SIZE, DISTRIBUTION AND ABUNDANCE OF JUVENILE CHINOOK SALMON OF THE NECHAKO RIVER, 1997

NECHAKO FISHERIES CONSERVATION PROGRAM
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ABSTRACT

The size, distribution, and abundance of juvenile chinook salmon (*Oncorhynchus tshawytscha*) was measured in the upper 100 km of the Nechako River in 1997 as part of the ninth year of the Nechako Fisheries Conservation Program (NFCP).

Flows of the upper Nechako River in 1997 were the highest recorded over the last 10 years. Those high flows cooled the upper Nechako River-water temperatures were lower in spring and summer 1997 than have been recorded over the last 10 years.

Monthly electrofishing surveys showed two centers of distribution of resident 0+ chinook. The upstream center moved upstream from April to June as the fish searched for rearing habitat. The downstream center remained stationary between 70 and 79.9 km from Kenney Dam. In November, resident 0+ chinook redistributed themselves evenly along the length of the upper river in preparation for overwintering.

Maximum catch-per-unit-effort (CPUE, number per 100 m^2 surveyed) of electrofished 0+ chinook occurred in mid-May for day catches and mid-June for night catches. Thereafter until early November, CPUE decreased at a rate of 0.53 %/d for day catches and 0.41 %/d for night catches.

Maximum numbers of outmigrating 0+ chinook captured by rotary screw traps at Diamond Island occurred in early May. Rotary screw trap catches of 0+ chinook decreased from May 10 to July 13 at a rate of 3.87 %/d for day catches. No loss rate could be calculated for night catches. A total of 3,006 0+ chinook and 216 1+ chinook were captured by the rotary screw traps. Expansion of these numbers by the proportion of river volume sampled by the traps provided an index of downstream migration of 133,812 0+ chinook and 7,963 1+ chinook.

Comparison of seasonal trends in size-at-date of 0+ chinook among the years 1989 to 1997 showed that low temperatures in spring and summer 1997 reduced rates of growth in weight and length, but not in condition. Comparison of seasonal trends in electrofishing CPUE and spatial distribution, and in the index of outmigration past Diamond Island, showed no obvious differences between 1997 and the years 1989 to 1996. However, the index of juvenile chinook outmigration for the years 1992 to 1997 was found to be significantly and positively correlated with the number of adults that spawned upstream of Diamond Island in the previous autumn, i.e. the autumns of 1991 to 1996.

That finding was used to standardise daily catch of 0+ chinook at Diamond Island for the number of adult spawners. Comparison of standardised outmigrant numbers showed no clear relationship between flows and outmigrant numbers for 1992 to 1997. A similar finding was obtained after standardising electrofishing CPUE for spawner number.

INTRODUCTION

This report describes juvenile chinook salmon (*Oncorhynchus tshawytscha*) size, distribution and abundance in the upper 100 km of the Nechako River in 1997.

This study was part of the ninth year (1997-1998) of the Nechako Fisheries Conservation Program (NFCP). The primary objectives of the 1997 survey were to measure the growth and spatial distribution of juvenile chinook in the upper Nechako River, and to obtain an index of the number of juvenile chinook that migrated downstream of Diamond Island from March to July. The secondary objective was to compare the 1997 biological parameters with those measured over 1987 to 1996, thereby providing the raw material for an assessment of the juvenile outmigration project.

NFCP monitoring efforts are concentrated in the upper 100 km of the Nechako River because it is the part of the river most subject to changes in flow due to fluctuations in discharge from the Nechako Reservoir. Other parts of the river are buffered by flow from the Nautley and Stuart Rivers as well as from large tributaries. Thus, the upper Nechako is the best part of the river to concentrate monitoring efforts to determine effects of flow on juvenile chinook.

METHODS

Study Sites

The study area included the upper 100 km of the Nechako River from Kenney Dam to Fort Fraser (Figure 1). It was divided into four reaches with the following boundaries, as originally defined by Envirocon Ltd. (1984):

Reach	Distance (km) from Kenney Dam
1	9.0-14.6
2	14.6-43.0
3	43.0-66.6
4	66.6-100.6

In this report, all longitudinal distances are in kilometres from Kenney Dam. However, the first 9 km are upstream of Cheslatta Falls within the Nechako River Canyon, which was dewatered by closing of Kenney Dam in October 1952. Thus, the first 10 km from Kenney Dam has only 1 km of flowing water from Cheslatta Falls that provides significant fish habitat.

Temperature and Flow

Mean daily water temperatures were measured by a datalogger installed at Bert Irvine's Lodge in Reach 2 of the river, 19 km below Kenney Dam. They are reported as preliminary data from Environment Canada.

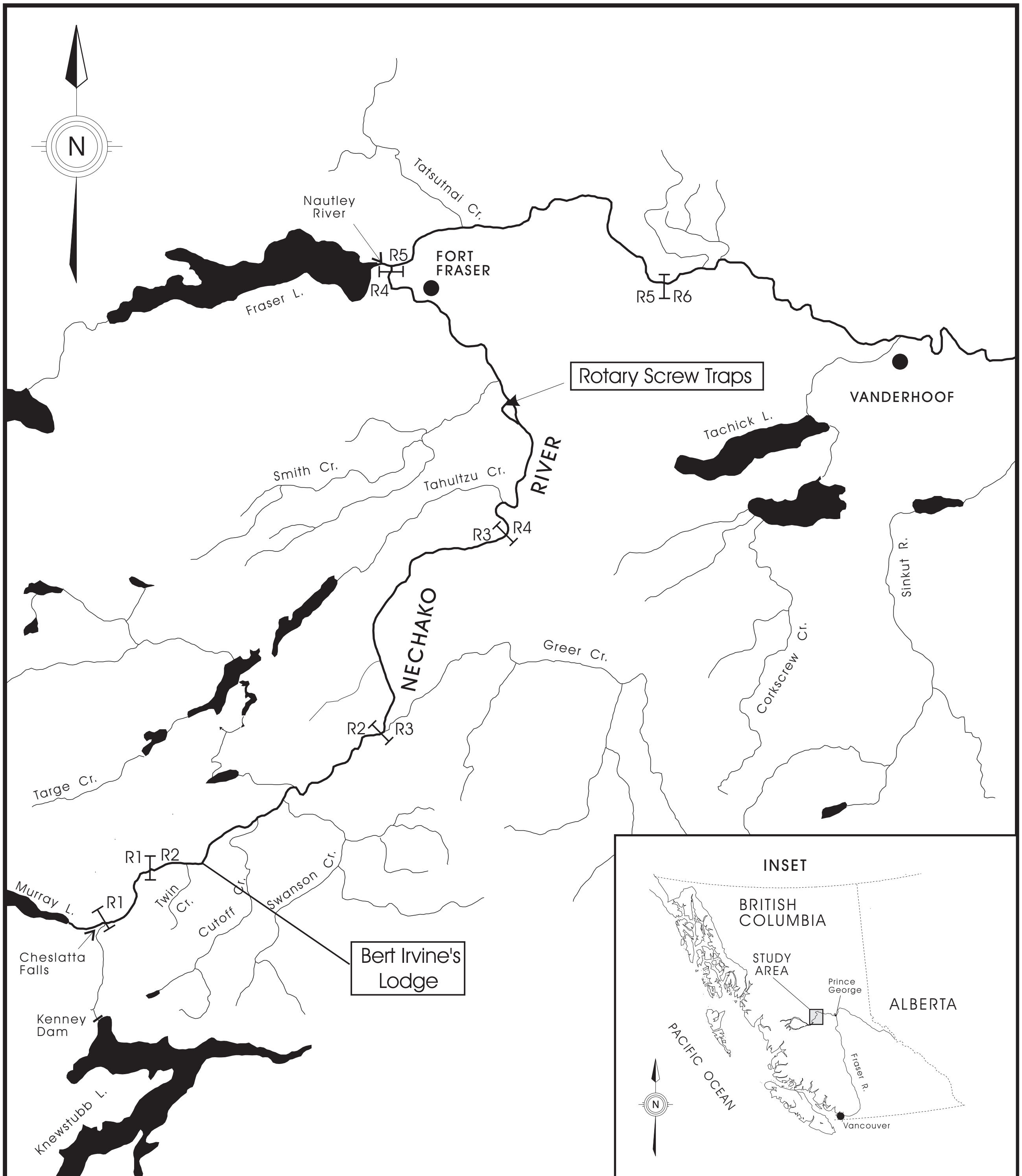
Spot water temperatures were recorded by hand-held thermometers in Reaches 1 to 4 during the electrofishing surveys, and at Diamond Island during operation of the rotary screw traps. Both sets of temperatures are reported as data from Triton Environmental Consultants Ltd.

Daily water flows were recorded at Skins Lake Spillway (WSC station 08JA013) and at the Nechako River below Cheslatta Falls (WSC station 08JA017), and are reported as preliminary data from Water Survey of Canada (WSC).

Electrofishing Surveys

Each year since 1990, NFCP has conducted electrofishing surveys of the upper Nechako River to measure the relative abundance and spatial distribution of juvenile chinook. The surveys began as a temporary replacement for inclined plane traps that were rendered inoperable in 1990 due to high river flows. Over the last eight years they have become one of the most important components of the chinook monitoring program, mainly because they show spatial variation in juvenile density during spring and summer-something no fixed gear can do-and because electrofishing can be done at high flow levels that would render some fixed gear inoperable.

In 1997, as in previous years, an index of juvenile chinook salmon abundance was obtained from single-pass electrofishing surveys of each of the four reaches. Surveys began in April and continued through May, June and early July. They were discontinued during late July and August because summer cooling flows were too high to allow safe and effective electrofishing. Large flows are released into the upper river during July and August to cool the river and thereby reduce prespawning mortality of sockeye



Nechako Fisheries Conservation Program

Map # M97-3-1

FIGURE 1. 1997 NECHAKO RIVER STUDY AREA AND TRAP LOCATIONS

salmon (*Oncorhynchus nerka*) migrating through the lower Nechako River to spawning grounds in the Stuart, Stellako and Nadina River systems. The program of releases is called the Summer Temperature Management Program or STMP. A final survey was conducted from October 31 to November 6. Surveys of Reaches 1 through 4 were completed in each of the months sampled. Electrofishing surveys were carried out at night as well as during the day. Night was defined as the time period between sunset and sunrise.

Surveys were conducted on prime habitat for juvenile chinook salmon, defined as depth greater than 0.5 m, velocity greater than 0.3 m/s and a substrate of gravel and cobble (Envirocon Ltd. 1984). That habitat was found mainly along the margins of the river, so electrofishing surveys did not sample the portion of the population that may have resided in mid-channel. However, mid-channel residents are a minor component of the population of juvenile chinook. Electrofishing surveys conducted by the Department of Fisheries and Oceans (DFO) showed that mid-channel densities of chinook were 70 times lower than densities along river margins (Nechako River Project 1987). The same study also showed that 97% of juvenile chinook observed by snorkelling were found along river margins.

Fish were captured with a single pass of a Smith Root model 15A backpack electrofisher, identified to species, counted, and released live back into the river. Catch-per-unit-effort (CPUE) of juvenile chinook was the number of fish caught at a site divided by the area that was electrofished. Area was expressed in units of 100 m^2 to avoid fractional CPUE. Age of juvenile chinook was recorded as 0+ or 1+, based on fork length. Juvenile chinook less than 90 mm long were classified as 0+. Those over 90 mm in length in the spring and early summer were classified as 1+, but those over 90 mm long in late summer were classified as 0+ because by that time all 1+ chinook had migrated out of the upper Nechako River. Rainbow trout were classified as juveniles if their length was <200 mm and adults if their length was >200 mm.

Before release, 10 to 15 chinook were measured for body size. Fork length was measured to the nearest 1 mm with a measuring board, and wet weight was measured to the nearest 0.01 g with an electronic balance. Following the practice of previous years, Fulton's condition factor (Ricker 1975):

(1) $CF = \text{weight (g)} \times 10^5 / [\text{fork length (mm)}]^3$

was used to assess physical condition.

Mean daily length and weight of 0+ and 1+ chinook were calculated separately for day and night catches because fish could potentially avoid sampling gear more successfully during the day than during the night, and because the behaviour of juvenile chinook varies with time of day-resting near instream cover during the day and migrating during dusk and dawn.

It is important to note that electrofished areas were not blocked off with nets, which meant that some fish could avoid capture by leaving a sampling area during a pass or by diving into crevices in the substrate. That meant that electrofishing catch was an underestimate of the total number of fish in a survey area. Two-pass or three-pass sampling of blocked off survey areas would have been necessary to estimate total numbers. However, the Nechako River electrofishing survey was not designed to estimate absolute numbers-it was designed to provide an index of relative abundance which could be compared between years.

That sampling strategy is called “semi-quantitative”, to use a term coined by Crozier and Kennedy (1995). It has two advantages over the fully quantitative method. First, it is the only electrofishing technique that can be used when it is impossible or impractical to enclose a survey area in blocking nets because the area is too large to be enclosed or flows through the area are too strong to allow nets to be installed. For example, almost all electrofishing conducted in lakes and reservoirs (DeVries et al. 1995; Van Den Ayle et al. 1995; Miranda et al. 1996), and in large rivers (R.L.&L. Environmental Services Ltd. 1994), is semi-quantitative. The upper Nechako River is too wide, deep and fast-moving to allow any part of the mainstem to be blocked off with nets.

Second, it is often necessary to use semi-quantitative methods when the region to be surveyed is large and contains many possible survey sites, but the time and resources available for sampling are limited (Crozier and Kennedy 1995). The upper Nechako River is too long for cost-effective quantitative sampling of its entire length several times a year.

There are two disadvantages of the semi-quantitative method. First, semi-quantitative electrofishing CPUE cannot be compared to fully quantitative CPUE unless the former are calibrated by the latter. That is, unless total numbers are estimated for a subset of the same areas that are semi-quantitatively surveyed, and a calibration relationship is developed from a comparison of the two types of CPUE (e.g., Serns 1982; Hall 1986; Coble 1992; McInerny and Degan 1993; Edwards et al. 1987). At present, conversion of electrofishing CPUE to absolute CPUE is not an NFCP objective because the purpose of the electrofishing surveys is to search for among-year variation in relative abundance of juvenile chinook abundance and not to compare it with absolute abundances of other chinook streams.

Second, semi-quantitative sampling assumes that the efficiency of capture, the fraction of total number of fish in a survey area that are caught in a single electrofishing pass, is constant for all sites and species of fish. However, electrofishing catch efficiency is known to vary significantly with fish species, fish body size, type of habitat, time of day, water temperature, and the training and experience of personnel conducting the survey (Bohlin et al. 1989, 1990). The NFCP electrofishing project reduced error in estimation of CPUE by sampling only one type of habitat (prime juvenile chinook habitat), by focusing analysis on only one species (chinook), by analysing CPUE from night and day surveys separately, and by using the same experienced crew leaders each year. However, the study plan does not account for changes in catch efficiency due to seasonal changes in fish size and water temperature.

Rotary Screw Traps

Rotary screw traps (RST) were used to estimate the number of juvenile chinook that migrated downstream past Diamond Island. RSTs were installed in early April and removed in mid-July to avoid high flows in July and August. The traps were not re-installed in September because too few chinook salmon had been caught in the fall of previous years to justify re-installation of traps in the fall of 1997.

An RST consisted of a floating platform on top of which was a rotating cone. In front of the cone was an A-frame with a winch that was used to set the vertical position of the mouth of the cone, half of which was always submerged. In the back of the cone was a live box where captured fish were kept alive until the trap was emptied. The cone was 1.43 m long and was made of 3 mm thick aluminum sheet metal with multiple perforations to allow for draining of water. The diameter of the cone tapered from 1.55 m at the mouth to 0.3 m at the downstream end. Inside the cone was an auger or screw, the blades of which were painted black to reduce avoidance by fish. As the current of the river struck the blades of the screw, it forced the cone to rotate. Any fish that entered the cone were trapped in a temporary chamber formed by the screw blades. As the cone rotated, the chamber moved down the cone until its contents were deposited in the live box.

Three RSTs were installed off Diamond Island: RST 1 near the left bank, RST 2 in the middle of the river, and RST 3 near the right bank. RSTs were suspended from a cable strung across the river channel. The 1.5 m space between the right bank of the river and RST 3 was blocked with a wing made of wood beams with wire mesh. The 15 m long space between the left bank of the river and RST 1 was not blocked with a wing.

Each trap was emptied twice each day at about 0700 and 2000 hours. All fish were collected from the live trap and counted and identified to species. A subsample of chinook salmon was kept for length and weight measurement, after which all fish, including the subsampled fish, were released live back into the river. The lengths and weights of a subsample of 10 to 15 chinook salmon were measured using the same techniques described above for the electrofishing surveys.

An index of the number of juvenile chinook passing Diamond Island in a day was calculated by multiplying the total number of fish caught in an RST in a time period (day or night) by the ratio of the total flow of the river to the flow that passes through the RST:

$$(2) \qquad N_{ij} = n_{ij}(V_j / v_{ij})$$

where N_{ij} = number of juvenile salmon passing Diamond Island on the *jth* date as estimated by the catches of the *ith* trap, n_{ij} = number of chinook salmon caught in the *ith* trap on the *jth* date, v_{ij} = water flow (m^3/s) through the *ith* trap on the *jth* date, and V_j = total water flow (m^3/s) of the Nechako River past Diamond Island on the *jth* date. All estimates of the rate at which the numbers of juvenile chinook changed with time were based on expanded numbers rather than on catches.

V_j was estimated from the height of the river surface at Diamond Island, as measured with a staff gauge, with a predictive regression between flow and the height of the staff gauge (cm) ($n = 125$, $r^2 = 0.99$, $P<0.001$):

(3) $\log_e(\text{Nechako flow, m}^3/\text{s}) = -3.373 + 1.668\log_e(\text{staff height, cm})$,

The regression was calculated for steady flow conditions during April and May from the combined years of 1992 to 1997. Flows and staff gauge height were $\log_e$-transformed to linearize the exponential relationship between the two variables.

Water flow though a trap (v_{ij}) was the product of one half the cross-sectional area (1.61 m^2) of the mouth of the trap (the trap mouth was always half-submerged) and average water velocity in front of the trap. Average water velocity was measured with a Swoffler (model 2100) flow meter at three different places in the front of the mouth of the RST. The one exception to this rule was RST 3, where v_{ij} was increased to include the water that flowed between it and the right bank of the river because the fish that would ordinarily have passed through this gap were diverted into RST 3 by the right wing.

Since there were three RSTs, there were three estimates of total number each day. The best estimate of the total index number of chinook salmon was the mean of the three estimates weighted by the flow that passed through each trap.

RESULTS AND DISCUSSION

Temperature

Mean daily water temperature of the upper Nechako River at Bert Irvine's Lodge rose from a minimum of 0.1°C on January 23 to a maximum of 16.9°C on August 14 and then decreased to a second minimum of 1.2°C on December 31 (Figure 2).

Spot temperatures taken during daytime electrofishing surveys of Reaches 1 to 4 during spring and early summer were higher than mean temperatures recorded at Bert Irvine's. The difference, weighted by the number of sites electrofished, was 1.0° in mid-April, 1.5°C in mid-May and 0.1°C in mid-June. In contrast, spot temperatures taken during daytime electrofishing surveys in July and November were lower than mean temperatures recorded at Bert Irvine's. The weighted difference was -0.4°C in July and -0.7°C in November.

Those differences indicate that the Skins Lake Spillway released cool water during winter and spring that warmed as it passed down the upper Nechako River. By late autumn, the situation was reversed with warm water spilling from the Reservoir and cooling as it passed down the river.

Spot temperatures taken during night-time electrofishing surveys of Reaches 1 to 4 were always lower than spot temperatures taken during the day due to variation in solar heating. Average differences between mean day and night spot temperatures were 0.7°C in mid-April, 1.3°C in mid-May, 0.3°C in mid-June, and 0.1°C in mid-July and early November.

Daytime spot temperatures taken at Diamond Island from April 5 to June 13 were an average of 1.4°C higher than mean temperatures recorded at Bert Irvine's Lodge due to heating of water as it passed down 70 km of river between the lodge and Diamond Island. Night-time sport temperatures at Diamond Island were an average of 1.0°C lower than daytime temperatures.

Flow

From January 1 to April 12, 1997, flow of the Nechako River was roughly constant at an average of 58 m^3/s (Figure 3). A spike of very high flows from January 25 to 29 was due to a malfunction in the flow sensor.

After April 12, flows increased steadily to a maximum of 362 m^3/s on July 5 and 6. Flows increased during the second half of April due to spring run-off from local tributaries. Increases from May 1 to early July were due to local run-off plus ramping up of flows from the Nechako Reservoir through the Skins Lake Spillway. Six consecutive ramping events occurred during that period as part of an extended forced spill that was required to lower the surface of the Nechako Reservoir. The magnitude and duration of the forced spill meant that it was not necessary to release any additional water to cool the river as part of the Sum-

Figure 2
Daily Temperatures of the Nechako River, 1997

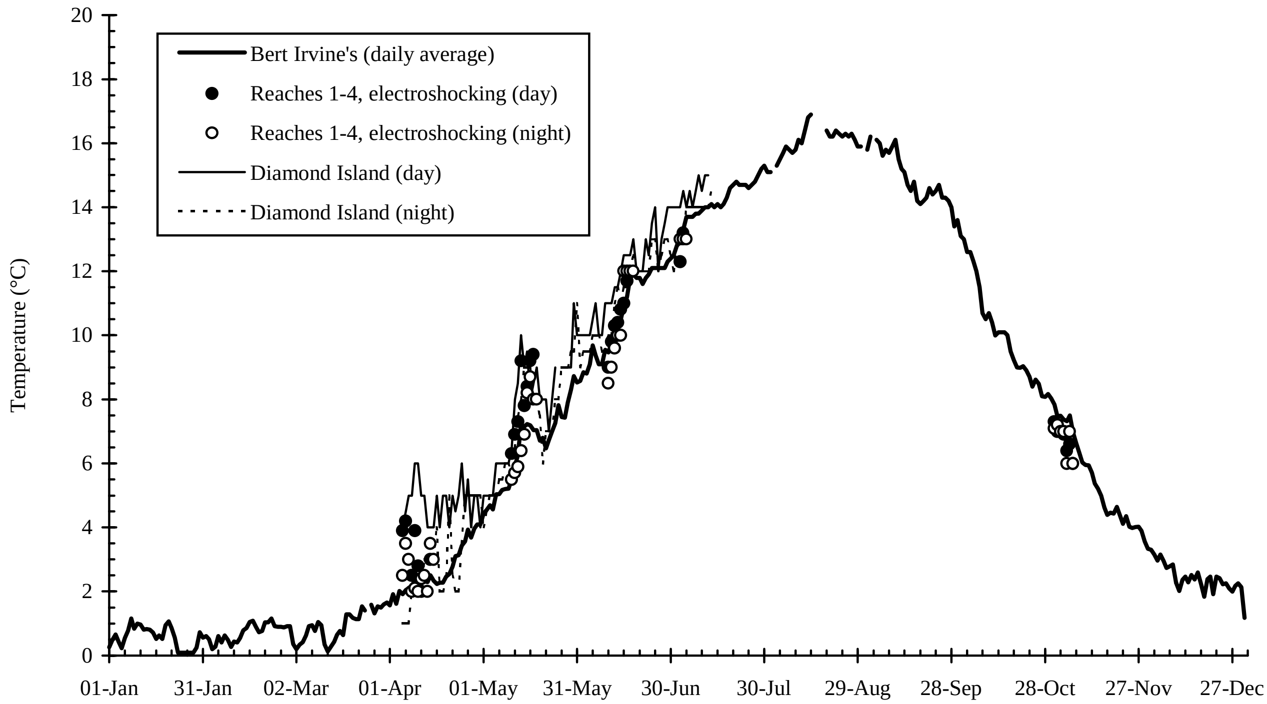
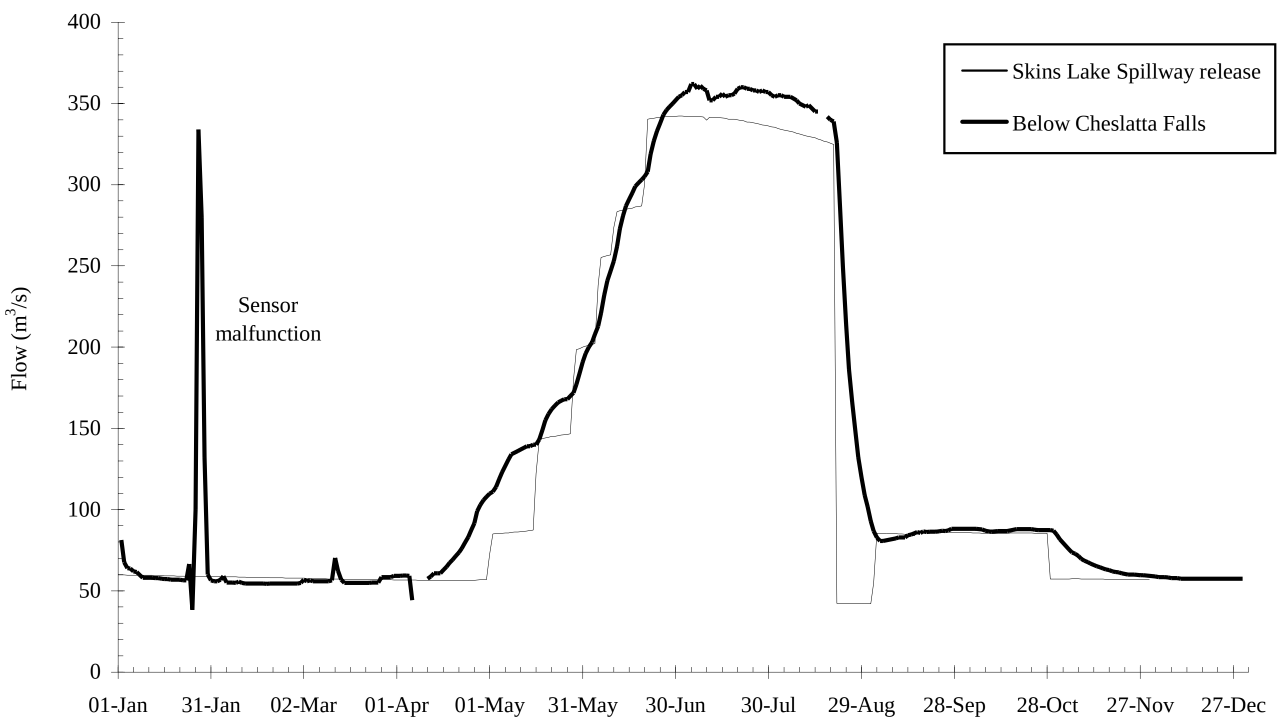


Figure 3
Daily Flows of the Nechako River, 1997



mer Temperature Management Project. That project was designed to reduce summer river temperatures so as to assist the migration of sockeye salmon (*Oncorhynchus nerka*) through the lower Nechako River to their spawning sites in the Stuart River and Fraser / Francois Lake systems.

From August 21 to September 2, 1997, flows below Cheslatta Falls fell from 326 m^3/s to 83 m^3/s in response to a decrease in flows from Skins Lake Spillway from 325 m^3/s on August 20 to 42 m^3/s on August 21. That decrease was done to assist sockeye and chinook spawners ascend the Nechako River during late August and September. Flows remained at an average of 86.3 m^3/s over October and most of November, and then decreased to an average of 57.0 m^3/s over December.

