Fishery Data Series No. 94-1

Production of Taku River Coho Salmon, 1991-1992

by

Steven Elliott

and

David R. Bernard

May 1994

Alaska Department of Fish and Game

Division of Sport Fish

FISHERY DATA SERIES NO. 94-1

PRODUCTION OF TAKU RIVER COHO SALMON, 1991-1992[1]

by

Steven Elliott

and

David R. Bernard

Alaska Department of Fish and Game
Division of Sport Fish
Anchorage, Alaska

May 1994

[1] This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-6, Job S-1-3.

The Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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 1991. Subsequent recovery of these fish in 1992 was used in part to estimate the harvest, production, exploitation rate, and estimate the abundance of smolt in 1991.

In 1991 a 12-foot diameter rotary smolt trap fished at Barrel Point, Taku River, caught 4,049 coho salmon smolt from 23 May to 26 June. Of these, 3,740 were coded wire tagged with tag number 04-28-49. Smolt sampled from the catch averaged 101 millimeters fork length, and were 56% age 1.0, 43% age 2.0, and 1% age 3.0.

In 1992, 83 adult coho salmon bearing coded wire tags implanted at Barrel Point were recovered in random samples of marine fisheries. These were pooled with 46 coded wire tags from adults that had been tagged as fingerlings or smolt at other locations in Taku River to produce an estimate of total marine harvest of 123,440 (SE=30,776). Of this harvest, the troll fishery took an estimated 34%, drift gill net fisheries took 64%, and recreational fisheries took 0.3%.

A mark recapture experiment conducted by the Commercial Fisheries Division estimated the in-river escapement of coho salmon in Taku River past Canyon Island at 89,270 (SE=19,182) fish. The return for 1992, the sum of escapement and harvest, was 212,710 (SE=36,264) and the exploitation rate of the return was an estimated 58% (SE=6%). The 1991 smolt abundance ranged from 743,164 (SE=247,062) to 990,885 (SE=373,772), estimates which are compromised because of bias resulting from low rates of recapture.

KEY WORDS: Coho salmon, *Oncorhynchus kisutch*, Taku River, harvest, troll fishery, drift gill net fishery, recreational fishery, escapement, migratory timing, timing, production, return, exploitation rate.

INTRODUCTION

The Taku River produces an estimated 100,000 - 300,000 coho salmon *Oncorhynchus kisutch* annually, many of which are caught in commercial and recreational fisheries in northern Southeast Alaska. Adult coho salmon returning to the Taku River first pass through an offshore troll fishery before they enter inside waters through Icy Straits. Before ascending the Taku River, these fish are exploited in the recreational fishery near Juneau and in the drift gill net fishery in District 111 (Figure 1). When in the river, the remaining coho salmon are exposed to a set gill net fishery just inside Canada (Figure 2). Because of the 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, the U.S. National Marine Fisheries Service, and the Canadian Department of Fisheries and Oceans have all conducted studies of this stock in recent years. In these studies, fingerlings or smolts were implanted with coded-wire tags (CWTs) or given pigment marks either where they resided or as they left Yehring Creek, the Nahlin River, Tatsamenie Lake, other tributaries, or the lower Taku River (Figure 2). In some studies weirs were used to sample returning adults to estimate the fraction of each stock marked with CWTs. Information from these assessment studies were used to estimate harvest of tributary stocks in commercial and recreational fisheries and where possible to estimate the abundance of smolt leaving these tributaries. Table 1 is a short bibliography of reports generated from some of these studies.

Our studies began in 1986 on coho salmon in Yehring Creek and Nahlin River both tributaries to Taku River. Because these stocks are small relative to total Taku River production, the project shifted emphasis of our assessment study away from tributaries to assessment of all production of coho salmon from the Taku River. Our new objectives were to estimate:

1) the abundance of coho salmon smolt leaving the Taku River in 1991;
2) the mean length of these smolt;
3) the age composition of these smolt; and
4) the harvest of adults returning to the Taku River in marine fisheries in 1992.

These objectives were accomplished by coded wire tagging and sampling smolt in 1991 in the lower Taku River. Other projects in our agency and in other agencies supplied information on fingerlings marked in 1990 at Tatsamenie Lake, the Nahlin River, and the lower Taku River and information on returning adults that were harvested in 1992 or that had escaped harvest that year.

METHODS

Smolt Capture, Coded Wire Tagging, and Sampling

A rotary smolt trap, constructed by E.G. Solutions of Corvallis, Oregon, was fished from 23 May to 26 June 1991 at Barrel Point near the mouth of Taku River (Figure 3). River boats were used to transport the trap's floats, cross beams, and decking to Barrel Point where they were assembled to form the trap platform. These components were too heavy (about 2,000 lbs) for most helicopters and the

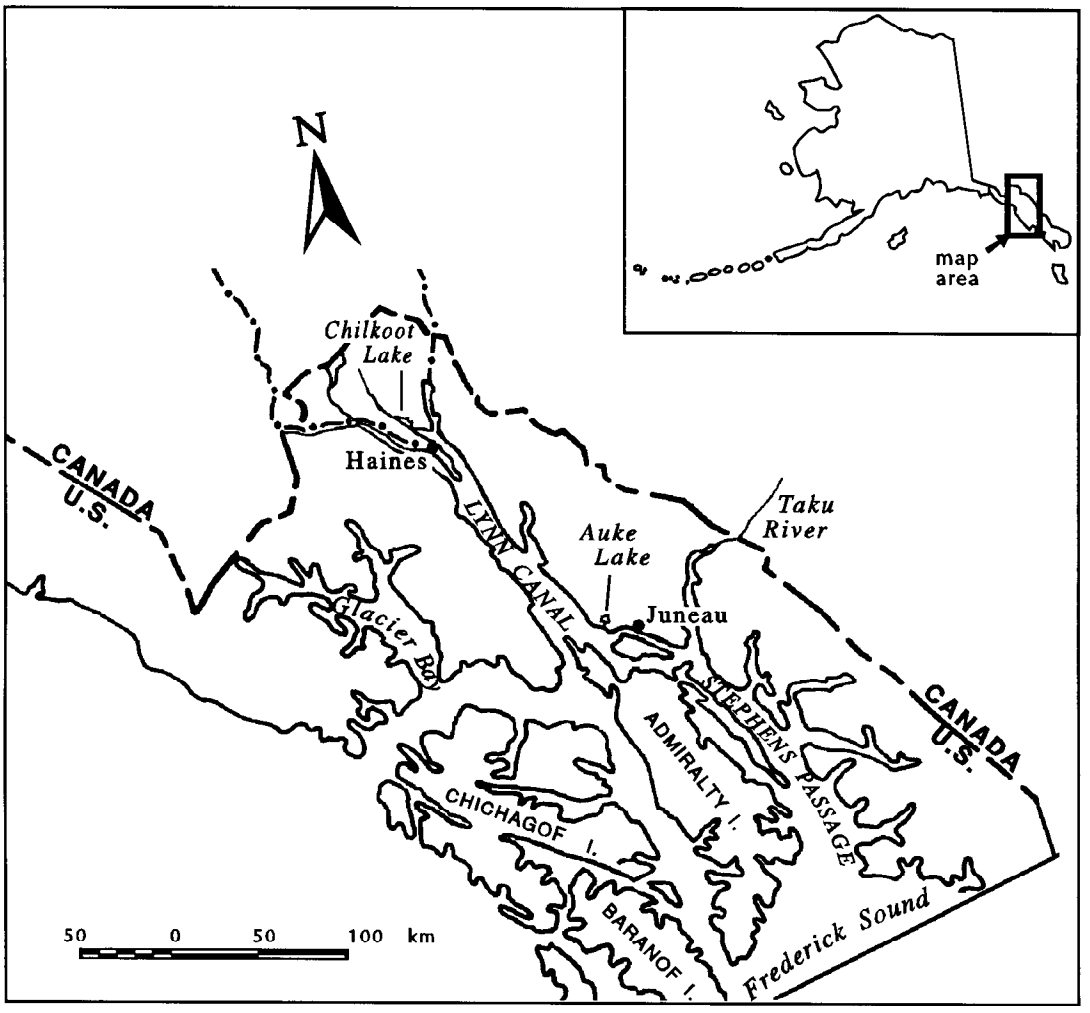


Figure 1. Northern Southeast Alaska showing migration routes of coho salmon bound for Taku River.

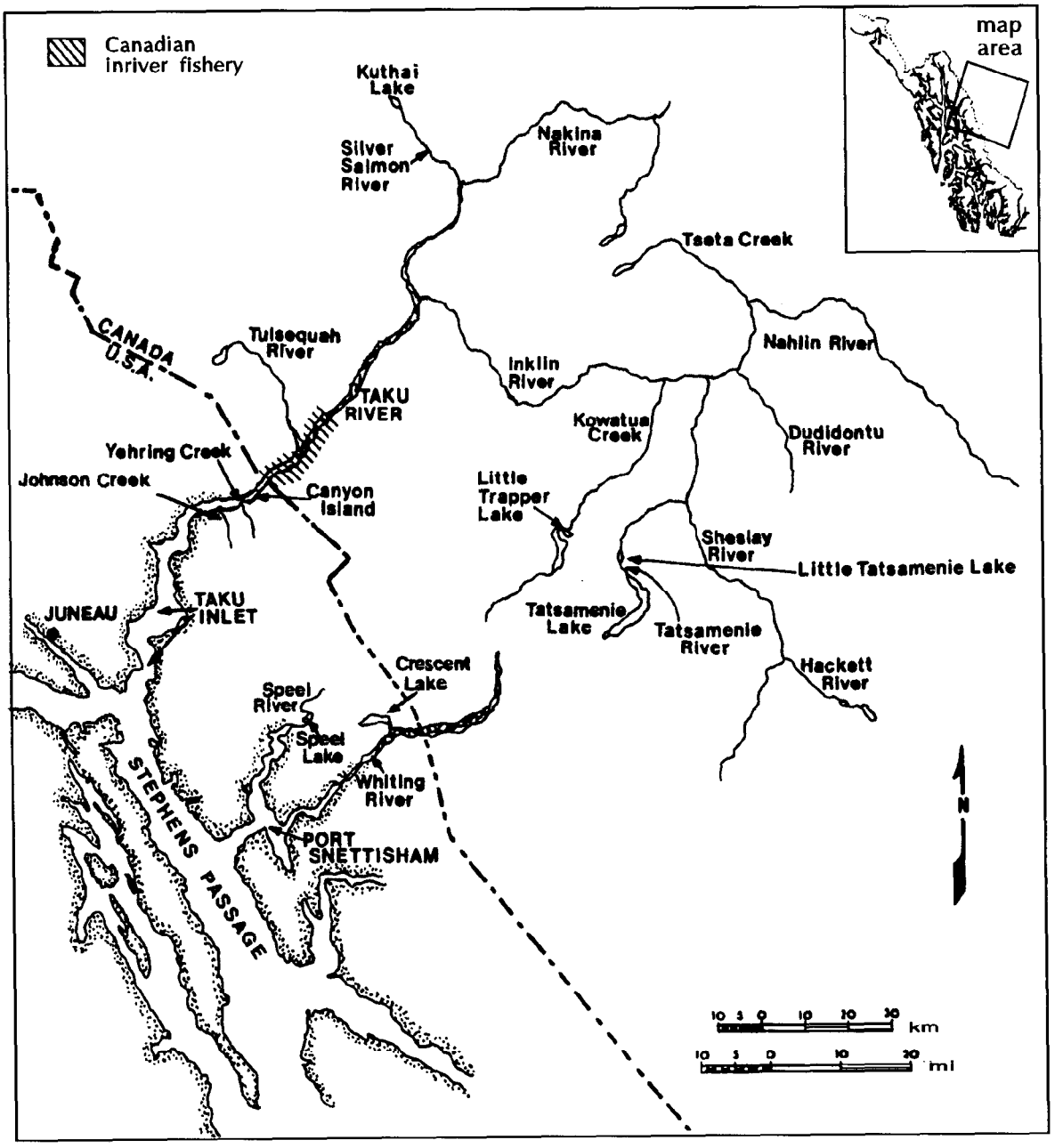


Figure 2. Taku River drainage, northwestern British Columbia and Southeast Alaska.

Table 1. Bibliography of stock assessment studies conducted on the Taku River.

Citation	Location	Objective
Elliott 1987	Yehring Creek	1986 Escapement
Elliott and Kunz 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 1993	Yehring Creek	Smolt Capture Methods
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
Murphy et al 1988	Taku River	1987 Smolt tagging
Pacific Salmon Commission	Taku River	Estimated Escapement
Shaul 1987	Nahlin River	1986 Escapement
		1986 Juvenile Tagging
	Tatsamene L.	1986 Escapement

-continued-

Table 1. (Page 2 of 2).

