Fishery Data Series No. 98-41

# Spawning Abundance of Chinook Salmon in the Taku River in 1997

by

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December 1998

Alaska Department of Fish and Game Division of Sport Fish

## Symbols and Abbreviations

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

**Weights and measures (metric)**

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

**Weights and measures (English)**

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

Spell out acre and ton.

**Time and temperature**

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

Spell out year, month, and week.

**Physics and chemistry**

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

**General**

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

**Mathematics, statistics, fisheries**

| | |
|---|---|
| alternate hypothesis | $H_A$ |
| base of natural logarithm | e |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | F, t, $\chi^2$, 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 |

# *FISHERY DATA SERIES NO. 98-41*

## SPAWNING ABUNDANCE OF CHINOOK SALMON IN THE TAKU RIVER IN 1997

by

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This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Projects F-10-12 and F-10-13, Job No. S-1-3.

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*This document should be cited as:*
*McPherson, Scott A., David R. Bernard, M. Scott Kelley, Patrick A. Milligan, and Phil Timpany. 1998. Spawning Abundance of chinook salmon in the Taku River in 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-41, Anchorage.*

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# ABSTRACT

A cooperative study involving the Alaska Department of Fish and Game, the Taku River Tlingit First Nation, and the Canadian Department of Fisheries and Oceans was conducted to estimate the number of spawning chinook salmon *Oncorhynchus tshawytscha* in the Taku River in 1997 with a mark-recapture experiment. Fish were captured at Canyon Island on the lower Taku River with fish wheels from May through August and were individually marked with back-sewn, solid-core spaghetti tags. All tagged fish were also batch marked with an opercle punch plus removal of the left axillary appendage. Sampling on the spawning grounds in tributaries was used to estimate the fraction of the population that had been marked. Spawning abundance of medium-size chinook salmon (401–659 mm long; mid-eye to fork of tail) was estimated to be 2,543 (SE = 926). Estimated spawning abundance of large-size fish (≥660 mm) was 114,938 (SE = 17,888), and the estimated total of medium and large fish was 117,481 (SE = 17,912). The aerial survey counts of large spawners conducted on some of the Taku River tributaries was 12% of the mark-recapture estimate, which was approximately one-half of the fraction counted in similar studies during 1989, 1990, 1995 and 1996. The 1991 brood year (age 1.4) constituted an estimated 60% of the age-.2 to age-.5 spawning population, followed by the 1992 brood year (mostly age 1.3), which constituted an estimated 37% of the estimated population.



Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Taku River, spawning abundance, mark-recapture; age, sex and length composition.


# INTRODUCTION

The Taku River produces the largest population of chinook salmon *Oncorhynchus tshawytscha* in Southeast Alaska (Pahlke and Bernard 1996; McPherson et al. 1997; Pahlke 1997). Prior to the mid-1970s, these fish were exploited in directed commercial and recreational fisheries, with annual commercial harvests estimated to have reached approximately 15,000 or more fish (Kissner 1976). As part of a program to rebuild stocks of chinook salmon in Southeast Alaska, various restrictions were placed on all intercepting fisheries (troll, gillnet and recreational) beginning in 1976. This rebuilding effort has been combined with a coastwide rebuilding program for chinook salmon in conjunction with the Pacific Salmon Treaty, since 1985.

Presently, migrating chinook salmon from the Taku River are caught incidentally in a commercial gillnet fishery located in U.S. waters near the river, and in an inriver Canadian gillnet fishery (Figure 1). Chinook salmon from the Taku River also constitute a large component of the spring catch in the recreational fishery in marine waters near Juneau and are caught in recreational fisheries in Canadian reaches of the drainage. Exploitation of this population is jointly managed by the U.S. and Canada through a subcommittee of the Pacific Salmon Commission (PSC).

Since 1975, escapements to the Taku River have been assessed by counting chinook salmon on the spawning grounds in six clearwater tributaries from helicopters (Pahlke 1997). Only "large" chinook salmon (typically 3-ocean age [age-.3] and older or approximately larger than 659 mm mid-eye to fork of tail [MEF]) are counted in these surveys. Fish age-.1 and age-.2 (1- and 2-ocean age) are not counted because of the difficulty of distinguishing these fish from other species from the air. Survey counts of large chinook salmon have been expanded to account for fish not present or observed during surveys and for unsurveyed tributaries (Mecum and Kissner 1989; PSC 1993). Factors used in the expansion have been based mostly on professional opinions of the ability to see fish during surveys and the distribution of spawners in the watershed.

Expansions were established in 1981 and were revised in 1991. In 1988, a study demonstrated that it was possible to mark and recapture sufficient large chinook salmon in the Taku River to estimate escapement (McGregor and Clark 1989). Information from tagging and radio-telemetry studies in 1989 and 1990 by the

Commercial Fisheries Division (CFD), the Canadian Department of Fisheries and Oceans (DFO), and the U.S. National Marine Fisheries Service (NMFS) was used to estimate the abundance of large chinook salmon in the Taku River: 40,329 (SE = 5,646) in 1989 and 52,142 (SE = 9,326) in 1990 (Pahlke and Bernard 1996; Eiler et al. *In prep.*). Chinook salmon were captured in fish wheels at Canyon Island, well below the upriver spawning grounds where chinook salmon were inspected for marks.

Chinook salmon from the Taku River are a "spring run" of salmon. Most returning adults are present in terminal marine areas from late April through early July, with a few present into August. Spawning occurs from late July to late September. Nearly all juveniles rear for one year in fresh water after emergence, smolt at age 1 (Kissner and Hubartt 1986), then rear in offshore waters where they are not subjected to exploitation by fisheries in Southeast Alaska. Returning adults have spent 1–5 years at sea, with younger fish (age-.1 and -.2) being mostly males, and the older fish (ages-.3, -.4 and -.5) being of both sexes. Ages-.2, -.3, and -.4 dominate the annual spawning population; age-.5 fish are uncommon (<5% of the run).

The objectives of this study were to estimate abundance of large chinook salmon spawning in the Taku River in 1997 and to estimate the age and sex composition of these fish.

# METHODS

## STUDY AREA

The Taku River originates in the Stikine Plateau of northwestern British Columbia, Canada (Figure 1), and flows nearly 300 km downstream, emptying into the Taku Inlet about 30 km east of Juneau, Alaska. The Taku River drains approximately 17,094 km$^2$ of land (Bigelow et al. 1995). Two principal tributaries, the Inklin and the Nakina rivers, merge at about 55 km above the U.S./Canada border to form the main body of the lower river. Discharge past Canyon Island (Figure 1) increases from an average of 60 m$^3$/sec in February to 1,097 m$^3$/sec in June (Bigelow et al. 1995). The mainstem is glacially turbid; however, the tributaries where most chinook salmon spawn are relatively clear waters, notably the Nahlin, Nakina, Kowatua, Tatsamenie, Dudidontu and Hackett rivers.

## CANYON ISLAND

Adult chinook salmon were captured with two fish wheels placed on opposite banks of the Taku River approximately 200 m apart at Canyon Island, located approximately 4 km downstream from the International border (Figure 1). These fish wheel sites have been in use since 1984. Fish wheel configurations and fish wheel operations are discussed in detail in Kelley and Milligan (1997).

The Taku River narrows significantly at Canyon Island, and much of the river, under low to medium water levels, is forced between a deep channel with bedrock on both banks, making it an ideal location for fish wheel operation. Fish wheels were operated continuously from 3 May through 20 September except during extreme high or low water levels and during maintenance or sampling.

Individual fish were dipnetted from live boxes, elevated, and transferred to a trough partially filled with river water where they were processed. Fish were handled with bare hands to prevent injury. While one person held the fish, another took samples and measurements, and a third recorded data. Length was measured to the nearest mm MEF, and gender determined from inspection of external characteristics. Four scales from every fourth fish handled were taken from the "preferred area", consistent with procedures described by (Welander 1940).

Scales were mounted onto gummed cards which held scales from 10 fish. The age of each fish was determined later from annual growth patterns of circuli (Olsen 1992) on images of scales impressed onto acetate magnified 70× (Clutter and Whitesel 1956). In cooperation with another project, the presence or absence of an adipose fin was noted for each fish sampled.

All captured chinook salmon judged uninjured were tagged and marked for the first-event of a mark-recapture experiment to estimate abundance. We tagged each subject with a "solid-core" spaghetti tag, which consisted of a 2 1/4″

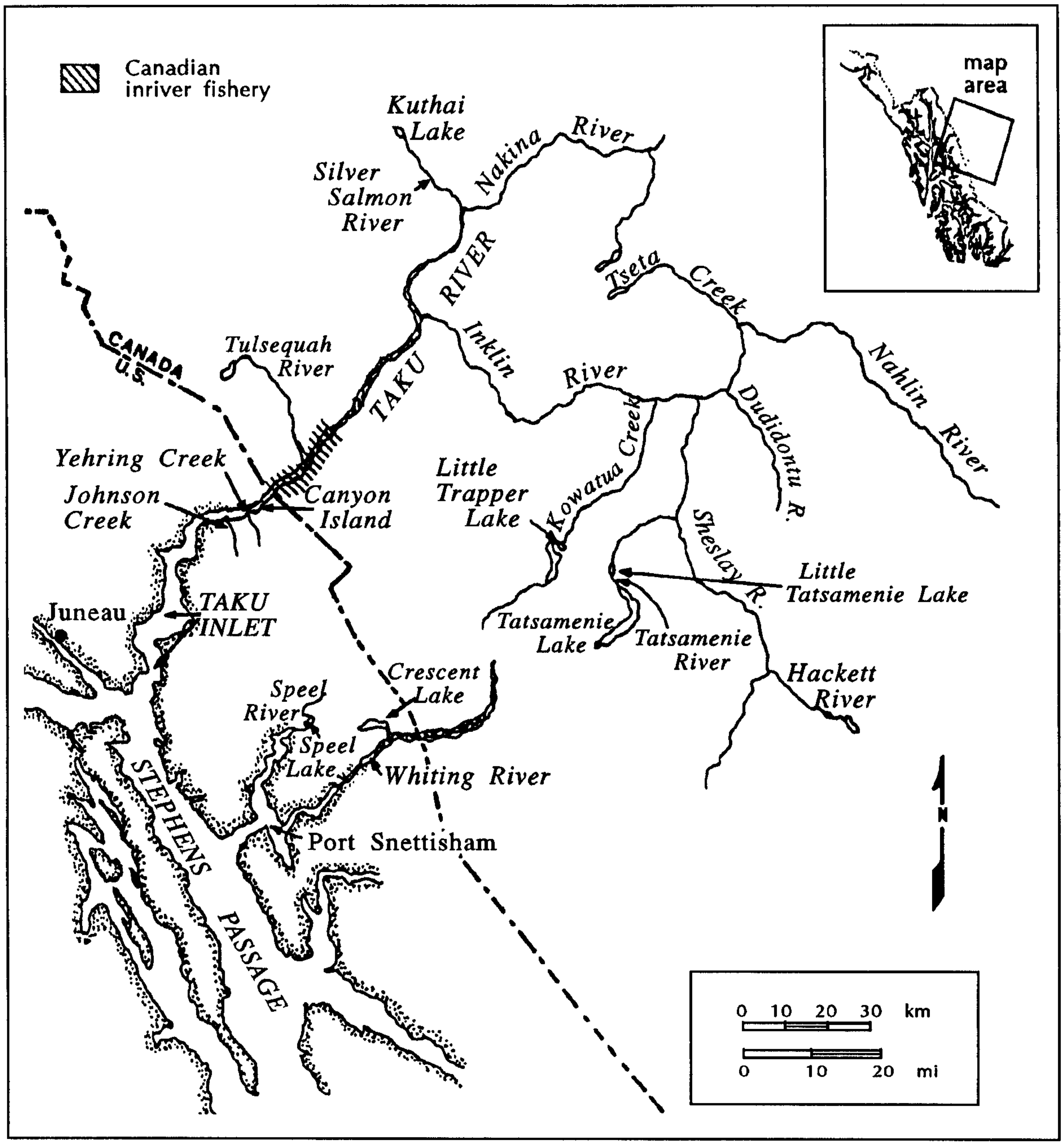


**Figure 1.–Taku Inlet and Taku River drainage.**

section of laminated plastic tubing shrunk onto a 15″ piece of 80-lb-test monofilament fishing line; an improved design over that used by Johnson on the Chilkat River in 1991 (Johnson et al. 1992). The monofilament was back-sewn just behind the dorsal fin and secured by crimping both ends of the monofilament in a line crimp. Excess monofilament was trimmed. Each tag was individually numbered and stamped with a contact phone number.

