952	1,950
125489	44216	TROLL	12-Sep-98	37	NW	113	41	710	314,915	85,395	2,246	2,230	1,952	1,950
86052	44641	TROLL	14-Sep-98	38	NW	114	25	790	314,915	85,395	2,246	2,230	1,952	1,950
38005	44640	TROLL	15-Sep-98	38	NW	113	91	727	314,915	85,395	2,246	2,230	1,952	1,950
86072	44640	TROLL	15-Sep-98	38	NW	114	25	735	314,915	85,395	2,246	2,230	1,952	1,950
38166	44641	TROLL	17-Sep-98	38	NW			725	314,915	85,395	2,246	2,230	1,952	1,950
125538	44640	TROLL	17-Sep-98	38	NW	113		780	314,915	85,395	2,246	2,230	1,952	1,950
125736	44233	TROLL	18-Sep-98	38	NW	113	41	798	314,915	85,395	2,246	2,230	1,952	1,950
86128	44641	TROLL	20-Sep-98	39	NW	113	91	785	314,915	85,395	2,246	2,230	1,952	1,950
86129	44640	TROLL	20-Sep-98	39	NW	113	91	775	314,915	85,395	2,246	2,230	1,952	1,950
38071	44640	TROLL	21-Sep-98	39	NW			671	314,915	85,395	2,246	2,230	1,952	1,950
86136	44640	TROLL	21-Sep-98	39	NW	114	21	760	314,915	85,395	2,246	2,230	1,952	1,950
125787	44640	TROLL	24-Sep-98	39	NW			667	314,915	85,395	2,246	2,230	1,952	1,950
28556	44640	SEINE	7-Aug-98	32	NE	112	16	625	4,752	1,873	41	41	37	37
35352	44640	SEINE	10-Aug-98	33	NE	112		760	10,963	2,486	55	55	51	51
14996	44640	SEINE	31-Aug-98	36	NE	109		799	12,261	3,132	53	53	44	44
39997	44640	SPORT	21-Jul-98	30	NE	113	41	630	10,640	3,752	94	87	83	83
54025	44641	SPORT	19-Jul-98	30	NE	111	40	700	314	130	1	1	1	1
54034	44640	SPORT	13-Aug-98	33	NE	112	15	690	2,839	1,056	21	18	14	14
54109	44216	SPORT	29-Aug-98	35	NE	111	50	760	3,867	1,032	43	39	38	38
54119	44641	SPORT	5-Sep-98	36	NE	111	50	665	2,535	1,001	51	43	39	39
54312	44216	SPORT	4-Sep-98	36	NE	111	50	740	2,535	1,001	51	43	39	39
54313	44216	SPORT	4-Sep-98	36	NE	111	50	765	2,535	1,001	51	43	39	39
54319	44640	SPORT	6-Sep-98	37	NE	111	50		2,535	1,001	51	43	39	39
54329	44641	SPORT	12-Sep-98	37	NE	111	50	810	2,535	1,001	51	43	39	39
54330	44640	SPORT	12-Sep-98	37	NE	111	50	815	2,535	1,001	51	43	39	39
54332	44640	SPORT	13-Sep-98	38	NE	111	50	740	2,535	1,001	51	43	39	39
54623	44640	SPORT	24-Aug-98	35	NE			770	2,808	2,808	136	136	118	117
54634	44640	SPORT	24-Aug-98	35	NE			660	2,808	2,808	136	136	118	117
54638	44640	SPORT	24-Aug-98	35	NE			725	2,808	2,808	136	136	118	117
54921	44640	SPORT	29-Aug-98	35	NE	111	50	720	3,867	1,032	43	39	38	38