Citation	Location	Objective
Shaul 1987	Tatsamene L.	1986 Juvenile Tagging
	Dudidontu R.	1986 Escapement
Shaul 1988	Tatsamene L.	1987 Juvenile Tagging
Shaul 1989	Nahlin River	1988 Harvest
	Mainstem	1988 Harvest
	Tatsamene L.	1988 Harvest
	Shesley R.	1988 Harvest
	Yehring Creek	1988 Harvest
	U.S. Tribs.	1988 Escapement
Shaul 1990	Nahlin River	1989 Harvest
	Mainstem	1989 Harvest
	Tatsamene L.	1989 Harvest
	Yehring Cr.	1989 Harvest
	U.S. Tribs.	1989 Escapement
Shaul 1992	Nahlin River	1990 Harvest
	Mainstem	1990 Harvest
	Tatsamene L.	1990 Harvest
	Yehring Cr.	1990 Harvest
	U.S. Tribs.	1990 Escapement

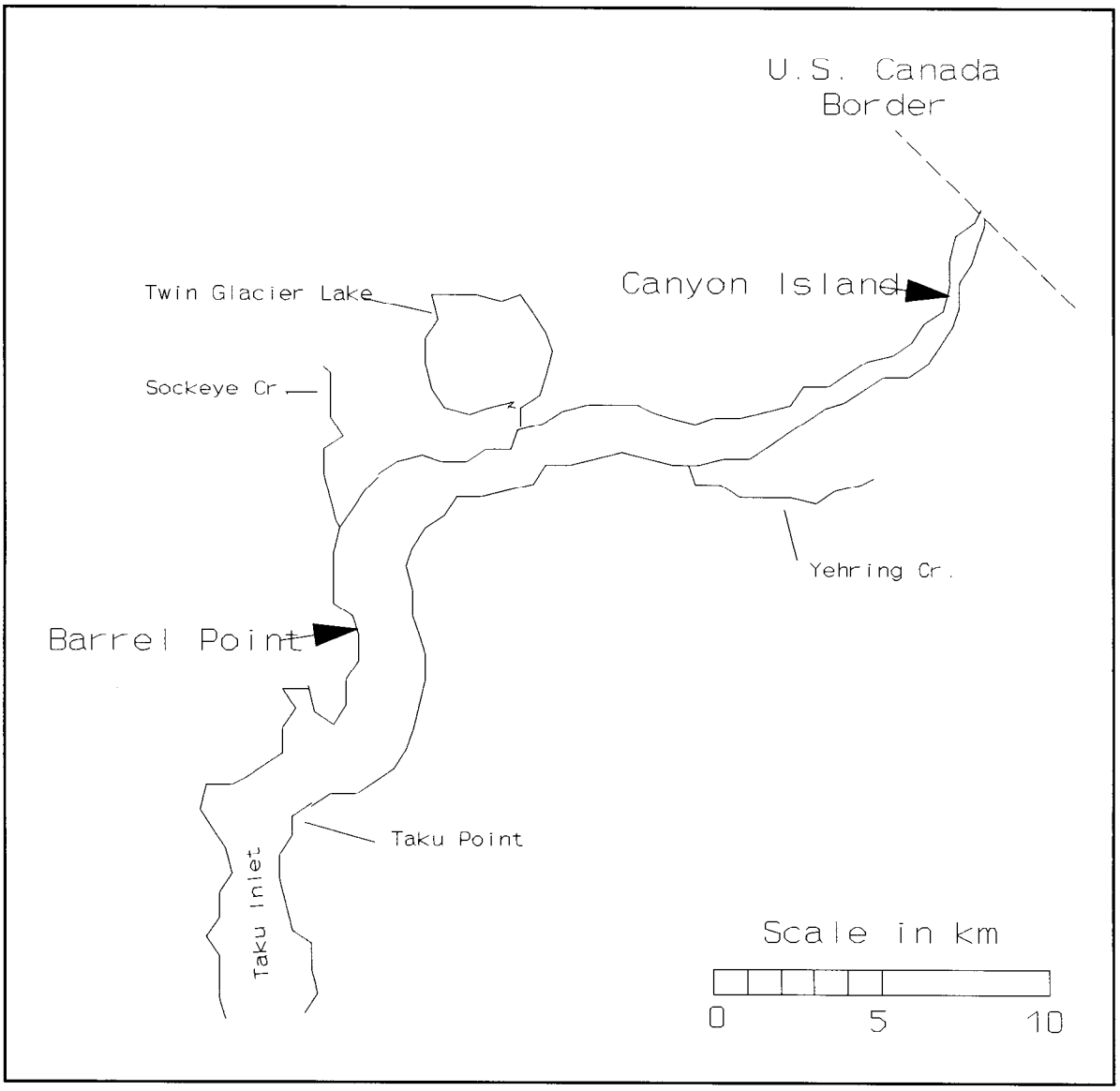


Figure 3. Lower Taku River.

site is not accessible by road. A helicopter transported the trap cone (about 900 lbs) and was later used to lower the cone into position on the trap platform. The trap had a 12-ft diameter upstream opening and was positioned in the thalweg along a steep rock bank where emigrating smolt were presumed to be concentrated. The trap was held about 10 m offshore by a boom log and secured with 1/2-in galvanized steel cable to 3/4-in steel rods driven into holes bored in upstream rock outcrops. Two members of a three technician crew were on duty at all times to keep the trap fishing 24 hrs a day. Early in the season, the trap was fished with little difficulty but with increased spring run-off, debris became a constant problem. Logs and sticks frequently jammed the cone and halted its rotation. Sometimes, debris clogged the throat of the cone and smolt were killed or badly scaled. Technicians visited the trap about every 4-6 hrs at the beginning of the season and every two hours at the peak of the migration, or whenever debris stopped the cone's rotation. Each morning and evening, fine debris was removed from the cone's mesh by a high pressure jet of water supplied by a gasoline powered water pump.

Salmonid smolt and fry were removed from the trap live box and processed each morning. Coho and chinook salmon *Oncorhynchus tshawytscha* smolt were separated by inspection from other species of *Oncorhynchus* and from Dolly Varden *Salvelinus malma* at the trap and transported to a nearby tagging shed. There, the fish were carefully examined and the two species of salmon were separated using a combination of characters. If identity was in doubt, the adipose fin was inspected with a hand lens for the presence of a "window" in the pigmentation (Meehan and Vania 1961) that indicated a chinook salmon smolt. All coho salmon smolt $\geq$ 60 mm fork length 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 CWT and marked by excision of the adipose fin following methods in Koerner (1977). Also, a small portion of the upper or lower caudal fin lobe was removed to distinguish these fish from any tagged fish still at large from releases made by other projects or agencies in the Nahlin and Tatsamenie Rivers and mainstem Taku River in previous years. Any smolt captured that had a missing adipose fin was passed through magnetic tag detector and if a tag was not detected, it was given a CWT, a caudal fin clip, and released upstream (as part of procedures for an abundance estimate). All smolt recaptured (adipose fish and a caudal fin clip) were passed through a magnetic detector and if a tag was not detected, the fish was given a CWT and released downstream. Tagged fish were held during the day in floating live boxes and transported upstream and released during the evening. The first 200 fish in each day's batch were held in a separate live box and checked for the retention of CWTs 24 hours later. The number of fish tagged, number of tagging related mortalities, and number of fish that had shed their tags were compiled and recorded on an *ADF&G CWT Tagging Summary and Release Information Form* and submitted to the Fisheries Rehabilitation Enhancement and Development Division[1] tag lab in Juneau when field work ended.

Age composition of emigrating coho salmon smolts in 1991 was estimated by systematically sampling every 100th smolt captured at Barrel Point. Each sampled

[1] This agency is now named: Commercial Fisheries Management and Development Division, (CFM&D).

smolt was measured to the nearest mm fork length (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 Anas (1963)]. Scales were mounted between two 25 by 75 mm glass slides and viewed through a microfiche reader at 10x magnification. Age was determined once for each fish and are reported in European notation. Proportions in the age composition and their variances were estimated as:

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

where y_i = the number of smolts in the sample determined to be of age i (see Table 2 for definitions of the remaining notation in Equation 1).

Estimate of Smolt Abundance

An abundance estimate of smolt leaving the Taku River in 1991 was attempted with a mark-recapture experiment based on the measured efficiency of the rotary trap to capture smolt. Smolts were captured daily, marked, and released upstream to be exposed again to capture in the rotary trap. The fraction of marked fish recaptured is a measure of the efficiency of the rotary trap in capturing smolt. Fish were marked and released differently throughout the season (Table 3) to detect relationships between trap efficiency, river flows, and how far upstream smolts are released. All marked smolts were released between 1100 and 1430 hrs in turbulent water to promote mixing with unmarked fish in the area. Fish captured at Barrel Point were examined for clipped fins, and all recaptured fish were measured to the nearest mm FL. Abundance was estimated with a variant of the Manly-Parr estimator (see Seber 1982) developed by Rawson (1984) for each day (stratum) of operation:

$$\hat{U}_h = C_h\left[\frac{D_h}{d_h} + \frac{(D_h - d_h)}{d_h^2}\right] \qquad V[\hat{U}_h] = C_h(C_h + d_h)D_h\left[\frac{D_h - d_h}{d_h^3}\right] \tag{2}$$

Abundance of emigrating smolt for the year was estimated as the sum of stratified estimates across the season:

$$\hat{N}_s = \sum_{h=1}^{L} \hat{U}_h + \sum_{h=1}^{L} D_h \qquad V[\hat{N}_s] = \sum_{h=1}^{L} V[\hat{U}_h] \tag{3}$$

where L is the number of strata (days) of operation.

Table 2. Notation used to describe the 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 their adipose fins in a sample from a harvest in 1992
a_2	=	Number of heads that arrive at Juneau for dissection (subset of a_1)
C_h	=	Number of smolt captured during stratum h in 1991
d_h	=	Number of marked smolts recaptured during stratum h in 1991
D_h	=	Number of smolts marked and released upstream in stratum h in 1991
E	=	Exploitation rate of adults in commercial and sport fisheries in 1992
H	=	Number of adults in a harvest in 1992
λ	=	Fraction of harvest in District 111 prior to 5 September, 1992
m_1	=	Number of heads with CWTs detected magnetically (subset of a_2)
m_2	=	Number of CWTs found through dissection and decoded (subset of m_1)
m_c	=	Number of CWTs with the appropriate code(s) (subset of m_2)
n_1	=	Number of adults in a harvest from the appropriate stock in 1992
n_2	=	Number of adults in a harvest inspected (the sample) in 1992
n_e	=	Number of adults sampled in 1992 to estimate θ
n_s	=	Number of smolt sampled to estimate age composition in 1991
N_e	=	Number of adults in escapement past Canyon Island in 1992
N_e^*	=	Number of adults in escapement prior to 5 September, 1992
N_H	=	Number of adults harvested in all strata and all fisheries in 1992
N_r	=	Number of adults returning to the Taku River in 1992
N_s	=	Number of smolts emigrating from the Taku River in 1991
p_i	=	Fraction of smolt with freshwater age i in 1992
θ	=	Fraction of the stock tagged with CWTs
U_h	=	Number of unmarked smolts emigrating during stratum h in 1991

Table 3. Secondary marks and location of release for coho salmon smolts captured in the rotary trap at Barrel Point on the Taku River in 1991. Secondary marks are partial excision of either the lower or upper lobe of the caudal fin. Refer to Figure 1 for locations.

Date	Flows	Caudal Fin Lobe	Location of Release	Km Upstream
20 May	Low	Lower	Yehring Creek	10
27 May	Low	Lower	Cap's Cabin	15
10 June	High	Lower	Yehring Creek	10
17 June	High	Lower	Cap's Cabin	15
All Other Days		Upper	Twin Glacier Creek	7

Estimate of Harvest

Harvest of coho salmon from the Taku River was estimated from samples taken from catches in commercial and recreational fisheries (Figure 1) and from samples from the escapement taken at Canyon Island (Figure 2). A subset of the catch was counted and inspected to find recaptured fish, those salmon without adipose fins. Whenever possible, heads of recaptured salmon are 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 undamaged, its code was read under a microscope. Oliver (1990) and Hubartt et al. (1993) present details of sampling commercial and recreational fisheries, respectively. The fraction of the return to the Taku River carrying CWTs was estimated from catches in fishwheels located at Canyon Island described by McGregor and Clark (1989). Information from catch and field sampling programs was expanded to estimate harvest of coho salmon bound for the Taku River:

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

where $\hat{M}$ is the final statistic obtained through sampling catches (remaining notation is defined in Table 2). All CWTs with codes corresponding to smolts in 1991 and to fingerlings tagged in 1990 by other projects were tallied to calculate m_c.

The bootstrap of Efron (1982) as modified by Buckland and Garthwaite (1991) was used to estimate M, its variance, and bias. Each fish inspected during a catch sampling program was placed into one of six capture histories depending on its fate in the program (Table 4). A multinomial, empirical density distribution with six cells was created with the data from the catch sampling program. Respective to the capture histories in Table 4, 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 ($\bar{M}$) and its variance V[M] were calculated as:

$$V[\bar{M}] = \frac{\sum_{b=1}^{B}\left(M_b-\bar{M}\right)^2}{B-1} \qquad \text{with} \quad \bar{M} = \frac{\sum_{b=1}^{B} M_b}{B}$$

where B is the number of bootstrap samples drawn (=2000). From Efron (1982), $\bar{M}-\hat{M}$ is a measure of bias in the statistic $\hat{M}$.

Once the bootstrap had been completed, information on harvest and from the field sampling program at Canyon Island were combined with the bootstrapped statistics

Table 4. Possible capture histories for salmon inspected 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

to estimate harvest and its variance. Equation (4) was used to estimate harvests of coho salmon from the Taku River in commercial and sport fisheries. In the case of wild stocks harvested in commercial fisheries where H is known and θ is estimated with error, the variance of the estimate was calculated according to the procedures of Goodman (1960):

$$V[\hat{n}_1] = H^2 \left(V[\bar{M}]\ \hat{\theta}^{-2} + V[\hat{\theta}^{-1}]\ \hat{M}^2 - V[\bar{M}]\ V[\hat{\theta}^{-1}]\right) \qquad (5)$$

Note that $\hat{M}$ and not $\bar{M}$ was used in Equation (5) even though $V[\bar{M}]$ was used as an approximation to $V[\hat{M}]$. If H and θ are both estimated with error (as in the case of wild stocks in sport fisheries where harvest is estimated) the variance can be estimated (Bernard 1992):

$$\begin{aligned} V[\hat{n}_1] = {} & V[\hat{N}]\ M^2\ \hat{\theta}^{-2} + V[\bar{M}]\ \hat{N}^2\ \hat{\theta}^{-2} + V[\hat{\theta}^{-1}]\hat{N}^2\ M^2 \\ & - V[\hat{N}]\ V[\bar{M}]\ \hat{\theta}^{-2} - V[\bar{M}]V[\hat{\theta}^{-1}]\ \hat{N}^2 - V[\hat{N}]V[\hat{\theta}^{-1}]\ M^2 \\ & + V[\hat{N}]\ V[\bar{M}]\ V[\hat{\theta}^{-1}] \end{aligned} \qquad (6)$$

where V[H] can be estimated from the angler surveys, $V[\ \hat{\theta}^{-1}\ ]$ can be estimated from a Monte Carlo simulation (e.g., Geiger 1990), and $V[\ \bar{M}\ ]$ can be estimated using the bootstrap technique (Efron 1982). In this study, equation (5) was used when CWT's were recovered in commercial fishery strata, and (6) was used when CWT's 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 fishwheels at Canyon Island was continuous with equal sampling effort expended throughout the passage of the escapement, θ was estimated as the proportion of successes in a binomial distribution. The estimate $\hat{\theta}$ and its variance were calculated as:

$$\hat{\theta} = \frac{y}{n_e} \qquad V[\hat{\theta}] = \frac{\hat{\theta}(1 - \hat{\theta})}{n_e - 1} \qquad (7)$$

where n_e = number of fish inspected in the field sampling program and y = the subset of n_e that had no adipose fins.

Because several fisheries exploited coho salmon over several months in 1992, 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 gill net fisheries were stratified by week and by fishing district. Statistics from the recreational fishery were stratified by fortnight. An estimate of the harvest $\hat{n}_1$ was calculated for each stratum, then summed across strata and across fisheries to obtain an estimate of all the harvest:

$$\hat{N}_c = \sum_{h=1}^{L} \hat{n}_{1h} \qquad V[\hat{N}_c] = \sum_{h=1}^{L} V[\hat{n}_{1h}] \tag{8}$$

where L is the number of strata. Because sampling was independent across strata and across fisheries, the variance of the sum of the estimates was calculated as the sum of the variances across strata.