As secondary marks, each fish was batch marked by a 5/16″ hole punched in the upper one-third of the left operculum (UOP) and by excision of the left axillary appendage (LAA).

## Sampling on the Spawning Grounds

In 1997, chinook salmon from the Nahlin, Nakina and Tatsatua (Tatsamenie) rivers were sampled as representative stocks of early-, mid-, and late-season migrants (ADF 1951; Eiler et al. *In prep*; Pahlke and Bernard 1996). All fish captured live at a weir situated below most spawning areas on the Nahlin River were inspected for marks from 19 June to 10 August. A carcass weir was used to inspect fish on the Nakina River from 2 to 21 August. Spawned-out and live fish were sampled from 31 August to 18 September on the upper Tatsamenie River (Tatsatua system). Carcasses and spent live fish were sampled from 29 August to 8 September on the lower Tatsamenie River using a partial carcass weir and sampling of spent fish. Sampled carcasses were marked with a lower opercle punch to prevent their being resampled at a later date.

All inspected fish were closely examined for the presence of the primary tag, the UOP and the LAA (secondary marks), for the absence of the adipose fin, then were measured to the nearest millimeter MEF. Scale samples were taken from a systematically drawn subset of inspected fish from each tributary according to procedures described above for Canyon Island.

## Abundance by Size

Abundance on the spawning grounds of "medium-size" (401–659 mm MEF) and "large-size" (≥660 mm MEF) chinook salmon was estimated separately with Chapman's modified Petersen mark-recapture estimator (Seber 1982, p. 60). The population was divided into size groups because fish wheels are selective for smaller fish (Meehan 1961; Pahlke and Bernard 1996). "Small" chinook salmon were <401 mm MEF. Estimated abundance ($\hat{N}_i$) of medium and large fish on the spawning grounds was calculated as

$$\hat{N}_i = \frac{(\hat{M}_i + 1)(C_i + 1)}{(R_i + 1)} - 1 \qquad (1)$$

where $\hat{M}_i$ is the estimated number of marked fish that survived to spawn of size $i$, $C_i$ is the number of fish of size $i$ inspected for marks on spawning grounds, and $R_i$ is the number of these inspected fish with marks.

The estimated number of marked fish on the spawning grounds was $\hat{M}_i = T_i - \hat{H}_i$, where $T_i$ is the number of tagged fish released at Canyon Island and $\hat{H}_i$ is the estimated number of tagged fish removed by fishing (censored from the experiment). The fraction of samples composed of recaptured fish ($R_i / C_i$) were compared across tributaries to determine if the estimator was consistent (Seber 1982, p. 439). Length distributions of medium and large fish tagged and released at Canyon Island were also compared with the length distributions of medium and large fish recaptured in all tributaries to detect potential size-selective sampling on the spawning grounds.

Estimated numbers of tagged medium and large fish censored from the experiment ($\hat{H}_i$) were tallies of returned tags and expanded samples from fisheries downstream and upstream of Canyon Island. The number of tagged chinook salmon recovered through sampling by CFD of catches from the Alaska gillnet fishery in Taku Inlet/Stephens Passage was expanded by the fraction of the catch of chinook salmon sampled (37.9% for 1997). No tags were recovered from a creel survey of the U.S. recreational fishery near Juneau (18% of the harvest was sampled); however, participants in this fishery voluntarily returned one tag. One tag was voluntarily returned from the inriver recreational fishery in Canada. Because of a reward (US$2) for each tag returned from the inriver Canadian gillnet fishery, tags recovered from 64 fish probably represented all marked fish caught in this fishery.

Variance, bias, and confidence intervals for $\hat{N}_i$ were estimated with modifications of bootstrap procedures described in Buckland and Garthwaite (1991). Medium-sized and large chinook salmon passing by Canyon Island were divided into seven capture histories (Table 1). The estimated number of fish passing Canyon Island $\hat{N}_i^+$ was greater than the estimate of abundance on the spawning grounds $\hat{N}_i$ by the number of marked fish censored in fisheries ($\hat{H}_i$).

A bootstrap sample was built by drawing with replacement a sample of size $\hat{N}_i^+$ from the empirical distribution defined by the capture histories. A new set of statistics from each bootstrap sample $\{\hat{M}_i^*, C_i^*, R_i^*, \hat{H}_i^*, T_i^*\}$ was generated, along with a new estimate $\hat{N}_i^*$ for abundance on the spawning grounds, and 1,000 such bootstrap samples were drawn creating the empirical distribution $\hat{F}(\hat{N}_i^*)$, which is an estimate of $F(\hat{N}_i)$. The difference between the average $\hat{N}_i^*$ of bootstrap estimates and $\hat{N}_i$ is an estimate of statistical bias in the latter statistic (Efron and Tibshirani 1993, Section 10.2). Confidence intervals were estimated from $\hat{F}(\hat{N}_i^*)$ with the percentile method (Efron and Tibshirani 1993, Section 13.3).

Variance was estimated as

$$v(\hat{N}_i^*) = (B-1)^{-1}\sum_{b=1}^{B}(\hat{N}_{i(b)}^* - \overline{\hat{N}}_i^*)^2 \qquad (2)$$

where $B$ is the number of bootstrap samples.

Abundance of spawning chinook salmon of both large and medium size was estimated as $\hat{N} = \hat{N}_{med} + \hat{N}_{lg}$. Confidence intervals for $\hat{N}$ and $v(\hat{N})$ were estimated as described above.

Because few small fish were recaptured on the spawning grounds, and because sampling on the spawning grounds was not designed to produce a representative sample of small fish (<401 mm), we did not estimate their abundance directly or indirectly through expansion.

## Age and Sex Composition

The proportion of the spawning population composed of a given age within medium-sized or large fish was estimated as a binomial variable from fish sampled at the Nahlin, Nakina, and Tatsamenie rivers:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_i} \qquad (3)$$

where $\hat{p}_{ij}$ is the estimated proportion of the population of age $j$ in sized group $i$, $n_{ij}$ is the number of chinook salmon of age $j$ of size group $i$, and $n_i$ is the number of chinook salmon in the sample $n$ of size group $i$ taken on the spawning grounds.

**Table 1.–Capture histories for medium-sized and large chinook salmon in the population spawning in the Taku River in 1997.** Notation explained in text.

| Capture history | Medium | Large | Source of Statistics |
|---|---|---|---|
| Marked, but censored in recreational fisheries | 0 | 2 | Returned |
| Marked, but censored in the U.S. marine commercial fishery | 0 | 8 | Observed/0.3788 |
| Marked, but censored in the Canadian inriver commercial fishery | 6 | 55 | Returned |
| Marked and not sampled in tributaries | 95 | 868 | $\hat{M}_i - R_i$ |
| Marked and recaptured in tributaries | 10 | 47 | $R_i$ |
| Not marked, but captured in tributaries | 253 | 5,975 | $C_i - R_i$ |
| Not marked and not sampled in tributaries | 2,185 | 108,048 | $\hat{N}_i - \hat{M}_i - C_i + R_i$ |
| Effective population for simulations | 2,549 | 115,003 | $\hat{N}_i^+$ |

Information taken at Canyon Island was not used to estimate age or sex composition of the spawning population, because fish wheels have been shown to selectively capture smaller salmon (Meehan 1961). Samples taken at the Nahlin, Nakina and Tatsamenie rivers were pooled, because investigations showed sampling on the spawning grounds had not been size-selective within a size group (McPherson et al. 1997). Sample variance was calculated as:

$$v(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_i - 1} \qquad (4)$$

Numbers of spawning fish by age were estimated as the summation of products of estimated age composition and estimated abundance within a size category:

$$\hat{N}_j = \sum_i \left(\hat{p}_{ij}\hat{N}_i\right) \qquad (5)$$

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

$$v(\hat{N}_j) = \sum_i \begin{pmatrix} v(\hat{p}_{ij})\hat{N}_i^{\,2} + v(\hat{N}_i)\hat{p}_{ij}^2 \\ - v(\hat{p}_{ij})v(\hat{N}_i) \end{pmatrix} \qquad (6)$$

The proportion of the spawning population >400 mm MEF composed of a given age was estimated as the summed totals across size categories:

$$\hat{p}_j = \frac{\hat{N}_j}{\hat{N}} \qquad (7)$$

with a variance approximated according to procedures in Seber (1982, p. 8-9):

$$v(\hat{p}_j) = \frac{\sum_i \left(v(\hat{p}_{ij})\hat{N}_i^2 + v(\hat{N}_i)(\hat{p}_{ij} - \hat{p}_j)^2\right)}{\hat{N}^2} \qquad (8)$$

Sex composition and age-sex composition for the entire spawning population and its associated variances were also estimated with the equations above by first redefining the binomial variables in samples to produce estimated proportions by sex $\hat{p}_k$, where $k$ denotes gender (male or female), such that $\sum_k \hat{p}_k = 1$, and by age-sex $\hat{p}_{jk}$, such that $\sum_{jk} \hat{p}_{jk} = 1$. Estimated sex composition for stocks in the Nahlin, Nakina and Tatsamenie rivers were again combined, and estimates from the Canyon Island fish wheels were excluded because of difficulty in accurately sexing fish (most are ocean-bright and have not developed secondary maturation characteristics).

# RESULTS

## TAGGING, RECOVERY AND ABUNDANCE

Of 1,323 chinook salmon caught at Canyon Island (Appendix A1), 1,239 were tagged and released (Table 2). Ninety-five percent (95%) of catches occurred between 6 May and 28 June, which was earlier than in 1996. Of fish tagged, 148 were small (≤400 mm MEF), 111 were medium-sized (401–659 mm MEF) and 980 were large (≥660 mm MEF). All fisheries, recreational and commercial, removed an estimated 74 tagged fish (6% of all tagged) from all size categories (Table 2).

Changes in water velocity can adversely affect catchability of migrating salmon in fish wheels, especially during periodic flooding from sudden releases of glacially retained water from the Tulsequah River (Kerr 1948; Marcus 1960). In 1997, water levels and flows remained lower than average and relatively stable throughout the project (Kelley et al. *In prep.*).