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
54930	44640	SPORT	30-Aug-98	36	NE	111	50		3,867	1,032	43	39	38	38
54987	44641	SPORT	26-Jul-98	31	NE	111	50	750	1,245	359	4	4	4	3
54995	44640	SPORT	28-Jul-98	31	NE	112	16	740	1,245	359	4	4	4	3
80214	44640	SPORT	28-Aug-98	35	NE	113	61	750	8,088	2,509	87	82	75	75
83195	44640	SPORT	24-Aug-98	35	NE			695	2,808	2,808	136	136	118	117
83224	44641	SPORT	24-Aug-98	35	NE			680	2,808	2,808	136	136	118	117
83246	44640	SPORT	24-Aug-98	35	NE			670	2,808	2,808	136	136	118	117
83260	44641	SPORT	23-Aug-98	35	NE			720	2,808	2,808	136	136	118	117
83274	44640	SPORT	23-Aug-98	35	NE			750	2,808	2,808	136	136	118	117
83292	44640	SPORT	23-Aug-98	35	NE			600	2,808	2,808	136	136	118	117
83293	44216	SPORT	23-Aug-98	35	NE			710	2,808	2,808	136	136	118	117
32596	44641	GILLNET	7-Jul-98	28	NE	111		698	131	42	1	1	1	1
10004	44640	GILLNET	29-Jul-98	31	NE	111	32	600	1,499	897	10	9	7	7
52292	44641	GILLNET	29-Jul-98	31	NE	111		725	1,499	897	10	9	7	7
52295	44641	GILLNET	29-Jul-98	31	NE	111		535	1,499	897	10	9	7	7
52296	44640	GILLNET	29-Jul-98	31	NE	111		695	1,499	897	10	9	7	7
52297	44641	GILLNET	29-Jul-98	31	NE	111		710	1,499	897	10	9	7	7
53411	44216	GILLNET	12-Aug-98	33	NE	111		545	2,431	1,623	25	22	19	19
53416	44640	GILLNET	12-Aug-98	33	NE	111		590	2,431	1,623	25	22	19	19
53419	44641	GILLNET	12-Aug-98	33	NE	111		655	2,431	1,623	25	22	19	19
53424	44641	GILLNET	12-Aug-98	33	NE	111		675	2,431	1,623	25	22	19	19
53427	44640	GILLNET	12-Aug-98	33	NE	111		765	2,431	1,623	25	22	19	19
53428	44233	GILLNET	12-Aug-98	33	NE	111		780	2,431	1,623	25	22	19	19
10229	44640	GILLNET	19-Aug-98	34	NE	111	32	590	1,977	1,059	24	24	23	23
10238	44233	GILLNET	19-Aug-98	34	NE	111	32	593	1,977	1,059	24	24	23	23
25687	44640	GILLNET	19-Aug-98	34	NE	111	32	590	1,977	1,059	24	24	23	23
25688	44640	GILLNET	19-Aug-98	34	NE	111	32	686	1,977	1,059	24	24	23	23
25689	44640	GILLNET	19-Aug-98	34	NE	111	32	454	1,977	1,059	24	24	23	23
35840	44640	GILLNET	20-Aug-98	34	NE	111		615	1,977	1,059	24	24	23	23
35841	44640	GILLNET	20-Aug-98	34	NE	111		795	1,977	1,059	24	24	23	23
35842	44640	GILLNET	20-Aug-98	34	NE	111		710	1,977	1,059	24	24	23	23
35843	44641	GILLNET	20-Aug-98	34	NE	111		565	1,977	1,059	24	24	23	23
35848	44640	GILLNET	20-Aug-98	34	NE	111		810	1,977	1,059	24	24	23	23
10239	44641	GILLNET	27-Aug-98	35	NE	111	32	670	3,040	1,453	32	31	31	31
10240	44641	GILLNET	27-Aug-98	35	NE	111	32	680	3,040	1,453	32	31	31	31
10241	44640	GILLNET	27-Aug-98	35	NE	111	32	655	3,040	1,453	32	31	31	31
10242	44640	GILLNET	27-Aug-98	35	NE	111	32	720	3,040	1,453	32	31	31	31
10249	44640	GILLNET	27-Aug-98	35	NE	111	32	630	3,040	1,453	32	31	31	31
122792	44640	GILLNET	27-Aug-98	35	NE	115		720	3,112	44	2	2	1	1
200746	44641	GILLNET	27-Aug-98	35	NE	111		771	3,040	1,453	32	31	31	31
200747	44640	GILLNET	27-Aug-98	35	NE	111		768	3,040	1,453	32	31	31	31
200748	44641	GILLNET	27-Aug-98	35	NE	111		695	3,040	1,453	32	31	31	31
200757	44216	GILLNET	27-Aug-98	35	NE	111		758	3,040	1,453	32	31	31	31
54818	44216	GILLNET	1-Sep-98	36	NE	115		785	3,830	949	25	25	22	22
46605	44641	GILLNET	2-Sep-98	36	NE	111	32	700	3,619	1,182	35	34	31	31
46607	44641	GILLNET	2-Sep-98	36	NE	111	32	690	3,619	1,182	35	34	31	31
46613	44641	GILLNET	2-Sep-98	36	NE	111	32	655	3,619	1,182	35	34	31	31