Estimate of Escapement

An estimate of escapement of coho salmon past Canyon Island in 1992 was calculated by expanding a partial estimate available from an ongoing mark-recapture experiment in another division of the Department (see McGregor and Clark 1988 for a description of this experiment). Coho salmon in this experiment were captured in two fishwheels at Canyon Island, tagged through the back with individually numbered plastic spaghetti tags, released, and recovered along with unmarked fish in set gill net fisheries five to ten miles upstream in Canada. As a result of poor catches of coho salmon after 5 September due to low water, and because of reduced sampling effort after that date in the set net fishery, the estimated escapement past Canyon Island prior to 5 September was obtained directly from the mark-recapture experiment (Andrew McGregor, Alaska Department of Fish and Game, personal communication). This partial estimate was expanded by the estimated fraction of the escapement that had passed Canyon Island by 5 September:

$$\hat{N}_e = \hat{N}_e^* \lambda^{-1} \qquad V[\hat{N}_e] = V[\hat{N}_e^*] \lambda^{-2} \tag{9}$$

The statistic λ is the fraction of the harvest in the drift gill net fishery in Taku Inlet (District 111) during 1992 that occurred prior to 5 September (transit time of coho salmon between Taku Inlet and Canyon Island was considered negligible). The statistic $V[\hat{N}_e]$ is a minimum because the measurement error in λ is unknown.

Estimates of Return and the Rate of Exploitation

Estimates of return of coho salmon to the Taku River in 1992 and their 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 return was calculated as the sum of the variances for estimated escapement and estimated harvest ($V[\hat{N}_r] = V[\hat{N}_e] + V[\hat{N}_H]$). The estimate of exploitation rate was calculated as:

$$\hat{E} = \frac{\hat{N}_H}{\hat{N}_r} \qquad V[\hat{E}] \approx \frac{V[\hat{N}_H]\hat{N}_e^2}{\hat{N}_r^2} + \frac{V[\hat{N}_e]\hat{N}_H^2}{\hat{N}_r^2} \tag{10}$$

The variance in Equation 10 was approximated with the delta method (see Seber 1982, p. 17).

RESULTS AND DISCUSSION

From 23 May to 26 June, 1991, 4,049 coho salmon smolt were captured in the rotary trap at Barrel Point, 3,953 of which were marked and implanted with CWTs, code 04-28-49, and released (Table 5). An estimated 3,740 (94.6%) of the released fish retained their tags. Frequency of emigration of coho salmon smolts (Figure 4) reflected the late start of operations due to a later than usual melting of snows around Barrel Point. According to estimates of migratory timing from Meehan and Siniff (1962), approximately a half to a third of all emigrating coho salmon smolts pass Barrel Point prior to 23 May. Coho salmon smolts averaged 100 mm long (Figure 5) substantially longer than means reported by other studies, with about half having a single freshwater annulus and about half with two (Table 6). Meehan and Siniff (1962) caught coho salmon smolt with an incline plane trap at Canyon Island and report a mean smolt length of 93 mm FL and indicate that about 10% of these were $\leq$ 69 mm FL. Murphy et al (1988) caught smolt with a fyke net and report a mean of 90 mm FL and indicate that 35%-50% of the smolt they captured were $\leq$ 69 mm FL. It is unlikely that our late start at Barrel Point produced larger smolts as Meehan and Siniff (1962) found that smolt lengths do not vary significantly over time. The difference in sizes reported by these three projects may be due inter-annual variation, differences in sample location, or a reflection of the different sampling gear used in each study. Measured lengths of smolts recaptured in the rotary trap (mean of 100 mm FL) were not significantly different from those of captured smolts (Kolmogorov Two-Sample Test, $D = 0.155$, $P = 0.88$; Figure 6) indicating that the rotary traps were not size-selective (e.g. that recaptured fish develop no behavior to avoid the rotary trap and by extension infers no trap avoidance behavior in the general population). Smolts and young of other species of salmon were also captured, but were not marked or tagged: 3,000 chinook salmon; 100 steelhead trout *O. mykiss*; and uncounted numbers of sockeye, pink, and chum salmon *O. nerka, O. gorbuscha, O. keta*, eulachon *Thaleichthys pacificus*, and Dolly Varden.

Attempts to estimate the abundance of coho salmon smolt through determining efficiency of the rotary trap exposed some shortcomings in the method and in our sampling. The number of recaptures was not large enough to test for changes in trap efficiency relative to distance of release upstream or to varied flow levels (Table 7). Numbers of recaptured smolt (average of 1.4 per stratum; Appendix A1) were low enough to indicate that there would be significant bias in estimates (see Appendix A2). And finally, the late start of operations in 1991 insured that any estimate of the abundance of smolt from a mark-recapture experiment conducted wholly within that year would be biased low.

An estimated 123,440 (SE=30,776) Taku River coho salmon were harvested in commercial and sport fisheries in 1992 (Table 8) based on the recovery of 129 CWTs. Estimates of relative bias in estimates across strata ranged from 0.1 to 57.2% with all but three below 3%. The gill net fishery in District 111 (at the mouth of Taku Inlet, see Figure 2) took just over 60% of this harvest (Table 9) while the troll fishery in the Northwest Quadrant (Figure 1) captured just 30% (Table 9). Harvest in the troll fisheries occurred from July through September while harvest in gill net fisheries occurred during the latter half of this

Table 5. Daily catch of coho salmon in one 12' diameter rotary smolt trap at Barrel Point, Taku River, 1991.

Date	Total Catch	Number Unmarked	Number Marked (Recaptured)	Trap Morts	Tagging Related Morts	Number Released Upstream
23-May	234	-	-	-	-	-
24-May	217	-	-	-	-	-
25-May	330	-	-	-	-	-
26-May	420	-	-	-	-	-
27-May	338	-	-	-	-	-
28-May	294	-	-	-	-	-
29-May	234	-	-	19	8	2,170
30-May	280	258	21	1	0	258
31-May	221	213	5	3	0	213
01-Jun	69	67	2	0	1	66
02-Jun	113	110	0	3	0	110
03-Jun	118	117	1	0	0	116
04-Jun	156	155	1	0	2	153
05-Jun	49	49	0	0	2	47
06-Jun	113	113	0	0	1	110
07-Jun	198	197	0	1	2	195
08-Jun	64	57	4	3	1	56
09-Jun	80	78	2	0	0	78
10-Jun	118	118	0	0	4	114
11-Jun	39	39	0	0	1	38
12-Jun	12	12	0	0	1	11
13-Jun	6	6	0	0	0	6
14-Jun	9	9	0	0	0	9
15-Jun	27	27	0	0	0	27
16-Jun	81	80	0	1	0	80
17-Jun	47	46	1	0	2	44
18-Jun	19	19	0	0	0	19
19-Jun	14	14	0	0	0	14

-continued-

Table 5. (Page 2 of 2).

Date	Total Catch	Number Unmarked	Number Marked (Recaptured)	Trap Morts	Tagging Related Morts	Number Released Upstream
20-Jun	14	14	0	0	0	14
21-Jun	-	-	-	-	-	-
22-Jun	2	2	0	0	0	2
23-Jun	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0
25-Jun	2	2	0	0	0	2
26-Jun	1	1	0	0	0	1
Total	4,049	3,981	37	31	25	3,953

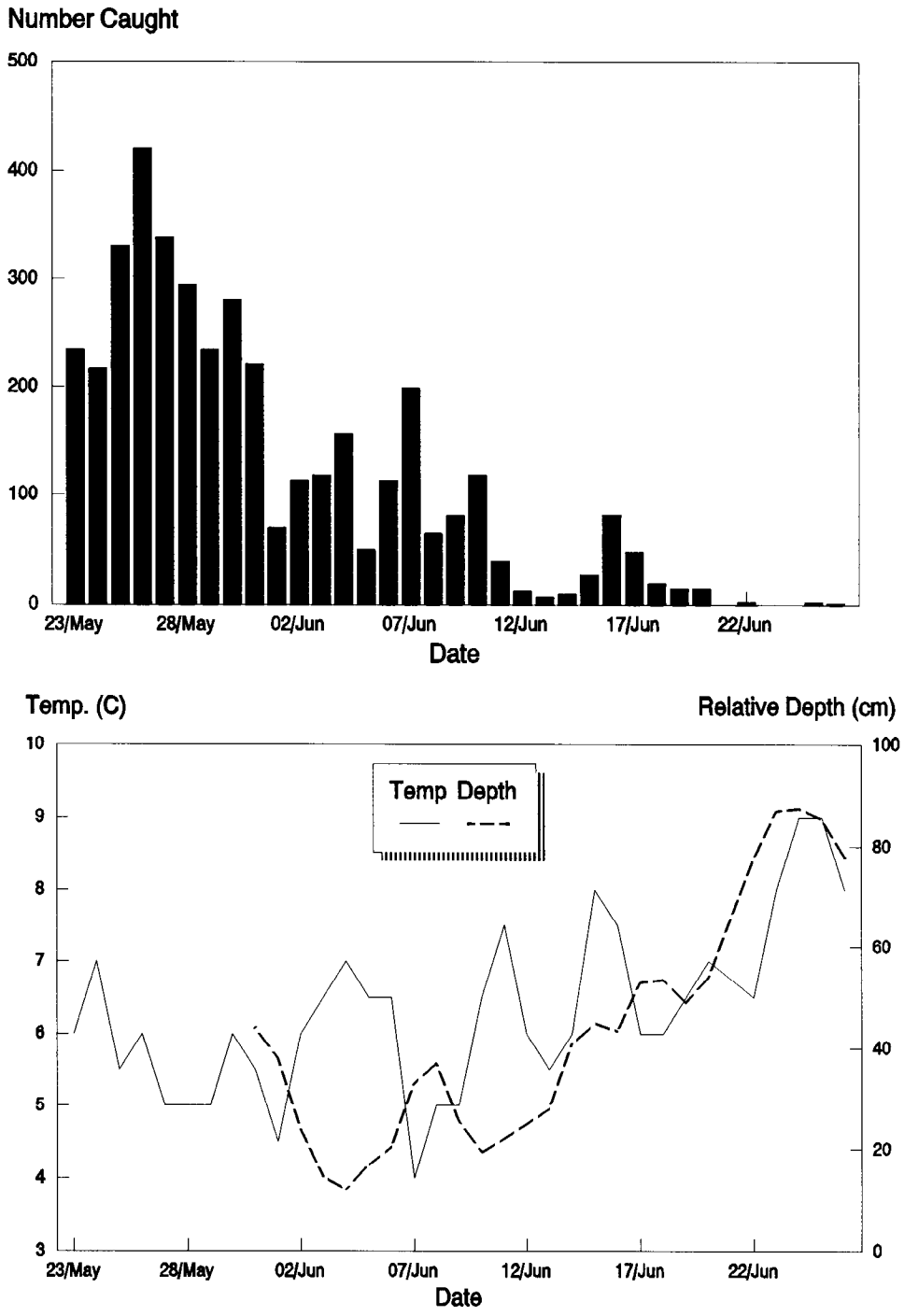


Figure 4. Catch of coho salmon smolt, daily temperature and depth at Barrel Point, 1991.

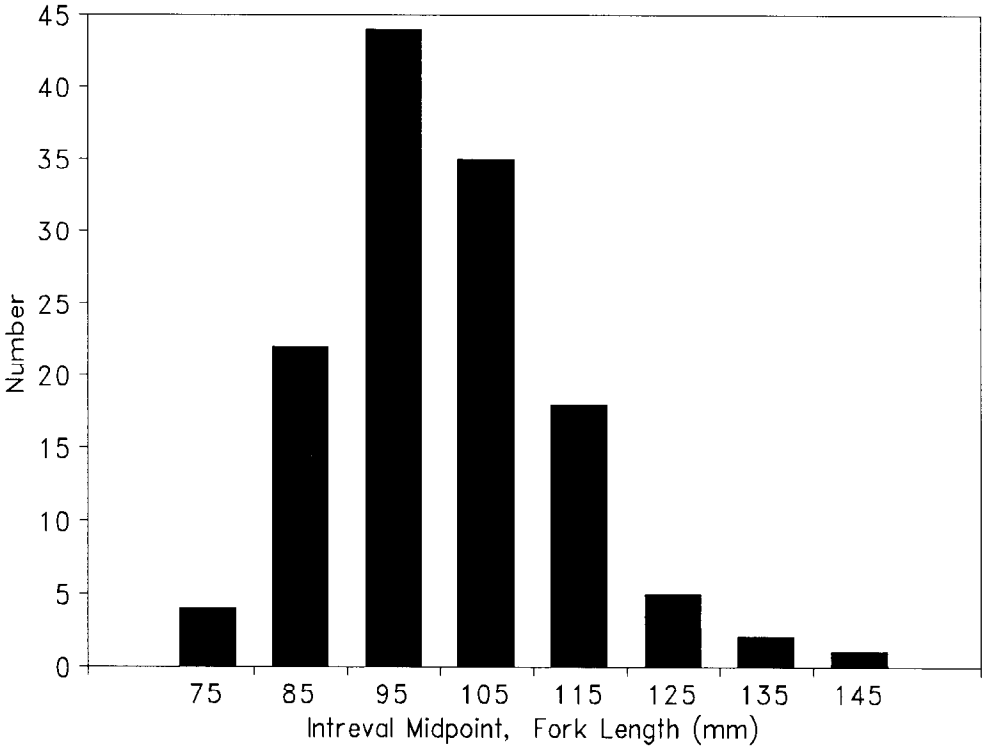


Figure 5. Length frequency of coho salmon smolt captured and measured at Barrel Point, 1991.

Table 6. Mean fork length and age composition of coho salmon smolts sampled in a 12-foot diameter rotary smolt trap at Barrel Point, Taku River, 1991.

