Fishery Data Series No. 96-25

Production of Coho Salmon from the Taku River, 1994–1995

by

Scott A. McPherson

and

David R. Bernard

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Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

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

Spell out year, month, and week.

Physics and chemistry

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

General

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

Mathematics, statistics, fisheries

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

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by

Scott A. McPherson
Division of Sport Fish, Douglas
and
David R. Bernard
Division of Sport Fish, Anchorage

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

September 1996

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Scott A. McPherson and David R. Bernard
Alaska Department of Fish and Game, Division of Sport Fish
P. O. Box 240020, Douglas, AK 99824-0020, USA

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ABSTRACT

As part of an ongoing study of the production of coho salmon *Oncorhynchus kisutch* from Taku River, near Juneau, Alaska, the Division of Sport Fish implanted coded wire tags in smolt leaving the river in spring 1994. Subsequent recovery of these fish was used to estimate the harvest, production, exploitation rate in 1995, and abundance of smolt in 1994. In 1994, two 12' diameter and two 8' diameter rotary smolt traps were fished near Canyon Island on the Taku River. Of 12,124 coho salmon smolt caught from 1 May to 25 June, 11,446 were coded wire tagged and released (5,334 with tag code 04-42-09, 5,149 with tag code 04-42-10, and 963 with tag code 04-42-11). Smolt sampled from the catch averaged 101 mm fork length and were 65% age 1.0 and 35% age 2.0. In 1995, 201 adult coho salmon bearing coded wire tags implanted near Canyon Island were recovered in random sampling of marine fisheries to produce an estimate of total marine harvest of 111,571 (SE = 12,186). Of this harvest, the troll fishery took an estimated 40%, drift gillnet fisheries took 51%, seine fisheries 1%, and recreational fisheries 7%. A mark-recapture experiment partially funded by Sport Fish Division was conducted by the Commercial Fisheries Management and Development Division and the Canadian Department of Fisheries and Oceans to estimate the inriver run of coho salmon past Canyon Island using a Darroch estimator. Estimated abundance was 69,448 (SE = 3,244) fish, of which 13,738 were harvested by inriver fishers above the U.S./Canada border, and escapement past all fisheries was estimated to be 55,710. The estimated total run, the sum of escapement and harvest, in 1995 for coho salmon originating above Canyon Island was 181,019 (SE = 12,610) and the marine exploitation rate was an estimated 62% (SE = 3%). The estimated total run in 1995 for coho salmon from the entire Taku River drainage was 232,076 (SE = 16,167), accounting for those fish originating below Canyon Island. The contribution of Taku River coho salmon (after accounting for fish below Canyon Island) to the Juneau marine sport fishery was an estimated 10,073 fish or 66% of the total estimated harvest in that fishery. The estimated smolt abundance in 1994 from above Canyon Island was 1,525,330 (SE = 339,822) using a modified Petersen estimator, and marine survival of coho salmon smolt from above Canyon Island was estimated at 12% (SE = 3%).

Key words: Coho salmon, *Oncorhynchus kisutch*, Taku River, harvest, troll fishery, drift gillnet fishery, recreational fishery, seine fishery, escapement, migratory timing, timing, production, return, exploitation rate, removal rate, marine survival.

INTRODUCTION

The Taku River produces an estimated 150,000–450,000 adult coho salmon *Oncorhynchus kisutch* annually, many of which are caught in commercial and recreational fisheries in northern Southeast Alaska (PSC 1993; Elliott and Bernard 1994). Coho salmon returning to the Taku River first pass through an offshore troll fishery before entering inside waters through Icy Strait (Figure 1). These fish then pass 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). Due to the large potential 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), U.S. National Marine Fisheries Service (NMFS), and the Canadian Department of Fisheries and Oceans (DFO) have all recently studied this stock, primarily to estimate harvest or escapement to specific tributaries of the Taku River (see Appendix A1).

Because coho salmon returning to the Taku River annually are treated as a single stock in management of fisheries, and because data from a single tributary may not reflect trends of overall production, the emphasis of our work shifted from tributaries to assessment of production of all coho salmon from the Taku River in 1991 (Elliott and Bernard 1994) and has continued since.

Objectives of this study were to estimate (1) the abundance of coho salmon smolt leaving the Taku River in 1994, (2) the mean length of these smolt, (3) age composition of these smolt, and (4) the harvest of adults returning to the Taku River in

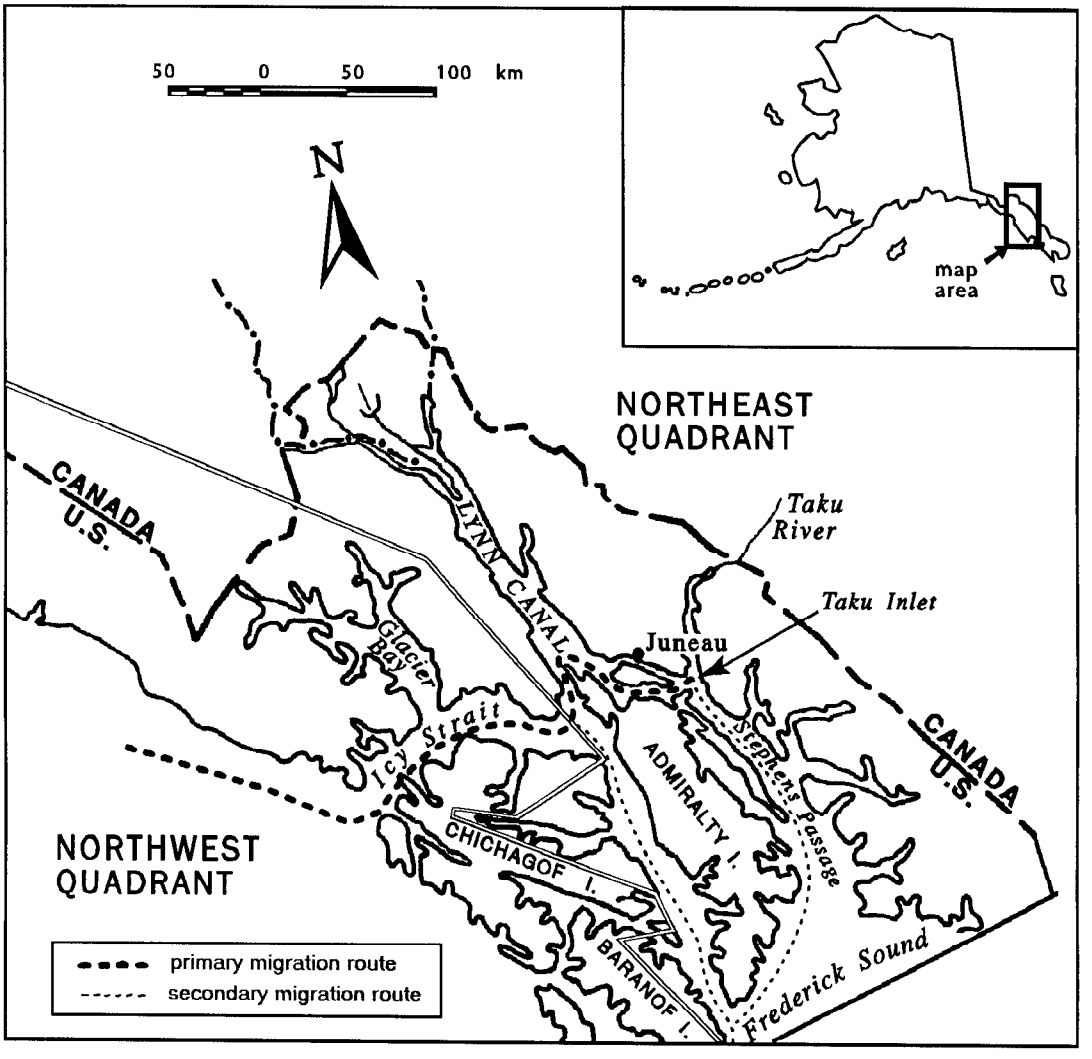

Figure 1.–Migration routes through northern Southeast Alaska of coho salmon bound for the Taku River.

marine fisheries in 1995. These objectives were accomplished by tagging and sampling smolt in 1994 in the lower Taku River. Other projects in our agency or in Canada supplied data on returning adults that were harvested or escaped in 1995.

METHODS

SMOLT CAPTURE, CODED WIRE TAGGING, AND SAMPLING

Four rotary smolt traps, constructed by E.G. Solutions of Corvallis, Oregon, were fished just above Canyon Island (approximately 3 km below the Canadian border) on the Taku River to capture smolt (Figure 3). In 1991 and 1992, rotary screw traps were fished at Barrel Point, approximately 12 km downriver. Because of difficulties in catching smolt and damage to traps from debris, operations were moved upriver near Canyon Island in 1993. At this location the Taku River is narrower and is confined principally to a single channel; it was anticipated that these confines would increase the numbers of smolt captured and tagged. The locations fished for each trap will be described separately, but some similarities applied to all four traps. Each trap consisted of a cone, a livebox, two pontoons for flotation, an apparatus to lift the cone from the water, and a mechanism to clean debris from the livebox. The cone (12' or 8'

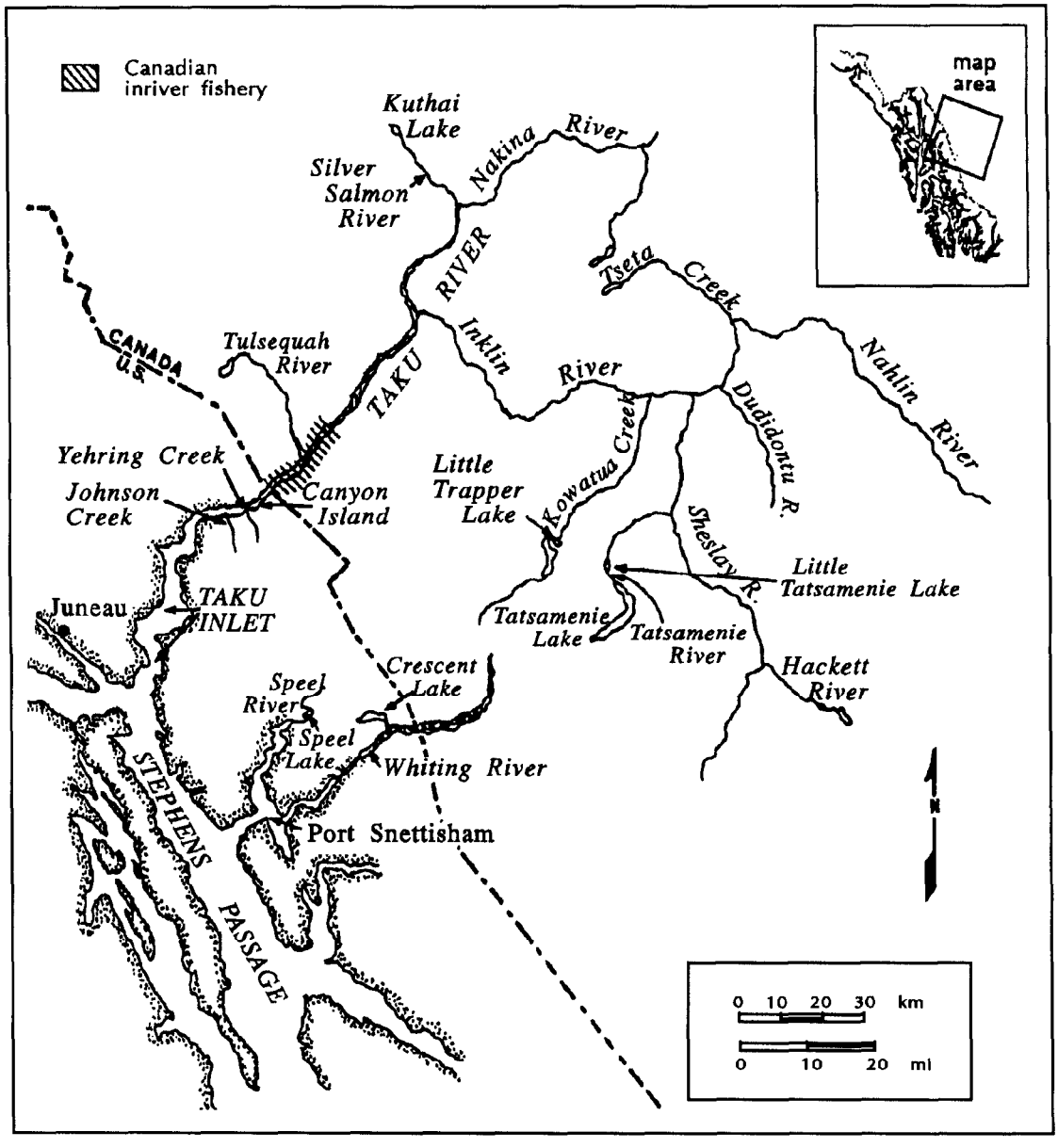

Figure 2.–Taku River drainage, northwestern British Columbia and Southeast Alaska.

the cone corkscrew backed to a narrow exit to a live-box; the junction between exit and livebox was sealed with a rubber collar to prevent fish from escaping. All four traps were held 2–10 m offshore by boom logs fixed to the bank and tied off by a tag line off the front pontoons. Each trap was secured as well by a safety line of 0.75-inch polypropylene tied to the inshore pontoon. All four traps were fished in the first 2 km above Canyon Island at various sites (Figure 3). The main current at these locations is located closest to the west riverbank. One 12' trap was fished at Site 2 from 8–27 May, at Site 7 from 28 May to 9 June and 14–25 June, and at Site 4 from 11–13 June (Figure 3). Site 2 was a partially embedded rootwad located about 15 m offshore of the East riverbank with a gently sloping gravel/silt substrate. Site 7 was a steep bank cut to bedrock on the West riverbank with fast current. Site 4 was located about 5 m off the East riverbank, with a gently sloping gravel/silt bank and a relatively slow current.