Sampling on the spawning grounds proved to be selective towards smaller chinook salmon. These findings are consistent with findings in 1996 (McPherson et al. 1997). Cumulative density functions for uncensored, marked fish >400 mm MEF were significantly larger than the corresponding function for fish recaptured on the spawning grounds (Figure 2). This is a result, as in 1996, from the large number of samples from the carcass weir on the Nakina River, which is biased

Table 2.–Numbers of chinook salmon marked at Canyon Island, removed by fisheries and inspected for marks in tributaries in 1997 by size group.

| | 0–400 mm MEF | 401–659 mm | ≥660 mm | Total |
|---|---|---|---|---|
| **A.** Released at Canyon Island with marks | 148 | 111 | 980 | 1,239 |
| **B.** Removed by: | | | | |
| **1.** Sport fisheries [a] | 0 | 0 | 2 | 2 |
| **2.** U.S. gillnet [b] | 0 | 0 | 8 | 8 |
| **3.** Canadian gillnet | 3 | 6 | 55 | 64 |
| Total removals | 3 | 6 | 65 | 74 |
| **C.** Estimated $\hat{M}$ | 145 | 105 | 915 | 1,165 |
| **D.** Inspected at: | | | | |
| **1.** Nakina River | | | | |
| Inspected | 108 | 163 | 3,666 | 3,937 |
| Recaptured | 2 | 6 | 34 | 42 |
| Recaptured/captured | | 0.037 | 0.009 | |
| **2.** Nahlin River | | | | |
| Inspected | 4 | 53 | 1,775 | 1,832 |
| Recaptured | 1 | 2 | 11 | 14 |
| Recaptured/captured | | 0.038 | 0.006 | |
| **3.** Kowatua/Tatsatua/Dudidontu | | | | |
| Inspected | 9 | 47 | 581 | 637 |
| Recaptured | 0 | 2 | 2 | 4 |
| Recaptured/captured | | 0.043 | 0.003 | |
| Total inspected | | | | |
| Inspected | 121 | 263 | 6,022 | 6,406 |
| Recaptured | 3 | 10 | 47 | 60 |
| Recaptured/captured | 0.025 | 0.038 | 0.008 | |

[a] Includes one fish from U.S. sport fishery and one fish from Canadian sport fishery.

[b] Estimated by expanding random recoveries in the U.S. gillnet fishery District 111 (Taku Inlet/Stephens Passage); in this fishery 37.9% of chinook salmon harvested in this fishery were sampled, yielding three large tagged chinook salmon.

towards capturing younger and smaller fish. Because the Nakina River represents a considerable amount of the production in the Taku River, estimates of abundance were stratified into medium-sized and large chinook salmon to retain samples from the Nakina River in the analysis. Separate comparisons of length distributions for medium-sized and large chinook salmon showed no significant size-selective sampling within each size group (P = 0.68 and P = 0.78; Figures 3 and 4).

In 1997, the estimated spawning abundance of medium-sized chinook salmon $\hat{N}_{ms}$ was 2,543 (SE = 926). This is based on 263 fish inspected for marks ($=C_{ms}$) at five tributaries, 10 of which were recaptured fish ($=R_{ms}$) (Tables 2 and 3). One (10%) of the 10 recovered medium-sized fish had lost its primary tag, but was detected as a marked fish from secondary marks. This fish was inspected at Nakina carcass weir. Fisheries censored an estimated 6 (5%) tagged fish ($=\hat{H}_{ms}$), making the estimated number of medium-sized tagged fish that survived to spawn 105 ($=\hat{M}_{ms}$). Similarities in the fraction marked among fish inspected in different tributaries (Nahlin River: 0.037; Nakina River: 0.038; Tatsamenie/Kowatua/ Dudidontu rivers: 0.043) indicate that the Petersen estimator based on data pooled across tributaries is a consistent estimator for the mark-recapture experiment ($\chi^2 = 0.03$, df = 2, P = 0.98). Estimated abundance of medium-sized fish has a 95% confidence interval of 1,680 to 5,166, and

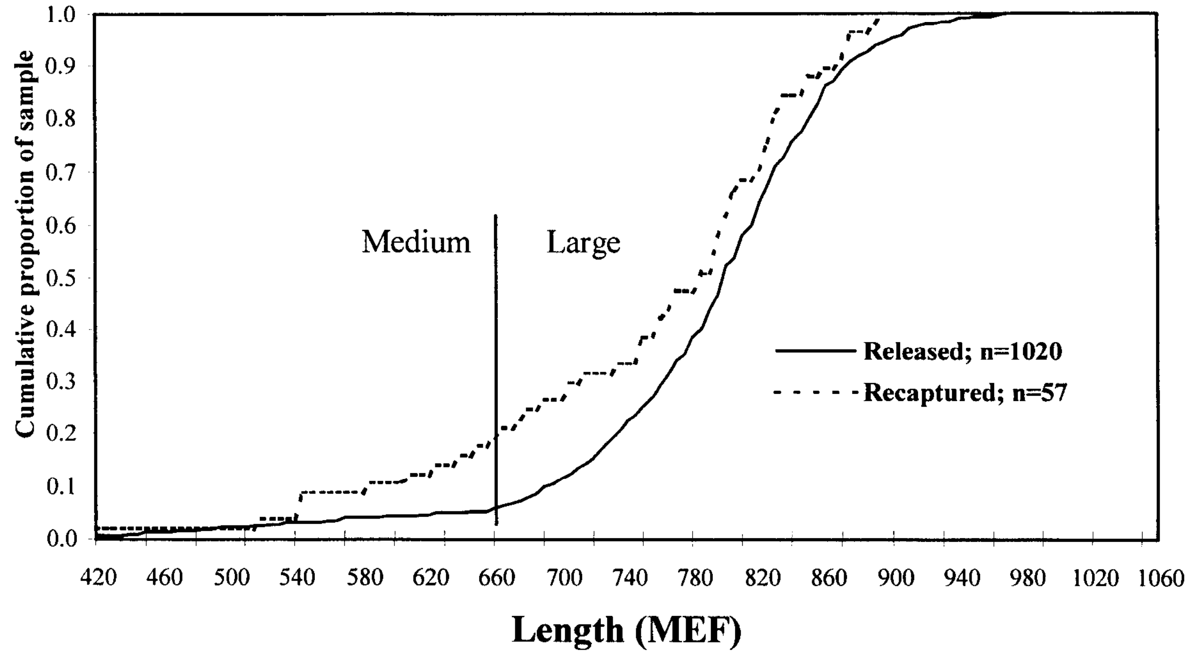


**Figure 2.–Cumulative relative frequencies of medium-sized and large chinook (combined) marked at Canyon Island in 1997 versus those subsequently recaptured in sampling at tributaries.**

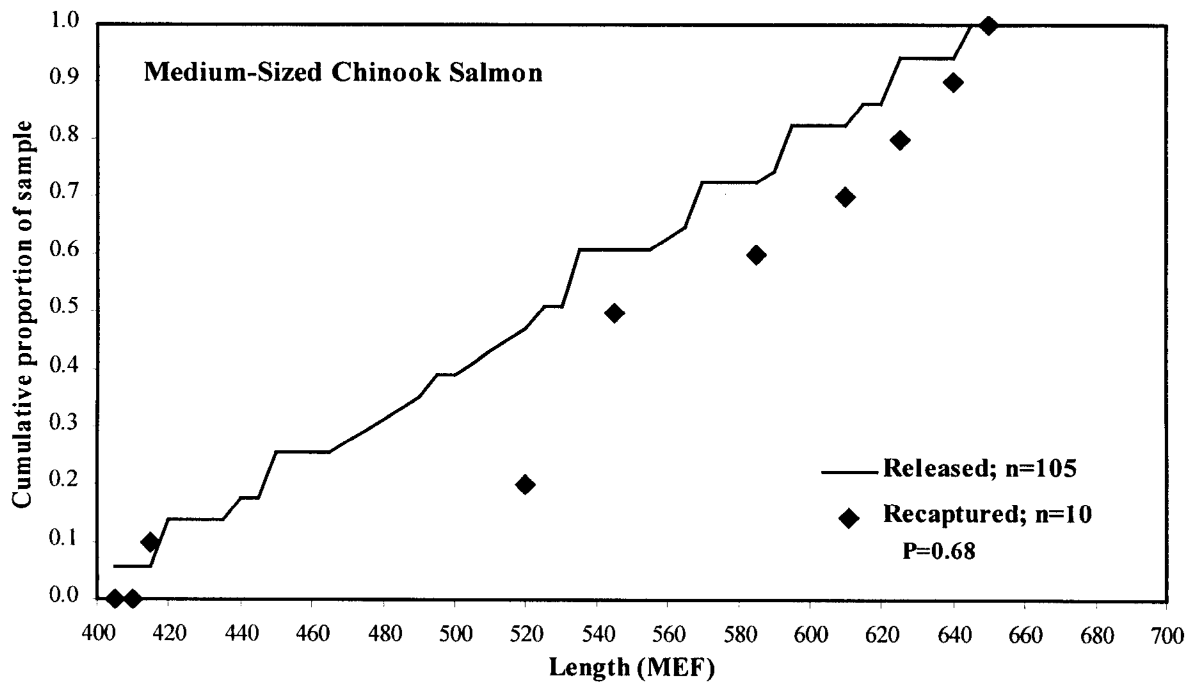


**Figure 3.–Cumulative relative frequencies of medium-sized chinook marked at Canyon Island in 1997 versus those subsequently recaptured in sampling at tributaries.**

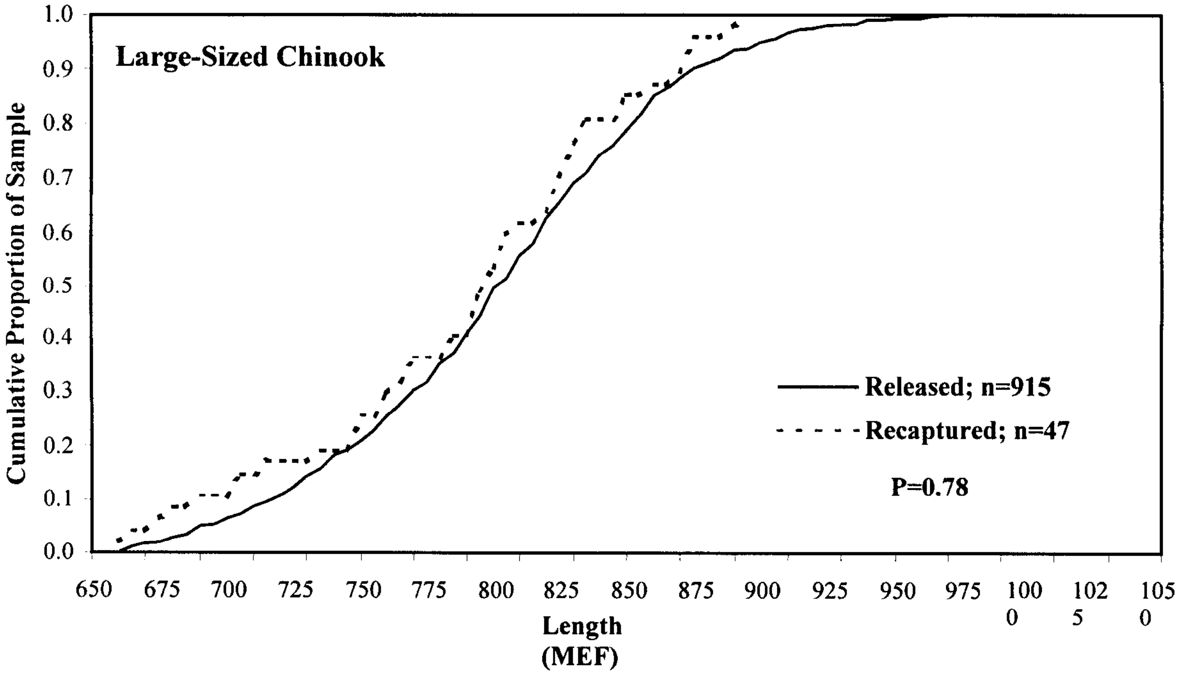


**Figure 4.–Cumulative relative frequencies of large chinook salmon marked at Canyon Island in 1997 versus those subsequently recaptured in sampling at tributaries.**

an estimated relative bias of 9.7%.