	Parent Year			
	1989	1988	1987	
	Age 1.	Age 2.	Age 3.	Total
No. Sampled	73	56	2	131
Mean Length (mm)	96	106	118	101
SD	9	12	32	12
SE	1	2	23	1
Percent Composition	56%	43%	1%	100%
SE	0.4%	0.4%	0.1%	-

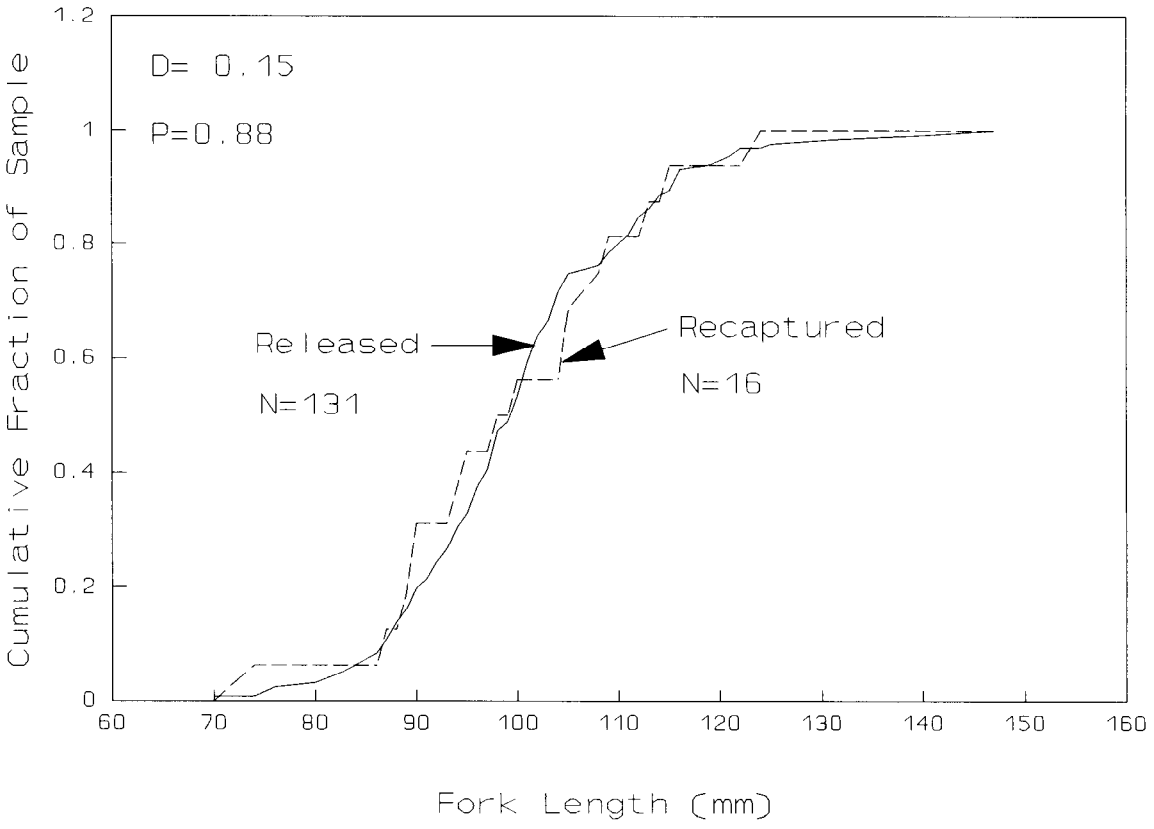


Figure 6. Cumulative relative frequency of fork lengths of coho salmon smolts captured and released then recaptured one to seven days later.

Table 7. Tallies of coho salmon smolt recaptured at Barrel Point on the Taku River, 1991.

	Location of Release		
	Twin Glacier Cr.	Yehring Cr.	Cap's Cabin
Low Flows (23 May to 6 June)			
No. Released	3,372	66	0
No. Recaptured	32	0	0
No. Not Recaptured	3,340	66	0
Percent Recaptured	1%	0%	0%
High Flows (7 June to 26 June)			
No. Released	432	0	56
No. Recaptured	6	0	1
No. Not Recaptured	426	0	55
Percent Recaptured	1%	0%	2%

Table 8. Estimated harvest of adult coho salmon bound for the Taku River in 1992 with $\hat{\theta} = 0.004657$ and $V[1/\hat{\theta}] = 24,598$. Random seed for bootstrap estimation of the SE was 689674388. In those 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	Quadrant	H	n_2	a_1	a_2	m_1	m_2	m_c	$\hat{n}_1$	Bias (%)	SE
27-28	6/28-7/11	5	NW	42,658	12,928	296	293	250	250	1	716	0.1%	711
29-34	7/12-8/22	6	NE	15,732	7,384	156	156	133	133	1	457	-0.7%	458
29-34	7/12-8/22	6	NW	821,616	193,431	3,973	3,948	3,435	3,434	16	14,689	0.0%	11,015
29-34	7/12-8/22	6	SW	116,489	49,059	1,288	1,254	1,091	1,090	1	524	-0.8%	524
35-41	8/23-10/10	7	NE	62,979	18,475	444	441	385	385	4	2,948	0.2%	2,378
35-41	8/23-10/10	7	NW	594,117	103,488	2,230	2,211	1,973	1,973	18	22,379	-0.3%	16,729
Subtotals				1,653,591	384,765	8,387	8,303	7,267	7,265	41	41,713	-0.2%	20,195

Drift Gill Net Fishery

Stat. Week	Dates	District	H	n_2	a_1	a_2	m_1	m_2	m_c	$\hat{n}_1$	Bias (%)	SE
26	6/21-6/27	115	615	264	4	4	2	2	2	1,000	1.1%	872
28	7/05-7/11	115	568	256	2	2	2	2	2	953	-1.3%	836
30	7/19-7/25	111	1,256	638	3	3	2	2	2	845	-0.6%	742
32	8/02-8/08	111	4,005	943	3	3	1	1	1	912	2.3%	906
33	8/09-8/15	111	7,756	1,844	8	7	4	4	1	1,032	0.5%	1,037
34	8/16-8/22	111	6,384	514	7	7	5	5	4	10,667	-0.4%	8,574
35	8/23-8/29	111	16,165	2,839	39	39	37	37	8	9,781	0.0%	7,556
35	8/23-8/29	115	10,900	3,700	27	27	26	26	1	633	0.2%	638
36	8/30-9/05	111	22,722	5,542	150	150	128	127	16	14,196	0.7%	10,660
36	8/30-9/05	115	24,659	6,855	131	130	121	121	1	778	-1.0%	780

-continued-

Table 8. (Page 2 of 2).

Stat. Week	Dates	District	H	n_2	a^1	a^2	m^1	m^2	m^c	$\hat{n}_1$	Bias (%)	SE
37	9/06-9/12	111	39,116	13,050	354	342	309	309	24	15,988	-0.4%	11,899
37	9/06-9/12	115	20,124	6,367	93	93	84	84	1	679	2.5%	674
38	9/13-9/19	111	43,950	8,514	371	371	357	357	13	14,409	-0.4%	10,860
39	9/20-9/26	111	25,921	6,961	257	257	243	243	8	6,396	0.1%	4,914
40	9/27-10/03	115	5,362	1,547	42	42	39	39	1	744	1.9%	748
Subtotals			229,503	59,834	1,491	1,477	1,360	1,359	85	79,013	0.3%	23,105

Seine Fishery

Weeks	Dates	District	H	n_2	a_1	a_2	m_1	m_2	m_c	$\hat{n}_1$	Bias (%)	SE
34	8/16-8/22	112	2,414	227	9	9	6	6	1	2,283	0.9%	2,315
Subtotals			2,414	227	9	9	6	6	1	2,283	0.9%	2,315

Sport Fishery

Bi-Week	Dates	Derby	Area	H	n_2	a_1	a_2	m_1	m_2	m_c	$\hat{n}_1$	Bias (%)	SE
16	8/07-8/09	Yes	Juneau	1,570	1,563	8	8	5	5	2	431	-2.3%	380
Subtotals				1,570	1,563	8	8	5	5	2	431	-2.3%	380
Totals				1,887,078	446,389	9,895	9,797	8,638	8,635	129	123,440	0.1%	30,776

Table 9. 1992 harvest and exploitation rate of Taku River coho salmon in Southeast Alaska fisheries.

Fishery	Area	Estimated Harvest	SE	Percent Harvested	Exploitation Rate
U.S. Troll Fishery	NE Quad	3,405	2,422	2.8%	1.6%
	NW Quad	37,784	20,042	30.6%	17.8%
	SW Quad	524	524	0.4%	0.2%
		41,713	20,195	33.8%	19.6%
Drift Gillnet	Dist. 111	74,226	23,030	60.1%	34.9%
	Dist. 115	4,787	1,868	3.9%	2.3%
		79,013	23,105	64.0%	37.1%
Seine Fishery	Dist. 112	2,283	2,315	1.8%	1.1%
		2,283	2,315	1.8%	1.1%
Recreational	Juneau	431	380	0.3%	0.2%
		431	380	0.3%	0.2%
Total Harvest		123,440	30,776	100.0%	58.0%
Escapement		89,270	19,182	-	42.0%
Total Return		212,710	36,264		100.0%

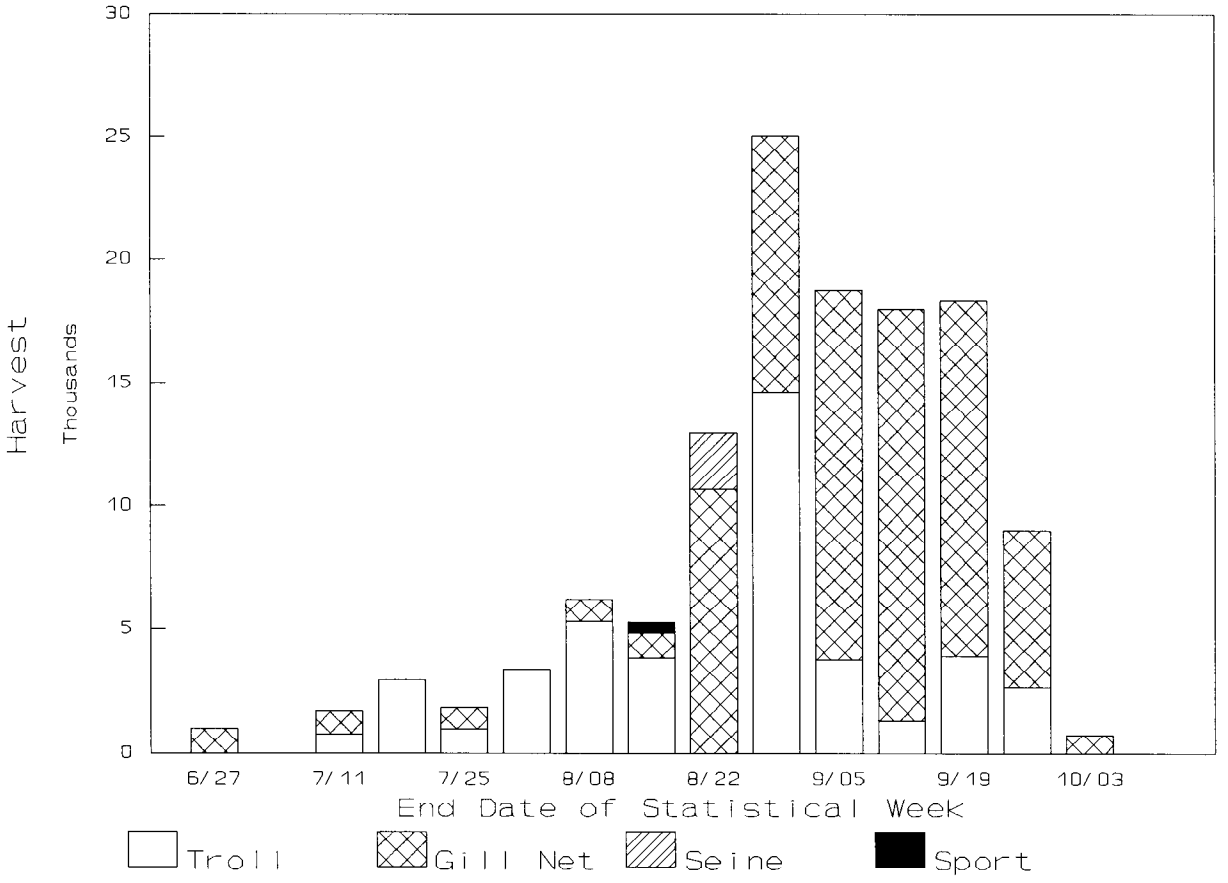


Figure 7. Estimated harvest of coho salmon bound for Taku River by commercial and recreational fisheries in 1992 by statistical week. Estimates of harvest in the Troll fisheries are approximated.

interval (Figure 7). Only two CWTs were recovered in recreational fisheries around Juneau, both during the Golden North Salmon Derby in which all harvested fish were submitted to officials. Eighty three CWTs with code 04-28-49 were recovered in 1992 along with 46 tags with other codes for coho salmon tagged as fingerlings in 1990 (Appendix A3). Codes 04-30-63, 04-31-09, and 04-33-34 correspond to fish from Tatsamenie Lake marked by the Alaska Department of Fish and Game, Division of Commercial Fisheries in cooperation with the Canadian Department of Fisheries and Oceans; code 04-28-46 corresponds to fish from the Nahlin River marked by this project in 1990; and code 03-01-01-05-01 corresponds to fish captured and released 15 km up from the mouth of the Taku River by the U.S. National Marine Fisheries Service. Most of the CWTs (85) were recovered in the drift gill net fishery in District 111. Tags with different codes were recovered with similar relative frequencies throughout this gill net fishery (Table 10). An estimate of θ is based on 1,503 coho salmon adults captured at Canyon Island in 1992, seven of which were missing adipose fins ($\hat{\theta}$= 7/1,503 = 0.004657; SE[$\hat{\theta}$]= 0.001757). None of the 7 recaptured adults were sacrificed to determine the codes on the tags they carried.

The estimated exploitation rate of coho salmon from the Taku River in commercial and sport fisheries ($\hat{E}$) was 58.0% (SE=6.1%) (Table 9) based on an estimated return ($\hat{N}_r$) of 212,710 (SE = 36,264). Cumulative harvest and exploitation rates were low until 23 August, after which both increased rapidly as the fish moved into Taku Inlet and were harvested in the District 111 drift gill net fishery (Figure 8). Estimated harvests in the troll fishery shown in Figures 6 and 7 were approximated as the number of recovered fish with appropriate codes, expanded by period/quadrant strata and tagging fraction, and summed by statistical week (Appendix A4). In further sampling in the mark-recapture experiment at Canyon Island in 1992, escapement was estimated at 49,750 (SE[$\hat{N}_e^*$]= 10,690) coho salmon prior to 5 September (Andrew McGregor, Alaska Dept. of Fish and Game, personal communication). Since 55.7% (=λ100) of the harvest in District 111 drift gill net fishery occurred prior to 5 September (see Figure 6), the estimate for all escapement of coho salmon past Canyon Island in 1992 is then 89,720 (SE[$\hat{N}_e$]= 19,182).

Due to our doubts about the using the efficiency of rotary traps to estimate abundance of coho salmon smolts, we used another mark-recapture experiment based on Bailey's modification of Petersen's estimator (see Seber 1982) for closed populations. Similar experiments have been conducted on other populations to estimate abundance of coho salmon smolts (see Elliott et al 1989, Elliott and Sterritt 1990, Elliott and Sterritt 1991, Schmidt 1985, Schmidt 1986, Schmidt 1987, Schmidt 1988, Schmidt 1990, Schmidt and DerHovanisian 1991). The two sampling events consisted of tagging smolts at Barrel Point in 1991 and sampling adults at Canyon Island in 1992. Bailey's modification was used because of the systematic nature of the sampling at Canyon Island. While the population in this experiment is not closed to losses from mortality, it is closed to recruitment because salmon return to their natal stream to spawn. Under these conditions, the experiment would produce an unbiased estimate of the number of smolt leaving Taku River in 1991, so long as marked fish (those carrying CWTs implanted at Barrel Point) had mixed completely with unmarked fish during their fourteen to sixteen months at sea. The pattern of recovery of CWTs in commercial fisheries

Table 10. Frequency of CWTs recovered during sampling the harvest of coho salmon the drift gill net fishery in District 111 in 1992. Smolt were marked at Barrel Point in 1991 with CWTs carrying code 04-28-49. Fingerlings were tagged in 1990 near Tatsamenie Lake (codes 04-30-63, 04-31-09, 04-33-34), in the Nahlin River (code 04-28-46), and 15 km up the river by the National Marine Fisheries Service (code 03-01-01-05-01).