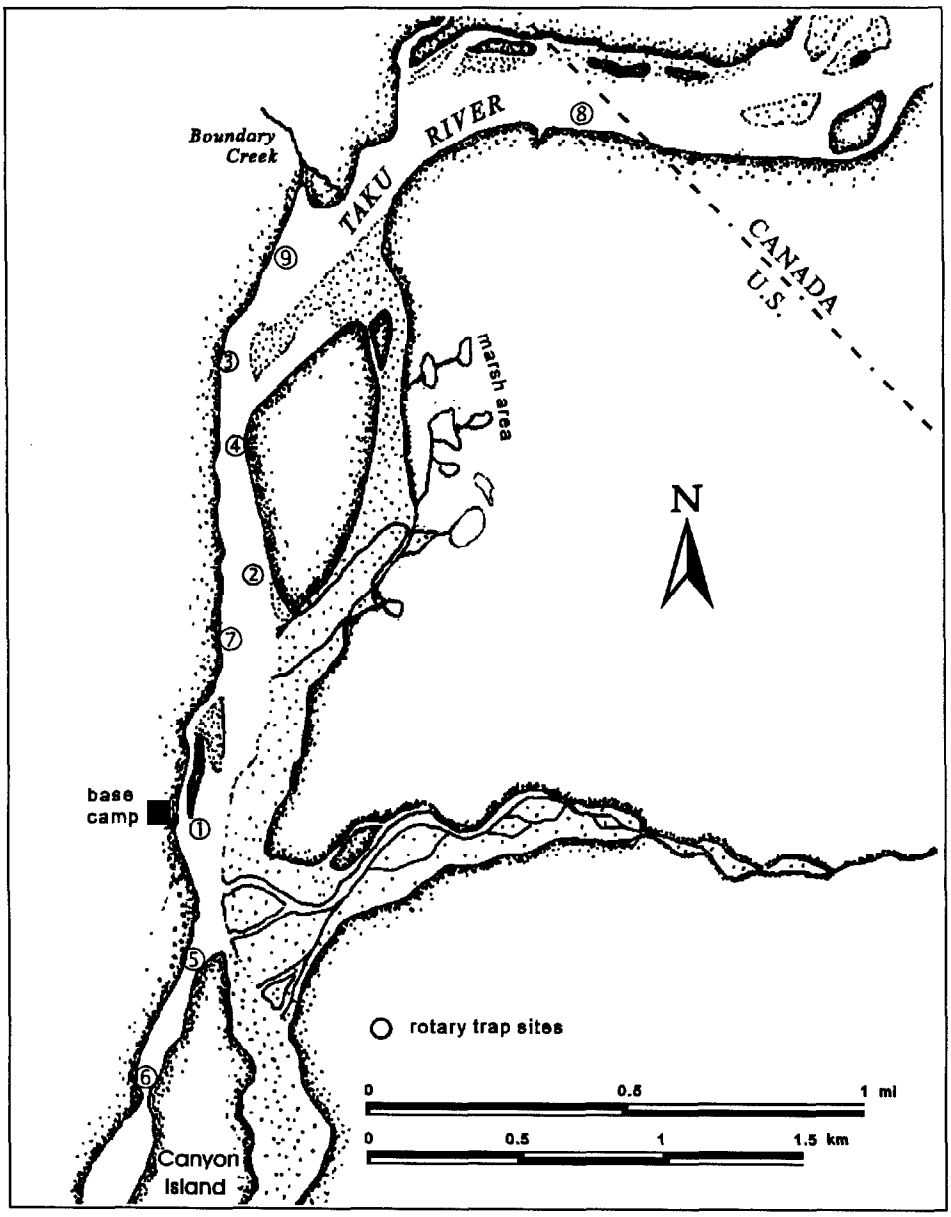

Figure 3.–Location of study area on Taku River near Canyon Island.

A second 12' trap was fished at Site 3 from 4 May to 25 June approximately 2 km above Canyon Island on the West riverbank. The riverbank at this location was a relatively steep bank with large substrate. This trap was fished just inside the main debris line and mainstem current.

One 8' trap was fished at Site 6 from 1–31 May in the narrows of Canyon Island on the East riverbank. The river at this location is steeply cut to bedrock and current was relatively fast. It was fished at Site 2 from 1–12 June and at Site 4 from 15–25 June. A second 8' trap was fished at Site 5 from 3 May to 4 June along a steep bank cut to bedrock in deep water of the narrows in Canyon Island, on the West bank just inside the main current and debris line.

Two members of a four- to six-person crew were on duty or on call at all times to keep the trap fishing 24 hours a day. Early in the season, all four traps were fished with little difficulty, but with increased spring runoff from 18–27 May, debris became a constant problem. After this time

most debris had been flushed out of upriver locations. During peak runoff logs and sticks frequently jammed the cones and halted rotation. At times, debris clogged the throat of the cone, and smolt were damaged or escaped. Technicians visited traps about every 4–6 hours at the beginning of the season, every 1–4 hours at the peak of migration, or whenever debris stopped rotation. Each morning and evening (or more often), fine debris was removed from the cones by a high pressure jet of water supplied by a gasoline-powered water pump.

Salmonid smolt and fry were removed from trap liveboxes during each visit, transported to holding boxes at camp, and processed each morning. Coho and chinook salmon *Oncorhynchus 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 morphological characteristics. A clear 'window' in the pigmentation of the adipose fin (Meehan and Vania 1961) indicated a chinook salmon smolt. Chinook salmon smolt are also more 'silver' in sheen from a side view; whereas coho salmon smolt have larger par marks, show a greater number of small dark pigmentation spots from a dorsal view, and have a longer first anal fin ray.

All coho salmon smolt $\geq$ 70 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 pumping the solution through a continuous loop containing 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. All chinook salmon smolt >50 mm FL were also tagged.

Fifty fish from each day's catch, selected midway through a day's tagging, were held in a separate livebox and checked 24 hours later for retention of CWTs and tagging mortality. When less than 50 fish of a species were caught in a day, the entire catch was held for 24 hours. 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 Commercial Fisheries Management and Development Division (CFMADD) Tag Lab in Juneau when field work ended.

Age composition of emigrating coho salmon smolts in 1994 was estimated by systematically sampling every 20th smolt captured above Canyon Island. Each sampled smolt was measured to the nearest mm FL. A smear of scales was taken two rows above the lateral line on the left side of each sampled smolt just ahead of the adipose fin (the 'preferred area' for sampling scales from coho smolt described in Scarnecchia [1979]). Scales were mounted between two 25-mm by 75-mm glass slides and viewed through a microfiche reader at 70x magnification. Age was determined once for each fish; ages are reported in European notation. Proportions in the age composition and their variances were estimated as

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

where y_i = the number of smolts in the sample determined to be of age i (see Table 1 for definitions of the remaining notation in equation 1 and in the rest of the text).

ESTIMATE OF SMOLT ABUNDANCE

Abundance of smolt leaving the Taku River in 1994 (and originating above Canyon Island) was estimated with a two-sample mark-recapture experiment using a Petersen estimate with Bailey's modifications (Bailey 1951, 1952):

$$\hat{N}_s = \frac{n_c\,(n_e - 1)}{m_e + 1}$$
$$v[\hat{N}_s] = \frac{n_c^2\,(n_e + 1)(n_e - m_e)}{(m_e + 1)^2(m_e + 2)} \qquad (2)$$

where N_s = number of smolts emigrating from the Taku River in 1994 (originating above Canyon Island), n_c = number of smolt CWTd in 1994, n_e = number of adults sampled in 1995 at Canyon Island and m_e = number of adults in that sample with missing adipose fins and valid coded wire tags from smolt tagging in 1994.

ESTIMATE OF HARVEST

Harvest of coho salmon from the Taku River (originating above Canyon Island) in 1995 was estimated from fish sampled from catches in commercial and recreational fisheries (Figure 1) and from the escapement past Canyon Island (Figure 2).

Because several fisheries exploited coho salmon over several months in 1995, the harvest of coho salmon from the Taku River 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. The estimate of harvest $\hat{n}_1$ was calculated for each stratum (h), then summed across strata and across fisheries to obtain an estimate of the total harvest:

$$\hat{N}_c = \sum_{h=1}^{L} \hat{n}_{1h} \qquad v[\hat{N}_c] = \sum_{h=1}^{L} v[\hat{n}_{1h}] \quad (3)$$

where L is the total number of strata from all fisheries. The variance of the sum of the estimates was calculated as the sum of the variances across strata because sampling was independent across strata and across fisheries.

A subset of the catch was counted and inspected to find recaptured fish, those salmon without adipose fins. Heads of all inspected salmon with adipose clips were retrieved, marked, and sent to Juneau for dissection. Heads that arrived in Juneau were passed through a magnetometer to detect a CWT and were dissected if the presence of metal was indicated. If a CWT was found and the tag was undamaged, its code was read under a microscope. Oliver (1990) and Hubartt et al. (1995) present details of sampling commercial and recreational fisheries, respectively. The fraction of the return to the Taku River carrying CWTs (θ) was estimated from catches in fish wheels located at Canyon Island, operations of which are described by Kelley et al. (*In press*). The parameter θ was calculated by dividing the number of coho salmon with valid CWTs by number of fish sampled.

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 are abbreviated as CWTs.

a_1	=	Number of adults missing adipose fins in a sample from a 1995 harvest in a stratum
a_2	=	Number of heads that arrive at Juneau for dissection (subset of a_1) in a stratum
E	=	Exploitation rate of adults in commercial and sport fisheries in 1995
H	=	Number of adults in a harvest in 1995 in a stratum
λ	=	Fraction of migration past Canyon Island before 27 September 1995
m_1	=	Number of heads with CWTs detected magnetically (subset of a_2) in a stratum
m_2	=	Number of CWTs found through dissection and decoded (subset of m_1) in a stratum
m_c	=	Number of CWTs with the appropriate code(s) (subset of m_2) in a stratum
m_e	=	Number of adults past Canyon Island with missing adipose fins in 1995
n_1	=	Number of adults in a harvest from the appropriate stock in 1995 in a stratum
n_2	=	Number of adults in a harvest inspected (the sample) in 1995 in a stratum
n_c	=	Number of smolt CWTd in 1994
n_e	=	Number of adults sampled in 1995 to estimate θ
n_s	=	Number of smolt sampled to estimate age composition in 1994
N_e	=	Number of adults in escapement past Canyon Island in 1995
N	=	Number of adults in escapement prior to 27 September 1995
N_c	=	Number of adults harvested in all strata and all fisheries in 1995
N_h	=	Number of adults harvested in fishery h in 1995
N_r	=	Number of adults returning to Taku River in 1995
N_s	=	Number of smolts emigrating from the Taku River in 1994
p_i	=	Fraction of smolt with freshwater age i in 1994
P_{th}	=	Fraction of catch in stratum t in fishery h in 1995
θ	=	Fraction of the stock tagged with CWTs

Information from catch and field sampling programs was expanded to estimate harvest of coho salmon bound for the Taku River for each stratum. The harvest in a stratum was calculated as

$$\hat{n}_1 = \frac{m_1 a_1 H m_c}{m_2 a_2 n_2 \hat{\theta}} = H \hat{\theta}^{-1} \hat{M} \quad (4)$$

Table 2.—Possible capture histories for salmon inspected in 1995 during a catch sampling program based on CWTs.

1.	Adipose fin was present
2.	Adipose fin was missing, but head never reached the lab
3.	Head arrived at lab, but was not dissected
4.	Head was dissected, but no tag was decoded
5.	Tag was decoded, but did not carry the appropriate code
6.	Tag did carry the appropriate code

where $\hat{M}$ is the final statistic obtained through sampling catches (remaining notation is defined in Table 1). All CWTs with codes corresponding to smolts tagged above Canyon Island in 1994 were tallied to calculate m_c. The bootstrap of Efron (1982) as modified by Buckland and Garthwaite (1991) was used to estimate the variance and statistical bias of $\hat{n}_1$. Each fish inspected during a catch sampling program was placed into one of six capture histories depending on its fate in the program (Table 2). A multinomial, empirical density distribution with six cells was created with the data from the catch sampling program. With respect to capture histories in Table 2, the probabilities of drawing a single sample from this distribution were calculated from the original data as follows:

$$\frac{n_2 - a_1}{n_2} \quad \frac{a_1 - a_2}{n_2} \quad \frac{a_2 - m_1}{n_2} \quad \frac{m_1 - m_2}{n_2} \quad \frac{m_2 - m_c}{n_2} \quad \frac{m_c}{n_2}$$

The bootstrap began with drawing a sample of size n_2 with replacement from the empirical distribution according to the probabilities based on the original data. Two thousand such samples were drawn, and the results of each (say the b^{th} sample) were tallied to obtain a new set of statistics $\{a_1^*, a_2^*, m_1^*, m_2^*, m_c^*\}_b$ and a value of M_b. The mean of M_b ($\overline{M}$) and its variance $v[\overline{M}]$ were calculated for each stratum

$$v[\overline{M}] = \frac{\sum_{b=1}^{B} (M_b - \overline{M})^2}{B - 1} \quad \text{with} \quad \overline{M} = \frac{\sum_{b=1}^{B} M_b}{B}$$

where B is the number of bootstrap samples drawn (=2000).

From Efron (1982), $\hat{M} - \overline{M}$ is a measure of bias in the statistic $\hat{M}$.

In the case of wild stocks harvested in commercial fisheries where H is known and θ is estimated with error, the variance of the estimated harvest was calculated according to the procedures of Goodman (1960):

$$v[\hat{n}_1] = H^2 \begin{pmatrix} v[\overline{M}]\,\hat{\theta}^{-2} + v[\hat{\theta}^{-1}]\,\hat{M}^2 \\ - v[\overline{M}]\,v[\hat{\theta}^{-1}] \end{pmatrix} \qquad (5)$$

Note that $\hat{M}$ and not $\overline{M}$ was used in equation (5) even though $v[\overline{M}]$ was used as an approximation to $v[\hat{M}]$. Whenever H and θ were both estimated with error (as in the case of wild stocks in sport fisheries where harvest is estimated), the variance was estimated for each stratum:

$$\begin{aligned} v[\hat{n}_1] = {} & v[\hat{H}]\,M^2\,\hat{\theta}^{-2} + v[\overline{M}]\;\hat{H}^2\,\hat{\theta}^{-2} + v[\hat{\theta}^{-1}]\hat{H}^2\,M^2 \\ & - v[\hat{H}]\,v[\overline{M}]\;\hat{\theta}^{-2} - v[\overline{M}]\,v[\hat{\theta}^{-1}]\;\hat{H}^2 \\ & - v[\hat{H}]\,v[\hat{\theta}^{-1}]\;M^2 + v[\hat{H}]\;v[\overline{M}]\;v[\hat{\theta}^{-1}] \end{aligned} \qquad (6)$$

where v[H] can be estimated from angler surveys, $v[\hat{\theta}^{-1}]$ can be estimated from a Monte Carlo simulation (e.g., Geiger 1990), and $v[\overline{M}]$ can be estimated using the bootstrap technique (Efron 1982). In this study, equation (5) was used when CWTs were recovered in commercial fishery strata, and (6) was used when CWTs were recovered in sport fishery strata.

The statistic $v[\hat{\theta}^{-1}]$ was estimated from a Monte Carlo simulation (see Geiger 1990). Since sampling with the 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 large set of simulated statistics $\{\theta_1^*, \theta_2^*, \ldots \theta_B^*\}$ was drawn from Binom $(\hat{\theta}, n_c)$ from which

$$\left\{\frac{1}{\theta_1^*}, \frac{1}{\theta_1^*}, \cdots \frac{1}{\theta_B^*}\right\} = \{y_1^*, y_2^*, \ldots y_B^*\};$$

$$v[\theta^{-1}] = \frac{\sum_{b=1}^{B} (y_b^* - \overline{y}^*)^2}{B - 1} \qquad (7)$$

where y = the subset of n_e that had no adipose fins and valid Canyon Island tags.

ESTIMATE OF ESCAPEMENT

An estimate of escapement of coho salmon past Canyon Island in 1995 was calculated by expanding a partial estimate available from an ongoing mark-recapture experiment in another division of the Department (see McGregor et al. [1989] for a description of this experiment). Coho salmon in this experiment were captured in two fish wheels at Canyon Island, tagged through the back with individually numbered plastic spaghetti tags, released, and recovered along with unmarked fish in set gillnet fisheries 5 to 10 km upstream in Canada. The estimated escapement past Canyon Island through 27 September was obtained directly from the mark-recapture experiment, using a maximum likelihood Darroch estimator with 10 capture and 10 recapture strata (Kelley et al. *in press*).