Size and Growth of Chinook Salmon

Electrofishing

0+ Chinook Salmon: Sources of Variation

To determine the factors responsible for changes in the size of 0+ chinook salmon over time, standard two-factor analyses of variance (ANOVA) of length-at-date and weight-at-date were conducted with two factors: time of day (two classes: day and night) and date (five classes: April, May, June, July and October-November). (In this case, and in all subsequent ANOVAs of this study, the date classes were chosen so that there was a roughly equal distribution of data in each class). The ANOVAs showed that:

(1) there were highly significant variation with date in mean length ($F_{4,4170}$ = 8816.6, $P<0.001$) and mean weight ($F_{4,4141}$ = 3427.8, $P<0.001$). Figures 4 and 5 (and Appendix 1) show that the variation was due to growth;

(2) mean length ($F_{1,4170}$ = 71.0, $P<0.001$) and mean weight ($F_{1,4141}$ = 50.6, $P<0.001$) were highly significantly different between day and night catches within a month. Figures 4 and 5 show that 0+ chinook tended to be smaller during the day than at night. The most likely reasons for the apparent day-night size differences are: (a) greater vulnerability of fish of all sizes to capture at night than during the day because fish cannot detect and avoid electrofishing gear as well at night as during the day; and (b) a wider size range of fish are active along the river margins during the day because juvenile chinook tend to migrate more at night than during the day to avoid predators; and

(3) the interaction of date and time of day was highly significant for both length ($F_{4,4170}$ = 21.5, $P<0.001$) and weight ($F_{4,5079}$ = 31.9, $P<0.001$). Figure 4 and 5 show that the interaction was due to seasonal variation in day-night size differences. That is, mean night sizes were almost identical to mean day sizes for April and May, but they were greater than mean day sizes for June, July and October-November. The most likely reasons are: (a) seasonal changes in size-selection of electrofishing gear due to an increase in avoidance ability of juvenile chinook as they grow in size and swimming ability; and (b) seasonal changes in the relative abundance and spatial distribution of fish of different sizes along the river margins.

0+ Chinook Salmon: Growth

Growth of 0+ chinook salmon electrofished along the river margins appeared to follow two separate growth stanzas (Ricker 1979). Growth was slow between April and May, but then it increased between May and November (Figures 4 and 5). The first stanza was due to continuous emergence of fry over a period of several weeks-the numbers of emergent fry were great enough to force mean size to stay close to the mean size of emergent fry. However, after emergence ceased, the second stanza began and the true growth rate of juvenile chinook became apparent. Based on the curvature of the mean length-at-date and weight-at-date plots shown in Figures 4 and 5, emergence appeared to have ceased in May.

Growth of 0+ chinook salmon after emergence ceased was described with a one-cycle Gompertz growth curve (Zweifel and Lasker 1976), the standard growth model for the early life history stages of fish. A “cycle” is a period of constant growth pattern with the same meaning as a “growth stanza”. The Gompertz model for length was:

(4) $$L = L_0 \exp[(A_0/\alpha)(1-\exp(-\alpha t))]$$

Figure 4
Mean (±1 SD) Length-at-date of 0+ Chinook Salmon, Nechako River, 1997: Electrofishing

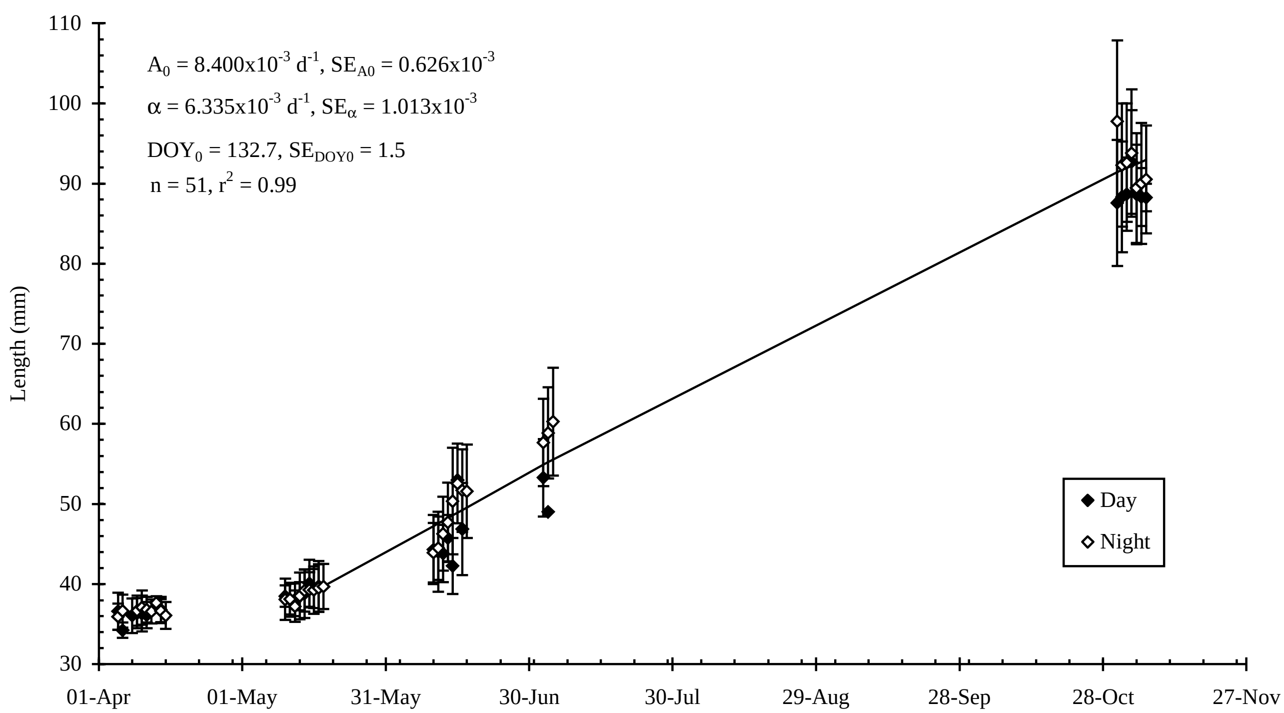
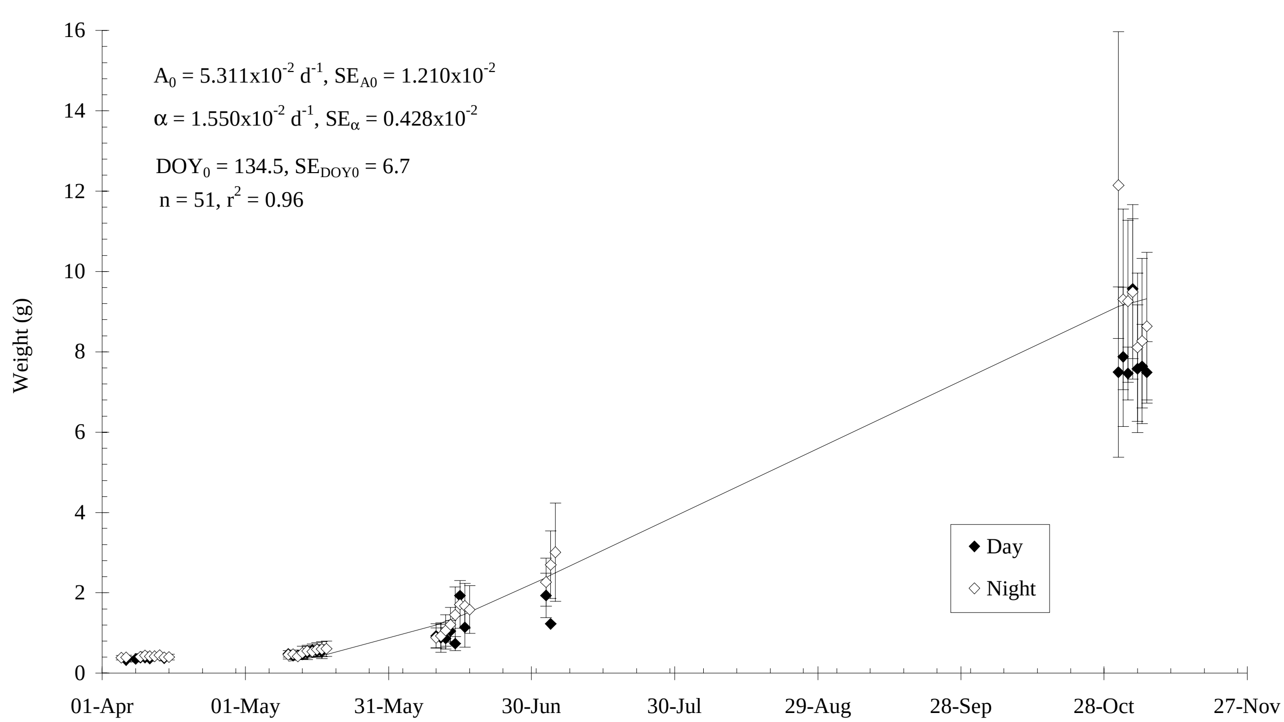


Figure 5
Mean (±1 SD) Weight-at-date of 0+ Chinook Salmon, Nechako River, 1997: Electrofishing



where L = length (mm) at age t (d), L_0 = length (mm) at emergence, A_0 = instantaneous growth rate (d^{-1}) at emergence, and α = instantaneous rate (d^{-1}) at which A_0 decayed with age. The one-cycle Gompertz model for weight was the same as equation (4) except that W_0, the weight (g) at emergence, was substituted for L_0.

The simplest way of estimating age from date was to modify equation (4) by inserting the parameter DOY_0, the mean day of the year (DOY) on which emergence ceased and the second growth stanza began. Therefore, $t = DOY - DOY_0$ and the modified Gompertz model for length was:

(5) $$L = L_0 \exp[(A_0/\alpha)(1-\exp(-\alpha(DOY - DOY_0)))].$$

L_0 was fixed at 38 mm and W_0 was fixed at 0.38 g, the mean length and weight of emergent chinook fry electrofished in April. Values of A_0, α and DOY_0 were estimated from mean daily lengths and weights with the non-linear regression program NLR of the SPSS statistical library. Each daily mean was weighted by its sample size. Day and night data were pooled to produce a single growth curve. Mean length-at-date and weight-at-date collected in April was excluded because it belonged to the first growth stanza.

The modified Gompertz curves provided good fits to lengths-at-date and weights-at-date, explaining between 96 and 99% of the variation in mean size (Figures 4 and 5). The average date at which emergence ceased was estimated to be between May 13 (DOY = 133) and May 14 (DOY = 134).

1+ Chinook Salmon: Growth

Growth of electrofished 1+ chinook was best described with simple linear regressions of mean length and weight on day of year, with mean size weighted by sample size (Figures 6 and 7). Both regressions were statistically significant. Mean length of 1+ chinook rose from 97 mm on April 5 (DOY = 95) to 107 mm on June 16 (DOY = 167) at a rate (±1 SE) of 0.139±0.015 mm/d. Mean weight rose from 11.37 g on April 5 to 15.49 g on June 16 at a rate (±1 SE) of 0.057±0.005 g/d.

Figure 6
Mean (±1 SD) Length-at-date of 1+ Chinook Salmon, Nechako River, 1997: Electrofishing

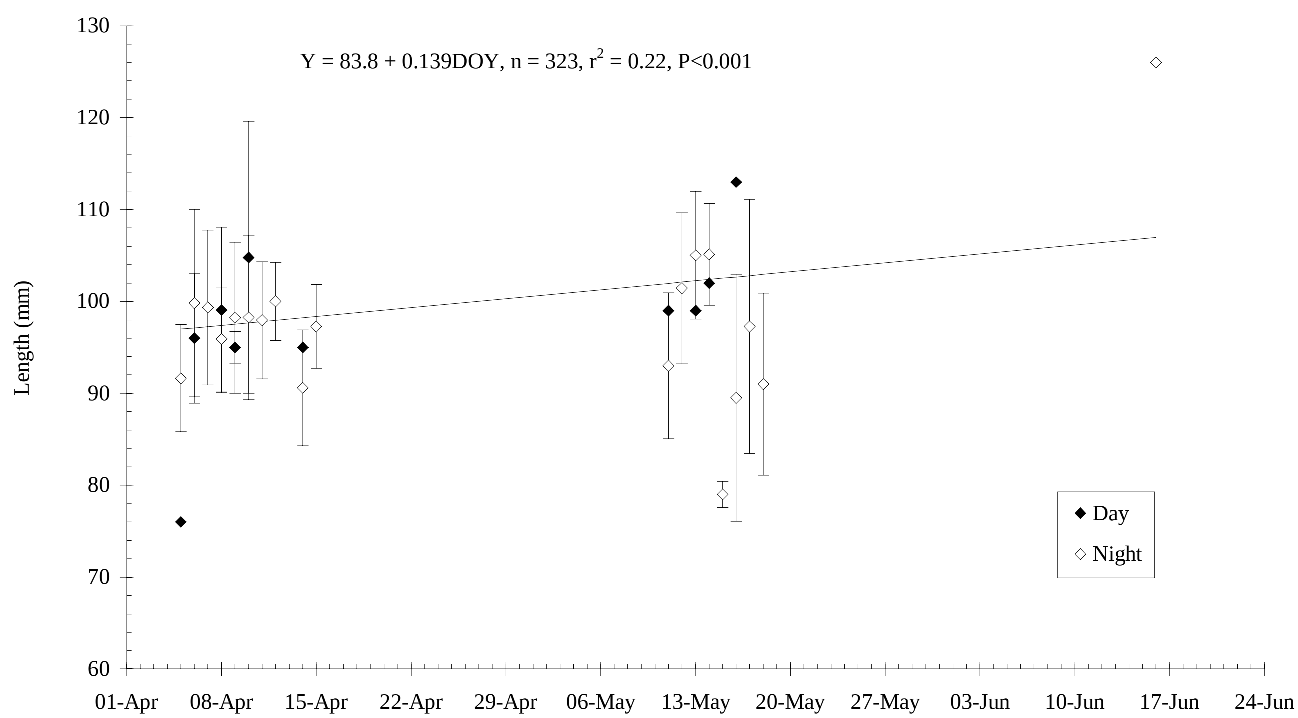
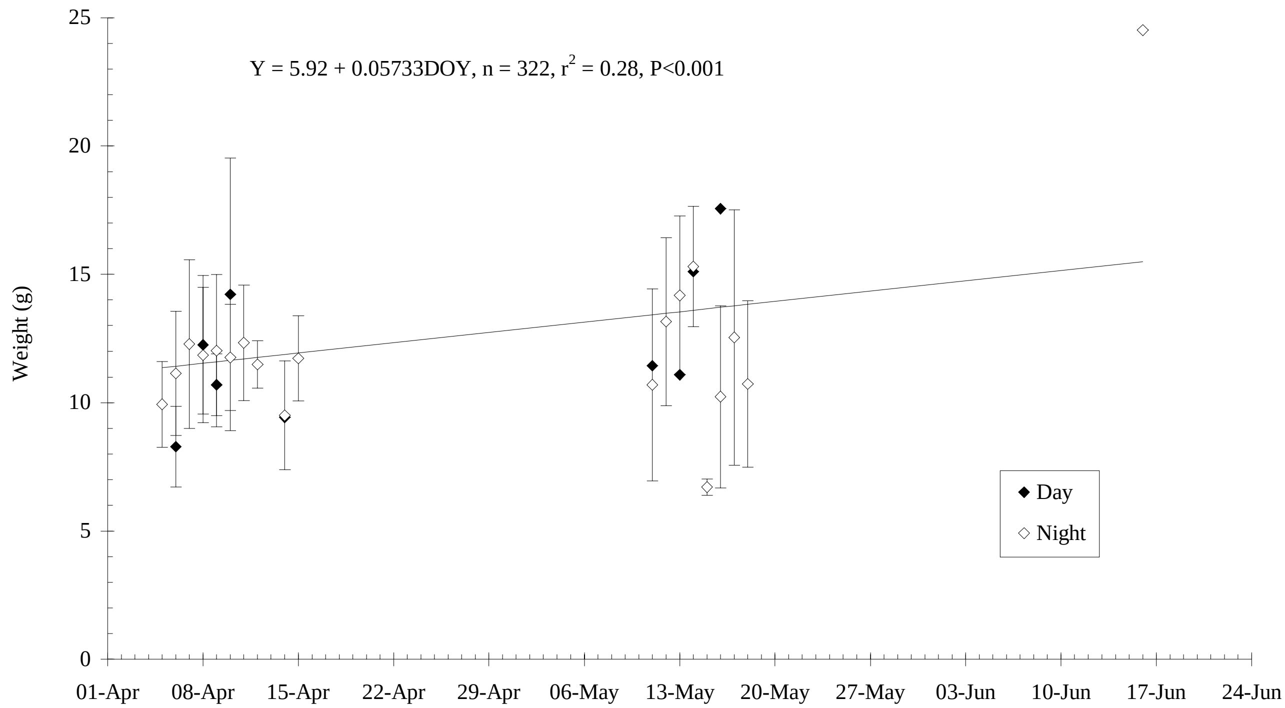


Figure 7
Mean (±1 SD) Weight-at-date of 1+ Chinook Salmon, Nechako River, 1997: Electrofishing



0+ and 1+ Chinook Salmon: Weight-Length Relationship

Following customary practice, a power function was used to model the relationship between weight and length of 0+ and 1+ chinook salmon:

(6a) $W = aL^b$

where a was a coefficient with units of g / mm and b was the length exponent. Equation (6a) was fit to individual weights and lengths after logarithmic transformation converted it to a linear regression:

(6b) $\log_e(W) = \log_e(a) + b\log_e(L)$.

Equation (6b) explained 98.7% of the variance in $\log_e(W)$ (Figure 8). However, it overestimated the weight of the largest fish, indicating that the weight-length relationship for juvenile chinook was not linear over the entire juvenile stage. Instead, there appeared to be one linear relationship for small 0+ fish and a second linear relationship for large 0+ fish plus all 1+ fish. The approximate $\log_e(L)$ at which the two groups diverged was 4.40 or a length of 81 mm. That average length was reached in September (see Figure 4).

0+ and 1+ Chinook Salmon: Condition

Condition of 0+ chinook increased from a mean of 0.81 g / mm^3 in April to an asymptotic mean value of 1.14 g / mm^3 in November (Figure 9). Condition of 1+ chinook salmon was constant over April and June at a mean condition similar to that of 0+ chinook captured in the fall of 1997 (Figure 10).

Diamond Island Traps

0+ Chinook Salmon: Sources of Variation

To determine if there were day-night differences in the size of juvenile chinook salmon caught by all three types of traps at Diamond Island, standard two-factor ANOVAs of length-at-date and weight-at-date were conducted. The ANOVAs were similar in structure to those conducted on chinook caught by electrofishing, and they showed similar results:

(1) there was highly significant variation in mean length ($F_{3,2031}$ = 1423.8, P<0.001) and in mean weight ($F_{3,2031}$ = 1111.3, P<0.001) due to growth (Appendix 2 and Figures 11 and 12);

Figure 8
Regression of Weight on Length for Juvenile Chinook Salmon, Nechako River, 1997: Electrofishing

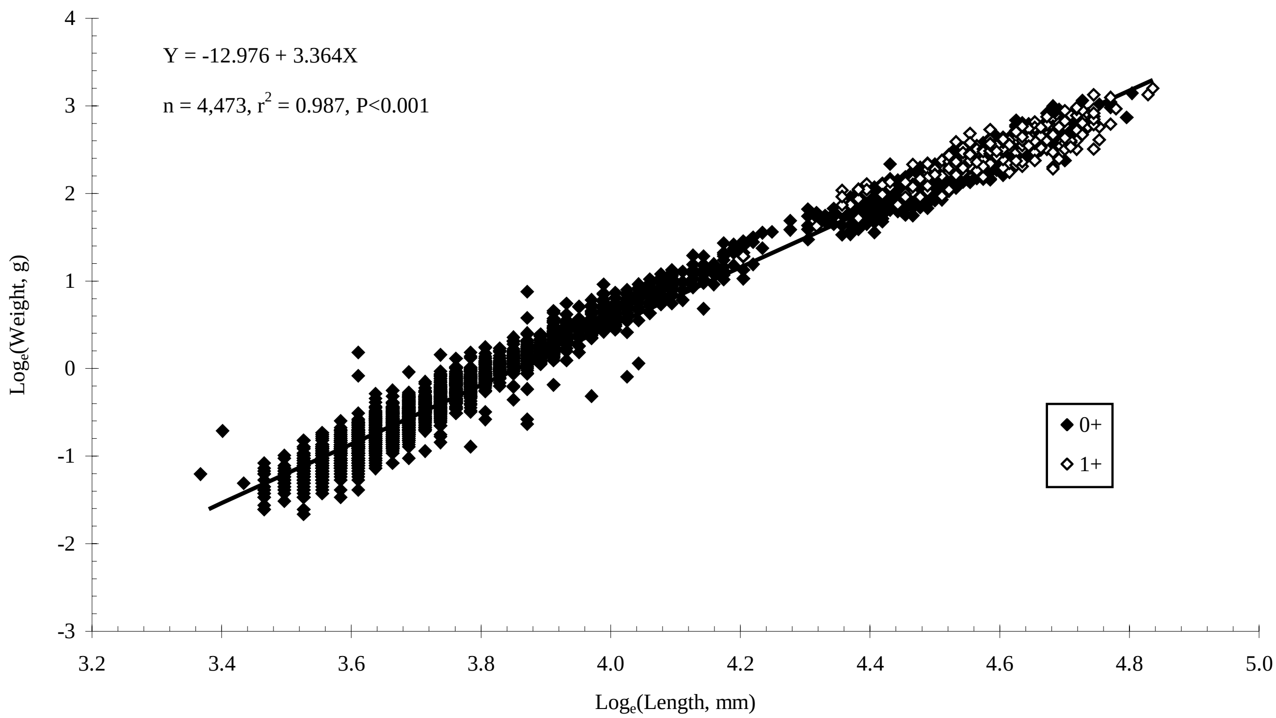


Figure 9
Mean (±1 SD) Condition-at-date of 0+ Chinook Salmon, Nechako River, 1997: Electrofishing

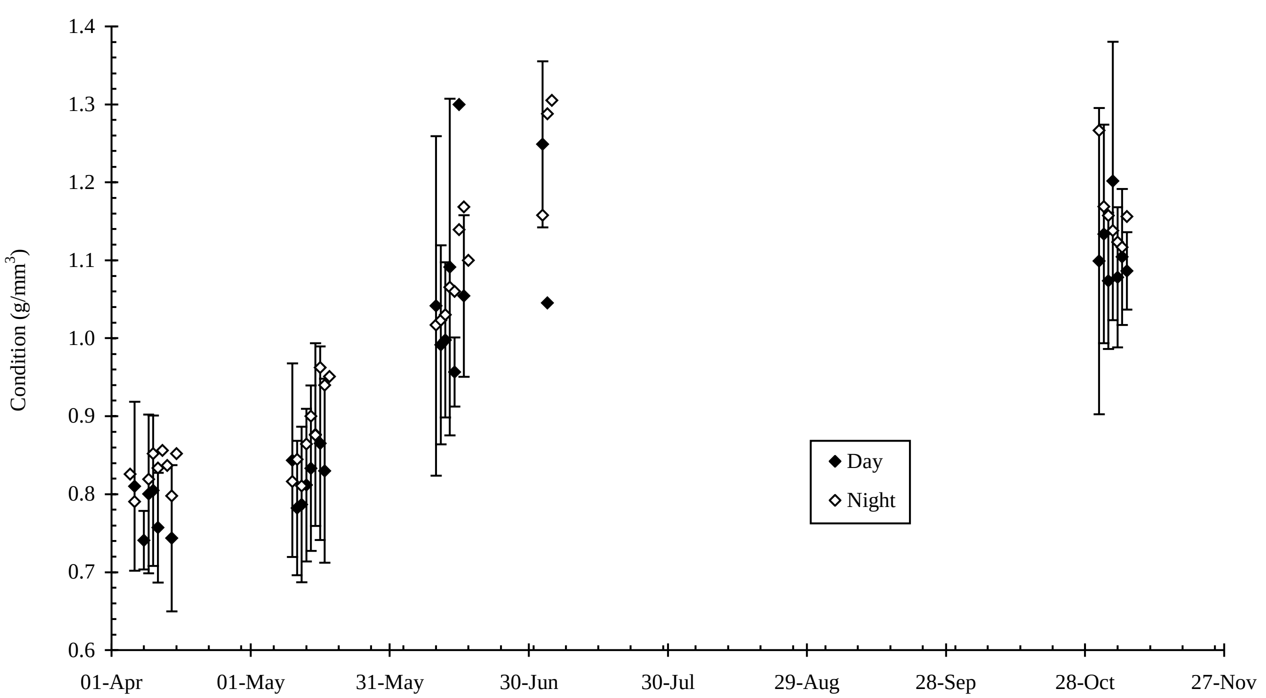


Figure 10
Mean (±1 SD) Condition-at-date of 1+ Chinook Salmon, Nechako River, 1997: Electrofishing

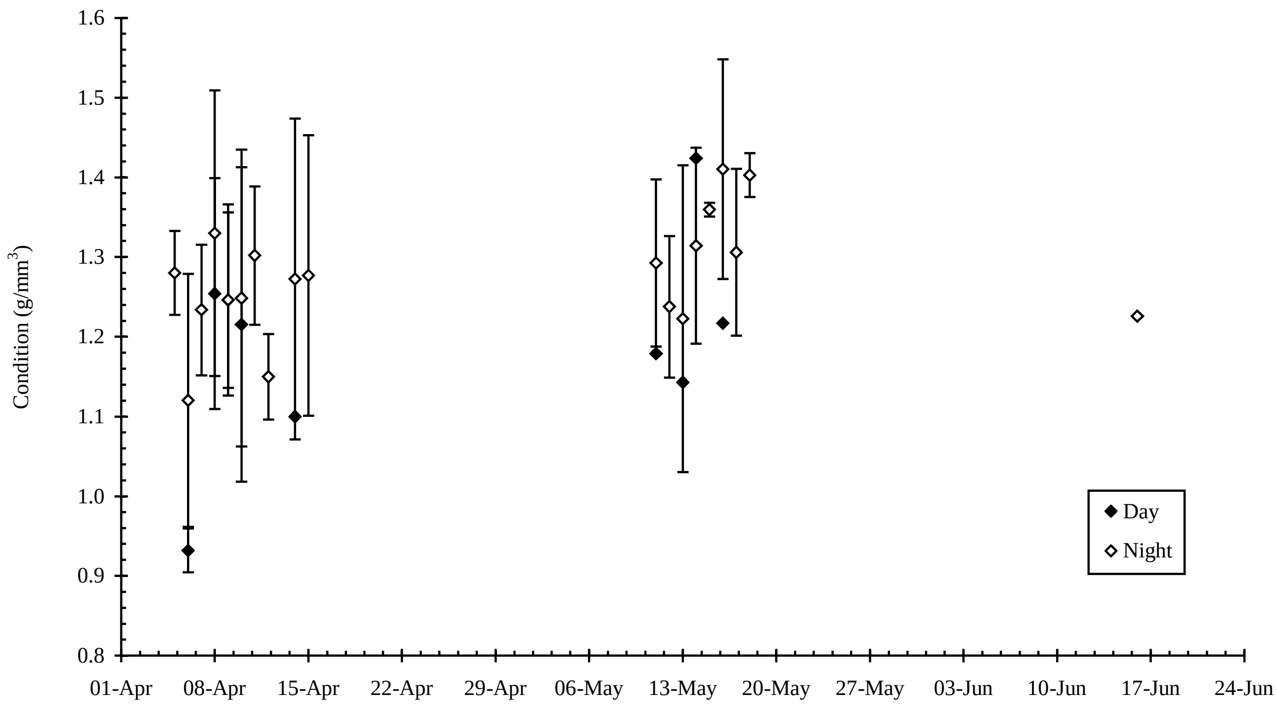


Figure 11
Mean (±1 SD) Length-at-date of 0+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997