Stat Week	Dates	Barrel Point	Tatsamenie Lake	NMFS	Nahlin River	Total	Sampled Harvest	Fraction Marked
28	Jul 04-10	0	0	0	0	0	67	0.00%
29	11-17	0	0	0	0	0	370	0.00%
30	18-24	1	0	0	1	2	638	0.31%
31	25-31	0	0	0	0	0	786	0.00%
32	Aug 01-07	1	0	0	0	1	943	0.11%
33	08-14	0	1	0	0	1	1,844	0.05%
34	15-21	1	3	0	0	4	514	0.78%
35	22-28	5	3	0	0	8	2,839	0.28%
36	Sep 29-04	9	7	0	0	16	5,542	0.29%
37	05-11	15	6	3	0	24	13,050	0.18%
38	12-18	11	2	0	0	13	8,514	0.15%
39	19-25	8	0	0	0	8	6,961	0.11%
40	Oct 26-02	0	0	0	0	0	1,176	0.00%
Total		51	22	3	1	77		

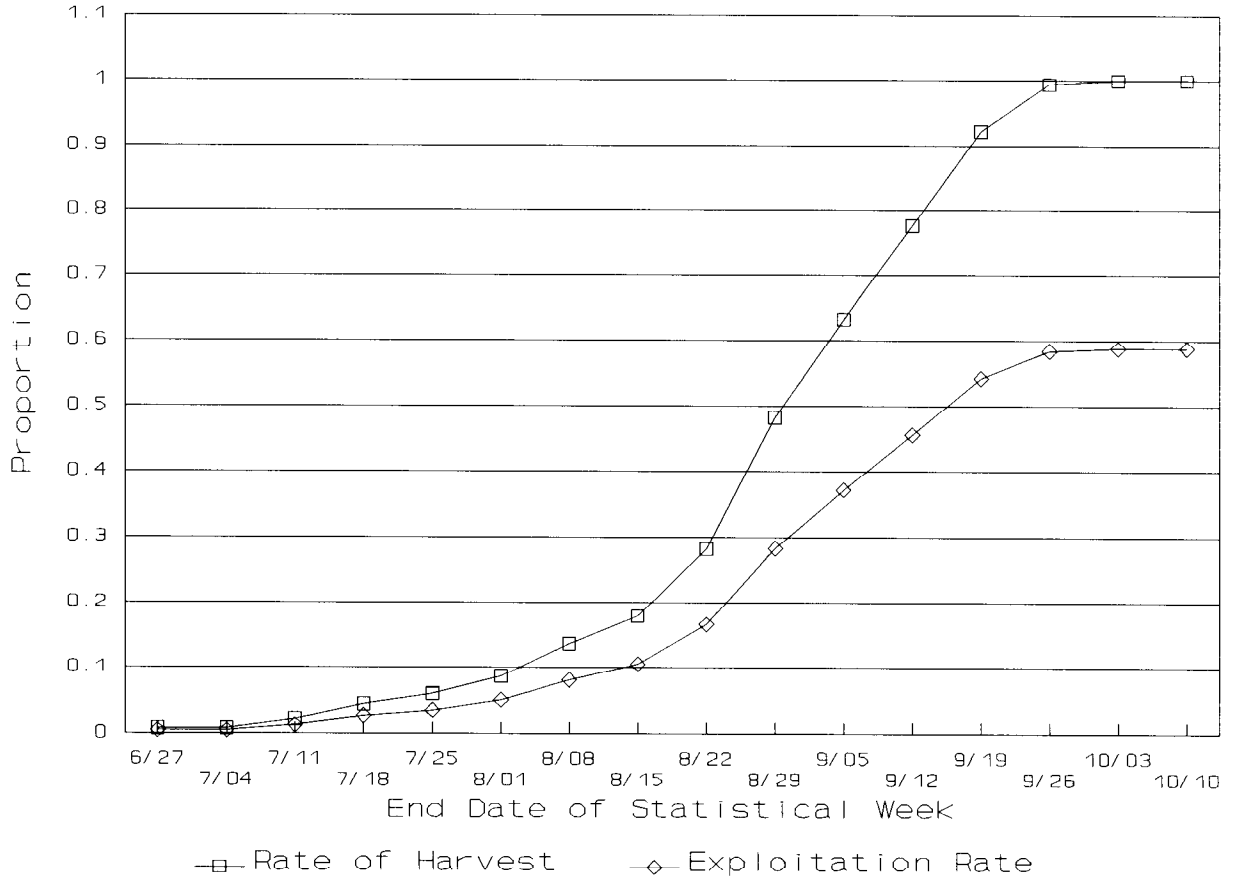


Figure 8. Cumulative rates of harvest and exploitation of coho salmon bound for Taku River in 1992 by statistical week. Estimates of harvest in Troll fisheries are approximated.

indicates that marked fish did mix significantly, if not completely with unmarked fish (see Table 10), even though only the latter half to two-thirds of the emigration of smolts had been exposed to capture at Barrel Point. Unfortunately, only seven adults were recaptured at Canyon Island in 1992 of which ≤ 7 carried CWTs implanted at Barrel Point a year earlier. If all seven recaptured adults carried tags with code 04-28-49, the estimated abundance of smolts ($\hat{N}_s$) is 743,164 [=3,953(1503+1)(7+1)$^{-1}$] with SE = 247,062. If five of the seven recaptured adults carried tags with code 04-28-49 (the ratio observed in commercial fisheries; see Appendix A5), the estimated abundance of smolts is 990,885 with SE = 373,772. Both these estimates are compromised because of problems with bias when numbers of recaptured fish are so small (see Seber 1982, p. 60). When capture histories for coho salmon were bootstrapped according to procedures in Efron (1982), estimates based on four and seven recaptured fish were 11 and 13% biased, respectively.

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 Barrel Point 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. Although our sampling effort at Barrel Point was relatively constant once we started in 1991, there was no effort prior to 23 May, and any smolts emigrating prior to that date had no chance of being captured and tagged. Sampling the commercial harvest can be depensatory with lower fractions of the harvest sampled at larger harvests. Fortunately, the drawn-out recovery of CWTs indicated considerable mixing of marked and unmarked coho salmon while at sea. Recoveries of CWTs in District 111 from coho salmon tagged at Barrel Point did not come from later harvests, but were spread throughout this fishery in rough proportion to harvests. Recovery of CWTs from fish marked in Tatsamenie Lake in 1990 followed roughly the same pattern, indicating that these tagged fish had mixed well with other coho salmon in the return. While the evidence of mixing between marked and unmarked fish can be detected through inspecting the temporal pattern of recovered tags, sufficiency of that mixing can not. If mixing had been complete, $\hat{\theta}$ would be time invariant. While too few coho salmon were recaptured at the fishwheels at Canyon Island to look for changes in $\hat{\theta}$ with time, many fish were recovered in the samples from the harvest in District 111. Unfortunately, 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. Coho salmon bound for a hatchery near Juneau were intercepted during the later days of the gill net fishery in District 111 (Appendix A6). Sufficiency of mixing of marked and unmarked fish could have been more rigorously tested with the many recoveries from fisheries if codes had been changed at least once during the emigration of smolts past Barrel Point (see Cormack and Skalski 1992).

The small estimated harvest of coho salmon from the Taku River in the sport fishery near Juneau may be misleading because of small sample sizes. First the estimated harvest of 431 Taku River coho salmon in a derby harvest of 1,570 indicates that 27% of coho salmon harvested in the derby were of Taku stock. Secondly, the two recovered tags from an inspected harvest of 1,563 during the Golden North Derby indicate that approximately 0.128% of the harvest carried CWTs representing the Taku River. Within the two-week period in which the Derby took

place, 210 coho salmon were sampled from harvests made before and after the Derby (from data reported in Hubartt et al 1993). The probability of recovering no CWTs given an expected rate of recovery of 0.128% is 0.76 $[=1-0.00128)^{210}]$. Sample sizes in other sampling strata varied from 2 to 1,056. Since these strata are based on the passage of time, the expected rate of recovery could have changed if the mix of stocks in the fishery had varied.

ACKNOWLEDGEMENTS

I thank Jarbo Crete, Jerry Owens, and Bruce Engdahl who pioneered the use of the rotary smolt trap on Taku River in 1991, Andy McGregor for providing estimates of escapement, and Sam Bertoni and the CFM&D tag lab in Juneau for data on CWT recoveries.

LITERATURE CITED

Anas, R. E. 1963. Red salmon scale studies, p. 114-116 in: Annual Report of the International North Pacific Fisheries Commission, 1961, Vancouver, British Columbia, Canada.

Bernard, D. 1992. Estimating harvest of salmon with coded-wire tags: a short course on the mechanics of estimating contributions of wild and hatchery stocks of salmon to sport and commercial fisheries in Alaska. Alaska Department of Fish and Game. Juneau, Alaska, 26-27 March, 1992. (unpublished).

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

Cormack, R. M., and J. R. Skalski. 1992. Analysis of coded wire tag returns from commercial catches. Canadian J. of Fisheries and Aquatic Sciences 49:1816-1825.

Efron, B. I. 1982. The jackknife, the bootstrap and other resampling plans. Society for Industrial and Applied Mathematics, CBMS-NSF Regional Conference Series in Applied Mathematics, No. 38.

Elliott, S. T. 1987. Coho salmon (*Oncorhynchus kisutch*) research: Chilkat Lake,
Chilkoot Lake, and Yehring Creek. Alaska Department of Fish and Game, Fishery Management Report, Juneau, Alaska.

Elliott, S. T. and K. J. Kuntz. 1988. A study of coho salmon in southeast Alaska: Chilkat Lake, Chilkoot Lake, Yehring Creek, and Vallenar Creek. Alaska Department of Fish and Game, Fishery Data Series No. 62, Juneau, Alaska.

Elliott, S. T., A. E. Schmidt, and D. A. Sterritt. 1989. A study of coho salmon
in southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 113, Juneau, Alaska.

Elliott, S. T. and D. A. Sterritt. 1990. A study of coho salmon in southeast Alaska, 1989: Chilkoot Lake, Yehring Creek, Auke Lake, Vallenar Creek. Alaska Department of Fish and Game, Fishery Data Series No. 90-53, Anchorage, Alaska.

Elliott, S. T. and D. A. Sterritt. 1991. Coho salmon studies in southeast Alaska, 1990: Auke Lake, Chilkoot Lake, Nahlin River, and Yehring Creek. Alaska Department of Fish and Game, Fishery Data Series No. 91-43, Anchorage, Alaska.

Elliott, S. T. 1992. A trough trap for catching coho salmon smolts emigrating from beaver ponds. North American Journal of Fisheries Management 12:837-840.

Geiger, H. J. 1990. Parametric bootstrap confidence intervals for estimating contributions of to fisheries from marked salmon populations, p. 667-676 *in* Parker, N. C., A. E. Giorgi, R. C. Heidinger, D. B. Jester, Jr., E. D. Prince, and G. A. Winans, eds., Fish Marking Techniques, American Fisheries Society Symposium No. 7, American Fisheries Society, Bethesda, Maryland.

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

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

Hubartt, D. J., A. E. Bingham, and P. A. Suchanek. 1993. Harvest estimates forselected marine sport fisheries in southeast Alaska during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-45, Anchorage.

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

McGregor, A. J. and J.E. Clark. 1988. Migratory timing and escapement of Taku River salmon stocks in 1987. ADF&G, Division of Commericial Fisheries, Regional Information Report 1J88-26, Juneau.

McGregor, A. J. and J.E. Clark. 1989. Migratory timing and escapement of Taku River salmon stocks in 1988. ADF&G, Division of Commericial Fisheries, Regional Information Report 1J89-40, Juneau.

McGregor, A. J., P.A. Milligan, and J.E. Clark. 1989. Adult mark-recapture studies of Taku River salmon stocks in 1989. ADF&G, Division of Commericial Fisheries, Technical Fisheries Report 91-05, Juneau.

Meehan, W. R. and D. B. Siniff. 1962. A study of downstream migrant anadromous fishes in the Taku River, Alaska. Transactions of the American Fisheries Society 91:399-407.

Meehan, W. R. and J. S. Vania. 1961. An external characteristic to differentiate between king and silver salmon juveniles in Alaska. Alaska Department of Fish and Game. Informational Leaflet No. 1. March 20, 1961.

Murphy, M. L., K V. Koski, J. M. Lorenz, and J. F. Thedinga. 1988. Migrations of juvenile salmon in the Taku River, Southeast Alaska. Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Auke Bay Laboratory. NWAFC Processed Report 88-91. 39 pp.

Oliver, G. T. 1990. Southeast Alaska port sampling project. Annual report for the period July 1, 1989 to June 30, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report 1J90-34, Juneau.

Pacific Salmon Commission. 1993. Transboundary river salmon production, harvest, and escapement estimates. 1992. Transboundary Technical Committee Report (93-3).

Rawson, K. 1984. An estimate of the size of a migrating population of juvenile salmon using an index of trap efficiency obtained by dye marking. Alaska Department of Fish and Game. Division of Fisheries Rehabilitation, Enhancement, and Development. Report No. 28: 23pp.

Schmidt, A.E. 1985. A study of coho salmon in Southeast Alaska. Alaska Dept. Fish and Game, Fed. Aid in Fish Rest., Annual Report of Performance, 1984-1985. Proj. F-9-17, G-II-D. 21 pp.

Schmidt, A.E. 1986. A study of coho salmon in Southeast Alaska. Alaska Dept. Fish and Game, Fed. Aid in Fish Rest., Annual Report of Performance, 1985-1986. Proj. F-10-1, 27 (S-1-4).

Schmidt, A.E. 1987. Coho salmon studies in Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 18, Juneau.

Schmidt, A.E. 1988. Coho salmon studies in Southeast Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 45, Juneau.

Schmidt, A.E. 1990. A study of coho salmon in Southeast Alaska, 1989: Salmon Lake, Eagle River, St. John and Sinitsin Creeks. Alaska Department of Fish and Game, Fishery Data Series No. 90-12, Juneau.

Schmidt, A.E. and J. A. DerHovanisian. 1991. A study of coho salmon in Southeast
Alaska, 1990: Salmon Lake, Eagle River, St. John and Sinitsin Creeks. Alaska Department of Fish and Game, Fishery Data Series No. 90-12, Juneau.

Seber, G. A. F. 1982. On the estimation of animal abundance and related parameters, 2nd ed. MacMillan and Company, New York.

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

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

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

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

Shaul, L.D. 1992. Taku River Coho Salmon Investigations, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Manuscript Report, Juneau.

APPENDIX A

Appendix A1. Number of coho salmon smolt recaptured at Barrel Point in 1991.