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
54930	44640	SPORT	30-Aug-98	36	NE	111	50		3,867	1,032	43	39	38	38
54987	44641	SPORT	26-Jul-98	31	NE	111	50	750	1,245	359	4	4	4	3
54995	44640	SPORT	28-Jul-98	31	NE	112	16	740	1,245	359	4	4	4	3
80214	44640	SPORT	28-Aug-98	35	NE	113	61	750	8,088	2,509	87	82	75	75
83195	44640	SPORT	24-Aug-98	35	NE			695	2,808	2,808	136	136	118	117
83224	44641	SPORT	24-Aug-98	35	NE			680	2,808	2,808	136	136	118	117
83246	44640	SPORT	24-Aug-98	35	NE			670	2,808	2,808	136	136	118	117
83260	44641	SPORT	23-Aug-98	35	NE			720	2,808	2,808	136	136	118	117
83274	44640	SPORT	23-Aug-98	35	NE			750	2,808	2,808	136	136	118	117
83292	44640	SPORT	23-Aug-98	35	NE			600	2,808	2,808	136	136	118	117
83293	44216	SPORT	23-Aug-98	35	NE			710	2,808	2,808	136	136	118	117
32596	44641	GILLNET	7-Jul-98	28	NE	111		698	131	42	1	1	1	1
10004	44640	GILLNET	29-Jul-98	31	NE	111	32	600	1,499	897	10	9	7	7
52292	44641	GILLNET	29-Jul-98	31	NE	111		725	1,499	897	10	9	7	7
52295	44641	GILLNET	29-Jul-98	31	NE	111		535	1,499	897	10	9	7	7
52296	44640	GILLNET	29-Jul-98	31	NE	111		695	1,499	897	10	9	7	7
52297	44641	GILLNET	29-Jul-98	31	NE	111		710	1,499	897	10	9	7	7
53411	44216	GILLNET	12-Aug-98	33	NE	111		545	2,431	1,623	25	22	19	19
53416	44640	GILLNET	12-Aug-98	33	NE	111		590	2,431	1,623	25	22	19	19
53419	44641	GILLNET	12-Aug-98	33	NE	111		655	2,431	1,623	25	22	19	19
53424	44641	GILLNET	12-Aug-98	33	NE	111		675	2,431	1,623	25	22	19	19
53427	44640	GILLNET	12-Aug-98	33	NE	111		765	2,431	1,623	25	22	19	19
53428	44233	GILLNET	12-Aug-98	33	NE	111		780	2,431	1,623	25	22	19	19
10229	44640	GILLNET	19-Aug-98	34	NE	111	32	590	1,977	1,059	24	24	23	23
10238	44233	GILLNET	19-Aug-98	34	NE	111	32	593	1,977	1,059	24	24	23	23
25687	44640	GILLNET	19-Aug-98	34	NE	111	32	590	1,977	1,059	24	24	23	23
25688	44640	GILLNET	19-Aug-98	34	NE	111	32	686	1,977	1,059	24	24	23	23
25689	44640	GILLNET	19-Aug-98	34	NE	111	32	454	1,977	1,059	24	24	23	23
35840	44640	GILLNET	20-Aug-98	34	NE	111		615	1,977	1,059	24	24	23	23
35841	44640	GILLNET	20-Aug-98	34	NE	111		795	1,977	1,059	24	24	23	23
35842	44640	GILLNET	20-Aug-98	34	NE	111		710	1,977	1,059	24	24	23	23
35843	44641	GILLNET	20-Aug-98	34	NE	111		565	1,977	1,059	24	24	23	23
35848	44640	GILLNET	20-Aug-98	34	NE	111		810	1,977	1,059	24	24	23	23
10239	44641	GILLNET	27-Aug-98	35	NE	111	32	670	3,040	1,453	32	31	31	31
10240	44641	GILLNET	27-Aug-98	35	NE	111	32	680	3,040	1,453	32	31	31	31
10241	44640	GILLNET	27-Aug-98	35	NE	111	32	655	3,040	1,453	32	31	31	31
10242	44640	GILLNET	27-Aug-98	35	NE	111	32	720	3,040	1,453	32	31	31	31
10249	44640	GILLNET	27-Aug-98	35	NE	111	32	630	3,040	1,453	32	31	31	31
122792	44640	GILLNET	27-Aug-98	35	NE	115		720	3,112	44	2	2	1	1
200746	44641	GILLNET	27-Aug-98	35	NE	111		771	3,040	1,453	32	31	31	31
200747	44640	GILLNET	27-Aug-98	35	NE	111		768	3,040	1,453	32	31	31	31
200748	44641	GILLNET	27-Aug-98	35	NE	111		695	3,040	1,453	32	31	31	31
200757	44216	GILLNET	27-Aug-98	35	NE	111		758	3,040	1,453	32	31	31	31
54818	44216	GILLNET	1-Sep-98	36	NE	115		785	3,830	949	25	25	22	22
46605	44641	GILLNET	2-Sep-98	36	NE	111	32	700	3,619	1,182	35	34	31	31
46607	44641	GILLNET	2-Sep-98	36	NE	111	32	690	3,619	1,182	35	34	31	31
46613	44641	GILLNET	2-Sep-98	36	NE	111	32	655	3,619	1,182	35	34	31	31