On 27 September fish wheels were stopped, and tagging of coho salmon ceased, while gillnetting ceased on 7 October. Under these circumstances, our mark-recapture experiment to estimate passage after 27 September was not successful. This partial estimate was expanded by the estimated fraction of the escapement that had passed Canyon Island by 27 September:

$$\hat{N}_e = \hat{N}_e^* \lambda^{-1} \qquad v[\hat{N}_e] = v[\hat{N}_e^*]\lambda^{-2} \qquad (8)$$

The statistic λ is the fraction of the migration estimated to have passed Canyon Island during 1995 that occurred prior to 27 September, based on previous years' run timing as estimated from CPUE in the District 111 commercial gillnet fishery through statistical week 29 using data from 1975 to 1995. The point estimate was 88.9% and the range across all years was 87.7% to 90.3%. The statistic $v[\hat{N}_e]$ is a minimum, because the measurement error in λ is unknown.

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 in 1995 and the associated exploitation rate in commercial and sport fisheries are based on the sum of estimated harvest and estimated escapement ($\hat{N}_r = \hat{N}_H + \hat{N}_e$). The variance of the estimated run was calculated as the sum of the variances for estimated escapement and estimated harvest ($v[\hat{N}_r] = v[\hat{N}_e] + v[\hat{N}_c]$). The estimate of exploitation rate was calculated as

$$\hat{E} = \frac{\hat{N}_c}{\hat{N}_r}$$
$$v[\hat{E}] \approx \frac{v[\hat{N}_c]\hat{N}_e^{\,2}}{\hat{N}_r^{\,4}} + \frac{v[\hat{N}_e]\hat{N}_c^{\,2}}{\hat{N}_r^{\,4}} \qquad (9)$$

The variance in equation (9) was approximated with the delta method (Seber 1982).

The estimated survival rate of smolts to adults was calculated as

$$\hat{S} = \frac{\hat{N}_r}{\hat{N}_s}$$
$$v[\hat{S}] \approx \hat{S}^2 \left[\frac{v[\hat{N}_r]}{\hat{N}_r^{\,2}} + \frac{v[\hat{N}_s]}{\hat{N}_s^{\,2}} \right] \qquad (10)$$

The variance in equation (10) was approximated with 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):

$$P_{th} = \frac{n_{th}}{N_{ch}} \qquad (11)$$

where n_{th} is the estimated catch of Taku River coho salmon in stratum t and fishery h; remaining notation is given in Table 1.

For a migration over a time interval of *n* strata, the mean of *t*:

$$\bar{t} = \sum_{t=1}^{n} t\, P_{th} \qquad (12)$$

is the mean date of harvest.

RESULTS

SMOLT TAGGING, AGE AND LENGTH IN 1994

From 1 May to 25 June 1994, 12,124 coho salmon smolt were captured in four rotary smolt traps located just above Canyon Island on the Taku River (Figure 3). Of this total, 11,446 were marked, implanted with CWTs, and released carrying tags; the remainder (678 fish) included 143 trap mortalities, 448 <70 mm FL and 87 fish that died or shed tags after handling (Table 3). The valid release (11,446) included 5,334 fish tagged with code 04-42-09 from 3–24 May, 5,149 fish tagged with code 04-42-10 between 25 May and 9 June, and 963 fish tagged with code 04-42-11 from 10–25 June. It was estimated that 99% of the released fish retained their tags for at least 24 hours.

Frequency of catches of coho salmon smolt reflected that 90% of the catches occurred over one month (Figure 4; Table 3), with catches of more than 100 coho smolt per day recorded for 32 continuous days from 12 May to 12 June. Catches were <100 coho smolt per day for the periods before and after the peak. The peak catches were approximately the same in timing as those 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.

Fishing effort in 1994 was relatively constant, after 7 May when all four traps were fishing (Table 4). Fishing was interrupted for Trap #1 27–28 May, for Traps #1 and #3 13–14 June, and for all four traps on 20 June when the river flooded from an upriver ice dam bursting above the Tulsequah River. Realizing that each trap was not fished the same number of hours, Trap #1 accounted for 20%, Trap #2 for 42%, Trap #3 for 15%, and Trap #4 for 23% of the total CPUE for coho salmon, which are similar to actual percentages of total catch by trap.

Coho salmon smolt averaged 101 mm FL (Table 5; Figure 5). Age composition of captured coho salmon smolts was 65.2% (SE = 2.2%) age 1.0, 34.6% (SE = 2.2%) age 2.0, and 0.2% age 3.0 (SE = 0.2%) (Table 5).

Smolts and young of other species of salmon were also captured. Of 10,308 chinook salmon smolt captured (Table 4), 9,858 were tagged and released with valid tags, 6,874 with tag code 04-42-27 and 2,984 with tag code 04-42-28. Analyses of these tagging data will be published when catches from that brood (1992) are completed after the 1999 calendar year.

Also captured, but not marked or tagged, were 4,417 sockeye salmon *O. nerka*, about 393 steelhead salmon *O. mykiss*, and uncounted numbers of chum salmon *O. keta*, pink salmon *O. gorbuscha*, and Dolly Varden. No eulachon *Thaleichthys pacificus* were caught at the Canyon Island site; scores of this species were caught at the Barrel Point site in 1991 and 1992. This species apparently does not migrate upriver as far as Canyon Island.

CODED WIRE TAG RECOVERY

In 1995, 201 CWTs with tag codes from Canyon Island were recovered from coho salmon in the various fisheries as random recoveries associated with port or creel sampling (Appendix A2). The greatest number (109) of tags were recovered from marine gillnet fisheries, with 100 from District 111 (Taku Inlet/Stephens Passage), eight from District 115 (Lynn Canal), and one in Prince William Sound. In the troll fishery, 79 tags were recovered—75 from the Northwest Quadrant on the outside coast (see Figure 1). Eleven (11) were recovered in the marine recreational fishery around Juneau from July into September. Two CWTs were recovered in the seine fishery in upper Chatham Strait.

Coho salmon bearing Canyon Island tags were recovered with similar relative frequencies throughout the duration of the District 111 gillnet fishery, though the fraction marked was slightly higher during the early (0.43%) and middle (0.42%) parts of the harvest, compared to that in the last segment (0.39%) (Table 6).

Tag codes 04-42-09 and 04-42-10 were recovered throughout this fishery, but a greater percentage of tag code 04-42-10 was recovered during the first two-thirds of the gillnet coho season.

Table 3.–Number of salmon smolt caught and tagged in four rotary screw traps near Canyon Island on the Taku River, 1994.

	Lower 12' trap		Upper 12' trap		Lower 8' trap		Upper 8' trap		Coho	Chinook	Coho	Chinook	Air temp (°C)		Water		Water depth	
Date	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook	total	total	CWTd	CWTd	Min	Max	temp	Precip	Inches	Feet
01-May													0.0	11.0	5.0	0.00	33	2.8
02-May													3.0	15.0	5.0	0.00	34	2.8
03-May					54	35			54	35	52	32	1.0	9.0	5.0	0.07	33	2.8
04-May					16	19	31	24	47	43	43	37	1.0	11.0	5.0	0.00	31	2.6
05-May			33	76	16	33	21	14	70	123	66	95	5.0	13.0	5.5	0.11	30	2.5
06-May			26	41	13	12	7	26	46	79	43	67	3.0	5.0	6.0	0.49	30	2.5
07-May			20	59	9	22	13	15	42	96	34	90	2.0	11.0	6.0	0.08	31	2.6
08-May			17	80	19	45	18	28	54	153	47	136	1.0	8.0	6.0	0.00	28	2.3
09-May	24	143	29	131	8	29	8	31	69	337	60	311	4.0	7.0	6.0	0.67	28	2.3
10-May	32	156	35	111	9	31	15	35	91	335	77	317	5.0	9.0	7.0	0.12	29	2.4
11-May	16	72	27	77	15	34	21	20	80	204	73	200	5.0	15.0	7.0	0.28	30	2.5
12-May	4	42	60	98	27	16	35	16	128	174	103	165	4.0	10.0	7.0	0.37	42	3.5
13-May	36	96	40	55	42	27	44	31	164	212	144	201	1.0	11.0	7.0	0.08	43	3.6
14-May	89	201	66	83	7	8	25	6	190	304	181	291	3.5	9.0	6.5	0.03	40	3.3
15-May	68	320	22	107	24	31	20	16	137	481	124	469	-2.0	9.0	7.0	0.00	39	3.3
16-May	87	389	15	71	18	29	21	14	143	507	133	487	0.0	20.0	7.0	0.00	39	3.3
17-May	119	310	84	114	13	23	27	34	243	484	223	441	3.0	21.0	7.0	0.00	48	4.0
18-May	117	151	116	116	25	25	118	36	387	338	352	314	4.0	20.0	7.0	0.00	56	4.7
19-May	65	67	253	94	71	79	225	84	620	329	559	323	3.0	11.0	7.0	0.00	64	5.3
20-May	123	126	242	97	32	14	263	118	663	356	625	355	3.0	21.0	7.0	0.02	75	6.3
21-May	130	221	341	162	173	51	173	121	832	564	797	555	3.0	12.0	7.0	0.01	91	7.6
22-May	5	6	234	129	47	20	121	107	435	276	401	262	5.0	14.0	7.0	0.02	97	8.1
23-May	70	202	362	133	125	37	174	69	740	446	725	441	5.0	15.0	7.0	0.01	89	7.4
24-May	63	182	248	87	99	31	126	47	542	351	527	347	4.0	15.0	6.5	0.17	83	6.9
25-May	43	141	209	54	136	45	105	51	498	294	487	291	4.0	13.0	7.0	0.16	86	7.2
26-May	47	98	160	66	84	25	105	33	397	223	389	222	3.0	13.0	7.0	0.06	81	6.8
27-May	34	42	265	81	79	19	91	31	471	174	461	173	3.0	14.0	7.0	0.12	74	6.2
28-May	0	0	236	70	70	20	98	24	406	114	397	114	-2.0	13.0	6.5	0.04	64	5.3
29-May	84	26	151	63	58	5	51	12	344	106	336	106	3.0	11.0	6.5	0.00	55	4.6
30-May	96	43	129	75	38	9	34	15	301	144	282	142	5.0	14.0	7.0	0.01	58	4.8
31-May	72	29	97	58	29	11	31	16	232	116	217	114	0.0	14.0	7.0	0.06	54	4.5
01-Jun	38	136	115	237	29	53	17	20	201	452	188	446	5.0	17.0	7.0	0.07	51	4.3
02-Jun	43	50	87	103	31	74	19	16	181	245	172	243	5.0	17.0	7.5	0.24	55	4.6
03-Jun	53	27	94	63	43	129	14	7	204	226	200	226	4.0	12.0	7.5	0.12	59	4.9
04-Jun	39	21	59	37	33	82	9	8	151	160	140	148	6.0	16.0	7.5	0.01	60	5.0
05-Jun	40	30	120	61	42	104	1	1	206	198	190	196	4.0	20.0	8.0	0.00	67	5.6
06-Jun	87	32	211	36	63	97	71	48	433	213	421	213	3.0	20.0	9.0	0.00	75	6.3

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Table 3.–Page 2 of 2.

Date	Lower 12' trap		Upper 12' trap		Lower 8' trap		Upper 8' trap		Coho total	Chinook total	Coho CWTd	Chinook CWTd	Air temp (^{0}C)		Water temp	Precip	Water depth	
	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook					Min	Max			Inches	Feet
07-Jun	170	29	170	25	65	123	178	62	583	239	578	239	2.0	20.0	8.0	0.00	81	6.8
08-Jun	81	27	142	28	61	145	142	53	428	253	420	253	3.0	20.0	8.5	0.01	81	6.8
09-Jun	57	19	112	16	28	133	98	57	296	226	291	225	3.0	20.0	8.5	0.00	83	6.9
10-Jun	9	14	99	19	44	72	71	42	224	147	222	147	2.0	20.0	8.5	0.01	82	6.8
11-Jun	6	6	48	19	14	49	56	32	124	106	121	106	8.0	20.0	9.0	0.01	83	6.9
12-Jun	3	12	76	30	7	53	35	44	121	139	119	139	7.0	21.0	8.0	0.37	90	7.5
13-Jun	3	8	48	20	8	5	23	11	84	44	80	44	10.0	18.0	9.0	0.04	107	8.9
14-Jun	0	0	52	9	0	0	14	5	67	14	66	14	9.0	23.0	8.0	0.00	113	9.4
15-Jun	17	4	53	4	0	0	15	5	87	13	85	13	2.0	22.0	8.0	0.00	106	8.8
16-Jun	27	5	32	3	6	18	23	8	88	34	88	34	2.0	22.0	8.5	0.00	96	8.0
17-Jun	7	6	34	13	2	19	18	13	61	51	58	51	2.0	21.0	8.0	0.00	94	7.8
18-Jun	6	5	18	3	2	17	18	11	49	40	43	36	8.0	15.0	8.0	0.10	94	7.8
19-Jun	5	5	25	8	2	8	5	10	38	32	33	31	8.0	15.0	8.0	0.01	98	8.2
20-Jun	1	0	10	3	0	20	3	2	15	28	13	25	8.0	14.0	5.0	0.03	124	10.3
21-Jun	0	0	0	0	0	0	0	0	0	0	0	0	7.0	12.0	6.5	0.03	126	10.5
22-Jun	4	0	8	3	3	7	1	2	17	13	15	12	10.0	16.0	9.0	0.00	88	7.3
23-Jun	4	3	11	4	2	3	7	2	24	12	19	12	8.0	16.0	9.0	0.00	99	8.3
24-Jun	0	1	4	1	0	9	1	0	5	11	4	11	5.0	21.0	9.0	0.00	106	8.8
25-Jun	0	0	9	5	2	8	0	0	11	14	9	13	11.0	20.0	9.5	0.02	107	8.9
Totals *	2,124	3,503	5,154	3,138	1,843	2,013	2,860	1,533	12,124	10,308	11,533	9,975						
Avg	44	73	99	60	34	37	54	29	225	191	214	185	4.0	15.2	7.2	0.07	69	5.7

* Total of 12,124 coho includes 143 trap mortalities, 448 fish <70mm FL, 87 fish that shed tags or died after tagging. Chinook total of 10,308 includes 121 trap mortalities, 212 fish <60mm FL, and 117 that shed tags or died after tagging.

Table 4.–Locations, hours fished, and CPUE of coho and chinook salmon smolt in four rotary traps fished near Canyon Island on the Taku River, 1994.