				Number of clips
29-May	2170	Twin Glacier	AD	-
30-May	258	Twin Glacier	AD	21 AD
31-May	213	Twin Glacier	UC	3 UC, 2 AD
01-Jun	66	Yehring Cr.	LC	2 UC
02-Jun	110	Twin Glacier	UC	OC
03-Jun	116	Twin Glacier	UC	1 UC
04-Jun	153	Twin Glacier	UC	1 UC
05-Jun	47	Twin Glacier	UC	0
06-Jun	110	Twin Glacier	UC	0
07-Jun	195	Twin Glacier	UC	0
08-Jun	56	Caps Place	LC	4 UC
09-Jun	78	Twin Glacier	UC	1 UC, 1 LC
10-Jun	114	Twin Glacier	UC	0
11-Jun	38	Twin Glacier	UC	0
12-Jun	11	Twin Glacier	UC	0
13-Jun	6	Twin Glacier	UC	0
14-Jun	9	Twin Glacier	UC	0
15-Jun	27	Yehring Cr.	LC	0
16-Jun	80	Twin Glacier	UC	0
17-Jun	44	Twin Glacier	UC	1 UC
18-Jun	19	Twin Glacier	UC	0
19-Jun	14	Twin Glacier	UC	0
20-Jun	14	Twin Glacier	UC	0
21-Jun				-
22-Jun	2	Twin Glacier	UC	0
23-Jun	0			0
24-Jun	0			0
25-Jun	2	Twin Glacier	UC	0
26-Jun	1	Twin Glacier	UC	0
Total	3953			37

Appendix A2. Memorandum on bias and precision of a mark recapture experiment using the trap efficiency method.

MEMORANDUM *STATE OF ALASKA*

To: Steve Elliott
Fishery Biologist
Region I
Sport Fish Division

Date: 26 March 1991

File No.:I.1000.300.1750(5)

Phone No.: 267-2380

From: David R. Bernard
Biometrician, Research and
Technical Services
Sport Fish Division
Anchorage

Subject:

Comments for Operational Planning for "A Study of coho salmon in Northern Southeast Alaska"

Steve, I've looked over the "Project Details" Section that you sent me. I'll be in Juneau in a week or two and we can talk about them then. I did however, take the liberty of running some crude simulations on the technique to estimate abundance as outlined in the materials you sent me. The method has some potential, but also has some pitfalls. Still, I suggest that we try the method since we've nothing to lose.

* * * *

The method in Rawson (1984) (hereafter called the "TE method") is actually a Petersen mark-recapture experiment, Kit's statements to the contrary notwithstanding. His formulations are mathematically equivalent to the those of the Manly-Parr method in Section 5.2 of Seber (1982). The Manly-Parr method is part of the Jolly-Seber method for estimating abundance in open populations and is (as Seber points out) "...a Petersen-type estimate ...". The apparent difference between the TE and the Manly-Parr methods arises from whether marked fish are part of the population. In Rawson (1984), n_1 is the number of *unmarked* fish caught during day $_i$ while in Seber (1982) its equivalent n_i is the number of all fish (*marked and unmarked*) caught during that day. The apparent differences disappear when U_i+D_i is substituted for N_i (number of *unmarked and marked fish in the population passing by the site on day i*) u_i+d_i (*number of unmarked and marked fish sampled on day i*) for n_i in the Manly-Parr method and the algebra reduced.

I crudely investigated the bias and relative precision in estimates from the TE method as a function of abundance (3 million), migratory pattern, and fraction caught. In the attached figure, the upper panel is a series of relative frequencies following a normal distribution coded to fit between 10 April and 30 June. I used these proportions to divide the 3 million into daily numbers, then "caught" the same fraction in the "net" each day. I "marked" all the fish and

---

-continued-

moved them "upstream". I used Kit's equations to estimate daily abundance and variance. I also ignored Kits's warning about sampling a subset of each days's catch to estimate the fraction marked. By doing so I may have slightly

underestimated V[N], however, as will be evident shortly, good precision is easily obtained with the TE method.

The lower panel in the figure is an expression of the relative precision and bias with the TE method in our situation. The numbers above the points in the bias line are the number of fish that would be handled for that "FRACTION SAMPLED". Note that the TE method provides good precision even at low sample sizes. The estimates of N* would each be very imprecise, but there would be about 80 of them (one for each day). Since summing daily abundance (Σn^{**}) increases the denominator in calculations of relative precision faster than summing variances $(\Sigma V[N_i])^{1/2}$ would increase the numerator, overall relative precision is good with over 80 daily experiments. What's bad is the bias. With low trap efficiency, few fish are recaptured and each estimate of N* is statistically biased. The biases are not compensating across days, so when the estimates are added, the bias in the overall estimate can be quite large. As trap efficiency increases, bias declines.

I suggest that around 2% (60,000) of the migration of 3 million be captured. At 60 thousand fish handled, bias in estimated abundance from the TE method is about 8% and relative precision about 6%. I realize that with the new technology and no experience with it on the river, setting a sampling rate of 60,000 is ambitious. At this level, $d_i > 7$ for at least 70% of the days. If we are well into the season and $d \leq 7$, we know we are in for trouble. Interestingly enough, about 60,000 smolts tagged is about what would be needed for a mark-recapture experiment based on Peterson's model with the second sampling event at the fishwheels a year later (to estimate within $\pm$ 25% of smolt abundance 90% of the time based on methods in Robson and Regier (1964)).

One last crucial point to using the TE method: how far upstream should fish be released? Fish should not be released so far upstream that more than one day is needed for all of them to again pass the the sampling site. However, neither should smolts be released so near upstream that the fraction of fish recaptured the next day is artificially high. We should design an experiment with multiple points of release upstream to determine the optimal distance upstream to release smolts. I'll work with you on this when I'm in Juneau.

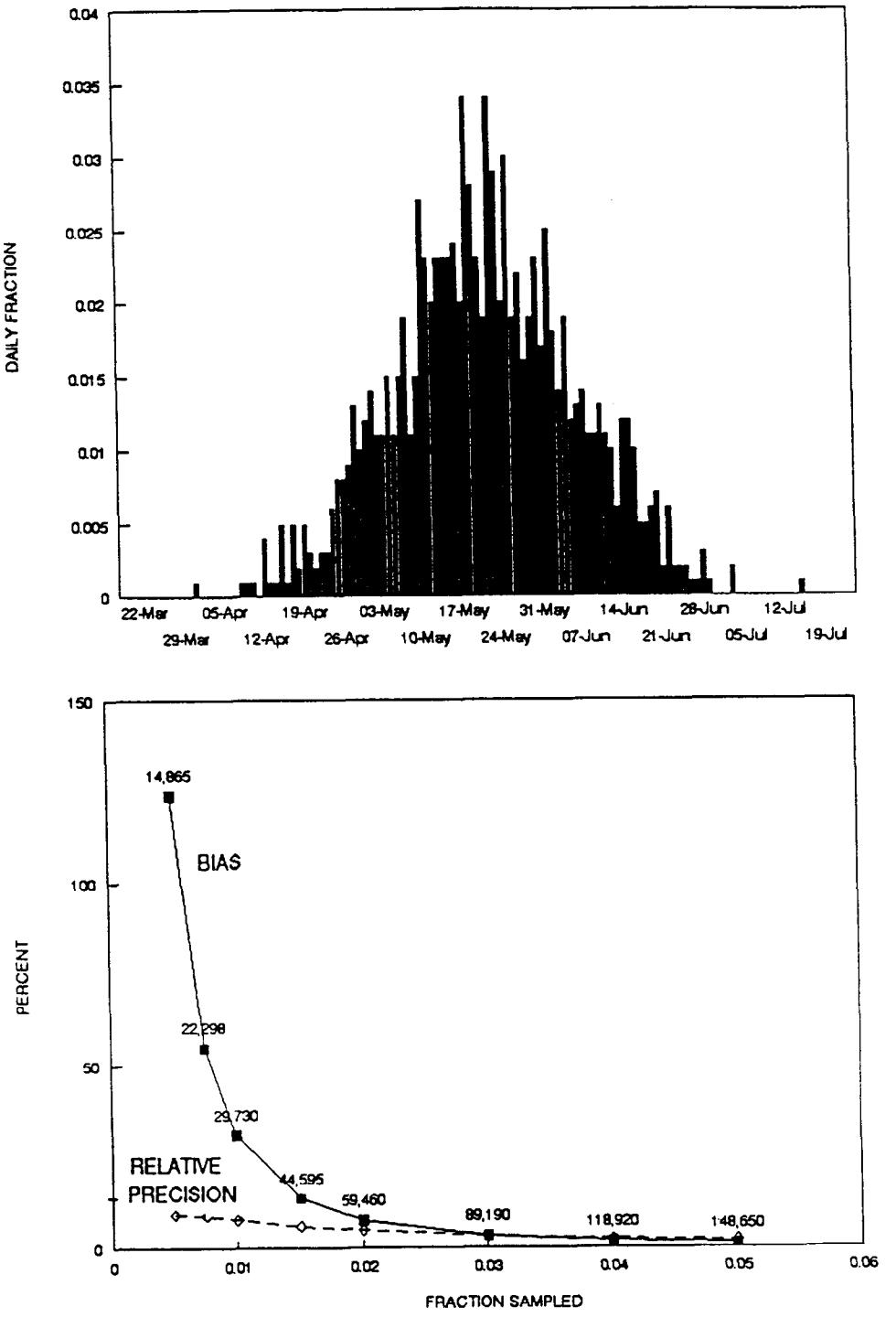
Rawson, K. 1984. An estimate of the size of a migrating population of juvenile salmon using an index of trap efficiency obtained by dye marking. Alaska Dept. of Fish and Game, Division of Fisheries Rehabilitation , Enhancement and Development, Report No. 28. 23 p.

Robson, D. S. and H. A. Regier, 1964. Sample size in Petersen mark-recapture experiments. Transactions of the American Fisheries Society 93:215-216.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, 2nd ed. Charles Griffin and Co., Ltd, London. 654 p.

-continued-

Appendix A2. (Page 3 of 3).



Appendix A3. Random and select recoveries of coded wire tagged coho salmon bound for Taku River in 1992.

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
RANDOM RECOVERIES															
24902	42846	BC NAHLIN	GILLN	23-Jun-92	26	4	NE	115-	689	615	264	4	4	2	2
50072	42846	BC NAHLIN	GILLN	22-Jul-92	30	6	NE	111-	716	1,256	638	3	3	2	2
50029	42849	TAKU R 111-32	GILLN	08-Jul-92	28	5	NE	115-	715	568	256	2	2	2	2
29861	42849	TAKU R 111-32	GILLN	22-Jul-92	30	6	NE	111-32	665	1,256	638	3	3	2	2
1626	42849	TAKU R 111-32	GILLN	05-Aug-92	32	6	NE	111-	781	4,005	943	3	3	1	1
29873	42849	TAKU R 111-32	GILLN	19-Aug-92	34	6	NE	111-	523	6,384	514	7	7	5	5
50713	42849	TAKU R 111-32	GILLN	25-Aug-92	35	7	NE	111-	791	16,165	2,839	39	39	37	37
50734	42849	TAKU R 111-32	GILLN	25-Aug-92	35	7	NE	111-		16,165	2,839	39	39	37	37
50715	42849	TAKU R 111-32	GILLN	25-Aug-92	35	7	NE	111-	700	16,165	2,839	39	39	37	37
50717	42849	TAKU R 111-32	GILLN	25-Aug-92	35	7	NE	111-	711	16,165	2,839	39	39	37	37[2]
70163	42849	TAKU R 111-32	GILLN	25-Aug-92	35	7	NE	111-32	682	16,165	2,839	39	39	37	37
52615	42849	TAKU R 111-32	GILLN	27-Aug-92	35	7	NE	115-31	589	10,900	3,700	27	27	26	26
70580	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-	695	22,722	5,542	150	150	128	127
50974	42849	TAKU R 111-32	GILLN	02-Sep-92	36	7	NE	111-	781	22,722	5,542	150	150	128	127
30291	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-	747	22,722	5,542	150	150	128	127
30292	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-	645	22,722	5,542	150	150	128	127
30274	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-32	674	22,722	5,542	150	150	128	127
70031	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-32	720	22,722	5,542	150	150	128	127
70027	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-32	690	22,722	5,542	150	150	128	127
30294	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-32	605	22,722	5,542	150	150	128	127

[2] Strata for this recovery inferred from date of harvest.

-continued-

Appendix A3. (Page 2 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
70036	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	111-32	742	22,722	5,542	150	150	128	127
70487	42849	TAKU R 111-32	GILLN	01-Sep-92	36	7	NE	115-	705	24,659	6,855	131	130	121	121
34605	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	718	39,116	13,050	354	342	309	309
70942	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	629	39,116	13,050	354	342	309	309
70977	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	678	39,116	13,050	354	342	309	309
51240	42849	TAKU R 111-32	GILLN	08-Sep-92	37	7	NE	111-	623	39,116	13,050	354	342	309	309
16148	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	685	39,116	13,050	354	342	309	309
70941	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	721	39,116	13,050	354	342	309	309
15874	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	706	39,116	13,050	354	342	309	309
15888	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	730	39,116	13,050	354	342	309	309
51206	42849	TAKU R 111-32	GILLN	08-Sep-92	37	7	NE	111-	655	39,116	13,050	354	342	309	309
70998	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	755	39,116	13,050	354	342	309	309
70979	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	699	39,116	13,050	354	342	309	309
16102	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	654	39,116	13,050	354	342	309	309
16116	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	621	39,116	13,050	354	342	309	309
37931	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-32	799	39,116	13,050	354	342	309	309
37933	42849	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-32	618	39,116	13,050	354	342	309	309
51115	42849	TAKU R 111-32	GILLN	08-Sep-92	37	7	NE	115-	697	20,124	6,367	93	93	84	84
15321	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	773	43,950	8,514	371	371	357	357
51389	42849	TAKU R 111-32	GILLN	17-Sep-92	38	7	NE	111-	788	43,950	8,514	371	371	357	357
15174	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	741	43,950	8,514	371	371	357	357
34768	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	725	43,950	8,514	371	371	357	357
15317	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	718	43,950	8,514	371	371	357	357