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length	H	n	a	a'	t	t'
48403	44641	GILLNET	2-Sep-98	36	NE	111	32	675	3,619	1,182	35	34	31	31
48413	44641	GILLNET	2-Sep-98	36	NE	111	32	665	3,619	1,182	35	34	31	31
48417	44641	GILLNET	2-Sep-98	36	NE	111	32	770	3,619	1,182	35	34	31	31
48418	44640	GILLNET	2-Sep-98	36	NE	111	32	725	3,619	1,182	35	34	31	31
10264	44640	GILLNET	8-Sep-98	37	NE	111	32	700	6,736	1,384	62	62	59	59
10275	44216	GILLNET	8-Sep-98	37	NE	111	32	730	6,736	1,384	62	62	59	59
48421	44640	GILLNET	8-Sep-98	37	NE	111	32	730	6,736	1,384	62	62	59	59
48423	44640	GILLNET	8-Sep-98	37	NE	111	32	710	6,736	1,384	62	62	59	59
48424	44641	GILLNET	8-Sep-98	37	NE	111	32	715	6,736	1,384	62	62	59	59
48426	44640	GILLNET	8-Sep-98	37	NE	111	32	750	6,736	1,384	62	62	59	59
48432	44641	GILLNET	8-Sep-98	37	NE	111	32	780	6,736	1,384	62	62	59	59
48441	44640	GILLNET	8-Sep-98	37	NE	111	32	730	6,736	1,384	62	62	59	59
48446	44640	GILLNET	8-Sep-98	37	NE	111	32	800	6,736	1,384	62	62	59	59
48450	44640	GILLNET	8-Sep-98	37	NE	111	32	710	6,736	1,384	62	62	59	59
53393	44640	GILLNET	8-Sep-98	37	NE	115		675	6,006	1,075	26	26	24	24
10282	44640	GILLNET	15-Sep-98	38	NE	111	32	745	6,524	2,465	108	103	91	90
10297	44216	GILLNET	16-Sep-98	38	NE	111	32	710	6,524	2,465	108	103	91	90
10299	44640	GILLNET	16-Sep-98	38	NE	111	32	720	6,524	2,465	108	103	91	90
46268	44641	GILLNET	16-Sep-98	38	NE	111	32	742	6,524	2,465	108	103	91	90
49756	44216	GILLNET	16-Sep-98	38	NE	111	32	721	6,524	2,465	108	103	91	90
49758	44640	GILLNET	16-Sep-98	38	NE	111	32	742	6,524	2,465	108	103	91	90
49759	44640	GILLNET	16-Sep-98	38	NE	111	32	730	6,524	2,465	108	103	91	90
49762	44216	GILLNET	16-Sep-98	38	NE	111	32	781	6,524	2,465	108	103	91	90
49769	44640	GILLNET	16-Sep-98	38	NE	111	32	766	6,524	2,465	108	103	91	90
49771	44640	GILLNET	16-Sep-98	38	NE	111	32	650	6,524	2,465	108	103	91	90
49773	44640	GILLNET	16-Sep-98	38	NE	111	32	810	6,524	2,465	108	103	91	90
49775	44640	GILLNET	16-Sep-98	38	NE	111	32	800	6,524	2,465	108	103	91	90
46202	44641	GILLNET	17-Sep-98	38	NE	111	32	670	6,524	2,465	108	103	91	90
46203	44640	GILLNET	17-Sep-98	38	NE	111	32	730	6,524	2,465	108	103	91	90
46212	44640	GILLNET	17-Sep-98	38	NE	111	32	750	6,524	2,465	108	103	91	90
46213	44641	GILLNET	17-Sep-98	38	NE	111	32	750	6,524	2,465	108	103	91	90
46279	44233	GILLNET	17-Sep-98	38	NE	111	32	795	6,524	2,465	108	103	91	90
46293	44640	GILLNET	17-Sep-98	38	NE	111	32	735	6,524	2,465	108	103	91	90
46227	44640	GILLNET	21-Sep-98	39	NE	111	32	840	482	246	11	11	8	8
73370	44641	GILLNET	22-Sep-98	39	NE	111		803	482	246	11	11	8	8
73371	44640	GILLNET	22-Sep-98	39	NE	111		656	482	246	11	11	8	8
46310	44640	GILLNET	23-Sep-98	39	NE	115		785	5,832	4,414	223	222	214	214
46369	44640	GILLNET	23-Sep-98	39	NE	115		807	5,832	4,414	223	222	214	214
46376	44641	GILLNET	23-Sep-98	39	NE	115		755	5,832	4,414	223	222	214	214
46399	44640	GILLNET	23-Sep-98	39	NE	115		768	5,832	4,414	223	222	214	214
46427	44640	GILLNET	23-Sep-98	39	NE	115		805	5,832	4,414	223	222	214	214
97011	44640	GILLNET	23-Sep-98	39	NE	111	32		482	246	11	11	8	8
46322	44640	GILLNET	24-Sep-98	39	NE	115		790	5,832	4,414	223	222	214	214
97302	44640	GILLNET	24-Sep-98	39	NE	115		820	5,832	4,414	223	222	214	214
97343	44216	GILLNET	24-Sep-98	39	NE	115		800	5,832	4,414	223	222	214	214
97346	44640	GILLNET	24-Sep-98	39	NE	115		802	5,832	4,414	223	222	214	214
97347	44216	GILLNET	24-Sep-98	39	NE	115		770	5,832	4,414	223	222	214	214