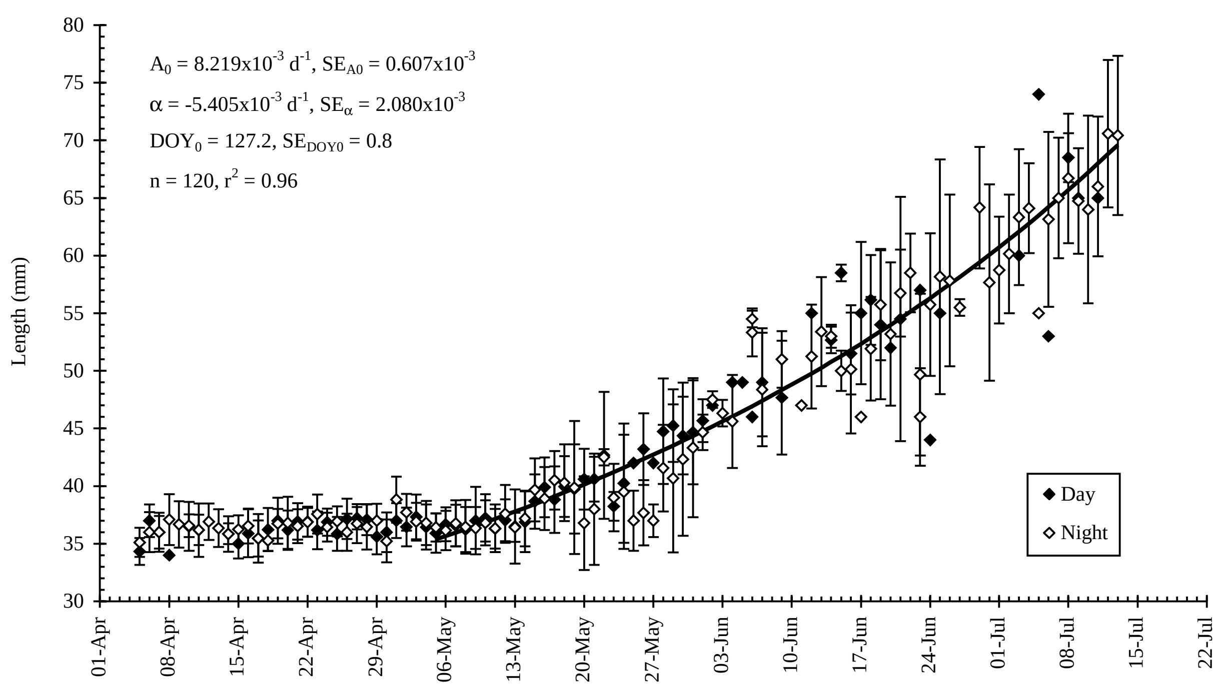
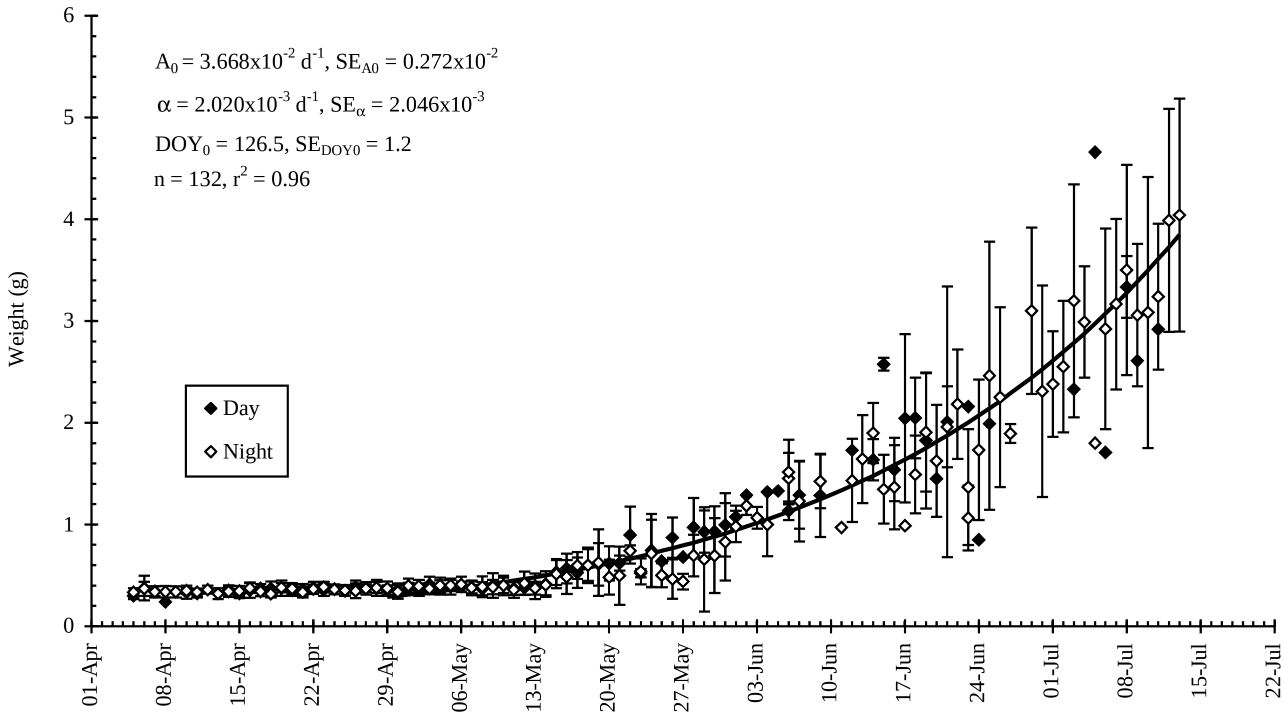


Figure 12
Mean (±1 SD) Weight-at-date of 0+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997



(2) mean length ($F_{1,2031}$ = 0.6, P = 0.452) and mean weight ($F_{1,2031}$ = 3.1, P = 0.080) of 0+ chinook salmon were not significantly different in night catches than in day catches; and

(3) the interaction of date and time of day was significant for length ($F_{3,2031}$ = 3.1, P = 0.027), but not for weight ($F_{3,2031}$ = 2.0, P = 0.113). The length interaction was due to greater mean length at night than during the day for June and July but not for April and May.

0+ Chinook Salmon: Growth

Lengths and weights of 0+ chinook captured at Diamond Island followed a similar trajectory with date as the electrofished 0+ chinook (Figures 11 and 12). The first stanza of growth ran from mid-April to late May, at which time the rate of fry emergence had dropped to a level that allowed the true population growth curve to become apparent. To fit Gompertz growth curves to the size-at-age data, the second stanza was defined as starting between April 25 (DOY = 115) and May 20 (DOY = 140), based on a visual assessment of the plots of size-at-date. Gompertz curves were then fit to size-at-date for each of the 26 possible starting dates and the regression that explained the most variation in size, i.e. had the highest r^2, was chosen. Starting dates of May 5 (DOY = 125) and April 29 (DOY = 119) were found to provide the highest r^2 for length and weight, respectively (Figures 11 and 12). The average date at which emergence ceased was estimated to be May 7 (DOY = 127) for both length and weight.

1+ Chinook Salmon: Growth

A total of 213 1+ chinook salmon were measured at Diamond Island in 1997 (Appendix 2). Two-way ANOVAs of size with time of day (i.e. day or night) and date showed that there were no significant changes in mean length with time of day ($F_{1,207}$ = 0.093, P = 0.761) or in mean length with date ($F_{2,207}$ = 0.8, P = 0.451) or in mean weight with time of day ($F_{1,207}$ = 0.003, P = 0.959) or in mean weight with date ($F_{2,207}$ = 2.7, P = 0.068), so no growth models were fit to the data (Figures 13 and 14).

Figure 13
Mean (±1 SD) Length-at-date of 1+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997

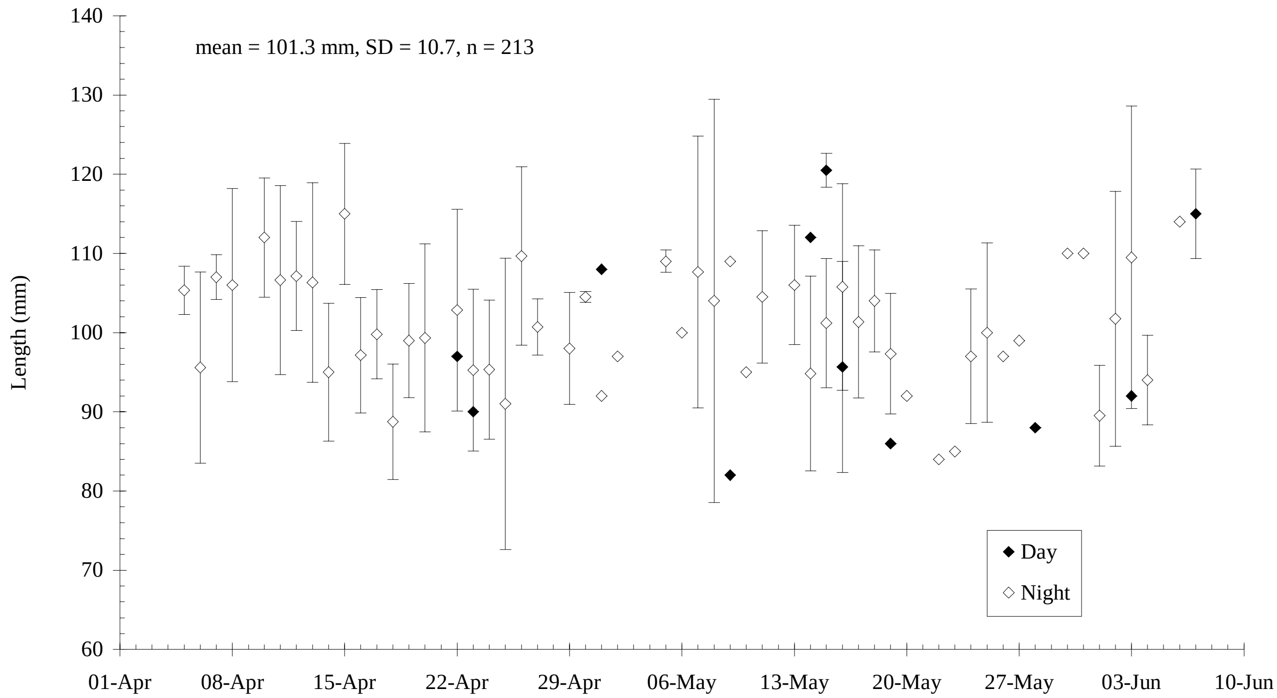
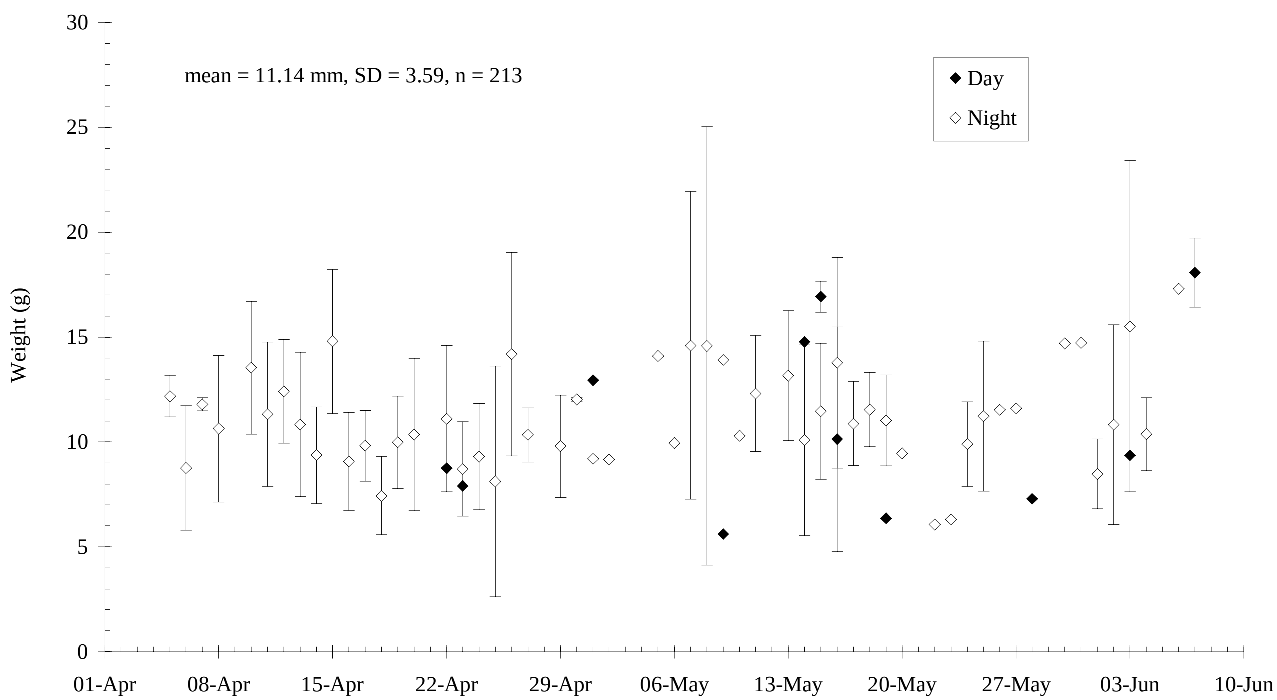


Figure 14
Mean (±1 SD) Weight-at-date of 1+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997



0+ and 1+ Chinook Salmon: Weight-Length Relationship

A regression of weight on length for trap-caught juvenile chinook salmon at Diamond Island: $\log_e(W) = -13.083 + 3.369\log_e(L)$ ($n = 2{,}252$, $r^2 = 0.98$, $P<0.001$), was almost identical to the regression for juvenile chinook salmon captured by electrofishing and so it is not shown as a figure in this report.

0+ and 1+ Chinook Salmon: Condition

The plot of mean condition-at-date of 0+ chinook salmon was similar to that shown for electrofished fish-condition increased over April and May to an asymptote in June and July (Figure 15). The asymptote lay between 1.0 and 1.2 g / mm^3.

Condition of 1+ chinook increased with date from 0.9 to 1.1 g / mm^3 in April to 1.1 to 1.3 g / mm^3 in June (Figure 16).

Catches of Chinook Salmon

Electrofishing/All Species

A total of 1,045 electrofishing sweeps were made along the margins of the upper Nechako River from April 5 to November 6, 1997. The average area covered by a sweep was 135 m^2 (SD = 133). A total of 30,625 fish from 14 species or families were captured and then released (Table 1). Chinook salmon was the most common species (n = 9,436 or 30.81% of the total number), followed by redsided shiner (n = 7,857 or 25.66%) and northern squawfish (n = 3,898 or 12.73%). Sockeye salmon was the least common species (n = 3 or 0.01%).

Electroshocking/0+ Chinook

A total of 9,050 0+ chinook were captured by electrofishing (Table 2), of which 27.3% were taken during daylight and the rest were taken at night. Catch-per-unit-effort (CPUE) of electrofishing catches of 0+ chinook ranged from 0.00 to 273.33 fish / 100 m^2. Variance of mean monthly CPUE increased directly with mean monthly CPUE, indicating that the $\log_e(CPUE + 1)$ transformation was required to stabilise the variance (Sokal and Rohlf 1981).

Temporal Distribution of CPUE

Maximum density of 0+ chinook salmon occurred in mid-May for day catches and mid-June for night catches (Table 2 and Figure 17). After the date of maximum density, $\log_e(CPUE + 1)$ decreased linearly with date through to November.

To calculate the average rate of loss of 0+ chinook density with time, individual measurements of $\log_e(CPUE + 1)$ were regressed on day of year for day and night catches separately. Data collected in April were excluded because it fell on the ascending left-hand limb of the catch curves. The predictive regressions were highly significant ($P<0.001$). The percent of variance explained by the regressions did not exceed 16% because of the large variation in $\log_e(CPUE + 1)$ due to non-uniform distribution of chinook along the river.

The night-time rate of loss of $\log_e(CPUE + 1)$ of 0.41 % / d (SE = 0.073) was slightly lower than the day-time rate of loss of 0.53 % / d (SE = 0.062) (Figure 17). However, the two rates were not statistically significant from one another ($t_{776} = 1.237$, $0.4<P<0.2$).

The intercept of the night regression of 2.820 (SE = 0.158) was 1.5 times greater than the intercept of the day regression of 1.893 (SE = 0.134), but the difference was not significantly different ($t_{776} = 1.414$, $0.2<P<0.1$). The main reason for the day-night difference in magnitude of $\log_e(CPUE + 1)$ is that young chinook salmon are more vulnerable to capture at night than during day, either because they were less able to detect and avoid the gear at night than during the day or because their distribution across habitats was different between night and day. That is, fry may have sought refuge during the day in habitat that was difficult to sample, but they came out of refuge at night and were therefore caught in greater numbers.

The differences between the predicted $\log_e(CPUE + 1)$ of day and night catches at the beginning and end of the regression period provide a range of estimates of the day-night difference in electrofishing catchability of 0+ chinook. In mid-May, the night-day difference was 1.082 (= 2.263 - 1.181), which means that night electrofishing caught an average of 3 times (= exp(1.082)) more 0+ chinook than day electrofishing. In early November, night electrofishing caught an average of 3.6 times (= exp(1.546 - 0.258)) more 0+ chinook than day electrofishing.

Figure 15
Mean (±1 SD) Condition-at-date of 0+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997

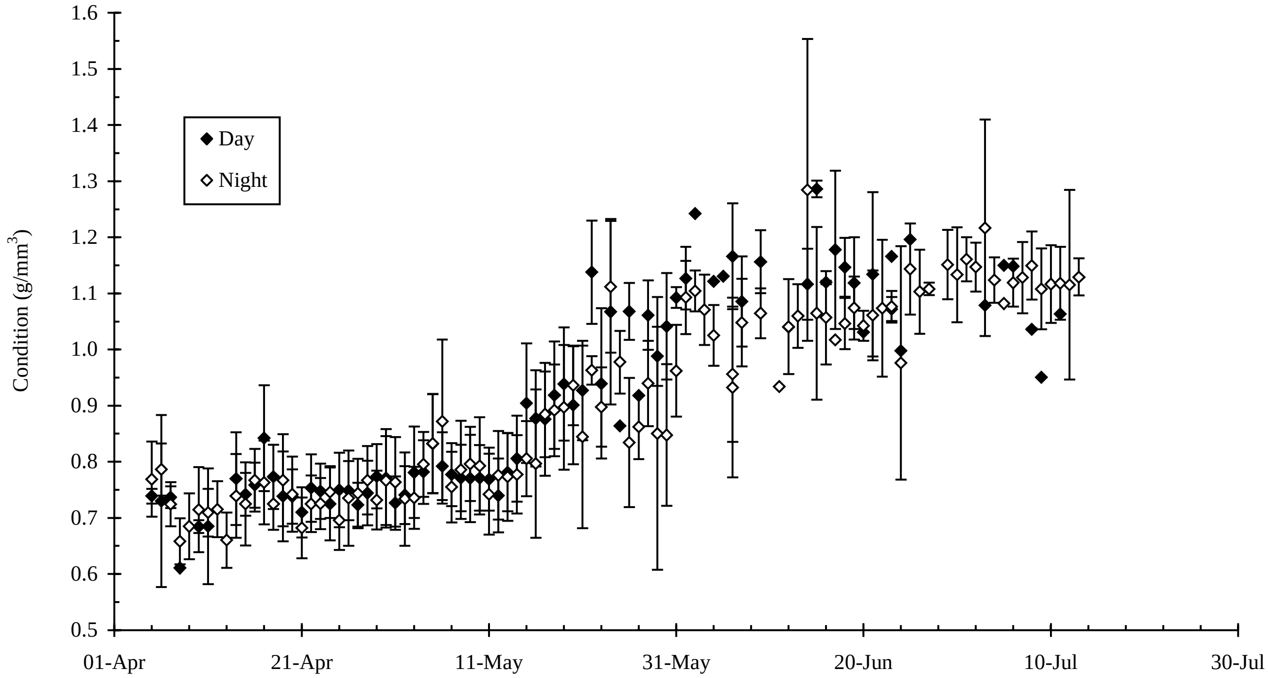


Figure 16
Mean (±1 SD) Condition-at-date of 1+ Chinook Salmon Captured in Traps
at Diamond Island, Nechako River, 1997

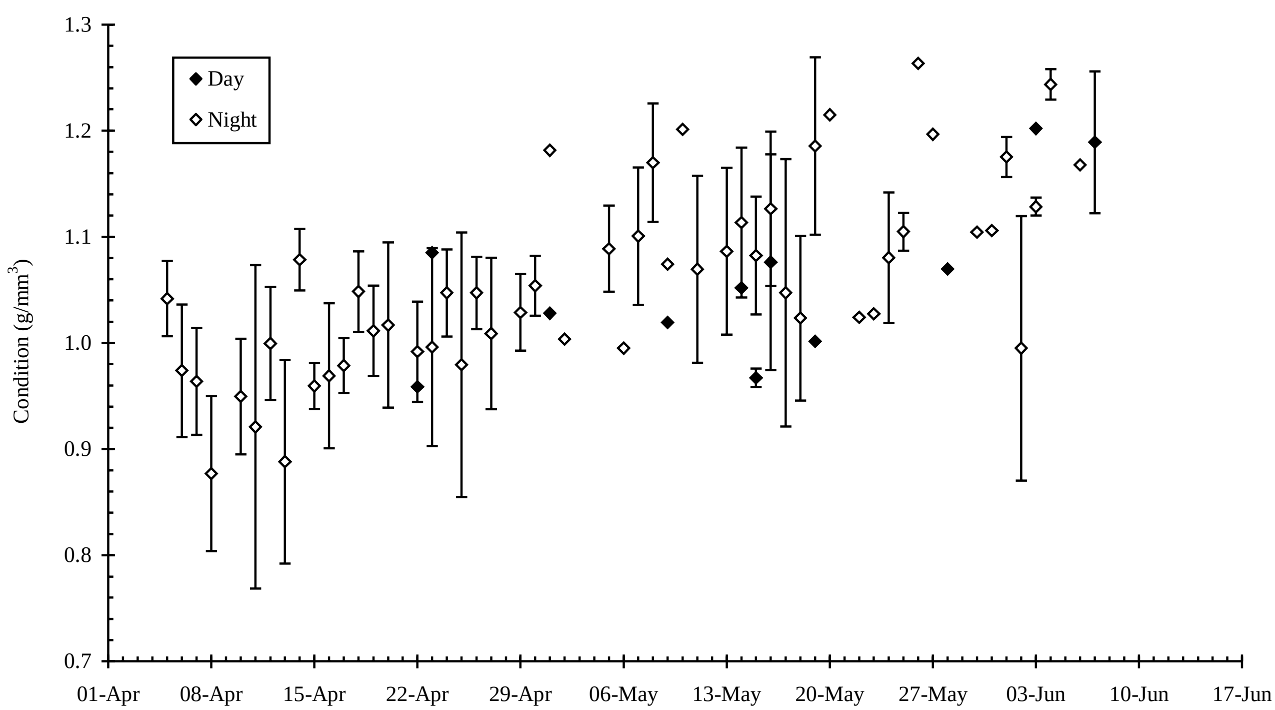


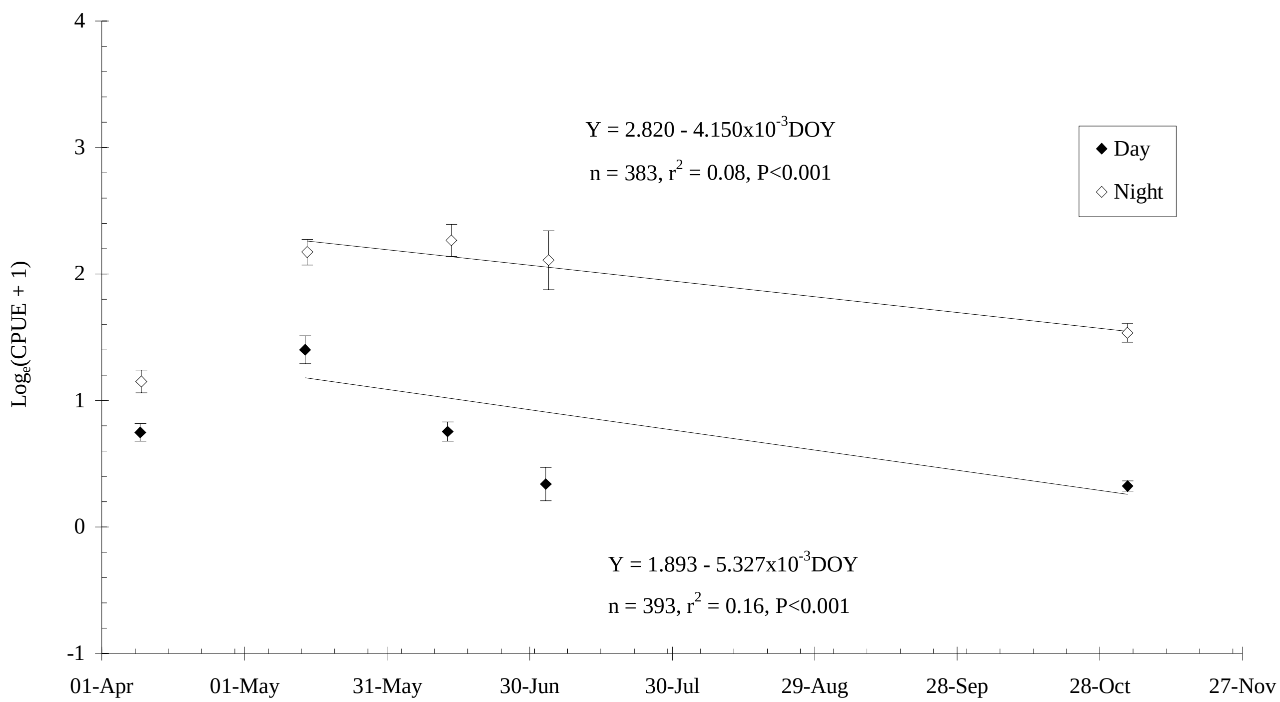
Table 1
Number of Fish Captured in the Upper Nechako River, 1997, by Electrofishing

		Adult				Juvenile				Total			
Species	Scientific Name	Day	Night	Total	Percent	Day	Night	Total	Percent	Day	Night	Total	Percent
Chinook salmon	*Oncorhynchus tshawytscha*	0	0	0	0.00	2501	6935	9436	30.81	2501	6935	9436	30.81
Redsided shiner	*Richardsonius balteatus*	225	1012	1237	4.04	1867	4753	6620	21.62	2092	5765	7857	25.66
Northern sqawfish	*Ptychocheilus oregonensis*	22	12	34	0.11	303	3561	3864	12.62	325	3573	3898	12.73
Leopard dace	*Rhinichthys falcatus*	546	322	868	2.83	761	816	1577	5.15	1307	1138	2445	7.98
Largescale sucker	*Catostomus macrocheilus*	8	12	20	0.07	622	1658	2280	7.44	630	1670	2300	7.51
Rocky mountain whitefish	*Prosopium williamsoni*	31	63	94	0.31	25	1676	1701	5.55	56	1739	1795	5.86
Sculpins (General)	*Cottidae*	195	202	397	1.30	413	491	904	2.95	608	693	1301	4.25
Longnose dace	*Rhinichthys cataractae*	175	6	181	0.59	989	109	1098	3.59	1164	115	1279	4.18
Rainbow trout	*Oncorhynchus mykiss*	9	71	80	0.26	16	101	117	0.38	25	172	197	0.64
Peamouth chub	*Mylocheilus caurinus*	0	0	0	0.00	47	44	91	0.30	47	44	91	0.30
Burbot	*Lota lota*	0	4	4	0.01	0	7	7	0.02	0	11	11	0.04
Lake trout	*Salvelinus namaycush*	0	0	0	0.00	6	2	8	0.03	6	2	8	0.03
Coho salmon	*Oncorhynchus kisutch*	0	0	0	0.00	4	0	4	0.01	4	0	4	0.01
Sockeye salmon	*Oncorhynchus nerka*	0	0	0	0.00	1	2	3	0.01	1	2	3	0.01
Total		1211	1704	2915	9.52	7555	20155	27710	90.48	8766	21859	30625	100.00

Table 2
Mean Monthly Electrofishing Catch-per-unit-effort (CPUE)
of Juvenile Chinook Salmon in the Nechako River, 1997

Date	Number 0+	Number 1+	n	0+ CPUE mean	0+ CPUE SD	1+ CPUE mean	1+ CPUE SD	0+ Log_e(CPUE+1) mean	0+ Log_e(CPUE+1) SD	1+ Log_e(CPUE+1) mean	1+ Log_e(CPUE+1) SD
Day											
09-Apr	342	27	136	2.119	3.881	0.145	0.554	0.7484	0.8031	0.0841	0.2675
13-May	1773	4	135	10.986	30.127	0.020	0.117	1.4023	1.2869	0.0148	0.0873
12-Jun	232	0	100	1.950	3.036	0.000	0.000	0.7541	0.7552	0.0000	0.0000
03-Jul	23	0	23	0.812	1.722	0.000	0.000	0.3405	0.6348	0.0000	0.0000
02-Nov	100	0	136	0.585	0.982	0.000	0.000	0.3240	0.4843	0.0000	0.0000
Night											
09-Apr	676	275	132	4.326	5.898	1.645	3.512	1.1506	1.0238	0.5652	0.7788
14-May	2379	79	134	14.518	16.111	0.508	1.220	2.1737	1.1756	0.2597	0.4724
13-Jun	2006	1	94	17.013	21.979	0.009	0.086	2.2664	1.2094	0.0064	0.0625
03-Jul	638	0	22	11.558	9.491	0.000	0.000	2.1090	1.0901	0.0000	0.0000
02-Nov	881	0	133	5.522	5.649	0.000	0.000	1.5349	0.8618	0.0000	0.0000

Figure 17
Mean (±1 SE) Monthly Electrofishing Catch-per-unit-effort (CPUE)
of 0+ Chinook Salmon, Nechako River, 1997



Spatial Distribution of CPUE

Figures 18 and 19 and Appendix 3 show the monthly distribution of mean $\log_e$(CPUE + 1) of 0+ chinook salmon over the upper 100 km of the Nechako River, aggregated into 10 km intervals.