	Rotary trap #1 (12' diameter)				Rotary trap #2 (12' diameter)				Rotary trap #3 (8' diameter)				Rotary trap #4 (8' diameter)				Total 4 rotary traps			
Date	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Total hours	CPUE coho	CPUE chinook	Water depth (ft)
01-May									#6	15.5	33	22					15.5	33	22	2.8
02-May									#6	24.0	32	21					24.0	32	21	2.8
03-May									#6	24.0	16	19	#5	12.5	40	31	36.5	56	50	2.8
04-May					#3	12.5	42	98	#6	24.0	16	33	#5	23.0	33	25	59.5	91	156	2.6
05-May					#3	24.0	37	66	#6	24.0	13	12	#5	24.0	7	26	72.0	57	104	2.5
06-May					#3	24.0	20	59	#6	24.0	9	22	#5	24.0	13	15	72.0	42	96	2.5
07-May					#3	24.0	17	80	#6	24.0	19	45	#5	24.0	18	28	72.0	54	153	2.6
08-May	#2	11.0	14	209	#3	24.0	29	131	#6	24.0	8	29	#5	24.0	8	31	83.0	59	400	2.3
09-May	#2	24.0	40	203	#3	23.0	37	116	#6	24.0	9	31	#5	24.0	15	35	95.0	100	385	2.3
10-May	#2	24.0	16	72	#3	24.0	27	77	#6	24.0	15	34	#5	24.0	21	20	96.0	79	203	2.4
11-May	#2	22.0	4	46	#3	24.0	60	98	#6	24.0	27	16	#5	24.0	35	16	94.0	126	176	2.5
12-May	#2	18.0	48	128	#3	19.5	49	68	#6	24.0	42	27	#5	24.0	44	31	85.5	183	254	3.5
13-May	#2	24.0	89	201	#3	24.0	66	83	#6	24.0	7	8	#5	24.0	25	6	96.0	187	298	3.6
14-May	#2	24.0	68	320	#3	24.0	22	107	#6	24.0	24	31	#5	24.0	20	16	96.0	134	474	3.3
15-May	#2	24.0	87	389	#3	24.0	15	71	#6	24.0	18	29	#5	24.0	21	14	96.0	141	503	3.3
16-May	#2	24.0	119	310	#3	24.0	84	114	#6	21.0	15	26	#5	24.0	27	34	93.0	245	484	3.3
17-May	#2	24.0	117	151	#3	20.5	136	136	#6	24.0	25	25	#5	24.0	118	36	92.5	396	348	4.0
18-May	#2	23.0	68	70	#3	20.0	304	113	#6	19.5	87	97	#5	24.0	225	84	86.5	684	364	4.7
19-May	#2	16.0	185	189	#3	24.0	242	97	#6	22.0	35	15	#5	24.0	263	118	86.0	724	419	5.3
20-May	#2	20.0	156	265	#3	24.0	341	162	#6	20.0	208	61	#5	24.0	173	121	88.0	878	609	6.3
21-May	#2	9.0	13	16	#3	24.0	234	129	#6	19.5	58	25	#5	24.0	121	107	76.5	426	277	7.6
22-May	#4	12.0	140	404	#3	24.0	362	133	#6	19.0	158	47	#5	24.0	174	69	79.0	834	653	8.1
23-May	#4	24.0	63	182	#3	24.0	248	87	#6	24.0	99	31	#5	24.0	126	47	96.0	536	347	7.4
24-May	#4	24.0	43	141	#3	24.0	209	54	#6	24.0	136	45	#5	24.0	105	51	96.0	493	291	6.9
25-May	#4	24.0	47	98	#3	24.0	160	66	#6	24.0	84	25	#5	24.0	105	33	96.0	396	222	7.2
26-May	#4	24.0	34	42	#3	24.0	265	81	#6	24.0	79	19	#5	24.0	91	31	96.0	469	173	6.8
27-May	#4	7.0	0	0	#3	24.0	236	70	#6	24.0	70	20	#5	24.0	98	24	79.0	404	114	6.2
28-May	#7	7.5	269	83	#3	24.0	151	63	#6	24.0	58	5	#5	24.0	51	12	79.5	529	163	5.3
29-May	#7	24.0	96	43	#3	24.0	129	75	#6	24.0	38	9	#5	24.0	34	15	96.0	297	142	4.6
30-May	#7	24.0	72	29	#3	24.0	97	58	#6	24.0	29	11	#5	24.0	31	16	96.0	229	114	4.8
31-May	#7	19.0	48	172	#3	24.0	115	237	#6	23.0	30	55	#5	24.0	17	20	90.0	210	484	4.5
01-Jun	#7	24.0	43	50	#3	24.0	87	103	#2	24.0	31	74	#5	24.0	19	16	96.0	180	243	4.3
02-Jun	#7	24.0	53	27	#3	24.0	94	63	#2	24.0	43	129	#5	24.0	14	7	96.0	204	226	4.6
03-Jun	#7	24.0	39	21	#3	18.0	79	49	#2	24.0	33	82	#5	24.0	9	8	90.0	160	160	4.9

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Table 4.–Page 2 of 2.

	Rotary trap #1 (12' diameter)				Rotary trap #2 (12' diameter)				Rotary trap #3 (8' diameter)				Rotary trap #4 (8' diameter)				Total 4 rotary traps			
Date	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Site	Hours	CPUE coho	CPUE chinook	Total hours	CPUE coho	CPUE chinook	Water depth (ft)
06-Jun	#7	24.0	170	29	#3	24.0	170	25	#2	24.0	65	123	#3	24.0	178	62	96.0	583	239	6.3
07-Jun	#7	24.0	81	27	#3	24.0	142	28	#2	23.0	64	151	#3	23.5	145	54	94.5	432	260	6.8
08-Jun	#7	24.0	57	19	#3	24.0	112	16	#2	24.0	28	133	#3	24.0	98	57	96.0	295	225	6.8
09-Jun	#7	23.5	9	14	#3	24.0	99	19	#2	24.0	44	72	#3	24.0	71	42	95.5	223	147	6.9
10-Jun	#7	24.0	6	6	#3	24.0	48	19	#2	24.0	14	49	#3	24.0	56	32	96.0	124	106	6.8
11-Jun	#7	24.0	3	12	#3	24.0	76	30	#2	24.0	7	53	#3	24.0	35	44	96.0	121	139	6.9
12-Jun	#7	20.0	4	10	#3	20.0	58	24	#2	18.0	11	7	#3	14.0	39	19	72.0	111	59	7.5
13-Jun	#7	9.0	0	0	#3	24.0	52	9					#3	24.0	14	5	57.0	66	14	8.9
14-Jun	#7	9.0	45	11	#3	24.0	53	4					#3	13.5	27	9	46.5	125	24	9.4
15-Jun	#7	18.0	36	7	#3	24.0	32	3	#4	11.0	13	39	#3	24.0	23	8	77.0	104	57	8.8
16-Jun	#7	20.5	8	7	#3	24.0	34	13	#4	24.0	2	19	#3	24.0	18	13	92.5	62	52	8.0
17-Jun	#7	24.0	6	5	#3	24.0	18	3	#4	24.0	2	17	#3	24.0	18	11	96.0	44	36	7.8
18-Jun	#7	24.0	5	5	#3	24.0	25	8	#4	24.0	2	8	#3	24.0	5	10	96.0	37	31	7.8
19-Jun	#7	24.0	1	0	#3	24.0	10	3	#4	24.0	0	20	#3	24.0	3	2	96.0	14	25	8.2
20-Jun																	0.0	0	0	10.3
21-Jun	#7	16.0	6	0	#3	16.0	12	5	#4	16.0	5	11	#3	16.0	2	3	64.0	24	18	10.5
22-Jun	#7	24.0	4	3	#3	24.0	11	4	#4	24.0	2	3	#3	24.0	7	2	96.0	24	12	7.3
23-Jun	#7	24.0	0	1	#3	24.0	4	1	#4	24.0	0	9	#3	24.0	1	0	96.0	5	11	8.3
24-Jun	#7	24.0	0	0	#3	24.0	9	5	#4	24.0	2	8	#3	15.0	0	0	87.0	11	13	8.8
25-Jun	#7	9.0	0	0	#3	9.0	0	0	#4	9.0	0	0	#3	9.0	0	0	36.0	0	0	8.9
Total		985.5	2,539	4,078		1190.5	5,289	3,259		1196.5	1,970	2,103		1194.5	2,913	1,566	4567.0	12,711	11,006	
Average		20.5	53	85		22.9	102	63		22.6	37	40		22.5	55	30	81.6	227	197	5.7
Percent of species total			20	37			42	30			15	19			23	14		100	100	

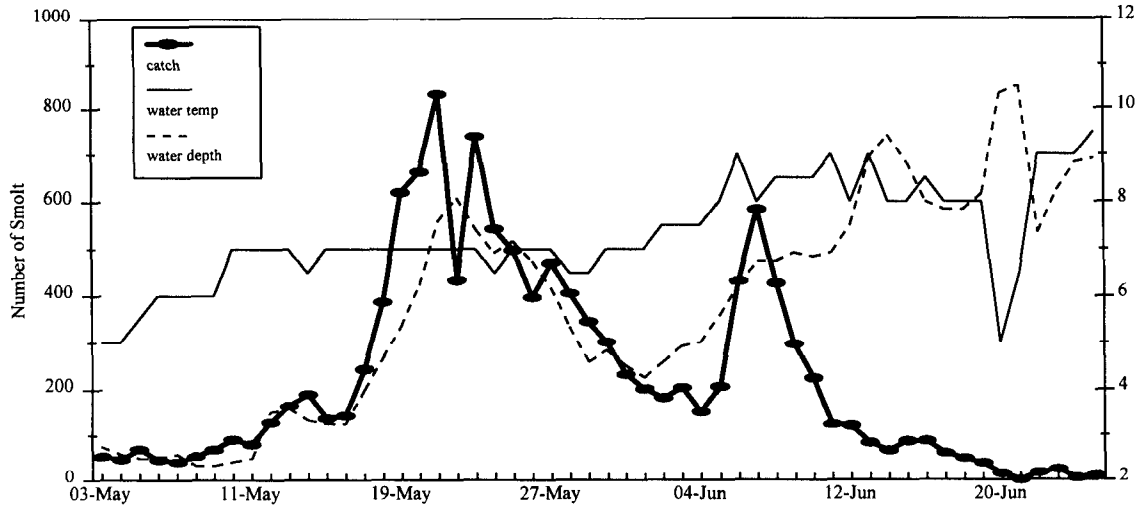

Figure 4.–Catch of coho salmon smolt, daily water temperature, and water depth near Canyon Island, Taku River, 1994.

In the Northwest Quadrant of the troll fishery, recoveries of tag code 04-42-09 were spread equally, but more of the recoveries of tag code 04-42-10 occurred late in the season. These data indicate that significant mixing of the two tag codes did occur in marine waters.

ESTIMATES OF θ AND SMOLT ABUNDANCE

The estimate of θ was 0.007112 (=18/2,531) with SE = 0.00167, and the estimate of smolt abundance $\hat{N}_s$ for 1994 is 1,525,330 [=11,446 $(2{,}531+1)(18+1)^{-1}$] with SE = 339,822. Both estimates were based on 2,531 coho salmon adults inspected in 1995 from catches in two fish wheels operated at Canyon Island (Appendix A3). Twenty-three (23) of the fish inspected were missing adipose fins, and all were sacrificed to determine the tag codes present; 18 contained Canyon Island tags implanted the previous year, and 5 (22%) had no tag.

We believe the difference to be due primarily to the small incidence of naturally missing adipose fins. In 1995, naturally missing adipose fins were observed in Taku River coho and chinook smolt;

Table 5.–Mean fork length and age composition of coho salmon smolts sampled from three rotary smolt traps near Canyon Island, Taku River, 1994 and mean length (mid-eye to fork of tail) and age composition of adult coho salmon sampled from fish wheels at Canyon Island in 1995.

SMOLT SAMPLED IN 1994

	Parent year			
	1992 Age 1.0	1991 Age 2.0	1990 Age 3.0	Total
Number sampled	298	158	1	457
Mean length (mm)	95	111	139	101
SD	12	14	0	15
SE	0.7	1.1	0	0.7
Percent composition	65.2%	34.6%	0.2%	100.0%
SE	2.2	2.2	0.2	

ADULTS SAMPLED IN 1995

	Parent year		
	1992 Age 1.1	1991 Age 2.1	Total
Number sampled	305	277	582
Mean length (mm)	580	592	586
SD	73	60	67
SE	4	4	3
Percent composition	52.4%	47.6%	100.0%
SE	2.0%	2.0%	

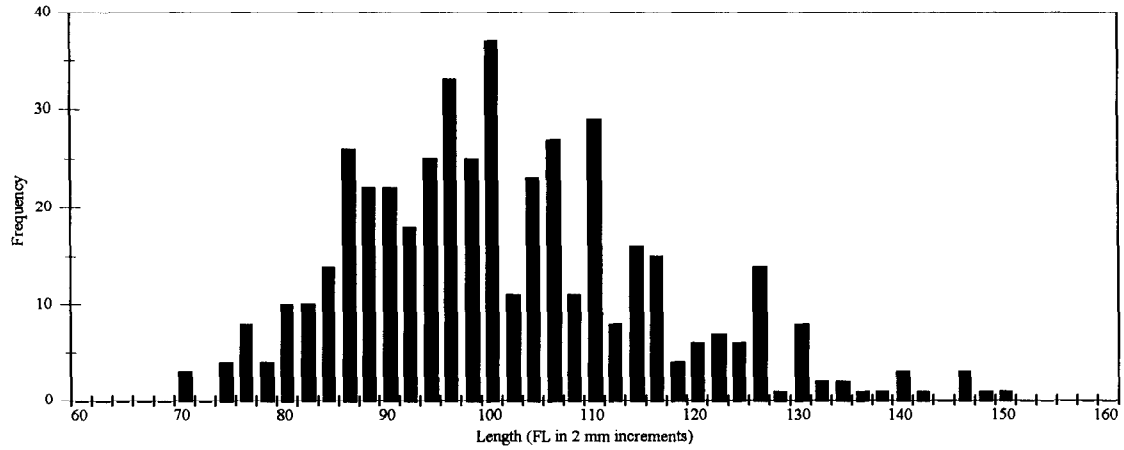

Figure 5. –Length frequency of coho salmon smolt captured and measured at Canyon Island, Taku River, 1994.

Table 6.–Frequency of CWTs recovered during sampling of the harvest of coho salmon in the drift gillnet fishery in District 111 and in the troll fishery in the Northwest Quadrant in 1995. Recoveries are from smolt marked at Canyon Island in 1994 with codes 04-42-09, 04-42-10, and 04-42-11.