Estimated abundance of large chinook salmon $\hat{N}_{ls}$ on the spawning grounds in 1997 was 114,938 (SE = 17,888). This estimate is based on 6,022 fish inspected for marks ($=C_{ls}$) at Nakina, Nahlin and Tatsamenie rivers, 47 of which were recaptured fish ($=R_{ls}$) (Tables 2 and 3). Fourteen (30%) of the 47 recovered large fish had lost their primary tag (all at Nakina carcass weir), but were detected as marked fish from secondary marks.

Fisheries censored an estimated 65 (7%) tagged fish ($=\hat{H}_{ls}$) making the estimated number of large tagged fish that survived to spawn 915 ($=\hat{M}_{ls}$). The fractions marked among fish inspected in different tributaries (Nahlin River: 0.009; Nakina River: 0.006; and Tatsamenie River: 0.003) were marginally different, but indicate that the Petersen estimator based on data pooled across tributaries is still a consistent estimator for the mark-recapture experiment. ($\chi^2$ = 3.01, df = 2, P = 0.22). Estimated abundance of large fish has a 95% confidence interval of 88,593 to 157,717, and an estimated relative bias of 2.2%.

The estimated abundance of all chinook salmon >400 mm MEF ($\hat{N}=\hat{N}_{ms}+\hat{N}_{ls}$) on the spawning grounds for 1997 was 117,481 (SE = 17,903). The estimated 95% confidence interval for $\hat{N}$ was 91,296 to 160,897.

## Estimates of Age and Sex Composition

Age-1.4 chinook salmon dominated the age and sex compositions of chinook salmon >400 mm MEF on the spawning grounds of the Taku River in 1997. Age-1.4 fish constituted 60% (SE = 1.2%) of the estimated escapement (Table 3), age-1.3 fish constituted 36% (SE = 1.1%), and age-1.2

**Table 3.–Estimated abundance and composition by age and sex of the spawning population in the Taku River in 1997 for medium-sized and large chinook salmon.**

| | | Brood year and age class | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 1992 | 1992 | 1991 | 1991 | 1990 | 1990 | |
| | | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 | 1.5 | Total |
| **PANEL A: AGE AND SEX COMPOSITION OF MEDIUM-SIZED CHINOOK SALMON** | | | | | | | | | |
| Males | n | 53 | 2 | 26 | 1 | 1 | 0 | 0 | **83** |
| | % | 57.6% | 2.2% | 28.3% | 1.1% | 1.1% | 0.0% | 0.0% | **90.2%** |
| | SE of % | 5.2% | 1.5% | 4.7% | 1.1% | 1.1% | 0.0% | 0.0% | **3.1%** |
| | Escapement | 1,465 | 55 | 719 | 28 | 28 | 0 | 0 | **2,294** |
| | SE of Esc. | 547 | 41 | 285 | 28 | 28 | 0 | 0 | **839** |
| Females | n | 1 | 0 | 7 | 0 | 1 | 0 | 0 | **9** |
| | % | 1.1% | 0.0% | 7.6% | 0.0% | 1.1% | 0.0% | 0.0% | **9.8%** |
| | SE of % | 1.1% | 0.0% | 2.8% | 0.0% | 1.1% | 0.0% | 0.0% | **3.1%** |
| | Escapement | 28 | 0 | 193 | 0 | 28 | 0 | 0 | **249** |
| | SE of Esc. | 28 | 0 | 96 | 0 | 28 | 0 | 0 | **117** |
| Sexes Combined | n | 54 | 2 | 33 | 1 | 2 | 0 | 0 | **92** |
| | % | 58.7% | 2.2% | 35.9% | 1.1% | 2.2% | 0.0% | 0.0% | **100.0%** |
| | SE of % | 5.2% | 1.5% | 5.0% | 1.1% | 1.5% | 0.0% | 0.0% | **0.0%** |
| | Escapement | 1,493 | 55 | 912 | 28 | 55 | 0 | 0 | **2,543** |
| | SE of Esc. | 557 | 41 | 353 | 28 | 41 | 0 | 0 | **926** |
| **PANEL B: AGE AND SEX COMPOSITION OF LARGE CHINOOK SALMON** | | | | | | | | | |
| Males | n | 15 | 1 | 332 | 6 | 327 | 0 | 0 | **681** |
| | % | 0.8% | 0.1% | 18.8% | 0.3% | 18.5% | 0.0% | 0.0% | **38.5%** |
| | SE of % | 0.2% | 0.1% | 0.9% | 0.1% | 0.9% | 0.0% | 0.0% | **1.2%** |
| | Escapement | 975 | 65 | 21,571 | 390 | 21,246 | 0 | 0 | **44,247** |
| | SE of Esc. | 290 | 65 | 3,519 | 168 | 3,469 | 0 | 0 | **7,010** |
| Females | n | 1 | 0 | 306 | 15 | 765 | 1 | 0 | **1,088** |
| | % | 0.1% | 0.0% | 17.3% | 0.8% | 43.2% | 0.1% | 0.0% | **61.5%** |
| | SE of % | 0.1% | 0.0% | 0.9% | 0.2% | 1.2% | 0.1% | 0.0% | **1.2%** |
| | Escapement | 65 | 0 | 19,882 | 975 | 49,705 | 65 | 0 | **70,691** |
| | SE of Esc. | 65 | 0 | 3,258 | 290 | 7,850 | 65 | 0 | **11,080** |
| Sexes Combined | n | 16 | 1 | 638 | 21 | 1,092 | 1 | 0 | **1,769** |
| | % | 0.9% | 0.1% | 36.1% | 1.2% | 61.7% | 0.1% | 0.0% | **100.0%** |
| | SE of % | 0.2% | 0.1% | 1.1% | 0.3% | 1.2% | 0.1% | 0.0% | **0.0%** |
| | Escapement | 1,040 | 65 | 41,453 | 1,364 | 70,951 | 65 | 0 | **114,938** |
| | SE of Esc. | 303 | 65 | 6,580 | 361 | 11,120 | 65 | 0 | **17,888** |
| **PANEL C: AGE AND SEX COMPOSITION OF MEDIUM-SIZED AND LARGE CHINOOK SALMON** | | | | | | | | | |
| Males | n | 68 | 3 | 358 | 7 | 328 | 0 | 0 | **764** |
| | % | 2.1% | 0.1% | 19.0% | 0.4% | 18.1% | 0.0% | 0.0% | **39.6%** |
| | SE of % | 0.5% | 0.1% | 0.9% | 0.1% | 0.9% | 0.0% | 0.0% | **1.2%** |
| | Escapement | 2,440 | 120 | 22,290 | 417 | 21,274 | 0 | 0 | **46,541** |
| | SE of Esc. | 620 | 77 | 3,530 | 171 | 3,469 | 0 | 0 | **7,060** |
| Females | n | 2 | 0 | 313 | 15 | 766 | 1 | 0 | **1,097** |
| | % | 0.1% | 0.0% | 17.1% | 0.8% | 42.3% | 0.1% | 0.0% | **60.4%** |
| | SE of % | 0.1% | 0.0% | 0.9% | 0.2% | 1.2% | 0.1% | 0.0% | **1.2%** |
| | Escapement | 93 | 0 | 20,075 | 975 | 49,732 | 65 | 0 | **70,940** |
| | SE of Esc. | 71 | 0 | 3,260 | 290 | 7,850 | 65 | 0 | **11,081** |
| Sexes Combined | n | 70 | 3 | 671 | 22 | 1,094 | 1 | 0 | **1,861** |
| | % | 2.2% | 0.1% | 36.1% | 1.2% | 60.4% | 0.1% | 0.0% | **100.0%** |
| | SE of % | 0.5% | 0.1% | 1.1% | 0.3% | 1.2% | 0.1% | 0.0% | **0.0%** |
| | Escapement | 2,532 | 120 | 42,365 | 1,392 | 71,006 | 65 | 0 | **117,481** |
| | SE of Esc. | 634 | 77 | 6,590 | 362 | 11,120 | 65 | 0 | **17,912** |

fish constituted 2% (SE = 0.5%); 40% (SE = 1.2%) were males. Age-1.2 fish constituted 59% of medium fish, and males accounted for 90% of all medium fish. Age-1.4 fish accounted for 62% of all large fish and females constituted 62% of large fish. Age-.1 fish were excluded from estimates of age and sex composition because of their scarcity and the difficulties in obtaining a representative sample of these small fish on the spawning grounds to estimate abundance.

Of the large fish sampled at Canyon Island, 64% were age-1.4 fish and 33% were age-1.3 fish (Appendix A2). Amongst medium fish sampled, 45% were age-1.2 and 45% were age-1.3 fish. This shows that, within size groups, the age composition from samples taken at Canyon Island are very close to those from the combined tributary samples. Average length by age of fish sampled on the spawning grounds are listed in Table 4.

# DISCUSSION

Our censoring of tagged fish caught in fisheries reduced bias in estimated abundance and its variance, but did not eliminate it completely. If there is mortality between sampling events in a mark-recapture experiment such as ours, estimated abundance will still be unbiased so long as marked and unmarked fish die at the same rate (Seber 1982, p. 71). However, at least some of the fish tagged and released at Canyon Island "backed down" to be caught in fisheries downstream (an estimated 8 of 1,239 tagged in 1997). This "backing-down" phenomenon of tagged chinook salmon has been observed in other studies (Milligan et al. 1984; Johnson et al. 1992, 1993; Bendock and Alexandersdottir 1993; Eiler et al. *In prep*). If this phenomenon occurs only with handled fish, tagged fish caught in fisheries downstream of Canyon Island represent a source of inflationary bias in estimated abundance. Although the inriver commercial fishery is upstream of Canyon Island,

**Table 4.–Estimated average length by age and sex on the spawning grounds in the Taku River in 1997.**

| PANEL A: SPAWNING GROUNDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Brood year and age class | | | | | | |
| | | 1994 | 1993 | 1992 | 1992 | 1991 | 1991 | 1990 |
| | | 1.1 | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 |
| **Males** | n | 36 | 70 | 3 | 358 | 7 | 328 | |
| | Average length | 352 | 595 | 592 | 755 | 799 | 871 | |
| | SD | 41 | 80 | 63 | 70 | 68 | 70 | |
| | SE | 7 | 10 | 36 | 4 | 26 | 4 | |
| **Females** | n | | 2 | | 313 | 15 | 766 | 1 |
| | Average length | | 636 | | 777 | 768 | 837 | 895 |
| | SD | | 76 | | 51 | 23 | 44 | |
| | SE | | 54 | | 3 | 6 | 2 | |
| **Sexes combined** | n | 36 | 72 | 3 | 671 | 22 | 1,094 | 1 |
| | Average length | 352 | 596 | 592 | 765 | 778 | 847 | 895 |
| | SD | 41 | 80 | 63 | 63 | 44 | 55 | |
| | SE | 7 | 9 | 36 | 2 | 9 | 2 | |

incidental catches of delayed chinook salmon in this fishery would also inflate estimated abundance, because the fishery opened 16 June, well after most unmarked fish would have passed upstream. Our censoring of these intercepted fish was incomplete, because we had only minimal estimates of the number caught in recreational fisheries. However, considering that no tags were found when 18% of the spring harvest in the U.S. recreational fishery was inspected (Hubartt et al. 1998), and considering the size of the Canadian recreational harvest (<100 chinook salmon of all sizes), this bias from partial censoring should be negligible. Uncertainty from sampling to estimate the number of censored fish was included in the sample variance for estimated abundance through bootstrapping.