In April, day sampling showed that the greatest CPUE of 0+ chinook occurred in a single region between 20.0 and 59.9 km from Kenney Dam, while the lowest non-zero CPUE was measured 80.0-89.9 km from the Dam. No juvenile chinook were caught within 9.9 km of Kenney Dam. Night sampling in April showed a similar pattern.

In May, the distribution of CPUE shifted from a unimodal to a bimodal distribution in both day and night sampling. One mode occurred in the 20.0-29.9 km interval and a second in the 70.0-79.9 km interval. Both were roughly the same magnitude.

In June, the upstream mode had moved closer to Kenney Dam. The greatest densities were recorded in the 10.0-19.9 km interval in both day and night catches. The downstream peak remained in the 70.0-79.9 km interval. Both modes were roughly the same magnitude.

In July, only the upper 35 km of the river were sampled, so only the first mode was sampled. It remained in the 10.0-19.9 km interval.

By late October and early November, the 0+ chinook remaining in the river had redistributed themselves roughly evenly along the length of the river, and no modes were visible. This pattern was the same in both day and night samples.

In summary, the electrofishing surveys of 1997 showed that 0+ chinook salmon were initially concentrated in the middle of the upper river in mid-April, but by May they had aggregated in two regions. The upstream aggregation indicated that some juveniles migrated upstream between April and July, presumably in search of rearing habitat. However, the upstream migration was limited in extent because few juveniles were found within 9.9 km of Kenney Dam. Finally, those juveniles remaining in the river by early November had redistributed themselves evenly over the upper river, presumably in search of overwintering habitat.

To quantify these observations, the monthly x-centroid, x_m (km), or weighted center of distribution of 0+ chinook along the longitudinal (x-axis) of the river, was calculated as:

$$(7) \quad x_m = \sum^{i} (CPUE_i . x_i) / \sum^{i} CPUE_i$$

where $CPUE_i$ = CPUE at site i, and x_i = longitudinal distance (km) from Kenney Dam to site i. The centroids confirmed the upstream migration of juvenile chinook towards Kenney Dam between April and June followed by downstream movement in fall as resident fish searched for overwintering habitat (Table 3).

Electrofishing/1+ Chinook

A total of 386 1+ chinook were captured by electrofishing (Table 2), of which 8.0% were taken during daylight and the rest were taken at night. CPUE of 1+ chinook ranged from 0.00 to 21.11 fish / 100 m^2, and decreased so rapidly with date that most, if not all, 1+ fish had left the upper Nechako River by the end of June (Table 2 and Figure 20). Greater numbers of 1+ fish were caught at night than during the day.

Average rates of loss of 1+ chinook at night over April, May and June were calculated by regressing mean monthly $\log_e$(CPUE + 1) against the three dates with non-zero catches. The night rate was 0.88 % / d (SE = 0.112) (Figure 20). The day rate could not be calculated using regression techniques due to a lack of day captures in June. Instead, a total instantaneous loss rate of night catches of 0.18 % / d over April and May was calculated as:

$$(8) \quad \text{loss rate} = -[100 / (t_{i+1} - t_i)][\log_e(CPUE + 1)_{i+1} - \log_e(CPUE + 1)_i],$$

where t_i = mid-date of month i, and t_{i+1} = mid-date of the following month.

Electrofishing CPUE for 1+ chinook showed that these fish were also concentrated in the upper river in April and May (Figure 21). The centroids of 1+ chinook were all in reach 2 (Table 3).

Diamond Island Rotary Screw Traps/0+ Chinook

A total of 3,222 juvenile chinook salmon were caught by rotary screw traps (RST) at Diamond Island in 1997 (Table 4). Over 93% of those juveniles were 0+ fish.

Figure 18
Mean (±1 SD) Monthly Catch-per-unit-effort (CPUE) of 0+ Chinook Salmon,
Nechako River, 1997: Electrofishing (day)

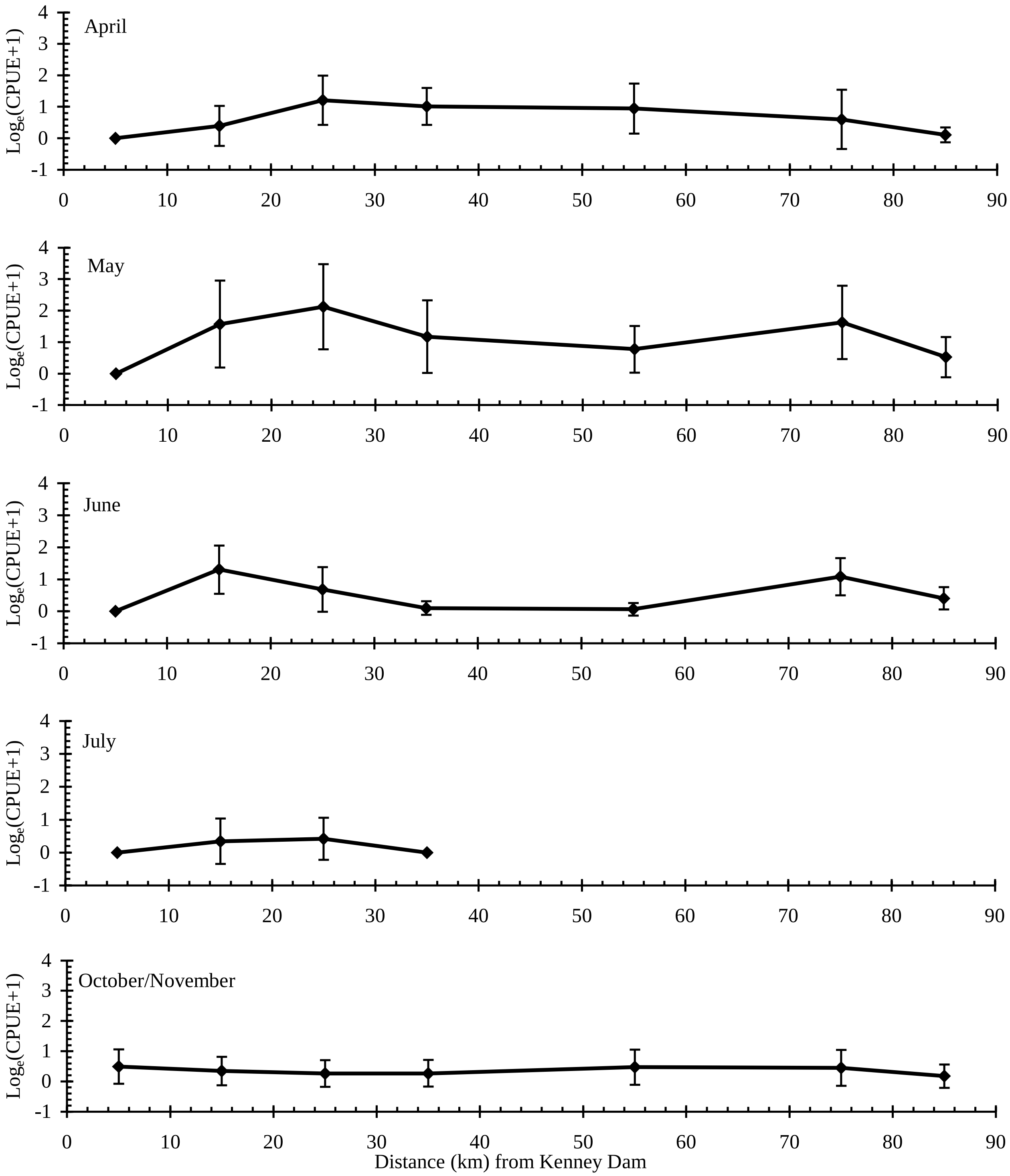


Figure 19
Mean (±1 SD) Monthly Catch-per-unit-effort (CPUE) of 1+ Chinook Salmon,
Nechako River, 1997: Electrofishing (night)

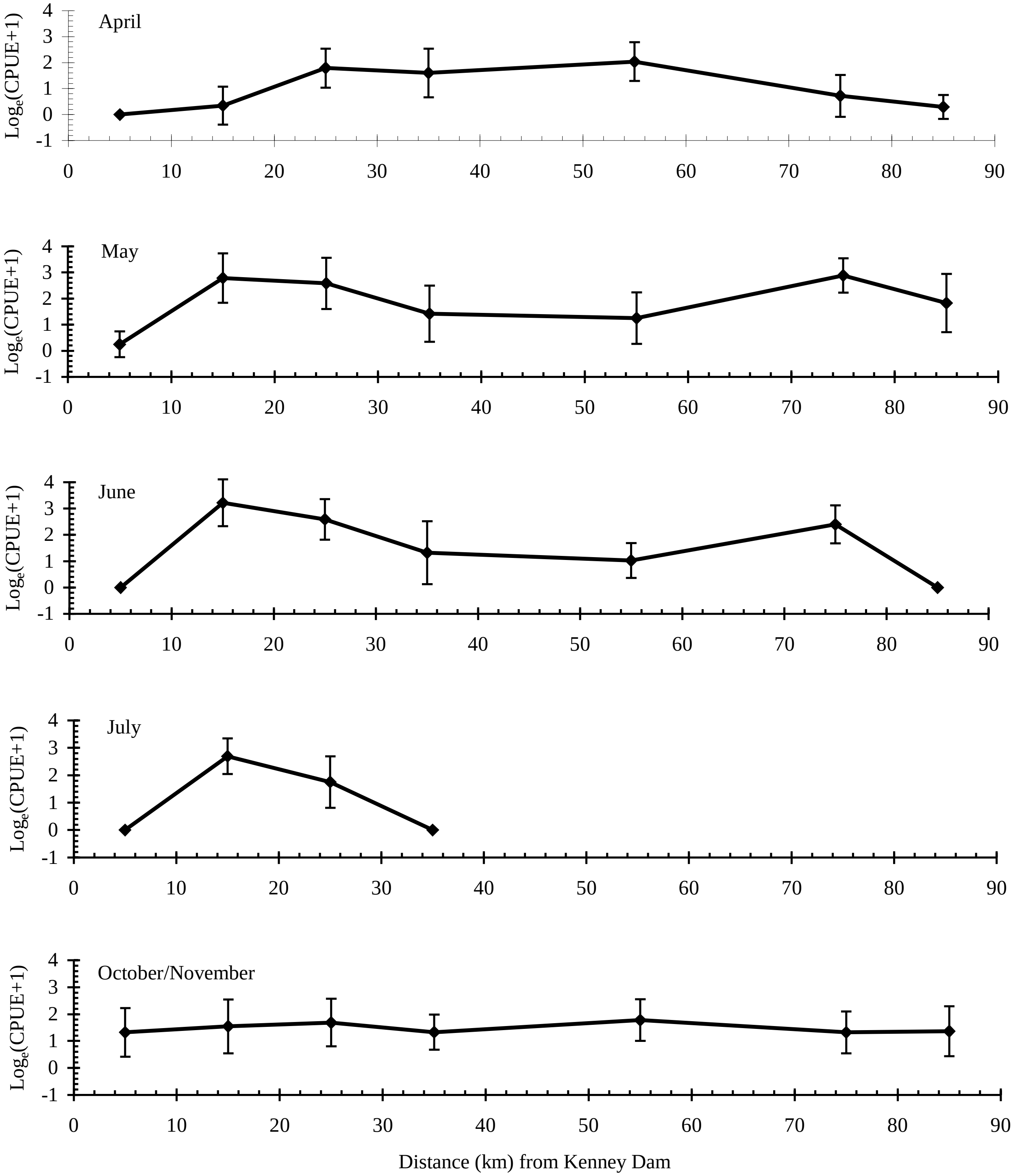


Table 3
Centroids of Juvenile Chinook Salmon Along the Longitudinal Axis of the Nechako River, 1997

	Centroid (km)	
Date	0+	1+
Day		
09-Apr	37.4	28.8
13-May	29.3	33.9
12-Jun	29.6	-
03-Jul	(19.3)[a]	-
02-Nov	42.1	-
Night		
09-Apr	37.4	47.3
14-May	35.9	35.2
13-Jun	25.8	55.8
03-Jul	(17.3)[a]	-
02-Nov	37.2	-

[a]inaccurate due to incomplete coverage of upper river.

Methods of Analysis

All analyses of RST catches were based on catches expanded by the ratio of river flow to trap flow according to equation (2).

The frequency distributions of catches of juvenile chinook salmon at Diamond Island required $\log_e$-transformation before analysis. However, the $\log_e$(number) transformation, rather than the $\log_e$(number + 1) transformation, was used for RST catches because the population expansion procedure effectively divided catches into two clusters of data: zero catches and non-zero catches. Non-zero catches were expanded by a factor of about 100 because most RSTs sampled about 1% of the daily flow of the river past Diamond Island, but zero catches were expanded to population estimates of zero-in effect they were not expanded at all. To avoid the problem of treating two separate clusters of data together, all zero catches of all Diamond Island traps were excluded from the analyses presented below.

Temporal Variance of Estimated Number

To determine which factors were responsible for changes in volume-adjusted numbers of 0+ chinook salmon caught in rotary screw traps, a standard three-

Figure 20
Mean (±1 SE) Monthly Electrofishing CPUE of 1+ Chinook Salmon, Nechako River, 1997

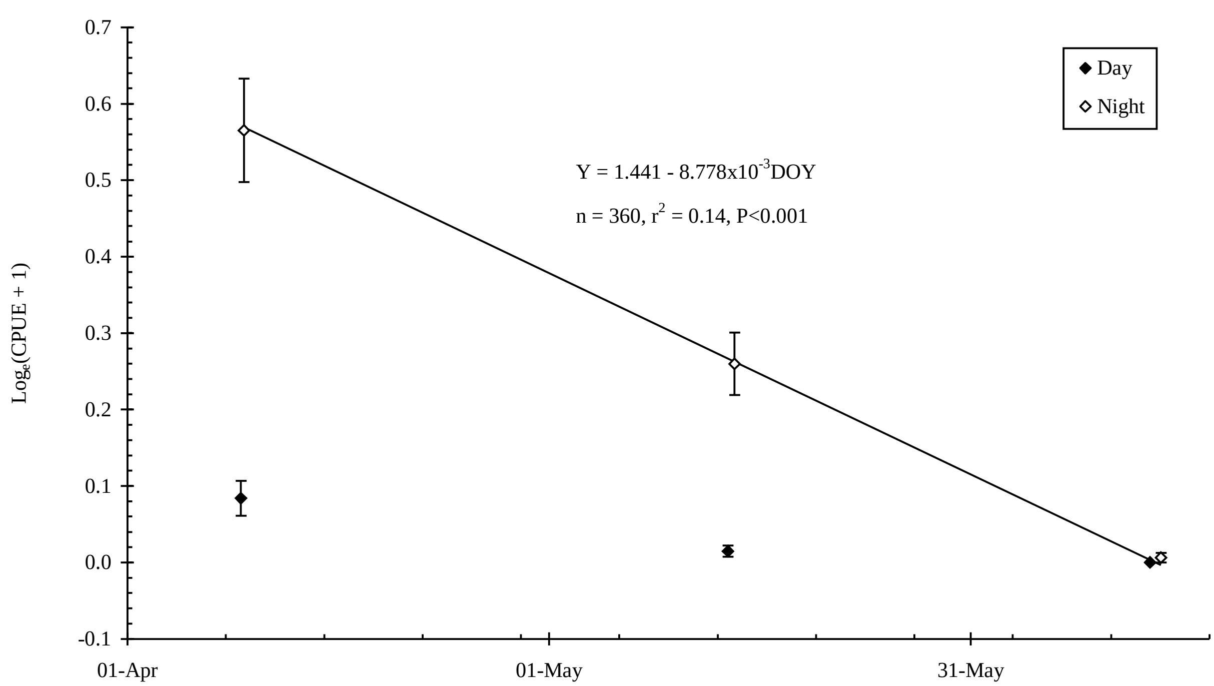


Figure 21
Spatial Distribution of 1+ Chinook Salmon in the Upper Nechako River, 1997: electrofishing

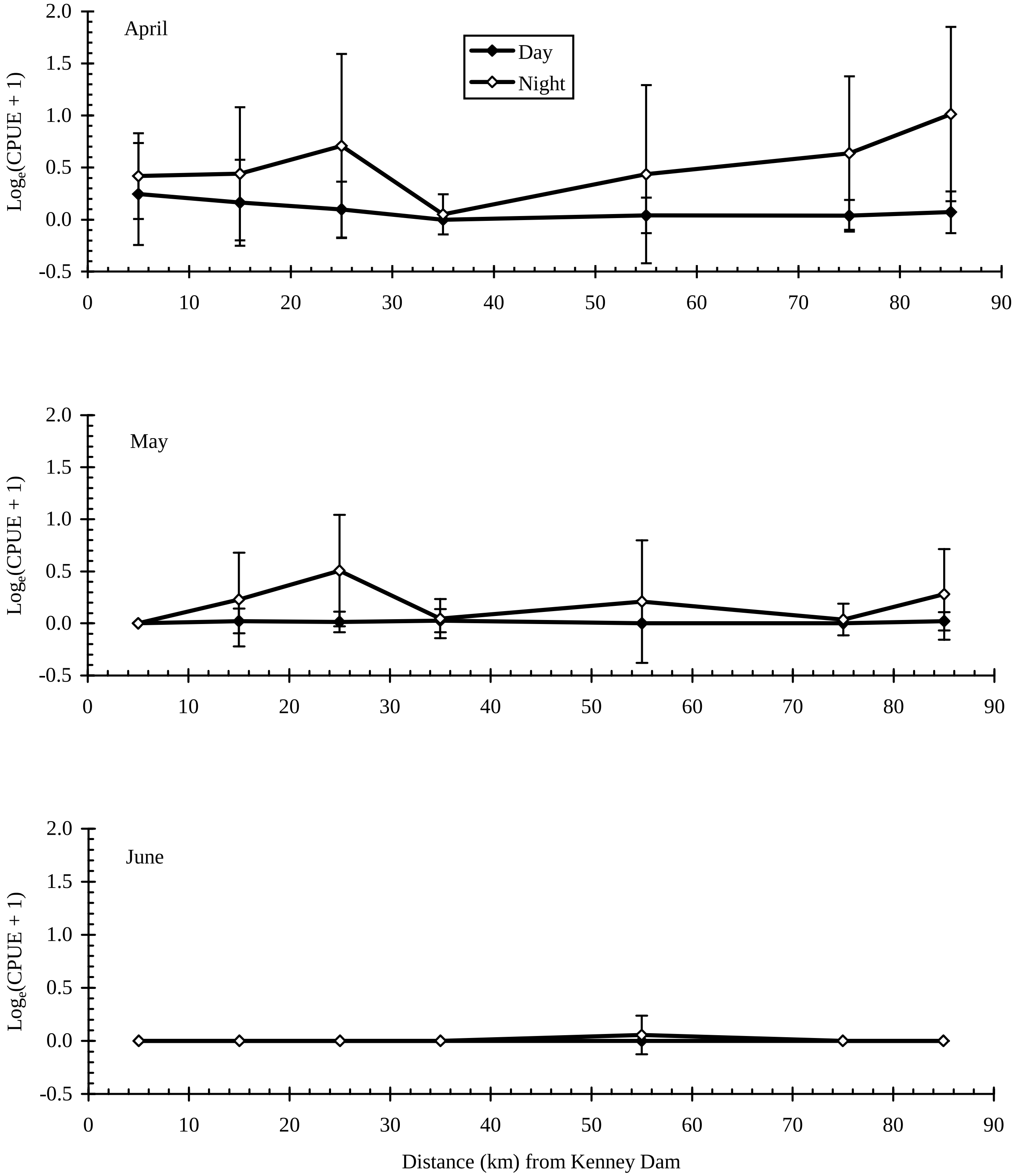


Table 4
Numbers of Juvenile Chinook Salmon Caught in Rotary Screw Traps at Diamond Island, Nechako River, 1997

Trap	0+ chinook			1+ chinook			
number	day	night	total	day	night	total	Total
1	326	446	772	12	100	112	884
2	275	505	780	5	60	65	845
3	639	815	1454	2	37	39	1493
total	1240	1766	3006	19	197	216	3222

way ANOVA of $\log_e$(number) on RST (three classes corresponding to the three traps), date (three classes: April, May and June-July), and time of day (two classes: day and night), was conducted. There were highly significant differences in $\log_e$(number) among dates ($F_{2,381}$ = 25.5, P<0.001) and among traps ($F_{2,381}$ = 29.3, P<0.001), but not between day and night ($F_{1,381}$ = 0.6, P = 0.431). There were also significant interactions of date and trap number ($F_{2,381}$ = 2.8, P = 0.024) and date, trap number and time of day ($F_{4,381}$ = 3.1, P = 0.016).

The date effect was due to variation in catch rates over the April to July period caused by recruitment of juveniles to the traps over April and early May followed by loss of juveniles over late May, June to July due to a combination of downstream dispersal, natural mortality, and changes in the catchability of the traps as chinook fry grew in size and increased their ability to avoid capture (Figures 22 and 23).

The trap effect was due to consistently greater catch rates in trap number 3 than in traps 1 and 2 (Table 4 and Appendix 4). This indicates that 0+ chinook salmon tended to pass closer to the right bank of the river than to middle of the river or the left bank.

The catch curves for the weighted average volume-expanded numbers measured during the day showed the typical three-part dome-shaped pattern observed in previous years. There was an initial period of increasing catches in April and early May as juveniles recruited to Diamond Island from upstream emergence sites. Catches reached a peak in early- to mid-May, and then decreased over late May and early June due to a combination of downstream dispersal, natural mortality, and changes in the catchability of the traps due to growth of juvenile chinook. Catches over late June and early July were constant or increased slightly with time. Night catches in particular increased at the end of June and the beginning of July.

To estimate the time rate of loss, a regression of $\log_e$(weighted average number) on day of year (DOY) were fit to the declining right-hand limb of the catch curves for day and night separately. May 10 (DOY = 130) was chosen as the beginning date of the regression period, based on the mid-date of the dome of the catch curves shown in Figures 22 and 23 plus the estimated dates of the end of the fry emergence period from growth analyses (May 5 to 14 or DOY 125 to 134). The instantaneous rate of loss for day catches was 3.87 % / d (SE = 0.75), which was seven times greater than the loss rates estimated from day electrofishing catches. The regression for night catches was not significant (n = 63, P = 0.36).

A total of 3,006 0+ chinook salmon were caught at the rotary screw traps in 1997 (Appendix 4). Summing the volume-expanded number of 0+ chinook that were estimated to have passed Diamond Island over the study period produced totals ranging from 94,020 for trap 2 to 242,252 for trap 3 (Appendix 4). The total index number of 0+ chinook that passed Diamond Island, weighted by the average percent of river flow filtered by each trap, was 133,812.

Diamond Island Rotary Screw Traps/1+ Chinook

There were no obvious temporal trends of $\log_e$(number) with date (Figure 24), apart from a maxima of night numbers in the second half of May. Mean $\log_e$(number) was greater at night than during the day.

A total of 216 1+ chinook were captured in the rotary screw traps which, when expanded by the percentage of river flow sampled by the traps, was equivalent to an index total of 7,963 1+ chinook that passed Diamond Island in 1996 (Appendix 4).

Diamond Island Rotary Screw Traps/Other Fishes

A total of 5,035 fish from 13 species or families were captured by the rotary screw traps in 1996 (Table 5).