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Head. number	Tag code	Gear	Recovery date	Stat. week	Quad-rant	District	Sub-dist.	Length
70246	44641	ESC. SURV.	16-Jul-98	29	NE	111	32	680
70247	44640	ESC. SURV.	17-Jul-98	29	NE	111	32	645
70248	no tag	ESC. SURV.	17-Jul-98	29	NE	111	32	665
70249	tag lost	ESC. SURV.	19-Jul-98	30	NE	111	32	640
70250	no tag	ESC. SURV.	28-Jul-98	31	NE	111	32	650
70251	no tag	ESC. SURV.	30-Jul-98	31	NE	111	32	645
70252	44641	ESC. SURV.	31-Jul-98	31	NE	111	32	665
70253	44640	ESC. SURV.	5-Aug-98	32	NE	111	32	435
70254	44641	ESC. SURV.	12-Aug-98	33	NE	111	32	680
70255	44640	ESC. SURV.	12-Aug-98	33	NE	111	32	450
70256	44641	ESC. SURV.	16-Aug-98	34	NE	111	32	560
70258	44640	ESC. SURV.	17-Aug-98	34	NE	111	32	630
70259	no tag	ESC. SURV.	17-Aug-98	34	NE	111	32	660
70260	44635	ESC. SURV.	17-Aug-98	34	NE	111	32	660
70261	no tag	ESC. SURV.	17-Aug-98	34	NE	111	32	660
70262	44641	ESC. SURV.	18-Aug-98	34	NE	111	32	500
70263	44640	ESC. SURV.	19-Aug-98	34	NE	111	32	485
70264	no tag	ESC. SURV.	20-Aug-98	34	NE	111	32	690
70265	44640	ESC. SURV.	22-Aug-98	34	NE	111	32	685
70267	44640	ESC. SURV.	27-Aug-98	35	NE	111	32	710
70268	44640	ESC. SURV.	27-Aug-98	35	NE	111	32	625
70269	44640	ESC. SURV.	30-Aug-98	36	NE	111	32	705
70270	44640	ESC. SURV.	31-Aug-98	36	NE	111	32	635
70271	44640	ESC. SURV.	31-Aug-98	36	NE	111	32	640
70272	44233	ESC. SURV.	7-Sep-98	37	NE	111	32	705
70273	44640	ESC. SURV.	11-Sep-98	37	NE	111	32	580
70274	44641	ESC. SURV.	13-Sep-98	38	NE	111	32	485
70275	44216	ESC. SURV.	13-Sep-98	38	NE	111	32	590
70276	44640	ESC. SURV.	15-Sep-98	38	NE	111	32	695
70277	44216	ESC. SURV.	15-Sep-98	38	NE	111	32	680
70278	no tag	ESC. SURV.	16-Sep-98	38	NE	111	32	680
70279	44640	ESC. SURV.	19-Sep-98	38	NE	111	32	755
70280	44640	ESC. SURV.	21-Sep-98	39	NE	111	32	720
70281	no tag	ESC. SURV.	21-Sep-98	39	NE	111	32	695
					SELECT RECOVERIES			
29855	44642	TROLL	26-Jul-98	31	NE	109	10	221
57948	44640	TROLL	29-Jul-98	31				
67703	44641	TROLL	6-Aug-98	32	NW	113	91	
67705	44640	TROLL	6-Aug-98	32	NW	113	91	
68199	44641	TROLL	14-Aug-98	33	NW	189	30	
54851	44640	TROLL	4-Sep-98	36	NW			665
125847	44640	TROLL	11-Sep-98	37	NW	189	30	
125375	44640	TROLL	14-Sep-98	38	NW	189	30	
45744	44640	TROLL	15-Sep-98	38	NW			
45749	44640	TROLL	15-Sep-98	38	NW			
97012	44640	SPORT	29-Aug-98	35	NE	111	50	
97013	44640	SPORT	12-Aug-98	33	NE	111	50	
10228	44640	GILLNET	13-Aug-98	33	NE	111	32	650

Appendix A4.–Numbers of coded wire tagged and untagged coho salmon in samples of immigrating salmon at Canyon Island in 1998.

Date	Gear type	Number examined	Number of clips	Valid tags	Head number	Tag code	Release site
1-Jul	fish wheel	1					
2-Jul	fish wheel	0					
3-Jul	fish wheel	0					
4-Jul	fish wheel	0					
5-Jul	fish wheel	0					
6-Jul	fish wheel	0					
7-Jul	fish wheel	0					
8-Jul	fish wheel	1					
9-Jul	fish wheel	0					
10-Jul	fish wheel	1					
11-Jul	fish wheel	0					
12-Jul	fish wheel	0					
13-Jul	fish wheel	2					
14-Jul	fish wheel	7					
15-Jul	fish wheel	2					
16-Jul	fish wheel	5	1	1	70246	44641	Canyon Island
17-Jul	fish wheel	11	2	1	70247	44640	Canyon Island
	fish wheel				70248	no tag	
18-Jul	fish wheel	9					
19-Jul	fish wheel	8	1	1	70249	tag lost	
20-Jul	fish wheel	11					
21-Jul	fish wheel	25					
22-Jul	fish wheel	25					
23-Jul	fish wheel	14					
24-Jul	fish wheel	18					
25-Jul	fish wheel	7					
26-Jul	fish wheel	28					
27-Jul	fish wheel	25					
28-Jul	fish wheel	28	1		70250	no tag	
29-Jul	fish wheel	18					
30-Jul	fish wheel	17	1		70251	no tag	
31-Jul	fish wheel	8	1	1	70252	44641	Canyon Island
1-Aug	fish wheel	0					
2-Aug	fish wheel	0					
3-Aug	fish wheel	0					
4-Aug	fish wheel	19					
5-Aug	fish wheel	30	1	1	70253	44640	Canyon Island
6-Aug	fish wheel	30					
7-Aug	fish wheel	40					
8-Aug	fish wheel	16					
9-Aug	fish wheel	18					
10-Aug	fish wheel	21					
11-Aug	fish wheel	18					
12-Aug	fish wheel	20	2	2	70254	44641	Canyon Island
	fish wheel				70255	44640	Canyon Island
13-Aug	fish wheel	18					
14-Aug	fish wheel	32					
15-Aug	fish wheel	49					
16-Aug	fish wheel	70	1	1	70256	44641	Canyon Island
17-Aug	fish wheel	75	4	2	70258	44640	Canyon Island
	fish wheel				70260	44635	Canyon Is. chinook
	fish wheel				70259	no tag	
	fish wheel				70261	no tag	