One capture history was excluded from the simulations: fish not captured at Canyon Island but caught in the inriver commercial fishery. Because we had no estimates of size composition of unmarked chinook salmon caught in this fishery, these fish were not represented in the simulations. Because so few fish shared this history (2,816 all sizes; total catch minus 64 recoveries), their exclusion probably did not meaningfully bias statistics.

While the loss rate of primary tags was unsettling, it did not bias estimates of abundance. Solid-core spaghetti tags were shed on 10% of medium recoveries (1/10), which were all males, and on 30% (14/47) of large recoveries. All lost primary tags were recorded from carcasses at the Nakina River. Recognition of secondary marks proved sufficient insurance to avoid bias in estimates of abundance from tag loss. No recaptured fish with a primary mark was observed to be missing both the secondary or tertiary mark.

Success of the mark-recapture experiment in 1997 depended heavily on marking chinook salmon at Canyon Island in proportion, or nearly in proportion, to their passing abundance. For our estimates of abundance to be unbiased (consistent), every fish must have had an equal chance of being marked at Canyon Island, or every fish on the spawning grounds must have had an equal chance of being inspected, or marked and unmarked fish must have mixed completely between Canyon Island and tributaries (from Seber 1982, pp. 437–9).

Fish in tributaries other than the Nakina, Nahlin, Kowatua, Tatsatua and Dudidontu rivers had no chance of being inspected, and differences in migratory timing of fish bound for different tributaries precludes complete mixing of marked and unmarked fish. Only by marking fish in proportion to their abundance at Canyon Island could we meet the assumption of proportionally tagging all stocks in the river. Changes in flow rates and censoring of marked fish removed by fisheries could have affected our ability to proportionally mark chinook salmon.

Still, our data for both medium-sized and large fish easily passed the test of consistency (Seber 1982, p. 439; see Figure 5), indicating that our marking had been proportional (or nearly so) for these fish, similar to mark-recapture studies of chinook salmon on the Taku River in 1989, 1990 and 1995 (Pahlke and Bernard 1996; McPherson et al. 1996, 1997). Because our samples came from populations that represented the earliest through the latest fish to pass by Canyon Island (ADF 1951; Eiler et al. *In prep.*), our estimates of abundance pertain to all chinook salmon spawning in the Taku River watershed.

In estimating abundance and age and sex composition for the watershed, we presumed that our combined tributary samples within the two size groups were representative of the total population. What differences there have been could be attributed to different methods of capturing chinook salmon employed in different tributaries. Because males tend to drift downstream in a moribund state after spawning, whereas females tend to die near their redds (Kissner and Hubartt 1986), estimates of age/sex/size composition for fish "caught" at carcass weirs tend to be biased towards males, which tend to be younger, smaller chinook salmon, whereas estimates from carcass-only surveys tend to be biased towards females, which are larger fish. Chinook salmon encountered at weirs passing live fish prior to their spawning are more likely to be of a representative size, age, and sex; as do spawning grounds surveys which employ gear to capture carcasses and live fish—i.e., collection of carcasses combined with netting of live fish.

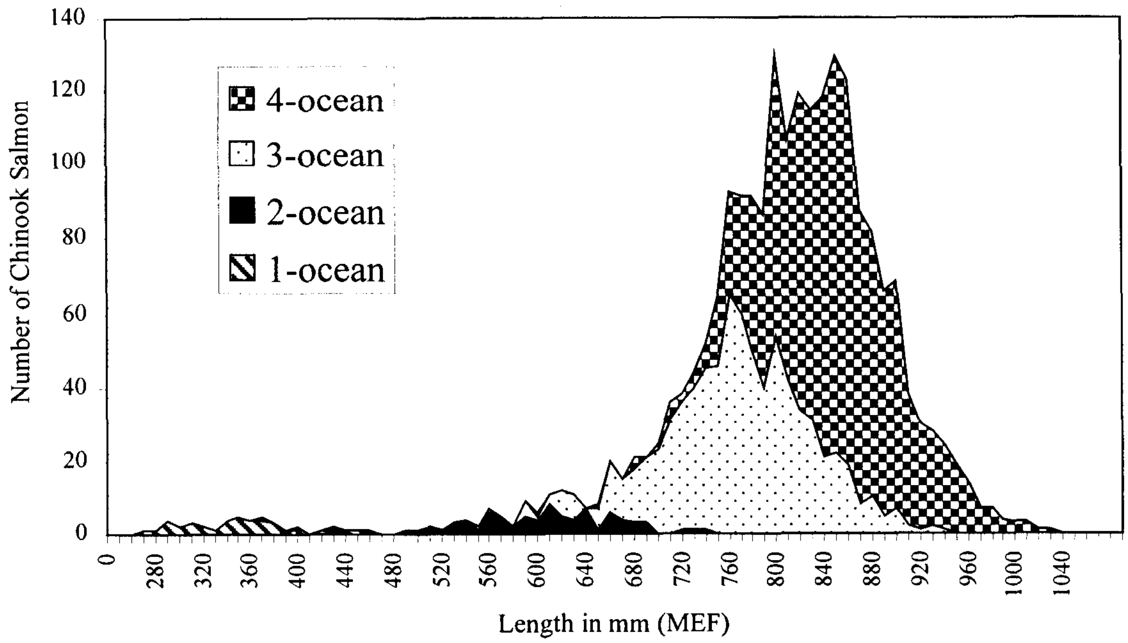


**Figure 5.–Numbers of chinook salmon by ocean-age from chinook salmon sampled at spawning grounds in all five tributaries in 1997.**

Estimated abundance of large chinook salmon on the spawning grounds of the Taku River was considerably greater in 1997 than the corresponding estimate from the aerial survey, a pattern seen on the Taku River in 1989, 1990, 1995 and 1996 (Table 5; Pahlke and Bernard 1996; McPherson et al. 1996, 1997) and in other studies of chinook salmon in Southeast Alaska and in northern British Columbia (Johnson et al. 1992; Pahlke et al. 1996).

The unexpanded survey counts, 9,480 for 1989, 12,249 for 1990, 8,757 for 1995 (Pahlke 1997), and 19,777 for 1996, represent 23.5% (1989), 23.5% (1990), 25.9% (1995) and 25.0% (1996) of the abundance estimates from mark-recapture experiments through 1996 (Table 5). In light of these comparisons, expansions used in aerial stock assessment have been changed. The survey counts in 1997 of 13,849 represented 12.0% of the abundance estimate of 114,938 from the mark-recapture experiment. This disparity from the four earlier studies could be due to: 1) timing of the aerial surveys; 2) a lower fraction counted because of larger abundance; 3) spreading of spawners into areas outside the index area within the six tributaries counted; and 4) distribution of a larger fraction of spawners into uncounted tributaries in 1997.

## CONCLUSION AND RECOMMENDATIONS

Since this project is to continue, we recommend some strategies to improve the precision of estimates. First, the same number of large chinook as in 1997 or a greater number of large chinook salmon should be tagged. Fish wheel catches may need to be supplemented with seine or gillnet gear during periods of low abundance or low water levels. Net gear has been used successfully to capture chinook salmon without harm in projects on the Chilkat, Unuk, Chickamin, Alsek, and Kenai rivers. We also recommend escapement goals for Taku River chinook salmon be examined by fall 1998 to reflect the knowledge gained from mark-recapture studies.

**Table 5.–Comparison of estimated abundance of large chinook (≥660 mm MEF) in the Taku River in 1989, 1990, and 1995–1997 between aerial surveys and through mark-recapture experiments.** Methods of expansions of counts from aerial surveys are described in Pahlke (1996). Confidence intervals for 1989 and 1990 are described in Pahlke and Bernard (1996), those for 1995–1997 are described in this document.

| | 1989 | 1990 | 1995 | 1996 | 1997 | Average | SD | CV |
|---|---|---|---|---|---|---|---|---|
| Raw aerial survey counts | 9,480 | 12,249 | 8,757 | 19,777 | 12,822 | 12,822 | 4,400 | 34.3% |
| Summed across 6 tribs (Nakina, Nahlin, Tseta, Kowatua, Dudidontu and Tatsamenie) | | | | | | | | |
| Mark-recapture estimate(M-R) | 40,329 | 52,142 | 33,805 | 79,019 | 114,938 | 64,047 | 33,290 | 52.0% |
| **Aerial survey counts/(M-R)** | **23.5%** | **23.5%** | **25.9%** | **25.0%** | **12.0%** | **22.0%** | **5.7%** | **25.7%** |
| M-R Standard Error | 5,646 | 9,326 | 5,060 | 9,048 | 17,888 | 9,394 | 5,126 | 54.6% |
| M-R lower 95% CI | 30,936 | 37,072 | 25,455 | 64,388 | 88,593 | 49,289 | 26,584 | 53.9% |
| M-R upper 95% CI | 56,995 | 80,784 | 45,216 | 99,866 | 157,717 | 88,116 | 44,286 | 50.3% |

## ACKNOWLEDGMENTS

We thank Heather Stilwell, Jerry Owens and Britt Lobdell of ADF&G, Mike Smarch and Terry Jack of TRTFN, and Marty Strachen and Monica Dahl of DFO for operating the fish wheels and providing data for tagging and fish wheel catches and effort; Ron Josephson and Gordon Garcia (ADF&G) for construction of new aluminum fish wheel baskets; Gordon Garcia for innovative ideas for fish wheel design; Ruger Jonsen (TRTFN) for sampling at Nakina carcass weir; Derek Ward and Mike Smarch (TRTFN) for sampling at Nahlin live weir; Brian Mercer (DFO) for sampling on the Kowatua and upper Tatsamenie Rivers; Ed Jones, Shane Rear, Roger Harding and Richard Bloomquist (ADF&G) for sampling on lower Tatsamenie and Dudidontu rivers; Keith Pahlke for aerial surveys and project assistance; Ed Jones for assistance in data summarization; Clyde Andrews for logistic support; Steve Elliott (ADF&G) for providing design, budget and editorial support; and Alma Seward for help in preparation of the final manuscript.

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# APPENDIX A

Appendix A1.–Fish wheel effort for chinook salmon, including water level, catches, numbers tagged, CPUE, and daily proportions in 1997.