Figure 22
Number of 0+ Chinook Salmon Passing Diamond Island, Nechako River, 1997,
as Estimated by Rotary Screw Traps (day)

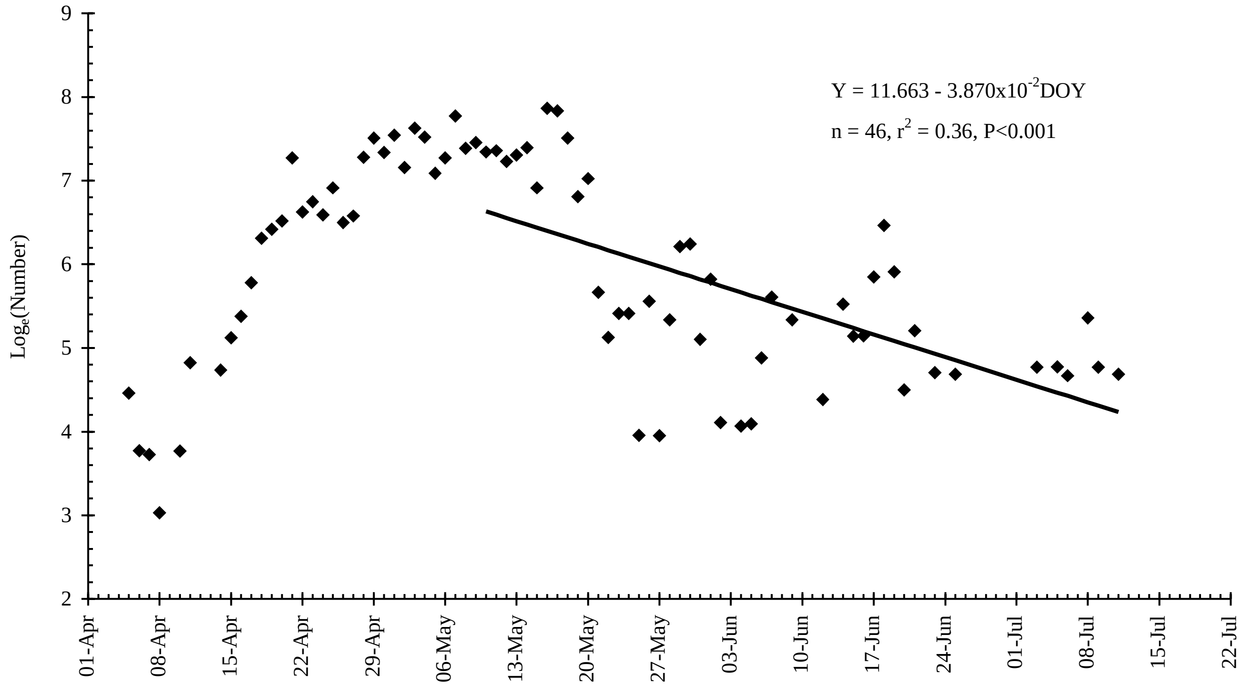


Figure 23
Number of 0+ Chinook Salmon Passing Diamond Island, Nechako River, 1997,
as Estimated by Rotary Screw Traps (night)

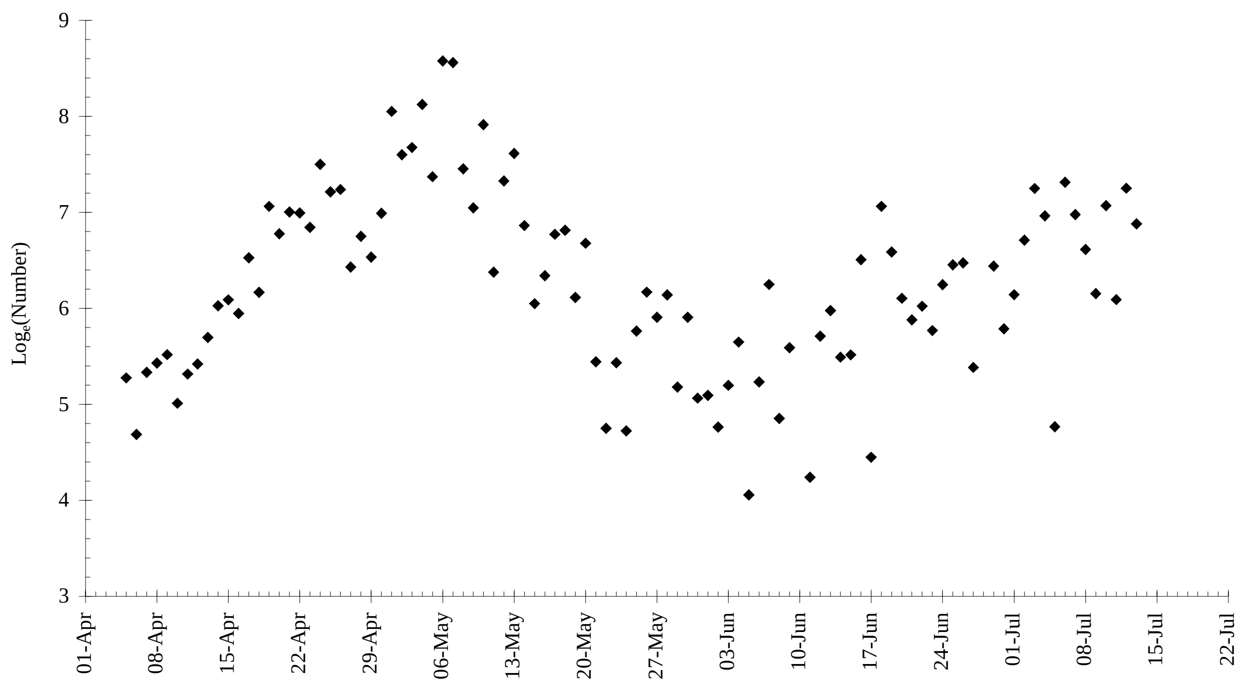
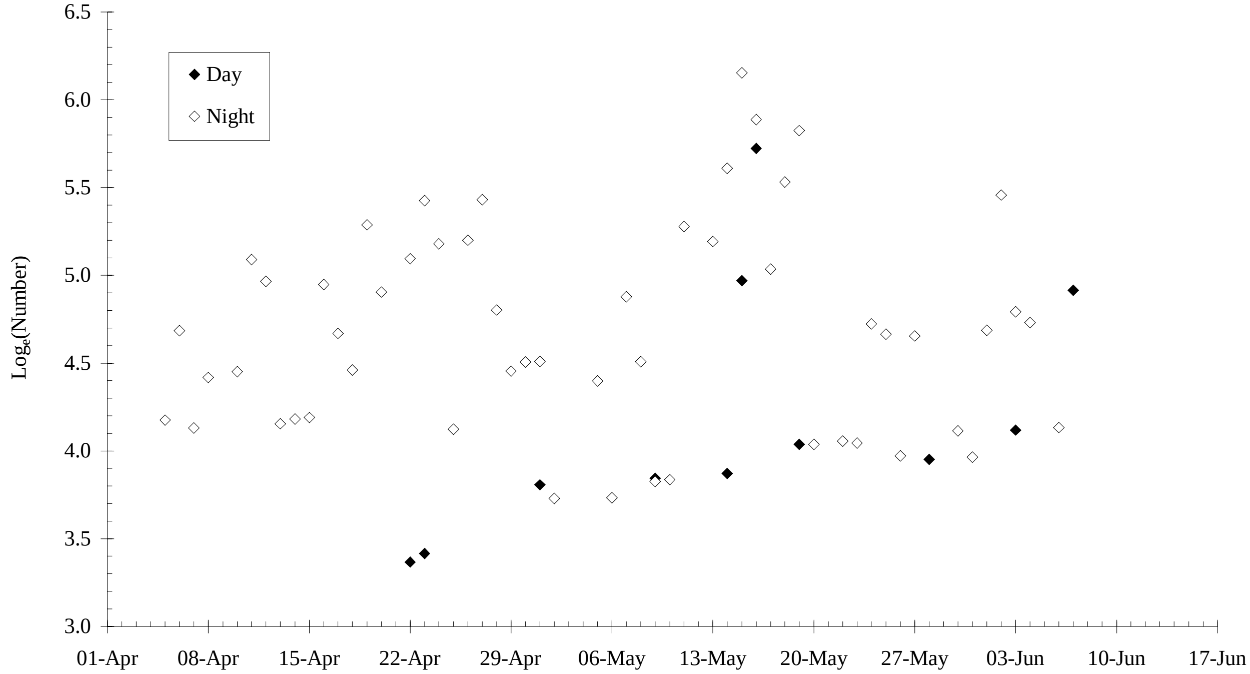


Figure 24
Number of 1+ Chinook Salmon Passing Diamond Island, 1997, as Estimated by Rotary Screw Traps



Chinook salmon was the most common species, making up 63.99% of all fish. The three most common non-salmonid fishes were northern squawfish, largescale sucker and redsided shiner. The least common fish was coho salmon-only 1 juvenile was caught in 1997.

Comparison with Previous Years

This section of the report compared the results of the 1997 investigations with results from the previous eight years of monitoring the upper Nechako River. The first step was to compare daily temperatures and flows among the years 1987 to 1997 so as to identify years of unusually high or low temperatures and flows. The next step was to determine if the biological features of 0+ chinook salmon population of the upper Nechako River reflected among-year differences in temperature and flow. That is, did changes in the timing and magnitude of flows and temperatures among years result in clear and unambiguous changes in size-at-date, growth curves, electrofishing CPUE, spatial distribution within the upper river, and the timing and magnitude of juvenile chinook outmigration past Diamond Island?

Because the index number of outmigrants is directly proportional to the number of adults that spawned in the upper Nechako in the previous autumn, the index number of outmigrants were also compared among years after standardisation for the number of spawners. Similar standardisation was also carried out for mean monthly electrofishing CPUE.

Temperature

Daily winter, spring and summer water temperatures recorded at Bert Irvine's Lodge in 1997 were among the lowest recorded since 1987 (Figure 25). In fact, during June and July, 1997, mean temperatures at Bert Irvine's were lower than the lowest daily mean recorded over the last 10 years. Those low temperatures were undoubtedly due in large part to the cooling effect of unusually high discharges into the Nechako River from the Nechako Reservoir during June and July 1997 (Figures 26 to 28).

After flows fell from their seasonal maximum in late summer of 1997, mean daily temperatures increased substantially and began to approach the 10-year mean. By the end of December 1997, mean daily tempera-

Table 5
Number of Fish Captured at Diamond Island, Nechako River, 1997, by Rotary Screw Traps

		Adult				Juvenile				Total			
Species	Scientific Name	Day	Night	Total	Percent	Day	Night	Total	Percent	Day	Night	Total	Percent
Chinook salmon	*Oncorhynchus tshawytscha*	0	0	0	0.00	1259	1963	3222	63.99	1259	1963	3222	63.99
Northern squawfish	*Ptychocheilus oregonensis*	0	18	18	0.36	76	455	531	10.55	76	473	549	10.90
Largescale sucker	*Catostomus macrocheilus*	0	3	3	0.06	16	402	418	8.30	16	405	421	8.36
Redsided shiner	*Richardsonius balteatus*	12	66	78	1.55	38	186	224	4.45	50	252	302	6.00
Peamouth chub	*Mylocheilus caurinus*	0	0	0	0.00	134	111	245	4.87	134	111	245	4.87
Leopard dace	*Rhinichthys falcatus*	5	43	48	0.95	27	81	108	2.14	32	124	156	3.10
Rainbow trout	*Oncorhynchus mykiss*	0	1	1	0.02	4	32	36	0.71	4	33	37	0.73
Longnose dace	*Rhinichthys cataractae*	2	10	12	0.24	1	22	23	0.46	3	32	35	0.70
Sculpins (General)	*Cottidae*	1	0	1	0.02	0	18	18	0.36	1	18	19	0.38
Rocky mountain whitefish	*Prosopium williamsoni*	0	7	7	0.14	2	9	11	0.22	2	16	18	0.36
Lake trout	*Salvelinus namaycush*	0	0	0	0.00	2	14	16	0.32	2	14	16	0.32
Sockeye salmon	*Oncorhynchus nerka*	0	0	0	0.00	3	11	14	0.28	3	11	14	0.28
Coho salmon	*Oncorhynchus kisutch*	0	0	0	0.00	0	1	1	0.02	0	1	1	0.02
Total		20	148	168	3.34	1562	3305	4867	96.66	1582	3453	5035	100.00

Figure 25
Mean, Minimum and Maximum Daily Water Temperatures of the Upper Nechako River at Bert Irvine's, 1987 to 1997

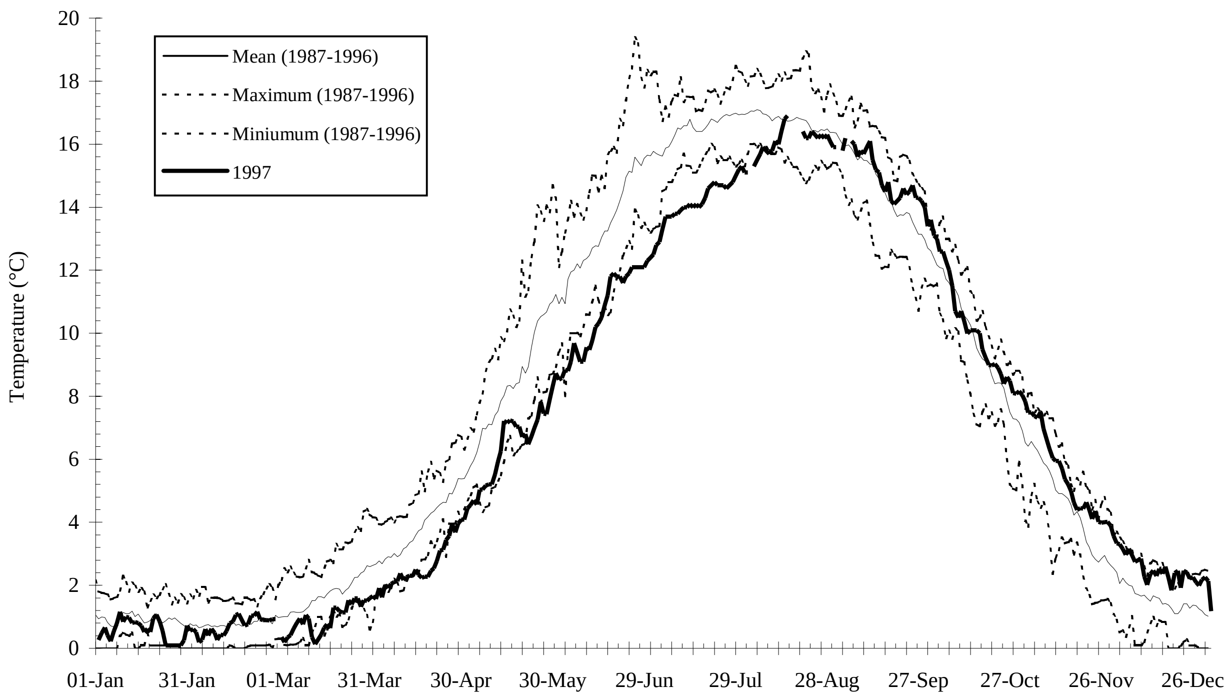


Figure 26
Mean, Minimum and Maximum Daily Flow of the Nechako River at Cheslatta Falls, 1987 to 1997

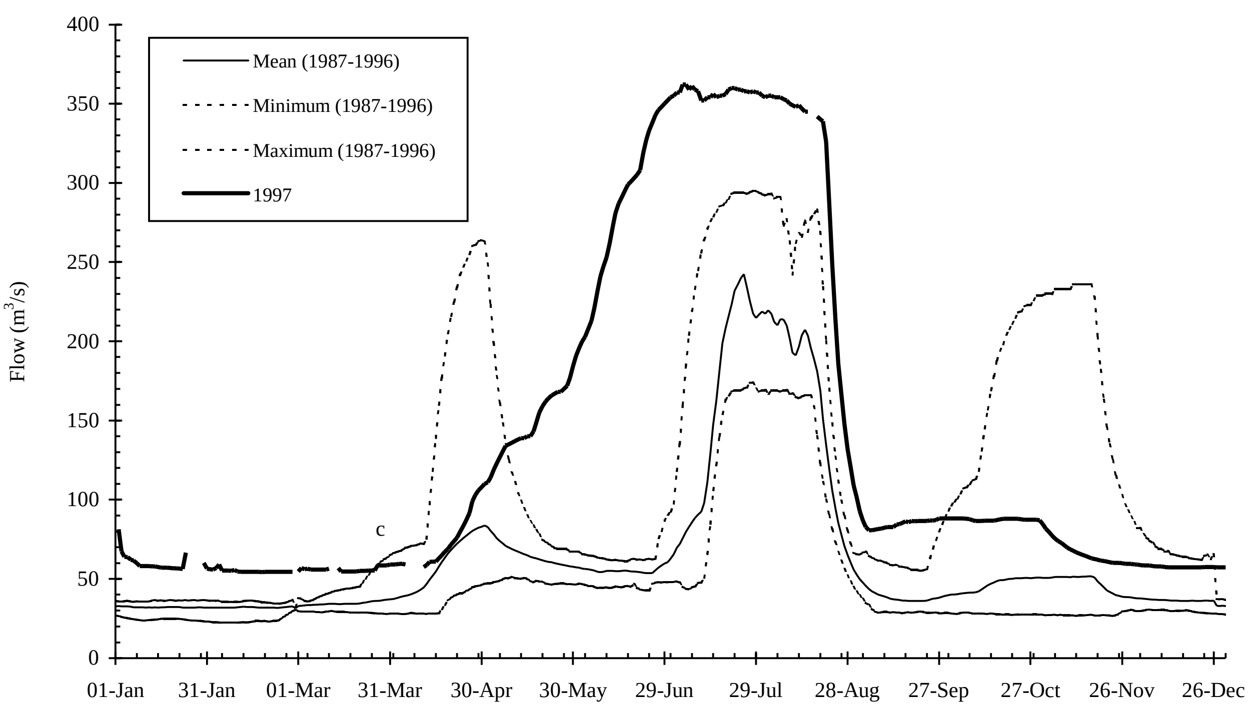
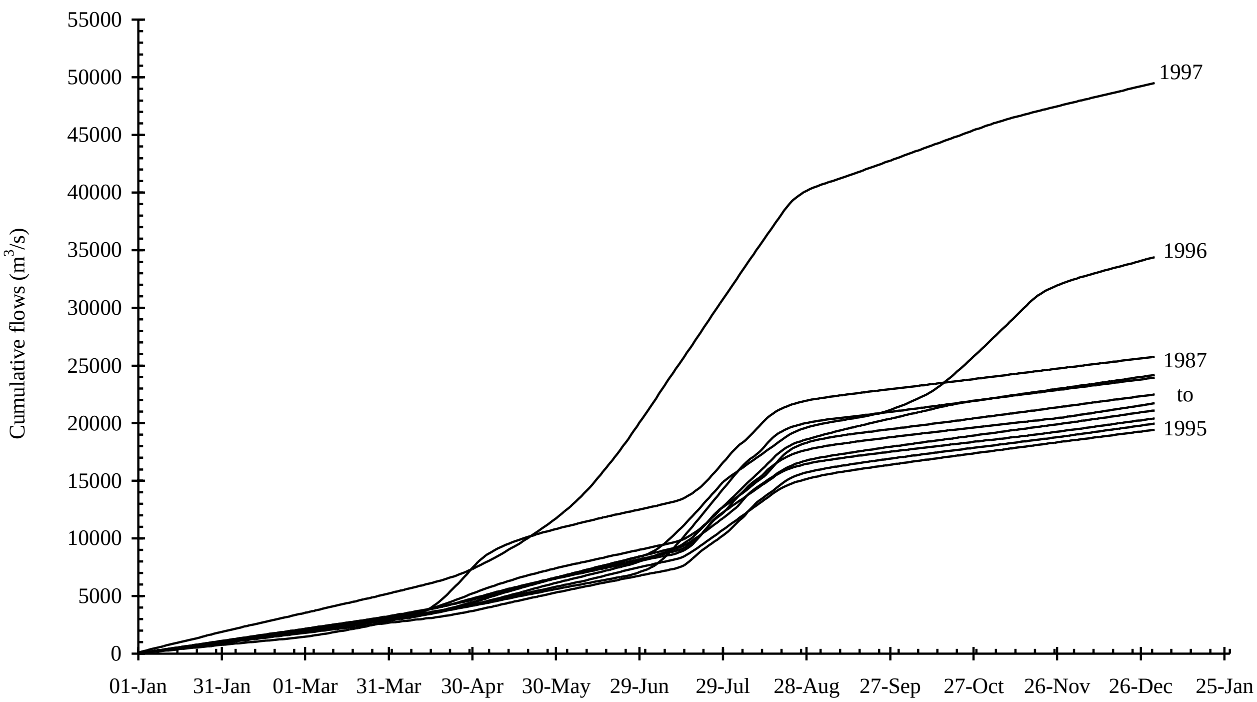


Figure 27
Cumulative Daily Flows of the Nechako River at Cheslatta Falls, 1987 to 1997



tures had begun to approach the maximum recorded over the 10-year period.

Flow

Flows of the upper Nechako River at Cheslatta Falls were unusually high throughout 1997 (Figure 26). In fact, flows from April to August, 1997, were the highest recorded over the last 10 years. The unusually high magnitude of the 1997 flows, and the unusual timing of those flows, can best be appreciated by a plot of cumulative daily flows for each year from 1987 to 1997 (Figure 27).

The typical flow pattern from 1987 to 1996 consisted of relatively low and constant flows from January to June, high cooling flows during July and August, followed by relatively low and constant flows from September to December. Brief periods of high discharge occurred in March-April, 1990, and in October-November, 1996. However, in 1997 flows exceeded the 10-year maximum in almost every month except April, October and November.

In summary, 1997 was an unusual year for the temperature and flow regime of the Nechako River. Record amounts of water were released early in the year into the Nechako River. Those high flows caused record low water temperatures in the upper river during the first half of the year. The effect of those high flows and low temperatures on the growth, distribution and outmigration of juvenile chinook are examined below.

Growth of 0+ Chinook Salmon

Plots of mean length-at-date and weight-at-date of 0+ chinook salmon calculated from the electrofishing surveys (Figure 28), and from rotary screw catches at Diamond Island (Figure 29), showed that mean size-at-date of juveniles from April to July, 1997, was amongst the lowest, if not the lowest, of any of the previous 8 years. The only other year with similarly low mean size-at-date was 1996, which was also a year of relatively high flows and low temperatures in the upper Nechako River.

In contrast, mean condition-at-date of 0+ chinook salmon in 1997 fell within the range of other 8 years.

Figure 28
Mean Size-at-date of 0+ Chinook Salmon, Upper Nechako River, 1989 to 1997 (electrofishing)

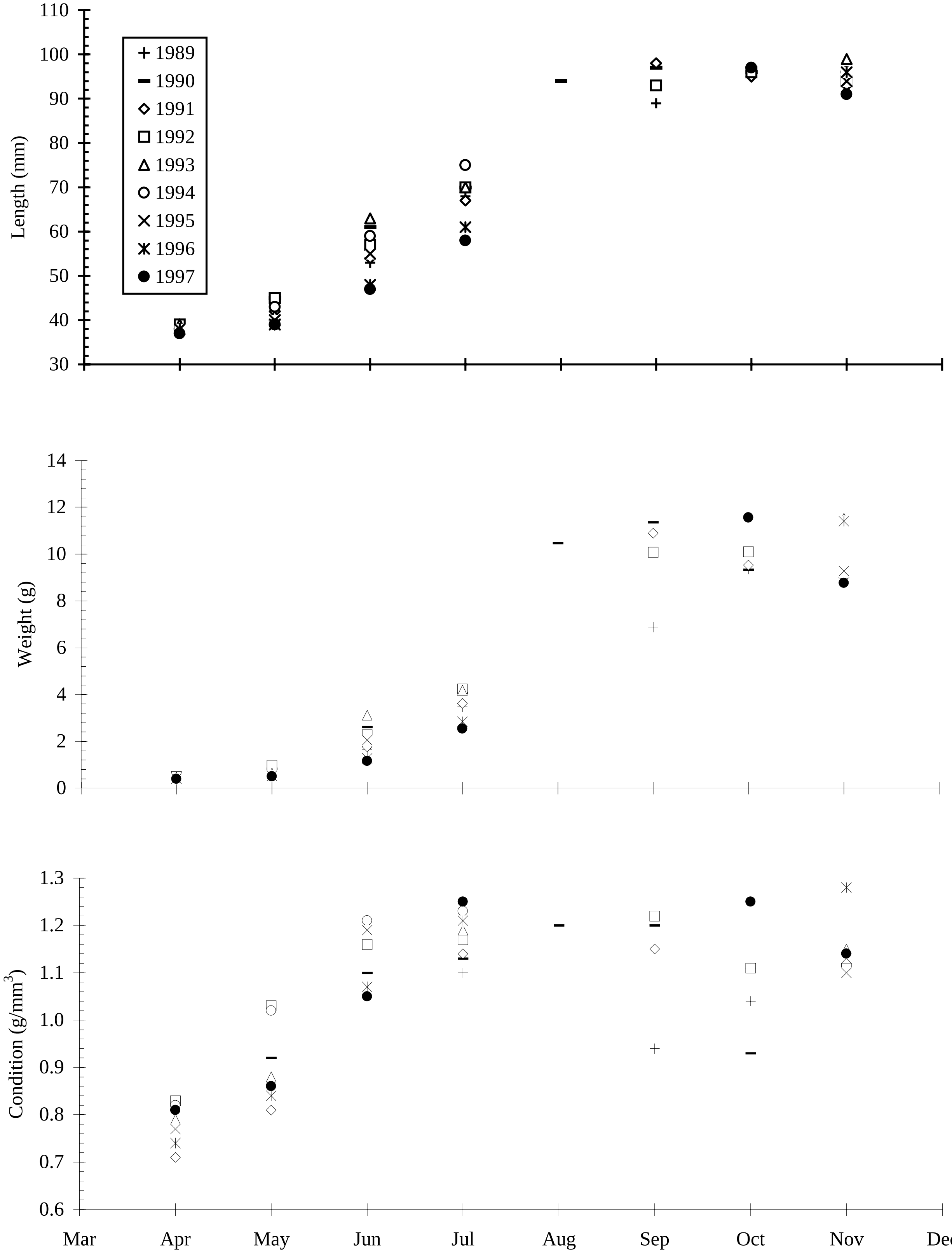
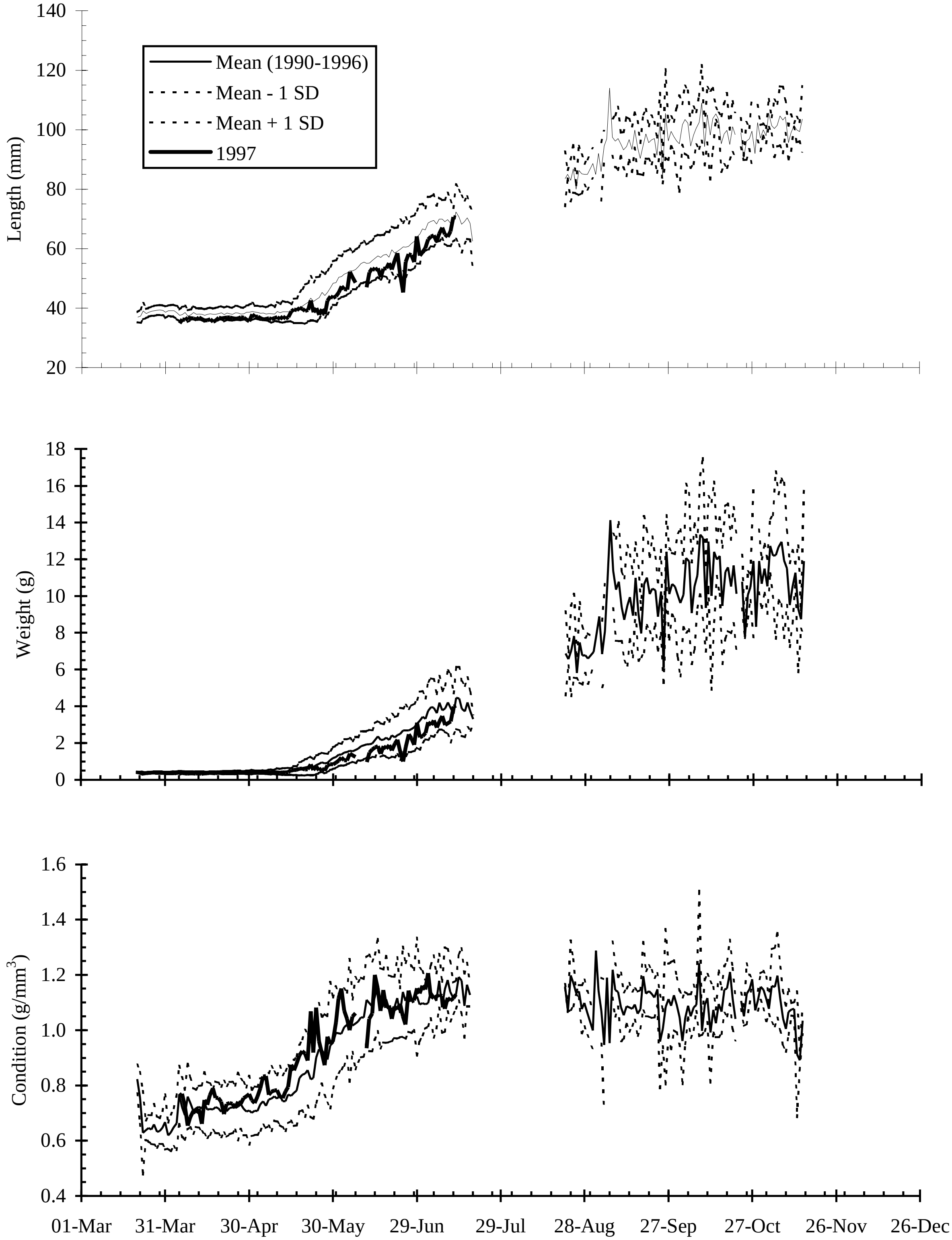


Figure 29
Mean Size-at-date of 0+ Chinook Salmon, Diamond Island, Nechako River, 1990 to 1997



Low length- and weight-at-date may have been due to delayed emergence of fry in the spring of 1997 or to low growth rates. To determine which possibility was correct, mean length-at-age and weight-at-age predicted by the growth curves for electrofished fish were compared (Table 6 and Figures 30 and 31). Those plots show that initial growth rates of 0+ chinook were lower in 1997 than in any of the previous 6 years, although final length and weight by the end of the outmigration monitoring season on July 13 ended up within the range of previous years. Comparison of the values of the DOY_0 parameter shows that chinook fry emerged later in 1997 than in most other years.