PANEL A: District 111 Gillnet Fishery

Stat week	Dates	Tag code 04-42-09	Tag code 04-42-10	Tag code 04-42-11	Total tags	Sampled harvest	Percent marked	Total harvest	Percent sampled
25	Jun 18-24	0	0	0	0	20	0.00	23	87.0
26	25-01	0	0	0	0	123	0.00	136	90.4
27	Jul 02-08	0	0	0	0	104	0.00	409	25.4
28	09-15	0	1	0	1	480	0.21	1,060	45.3
29	16-22	0	0	0	0	558	0.00	1,685	33.1
30	23-29	1	2	0	3	716	0.42	2,141	33.4
31	30-05	3	2	0	5	1,651	0.30	2,356	70.1
32	Aug 06-12	6	6	0	12	1,602	0.75	5,586	28.7
33	13-19	3	3	0	6	1,035	0.58	5,117	20.2
34	20-26	7	7	1	15	3,077	0.49	11,659	26.4
35	27-02	4	4	1	9	2,951	0.30	12,483	23.6
36	Sep 03-09	9	5	1	15	3,366	0.45	13,005	25.9
37	10-16	2	0	0	2	1,155	0.17	4,319	26.7
38	17-23	13	5	0	18	4,203	0.43	15,283	27.5
39	24-30	6	4	0	10	2,375	0.42	8,364	28.4
Total		54	39	3	96	23,416	0.41	83,626	28.0
Stat weeks	Dates	Tag Code 04-42-09	Tag Code 04-42-10	Tag Code 04-42-11	Total tags	Sampled harvest	Percent marked	Total harvest	Percent sampled
26-34	Jun 19-Aug 20	13	14	0	27	6,289	0.429	18,513	34.0
35-37	Aug 21-Sep 10	20	16	3	39	9,394	0.415	37,147	25.3
38-41	Sep 11-Oct 08	21	9	0	30	7,733	0.388	27,966	27.7
Total		54	39	3	96	23,416	0.410	83,626	28.0

PANEL B: Northwest Quadrant Troll Fishery

Stat weeks	Dates	Tag code 04-42-09	Tag code 04-42-10	Tag code 04-42-11	Total tags	Sampled harvest	Percent marked	Total harvest	Percent sampled
27-30	7/02-7/29	9	10	1	20	106,168	0.019	421,179	25.2
31-33	7/30-8/19	15	12	0	27	106,480	0.025	359,837	29.6
34-38	8/20-9/23	19	10	1	30	101,141	0.030	479,750	21.1
Total		43	32	2	77	313,789	0.025	1,260,766	24.9

additionally, a two-week tag retention trial was implemented and tag retention was 100%, similar to the 24-hour rates (S. McPherson, unpublished data). This phenomenon was observed in only a small fraction of 1% (0.1% to 0.2%) of captured smolt, but when less than 1% of the migration is captured and tagged it can adversely affect estimates of smolt production and marine survival.

ESTIMATES OF HARVEST, ESCAPEMENT AND EXPLOITATION IN 1995

On the basis of CWT recoveries, it was estimated that 111,571 (SE = 12,186) Taku River coho salmon originating from above Canyon Island were harvested in marine commercial and sport fisheries in 1995 (Table 7). Estimates of relative bias in $\hat{M}$ across strata ranged from 0.0% to 3.8%. The troll fishery in the Northwest, Northeast and Southwest Quadrants took 40% of the estimated harvest, and the drift gillnet fisheries in Taku Inlet/Stephens Passage, Lynn Canal and Prince William Sound took 51% of the harvest (Table 8). Harvests in these fisheries occurred from July through September. The troll harvest was spread over a long period (July to Sept.) and most of the gillnet harvests occurred in August and September with a peak in September (Figure 6). The estimated mean date of harvest in the troll fishery was 15 August, compared to 31 August for the gillnet fishery (Appendix A4), dates that were approximately the same as observed in 1992 and 1993 for the troll fishery and the same as observed for the gillnet fishery in 1994 for both fisheries (McPherson et al. 1994; McPherson and Bernard 1995). Taku River coho salmon (originating above Canyon Island) contributed an estimated 61% (51,286 fish) of the District 111 gillnet catch (83,626 fish). Fifty percent of the estimated total Taku coho harvest was taken by 26 August, 11 days later than in 1994, when 57% of the troll and 40% of the harvest in gillnets had occurred (Appendix A4; Figure 6). Most (60%) of the estimated gillnet harvest occurred after 1 September. The estimated contribution to the Juneau marine recreational fishery was 7,857 fish or 7.0% of the total Taku River harvest; this equates to 52% of the estimated 15,172 coho salmon caught in the Juneau marine fishery, using harvest and sampling data from Hubartt et al. (*in press*). The seine fishery in northern Southeast Alaska caught an estimated 1.7% of the total Taku River harvest.

The estimated exploitation rate ($\hat{E}$) for coho salmon from the Taku River in marine commercial and sport fisheries of 61.63% (SE = 2.8%) (Table 8) was based on an estimated total run ($\hat{N}_r$) of 181,019 (SE = 12,610) for fish above Canyon Island. Marine survival was estimated at 11.9% (SE = 2.8%). In the 1995 mark-recapture experiment at Canyon Island, inriver abundance (above Canyon Island) was estimated at 61,739 (SE = 2,882) coho salmon prior to 27 September (Kelley et al. *in press*).

Because 88.9% (= λ100) of the immigration past Canyon Island occurred prior to 27 September (from prior years migratory data), the estimate for inriver abundance of coho salmon for the season past Canyon Island in 1995 is then 69,448 ($SE[\hat{N}_e] = 3,244$) and includes 13,738 fish taken in the Canadian inriver set/drift gillnet and aboriginal food fisheries. Estimated escapement was 55,710 coho salmon. Age composition of adult coho salmon sampled from catches in Canyon Island fish wheels was 52.4% (SE = 2.0%) age 1.1 and 47.6% (SE = 2.0%) age 2.1 (Table 5), and the mean length of adults at Canyon Island was 582 mm (SE = 3) mid-eye to fork of tail.

DISCUSSION

Smolt captured and tagged in 1994 were similar in size to smolt captured and tagged from 1991–1993 on the Taku River. In 1994, smolt captured at Canyon Island averaged 101 mm FL, compared to 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). These differences can be attributed to differences in age structure and associated size characteristics, since the same gear (rotary traps) and tagging strategy (fish $\geq$70 mm FL) was used each year. Coho salmon smolt in 1994 were 65% age 1.0 and 35% age 2.0, compared to 78% age 1.0 and 22% age 2.0

Table 7.–Estimated harvest of adult coho salmon bound for the Taku River in 1995 with $\hat{\theta} = 0.007112$ and $V[1/\hat{\theta}] = 1{,}609$. Random seed for bootstrap estimation of the SE was 408,359,473. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

TROLL FISHERY

Weeks	Dates	Period	Quad.	H	Var[H]	n_2	a_1	a_2	m_1	m_2	m_c	n_1	Bias (%)	SE
27–30	7/02–7/29	3	NE	27,420	0	11,564	132	130	92	92	2	677	0.0	505
27–30	7/02–7/29	3	NW	421,179	0	106,168	1,310	1,294	1,030	1,030	19	10,730	0.0	3,821
31–33	7/30–8/19	4	NE	29,754	0	10,412	112	110	91	91	1	409	0.0	414
31–33	7/30–8/19	4	NW	359,837	0	106,480	1,623	1,608	1,314	1,314	26	12,470	0.0	4,261
34–38	8/20–9/23	5	NE	51,228	0	18,002	271	270	202	201	1	404	0.5	403
34–38	8/20–9/23	5	NW	479,750	0	101,141	1,787	1,757	1,516	1,516	30	20,351	0.0	6,832
Subtotal troll fishery				1,369,168	0	353,767	5,235	5,169	4,245	4,244	79	45,041	–0.1	8,945

GILLNET FISHERY

Stat. wk	Dates	District	H	Var[H]	n_2	a_1	a_2	m_1	m_2	m_c	n_1	Bias (%)	SE
24	6/11–6/17	212	240	0	120	2	2	2	2	1	281	0.4	279
27	7/02–7/08	115	275	0	105	2	2	1	1	1	368	0.0	371
28	7/09–7/15	111	1,060	0	480	2	2	1	1	1	311	–1.0	305
29	7/16–7/22	115	221	0	197	1	1	1	1	1	158	–1.9	160
30	7/23–7/29	111	2,141	0	716	6	6	6	6	4	1,682	–0.5	937
31	7/30–8/05	111	2,356	0	1,651	8	8	6	6	6	1,204	0.4	573
32	8/06–8/12	111	5,586	0	1,602	15	15	15	15	13	6,374	0.4	2,479
33	8/13–8/19	111	5,117	0	1,035	9	9	9	9	6	4,171	–0.4	2,028
34	8/20–8/26	111	11,659	0	3,077	34	33	27	27	15	8,234	0.8	3,073
35	8/27–9/02	111	12,483	0	2,951	15	15	11	11	9	5,353	0.9	2,296
36	9/03–9/09	111	13,005	0	3,366	153	152	140	140	16	8,750	0.3	3,230
37	9/10–9/16	111	4,319	0	1,155	24	24	21	21	2	1,052	–0.6	774
37		115	22,023	0	2,650	144	144	138	138	3	3,506	1.6	2,167
38	9/17–9/23	111	15,283	0	4,203	207	207	198	198	18	9,203	–0.6	3,350
38		115	20,119	0	6,708	603	602	594	593	2	846	1.1	626
39	9/24–9/30	111	8,364	0	2,375	44	44	41	41	10	4,952	0.0	2,056
39		115	6,131	0	2,313	174	173	169	169	1	375	–1.1	379
Subtotal gillnet fishery			130,382	0	34,704	1,443	1,439	1,380	1,379	109	56,820	0.3	7,621

SEINE FISHERY

Stat. wk	Dates	District	H	Var[H]	n_2	a_1	a_2	m_1	m_2	m_c	n_1	Bias (%)	SE
28	7/09–7/15	112	224	0	34	2	2	2	2	2	1,853	2.3	1,310
Subtotal seine fishery			224	0	34	2	2	2	2	2	1,853	2.3	1,310

SPORT FISHERY

Biweek	Dates	Derby	Area	H	Var[H]	n_2	a_1	a_2	m_1	m_2	m_c	n_1	Bias (%)	SE
13	6/19–7/02		Juneau	313	5,662	37	1	1	1	1	1	1,189	1.6	1,149
16	7/31–8/13		Juneau	1,736	63,329	187	2	2	2	2	2	2,611	–2.1	1,898
17	8/14–8/27	yes	Juneau	2,914	54,893	2,306	34	34	27	27	4	711	–0.1	409
17			Juneau	2,856	631,035	723	21	14	14	14	3	2,499	0.4	1,639
19	9/11–9/24		Juneau	253	3,476	42	4	4	4	4	1	847	–3.8	867
Subtotal sport fishery				8,072	758,395	3,295	62	55	48	48	11	7,857	–0.8	2,920
TOTAL				1,507,846	758,395	391,800	6,742	6,665	5,675	5,673	201	111,571	0.1	12,186

Table 8.–Harvest and removal rate of Taku River coho salmon in Southeast Alaska fisheries in 1995.

Fishery	Area	Estimated harvest	SE	Percent of marine harvest	Percent of total run	Removal rate[a]
U.S. troll fishery	NE Quad	1,490	767	1.3	0.8	
	NW Quad	43,551	8,912	39.0	24.1	
	Subtotal	45,041	8,945	40.4	24.9	24.9
Drift gillnet	Dist. 111	51,286	7,263	46.0	28.3	
	Dist. 115	5,253	2,323	4.7	2.9	
	Prince Wm. Sound	281	279	0.3	0.2	
	Subtotal	56,820	7,621	50.9	31.4	45.0
Seine fishery	Dist. 112	1,853	1,310	1.7	1.0	
	Subtotal	1,853	1,310	1.7	1.0	1.4
Recreational	Juneau	7,857	2,920	7.0	4.3	
	Subtotal	7,857	2,920	7.0	4.3	5.9
Total marine harvest		111,571	12,186	100.0	61.6	61.6
Escapement		55,710			30.8	
Canadian catch		13,738			7.6	19.8
Inriver run		69,448	3,244			
TOTAL RUN		181,019	12,610			

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

in 1993, 34.5% age 1.0 and 65% age 2.0 in 1992 and 56% age 1.0 and 43% age 2.0 in 1991. These data suggest stronger production from the 1989 and 1991 broods than from the 1988 or 1990 broods.

Age composition of coho salmon sampled from rotary smolt catches in 1994 at Canyon Island were significantly different ($P<0.001$) from adults sampled from fish wheel catches in 1995 at Canyon Island; e.g., smolt captured were 65.2% age 1. while adults were 52.4% (SE = 2.5) age 1. This difference may be due to outmigration of age-2. smolt prior to trap operation or size selection of smaller (younger) smolt. It may also be due to rearing below Canyon Island of progeny of spawners above Canyon Island that migrate to the lower river midsummer and spend a second year rearing before smoltification as documented by Murphy et al. (1988).

Our estimates of escapement (55,710), catch (111,571+13,738) and total run (181,019) are minimum estimates of those parameters for the 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 calculated total escapement in the Taku River in 1995 at 75,308 ([55,710 + 13,738]/0.78 – 13,738), total marine harvest at 143,040 (111,571/0.78), and total run at 232,076. Exploitation rate (61.6%) and marine survival (12%) remained the same as for estimates for fish from above Canyon Island. Total Taku River contributions to the Juneau area marine boat fishery were 10,073 (7,857/0.78) or 66% of the total sport harvest of 15,172 coho salmon in this area.

Recovery data and patterns of migration indicate the estimate of smolt production was unbiased. Bailey's modification of the Petersen estimate was

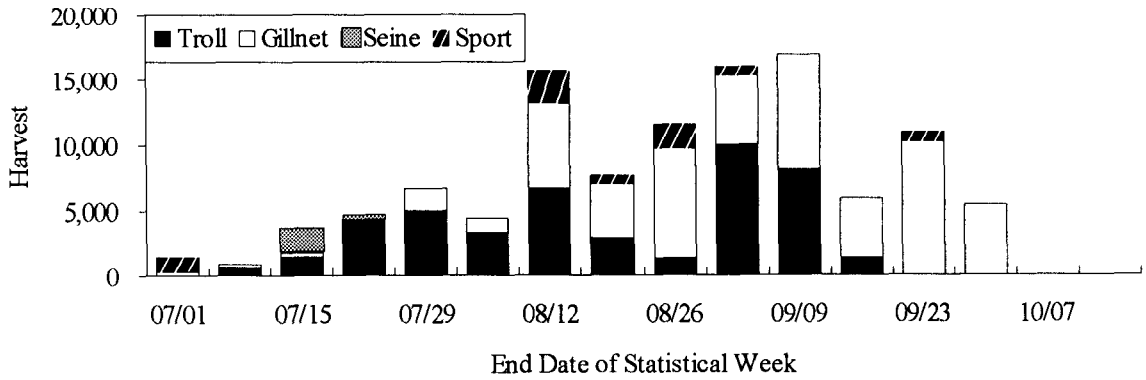

Figure 6. –Estimated harvest of coho salmon bound for Taku River by marine commercial and recreational fisheries in 1995 by statistical week. Weekly estimates of harvest in the troll fishery are approximated.

used because of the systematic nature of the sampling of 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. Under these conditions, the experiment produced an unbiased estimate of the number of smolt leaving Taku River above Canyon Island in 1994, so long as marked fish (those carrying CWTs implanted at Canyon Island) had mixed completely with unmarked fish during their 14 to 16 months at sea. The pattern of recovery of CWTs in commercial fisheries indicates that marked fish did mix significantly with unmarked fish (see Table 6 and below).

The recovery of CWTs in commercial fisheries is indicative of the representative sampling needed to produce accurate estimates of harvest. 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 the catch sampling of harvests were not random, but systematic.