| | Fish wheel #1 | | Fish wheel #2 | | Water | Fish wheels combined | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hours | | Hours | | level | Tagged small | Tagged small | Tagged medium | Tagged medium | Tagged large | Tagged Large | Total tagged | Tagged | Total catch | Total catch | CPUE | CPUE | Daily | Cum. |
| Date | fished | RPM | fished | RPM | (in.) | daily | cum. | daily | cum. | daily | cum. | daily | cum. | daily | cum. | daily | cum. | prop. | prop. |
| 27-Apr | | | | | -0.2 | | | | | | | | | | | | | | |
| 28-Apr | | | | | -0.2 | | | | | | | | | | | | | | |
| 29-Apr | | | | | 0.1 | | | | | | | | | | | | | | |
| 30-Apr | | | | | -0.1 | | | | | | | | | | | | | | |
| 1-May | | | | | 2 | | | | | | | | | | | | | | |
| 2-May | | | | | 2 | | | | | | | | | | | | | | |
| 3-May | 0 | | 12.00 | 1.5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.000 | 0.000 |
| 4-May | 0 | | 11.67 | 1.7 | 8 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 0.26 | 0.26 | 0.008 | 0.008 |
| 5-May | 0 | | 10.55 | 2.1 | 12 | 0 | 0 | 0 | 0 | 2 | 5 | 2 | 5 | 2 | 5 | 0.19 | 0.45 | 0.006 | 0.015 |
| 6-May | 0 | | 23.25 | 2.1 | 17 | 0 | 0 | 0 | 0 | 7 | 12 | 7 | 12 | 8 | 13 | 0.34 | 0.79 | 0.011 | 0.026 |
| 7-May | 0 | | 23.33 | 2.4 | 19 | 0 | 0 | 0 | 0 | 3 | 15 | 3 | 15 | 3 | 16 | 0.13 | 0.92 | 0.004 | 0.030 |
| 8-May | 0 | | 23.42 | 2.1 | 25 | 1 | 1 | 0 | 0 | 2 | 17 | 3 | 18 | 4 | 20 | 0.17 | 1.09 | 0.006 | 0.036 |
| 9-May | 0 | | 23.75 | 2.2 | 22 | 0 | 1 | 0 | 0 | 2 | 19 | 2 | 20 | 2 | 22 | 0.08 | 1.17 | 0.003 | 0.039 |
| 10-May | 0 | | 23.67 | 2.3 | 21 | 0 | 1 | 0 | 0 | 3 | 22 | 3 | 23 | 3 | 25 | 0.13 | 1.30 | 0.004 | 0.043 |
| 11-May | 0 | | 23.50 | 2.7 | 21 | 0 | 1 | 0 | 0 | 1 | 23 | 1 | 24 | 1 | 26 | 0.04 | 1.34 | 0.001 | 0.044 |
| 12-May | 0.00 | | 23.33 | 2.9 | 44 | 1 | 2 | 2 | 2 | 4 | 27 | 7 | 31 | 7 | 33 | 0.30 | 1.64 | 0.010 | 0.054 |
| 13-May | 0.00 | | 21.42 | 3.2 | 48 | 0 | 2 | 0 | 2 | 5 | 32 | 5 | 36 | 5 | 38 | 0.23 | 1.88 | 0.008 | 0.062 |
| 14-May | 0.00 | | 23.08 | 3.1 | 72 | 0 | 2 | 1 | 3 | 6 | 38 | 7 | 43 | 7 | 45 | 0.30 | 2.18 | 0.010 | 0.072 |
| 15-May | 6.83 | 3.2 | 23.33 | 3.2 | 97 | 0 | 2 | 1 | 4 | 6 | 44 | 7 | 50 | 8 | 53 | 0.27 | 2.45 | 0.009 | 0.080 |
| 16-May | 23.33 | 2.4 | 22.00 | 2.4 | 78 | 0 | 2 | 1 | 5 | 38 | 82 | 39 | 89 | 39 | 92 | 0.86 | 3.31 | 0.028 | 0.109 |
| 17-May | 23.33 | 2.5 | 21.92 | 2.6 | 60 | 0 | 2 | 0 | 5 | 48 | 130 | 48 | 137 | 51 | 143 | 1.13 | 4.43 | 0.037 | 0.146 |
| 18-May | 22.25 | 2.3 | 23.08 | 2.4 | 51 | 0 | 2 | 4 | 9 | 34 | 164 | 40 | 177 | 41 | 184 | 0.90 | 5.34 | 0.030 | 0.176 |
| 19-May | 23.33 | 2.3 | 23.67 | 2.2 | 49 | 1 | 3 | 1 | 10 | 16 | 180 | 17 | 194 | 19 | 203 | 0.40 | 5.74 | 0.013 | 0.189 |
| 20-May | 23.50 | 2.6 | 23.67 | 2.5 | 51 | 3 | 6 | 1 | 11 | 12 | 192 | 16 | 210 | 16 | 219 | 0.34 | 6.08 | 0.011 | 0.200 |
| 21-May | 23.08 | 2.7 | 23.08 | 2.8 | 60 | 3 | 9 | 0 | 11 | 16 | 208 | 19 | 229 | 22 | 241 | 0.48 | 6.56 | 0.016 | 0.216 |
| 22-May | 23.00 | 3.0 | 22.83 | 3.3 | 70 | 2 | 11 | 2 | 13 | 31 | 239 | 37 | 266 | 40 | 281 | 0.87 | 7.43 | 0.029 | 0.244 |
| 23-May | 22.75 | 3.2 | 22.75 | 3.0 | 89 | 3 | 14 | 0 | 13 | 26 | 265 | 29 | 295 | 30 | 311 | 0.66 | 8.09 | 0.022 | 0.266 |
| 24-May | 23.08 | 3.2 | 23.08 | 3.2 | 102 | 0 | 14 | 0 | 13 | 19 | 284 | 19 | 314 | 21 | 332 | 0.45 | 8.54 | 0.015 | 0.281 |
| 25-May | 23.25 | 2.7 | 23.16 | 2.5 | 97 | 1 | 15 | 1 | 14 | 31 | 315 | 33 | 347 | 37 | 369 | 0.80 | 9.34 | 0.026 | 0.307 |
| 26-May | 22.00 | 2.4 | 22.67 | 2.7 | 81 | 6 | 21 | 7 | 21 | 43 | 358 | 56 | 403 | 58 | 427 | 1.30 | 10.64 | 0.043 | 0.350 |
| 27-May | 23.08 | 2.4 | 23.16 | 2.4 | 63 | 3 | 24 | 8 | 29 | 35 | 393 | 46 | 449 | 50 | 477 | 1.08 | 11.72 | 0.036 | 0.385 |
| 28-May | 23.00 | 2.5 | 22.83 | 2.1 | 51 | 4 | 28 | 5 | 34 | 33 | 426 | 42 | 491 | 46 | 523 | 1.00 | 12.73 | 0.033 | 0.418 |
| 29-May | 22.42 | 2.6 | 23.33 | 2.8 | 58 | 2 | 30 | 4 | 38 | 25 | 451 | 31 | 522 | 31 | 554 | 0.68 | 13.40 | 0.022 | 0.441 |
| 30-May | 23.58 | 2.6 | 23.50 | 2.9 | 73 | 2 | 32 | 3 | 41 | 13 | 464 | 18 | 540 | 18 | 572 | 0.38 | 13.79 | 0.013 | 0.453 |
| 31-May | 23.25 | 2.1 | 22.92 | 2.6 | 68 | 2 | 34 | 1 | 42 | 18 | 482 | 21 | 561 | 25 | 597 | 0.54 | 14.33 | 0.018 | 0.471 |
| 1-Jun | 23.58 | 2.3 | 22.45 | 2.5 | 60 | 3 | 37 | 5 | 47 | 27 | 509 | 35 | 596 | 37 | 634 | 0.80 | 15.13 | 0.026 | 0.498 |
| 2-Jun | 23.33 | 2.5 | 23.00 | 2.8 | 59 | 5 | 42 | 3 | 50 | 29 | 538 | 38 | 634 | 39 | 673 | 0.84 | 15.97 | 0.028 | 0.525 |
| 3-Jun | 23.33 | 2.4 | 23.33 | 2.3 | 60 | 9 | 51 | 2 | 52 | 18 | 556 | 29 | 663 | 31 | 704 | 0.66 | 16.64 | 0.022 | 0.547 |
| 4-Jun | 23.33 | 2.8 | 23.08 | 2.8 | 64 | 2 | 53 | 6 | 58 | 23 | 579 | 31 | 694 | 31 | 735 | 0.67 | 17.30 | 0.022 | 0.569 |
| 5-Jun | 20.08 | 2.4 | 21.16 | 2.6 | 77 | 1 | 54 | 1 | 59 | 55 | 634 | 57 | 751 | 58 | 793 | 1.41 | 18.71 | 0.046 | 0.615 |
| 6-Jun | 23.50 | 3.2 | 23.42 | 3.3 | 103 | 0 | 54 | 1 | 60 | 16 | 650 | 17 | 768 | 19 | 812 | 0.40 | 19.12 | 0.013 | 0.629 |
| 7-Jun | 22.92 | 2.7 | 23.25 | 2.6 | 91 | 2 | 56 | 2 | 62 | 26 | 676 | 30 | 798 | 32 | 844 | 0.69 | 19.81 | 0.023 | 0.651 |
| 8-Jun | 22.67 | 2.5 | 23.50 | 2.6 | 74 | 3 | 59 | 2 | 64 | 20 | 696 | 25 | 823 | 26 | 870 | 0.56 | 20.37 | 0.019 | 0.670 |
| 9-Jun | 22.42 | 2.3 | 22.75 | 2.6 | 67 | 6 | 65 | 3 | 67 | 38 | 734 | 47 | 870 | 50 | 920 | 1.11 | 21.48 | 0.036 | 0.706 |

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Appendix A1.–(Page 2 of 2)