In summary, low water temperatures in the winter and spring of 1997 both delayed chinook fry emergence and reduced initial growth rates compared to previous years. However, because the rate at which the initial growth rate decreased with time (the α parameter of Table 6) was also lower in 1997 than in previous years, the final average size of juveniles in July, 1997, fell within the range observed in July for previous years.

Spatial and Temporal Distribution of 0+ Chinook

Unlike growth data, the catch curves of monthly electrofishing CPUE in 1997 (Figure 32), and the seasonal pattern of change in the centroids of 0+ chinook in 1997 (Figure 33), did not show any features that were clearly different from those of the previous 8 years.

The daily indices of 0+ chinook outmigration measured at Diamond Island in 1997 also fell within the range observed in the previous 6 years (Figure 34).

Together, these findings show that the high flows and low temperatures of the upper Nechako River in 1997 were not reflected in the spatial and temporal distribution of 0+ chinook fry in 1997.

Correlation of Outmigrant Number and Spawner Number

One possible reason for the lack of an obvious relationship between flows and the distribution and abundance of juvenile chinook in the upper Nechako River is that a flow "signal" may have been obscured by among-year variation in the number of emergent fry which, in turn, was due to among-year variation in the number of spawners.

The total number of outmigrating 0+ chinook that passed Diamond Island between April and July of each year from 1992 to 1997 was significantly correlated with the number of parents that spawned upstream of Diamond Island from 1991 to 1996 (Table 7 and Figure 35). A linear regression explained 70% of the variation in the total annual number of 0+ outmigrants. This is the first year in which this relationship has achieved statistical significance.

The intercept of the regression is not statistically significant ($P>0.05$) from zero, a result that was expected because zero spawners should produce zero juvenile outmigrants. If the intercept is assumed to be zero, i.e. if the regression is forced through the origin, then the slope of the regression increases to 97.61, the SE of the slope falls from 24.97 to 8.09, and the probability (P) that the slope is not significantly different from zero decreases from 0.023 to 0.017.

Spawner-Standardised Outmigrants and Electrofishing CPUE

The significant outmigrant-spawner relationship means that it is now possible to remove the variation in $\log_e$(outmigrant number) that is caused by among-year variation in spawner number. Each daily outmigrant estimate was divided by the total number of adults that spawned upstream of Diamond Island in the previous fall. Comparison of Figures 34 and 36 shows that standardisation for spawner number did indeed reduce among-year variation in daily outmigration index, although considerable variation remains. (Note that data for the year 1991 was not included in Figure 35 because it was not comparable with data from the years 1992 to 1997. See Table 7 for an explanation.)

A similar standardisation procedure was carried out for the monthly electrofishing CPUE data by dividing each monthly geometric mean CPUE + 1 by the number of spawners counted in reaches 1 to 4 of the upper river in the previous autumn. This procedure assumes a significant correlation between total annual electrofishing CPUE and spawner number in the previous autumn. The existence of such a relationship is a reasonable assumption, but it is not confirmed. Comparison of Figures 32 and 37 shows that spawner standardisation resulted in a decrease in among-year variation of monthly CPUE, particularly for the

Table 6
Comparison of Growth of 0+ Chinook Salmon, Nechako River, 1991 to 1997

	Length (mm)				Weight (g)				
Year	L_0	DOY_0	A_0	α	W_0	DOY_0	A_0	α	Comments
Electroshocking									
1991	38.2	121.2	0.007677	0.005271	0.40	139.8	0.067570	0.020670	day, 1st and 2nd stanza pooled
1991	38.2	121.6	0.010650	0.009778	0.40	135.9	0.072750	0.022430	night, 1st and 2nd stanza pooled
1992	39.0	114.2	0.006313	0.003245	0.45	127.7	0.060320	0.019060	day, 1st and 2nd stanza pooled
1992	39.0	112.8	0.009206	0.008405	0.45	126.4	0.066320	0.021250	night, 1st and 2nd stanza pooled
1993	39.0	116.0	0.010600	0.009590	0.45	124.0	0.062600	0.018700	day and night pooled, 1st and 2nd stanza pooled
1994	38.5	111.1	0.011100	0.010300	0.41	128.2	0.081300	0.025200	day and night pooled, 1st and 2nd stanza pooled
1995	38.0	129.1	0.013710	0.013870	0.40	127.9	0.067060	0.020830	day and night pooled, 2nd stanza only
1996	38.0	139.6	0.011240	0.009557	0.38	140.5	0.061470	0.017020	day and night pooled, 2nd stanza only
1997	38.0	132.7	0.008400	0.006335	0.38	134.5	0.053110	0.015500	day and night pooled, 2nd stanza only
Diamond Island traps									
1991	38.2	123.3	0.009134	0.006193	0.40	124.1	0.045530	0.012100	day, 1st and 2nd stanza pooled
1991	38.2	121.3	0.008835	0.005634	0.40	124.7	0.047100	0.012400	night, 1st and 2nd stanza pooled
1992	39.0	102.1	0.005937	0.002211	0.45	114.4	0.039290	0.012210	day, 1st and 2nd stanza pooled
1992	39.0	102.3	0.007691	0.004576	0.45	114.6	0.043170	0.011780	night, 1st and 2nd stanza pooled
1993	39.0	120.7	0.009540	0.005340	0.45	127.1	0.061000	0.017200	day and night pooled, 1st and 2nd stanza pooled
1994	38.5	114.0	0.007220	0.009280	0.41	119.2	0.056900	0.012600	day and night pooled, 1st and 2nd stanza pooled
1995	38.0	134.8	0.021760	0.028320	0.40	134.2	0.110300	0.066370	day and night pooled, 2nd stanza only
1996	38.0	144.9	0.017430	0.021070	0.38	142.5	0.085980	0.033410	day and night pooled, 2nd stanza only
1997	36.0	127.2	0.008219	-0.005405	0.38	126.5	0.036680	0.002020	day and night pooled, 2nd stanza only

Figure 30
Predicted Growth in Length of 0+ Chinook Sampled by Electrofishing
in the Upper Nechako River, 1991 to 1997

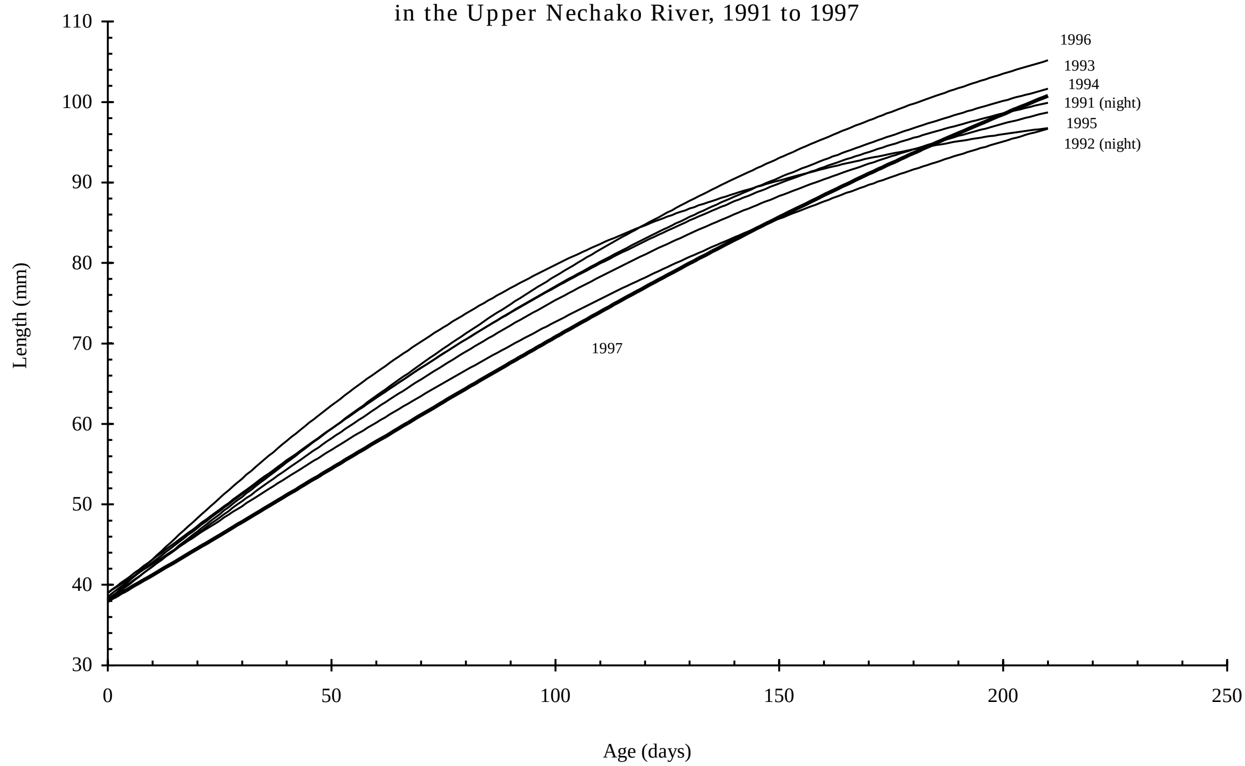


Figure 31
Predicted Growth in Weight of 0+ Chinook Sampled by Electrofishing
in the Upper Nechako River, 1991 to 1997

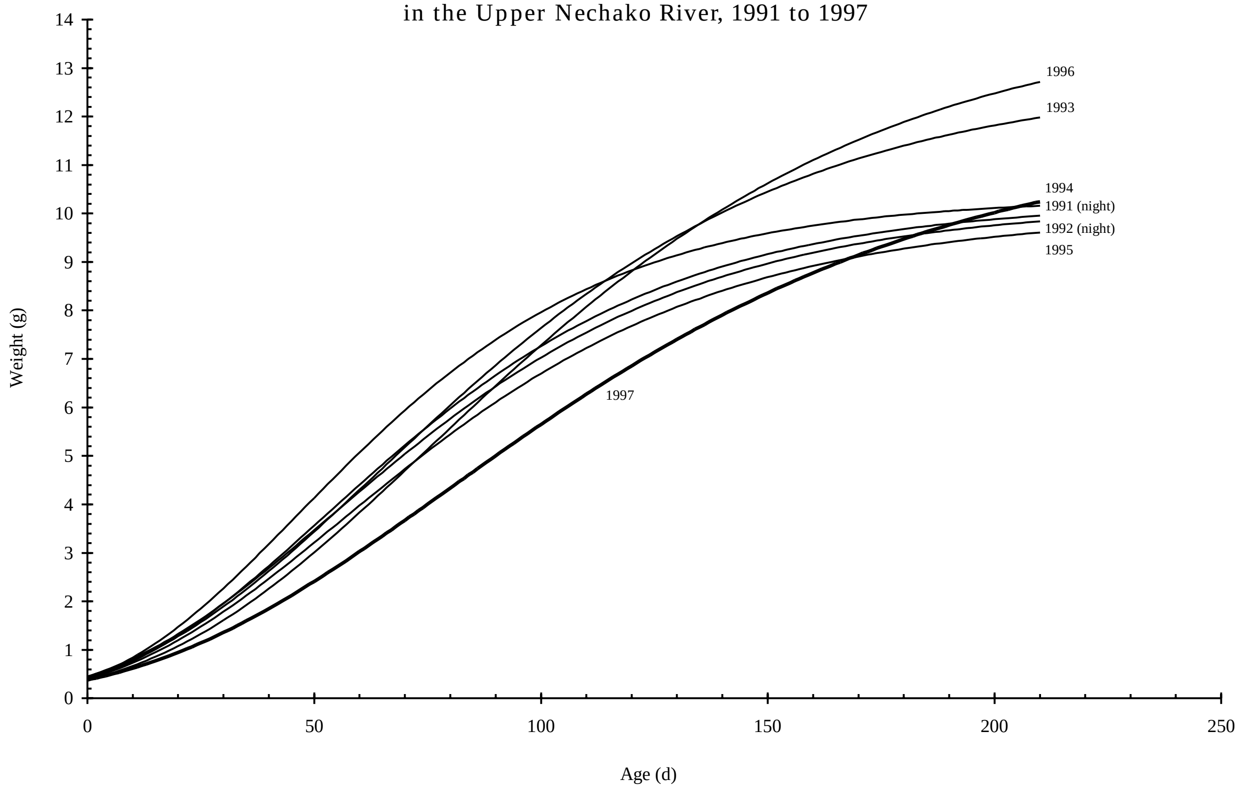


Figure 32
Mean Monthly CPUE of 0+ Chinook, Upper Nechako River, 1989 to 1997

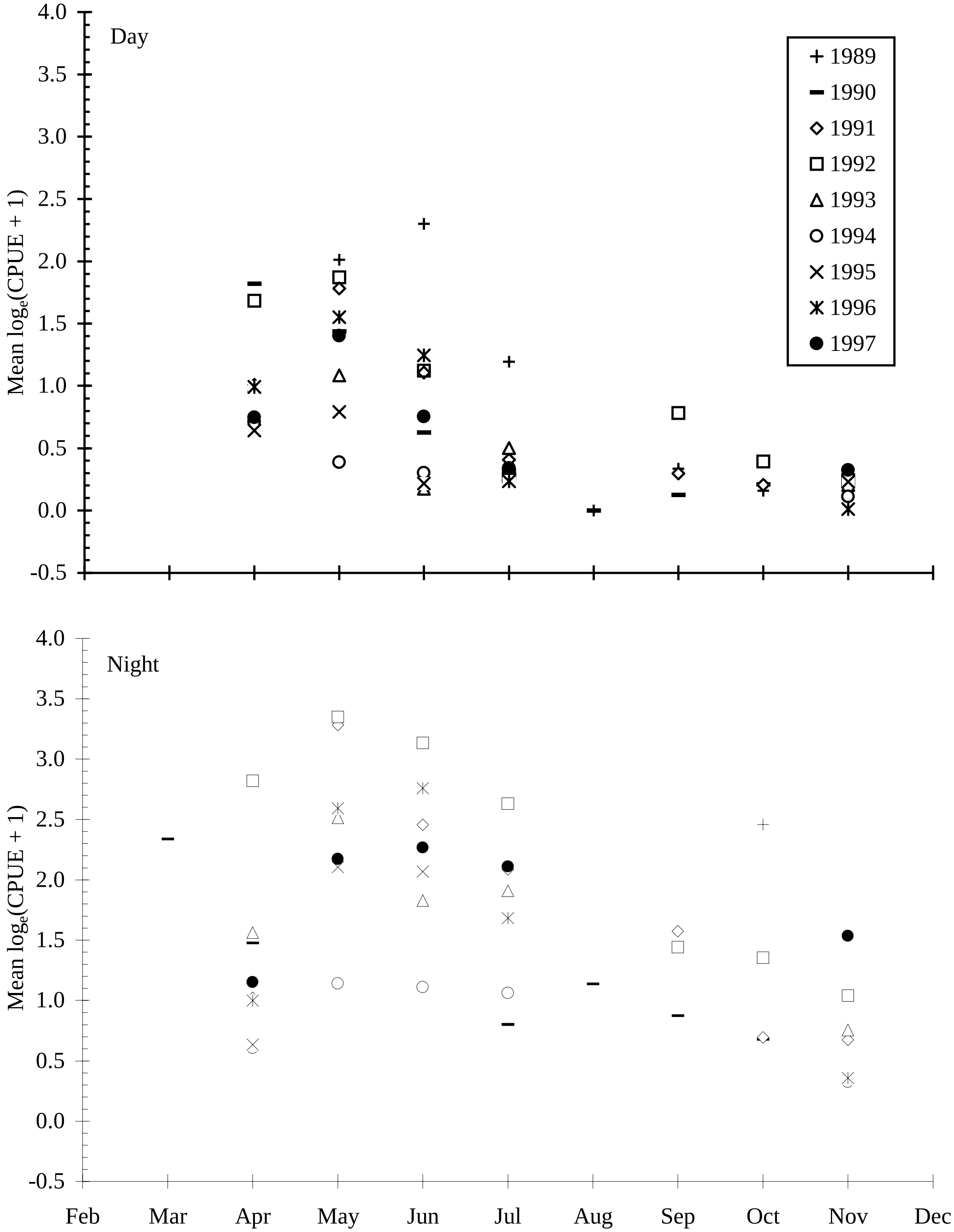


Figure 33
Monthly Centroids of 0+ Chinook, Upper Nechako River, 1991 to 1997

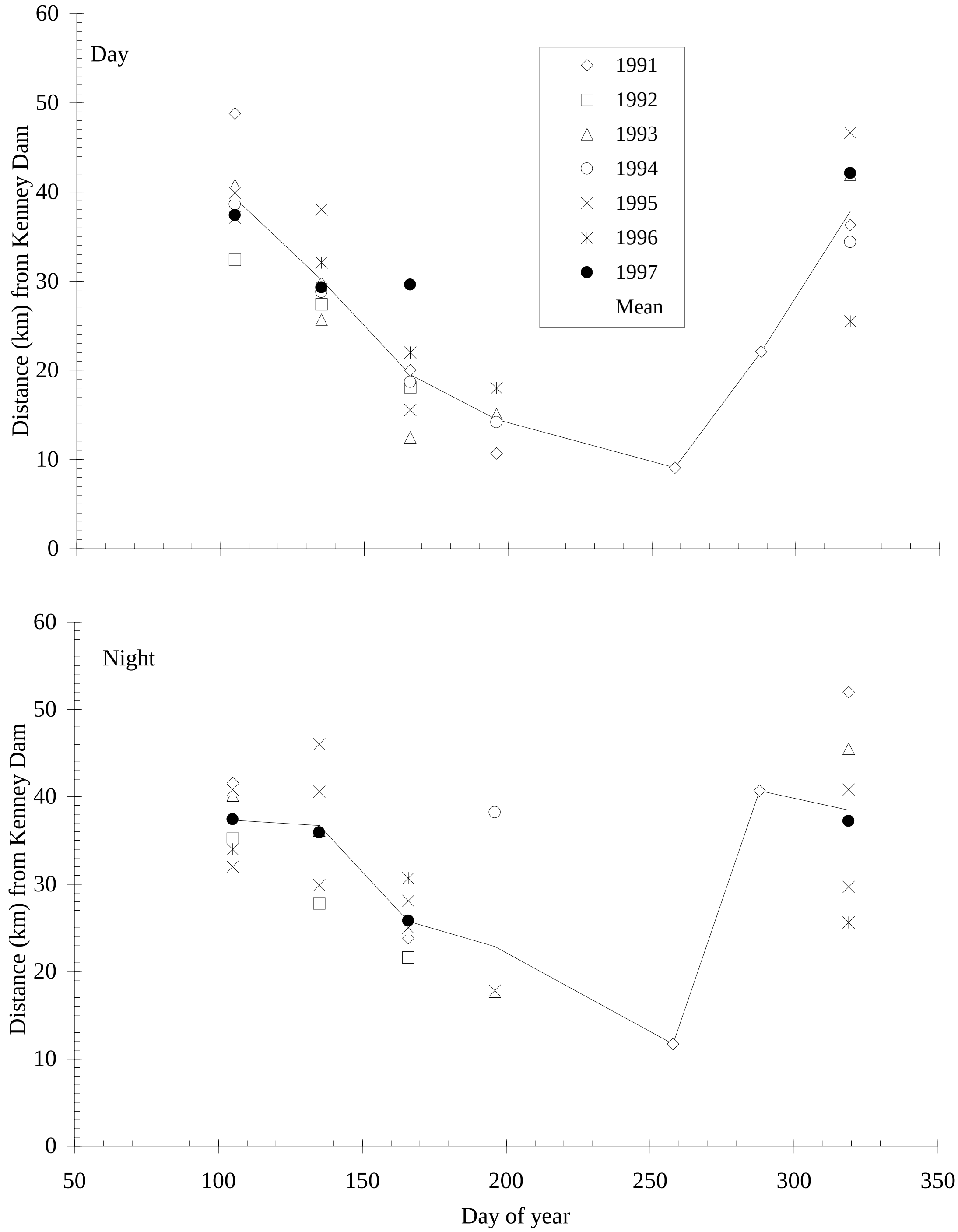


Figure 34
Daily Index of 0+ Chinook Outmigration, Diamond Island, Nechako River, 1991 to 1997

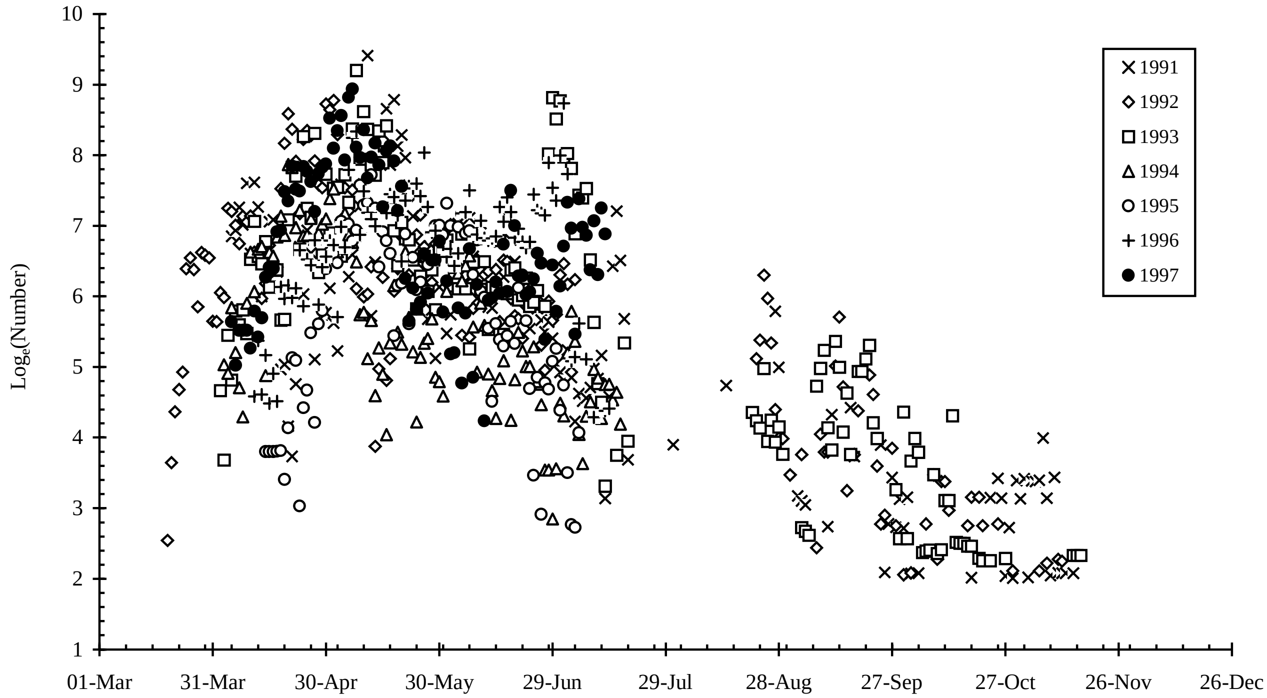


Table 7
Comparison of the Index Numbers of Juvenile Chinook Salmon Migrating Out of the Upper Nechako River With Numbers of the Parent Generation

Year	Total number of spawners	Number of spawners upstream of Diamond Island	Index number of outmigrating 0+ chinook the following year	Sampling period	Total index number of outmigrating 0+ chinook the following year	Total sampling period
1990	2642	1686	104182	Apr. 5 - July 31	105702	Apr. 5 - Nov. 15
1991	2360	1306	116538	Mar. 14 - July 17	119860	Mar. 14 - Nov. 17
1992	2498	1074	143000	Apr. 2 - July 19	146170	Apr. 2 - Nov. 16
1993	664	347	47589	Apr. 2 - July 17	47589	Apr. 2 - July 17
1994	1144	659	45025	Apr. 13 - July 13	45025	Apr. 13 - July 11
1995	1689	1143	105576	Apr. 12 - July 14	105576	Apr. 12- July 14
1996	2040	1455	133812	Apr. 5 - July 13	133812	Apr. 5 - July 13

Note: the number of outmigrants estimated in 1991 (brood year 1990) is not comparable to the numbers of outmigrants estimated in subsequent years because one of the RSTs in 1991 had a wooden wing attached to one side that funneled additional fry into the RST, and which, therefore, required the assumption of greater flow into the trap.