Like two-event mark-recapture experiments, 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 once all four traps were started in 1994, and it is unlikely that much of the migration occurred prior to 1 May. Also, the drawn-out recovery of CWTs indicated considerable mixing of marked and unmarked coho salmon while at sea. 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. In addition, different gear was used to capture gear in the two events, which minimizes problems associated with gear bias.

While evidence of mixing between marked and unmarked fish can be detected through inspecting the temporal pattern of recovered tags, the sufficiency of that mixing cannot. If mixing had been complete, $\hat{\theta}$ would be time invariant. Too few coho salmon were recaptured at the fish wheels at Canyon Island in 1995 to look for changes in $\hat{\theta}$ with time, and, while many fish were recovered in the samples from the harvest in District 111, harvest of any coho salmon in District 111 not bound for the Taku River would cloud any inference drawn from the fishery as to variability in θ.

For example, coho salmon bound for Gastineau Hatchery (a private non-profit hatchery operated by Douglas Island Pink and Chum Inc. [DIPAC])

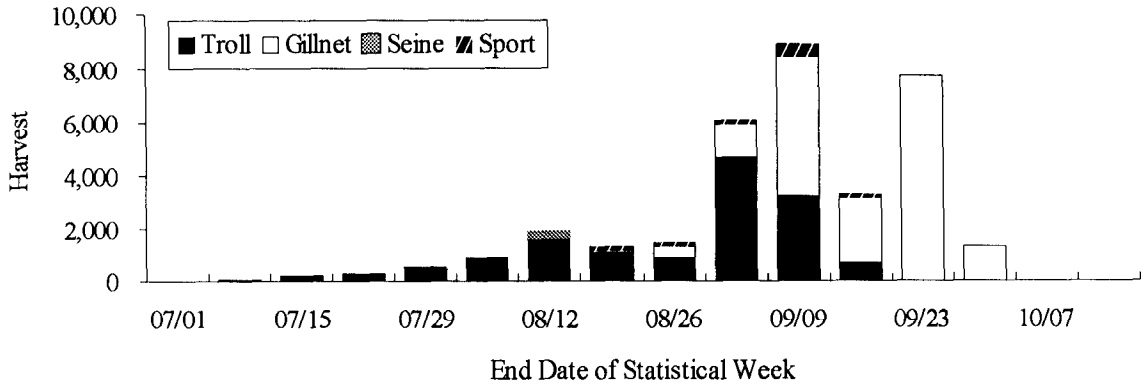

Figure 7.–Estimated harvest of coho salmon bound for Gastineau Hatchery by marine commercial and recreational fisheries in 1995 by statistical week. Weekly estimates of harvest in the troll fishery are approximated.

and certainly other wild and hatchery stocks contribute to this fishery as well.

The Taku River wild (expanded to total Taku drainage) and DIPAC (Gastineau and Sheep Creek releases) coho salmon should prove to be reliable indicator stocks for the Juneau area. Together, these populations contributed an estimated 95% of the District 111 gillnet harvests (compares to 71% in 1994 and 61% in 1993) and 73% of the Juneau marine boat harvest (compares to 52% in 1994 and 29% in 1993) (Table 8; Appendix A5). Estimated exploitation rates were similar—62% for Taku fish and 59% for DIPAC fish. Distribution of estimated harvests were similar (Figures 6, 7); and estimated percentages taken in the troll fishery (40% vs. 42%) and in the District 111 gillnet fishery (38% vs. 42%). Mean dates of overall harvest were different by two weeks—23 August for Taku fish and 4 September for DIPAC fish (Appendices A3 and A6). It is anticipated that data taken from these two runs can be developed to assess run strength of coho salmon in the Juneau area on an inseason basis.

The percentage of the estimated harvest of coho salmon from the Taku River contributing to the sport fishery near Juneau in 1995 was higher than in 1992-1994, probably because of decreased survival of the other stocks which contribute to this fishery. The Juneau marine boat harvest of coho salmon in 1994 was 62,218 fish (a record), four times that in 1995 (15,172 fish).

CONCLUSION AND RECOMMENDATIONS

Results from this project are contributing to development of a long-term database. We estimated smolt production in 1994 and adult production in 1995, the fourth consecutive year these parameters have been estimated for this population. Escapements have been estimated since 1987 by CFMADD and DFO. We feel that this program, in the future, will enable us to provide valuable management tools, such as inseason assessment of run strength, evaluation of adult production parameters, 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 can be accomplished by starting slightly earlier to cover a greater proportion of smolt emigration and by deploying more trapping gear and improving the gear currently deployed; a greater number of tags

would then be recovered from fisheries, increasing the precision of θ, estimated from sampling adults inriver. Second, we can test whether θ is time invariant during the return migration. Third, the estimate of escapement can be improved by operating the mark-recapture experiment through the duration of the immigration of adults. We recommend a design be developed for a fish wheel that can be operated more efficiently during the variable water conditions which often prevail during the fall season. We also need to determine if the rotary screw traps select for a particular size of smolt.

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APPENDIX A

Appendix A1.–Bibliography of coho salmon 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
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 1993 adult harvest and escapement
McPherson and Bernard 1995	Taku River	1993 smolt abundance and 1994 adult 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
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.–Random and select recoveries of coded wire tagged coho salmon bound for Taku River above Canyon Island in 1995.

RANDOM RECOVERIES

Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
99409	44210	TAKU R	ESC SUR	8/8/95	32	4	NE	111	32	445						
99410	44210	TAKU R	ESC SUR	8/9/95	32	4	NE	111	32	450						
99411	44209	TAKU R	ESC SUR	8/14/95	33	4	NE	111	32	630						
99412	44210	TAKU R	ESC SUR	8/17/95	33	4	NE	111	32	615						
99413	44210	TAKU R	ESC SUR	8/17/95	33	4	NE	111	32	620						
99415	44210	TAKU R	ESC SUR	8/19/95	33	4	NE	111	32	645						
99417	44209	TAKU R	ESC SUR	8/23/95	34	5	NE	111	32	460						
99418	44210	TAKU R	ESC SUR	8/23/95	34	5	NE	111	32	540						
99419	44209	TAKU R	ESC SUR	8/29/95	35	5	NE	111	32	640						
99420	44209	TAKU R	ESC SUR	8/31/95	35	5	NE	111	32	645						
99422	44210	TAKU R	ESC SUR	9/1/95	35	5	NE	111	32	605						
99424	44209	TAKU R	ESC SUR	9/2/95	35	5	NE	111	32	630						
99423	44210	TAKU R	ESC SUR	9/2/95	35	5	NE	111	32	560						
99425	44210	TAKU R	ESC SUR	9/5/95	36	5	NE	111	32	465						
99426	44210	TAKU R	ESC SUR	9/7/95	36	5	NE	111	32	510						
99427	44210	TAKU R	ESC SUR	9/7/95	36	5	NE	111	32	440						
99428	44210	TAKU R	ESC SUR	9/9/95	36	5	NE	111	32	680						
99431	44209	TAKU R	ESC SUR	9/23/95	38	5	NE	111	32	690						
41545	44210	TAKU R	GILLNET	7/13/95	28	3	NE	111	32	665	1,060	480	2	2	1	1
28085	NONS.	TAKU R	GILLNET	7/25/95	30	3	NE	111	32	570	2,141	716	6	6	6	6
14269	44210	TAKU R	GILLNET	7/26/95	30	3	NE	111		634	2,141	716	6	6	6	6
78005	44210	TAKU R	GILLNET	7/26/95	30	3	NE	111	32	646	2,141	716	6	6	6	6
14227	44209	TAKU R	GILLNET	7/27/95	30	3	NE	111		514	2,141	716	6	6	6	6
78007	44210	TAKU R	GILLNET	8/1/95	31	4	NE	111	32	718	2,356	1,651	8	8	6	6
28088	44209	TAKU R	GILLNET	8/2/95	31	4	NE	111		695	2,356	1,651	8	8	6	6
41943	44209	TAKU R	GILLNET	8/2/95	31	4	NE	111		704	2,356	1,651	8	8	6	6
41940	44210	TAKU R	GILLNET	8/2/95	31	4	NE	111		674	2,356	1,651	8	8	6	6
78008	NONS.	TAKU R	GILLNET	8/2/95	31	4	NE	111		628	2,356	1,651	8	8	6	6
14325	44209	TAKU R	GILLNET	8/3/95	31	4	NE	111		746	2,356	1,651	8	8	6	6
78113	43802	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	581	5,586	1,602	15	15	15	15
78112	44209	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	548	5,586	1,602	15	15	15	15
78117	44209	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	501	5,586	1,602	15	15	15	15
78118	44209	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	596	5,586	1,602	15	15	15	15
78122	44209	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	697	5,586	1,602	15	15	15	15
78111	44210	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	608	5,586	1,602	15	15	15	15
78114	44210	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	557	5,586	1,602	15	15	15	15
78119	44210	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	555	5,586	1,602	15	15	15	15

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Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
78120	44210	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	704	5,586	1,602	15	15	15	15
78121	44210	TAKU R	GILLNET	8/9/95	32	4	NE	111	32	553	5,586	1,602	15	15	15	15
42308	44209	TAKU R	GILLNET	8/10/95	32	4	NE	111		661	5,586	1,602	15	15	15	15
42309	44209	TAKU R	GILLNET	8/10/95	32	4	NE	111		640	5,586	1,602	15	15	15	15
42313	44210	TAKU R	GILLNET	8/10/95	32	4	NE	111		624	5,586	1,602	15	15	15	15
78124	44209	TAKU R	GILLNET	8/16/95	33	4	NE	111	32	673	5,117	1,035	9	9	9	9
78127	44210	TAKU R	GILLNET	8/16/95	33	4	NE	111	32	660	5,117	1,035	9	9	9	9
42100	44209	TAKU R	GILLNET	8/17/95	33	4	NE	111	32	712	5,117	1,035	9	9	9	9
42258	44209	TAKU R	GILLNET	8/17/95	33	4	NE	111	32	731	5,117	1,035	9	9	9	9
42099	44210	TAKU R	GILLNET	8/17/95	33	4	NE	111	32	606	5,117	1,035	9	9	9	9
42256	44210	TAKU R	GILLNET	8/17/95	33	4	NE	111	32	686	5,117	1,035	9	9	9	9
42673	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111		690	11,659	3,077	34	33	27	27
42674	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111		691	11,659	3,077	34	33	27	27
42676	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111		636	11,659	3,077	34	33	27	27
42677	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111		716	11,659	3,077	34	33	27	27
78137	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	660	11,659	3,077	34	33	27	27
78139	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	725	11,659	3,077	34	33	27	27
78141	44209	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	619	11,659	3,077	34	33	27	27
42680	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111		577	11,659	3,077	34	33	27	27
42683	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111		665	11,659	3,077	34	33	27	27
78138	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	690	11,659	3,077	34	33	27	27
78140	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	695	11,659	3,077	34	33	27	27
78146	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	729	11,659	3,077	34	33	27	27
78147	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	663	11,659	3,077	34	33	27	27
78148	44210	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	764	11,659	3,077	34	33	27	27
78144	44211	TAKU R	GILLNET	8/24/95	34	5	NE	111	32	625	11,659	3,077	34	33	27	27
42789	44209	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	735	12,483	2,951	15	15	11	11
42791	44209	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	720	12,483	2,951	15	15	11	11
42792	44209	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	725	12,483	2,951	15	15	11	11
78223	44209	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	757	12,483	2,951	15	15	11	11
42790	44210	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	805	12,483	2,951	15	15	11	11
78188	44210	TAKU R	GILLNET	8/30/95	35	5	NE	111		680	12,483	2,951	15	15	11	11
78217	44210	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	674	12,483	2,951	15	15	11	11
78219	44210	TAKU R	GILLNET	8/30/95	35	5	NE	111	32	628	12,483	2,951	15	15	11	11
78170	44211	TAKU R	GILLNET	8/30/95	35	5	NE	111		709	12,483	2,951	15	15	11	11
43006	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	723	13,005	3,366	153	152	140	140
43014	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	704	13,005	3,366	153	152	140	140
43022	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	700	13,005	3,366	153	152	140	140

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Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
43026	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	706	13,005	3,366	153	152	140	140
43104	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	661	13,005	3,366	153	152	140	140
43110	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	736	13,005	3,366	153	152	140	140
78306	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	749	13,005	3,366	153	152	140	140
78338	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	721	13,005	3,366	153	152	140	140
78339	44209	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	729	13,005	3,366	153	152	140	140
43002	44210	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	705	13,005	3,366	153	152	140	140
43017	44210	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	643	13,005	3,366	153	152	140	140
43030	44210	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	672	13,005	3,366	153	152	140	140
43042	44210	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	618	13,005	3,366	153	152	140	140
78344	44210	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	693	13,005	3,366	153	152	140	140
43032	44211	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	700	13,005	3,366	153	152	140	140
78334	NONS.	TAKU R	GILLNET	9/6/95	36	5	NE	111	32	665	13,005	3,366	153	152	140	140
43073	44209	TAKU R	GILLNET	9/12/95	37	5	NE	111		759	4,319	1,155	24	24	21	21
78362	44209	TAKU R	GILLNET	9/13/95	37	5	NE	111	32	808	4,319	1,155	24	24	21	21
17675	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111	32	750	15,283	4,203	207	207	198	198
17693	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111	32	835	15,283	4,203	207	207	198	198
17741	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111	32	780	15,283	4,203	207	207	198	198
42517	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		747	15,283	4,203	207	207	198	198
42518	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		752	15,283	4,203	207	207	198	198
42524	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		722	15,283	4,203	207	207	198	198
42530	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		730	15,283	4,203	207	207	198	198
42544	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		725	15,283	4,203	207	207	198	198
43453	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		766	15,283	4,203	207	207	198	198
43469	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		705	15,283	4,203	207	207	198	198
43475	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		695	15,283	4,203	207	207	198	198
43481	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111		709	15,283	4,203	207	207	198	198
78453	44209	TAKU R	GILLNET	9/20/95	38	5	NE	111			15,283	4,203	207	207	198	198
17689	44210	TAKU R	GILLNET	9/20/95	38	5	NE	111	32	790	15,283	4,203	207	207	198	198
17698	44210	TAKU R	GILLNET	9/20/95	38	5	NE	111	32	670	15,283	4,203	207	207	198	198
42520	44210	TAKU R	GILLNET	9/20/95	38	5	NE	111		662	15,283	4,203	207	207	198	198
42528	44210	TAKU R	GILLNET	9/20/95	38	5	NE	111		742	15,283	4,203	207	207	198	198
43292	44210	TAKU R	GILLNET	9/20/95	38	5	NE	111		630	15,283	4,203	207	207	198	198
43557	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		718	8,364	2,375	44	44	41	41
43559	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		845	8,364	2,375	44	44	41	41
43561	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		720	8,364	2,375	44	44	41	41
43565	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		714	8,364	2,375	44	44	41	41
43566	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		688	8,364	2,375	44	44	41	41