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Date	Gear type	Number examined	Number of clips	Valid tags	Head number	Tag code	Release site
18-Aug	fish wheel	84	1	1	70262	44641	Canyon Island
19-Aug	fish wheel	73	1	1	70263	44640	Canyon Island
20-Aug	fish wheel	49	1		70264	no tag	
21-Aug	fish wheel	17					
22-Aug	fish wheel	17	1	1	70265	44640	Canyon Island
23-Aug	fish wheel	4					
24-Aug	fish wheel	15					
25-Aug	fish wheel	15					
26-Aug	fish wheel	25					
27-Aug	fish wheel	33	2	2	70267	44640	Canyon Island
	fish wheel				70268	44640	Canyon Island
28-Aug	fish wheel	26					
29-Aug	fish wheel	22					
30-Aug	fish wheel	55	1	1	70269	44640	Canyon Island
31-Aug	fish wheel	34	2	2	70270	44641	Canyon Island
	fish wheel				70271	44640	Canyon Island
1-Sep	fish wheel	16					
2-Sep	fish wheel	38					
3-Sep	fish wheel	29					
4-Sep	fish wheel	17					
5-Sep	fish wheel	10					
6-Sep	fish wheel	7					
7-Sep	fish wheel	18	1	1	70272	44233	Canyon Island
8-Sep	fish wheel	27					
9-Sep	fish wheel	37					
10-Sep	fish wheel	16					
11-Sep	fish wheel	5	1	1	70273	44640	Canyon Island
12-Sep	fish wheel	34					
13-Sep	fish wheel	39	2	2	70274	44641	Canyon Island
	fish wheel				70275	44216	Canyon Island
14-Sep	fish wheel	20					
	gillnet	3					
15-Sep	fish wheel	22	2	2	70276	44640	Canyon Island
	fish wheel				70277	44216	Canyon Island
	gillnet	19					
16-Sep	gillnet	32	1		70278	no tag	
17-Sep	gillnet	30					
18-Sep	gillnet	33					
19-Sep	gillnet	35	1	1	70279	44640	Canyon Island
20-Sep	gillnet	23					
21-Sep	gillnet	29	2	1	70280	44640	Canyon Island
	gillnet				70281	no tag	
22-Sep	gillnet	20					
23-Sep	gillnet	22					
TOTAL		1,777	34	26			
Marked fraction ($\hat{\theta}_h$)		0.0146					
SE($\hat{\theta}_h$)		0.00285					

Appendix A5.–Estimated harvests of coho salmon bound for Taku River above Canyon Island in 1998 in marine commercial and sport fisheries by statistical week. Harvest in the troll fishery (NW Quadrant) was approximated by weighting period catches by the number of tags recovered in a statistical week.

		Estimated harvest by fishery									
		Troll Northwest Quadrant									
Stat week	Ending date	NW troll tags	NW Quad. troll period	NW Quad. troll stat. week	Gillnet	Seine	Sport	TOTAL	Estimated weekly prop. harvest	Estimated cum. total harvest	Estimated cum. prop. harvest
27	4-Jul	1		228				228	0.00	228	0.00
28	11-Jul	10		2,281	213		0	2,494	0.05	2,722	0.05
29	18-Jul	4		912			165	1,077	0.02	3,799	0.07
30	25-Jul	11		2,509			280	2,789	0.05	6,589	0.12
31	1-Aug	9		2,053	634		561	3,249	0.06	9,837	0.18
32	8-Aug	14		3,193		173	0	3,366	0.06	13,204	0.25
33	15-Aug	15	14,597	3,421	698	301	214	4,635	0.09	17,838	0.33
34	22-Aug	2		508	1,276		0	1,784	0.03	19,623	0.37
35	29-Aug	21		5,336	6,162		1,770	13,269	0.25	32,891	0.62
36	5-Sep	11		2,795	1,784	268	719	5,566	0.10	38,457	0.72
37	12-Sep	11		2,795	3,708		719	7,222	0.14	45,679	0.86
38	19-Sep	6		1,525	3,452			4,977	0.09	50,656	0.95
39	26-Sep	5	14,230	1,271	1,442			2,713	0.05	53,368	1.00
Total		120	28,827	28,827	19,371	742	4,428	53,368			
Estimated mean date of harvest				8/15/98	9/1/98	8/17/98	8/21/98	8/22/98			

Appendix A6.–Marking effort and river stage for the adult coho salmon mark-recapture experiment at Canyon Island during 1998. Fish tagged includes the six tagged fish that were removed from the experiment because they were caught in other fisheries prior to reaching the recovery area.