| | Fish wheel #1 | | Fish wheel #2 | | | Fish wheels combined | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hours fished | RPM | Hours fished | RPM | Water level (in.) | Tagged small daily | Tagged small cum. | Tagged medium daily | Tagged medium cum. | Tagged large daily | Tagged large cum. | Total tagged daily | Tagged cum. | Total catch daily | Total catch cum. | CPUE daily | CPUE cum. | Daily prop. | Cum. prop. |
| 10-Jun | 23.08 | 2.3 | 23.08 | 2.6 | 60 | 5 | 70 | 3 | 70 | 18 | 752 | 27 | 897 | 27 | 947 | 0.58 | 22.06 | 0.019 | 0.726 |
| 11-Jun | 23.33 | 2.3 | 23.08 | 2.5 | 57 | 4 | 74 | 5 | 75 | 14 | 766 | 23 | 920 | 25 | 972 | 0.54 | 22.60 | 0.018 | 0.743 |
| 12-Jun | 23.16 | 2.4 | 22.67 | 2.5 | 59 | 2 | 76 | 2 | 77 | 14 | 780 | 19 | 939 | 21 | 993 | 0.46 | 23.06 | 0.015 | 0.758 |
| 13-Jun | 23.00 | 2.8 | 23.25 | 2.7 | 67 | 6 | 82 | 1 | 78 | 10 | 790 | 16 | 955 | 18 | 1,011 | 0.39 | 23.45 | 0.013 | 0.771 |
| 14-Jun | 23.00 | 2.5 | 22.25 | 2.8 | 71 | 6 | 88 | 6 | 84 | 23 | 813 | 36 | 991 | 38 | 1,049 | 0.84 | 24.29 | 0.028 | 0.799 |
| 15-Jun | 23.00 | 2.2 | 21.92 | 2.7 | 70 | 14 | 102 | 2 | 86 | 17 | 830 | 33 | 1,024 | 35 | 1,084 | 0.78 | 25.07 | 0.026 | 0.824 |
| 16-Jun | 22.92 | 2.2 | 22.42 | 2.8 | 70 | 1 | 103 | 5 | 91 | 21 | 851 | 28 | 1,052 | 32 | 1,116 | 0.71 | 25.77 | 0.023 | 0.848 |
| 17-Jun | 22.75 | 2.3 | 21.42 | 2.7 | 66 | 2 | 105 | 1 | 92 | 14 | 865 | 17 | 1,069 | 17 | 1,133 | 0.38 | 26.16 | 0.013 | 0.860 |
| 18-Jun | 23.33 | 2.3 | 23.08 | 2.2 | 58 | 9 | 114 | 3 | 95 | 11 | 876 | 22 | 1,091 | 24 | 1,157 | 0.52 | 26.68 | 0.017 | 0.877 |
| 19-Jun | 23.67 | 2.3 | 23.25 | 2.5 | 58 | 5 | 119 | 1 | 96 | 9 | 885 | 15 | 1,106 | 17 | 1,174 | 0.36 | 27.04 | 0.012 | 0.889 |
| 20-Jun | 23.33 | 2.2 | 23.16 | 2.4 | 59 | 3 | 122 | 0 | 96 | 7 | 892 | 10 | 1,116 | 11 | 1,185 | 0.24 | 27.28 | 0.008 | 0.897 |
| 21-Jun | 23.00 | 2.1 | 23.00 | 2.4 | 57 | 3 | 125 | 1 | 97 | 11 | 903 | 14 | 1,130 | 16 | 1,201 | 0.35 | 27.62 | 0.011 | 0.908 |
| 22-Jun | 23.00 | 2.6 | 23.00 | 2.9 | 69 | 3 | 128 | 1 | 98 | 8 | 911 | 12 | 1,142 | 13 | 1,214 | 0.28 | 27.91 | 0.009 | 0.918 |
| 23-Jun | 22.75 | 2.6 | 22.50 | 2.4 | 81 | 1 | 129 | 4 | 102 | 6 | 917 | 11 | 1,153 | 12 | 1,226 | 0.27 | 28.17 | 0.009 | 0.926 |
| 24-Jun | 23.00 | 2.7 | 23.16 | 2.6 | 89 | 3 | 132 | 2 | 104 | 3 | 920 | 8 | 1,161 | 8 | 1,234 | 0.17 | 28.34 | 0.006 | 0.932 |
| 25-Jun | 23.08 | 2.6 | 23.08 | 2.5 | 87 | 1 | 133 | 2 | 106 | 6 | 926 | 10 | 1,171 | 9 | 1,243 | 0.19 | 28.54 | 0.006 | 0.939 |
| 26-Jun | 23.25 | 2.8 | 23.42 | 2.8 | 86 | 0 | 133 | 1 | 107 | 4 | 930 | 5 | 1,176 | 5 | 1,248 | 0.11 | 28.65 | 0.004 | 0.942 |
| 27-Jun | 23.58 | 3.3 | 23.25 | 3.1 | 101 | 1 | 134 | 0 | 107 | 3 | 933 | 5 | 1,181 | 5 | 1,253 | 0.11 | 28.75 | 0.004 | 0.946 |
| 28-Jun | 23.50 | 3.2 | 23.16 | 3.0 | 110 | 1 | 135 | 0 | 107 | 6 | 939 | 7 | 1,188 | 8 | 1,261 | 0.17 | 28.93 | 0.006 | 0.951 |
| 29-Jun | 22.83 | 2.9 | 23.08 | 2.8 | 94 | 2 | 137 | 0 | 107 | 4 | 943 | 6 | 1,194 | 6 | 1,267 | 0.13 | 29.06 | 0.004 | 0.956 |
| 30-Jun | 23.16 | 2.7 | 23.33 | 2.5 | 89 | 0 | 137 | 0 | 107 | 5 | 948 | 5 | 1,199 | 5 | 1,272 | 0.11 | 29.16 | 0.004 | 0.959 |
| 1-Jul | 22.92 | 2.6 | 22.67 | 2.4 | 84 | 3 | 140 | 1 | 108 | 6 | 954 | 10 | 1,209 | 10 | 1,282 | 0.22 | 29.38 | 0.007 | 0.966 |
| 2-Jul | 9.42 | 3.2 | 22.16 | 2.7 | 95 | 2 | 142 | 2 | 110 | 6 | 960 | 10 | 1,219 | 10 | 1,292 | 0.32 | 29.70 | 0.010 | 0.977 |
| 3-Jul | 13.92 | 2.9 | 23.08 | 2.1 | 95 | 0 | 142 | 0 | 110 | 5 | 965 | 5 | 1,224 | 5 | 1,297 | 0.14 | 29.83 | 0.004 | 0.981 |
| 4-Jul | 23.16 | 2.6 | 23.00 | 2.6 | 79 | 3 | 145 | 0 | 110 | 0 | 965 | 3 | 1,227 | 3 | 1,300 | 0.06 | 29.90 | 0.002 | 0.983 |
| 5-Jul | 23.16 | 2.4 | 23.08 | 2.6 | 79 | 0 | 145 | 0 | 110 | 1 | 966 | 1 | 1,228 | 3 | 1,303 | 0.06 | 29.96 | 0.002 | 0.985 |
| 6-Jul | 22.92 | 2.7 | 23.08 | 2.7 | 80 | 0 | 145 | 0 | 110 | 1 | 967 | 1 | 1,229 | 1 | 1,304 | 0.02 | 29.99 | 0.001 | 0.986 |
| 7-Jul | 22.92 | 3.1 | 22.42 | 2.8 | 90 | 0 | 145 | 0 | 110 | 3 | 970 | 4 | 1,233 | 3 | 1,307 | 0.07 | 30.05 | 0.002 | 0.988 |
| 8-Jul | 16.83 | 2.8 | 22.33 | 2.8 | 87 | 1 | 146 | 0 | 110 | 0 | 970 | 1 | 1,234 | 1 | 1,308 | 0.03 | 30.08 | 0.001 | 0.989 |
| 9-Jul | 22.16 | 2.7 | 22.75 | 2.6 | 81 | 2 | 148 | 0 | 110 | 2 | 972 | 3 | 1,237 | 4 | 1,312 | 0.09 | 30.17 | 0.003 | 0.992 |
| 10-Jul | 22.92 | 2.7 | 23.08 | 2.6 | 74 | 0 | 148 | 0 | 110 | 1 | 973 | 1 | 1,238 | 1 | 1,313 | 0.02 | 30.19 | 0.001 | 0.993 |
| 11-Jul | 23.16 | 2.6 | 22.00 | 2.6 | 77 | 0 | 148 | 0 | 110 | 0 | 973 | 0 | 1,238 | 0 | 1,313 | 0.00 | 30.19 | 0.000 | 0.993 |
| 12-Jul | 22.92 | 2.8 | 23.08 | 2.9 | 79 | 0 | 148 | 0 | 110 | 1 | 974 | 1 | 1,239 | 1 | 1,314 | 0.02 | 30.21 | 0.001 | 0.993 |
| 13-Jul | 23.00 | 3.2 | 21.50 | 3.2 | 84 | 0 | 148 | 0 | 110 | 1 | 975 | 1 | 1,240 | 2 | 1,316 | 0.04 | 30.26 | 0.001 | 0.995 |
| 14-Jul | 22.42 | 3.1 | 22.08 | 3.1 | 86 | 0 | 148 | 0 | 110 | 1 | 976 | 1 | 1,241 | 1 | 1,317 | 0.02 | 30.28 | 0.001 | 0.996 |
| 15-Jul | 23.16 | 2.8 | 23.16 | 2.8 | 78 | 0 | 148 | 0 | 110 | 0 | 976 | 0 | 1,241 | 0 | 1,317 | 0.00 | 30.28 | 0.000 | 0.996 |
| 16-Jul | 22.83 | 2.5 | 23.08 | 2.6 | 75 | 0 | 148 | 1 | 111 | 0 | 976 | 1 | 1,242 | 1 | 1,318 | 0.02 | 30.30 | 0.001 | 0.996 |
| 17-Jul | 23.33 | 2.2 | 23.42 | 2.6 | 70 | 0 | 148 | 0 | 111 | 0 | 976 | 0 | 1,242 | 0 | 1,318 | 0.00 | 30.30 | 0.000 | 0.996 |
| 18-Jul | 23.33 | 2.2 | 22.92 | 2.5 | 64 | 0 | 148 | 0 | 111 | 0 | 976 | 0 | 1,242 | 0 | 1,318 | 0.00 | 30.30 | 0.000 | 0.996 |
| 19-Jul | 23.25 | 2.2 | 23.25 | 2.5 | 65 | 0 | 148 | 0 | 111 | 0 | 976 | 0 | 1,242 | 0 | 1,318 | 0.00 | 30.30 | 0.000 | 0.996 |
| 20-Jul | 23.16 | 2.5 | 23.25 | 2.6 | 69 | 0 | 148 | 0 | 111 | 0 | 976 | 0 | 1,242 | 0 | 1,318 | 0.00 | 30.30 | 0.000 | 0.996 |
| 21-Jul | 22.92 | 2.2 | 22.75 | 2.6 | 66 | 0 | 148 | 0 | 111 | 1 | 977 | 1 | 1,243 | 2 | 1,320 | 0.04 | 30.34 | 0.001 | 0.998 |
| 22-Jul | 23.08 | 2.6 | 23.42 | 2.8 | 70 | 0 | 148 | 0 | 111 | 1 | 978 | 1 | 1,244 | 1 | 1,321 | 0.02 | 30.36 | 0.001 | 0.999 |
| 23-Jul | 23.00 | 3.0 | 22.33 | 2.7 | 84 | 0 | 148 | 0 | 111 | 1 | 979 | 1 | 1,245 | 1 | 1,322 | 0.02 | 30.39 | 0.001 | 0.999 |
| 24-Jul | 23.16 | 3.0 | 22.75 | 3.1 | 86 | 0 | 148 | 0 | 111 | 1 | 980 | 1 | 1,246 | 1 | 1,323 | 0.02 | 30.41 | 0.001 | 1.000 |

**Appendix A2.–Age composition by sex and age from samples aged from chinook salmon in the Taku River in 1997 by size group and location.**

| | | | AGE CLASS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 | 1.5 | Total |
| Nakina Large fish | Male | n | 2 | 1 | 145 | 4 | 191 | | | 343 |
| | | % | 0.6% | 0.3% | 42.3% | 1.2% | 55.7% | | | 42.7% |
| | Female | n | | | 105 | 5 | 351 | | | 461 |
| | | % | | | 22.8% | | 76.1% | | | 57.3% |
| | Total | n | 2 | 1 | 250 | 9 | 542 | | | 804 |
| | | % | 0.2% | 0.1% | 31.1% | 1.1% | 67.4% | | | |
| Nakina Medium fish | Male | n | 24 | | 14 | | | | | 38 |
| | | % | 63.2% | | 36.8% | | | | | 97.4% |
| | Female | n | | | 1 | | | | | 1 |
| | | % | | | 100.0% | | | | | 2.6% |
| | Total | n | 24 | | 15 | | | | | 39 |
| | | % | 61.5% | | 38.5% | | | | | |
| Nakina Large + medium | Male | n | 26 | 1 | 159 | 4 | 191 | | | 381 |
| | | % | 6.8% | 0.3% | 41.7% | 1.0% | 50.1% | | | 45.2% |
| | Female | n | | | 106 | 5 | 351 | | | 462 |
| | | % | | | 22.9% | 1.1% | 76.0% | | | 54.8% |
| | Total | n | 26 | 1 | 265 | 9 | 542 | | | 843 |
| | | % | 3.1% | 0.1% | 31.4% | 1.1% | 64.3% | | | |
| Nahlin Large fish | Male | n | 4 | | 84 | 2 | 72 | | | 162 |
| | | % | 2.5% | | 51.9% | 1.2% | 44.4% | | | 36.4% |
| | Female | n | | | 105 | 8 | 169 | 1 | | 283 |
| | | % | | | 37.1% | | 59.7% | 0.4% | | 63.6% |
| | Total | n | 4 | | 189 | 10 | 241 | 1 | | 445 |
| | | % | 0.9% | | 42.5% | 2.2% | 54.2% | 0.2% | | |
| Nahlin Medium fish | Male | n | 8 | 2 | 8 | 1 | 1 | | | 20 |
| | | % | 40.0% | 10.0% | 40.0% | 5.0% | 5.0% | | | 87.0% |
| | Female | n | 1 | | 2 | | | | | 3 |
| | | % | 33.3% | | 66.7% | | | | | 13.0% |
| | Total | n | 9 | 2 | 10 | 1 | 1 | | | 23 |
| | | % | 39.1% | 8.7% | 43.5% | 4.3% | 4.3% | | | |
| Nahlin Large + medium | Male | n | 12 | 2 | 92 | 3 | 73 | | | 182 |
| | | % | 6.6% | 1.1% | 50.5% | 1.6% | 40.1% | | | 38.9% |
| | Female | n | 1 | | 107 | 8 | 169 | 1 | | 286 |
| | | % | 0.3% | | 37.4% | 2.8% | 59.1% | 0.3% | | 61.1% |
| | Total | n | 13 | 2 | 199 | 11 | 242 | 1 | | 468 |
| | | % | 2.8% | 0.4% | 42.5% | 2.4% | 51.7% | 0.2% | | |
| Dudidontu Large fish | Male | n | | | 33 | | 20 | | | 53 |
| | | % | | | 62.3% | | 37.7% | | | 43.1% |
| | Female | n | | | 34 | | 36 | | | 70 |
| | | % | | | 48.6% | | 51.4% | | | 56.9% |
| | Total | n | | | 67 | | 56 | | | 123 |
| | | % | | | 54.5% | | 45.5% | | | |
| Dudidontu Medium fish | Male | n | 3 | | 1 | | | | | 4 |
| | | % | 75.0% | | 25.0% | | | | | 100.0% |
| | Female | n | | | | | | | | 0 |
| | | % | | | | | | | | 0.0% |
| | Total | n | 3 | | 1 | | | | | 4 |
| | | % | 75.0% | | 25.0% | | | | | |
| Dudidontu Large + medium | Male | n | 3 | | 34 | | 20 | | | 57 |
| | | % | 5.3% | | 59.6% | | 35.1% | | | 44.9% |
| | Female | n | 0 | | 34 | | 36 | | | 70 |
| | | % | 0.0% | | 48.6% | | 51.4% | | | 55.1% |
| | Total | n | 3 | | 68 | | 56 | | | 127 |
| | | % | 2.4% | | 53.5% | | 44.1% | | | |