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Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
43571	44209	TAKU R	GILLNET	9/27/95	39	5	NE	111		700	8,364	2,375	44	44	41	41
17771	44210	TAKU R	GILLNET	9/27/95	39	5	NE	111		730	8,364	2,375	44	44	41	41
43562	44210	TAKU R	GILLNET	9/27/95	39	5	NE	111		739	8,364	2,375	44	44	41	41
43568	44210	TAKU R	GILLNET	9/27/95	39	5	NE	111		688	8,364	2,375	44	44	41	41
43585	44210	TAKU R	GILLNET	9/27/95	39	5	NE	111		690	8,364	2,375	44	44	41	41
40673	44209	TAKU R	GILLNET	7/4/95	27	3	NE	115		633	275	105	2	2	1	1
41768	44210	TAKU R	GILLNET	7/18/95	29	3	NE	115		610	221	197	1	1	1	1
43145	44209	TAKU R	GILLNET	9/12/95	37	5	NE	115		774	22,023	2,650	144	144	138	138
43157	44209	TAKU R	GILLNET	9/12/95	37	5	NE	115		677	22,023	2,650	144	144	138	138
43164	44209	TAKU R	GILLNET	9/12/95	37	5	NE	115		714	22,023	2,650	144	144	138	138
28452	44209	TAKU R	GILLNET	9/19/95	38	5	NE	115		720	20,119	6,708	603	602	594	593
78440	44210	TAKU R	GILLNET	9/20/95	38	5	NE	115			20,119	6,708	603	602	594	593
43509	44209	TAKU R	GILLNET	9/26/95	39	5	NE	115		655	6,131	2,313	174	173	169	169
95005	44209	TAKU R	GILLNET	6/16/95	24	2	PW	212	25	565	240	120	2	2	2	2
14040	44209	TAKU R	SEINE	7/10/95	28	3	NE	112			224	34	2	2	2	2
14041	44209	TAKU R	SEINE	7/10/95	28	3	NE	112			224	34	2	2	2	2
13557	44211	TAKU R	SPORT	7/1/95	26	2	NE	111	50	630	313	37	1	1	1	1
13276	44210	TAKU R	SPORT	8/8/95	32	4	NE	111	50		1,736	187	2	2	2	2
13459	44210	TAKU R	SPORT	8/11/95	32	4	NE	111	50		1,736	187	2	2	2	2
13608	44210	TAKU R	SPORT	8/18/95	33	4	NE	111	50	665	2,213	2,213	33	33	26	26
13643	44209	TAKU R	SPORT	8/20/95	34	4	NE	111		680	2,213	2,213	33	33	26	26
13460	44210	TAKU R	SPORT	8/23/95	34	4	NE	111	50		2,856	723	21	14	14	14
13279	43801	TAKU R	SPORT	8/25/95	34	4	NE	111	50		2,856	723	21	14	14	14
13283	44210	TAKU R	SPORT	8/27/95	35	5	NE	111	50	720	2,856	723	21	14	14	14
13483	44209	TAKU R	SPORT	9/23/95	38	5	NE	111	40		253	42	4	4	4	4
13620	44210	TAKU R	SPORT	8/19/95	33	4	NE	112	15	670	2,213	2,213	33	33	26	26
13902	44210	TAKU R	SPORT	8/19/95	33	4	NE	112	15	655	2,213	2,213	33	33	26	26
31133	44209	TAKU R	TROLL	7/9/95	28	3	NE	109		645	27,420	11,564	132	130	92	92
28889	44210	TAKU R	TROLL	7/17/95	29	3	NE	109	10	633	27,420	11,564	132	130	92	92
79009	44209	TAKU R	TROLL	7/31/95	31	4	NE	109		709	29,754	10,412	112	110	91	91
34519	44210	TAKU R	TROLL	9/2/95	35	5	NE	112		665	51,228	18,002	271	270	202	201
9923	44209	TAKU R	TROLL	7/19/95	29	3	NW	113	91	710	421,179	106,168	1,310	1,294	1,030	1,030
26458	44210	TAKU R	TROLL	7/25/95	30	3	NW	113	91	633	421,179	106,168	1,310	1,294	1,030	1,030
26482	44209	TAKU R	TROLL	7/28/95	30	3	NW	113	91	655	421,179	106,168	1,310	1,294	1,030	1,030
26480	44210	TAKU R	TROLL	7/28/95	30	3	NW	113	91	565	421,179	106,168	1,310	1,294	1,030	1,030
32167	44209	TAKU R	TROLL	8/2/95	31	4	NW	113	91	624	359,837	106,480	1,623	1,608	1,314	1,314
82188	44209	TAKU R	TROLL	8/2/95	31	4	NW	113	91	748	359,837	106,480	1,623	1,608	1,314	1,314
82264	44209	TAKU R	TROLL	8/6/95	32	4	NW	113		835	359,837	106,480	1,623	1,608	1,314	1,314

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Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
26628	44210	TAKU R	TROLL	8/12/95	32	4	NW	113	91	655	359,837	106,480	1,623	1,608	1,314	1,314
26665	44210	TAKU R	TROLL	8/12/95	32	4	NW	113	91	668	359,837	106,480	1,623	1,608	1,314	1,314
33529	44209	TAKU R	TROLL	8/14/95	33	4	NW	113	91	683	359,837	106,480	1,623	1,608	1,314	1,314
34762	44209	TAKU R	TROLL	9/7/95	36	5	NW	113		698	479,750	101,141	1,787	1,757	1,516	1,516
82035	44210	TAKU R	TROLL	7/9/95	28	3	NW	114	27	531	421,179	106,168	1,310	1,294	1,030	1,030
9940	44209	TAKU R	TROLL	7/26/95	30	3	NW	114	21	550	421,179	106,168	1,310	1,294	1,030	1,030
9762	44209	TAKU R	TROLL	8/23/95	34	5	NW	114	21	700	479,750	101,141	1,787	1,757	1,516	1,516
9793	44209	TAKU R	TROLL	8/26/95	34	5	NW	114	21	740	479,750	101,141	1,787	1,757	1,516	1,516
82354	44209	TAKU R	TROLL	8/27/95	35	5	NW	114	25	774	479,750	101,141	1,787	1,757	1,516	1,516
82367	44209	TAKU R	TROLL	8/28/95	35	5	NW	114	21	649	479,750	101,141	1,787	1,757	1,516	1,516
82434	44211	TAKU R	TROLL	8/29/95	35	5	NW	114		633	479,750	101,141	1,787	1,757	1,516	1,516
77204	NONS.	TAKU R	TROLL	8/29/95	35	5	NW	114	21	760	479,750	101,141	1,787	1,757	1,516	1,516
82472	44209	TAKU R	TROLL	8/31/95	35	5	NW	114	21	669	479,750	101,141	1,787	1,757	1,516	1,516
82560	44209	TAKU R	TROLL	9/6/95	36	5	NW	114	25	747	479,750	101,141	1,787	1,757	1,516	1,516
82553	44210	TAKU R	TROLL	9/6/95	36	5	NW	114	25	674	479,750	101,141	1,787	1,757	1,516	1,516
26876	44210	TAKU R	TROLL	9/9/95	36	5	NW	114	21	695	479,750	101,141	1,787	1,757	1,516	1,516
26908	44210	TAKU R	TROLL	9/11/95	37	5	NW	114	21	690	479,750	101,141	1,787	1,757	1,516	1,516
82119	44209	TAKU R	TROLL	7/18/95	29	3	NW	116	11	615	421,179	106,168	1,310	1,294	1,030	1,030
82120	NONS.	TAKU R	TROLL	7/18/95	29	3	NW	116	11	650	421,179	106,168	1,310	1,294	1,030	1,030
26470	44209	TAKU R	TROLL	7/28/95	30	3	NW	116	12	686	421,179	106,168	1,310	1,294	1,030	1,030
9725	44209	TAKU R	TROLL	8/6/95	32	4	NW	116		590	359,837	106,480	1,623	1,608	1,314	1,314
9722	44210	TAKU R	TROLL	8/6/95	32	4	NW	116	14	660	359,837	106,480	1,623	1,608	1,314	1,314
32699	44210	TAKU R	TROLL	8/7/95	32	4	NW	116	11	658	359,837	106,480	1,623	1,608	1,314	1,314
82287	44209	TAKU R	TROLL	8/11/95	32	4	NW	116	11	776	359,837	106,480	1,623	1,608	1,314	1,314
9747	44210	TAKU R	TROLL	8/12/95	32	4	NW	116	12		359,837	106,480	1,623	1,608	1,314	1,314
82509	44209	TAKU R	TROLL	8/31/95	35	5	NW	116	11	661	479,750	101,141	1,787	1,757	1,516	1,516
82491	44210	TAKU R	TROLL	8/31/95	35	5	NW	116	11	567	479,750	101,141	1,787	1,757	1,516	1,516
31946	44210	TAKU R	TROLL	7/29/95	30	3	NW	154		583	421,179	106,168	1,310	1,294	1,030	1,030
32534	44210	TAKU R	TROLL	8/12/95	32	4	NW	154		560	359,837	106,480	1,623	1,608	1,314	1,314
26362	44210	TAKU R	TROLL	7/11/95	28	3	NW	156		595	421,179	106,168	1,310	1,294	1,030	1,030
82227	44210	TAKU R	TROLL	8/6/95	32	4	NW	156		533	359,837	106,480	1,623	1,608	1,314	1,314
82176	44210	TAKU R	TROLL	7/30/95	31	4	NW	157		660	359,837	106,480	1,623	1,608	1,314	1,314
34184	44209	TAKU R	TROLL	9/1/95	35	5	NW	181		710	479,750	101,141	1,787	1,757	1,516	1,516
34601	44210	TAKU R	TROLL	9/1/95	35	5	NW	181		651	479,750	101,141	1,787	1,757	1,516	1,516
34614	44209	TAKU R	TROLL	9/3/95	36	5	NW	181		755	479,750	101,141	1,787	1,757	1,516	1,516
34662	44209	TAKU R	TROLL	9/3/95	36	5	NW	181		741	479,750	101,141	1,787	1,757	1,516	1,516
34631	44210	TAKU R	TROLL	9/3/95	36	5	NW	181		654	479,750	101,141	1,787	1,757	1,516	1,516
34991	44209	TAKU R	TROLL	9/6/95	36	5	NW	181		766	479,750	101,141	1,787	1,757	1,516	1,516

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Head number	Tag code	Release location	Gear	Date	Stat. week	Troll period	Quad-rant	District	SD	Length	H	n_2	a_1	a_2	m_1	m_2
25271	44210	TAKU R	TROLL	9/7/95	36	5	NW	189	30	800	479,750	101,141	1,787	1,757	1,516	1,516
25276	44209	TAKU R	TROLL	9/10/95	37	5	NW	189	40	708	479,750	101,141	1,787	1,757	1,516	1,516
82014	44209	TAKU R	TROLL	7/5/95	27	3	NW			576	421,179	106,168	1,310	1,294	1,030	1,030
82116	44211	TAKU R	TROLL	7/17/95	29	3	NW			600	421,179	106,168	1,310	1,294	1,030	1,030
31763	44210	TAKU R	TROLL	7/18/95	29	3	NW			522	421,179	106,168	1,310	1,294	1,030	1,030
31770	44210	TAKU R	TROLL	7/18/95	29	3	NW			568	421,179	106,168	1,310	1,294	1,030	1,030
25116	44210	TAKU R	TROLL	7/19/95	29	3	NW			640	421,179	106,168	1,310	1,294	1,030	1,030
14255	44209	TAKU R	TROLL	7/24/95	30	3	NW			564	421,179	106,168	1,310	1,294	1,030	1,030
82153	44209	TAKU R	TROLL	7/29/95	30	3	NW			663	421,179	106,168	1,310	1,294	1,030	1,030
82154	44210	TAKU R	TROLL	7/29/95	30	3	NW			676	421,179	106,168	1,310	1,294	1,030	1,030
79195	44209	TAKU R	TROLL	8/4/95	31	4	NW			645	359,837	106,480	1,623	1,608	1,314	1,314
79199	44209	TAKU R	TROLL	8/4/95	31	4	NW			638	359,837	106,480	1,623	1,608	1,314	1,314
79206	44209	TAKU R	TROLL	8/4/95	31	4	NW			685	359,837	106,480	1,623	1,608	1,314	1,314
32957	44209	TAKU R	TROLL	8/6/95	32	4	NW			749	359,837	106,480	1,623	1,608	1,314	1,314
32963	44210	TAKU R	TROLL	8/6/95	32	4	NW			626	359,837	106,480	1,623	1,608	1,314	1,314
79303	44209	TAKU R	TROLL	8/9/95	32	4	NW			663	359,837	106,480	1,623	1,608	1,314	1,314
79320	44210	TAKU R	TROLL	8/11/95	32	4	NW			615	359,837	106,480	1,623	1,608	1,314	1,314
33560	44209	TAKU R	TROLL	8/14/95	33	4	NW			716	359,837	106,480	1,623	1,608	1,314	1,314
33630	44209	TAKU R	TROLL	8/14/95	33	4	NW			762	359,837	106,480	1,623	1,608	1,314	1,314
33683	44209	TAKU R	TROLL	8/14/95	33	4	NW			695	359,837	106,480	1,623	1,608	1,314	1,314
33548	44210	TAKU R	TROLL	8/14/95	33	4	NW			660	359,837	106,480	1,623	1,608	1,314	1,314
33557	44210	TAKU R	TROLL	8/14/95	33	4	NW			723	359,837	106,480	1,623	1,608	1,314	1,314
79396	44209	TAKU R	TROLL	8/28/95	35	5	NW			693	479,750	101,141	1,787	1,757	1,516	1,516
79420	44209	TAKU R	TROLL	8/28/95	35	5	NW			687	479,750	101,141	1,787	1,757	1,516	1,516
26788	44209	TAKU R	TROLL	8/29/95	35	5	NW			720	479,750	101,141	1,787	1,757	1,516	1,516
26818	44209	TAKU R	TROLL	8/31/95	35	5	NW			728	479,750	101,141	1,787	1,757	1,516	1,516
34927	44210	TAKU R	TROLL	8/31/95	35	5	NW			641	479,750	101,141	1,787	1,757	1,516	1,516
34980	44209	TAKU R	TROLL	9/6/95	36	5	NW			718	479,750	101,141	1,787	1,757	1,516	1,516
82620	44209	TAKU R	TROLL	9/8/95	36	5	NW			631	479,750	101,141	1,787	1,757	1,516	1,516
35312	44210	TAKU R	TROLL	9/9/95	36	5	NW			718	479,750	101,141	1,787	1,757	1,516	1,516
SELECT RECOVERIES																
78109	44209	TAKU R	GILLNET	8/8/95	32	32	NE	111	32							
9916	44210	TAKU R	TROLL	7/2/95	27	3	NW	114	21							
34507	44209	TAKU R	TROLL	8/31/95	35	5	NW	181		658						
32278	44209	TAKU R	TROLL	7/6/95	27	3										
14311	44210	TAKU R	TROLL	7/22/95	29	3	NW									
34597	44209	TAKU R	TROLL	9/5/95	36	5										
35010	44209	TAKU R	TROLL	9/8/95	36	5										
25292	44209	TAKU R	TROLL	9/15/95	37	5										

Appendix A3.–Numbers of coded wire tagged and untagged coho salmon in samples of immigrating salmon at Canyon Island fish wheels in 1995.