Figure 35
Regression of the Number of 0+ Chinook Salmon Outmigrants on the Number of Parent Spawners Above Diamond Island, Nechako River

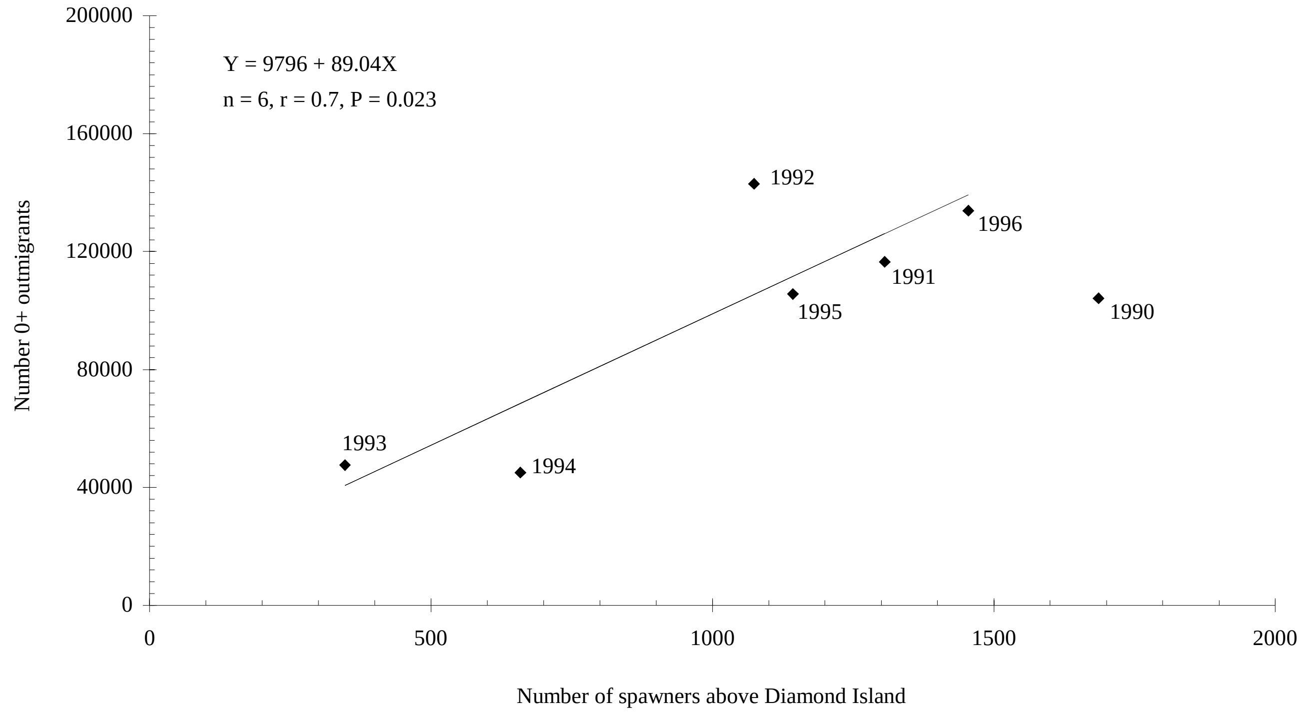
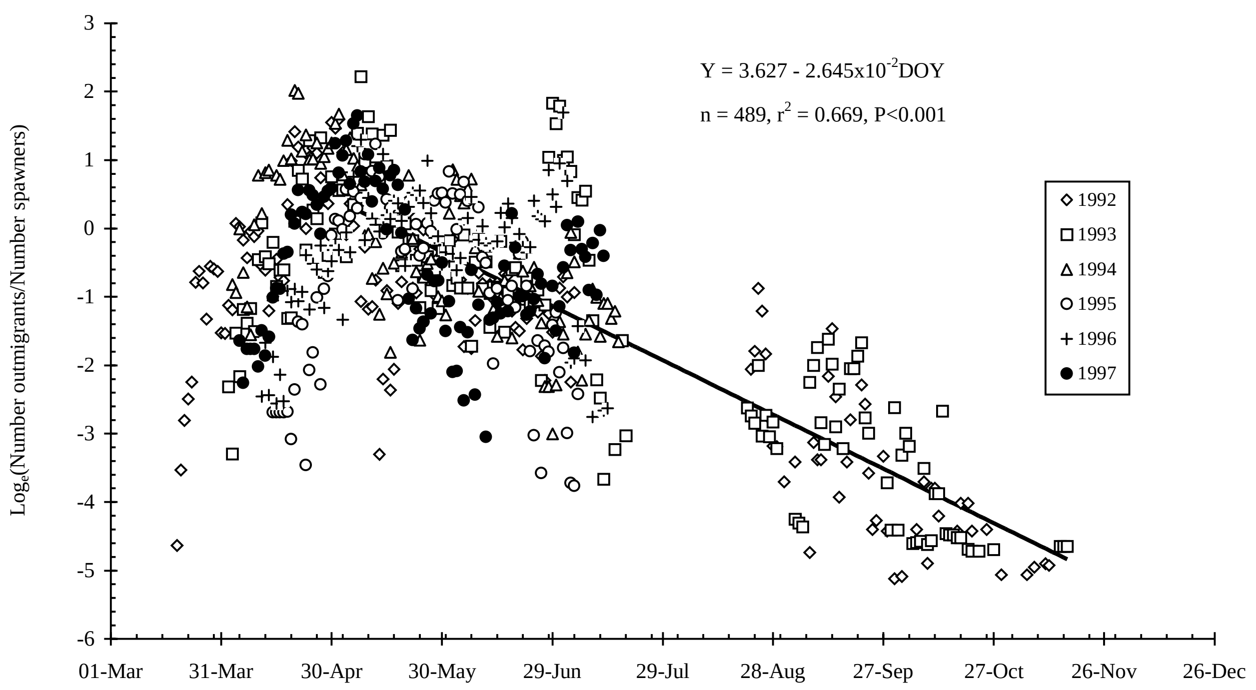


Figure 36
Daily Index of 0+ Chinook Outmigration at Diamond Island, Nechako River, 1992 to 1997, Standardised for the Number of Spawners Above Diamond Island in the Previous Autumn



months of May and June, as well as changes in the relative ranking of years for each month.

However, the consequence of standardising outmigrant numbers for the numbers of parent spawners was that the relative position and seasonal trend of the 1997 outmigrant estimates was rendered even more similar to those of the previous 5 years. In other words, the relatively high flows and low temperatures of the upper Nechako River in 1997 were not reflected in higher (or lower) spawner-standardised outmigrant estimates. A similar result was found for the seasonal pattern and magnitude of spawner-standardised electrofishing CPUE for 1997-it did not appear substantially different from those of the previous 8 years.

To examine this issue in greater detail, an average rate of loss of spawner-standardised outmigrants for the years 1992 to 1997 was calculated from the descending right-hand limb of the catch curve in Figure 36. The beginning date of the right-hand limb was estimated by calculating a 5-day running average of the loge-transformed spawner-standardised outmigrant numbers. The highest value of those running averages occurred on May 8 (DOY = 128). A linear regression of the loge-transformed spawner-standardised outmigrant numbers on DOY for all days after May 7 explained 70% of the variation in the dependent variable with a slope (or loss rate) of 2.65 %/day (SE = 0.084) (Figure 36).

One-way ANOVA of the residuals of the regression, i.e. the difference between observed and predicted, was highly significantly ($F_{5,488}$ = 9.470, P<0.001) different among the 6 years. Tukey's Honestly Significant Different (HSD) range test showed that the reasons for the significant differences were that: (a) the residual $\log_e$-transformed spawner-standardised outmigrant numbers for 1996 were significantly greater than those for 1992, 1994, 1995 and 1997, but not for 1993; and (b) the residual $\log_e$-transformed spawner-standardised outmigrant numbers for 1993 were significantly greater than those for 1992.

Similarly, average rates of loss of spawner-standardised electrofishing CPUE + 1 for the years 1989 to 1997 were calculated from the descending right-hand limb of the day and night catch curves in Figure 37. The month of May was assumed to be the beginning date of the right-hand limbs of both catch curves. Linear regressions of $\log_e$-transformed spawner-standardised electrofishing CPUE + 1 on DOY for all months after April (assuming the DOY for the 15th of each month) explained between 40 and 58% of the variation in the dependent variable with slopes of 0.63 %/day (SE = 0.13) for day catches and 0.99%/day (SE = 0.14) for night catches (Figure 37).

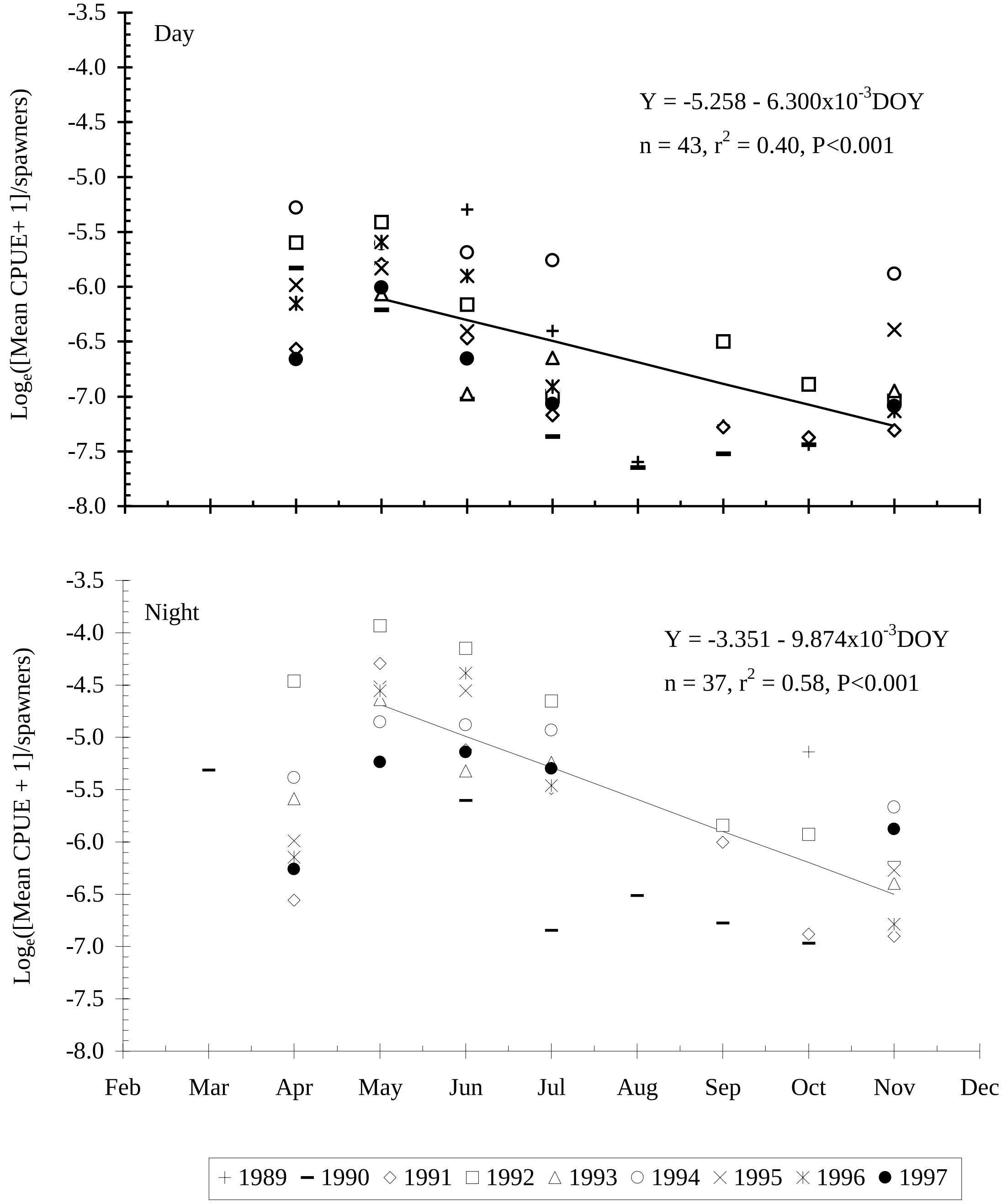
A one-way ANOVA of the residuals of the day regression was significantly ($F_{8,42}$ = 3.801, P = 0.003) different among the 9 years. Tukey's HSD range test showed that the reason for the significant difference was that 1994 had greater CPUE than 1990 and 1991.

A one-way ANOVA of the residuals of the night regression was highly significantly ($F_{8,36}$ = 7.588, P<0.001) different among the 9 years. Tukey's HSD range test showed that the reason for the significant difference was that 1990 had lower CPUE than all other 8 years.

In summary, regression analysis of the right-hand limbs of the catch curves for spawner-standardised outmigrant numbers and electrofishing CPUE showed no clear relationship between flows and outmigrant numbers or flows and electrofishing CPUE. Although 1997 was a year of unusually high flows and low temperatures, the number of 0+ chinook outmigrants counted past Diamond Island, as well as the CPUE of the monthly electrofishing surveys, was not unusually high or low compared to previous years, even after numbers and CPUE had been standardised for spawner numbers.

This conclusion suggests that dispersal and outmigration of 0+ chinook in the upper Nechako River is essentially independent of flows over the range observed over the past 9 years. This makes sense from an evolutionary perspective because chinook salmon of the Nechako River lived for millennia under a regime of much greater flows than have experienced in the 40+ years since Kenney Dam was built. Presumably, juvenile chinook are able to adapt to variable flows by moving into low-velocity shallow water during periods of high flows and then moving out into high-velocity deeper water during periods of low flows.

Figure 37
Geometric Mean Monthly (CPUE + 1) of 0+ Chinook, Standardised for the Number of Spawners in Reaches 1-4 in the Previous Autumn, 1989 to 1997



REFERENCES

Bohlin, T., S. Haurin, T.G. Heggberget, G. Rasmussen, and S.J. Saltveit. 1989. Electrofishing-theory and practice with special emphasis on salmonids. Hydrobiologia 173: 9-43.

Bohlin, T., T.G. Heggberget, and C. Strange. 1990. Electric fishing for sampling and stock assessment, p. 112-139. In Fishing with electricity: applications in freshwater fisheries management. Edited by I.C. Cowx and P. Lamarque. Fishing News Books, Oxford, U.K.

Bradford, M.J. 1994. Trends in the abundance of chinook salmon (Oncorhynchus tshawytscha) of the Nechako River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 51: 965-973.

Coble, D.W. 1992. Predicting population density of largemouth bass from electrofishing catch per effort. North American Journal of Fisheries Management 12: 650-652.

Crozier, W.W., and G.J.A. Kennedy. 1995. Application of a fry (0+) abundance index, based on semi-quantitative electrofishing, to predict Atlantic salmon smolt runs in the River Bush, Northern Ireland. Journal of Fish Biology 47: 107-114.

DeVries, M.R., M.J. Van Den Ayle, and E.R. Gilliland. 1995. Assessing shad abundance: Electrofishing with active and passive fish collection. North American Journal of Fisheries Management 15: 891-897.

Edwards, C.M., R.W. Drenner, K.L. Gallo, and K.E. Rieger. 1997. Estimation of population density of largemouth bass in ponds by using mark-recapture and electrofishing catch per effort. North American Journal of Fisheries Management 17: 719-725.

Envirocon Ltd. 1984. Environmental studies associated with the proposed Kemano Completion Hydroelectric Development. Volumes 1-22. Prepared for the Aluminum Company of Canada, Vancouver, B.C.

Hall, T.J. 1986. Electrofishing catch per hour as an indicator of largemouth bass density in Ohio impoundments. North American Journal of Fisheries Management 6: 397-400.

Jobling, M. 1983. Growth studies with fish-overcoming the problems of size variation. Journal of Fish Biology 22: 153-157.

McInerny, M.C., and D.J. Degan. 1993. Electrofishing catch rates as an index of largemouth bass population density in two large reservoirs. North American Journal of Fisheries Management 13: 223-228.

Miranda, L.E. W.D. Hubbard, S. Sangare, and T. Holman. 1996. Optimizing electrofishing sample duration for estimating relative abundance of largemouth bass in reservoirs. North American Journal of Fisheries Management 16: 324-331.

Nechako River Project. 1987. Studies of juvenile chinook salmon in the Nechako River, British Columbia - 1985 and 1986. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1954.

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

Ricker, W.E. 1979. Growth rates and models. In Fish physiology, Volume VIII: Bioenergetics and growth. Edited by W.S. Hoar, D.J. Randall, and J.R. Brett. Academic Press, New York. pp. 677-743.

R.L.&L. Environmental Services Ltd. 1994. Fish stock and habitat assessments for the Columbia River below Revelstoke Canyon Dam. Report prepared for the Environmental Resources Division of B.C. Hydro, Vancouver, B.C.

Serns, S.L. 1982. Relationship of walleye fingerling density and electrofishing catch per effort in northern Wisconsin lakes. North American Journal of Fisheries Management 2: 38-44.

Sokal, R.R., and Rohlf, F.J. 1981. Biometry. 2nd edition. W.H. Freeman and Company, New York.

Van Den Ayle, M.J., J. Boxrucker, P. Michaeletz, B. Vondracek, and G.R. Ploskey. 1995. Comparison of catch rate, length distribution, and precision of six gears used to sample reservoir shad populations. North American Journal of Fisheries Management 15: 940-955.

Zweifel, J.R., and Lasker, R. 1976. Prehatch and posthatch growth of fishes-a general model. Fishery Bulletin 74: 609-621.

APPENDIX 1

Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

APPENDIX 1

Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
Chinook salmon, 0+ (day)										
05-Apr	95	37	2	29	-	-	0	-	-	0
06-Apr	96	34	1	4	0.33	0.04	4	0.81	0.11	4
08-Apr	98	36	2	14	0.35	0.07	14	0.74	0.04	14
09-Apr	99	36	2	89	0.39	0.08	89	0.80	0.10	89
10-Apr	100	36	2	65	0.39	0.08	65	0.80	0.10	65
11-Apr	101	36	2	42	0.36	0.07	42	0.76	0.07	42
14-Apr	104	37	2	49	0.37	0.07	49	0.74	0.09	49
10-May	130	39	1	10	0.48	0.08	10	0.84	0.12	10
11-May	131	38	2	59	0.44	0.10	59	0.78	0.09	59
12-May	132	38	2	198	0.44	0.11	198	0.79	0.10	198
13-May	133	38	2	113	0.47	0.10	113	0.81	0.10	113
14-May	134	39	3	54	0.50	0.16	54	0.83	0.11	54
15-May	135	40	3	38	0.58	0.15	38	0.88	0.12	38
16-May	136	39	2	84	0.54	0.15	84	0.87	0.12	84
17-May	137	40	3	31	0.54	0.18	31	0.83	0.12	31
10-Jun	161	44	4	75	0.93	0.30	75	1.04	0.22	75
11-Jun	162	44	5	58	0.89	0.36	58	0.99	0.13	58
12-Jun	163	44	4	22	0.87	0.27	22	1.00	0.10	22
13-Jun	164	46	3	11	1.05	0.26	11	1.09	0.22	11
14-Jun	165	42	4	4	0.74	0.18	4	0.96	0.04	4
15-Jun	166	53	0	1	1.93	0.00	1	1.30	0.00	1
16-Jun	167	47	6	44	1.14	0.49	44	1.05	0.10	44
03-Jul	184	53	5	14	1.94	0.56	14	1.25	0.11	14
04-Jul	185	49	0	1	1.23	0.00	1	1.05	0.00	1
31-Oct	304	88	8	16	7.49	2.12	16	1.10	0.20	16
01-Nov	305	88	7	15	7.87	1.73	15	1.13	0.14	15
02-Nov	306	89	5	12	7.46	0.66	12	1.07	0.09	12
03-Nov	307	93	6	10	9.57	1.74	10	1.20	0.18	10
04-Nov	308	89	6	19	7.58	1.59	19	1.08	0.09	19
05-Nov	309	88	4	19	7.64	1.04	19	1.10	0.09	19
06-Nov	310	88	2	4	7.49	0.77	4	1.09	0.05	4
Chinook salmon, 0+ (night)										
05-Apr	95	36	2	31	0.38	0.06	31	0.83	0.08	31
06-Apr	96	37	2	11	0.39	0.06	11	0.79	0.06	11
09-Apr	99	37	2	157	0.41	0.08	157	0.82	0.11	157
10-Apr	100	37	2	34	0.44	0.10	34	0.85	0.10	34
11-Apr	101	37	2	72	0.42	0.08	72	0.83	0.08	72
12-Apr	102	37	2	72	0.42	0.08	72	0.86	0.09	72
13-Apr	103	38	1	6	0.45	0.05	6	0.84	0.05	6
14-Apr	104	37	1	58	0.40	0.07	58	0.80	0.07	58
15-Apr	105	36	2	66	0.40	0.07	66	0.85	0.10	66
10-May	130	38	3	10	0.46	0.10	10	0.82	0.06	10
11-May	131	38	2	63	0.47	0.10	63	0.84	0.12	63

APPENDIX 1 (continued)
Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g/mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
12-May	132	37	2	147	0.42	0.09	147	0.81	0.09	147
13-May	133	39	3	224	0.51	0.16	224	0.86	0.11	224
14-May	134	39	3	141	0.55	0.15	141	0.90	0.10	141
15-May	135	39	2	70	0.54	0.14	70	0.88	0.11	70
16-May	136	39	3	141	0.59	0.17	141	0.96	0.15	141
17-May	137	40	3	121	0.60	0.19	121	0.94	0.12	121
18-May	138	40	3	20	0.61	0.19	20	0.95	0.13	20
10-Jun	161	44	4	26	0.88	0.24	26	1.02	0.09	26
11-Jun	162	44	4	134	0.93	0.29	134	1.02	0.16	134
12-Jun	163	46	5	154	1.06	0.39	154	1.03	0.11	154
13-Jun	164	48	5	145	1.21	0.44	145	1.07	0.11	145
14-Jun	165	50	7	75	1.45	0.70	75	1.06	0.17	75
15-Jun	166	53	5	14	1.71	0.59	14	1.14	0.13	14
16-Jun	167	52	5	49	1.67	0.56	49	1.17	0.10	49
17-Jun	168	52	6	80	1.58	0.59	80	1.10	0.12	80
03-Jul	184	58	5	44	2.27	0.60	44	1.16	0.11	44
04-Jul	185	59	6	94	2.70	0.84	94	1.29	0.15	94
05-Jul	186	60	7	18	3.01	1.22	18	1.31	0.11	18
31-Oct	304	98	10	113	12.15	3.82	113	1.27	0.15	113
01-Nov	305	92	8	108	9.30	2.25	108	1.17	0.12	108
02-Nov	306	93	7	160	9.26	2.02	160	1.16	0.13	160
03-Nov	307	94	8	74	9.49	2.18	74	1.14	0.12	74
04-Nov	308	89	7	94	8.11	1.84	94	1.12	0.14	94
05-Nov	309	90	8	91	8.27	2.06	91	1.12	0.11	91
06-Nov	310	91	7	59	8.63	1.84	59	1.16	0.13	59
Chinook salmon, 1+ (day)										
05-Apr	95	76	0	1						
06-Apr	96	96	7	2	8.29	1.58	2	0.93	0.03	2
08-Apr	98	99	9	15	12.25	2.70	15	1.25	0.14	15
09-Apr	99	95	2	3	10.70	1.20	3	1.25	0.11	3
10-Apr	100	105	15	5	14.22	5.31	5	1.22	0.20	5
14-Apr	104	95	0	1	9.43	0.00	1	1.10	0.00	1
11-May	131	99	0	1	11.44	0.00	1	1.18	0.00	1
13-May	133	99	0	1	11.09	0.00	1	1.14	0.00	1
14-May	134	102	0	1	15.11	0.00	1	1.42	0.00	1
16-May	136	113	0	1	17.56	0.00	1	1.22	0.00	1
Chinook salmon, 1+ (night)										
05-Apr	95	92	6	25	9.93	1.68	25	1.28	0.05	25
06-Apr	96	100	10	38	11.14	2.42	38	1.12	0.16	38
07-Apr	97	99	8	6	12.29	3.29	6	1.23	0.08	6
08-Apr	98	96	6	11	11.86	2.63	11	1.33	0.18	11
09-Apr	99	98	8	86	12.03	2.97	86	1.25	0.12	86
10-Apr	100	98	9	8	11.76	2.07	8	1.25	0.19	8

APPENDIX 1 (continued)
Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
11-Apr	101	98	6	22	12.33	2.25	22	1.30	0.09	22
12-Apr	102	100	4	2	11.50	0.93	2	1.15	0.05	2
14-Apr	104	91	6	5	9.50	2.12	5	1.27	0.20	5
15-Apr	105	97	5	14	11.73	1.66	14	1.28	0.18	14
11-May	131	93	8	3	10.70	3.74	3	1.29	0.10	3
12-May	132	101	8	9	13.15	3.27	9	1.24	0.09	9
13-May	133	105	7	41	14.18	3.09	41	1.22	0.19	41
14-May	134	105	6	8	15.31	2.34	8	1.31	0.12	8
15-May	135	79	1	2	6.71	0.32	2	1.36	0.01	2
16-May	136	90	13	2	10.23	3.55	2	1.41	0.14	2
17-May	137	97	14	7	12.54	4.98	7	1.31	0.10	7
18-May	138	91	10	2	10.73	3.25	2	1.40	0.03	2
16-Jun	167	126	0	1	24.52	0.00	1	1.23	0.00	1
Burbot, adult (night)										
15-Apr	105	220	0	1						
12-Jun	163	300	0	1						
01-Nov	305	260	0	1						
04-Nov	308	280	0	1						
Burbot, juvenile (night)										
06-Apr	96	102	0	1	9.21	0.00	1	0.87	0.00	1
09-Apr	99	139	16	2	18.93	6.69	2	0.69	0.02	2
15-Apr	105	155	0	1	31.26	0.00	1	0.84	0.00	1
13-May	133	160	0	1	30.19	0.00	1	0.74	0.00	1
05-Nov	309	170	0	1	30.62	0.00	1	0.62	0.00	1
06-Nov	310	222	0	1	70.84	0.00	1	0.65	0.00	1
Lake trout, 1+ (day)										
08-Apr	98	74	0	1	2.85	0.00	1	0.70	0.00	1
09-Apr	99	70	0	1	3.26	0.00	1	0.95	0.00	1
10-Apr	100	62	0	1	1.97	0.00	1	0.83	0.00	1
13-May	133	84	0	1	4.37	0.00	1	0.74	0.00	1
11-Jun	162	80	0	1	3.05	0.00	1	0.60	0.00	1
Lake trout, 1+ (night)										
09-Apr	99	58	0	1	1.57	0.00	1	0.80	0.00	1
Rainbow trout, adult (day)										
13-May	133	225	35	2						
15-May	135	200	0	2						
01-Nov	305	200	0	1						

APPENDIX 1 (continued)
Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
Rainbow trout, adult (night)										
05-Apr	95	250	0	1						
06-Apr	96	250	0	3						
10-May	130	300	0	2						
11-May	131	200	0	1						
12-May	132	250	71	2						
10-Jun	161	200	0	1						
16-Jun	167	300	0	1						
17-Jun	168	300	0	1						
31-Oct	304	241	44	11						
01-Nov	305	256	36	13	98.08	0.00	1	1.19	0.00	1
02-Nov	306	235	33	6	99.00	0.00	2	1.01	0.09	2
03-Nov	307	262	33	13	93.39	0.00	1	0.95	#DIV/0!	1
04-Nov	308	227	21	4	93.83	3.67	2	1.03	0.13	2
05-Nov	309	300	50	3						
Rainbow trout, juvenile (day)										
05-Apr	95	92	0	1						
08-Apr	98	100	21	6	11.30	6.85	6	1.07	0.11	6
09-Apr	99	87	0	1	8.50	0.00	1	1.29	0.00	1
14-Apr	104	106	62	2	6.02	0.00	1	2.53	0.00	1
15-May	135	103	0	1	12.85	0.00	1	1.18	0.00	1
10-Jun	161	94	0	1	7.20	0.00	1	0.87	0.00	1
31-Oct	304	76	0	1	5.55	0.00	1	1.26	0.00	1
05-Nov	309	86	7	3	6.52	1.30	3	1.02	0.12	3
Rainbow trout, juvenile (night)										
08-Apr	98	110	39	11	16.88	19.42	11	1.06	0.26	11
09-Apr	99	93	18	14	9.84	5.07	14	1.23	0.39	14
11-Apr	101	110	1	2	15.19	0.36	2	1.16	0.01	2
14-Apr	104	134	14	4	27.50	7.14	4	1.13	0.08	4
15-Apr	105	49	0	1	1.30	0.00	1	1.13	0.00	1
10-May	130	104	20	3	14.61	10.49	3	1.17	0.19	3
11-May	131	96	6	6	11.03	2.13	6	1.22	0.04	6
12-May	132	96	17	6	10.09	7.85	6	1.02	0.18	6
13-May	133	129	40	3	38.65	26.46	3	1.57	0.55	3
14-May	134	141	41	2	36.13	27.37	2	1.16	0.05	2
15-May	135	103	33	2	13.79	11.34	2	1.11	0.03	2
16-May	136	122	31	2	23.81	14.91	2	1.24	0.12	2
10-Jun	161	134	0	1	27.30	0.00	1	1.14	0.00	1
11-Jun	162	116	22	5	19.83	13.28	5	1.16	0.12	5
12-Jun	163	117	1	2	15.37	2.05	2	0.96	0.09	2
13-Jun	164	86	0	1	6.50	0.00	1	1.03	0.00	1
14-Jun	165	128	1	2	21.74	6.18	2	1.04	0.33	2
16-Jun	167	135	0	1	32.10	0.00	1	1.31	0.00	1