Statistical week	Date	River stage (m)	Hours fished		Fish tagged
			Fish wheel	Gillnet	
27	7/1/98	1.86	41.5		0
27	7/2/98	2.13	46.67		0
27	7/3/98	2.10	47.08		0
27	7/4/98	2.23	46.58		0
28	7/5/98	2.16	40.5		0
28	7/6/98	2.29	21.92		0
28	7/7/98	1.86	22.25		0
28	7/8/98	1.74	32.67		1
28	7/9/98	1.55	46.08		0
28	7/10/98	1.55	46.66		0
28	7/11/98	1.58	46.41		0
29	7/12/98	1.58	46.24		0
29	7/13/98	1.52	44.42		1
29	7/14/98	1.40	45		7
29	7/15/98	1.40	44.91		1
29	7/16/98	1.40	45.25		4
29	7/17/98	1.43	44.91		8
29	7/18/98	1.37	45.5		9
30	7/19/98	1.28	36		7
30	7/20/98	1.22	43.84		11
30	7/21/98	1.28	43.91		25
30	7/22/98	1.49	44.33		25
30	7/23/98	1.68	43.83		14
30	7/24/98	1.65	45.33		18
30	7/25/98	1.55	45.17		7
31	7/26/98	1.92	44.83		27
31	7/27/98	1.89	43.83		24
31	7/28/98	1.74	44.32		26
31	7/29/98	1.77	45.75		17
31	7/30/98	1.55	45.75		15
31	7/31/98	2.26	29.59		7
31	8/1/98	4.27			0
32	8/2/98	4.27			0
32	8/3/98	1.52	8		0
32	8/4/98	1.34	19.42		18
32	8/5/98	1.31	30.92		25
32	8/6/98	1.28	45.5		28
32	8/7/98	0.95	45.91		39
32	8/8/98	1.28	44.75		15
33	8/9/98	1.28	45.08		17
33	8/10/98	0.94	45.5		20
33	8/11/98	1.04	45.91		17
33	8/12/98	0.91	45.99		16
33	8/13/98	0.98	46.24		18
33	8/14/98	1.19	46.49		30
33	8/15/98	1.37	45		48
34	8/16/98	1.25	44.41		63
34	8/17/98	1.49	44.42		68
34	8/18/98	1.65	44.42		78
34	8/19/98	1.46	45.41		65
34	8/20/98	1.10	45.83		47
34	8/21/98	0.94	45.92		14
34	8/22/98	0.85	45.83		15
35	8/23/98	1.16	47		3
35	8/24/98	1.01	46.41		14
35	8/25/98	1.19	45.83		15
35	8/26/98	0.94	46.67		24
35	8/27/98	1.07	46		31
35	8/28/98	0.79	46.92		21
35	8/29/98	1.31	46.42		22
36	8/30/98	1.43	46.33		50
36	8/31/98	1.10	46.75		30
36	9/1/98	1.25	47.08		15
36	9/2/98	1.31	44.92		37
36	9/3/98	1.22	49.41		26
36	9/4/98	0.94	47.08		15
36	9/5/98	0.34	47.09		9
37	9/6/98	0.55	47.41		6
37	9/7/98	0.64	47.22		16
37	9/8/98	0.98	46.67		27
37	9/9/98	0.85	45.99		34
37	9/10/98	0.55	46.25		15
37	9/11/98	0.34	47.6		3
37	9/12/98	1.19	46.25		33
38	9/13/98	0.94	46.5		35
38	9/14/98	0.70	47.25	1.50	22[a]
38	9/15/98	0.46	38.98	3.58	39[b]
38	9/16/98	-0.09		4.25	30
38	9/17/98	-0.24		3.08	29
38	9/18/98	-0.30		4.25	31
38	9/19/98	-0.46		3.58	32
39	9/20/98	-0.37		3.67	23
39	9/21/98	-0.18		4.42	25
39	9/22/98	0.00		5.08	18
39	9/23/98	-0.06		5.67	17
Total					1,642

[a] Includes 2 fish in the gillnet.

[b] Includes 17 fish in the gillnet.

Appendix A7.–Summary of population parameters for the full duration of the Taku River coho salmon run, 1987–1998.

COHO SALMON ABOVE CANYON ISLAND

Calendar year	Escape-ment	Canadian harvest	Inriver run	Est. U.S. marine harvest	Estimated total run	Total harvest rate (%)	U.S. marine 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	186,677	54.5	51.6	743,000	NE
1993	109,457	4,634	114,091	97,758	211,849	48.3	46.1	1,510,000	14.0
1994	96,343	14,693	111,036	228,607	339,643	71.6	67.3	1,476,000	23.0
1995	55,710	13,738	69,448	111,571	181,019	69.2	61.6	1,525,000	11.9
1996	44,635	5,052	49,687	44,529	94,216	52.6	47.3	986,489	9.6
1997	32,345	2,690	35,035	15,825	50,860	36.4	31.1	759,763	6.7
1998	61,382	5,090	66,472	53,368	119,840	48.8	44.5	853,662	14.0
Standard Errors									
1992			19,033	24,005	30,635		8.2	247,000	
1993			17,503	19,256	26,022		6.2	418,051	4.2
1994			6,529	36,734	37,310		3.8	368,411	6.3
1995			3,242	12,186	12,610		2.8	339,822	2.8
1996			3,650	6,494	7,449		4.1	214,152	2.2
1997			4,120	2,691	4,921		4.4	154,051	1.5
1998			5,394	7,435	9,186		4.0	147,260	2.6

COHO SALMON FROM ENTIRE TAKU RIVER DRAINAGE

Calendar year	Escape-ment	Canadian harvest	Inriver run	Est. U.S. marine harvest	Estimated total run	Total harvest rate (%)	U.S. marine 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	239,330	53.9	51.6	952,774	NE
1993	141,637	4,634	146,271	125,331	271,601	47.9	46.1	1,935,938	14.0
1994	127,661	14,693	142,354	293,086	435,440	70.7	67.3	1,892,147	23.0
1995	75,298	13,738	89,036	143,040	232,076	67.6	61.6	1,955,551	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
Standard Errors									
1992			24,401	30,776	39,275		8.2	374,000	
1993			22,440	24,687	33,362		6.2	535,963	4.2
1994			8,371	47,095	47,833		3.8	472,321	6.3
1995			4,156	15,623	16,167		2.8	435,669	2.8
1996			4,679	8,326	9,551		4.1	274,554	2.2
1997			5,282	3,450	6,309		4.4	197,501	1.5
1998			6,915	9,532	11,776		4.0	188,795	2.6

Appendix A8.–Weekly and season estimates of inriver run, harvest and escapement of coho salmon above Canyon Island in the Taku River, 1987–1998.