-continued-

Appendix A3. (Page 3 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
51504	42849	TAKU R 111-32	GILLN	17-Sep-92	38	7	NE	111-	686	43,950	8,514	371	371	357	357
51492	42849	TAKU R 111-32	GILLN	17-Sep-92	38	7	NE	111-	850	43,950	8,514	371	371	357	357
15369	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	765	43,950	8,514	371	371	357	357
34797	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-	750	43,950	8,514	371	371	357	357
14045	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-32	719	43,950	8,514	371	371	357	357
2906	42849	TAKU R 111-32	GILLN	16-Sep-92	38	7	NE	111-32		43,950	8,514	371	371	357	357
17804	42849	TAKU R 111-32	GILLN	22-Sep-92	39	7	NE	111-	692	25,921	6,961	257	257	243	243
17805	42849	TAKU R 111-32	GILLN	22-Sep-92	39	7	NE	111-	710	25,921	6,961	257	257	243	243
17813	42849	TAKU R 111-32	GILLN	22-Sep-92	39	7	NE	111-	720	25,921	6,961	257	257	243	243
17605	42849	TAKU R 111-32	GILLN	22-Sep-92	39	7	NE	111-		25,921	6,961	257	257	243	243
17628	42849	TAKU R 111-32	GILLN	22-Sep-92	39	7	NE	111-		25,921	6,961	257	257	243	243
95911	42849	TAKU R 111-32	GILLN	23-Sep-92	39	7	NE	111-32	695	25,921	6,961	257	257	243	243
95909	42849	TAKU R 111-32	GILLN	23-Sep-92	39	7	NE	111-32	725	25,921	6,961	257	257	243	243
14189	42849	TAKU R 111-32	GILLN	23-Sep-92	39	7	NE	111-32	746	25,921	6,961	257	257	243	243
17896	42849	TAKU R 111-32	GILLN	29-Sep-92	40	7	NE	115-	727	5,362	1,547	42	42	39	39
69661	42849	TAKU R 111-32	SPORT	09-Aug-92	16	6	NE	111-	600	1,570	1,563	8	8	5	5
23579	42849	TAKU R 111-32	TROLL	06-Jul-92	28	5	NW	113-71	579	42,658	12,928	296	293	250	250
66192	42849	TAKU R 111-32	TROLL	13-Jul-92	29	6	NW	114-21	696	821,616	193,431	3,973	3,948	3,435	3,434
52150	42849	TAKU R 111-32	TROLL	15-Jul-92	29	6	NW	114-23	541	821,616	193,431	3,973	3,948	3,435	3,434
66215	42849	TAKU R 111-32	TROLL	15-Jul-92	29	6	NW	154-	584	821,616	193,431	3,973	3,948	3,435	3,434
25437	42849	TAKU R 111-32	TROLL	20-Jul-92	30	6	NW	154-	571	821,616	193,431	3,973	3,948	3,435	3,434

-continued-

Appendix A3. (Page 4 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
52283	42849	TAKU R 111-32	TROLL	29-Jul-92	31	6	NW	114-21	664	821,616	193,431	3,973	3,948	3,435	3,434
52242	42849	TAKU R 111-32	TROLL	26-Jul-92	31	6	NW	116-	453	821,616	193,431	3,973	3,948	3,435	3,434
52263	42849	TAKU R 111-32	TROLL	28-Jul-92	31	6	NW	116-11	620	821,616	193,431	3,973	3,948	3,435	3,434
50164	42849	TAKU R 111-32	TROLL	02-Aug-92	32	6	NW	-	716	821,616	193,431	3,973	3,948	3,435	3,434
47577	42849	TAKU R 111-32	TROLL	07-Aug-92	32	6	SW	-	604	116,489	49,059	1,288	1,254	1,091	1,090
66663	42849	TAKU R 111-32	TROLL	02-Aug-92	32	6	NW	154-	547	821,616	193,431	3,973	3,948	3,435	3,434
66789	42849	TAKU R 111-32	TROLL	06-Aug-92	32	6	NW	154-	656	821,616	193,431	3,973	3,948	3,435	3,434
28490	42849	TAKU R 111-32	TROLL	12-Aug-92	33	6	NW	-	683	821,616	193,431	3,973	3,948	3,435	3,434
28522	42849	TAKU R 111-32	TROLL	14-Aug-92	33	6	NW	156-	594	821,616	193,431	3,973	3,948	3,435	3,434
50635	42849	TAKU R 111-32	TROLL	24-Aug-92	35	7	NW	-	706	594,117	103,488	2,230	2,211	1,973	1,973
67075	42849	TAKU R 111-32	TROLL	25-Aug-92	35	7	NW	-	716	594,117	103,488	2,230	2,211	1,973	1,973
50781	42849	TAKU R 111-32	TROLL	26-Aug-92	35	7	NW	-	794	594,117	103,488	2,230	2,211	1,973	1,973
50648	42849	TAKU R 111-32	TROLL	24-Aug-92	35	7	NW	-	616	594,117	103,488	2,230	2,211	1,973	1,973
52644	42849	TAKU R 111-32	TROLL	28-Aug-92	35	7	NE	112-	563	62,979	18,475	444	441	385	385
28763	42849	TAKU R 111-32	TROLL	28-Aug-92	35	7	NW	154-	645	594,117	103,488	2,230	2,211	1,973	1,973
50815	42849	TAKU R 111-32	TROLL	31-Aug-92	36	7	NW	-	772	594,117	103,488	2,230	2,211	1,973	1,973
67338	42849	TAKU R 111-32	TROLL	07-Sep-92	37	7	NW	116-11	608	594,117	103,488	2,230	2,211	1,973	1,973
52931	42849	TAKU R 111-32	TROLL	17-Sep-92	38	7	NW	114-21	773	594,117	103,488	2,230	2,211	1,973	1,973
52938	42849	TAKU R 111-32	TROLL	17-Sep-92	38	7	NW	114-25	747	594,117	103,488	2,230	2,211	1,973	1,973
53077	42849	TAKU R 111-32	TROLL	20-Sep-92	39	7	NW	114-25	607	594,117	103,488	2,230	2,211	1,973	1,973
51534	42849	TAKU R 111-32	TROLL	21-Sep-92	39	7	NW	114-25	774	594,117	103,488	2,230	2,211	1,973	1,973

-continued-

Appendix A3. (Page 5 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
41827	43063	BC TATSAMENIE	GILLN	25-Jun-92	26	4	NE	115-	584	615	264	4	4	2	2
1964	43063	BC TATSAMENIE	GILLN	13-Aug-92	33	6	NE	111-	616	7,756	1,844	8	7	4	4
70157	43063	BC TATSAMENIE	GILLN	25-Aug-92	35	7	NE	111-32	767	16,165	2,839	39	39	37	37
30299	43063	BC TATSAMENIE	GILLN	01-Sep-92	36	7	NE	111-	641	22,722	5,542	150	150	128	127
70026	43063	BC TATSAMENIE	GILLN	01-Sep-92	36	7	NE	111-32	680	22,722	5,542	150	150	128	127
70991	43063	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	695	39,116	13,050	354	342	309	309
15381	43063	BC TATSAMENIE	GILLN	16-Sep-92	38	7	NE	111-	654	43,950	8,514	371	371	357	357
52347	43063	BC TATSAMENIE	TROLL	06-Aug-92	32	6	NW	-	654	821,616	193,431	3,973	3,948	3,435	3,434
29880	43109	BC TATSAMENIE	GILLN	19-Aug-92	34	6	NE	-	575	6,384	514	7	7	5	5
50375	43109	BC TATSAMENIE	GILLN	20-Aug-92	34	6	NE	111-	664	6,384	514	7	7	5	5
29875	43109	BC TATSAMENIE	GILLN	19-Aug-92	34	6	NE	111-		6,384	514	7	7	5	5
50711	43109	BC TATSAMENIE	GILLN	25-Aug-92	35	7	NE	111-	775	16,165	2,839	39	39	37	37
70161	43109	BC TATSAMENIE	GILLN	25-Aug-92	35	7	NE	111-32	780	16,165	2,839	39	39	37	37
30281	43109	BC TATSAMENIE	GILLN	01-Sep-92	36	7	NE	111-	670	22,722	5,542	150	150	128	127
70560	43109	BC TATSAMENIE	GILLN	01-Sep-92	36	7	NE	111-	703	22,722	5,542	150	150	128	127
50996	43109	BC TATSAMENIE	GILLN	02-Sep-92	36	7	NE	111-	719	22,722	5,542	150	150	128	127
50984	43109	BC TATSAMENIE	GILLN	02-Sep-92	36	7	NE	111-	654	22,722	5,542	150	150	128	127
15861	43109	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	699	39,116	13,050	354	342	309	309
70944	43109	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	650	39,116	13,050	354	342	309	309
16101	43109	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	705	39,116	13,050	354	342	309	309
16122	43109	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	754	39,116	13,050	354	342	309	309

-continued-

Appendix A3. (Page 6 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
15880	43109	BC TATSAMENIE	GILLN	09-Sep-92	37	7	NE	111-	660	39,116	13,050	354	342	309	309
50537	43109	BC TATSAMENIE	SEINE	16-Aug-92	34	6	NE	112-	722	2,414	227	9	9	6	6
69761	43109	BC TATSAMENIE	SPORT	08-Aug-92	16	6	NE	111-	620	1,570	1,563	8	8	5	5
1489	43109	BC TATSAMENIE	TROLL	30-Jul-92	31	6	NE	109-61	541	15,732	7,384	156	156	133	133
50761	43109	BC TATSAMENIE	TROLL	26-Aug-92	35	7	NW	-	681	594,117	103,488	2,230	2,211	1,973	1,973
52649	43109	BC TATSAMENIE	TROLL	28-Aug-92	35	7	NE	112-	660	62,979	18,475	444	441	385	385
52650	43109	BC TATSAMENIE	TROLL	28-Aug-92	35	7	NE	112-	735	62,979	18,475	444	441	385	385
67100	43109	BC TATSAMENIE	TROLL	28-Aug-92	35	7	NW	116-	650	594,117	103,488	2,230	2,211	1,973	1,973
67244	43109	BC TATSAMENIE	TROLL	31-Aug-92	36	7	NW	-	770	594,117	103,488	2,230	2,211	1,973	1,973
52711	43109	BC TATSAMENIE	TROLL	03-Sep-92	36	7	NW	114-25	696	594,117	103,488	2,230	2,211	1,973	1,973
70571	43334	BC TATSAMENIE	GILLN	01-Sep-92	36	7	NE	111-	709	22,722	5,542	150	150	128	127
51388	43334	BC TATSAMENIE	GILLN	17-Sep-92	38	7	NE	111-	719	43,950	8,514	371	371	357	357
52648	43334	BC TATSAMENIE	TROLL	28-Aug-92	35	7	NE	112-	670	62,979	18,475	444	441	385	385
19859	301010501	TAKU R 111-32	GILLN	09-Jul-92	28	5	NE	115-	731	568	256	2	2	2	2
70972	301010501	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	622	39,116	13,050	354	342	309	309
16138	301010501	TAKU R 111-32	GILLN	09-Sep-92	37	7	NE	111-	700	39,116	13,050	354	342	309	309
51244	301010501	TAKU R 111-32	GILLN	08-Sep-92	37	7	NE	111-	729	39,116	13,050	354	342	309	309

-continued-

Appendix A3. (Page 7 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
52364	301010501	TAKU R 111-32	TROLL	05-Aug-92	32	6	NW	154-	613	821,616	193,431	3,973	3,948	3,435	3,434
50503	301010501	TAKU R 111-32	TROLL	13-Aug-92	33	6	NW	-	555	821,616	193,431	3,973	3,948	3,435	3,434
69067	301010501	TAKU R 111-32	TROLL	12-Aug-92	33	6	NW	189-30	740	821,616	193,431	3,973	3,948	3,435	3,434
31530	301010501	TAKU R 111-32	TROLL	28-Aug-92	35	7	NW	113-	729	594,117	103,488	2,230	2,211	1,973	1,973
31251	301010501	TAKU R 111-32	TROLL	02-Sep-92	36	7	NW	-	710	594,117	103,488	2,230	2,211	1,973	1,973
52936	301010501	TAKU R 111-32	TROLL	17-Sep-92	38	7	NW	114-25	698	594,117	103,488	2,230	2,211	1,973	1,973
SELECT AND VOLUNTARY RECOVERIES															
2902	42849	TAKU R 111-32		12-Sep-92	37	7	NE	111-40							
66800	42849	TAKU R 111-32	TROLL	06-Aug-92	32	6	NW	156-	616						
66779	42849	TAKU R 111-32	TROLL	05-Aug-92	32	6		-							
31105	42849	TAKU R 111-32	TROLL	15-Aug-92	33	6		-							
29574	42849	TAKU R 111-32	TROLL	13-Aug-92	33	6		-							
26965	42849	TAKU R 111-32	TROLL	10-Aug-92	33	6		-							
52598	42849	TAKU R 111-32	TROLL	25-Aug-92	35	7		-	596						
31941	42849	TAKU R 111-32	TROLL	05-Sep-92	36	7		-							
14636	42849	TAKU R 111-32	TROLL	04-Sep-92	36	7		-							
29581	43063	BC TATSAMENIE	TROLL	13-Aug-92	33	6		-							
50220	43109	BC TATSAMENIE	SEINE	01-Aug-92	31	6		-	615						

-continued-

Appendix A3. (Page 8 of 8).

Head Number	Tag Code	Release Site	Gear	Recovery Date	Stat Week	Troll Period	Quad.	District	Length	H	n_2	a_1	a_2	m_1	m_2
29577	43109	BC TATSAMENIE	TROLL	13-Aug-92	33	6		-							
33501	43109	BC TATSAMENIE	TROLL	21-Aug-92	34	6		-							
50736	43334	BC TATSAMENIE	GILLN	25-Aug-92	35	7	NE	111-							

Appendix A4. Harvests of coho salmon bound for Taku River in 1992 in commercial and sport fisheries in 1992 by statistical week (Panel A). Harvest in the troll fishery is approximated for statistical weeks by summing the preferred contributions (expanded tags/theta) during each week where theta = 0.004657 (Panel B).

PANEL A.

		Harvest by Fishery									
Stat Week	End Date of Week	Troll (Period)	Troll (StatWk)	Gill Net	Seine	Sport	Total Harvest	p_i of Harvest	Cum. Harvest	Cum. p_i of harvest.	Cum. Exploit. Rate
26	6/27			1,000			1,000	0.8%	1,000	0.8%	0.5%
27	7/04						0	0.0%	1,000	0.8%	0.5%
28	7/11	716	756	953			1,709	1.4%	2,709	2.2%	1.3%
29	7/18		2,912				2,912	2.3%	5,621	4.5%	2.6%
30	7/25		971	845			1,816	1.5%	7,437	5.9%	3.5%
31	8/01		3,369				3,369	2.7%	10,806	8.6%	5.1%
32	8/08		5,323	912			6,235	5.0%	17,041	13.6%	8.0%
33	8/15		3,818	1,032		431	5,281	4.2%	22,322	17.8%	10.5%
34	8/22	15,670	0	10,667	2,283		12,950	10.4%	35,272	28.2%	16.6%
35	8/29		14,632	10,414			25,046	20.0%	60,318	48.2%	28.4%
36	9/05		3,758	14,974			18,732	15.0%	79,050	63.2%	37.2%
37	9/12		1,314	16,667			17,981	14.4%	97,031	77.6%	45.6%
38	9/19		3,900	14,409			18,309	14.6%	115,340	92.2%	54.2%
39	9/26		2,628	6,396			9,024	7.2%	124,364	99.4%	58.5%
40	10/03			744			744	0.6%	125,108	100.0%	58.8%
41	10/10	25,327					0	0.0%	125,108	100.0%	58.8%
Total		41,713	43,381	79,013	2,283	431	125,108				

- continued -

Appendix A4. (Page 2 of 4).