Date	Number examined	Number of clips	Valid tags	Head number	Tag code	Comments
22-Jun	1					
23-Jun	0					
24-Jun	0					
25-Jun	0					
26-Jun	0					
27-Jun	0					
28-Jun	0					
29-Jun	0					
30-Jun	1					
01-Jul	1					
02-Jul	4					
03-Jul	1					
04-Jul	2					
05-Jul	5					
06-Jul	2					
07-Jul	1					
08-Jul	2					
09-Jul	3					
10-Jul	3					
11-Jul	3					
12-Jul	19					
13-Jul	17					
14-Jul	3					
15-Jul	4					
16-Jul	4					
17-Jul	11					
18-Jul	25					
19-Jul	29					
20-Jul	20					
21-Jul	22					
22-Jul	35					
23-Jul	36					
24-Jul	29					
25-Jul	0					
26-Jul	0					
27-Jul	2					
28-Jul	25					
29-Jul	16					
30-Jul	5					
31-Jul	6					
01-Aug	7					
02-Aug	20					
03-Aug	7					
04-Aug	10					
05-Aug	12					
06-Aug	9					
07-Aug	21					
08-Aug	11	1	1	99409	04-42-10	Canyon Island
09-Aug	15	1	1	99410	04-42-10	Canyon Island
10-Aug	11					
11-Aug	24					
12-Aug	32					
13-Aug	25					

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Date	Number examined	Number of clips	Valid tags	Head number	Tag code	Comments
14-Aug	29	1	1	99411	04-42-09	Canyon Island
15-Aug	35					
16-Aug	56					
17-Aug	53	1	1	99412	04-42-10	Canyon Island
		1	1	99413	04-42-10	Canyon Island
18-Aug	39	1		99414		NO TAG
19-Aug	40	1	1	99415	04-42-10	Canyon Island
20-Aug	49					
21-Aug	50					
22-Aug	70					
23-Aug	141	1		99416		NO TAG
		1	1	99417	04-42-09	Canyon Island
		1	1	99418	04-42-10	Canyon Island
24-Aug	106					
25-Aug	143					
26-Aug	95					
27-Aug	45					
28-Aug	34					
29-Aug	39	1	1	99419	04-42-09	Canyon Island
30-Aug	32					
31-Aug	33	1	1	99420	04-42-09	Canyon Island
01-Sep	97	1		99421		NO TAG
		1	1	99422	04-42-10	Canyon Island
02-Sep	104	1	1	99423	04-42-10	Canyon Island
		1	1	99424	04-42-09	Canyon Island
03-Sep	158					
04-Sep	98					
05-Sep	40	1	1	99425	04-42-10	Canyon Island
06-Sep	33					
07-Sep	52	1	1	99426	04-42-10	Canyon Island
		1	1	99427	04-42-10	Canyon Island
08-Sep	70					
09-Sep	21	1	1	99428	04-42-10	Canyon Island
10-Sep	1					
11-Sep	0					
12-Sep	0					
13-Sep	27	1		99429		NO TAG
14-Sep	43					
15-Sep	47					
16-Sep	27					
17-Sep	11	1		99430		NO TAG
18-Sep	4					
19-Sep	0					
20-Sep	2					
21-Sep	6					
22-Sep	6					
23-Sep	25	1	1	99431	04-42-09	Canyon Island
24-Sep	12					
25-Sep	11					
26-Sep	4					
27-Sep	2					
Total	2,531	23	18			
Marked/Unmarked Ratio			0.0071118			

Appendix A4.–Harvests of coho salmon bound for Taku River above Canyon Island in 1995 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. wk	NE/SW Quad. troll	troll	Gillnet	Seine	Sport	TOTAL	Estimated weekly prop. harvest	Estimated cum. total harvest	Estimated cum. prop. harvest
26	7/01			0		0	281		1,189	1,470	0.013	1,470	0.013
27	7/08	1		565		565	368			933	0.008	2,403	0.022
28	7/15	2		1,129	338	1,467	311	1,853		3,631	0.033	6,034	0.054
29	7/22	7		3,953	339	4,292	158			4,450	0.040	10,484	0.094
30	7/29	9	10,730	5,083		5,083	1,682			6,765	0.061	17,249	0.155
31	8/05	6		2,878	409	3,287	1,204			4,491	0.040	21,740	0.195
32	8/12	14		6,715		6,715	6,374		2,611	15,700	0.141	37,439	0.336
33	8/19	6	12,470	2,878		2,878	4,171		533	7,582	0.068	45,021	0.404
34	8/26	2		1,357		1,357	8,234		1,852	11,443	0.103	56,464	0.506
35	9/02	14		9,497	404	9,901	5,353		825	16,079	0.144	72,543	0.650
36	9/09	12		8,140		8,140	8,750			16,890	0.151	89,433	0.802
37	9/16	2		1,357		1,357	4,558			5,915	0.053	95,348	0.855
38	9/23		20,351	0		0	10,049		847	10,896	0.098	106,244	0.952
39	9/30			0		0	5,327			5,327	0.048	111,571	1.000
Total		75	43,551	43,551	1,490	45,041	56,820	1,853	7,857	111,571	1.000		
	Estimated mean date of harvest					8/15	8/31	7/10	8/12	8/23			

Appendix A5.–Number of coho salmon released in 1994 by DIPAC (Panel A) and estimated harvests from recoveries of CWTs in fisheries in 1995 (Panel B).

PANEL A: Number of coho salmon released and tagged in 1994 by DIPAC at Gastineau Hatchery and the Sheep Creek net pen site

Tag code	Species	Brood year	Release site	Marked & tagged	Total fish. released	Marked/ unmarked
04-42-46	COHO	92	Sheep Creek	17,104	176,964	0.0967
04-42-47	COHO	92	Sheep Creek	18,276	194,493	0.0940
04-42-48	COHO	92	Sheep Creek	18,793	192,114	0.0978
04-42-49	COHO	92	Gastineau Hatchery	18,353	190,296	0.0964
04-42-50	COHO	92	Gastineau Hatchery	17,785	189,986	0.0936
TOTAL				90,311	943,853 [a]	0.0957

[a] Does not include 48.574 frv released into Davidson Cr. (Taku R.) 9/10/93 (1992 brood).

PANEL B: Estimated harvest of adult coho salmon bound for Gastineau Hatchery in 1995 with $\hat{\theta}$ = 0.095688 and V[1/θ] = 0.0010940. Random seed for bootstrap estimation of the SE was 960893232. In fishing periods and fishing quadrants for which no CWT was recovered with the appropriate code, harvest was assumed to be zero.

Fishery				Catch N	Var[N]	n_2	a_1	a_2	m_1	m_2	mc	n_1	Contrib-Boot-Est	SE
TROLL	27-30	3	NW	421,179	0	106,168	1,310	1,294	1,030	1,030	21	881	859	204
TROLL	27-30	3	SE	18,091	0	5,239	70	70	55	55	1	36	35	35
TROLL	27-30	3	SW	81,722	0	34,595	313	307	223	223	4	101	96	51
TROLL	31-33	4	NW	359,837	0	106,480	1,623	1,608	1,314	1,314	99	3,529	3,546	350
TROLL	31-33	4	SE	34,039	0	11,596	111	110	80	80	1	31	31	30
TROLL	31-33	4	SW	93,164	0	43,751	331	319	229	229	3	69	67	41
TROLL	34-38	5	NE	51,228	0	18,002	271	270	202	201	27	810	807	147
TROLL	34-38	5	NW	479,750	0	101,141	1,787	1,757	1,516	1,516	172	8,672	8,767	685
TROLL	34-38	5	SE	87,303	0	24,528	370	365	273	273	1	38	43	39
				1,626,313	0	451,500	6,186	6,100	4,922	4,921	329	14,167	14,251	814
SPORT	33-34	17	111/112 Derby	2,213	0	2,213	33	33	26	26	7	73	73	25
SPORT	33-34	17	111/112 Derby TH	701	54,893	93	1	1	1	1	1	79	68	74
SPORT	34-35	17	111/112 MB	2,856	631,035	723	21	14	14	14	4	248	243	132
SPORT	3	18	111 50 MB	3,394	548,611	458	9	7	7	7	4	398	378	178

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Fishery				Catch N	Var[N]	n_2	a_1	a_2	m_1	m_2	mc	n_1	Contrib-Boot-Est	SE
SPORT	3	19	111 50 MB	253	3,476	42	4	4	4	4	3	189	192	102
				9,417	1,238,015	3,529	68	59	52	52	19	987	954	256
SEINE	32	109	61	23,717	0	4,850	20	20	16	16	1	51	47	48
SEINE	34	109	20	51,448	0	12,143	156	156	124	124	1	44	49	47
				75,165	0	16,993	176	176	140	140	2	95	96	67
GILLNET	30	115	Lynn Canal	18	0	18	1	1	1	1	1	10	10	11
GILLNET	31	106	Pt. Baker	9,581	0	2,851	36	35	25	25	1	36	38	40
GILLNET	32	111	Taku	5,586	0	1,602	15	15	15	15	2	73	80	50
GILLNET	33	111	Taku	5,117	0	1,035	9	9	9	9	2	103	90	68
GILLNET	34	111	Taku	11,659	0	3,077	34	33	27	27	11	449	463	142
GILLNET	35	111	Taku	12,483	0	2,951	15	15	11	11	3	133	123	77
GILLNET	35	115	Lynn Canal	15,822	0	3,128	88	88	86	86	8	423	447	139
GILLNET	35	111/115	Taku/Lynn	28,305	0	7,273	158	158	149	149	18	732	754	191
GILLNET	36	111	Taku	13,005	0	3,366	153	152	140	140	115	4,674	4,597	437
GILLNET	36	115	Lynn Canal	9,526	0	939	32	32	29	29	1	106	113	115
GILLNET	36	111/115	Taku/Lynn	22,531	0	4,704	218	217	200	200	8	402	382	154
GILLNET	37	111	Taku	4,319	0	1,155	24	24	21	21	17	664	667	185
GILLNET	37	115	Lynn Canal	22,023	0	2,650	144	144	138	138	21	1,824	1,813	410
GILLNET	38	111	Taku	15,283	0	4,203	207	207	198	198	161	6,118	6,157	493
GILLNET	38	115	Lynn Canal	20,119	0	6,708	603	602	594	593	29	912	932	177
GILLNET	38	111/115	Taku/Lynn	35,402	0	12,512	904	903	884	883	22	652	649	128
GILLNET	39	111	Taku	8,364	0	2,375	44	44	41	41	30	1,104	1,110	234
GILLNET	39	115	Lynn Canal	6,131	0	2,313	174	173	169	169	7	195	201	74
				245,274	0	62,860	2,859	2,852	2,737	2,735	457	18,610	18,626	934
Total				1,956,169	1,238,015	534,882	9,289	9,187	7,851	7,848	807	33,859	33,927	1,267

Appendix A6.–Harvest and removal rate of coho salmon from DIPAC in Southeast Alaska fisheries in 1995.

Fishery	Area	Estimated harvest	SE	Percent of marine harvest	Percent of total run	Removal rate
U.S. troll fishery	SW Quad	170	65	0.5	0.3	
	SE Quad	105	60	0.3	0.2	
	NW Quad	13,082	796	38.6	22.7	
	NE Quad	810	147	2.4	1.4	
	Subtotal	14,167	814	41.8	24.6	24.6
Drift gillnet	Dist. 106	36	40	0.1	0.1	
	Dist. 111	13,318	746	39.3	23.1	
	Dist. 115	3,470	487	10.2	6.0	
	Dist. 111/115	1,786	277	5.3	3.1	
	Subtotal	18,610	934	55.0	32.3	43.9
Seine fishery	Dist. 109	95	67	0.3	0.2	
	Subtotal	95	67	0.3	0.2	0.2
Recreational	Juneau	987	256	2.9	1.7	
	Subtotal	987	256	2.9	1.7	2.3
Total marine harvest		33,859	1,267	100.0	58.8	58.8
Terminal run	Sport	2,212	303 [a]			
	Cost recovery	15,675 [b]				
	Brood stock	1,568 [b]				
	Charitable	4,283 [b]				
	Subtotal	23,738	303			
TOTAL RUN		57,597	1,303			

[a] Beers (*In press*).

[b] Rick Focht (DIPAC, personal communication).

Appendix A7.–Harvests of coho salmon bound for Gastineau Hatchery in 1995 in marine commercial and sport fisheries by statistical week. Harvest in the troll fishery 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. wk	NE/SW/SE Quad. troll	Troll	Gillnet	Seine	Sport	TOTAL	Estimated weekly prop. harvest	Estimated cum. total harvest	Estimated cum. prop harvest
26	7/01			0		0				0	0.000	0	0.000
27	7/08	1		42		42				42	0.001	42	0.001
28	7/15	5		210		210				210	0.006	252	0.007
29	7/22	4		168	101	269				269	0.008	521	0.015
30	7/29	11	881	461	36	497	10			507	0.015	1,028	0.030
31	8/05	23		820	69	889	36			925	0.027	1,953	0.058
32	8/12	45		1,604	31	1,635	73	51		1,759	0.052	3,712	0.110
33	8/19	31	3,529	1,105		1,105	103		131	1,339	0.040	5,051	0.149
34	8/26	18		908		908	449	44	145	1,546	0.046	6,597	0.195
35	9/02	83		4,185	458	4,643	1,288		124	6,055	0.179	12,651	0.374
36	9/09	58		2,924	360	3,284	5,182		398	8,864	0.262	21,516	0.635
37	9/16	13		655	30	685	2,488		189	3,362	0.099	24,878	0.735
38	9/23		8,672	0		0	7,682			7,682	0.227	32,560	0.962
39	9/30			0		0	1,299			1,299	0.038	33,859	1.000
40	10/07			0		0	0			0	0.000	33,859	1.000
41	10/14			0		0	0			0	0.000	33,859	1.000
Total		292	13,082	13,082	1,085	14,167	18,610	95	987	33,859	1.000		
Estimated mean date of harvest						8/31	9/13	8/16	9/02	9/04			

Appendix A8.–Computer data files on 1994 Taku River coho salmon smolt and subsequent estimates of 1995 Taku River adult coho salmon run parameters.

File Name	Description
95CWT.xls	Spreadsheet of random and select recoveries of CWTd Taku River and DIPAC coho salmon in 1995 with recovery statistics, including condensed strata of random recoveries for input into *CWT4.exe.*
94CI43SM.xls	Spreadsheet of age and length data for coho salmon smolt caught at Canyon Island in 1994.
95TAKREP.wq1	Spreadsheet of inriver recovery from Canyon Island fish wheels; θ, smolt, exploitation rate, marine survival, migratory timing calculation; fishery contribution and distribution data; output from *CWT4.exe*, daily smolt catch and CPUE data, DIPAC releases for 1992 brood year; frequency of CWT recoveries; and adult age, sex and size data for Taku River adults in 1995.
CWT4.exe	Program to estimate harvests from CWT recovery data.
TAKUCO95.doc	WORD 6.0 (Windows) file of this FDS report.