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## Appendix A2.–(Page 2 of 3)

| | | | AGE CLASS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 | 1.5 | Total |
| Lower Tatsamenie | Male | n | 5 | | 79 | | 61 | | | 145 |
| Large fish | | % | 3.4% | | 54.5% | | 42.1% | | | 34.0% |
| | Female | n | | | 70 | 2 | 210 | | | 282 |
| | | % | | | 24.8% | 0.7% | 74.5% | | | 66.0% |
| | Total | n | 5 | | 149 | 2 | 271 | | | 427 |
| | | % | 1.2% | | 34.9% | 0.5% | 63.5% | | | |
| Lower Tatsamenie | Male | n | 7 | | 2 | | | | | 9 |
| Medium fish | | % | 77.8% | | 22.2% | | | | | 90.0% |
| | Female | n | | | 1 | | | | | 1 |
| | | % | | | 100.0% | | | | | 10.0% |
| | Total | n | 7 | | 3 | | | | | 10 |
| | | % | 70.0% | | 30.0% | | | | | |
| Lower Tatsamenie | Male | n | 12 | | 81 | | 61 | | | 154 |
| Large + medium | | % | 7.8% | | 52.6% | | 39.6% | | | 35.2% |
| | Female | n | | | 71 | 2 | 210 | | | 283 |
| | | % | | | 25.1% | 0.7% | 74.2% | | | 64.8% |
| | Total | n | 12 | | 152 | 2 | 271 | | | 437 |
| | | % | 2.7% | | 34.8% | 0.5% | 62.0% | | | |
| Upper Tatsamenie | Male | n | 4 | | 24 | | 3 | | | 31 |
| Large fish | | % | 12.9% | | 77.4% | | 9.7% | | | 33.3% |
| | Female | n | 1 | | 26 | | 35 | | | 62 |
| | | % | 1.6% | | 41.9% | | 56.5% | | | 66.7% |
| | Total | n | 5 | | 50 | | 38 | | | 93 |
| | | % | 5.4% | | 53.8% | | 40.9% | | | |
| Upper Tatsamenie | Male | n | 11 | | 1 | | | | | 12 |
| Medium fish | | % | 91.7% | | 8.3% | | | | | 75.0% |
| | Female | n | | | 3 | | 1 | | | 4 |
| | | % | | | 75.0% | | 25.0% | | | 25.0% |
| | Total | n | 11 | | 4 | | 1 | | | 16 |
| | | % | 68.8% | | 25.0% | | 6.3% | | | |
| Upper Tatsamenie | Male | n | 15 | | 25 | | 3 | | | 43 |
| Large + medium | | % | 34.9% | | 58.1% | | 7.0% | | | 39.4% |
| | Female | n | 1 | | 29 | | 36 | | | 66 |
| | | % | 1.5% | | 43.9% | | 54.5% | | | 60.6% |
| | Total | n | 16 | | 54 | | 39 | | | 109 |
| | | % | 14.7% | | 49.5% | | 35.8% | | | |
| Nakina, Nahlin, | Male | n | 15 | 1 | 332 | 6 | 327 | | | 681 |
| and Tatsamenie | | % | 2.2% | 0.1% | 48.8% | 0.9% | 48.0% | | | 38.5% |
| Combined | Female | n | 1 | | 306 | 15 | 765 | 1 | | 1,088 |
| | | % | 0.1% | | 28.1% | 1.4% | 70.3% | 0.1% | | 61.5% |
| Large fish | Total | n | 16 | 1 | 638 | 21 | 1,092 | 1 | | 1,769 |
| | | % | 0.9% | 0.1% | 36.1% | 1.2% | 61.7% | 0.1% | | |
| Nakina, Nahlin, | Male | n | 50 | 2 | 25 | 1 | 1 | | | 79 |
| and Tatsamenie | | % | 63.3% | 2.5% | 31.6% | 1.3% | 1.3% | | | 89.8% |
| Combined | Female | n | 1 | | 7 | 0 | 1 | | | 9 |
| | | % | 11.1% | | 77.8% | 0.0% | 11.1% | | | 10.2% |
| Medium fish | Total | n | 51 | 2 | 32 | 1 | 2 | | | 88 |
| | | % | 58.0% | 2.3% | 36.4% | 1.1% | 2.3% | | | |
| Nakina, Nahlin, | Male | n | 65 | 3 | 357 | 7 | 328 | | | 760 |
| and Tatsamenie | | % | 8.6% | 0.4% | 47.0% | 0.9% | 43.2% | | | 40.9% |
| Combined | Female | n | 2 | | 313 | 15 | 766 | 1 | | 1,097 |
| | | % | 0.2% | | 28.5% | 1.4% | 69.8% | 0.1% | | 59.1% |
| Large + medium | Total | n | 67 | 3 | 670 | 22 | 1,094 | 1 | | 1,857 |
| | | % | 3.6% | 0.2% | 36.1% | 1.2% | 58.9% | 0.1% | | |

-continued-

**Appendix A2.–(Page 3 of 3)**

| | | | AGE CLASS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.2 | 2.2 | 1.3 | 2.3 | 1.4 | 2.4 | 1.5 | Total |
| Canyon Island | Male | n | 1 | | 47 | 3 | 61 | 2 | | 114 |
| Large fish | | % | 0.9% | | 41.2% | 2.6% | 53.5% | 1.8% | | 56.2% |
| Tagged | Female | n | | | 20 | | 69 | | | 89 |
| | | % | | | 22.5% | | 77.5% | | | 43.8% |
| | Total | n | 1 | | 67 | 3 | 130 | 2 | | 203 |
| | | % | 0.5% | | 33.0% | 1.5% | 64.0% | 1.0% | | |
| Canyon Island | Male | n | 9 | 1 | 9 | | 1 | | | 20 |
| Medium fish | | % | 45.0% | 5.0% | 45.0% | | 5.0% | | | 100.0% |
| Tagged | Female | n | | | | | | | | |
| | | % | | | | | | | | |
| | Total | n | 9 | 1 | 9 | | 1 | | | 20 |
| | | % | 45.0% | 5.0% | 45.0% | | 5.0% | | | |
| Canyon Island | Male | n | 10 | 1 | 56 | 3 | 62 | 2 | | 134 |
| Large + medium | | % | 7.5% | 0.7% | 41.8% | 2.2% | 46.3% | 1.5% | | 60.1% |
| Tagged | Female | n | | | 20 | | 69 | | | 89 |
| | | % | | | 22.5% | | 77.5% | | | 39.9% |
| | Total | n | 10 | 1 | 76 | 3 | 131 | 2 | | 223 |
| | | % | 4.5% | 0.4% | 34.1% | 1.3% | 58.7% | 0.9% | | |
| All tributaries | Male | n | 15 | 1 | 365 | 6 | 347 | | | 734 |
| Large fish | | % | 2.0% | 0.1% | 49.7% | 0.8% | 47.3% | | | 38.8% |
| Inspected | Female | n | 1 | | 340 | 15 | 801 | 1 | | 1,158 |
| | | % | 0.1% | | 29.4% | 1.3% | 69.2% | 0.1% | | 61.2% |
| | Total | n | 16 | 1 | 705 | 21 | 1,148 | 1 | | 1,892 |
| | | % | 0.8% | 0.1% | 37.3% | 1.1% | 60.7% | 0.1% | | |
| All tributaries | Male | n | 53 | 2 | 26 | 1 | 1 | | | 83 |
| Medium fish | | % | 63.9% | 2.4% | 31.3% | 1.2% | 1.2% | | | 90.2% |
| Inspected | Female | n | 1 | | 7 | | 1 | | | 9 |
| | | % | 11.1% | | 77.8% | | 11.1% | | | 9.8% |
| | Total | n | 54 | 2 | 33 | 1 | 2 | | | 92 |
| | | % | 58.7% | 2.2% | 35.9% | 1.1% | 2.2% | | | |
| All tributaries | Male | n | 68 | 3 | 391 | 7 | 348 | | | 817 |
| Large + medium | | % | 8.3% | 0.4% | 47.9% | 0.9% | 42.6% | | | 41.2% |
| Inspected | Female | n | 2 | | 347 | 15 | 802 | 1 | | 1,167 |
| | | % | 0.2% | | 29.7% | 1.3% | 68.7% | 0.1% | | 58.8% |
| | Total | n | 70 | 3 | 738 | 22 | 1,150 | 1 | | 1,984 |
| | | % | 3.5% | 0.2% | 37.2% | 1.1% | 58.0% | 0.1% | | |

**Appendix A3.–Computer files used to estimate the spawning abundance of chinook salmon in the Taku River in 1997.**

| File Name | Description |
|---|---|
| TAKUKI97.xls | Spreadsheet with chi-square tests, age and length composition, bootstrap setup and output, U.S. gillnet sampling, fish wheel catch and effort data. |
| 41TAKU96.exe | BASIC compiled program for bootstrapping abundance estimates to estimate variance and bias. |
| LGTAKU97.dat | Data file for large chinook for 41TAKU96.exe. |
| MDTAKU97.dat | Data file for medium-sized chinook for 41TAKU96.exe. |
| 97CI41SM.xls | Spreadsheet of chinook salmon caught and tagged at Canyon Island: tagging data; spaghetti tags recovered; age, sex and length data for chinook tagged. |
| 97DUDI41.xls | Spreadsheet of chinook salmon sampled for tag recovery on the Dudidontu River: fish inspected; age, sex and length data. |
| 97KOWA41.xls | Spreadsheet of chinook salmon sampled for tag recovery on the Kowatua River: fish inspected; tag recoveries; age, sex and length data. |
| 97NAKNAHSM.xls | Spreadsheet of chinook salmon sampled for tag recovery at the Nakina carcass weir and at the Nahlin River live weir: fish inspected; tag recoveries; age, sex and length data; CWT recovery data. |
| 97LTAT41.xls | Spreadsheet of chinook salmon sampled for tag recovery on the lower Tatsamenie River: fish inspected; tag recoveries; age, sex and length data. |
| 97UTAT41.xls | Spreadsheet of chinook salmon sampled for tag recovery on the upper Tatsamenie River: fish inspected; tag recoveries; age, sex and length data; CWT recovery data. |