PANEL B.

Head Number	Tag Number	Fishery	Preferred Samp. Expansion	Expanded tags/theta	Date of Recovery	Stat Week	District
23579	42849	TROLL	3.52	756	07/06/92	28	113
SUBTOTAL				756			
66215	42849	TROLL	4.52	971	07/15/92	29	154
52150	42849	TROLL	4.52	971	07/15/92	29	114
66192	42849	TROLL	4.52	971	07/13/92	29	114
SUBTOTAL				2912			
25437	42849	TROLL	4.52	971	07/20/92	30	154
SUBTOTAL				971			
52283	42849	TROLL	4.52	971	07/29/92	31	114
52242	42849	TROLL	4.52	971	07/26/92	31	116
52263	42849	TROLL	4.52	971	07/28/92	31	116
1489	43109	TROLL	2.13	457	07/30/92	31	109
SUBTOTAL				3369			
47577	42849	TROLL	2.58	554	08/07/92	32	
50164	42849	TROLL	4.52	971	08/02/92	32	
66663	42849	TROLL	4.52	971	08/02/92	32	154
52364	301010501	TROLL	4.37	938	08/05/92	32	154

- continued -

Appendix A4. (Page 2 of 4).

Head Number	Tag Number	Fishery	Preferred Samp. Expansion	Expanded tags/theta	Date of Recovery	Stat Week	District
52347	43063	TROLL	4.28	919	08/06/92	32	
66789	42849	TROLL	4.52	971	08/06/92	32	154
SUBTOTAL				5323			
28522	42849	TROLL	4.52	971	08/14/92	33	156
28490	42849	TROLL	4.52	971	08/12/92	33	
50503	301010501	TROLL	4.37	938	08/13/92	33	
69067	301010501	TROLL	4.37	938	08/12/92	33	189
SUBTOTAL				3818			
50648	42849	TROLL	6.12	1314	08/24/92	35	
67075	42849	TROLL	6.12	1314	08/25/92	35	
28763	42849	TROLL	6.12	1314	08/28/92	35	154
31530	301010501	TROLL	5.92	1271	08/28/92	35	113
50761	43109	TROLL	5.79	1243	08/26/92	35	
50635	42849	TROLL	6.12	1314	08/24/92	35	
50781	42849	TROLL	6.12	1314	08/26/92	35	
67100	43109	TROLL	5.79	1243	08/28/92	35	116
52648	43334	TROLL	3.43	737	08/28/92	35	112
52649	43109	TROLL	3.43	737	08/28/92	35	112
52650	43109	TROLL	3.43	737	08/28/92	35	112
52644	42849	TROLL	3.63	779	08/28/92	35	112
50815	42849	TROLL	6.12	1314	08/31/92	35	

- continued -

Appendix A4. (Page 3 of 4).

Head Number	Tag Number	Fishery	Preferred Samp. Expansion	Expanded tags/theta	Date of Recovery	Stat Week	District
	SUBTOTAL			14632			
67244	43109	TROLL	5.79	1243	08/31/92	36	
31251	301010501	TROLL	5.92	1271	09/02/92	36	
52711	43109	TROLL	5.79	1243	09/03/92	36	114
	SUBTOTAL			3758			
67338	42849	TROLL	6.12	1314	09/07/92	37	116
	SUBTOTAL			1314			
52931	42849	TROLL	6.12	1314	09/17/92	38	114
52938	42849	TROLL	6.12	1314	09/17/92	38	114
52936	301010501	TROLL	5.92	1271	09/17/92	38	114
	SUBTOTAL			3900			
53077	42849	TROLL	6.12	1314	09/20/92	39	114
51534	42849	TROLL	6.12	1314	09/21/92	39	114
	SUBTOTAL			2628			
	TOTAL			84132			

Appendix A5. Number of coded wire tags from Taku River recovered in the District 111 drift gill net fishery in 1992.

Tag Code	Release Site	Number Recovered
04-28-46	Nahlin River, Taku River	1
04-28-49	Barrel Point, Taku River	51
04-30-63	Tatsamenie Lake	6
04-31-09	Tatsamenie Lake	14
04-33-34	Tatsamenie Lake	2
03-01-01-05-01	Taku River	3
Total		77

Appendix A6. Number of coho salmon released in 1991 by Dipac hatchery in Gastineau Channel and Sheep Creek (Panel A) and subsequent recoveries (Panel B) in commercial, recreational, or cost recovery fisheries and in rack return or escapement.

PANEL A

Tag Code	Brood Year	Release Site	Number Released
043610	89	Sheep Creek	167,963
043611	89	Sheep Creek	170,546
043612	89	Sheep Creek	166,778
043613	89	Gastineau Channel	169,436
043614	89	Gastineau Channel	169,028
043615	89	Gastineau Channel	169,355
Total			1,013,355

PANEL B

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
Gillnet	04-36-14	106	39	1	50
Gillnet	04-36-12	106	39	2	100
Gillnet	04-36-13	108	36	1	46
Gillnet	04-36-10	108	36	1	45
Gillnet	04-36-15	108	36	1	45
Gillnet	04-36-14	108	37	1	92
Gillnet	04-36-14	111	33	1	52
Gillnet	04-36-15	111	33	2	107
Gillnet	04-36-12	111	34	1	136
Gillnet	04-36-15	111	34	1	
Gillnet	04-36-11	111	34	1	141
Gillnet	04-36-15	111	35	5	316
Gillnet	04-36-14	111	35	7	434
Gillnet	04-36-10	111	35	4	254
Gillnet	04-36-11	111	35	5	324
Gillnet	04-36-12	111	35	3	187
Gillnet	04-36-13	111	35	3	192
Gillnet	04-36-14	111	36	19	854

-continued-

Appendix A6. (Page 2 of 6).

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
Gillnet	04-36-11	111	36	19	892
Gillnet	04-36-12	111	36	27	1,222
Gillnet	04-36-13	111	36	10	464
Gillnet	04-36-10	111	36	17	782
Gillnet	04-36-15	111	36	13	597
Gillnet	04-36-14	111	37	51	1,722
Gillnet	04-36-10	111	37	31	1,071
Gillnet	04-36-13	111	37	42	1,463
Gillnet	04-36-11	111	37	49	1,728
Gillnet	04-36-15	111	37	51	1,758
Gillnet	04-36-12	111	37	41	1,393
Gillnet	04-36-12	111	38	79	4,466
Gillnet	04-36-11	111	38	83	4,870
Gillnet	04-36-15	111	38	44	2,523
Gillnet	04-36-10	111	38	49	2,816
Gillnet	04-36-13	111	38	44	2,550
Gillnet	04-36-14	111	38	37	2,078
Gillnet	04-36-12	111	39	55	2,243
Gillnet	04-36-13	111	39	35	1,463
Gillnet	04-36-15	111	39	22	910
Gillnet	04-36-11	111	39	44	1,863
Gillnet	04-36-14	111	39	31	1,256
Gillnet	04-36-10	111	39	38	1,575
Gillnet	04-36-10	111	40	9	230
Gillnet	04-36-15	111	40	3	77
Gillnet	04-36-11	111	40	5	131
Gillnet	04-36-14	111	40	1	25
Gillnet	04-36-13	111	40	2	52
Gillnet	04-36-12	111	40	4	101
Gillnet	04-36-13	112	31	1	.
Gillnet	04-36-10	115	35	2	66
Gillnet	04-36-11	115	36	4	165
Gillnet	04-36-10	115	36	1	40
Gillnet	04-36-15	115	36	7	282
Gillnet	04-36-13	115	36	10	407
Gillnet	04-36-14	115	36	10	394

-continued-

Appendix A6. (Page 3 of 6).

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
Gillnet	04-36-12	115	36	5	199
Gillnet	04-36-15	115	37	1	35
Gillnet	04-36-11	115	37	1	36
Gillnet	04-36-14	115	37	3	103
Gillnet	04-36-12	115	37	4	138
Gillnet	04-36-13	115	38	5	562
Gillnet	04-36-12	115	38	1	110
Gillnet	04-36-14	115	38	1	109
Gillnet	04-36-15	115	38	1	111
Gillnet	04-36-15	115	39	4	333
Gillnet	04-36-13	115	39	8	672
Gillnet	04-36-11	115	39	7	596
Gillnet	04-36-12	115	39	4	328
Gillnet	04-36-14	115	39	3	244
Gillnet	04-36-14	115	40	2	75
Gillnet	04-36-11	115	40	1	39
Gillnet	04-36-12	115	40	2	76
Gillnet	04-36-13	115	40	2	78
Gillnet	04-36-10	115	40	1	39
SUBTOTAL				1,086	50,932
Seine	04-36-13	104	30	1	8
Seine	04-36-10	109	33	1	73
Seine	04-36-15	109	33	1	73
Seine	04-36-11	109	33	1	74
Seine	04-36-14	109	34	2	91
Seine	04-36-12	109	34	2	92
Seine	04-36-13	109	34	4	189
Seine	04-36-10	109	34	1	47
Seine	04-36-11	109	34	1	48
Seine	04-36-15	109	35	1	60
Seine	04-36-14	109	35	1	59
Seine	04-36-11	109	36	1	22
Seine	04-36-14	110	33	1	17
Seine	04-36-14	110	34	1	24

-continued-

Appendix A6. (Page 4 of 6).

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
Seine	04-36-12	110	34	1	24
Seine	04-36-13	110	34	2	50
Seine	04-36-15	112	32	1	111
Seine	04-36-14	112	32	2	218
Seine	04-36-13	112	33	1	46
Seine	04-36-15	112	33	4	184
Seine	04-36-14	112	33	1	45
Seine	04-36-10	112	33	2	92
Seine	04-36-11	112	34	3	363
Seine	04-36-12	112	34	1	116
Seine	04-36-11	112	36	1	34
Seine	04-36-14	114	34	2	26
Seine	04-36-10	114	34	2	27
Seine	04-36-11	114	34	1	14
Seine	04-36-14	114	36	2	108
Seine	04-36-15	114	36	2	110
Seine	04-36-12	114	36	3	162
Seine	04-36-11	114	36	1	56
Seine	04-36-10	114	36	3	165
SUBTOTAL				**54**	**2,828**
Troll	04-36-12	NE	7	2	75
Troll	04-36-15	NE	7	4	153
Troll	04-36-10	NE	7	1	38
Troll	04-36-14	NE	7	3	112
Troll	04-36-11	NE	7	6	234
Troll	04-36-13	NE	7	8	308
Troll	04-36-13	NW	5	1	37
Troll	04-36-15	NW	6	16	760
Troll	04-36-13	NW	6	23	1,104
Troll	04-36-11	NW	6	13	632
Troll	04-36-12	NW	6	24	1,124
Troll	04-36-14	NW	6	24	1,117
Troll	04-36-10	NW	6	12	571

-continued-

Appendix A6. (Page 5 of 6).

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
Troll	04-36-10	NW	7	65	4,190
Troll	04-36-13	NW	7	98	6,370
Troll	04-36-11	NW	7	100	6,581
Troll	04-36-15	NW	7	93	5,982
Troll	04-36-14	NW	7	99	6,237
Troll	04-36-12	NW	7	75	4,756
Troll	04-36-13	SW	5	1	44
Troll	04-36-12	SW	7	1	35
SUBTOTAL				**669**	**40,460**
COST RECOV	04-36-12	111	37	23	1,789
COST RECOV	04-36-14	111	37	36	2,783
COST RECOV	04-36-10	111	37	11	870
COST RECOV	04-36-11	111	37	9	727
COST RECOV	04-36-15	111	37	24	1,894
COST RECOV	04-36-13	111	37	26	2,074
COST RECOV	04-36-14	111	38	49	2,807
COST RECOV	04-36-15	111	38	52	3,041
COST RECOV	04-36-12	111	38	25	1,441
COST RECOV	04-36-11	111	38	29	1,735
COST RECOV	04-36-10	111	38	22	1,289
COST RECOV	04-36-13	111	38	52	3,073
COST RECOV	04-36-11	111	39	50	4,428
COST RECOV	04-36-15	111	39	56	4,847
COST RECOV	04-36-13	111	39	49	4,287
COST RECOV	04-36-14	111	39	44	3,730
COST RECOV	04-36-12	111	39	50	4,267
COST RECOV	04-36-10	111	39	36	3,123
COST RECOV	04-36-14	111	40	17	2,629
COST RECOV	04-36-13	111	40	19	3,032
COST RECOV	04-36-10	111	40	9	1,424
COST RECOV	04-36-11	111	40	16	2,584
COST RECOV	04-36-15	111	40	17	2,684
COST RECOV	04-36-12	111	40	11	1,712
SUBTOTAL				**732**	**62,270**

-continued-

Appendix A6. (Page 6 of 6).

Fishery	Tag Code	District/ Quadrant	StatWk/ Period	mc	Preferred Contribution
RACK RETUR	All	111	36-44	183	.
SUBTOTAL				**183**	.
SPORT	04-36-11	111	32	1	11
SPORT	04-36-10	111	33	1	11
SPORT	04-36-13	111	35	2	185
SPORT	04-36-15	111	36	1	79
SPORT	04-36-14	111	37	1	78
SPORT	04-36-13	111	38	1	80
SPORT	04-36-15	111	38	1	79
SPORT	04-36-12	111	38	1	78
SPORT	04-36-11	111	39	2	112
SPORT	04-36-10	112	35	1	92
SPORT	04-36-11	114	35	1	94
SUBTOTAL				13	**899**
TOTAL				**2,737**	**157,389**

Appendix A7. Computer data files on 1991 Taku River coho salmon smolt and subsequent estimates of 1992 Taku River adult coho salmon harvest.

File Name	Description
TAKUCWT1.WK1	SPREADSHEET OF RANDOM AND SELECT RECOVERIES OF CWTED TAKU RIVER COHO SALMON IN 1992
TAKUCWT2.WK1	SPREADSHEET OF RANDON RECOVERIES (ABOVE) CONDENSED FOR INPUT INTO *CWT4EXP.EXE*
TABLE7.WK1	SPREADSHEET OF ESTIMATED HARVESTS: OUTPUT FROM *CWT4EXP.EXE*
DAILYCAT.WK1	SPREADSHEET OF DAILY CATCHES OF COHO SMOLT ON TAKU RIVER, 1991
KSDATA.WK1	SPREADSHEET OF KS TEST OF SMOLT RECAPTURE DATA
EXPLOIT.WK1	SPREADSHEET OF HARVEST, ESCAPMENT, AND EXPLOITATION RATES
TAK91ASL.WK1	SPREADSHEET OF 1991 TAKU RIVER AGE LENGTH DATA
SMTAGE91.	TEXT FILE OF AGE-LENGHT STATISTICS (SAS OUTPUT)
CWT4EXP.EXE	PROGRAM TO ESTIMATE HARVESTS FROM CWT RECOVERY DATA
NSECOH92.FN5	WP 5.1 (DOS) FILE OF THIS FDS REPORT