Recovery week	Year												87–98 average
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
27										45		11	19
28										464	5	55	131
29									1,460	853	106	337	551
30		548	1,425	1,479	2,517	3,298	641	3,348	2,628	1,525	134	1,968	1,626
31	3,841	1,060	878	2,186	2,209	1,741	2,386	5,026	4,582	2,159	843	2,932	2,487
32	2,529	1,526	2,693	1,051	4,157	10,040	3,186	3,988	2,100	6,216	738	5,226	3,621
33	3,623	1,257	300	1,910	4,867	4,875	4,550	4,308	5,299	5,337	1,265	4,116	3,476
34	4,721	7,412	9,598	11,095	1,740	500	12,759	9,827	8,764	6,589	1,542	4,428	6,581
35	3,503	8,366	8,385	17,739	27,296	2,170	3,424	15,029	10,565	7,861	2,589	6,007	9,411
36	4,061	5,583	14,038	17,855	5,924	13,332	19,703	7,904	10,951	7,362	3,028	5,508	9,604
37	3,843	11,371	10,181	12,563	17,411	14,601	15,427	34,400	7,118	2,900	10,211	5,758	12,149
38	6,009	1,446	3,351	9,596	4,708			13,583	5,889	1,312	10,236	3,265	5,940
39	11,440	4,524	8,031	407	9,100			787	2,109	1,549	1,462	4,384	4,379
40			1,960		33,009			443	273		2,875	5,293	
41					11,371								
42					4,410								
43					4,204								
Mark-recapture period run	43,570	43,093	60,841	75,881	132,923	50,557	62,076	98,643	61,738	44,172	35,035	49,290	63,152
SE	3,096	7,162	11,174	21,813	19,051	10,645	9,523	5,800	2,882	3,405	4,160	4,485	
Total inriver catch	6,519	3,643	4,033	3,685	5,439	5,541	4,634	14,693	13,738	5,052	2,690	5,090	6,230
Expanded inriver run [a]	61,976	43,093	60,841	75,881	132,923	90,394	114,091	111,036	69,448	49,687	35,035	66,472	75,906
Escapement above Canyon Island	55,457	39,450	56,808	72,196	127,484	84,901	109,457	96,343	55,710	44,635	32,345	61,382	69,677
SE	4,053	7,162	11,174	21,813	19,051	19,033	17,503	6,529	3,242	3,650	4,120	5,394	

[a] Expansions for run timing may be revised pending further studies.

Appendix A9.–Estimated age compostition of coho salmon sampled from catches in fish wheels at Canyon Island, 1983–1998.

Year	Sample size	Percent by age class					
		1.0	1.1	2.0	2.1	3.1	4.0
1983	477	0.0	56.0	0.0	44.2	0.0	0.0
1984	630	0.3	43.2	0.5	56.2	6.0	0.0
1985	825	0.0	44.5	0.2	51.4	4.0	0.0
1986	475	0.6	44.0	0.4	52.8	2.7	0.0
1987	1,700	0.1	32.4	0.3	65.1	2.4	0.1
1988	1,338	1.1	32.3	0.8	59.0	6.8	0.0
1989	1,826	0.0	49.3	0.1	48.5	2.1	0.0
1990	1,463	0.0	29.3	0.0	67.9	2.9	0.1
1991	523	0.4	31.4	0.0	67.7	1.3	0.0
1992	534	0.4	51.5	0.0	48.1	0.0	0.0
1993	498	0.0	39.4	0.6	60.0	0.8	0.0
1994	539	0.0	44.8	0.6	55.0	0.4	0.0
1995	582	0.0	52.6	0.0	47.8	0.0	0.0
1996	599	0.0	56.3	0.0	43.2	0.5	0.0
1997	481	0.0	64.7	0.0	35.3	0.0	0.0
1998	610	0.0	67.7	0.0	32.3	0.0	0.0
Average(83–98)		0.1	54.4	0.1	45.3	0.2	0.0
SD(83–98)		0.1	8.6	0.2	8.4	0.2	0.1
CV(83–98)		225%	16%	163%	19%	116%	400%

Year	Sample size	Average length by age class in MEF					Total
		1.0	1.1	2.0	2.1	3.1	
1983	476		589		610		596
1984	620		566	320	608	565	582
1985	765		584		616	625	599
1986	455	320	577		598	645	587
1987	633	330	568	310	592	596	582
1988	607		595		612	655	604
1989	621		581		601	623	589
1990	639		569		623		600
1991	592		607		623		614
1992	524	303	574	325	606		587
1993	567		578	270	592	680	584
1994	553		592	333	611		599
1995	597		584		588		586
1996	592		575		602	588	588
1997	478		575		603		585
1998	609		601		616		606
Average(83–98)	583	318	582	312	606	622	593
SD(83–98)		14	12	25	11	38	10
CV(83–98)		4%	2%	8%	2%	6%	2%

Appendix A10.–Computer data files on 1997 Taku River coho salmon smolt and subsequent estimates of 1998 Taku River adult coho salmon run parameters.

File name	Description
98TAKCWT.xls	Excel (Office 97) workbook with spreadsheets of random and select recoveries of CWTs in 1998 and estimated harvest calculations by strata and season.
98TAKREP.xls	Excel (Office 97) workbook with spreadsheets of CWT sampling in Canyon Island fish wheels, estimation of smolt abundance, total runs, marine survival, Table 5, Table 7, Appendix A4, and Appendix A2.
97SMOLT.xls	Excel (Office 97) workbook with spreadsheets of smolt catches and lengths and weights during 1997.