APPENDIX 1 (continued)
Mean Size and Condition of Fish Captured by Electrofishing in the Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g/mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
17-Jun	168	139	0	1	32.00	0.00	1	1.19	0.00	1
03-Jul	184	117	33	2	21.67	17.83	2	1.19	0.09	2
04-Jul	185	145	0	1	30.40	0.00	1	1.00	0.00	1
31-Oct	304	115	39	6	22.16	22.32	6	1.16	0.15	6
01-Nov	305	127	53	3	27.99	27.81	3	1.11	0.20	3
02-Nov	306	141	26	2	28.33	15.76	2	0.96	0.03	2
03-Nov	307	79	1	2	5.34	0.91	2	1.10	0.16	2
04-Nov	308	149	60	6	55.95	40.66	6	1	0	6
05-Nov	309	79	1	2	5.94	0.14	2	1.23	0.06	2
06-Nov	310	153	19	2	60.09	28.69	2	1.62	0.19	2
Sockeye salmon, 0+ (day)										
13-Jun	164	33	-	1	0.25	-	1	0.70	-	1
Sockeye salmon, 0+ (night)										
14-May	134	28	-	1	0.17	-	1	0.77	-	1
03-Jul	184	52	-	1	1.26	-	1	0.90	-	1

Appendix 2

Mean Size and Condition of Fish Captured by Rotary Screw Traps, Diamond Island, Nechako River, 1997

Appendix 2
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g/mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
Chinook salmon 0+ (day)										
05-Apr	95	34	1	3	0.30	0.03	3	0.74	0.01	3
06-Apr	96	37	1	2	0.38	0.12	2	0.73	0.15	2
07-Apr	97	36	1	2	0.35	0.05	2	0.74	0.02	2
08-Apr	98	34	0	1	0.24	0.00	1	0.61	0.00	1
10-Apr	100	37	2	2	0.34	0.06	2	0.68	0.01	2
11-Apr	101	36	2	6	0.32	0.04	6	0.69	0.10	6
14-Apr	104	36	1	7	0.36	0.05	7	0.77	0.08	7
15-Apr	105	35	1	7	0.32	0.04	7	0.74	0.04	7
16-Apr	106	36	2	10	0.36	0.07	10	0.76	0.04	10
17-Apr	107	35	2	11	0.37	0.04	11	0.84	0.09	11
18-Apr	108	36	2	18	0.37	0.07	18	0.77	0.06	18
19-Apr	109	37	2	20	0.38	0.08	20	0.74	0.08	20
20-Apr	110	36	2	17	0.35	0.06	17	0.74	0.05	17
21-Apr	111	37	2	28	0.36	0.05	28	0.71	0.04	28
22-Apr	112	37	1	11	0.38	0.06	11	0.75	0.06	11
23-Apr	113	36	2	12	0.36	0.06	12	0.75	0.05	12
24-Apr	114	37	1	23	0.36	0.05	23	0.72	0.06	23
25-Apr	115	36	1	21	0.35	0.04	21	0.75	0.07	21
26-Apr	116	37	2	19	0.39	0.06	19	0.75	0.05	19
27-Apr	117	37	1	19	0.37	0.04	19	0.72	0.04	19
28-Apr	118	37	1	25	0.38	0.06	25	0.74	0.06	25
29-Apr	119	36	2	30	0.35	0.05	30	0.77	0.06	30
30-Apr	120	36	2	24	0.36	0.06	24	0.77	0.09	24
01-May	121	37	2	25	0.37	0.06	25	0.73	0.05	25
02-May	122	36	2	22	0.36	0.06	22	0.74	0.05	22
03-May	123	37	2	25	0.41	0.08	25	0.78	0.08	25
04-May	124	36	2	27	0.38	0.07	27	0.78	0.06	27
05-May	125	36	2	25	0.39	0.08	25	0.83	0.09	25
06-May	126	37	1	25	0.39	0.05	25	0.79	0.06	25
07-May	127	37	2	30	0.38	0.06	30	0.78	0.06	30
08-May	128	36	2	24	0.37	0.06	24	0.77	0.06	24
09-May	129	37	3	25	0.40	0.12	25	0.77	0.08	25
10-May	130	37	2	25	0.40	0.08	25	0.77	0.06	25
11-May	131	36	2	27	0.37	0.06	27	0.77	0.06	27
12-May	132	37	2	25	0.38	0.07	25	0.74	0.07	25
13-May	133	37	3	26	0.39	0.13	26	0.78	0.07	26
14-May	134	37	3	29	0.42	0.13	29	0.81	0.08	29
15-May	135	39	2	21	0.53	0.13	21	0.90	0.11	21
16-May	136	40	3	28	0.57	0.15	28	0.88	0.09	28
17-May	137	39	3	30	0.53	0.15	30	0.88	0.10	30
18-May	138	40	3	28	0.60	0.16	28	0.92	0.10	28
19-May	139	40	4	16	0.61	0.21	16	0.94	0.10	16
20-May	140	41	3	20	0.62	0.17	20	0.90	0.11	20

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
21-May	141	41	2	5	0.62	0.07	5	0.93	0.09	5
22-May	142	43	6	3	0.90	0.28	3	1.14	0.09	3
23-May	143	38	1	4	0.52	0.04	4	0.94	0.13	4
24-May	144	40	5	4	0.75	0.36	4	1.07	0.17	4
25-May	145	42	0	1	0.64	0.00	1	0.86	0.00	1
26-May	146	43	3	5	0.87	0.20	5	1.07	0.05	5
27-May	147	42	0	1	0.68	0.00	1	0.92	0.00	1
28-May	148	45	5	4	0.97	0.29	4	1.06	0.06	4
29-May	149	45	3	8	0.93	0.21	8	0.99	0.05	8
30-May	150	44	3	8	0.93	0.25	8	1.04	0.10	8
31-May	151	45	5	3	1.00	0.31	3	1.09	0.02	3
01-Jun	152	46	2	6	1.08	0.11	6	1.13	0.06	6
02-Jun	153	47	0	1	1.29	0.00	1	1.24	0.00	1
04-Jun	155	49	0	1	1.32	0.00	1	1.12	0.00	1
05-Jun	156	49	0	1	1.33	0.00	1	1.13	0.00	1
06-Jun	157	46	0	2	1.14	0.09	2	1.17	0.09	2
07-Jun	158	49	5	4	1.29	0.33	4	1.09	0.08	4
09-Jun	160	48	5	3	1.29	0.41	3	1.16	0.06	3
12-Jun	163	55	0	1	1.73	0.00	1	1.04	0.00	1
14-Jun	165	53	1	3	1.64	0.20	3	1.12	0.06	3
15-Jun	166	59	1	2	2.58	0.06	2	1.29	0.01	2
16-Jun	167	52	4	2	1.54	0.31	2	1.12	0.00	2
17-Jun	168	55	6	4	2.04	0.83	4	1.18	0.14	4
18-Jun	169	56	4	7	2.05	0.40	7	1.15	0.05	7
19-Jun	170	54	6	4	1.83	0.67	4	1.12	0.08	4
20-Jun	171	52	0	1	1.45	0.00	1	1.03	0.00	1
21-Jun	172	55	11	2	2.01	1.33	2	1.13	0.15	2
23-Jun	174	57	0	1	2.16	0.00	1	1.17	0.00	1
24-Jun	175	44	0	1	0.85	0.00	1	1.00	0.00	1
25-Jun	176	55	0	1	1.99	0.00	1	1.20	0.00	1
03-Jul	184	60	0	1	2.33	0.00	1	1.08	0.00	1
05-Jul	186	74	0	1	4.66	0.00	1	1.15	0.00	1
06-Jul	187	53	0	1	1.71	0.00	1	1.15	0.00	1
08-Jul	189	69	2	2	3.34	0.30	2	1.04	0.00	2
09-Jul	190	65	0	1	2.61	0.00	1	0.95	0.00	1
11-Jul	192	65	0	1	2.92	0.00	1	1.06	0.00	1
Chinook salmon 0+ (night)										
05-Apr	95	35	1	9	0.33	0.04	9	0.77	0.07	9
06-Apr	96	36	2	5	0.37	0.07	5	0.79	0.05	5
07-Apr	97	36	2	10	0.34	0.05	10	0.72	0.04	10
08-Apr	98	37	2	11	0.34	0.06	11	0.66	0.04	11
09-Apr	99	37	2	12	0.34	0.05	12	0.68	0.06	12
10-Apr	100	37	1	7	0.35	0.03	7	0.71	0.08	7

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
11-Apr	101	36	1	10	0.34	0.03	10	0.71	0.04	10
12-Apr	102	37	2	11	0.36	0.04	11	0.72	0.05	11
13-Apr	103	36	2	14	0.32	0.06	14	0.66	0.05	14
14-Apr	104	36	2	19	0.34	0.05	19	0.74	0.07	19
15-Apr	105	36	1	20	0.35	0.05	20	0.73	0.07	20
16-Apr	106	37	2	13	0.38	0.05	13	0.77	0.06	13
17-Apr	107	35	2	22	0.34	0.05	22	0.76	0.07	22
18-Apr	108	35	1	11	0.32	0.04	11	0.73	0.05	11
19-Apr	109	37	1	27	0.38	0.05	27	0.77	0.08	27
20-Apr	110	37	2	30	0.37	0.05	30	0.74	0.07	30
21-Apr	111	37	1	27	0.33	0.05	27	0.68	0.05	27
22-Apr	112	37	1	30	0.36	0.05	30	0.73	0.05	30
23-Apr	113	38	2	14	0.39	0.05	14	0.73	0.05	14
24-Apr	114	36	1	16	0.36	0.04	16	0.75	0.05	16
25-Apr	115	37	1	30	0.35	0.05	30	0.70	0.05	30
26-Apr	116	36	2	22	0.35	0.07	22	0.74	0.08	22
27-Apr	117	37	2	19	0.37	0.06	19	0.74	0.06	19
28-Apr	118	36	2	20	0.38	0.08	20	0.77	0.06	20
29-Apr	119	37	1	15	0.37	0.07	15	0.73	0.05	15
30-Apr	120	35	2	22	0.34	0.07	22	0.77	0.08	22
01-May	121	39	2	28	0.40	0.07	28	0.76	0.08	28
02-May	122	38	2	29	0.40	0.06	29	0.73	0.08	29
03-May	123	37	2	23	0.37	0.06	23	0.74	0.06	23
04-May	124	37	2	30	0.40	0.08	30	0.80	0.06	30
05-May	125	36	1	22	0.40	0.05	22	0.83	0.09	22
06-May	126	36	2	28	0.41	0.08	28	0.87	0.15	28
07-May	127	37	2	30	0.38	0.07	30	0.75	0.06	30
08-May	128	36	2	15	0.39	0.10	15	0.79	0.09	15
09-May	129	36	2	20	0.39	0.07	20	0.80	0.07	20
10-May	130	37	2	30	0.40	0.09	30	0.79	0.09	30
11-May	131	36	2	12	0.36	0.08	12	0.74	0.07	12
12-May	132	38	3	17	0.42	0.11	17	0.78	0.08	17
13-May	133	36	1	22	0.38	0.06	22	0.77	0.08	22
14-May	134	37	2	21	0.41	0.10	21	0.78	0.07	21
15-May	135	40	3	9	0.51	0.14	9	0.81	0.07	9
16-May	136	39	3	11	0.48	0.17	11	0.80	0.13	11
17-May	137	41	3	14	0.60	0.13	14	0.88	0.08	14
18-May	138	40	3	18	0.60	0.17	18	0.89	0.08	18
19-May	139	40	6	8	0.63	0.33	8	0.90	0.11	8
20-May	140	37	4	14	0.48	0.17	14	0.94	0.07	14
21-May	141	38	5	4	0.50	0.29	4	0.84	0.16	4
22-May	142	43	1	2	0.74	0.06	2	0.96	0.03	2
23-May	143	39	3	4	0.54	0.13	4	0.90	0.07	4

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

		Length (mm)			Weight (g)			Condition (g/mm^3)		
Date	DOY	mean	SD	n	mean	SD	n	mean	SD	n
24-May	144	40	5	2	0.72	0.33	2	1.11	0.12	2
25-May	145	37	3	6	0.50	0.12	6	0.98	0.06	6
26-May	146	38	3	9	0.46	0.19	9	0.83	0.12	9
27-May	147	37	1	4	0.44	0.08	4	0.86	0.06	4
28-May	148	42	4	9	0.70	0.21	9	0.94	0.08	9
29-May	149	41	6	3	0.66	0.51	3	0.85	0.24	3
30-May	150	42	7	6	0.70	0.37	6	0.85	0.13	6
31-May	151	43	6	3	0.83	0.38	3	0.96	0.08	3
01-Jun	152	45	2	3	0.98	0.15	3	1.09	0.06	3
02-Jun	153	48	1	2	1.19	0.09	2	1.10	0.04	2
03-Jun	154	46	1	3	1.07	0.11	3	1.07	0.06	3
04-Jun	155	46	4	5	1.00	0.31	5	1.02	0.05	5
06-Jun	157	53	2	3	1.45	0.25	3	0.96	0.12	3
06-Jun	157	55	1	2	1.52	0.32	2	0.93	0.16	2
07-Jun	158	48	5	8	1.23	0.40	8	1.05	0.08	8
09-Jun	160	51	2	4	1.43	0.26	4	1.06	0.04	4
11-Jun	162	47	0	1	0.97	0.00	1	0.93	0.00	1
12-Jun	163	51	5	4	1.43	0.41	4	1.04	0.08	4
13-Jun	164	53	5	5	1.64	0.43	5	1.06	0.06	5
14-Jun	165	53	1	3	1.90	0.29	3	1.28	0.27	3
15-Jun	166	50	2	3	1.35	0.34	3	1.06	0.15	3
16-Jun	167	50	6	8	1.37	0.41	8	1.06	0.08	8
17-Jun	168	46	0	1	0.99	0.00	1	1.02	0.00	1
18-Jun	169	52	4	13	1.49	0.38	13	1.05	0.05	13
19-Jun	170	56	5	8	1.91	0.58	8	1.07	0.06	8
20-Jun	171	53	6	5	1.62	0.55	5	1.04	0.03	5
21-Jun	172	57	4	4	1.96	0.40	4	1.06	0.08	4
22-Jun	173	59	3	4	2.18	0.54	4	1.07	0.12	4
23-Jun	174	50	7	3	1.37	0.57	3	1.07	0.02	3
23-Jun	174	46	4	2	1.07	0.32	2	1.08	0.03	2
24-Jun	175	56	6	4	1.73	0.69	4	0.98	0.21	4
25-Jun	176	58	10	6	2.46	1.32	6	1.14	0.08	6
26-Jun	177	58	7	6	2.25	0.88	6	1.10	0.07	6
27-Jun	178	56	1	2	1.90	0.09	2	1.11	0.01	2
29-Jun	180	64	5	6	3.10	0.82	6	1.15	0.06	6
30-Jun	181	58	9	3	2.31	1.04	3	1.13	0.08	3
01-Jul	182	59	5	4	2.38	0.52	4	1.16	0.04	4
02-Jul	183	60	5	7	2.55	0.65	7	1.15	0.04	7
03-Jul	184	63	6	12	3.20	1.15	12	1.22	0.19	12
04-Jul	185	64	4	9	2.99	0.55	9	1.12	0.04	9
05-Jul	186	55	0	1	1.80	0.00	1	1.08	0.00	1
06-Jul	187	63	8	13	2.92	0.99	13	1.12	0.04	13
07-Jul	188	65	5	10	3.17	0.84	10	1.13	0.06	10
08-Jul	189	67	6	7	3.50	1.03	7	1.15	0.06	7

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g / mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
09-Jul	190	65	5	4	3.06	0.70	4	1.11	0.07	4
10-Jul	191	64	8	10	3.08	1.33	10	1.12	0.07	10
11-Jul	192	66	6	4	3.24	0.72	4	1.12	0.06	4
12-Jul	193	71	6	12	3.99	1.10	12	1.12	0.17	12
13-Jul	194	70	7	9	4.04	1.15	9	1.13	0.03	9
Chinook salmon 1+ (day)										
22-Apr	112	97	0	1	8.75	0.00	1	0.96	0.00	1
23-Apr	113	90	0	1	7.91	0.00	1	1.09	0.00	1
01-May	121	108	0	1	12.95	0.00	1	1.03	0.00	1
09-May	129	82	0	1	5.62	0.00	1	1.02	0.00	1
14-May	134	112	0	1	14.78	0.00	1	1.05	0.00	1
15-May	135	121	2	2	16.93	0.74	2	0.97	0.01	2
16-May	136	96	13	6	10.13	5.36	6	1.08	0.10	6
19-May	139	86	0	1	6.37	0.00	1	1.00	0.00	1
28-May	148	88	0	1	7.29	0.00	1	1.07	0.00	1
03-Jun	154	92	0	1	9.36	0.00	1	1.20	0.00	1
07-Jun	158	115	6	2	18.08	1.65	2	1.19	0.07	2
Chinook salmon 1+ (night)										
05-Apr	95	105	3	3	12.19	1.00	3	1.04	0.04	3
06-Apr	96	96	12	5	8.76	2.96	5	0.97	0.06	5
07-Apr	97	107	3	2	11.80	0.32	2	0.96	0.05	2
08-Apr	98	106	12	4	10.64	3.49	4	0.88	0.07	4
10-Apr	100	112	8	4	13.54	3.17	4	0.95	0.05	4
11-Apr	101	107	12	8	11.32	3.44	8	0.92	0.15	8
12-Apr	102	107	7	7	12.41	2.47	7	1.00	0.05	7
13-Apr	103	106	13	3	10.83	3.44	3	0.89	0.10	3
14-Apr	104	95	9	3	9.37	2.30	3	1.08	0.03	3
15-Apr	105	115	9	3	14.79	3.43	3	0.96	0.02	3
16-Apr	106	97	7	7	9.08	2.34	7	0.97	0.07	7
17-Apr	107	100	6	5	9.82	1.69	5	0.98	0.03	5
18-Apr	108	89	7	4	7.44	1.86	4	1.05	0.04	4
19-Apr	109	99	7	9	9.98	2.20	9	1.01	0.04	9
20-Apr	110	99	12	6	10.36	3.62	6	1.02	0.08	6
22-Apr	112	103	13	6	11.11	3.49	6	0.99	0.05	6
23-Apr	113	95	10	8	8.72	2.25	8	1.00	0.09	8
24-Apr	114	95	9	6	9.30	2.54	6	1.05	0.04	6
25-Apr	115	91	18	2	8.12	5.50	2	0.98	0.12	2
26-Apr	116	110	11	6	14.18	4.85	6	1.05	0.03	6
27-Apr	117	101	4	7	10.33	1.29	7	1.01	0.07	7
29-Apr	119	98	7	2	9.80	2.44	2	1.03	0.04	2
30-Apr	120	105	1	2	12.03	0.08	2	1.05	0.03	2

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g/mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
01-May	121	92	0	1	9.20	0.00	1	1.18	0.00	1
02-May	122	97	0	1	9.16	0.00	1	1.00	0.00	1
05-May	125	109	1	2	14.10	0.02	2	1.09	0.04	2
06-May	126	100	0	1	9.95	0.00	1	1.00	0.00	1
07-May	127	108	17	3	14.60	7.32	3	1.10	0.06	3
08-May	128	104	25	2	14.58	10.44	2	1.17	0.06	2
09-May	129	109	0	1	13.91	0.00	1	1.07	0.00	1
10-May	130	95	0	1	10.30	0.00	1	1.20	0.00	1
11-May	131	105	8	4	12.31	2.76	4	1.07	0.09	4
13-May	133	106	8	4	13.16	3.10	4	1.09	0.08	4
14-May	134	95	12	6	10.08	4.54	6	1.11	0.07	6
15-May	135	101	8	10	11.46	3.24	10	1.08	0.06	10
16-May	136	106	13	8	13.78	5.03	8	1.13	0.07	8
17-May	137	101	10	3	10.88	2.01	3	1.05	0.13	3
18-May	138	104	6	5	11.54	1.77	5	1.02	0.08	5
19-May	139	97	8	6	11.03	2.17	6	1.19	0.08	6
20-May	140	92	0	1	9.46	0.00	1	1.21	0.00	1
22-May	142	84	0	1	6.07	0.00	1	1.02	0.00	1
23-May	143	85	0	1	6.31	0.00	1	1.03	0.00	1
24-May	144	97	8	2	9.90	2.02	2	1.08	0.06	2
25-May	145	100	11	2	11.23	3.58	2	1.10	0.02	2
26-May	146	97	0	1	11.53	0.00	1	1.26	0.00	1
27-May	147	99	0	1	11.61	0.00	1	1.20	0.00	1
30-May	150	110	0	1	14.70	0.00	1	1.10	0.00	1
31-May	151	110	0	1	14.72	0.00	1	1.11	0.00	1
01-Jun	152	90	6	2	8.48	1.66	2	1.18	0.02	2
02-Jun	153	102	16	4	10.83	4.77	4	0.99	0.12	4
03-Jun	154	110	19	2	15.52	7.91	2	1.13	0.01	2
04-Jun	155	94	6	2	10.38	1.75	2	1.24	0.01	2
06-Jun	157	114	0	1	17.30	0.00	1	1.17	0.00	1
Coho salmon 0+ (night)										
29-Jun	180	57	0	1	2.05	0.00	1	1.11	0.00	1
Lake trout 0+ (day)										
05-Apr	95	35	0	1	0.32	0.00	1	0.75	0.00	1
14-May	134	69	0	1	2.10	0.00	1	0.64	0.00	1
Lake trout 0+ (night)										
06-Apr	96	71	0	1	2.32	0.00	1	0.65	0.00	1
07-Apr	97	71	0	1	2.46	0.00	1	0.69	0.00	1
23-Apr	113	76	0	1	2.80	0.00	1	0.64	0.00	1
03-May	123	71	6	2	2.55	0.59	2	0.72	0.03	2
06-May	126	116	0	1	12.89	0.00	1	0.83	0.00	1

Appendix 2 (continued)
Mean Size and Condition of Fish Captured by Rotary Screw Traps,
Diamond Island, Nechako River, 1997

Date	DOY	Length (mm)			Weight (g)			Condition (g/mm^3)		
		mean	SD	n	mean	SD	n	mean	SD	n
08-May	128	91	26	3	6.14	5.85	3	0.66	0.06	3
09-May	129	81	0	1	3.93	0.00	1	0.74	0.00	1
11-May	131	73	0	2	2.41	0.00	2	0.62	0.00	2
14-May	134	84	0	1	4.26	0.00	1	0.72	0.00	1
29-May	149	80	0	1	3.63	0.00	1	0.71	0.00	1
07-Jun	158	71	0	1	2.54	0.00	1	0.71	0.00	1
Rainbow trout, adult (night)										
09-Apr	99	210	0	1						
29-Apr	119	252	0	1						
Rainbow trout, juvenile (day)										
15-May	135	72	0	1	16.08	0.00	1	4.31	0.00	1
21-May	141	85	0	1	8.75	0.00	1	1.42	0.00	1
Rainbow trout, juvenile (night)										
11-Apr	101	130	0	1						
27-Apr	117	121	0	1	16.08	0.00	1	0.91	0.00	1
30-Apr	120	128	0	1						
24-May	144	84	0	1	6.54	0.00	1	1.10	0.00	1
25-May	145	98	18	3	10.27	5.45	3	1.01	0.01	3
27-May	147	94	15	3	9.16	3.83	3	1.06	0.05	3
28-May	148	101	12	3	11.22	4.25	3	1.04	0.09	3
29-May	149	105	18	6	12.78	6.04	6	1.04	0.02	6
31-May	151	120	12	2	17.77	5.06	2	1.03	0.01	2
01-Jun	152	110	0	1	13.42	0.00	1	1.01	0.00	1
02-Jun	153	102	16	3	9.18	1.38	3	0.90	0.25	3
03-Jun	154	121	1	2	15.22	6.63	2	0.87	0.36	2
06-Jun	157	180	0	1	45.00	0.00	1	0.77	0.00	1
08-Jun	159	118	0	1	17.63	0.00	1	1.07	0.00	1
14-Jun	165	120	0	1	17.31	0.00	1	1.00	0.00	1
Sockeye salmon 0+ (day)										
14-May	134	22	0	1	0.12	0.00	1	1.13	0.00	1
15-May	135	33	0	1	0.24	0.00	1	0.67	0.00	1
Sockeye salmon 0+ (night)										
08-May	128	34	0	1	0.16	0.00	1	0.41	0.00	1
26-May	146	30	1	2	0.15	0.03	2	0.58	0.07	2
30-May	150	32	0	2	0.25	0.01	2	0.75	0.02	2
31-May	151	35	0	1	0.35	0.00	1	0.82	0.00	1
14-Jun	165	38	0	1	0.44	0.00	1	0.80	0.00	1
22-Jun	173	45	0	1	0.74	0.00	1	0.81	0.00	1
23-Jun	174	47	0	1	0.94	0.00	1	0.91	0.00	1
25-Jun	176	36	0	1	0.34	0.00	1	0.73	0.00	1
06-Jul	187	39	0	1	0.48	0.00	1	0.81	0.00	1

Appendix 3

Mean Monthly Electrofishing Catch-per-unit-effort (CPUE) of Juvenile Chinook Salmon by 10 km Intervals of the Nechako River, 1997

Appendix 3
Mean Monthly Electrofishing Catch-per-unit-effort (CPUE) of Juvenile Chinook Salmon by 10 km Intervals of the Nechako River, 1997

Date	Distance (km) from Kenney Dam	0+ $\log_e$(CPUE+1)			1+ $\log_e$(CPUE+1)		
		mean	SD	n	mean	SD	n
Day							
April	0.0-9.9	0.0000	0.0000	4	0.2452	0.4904	4
	10.0-19.9	0.3934	0.6375	26	0.1618	0.4136	26
	20.0-29.9	1.2111	0.7833	38	0.0968	0.2693	38
	30.0-39.9	1.0117	0.5866	16	0.0000	0.0000	16
	50.0-59.9	0.9440	0.7992	19	0.0393	0.1714	19
	70.0-79.9	0.5997	0.9493	16	0.0379	0.1515	16
	80.0-89.9	0.1070	0.2382	17	0.0713	0.2013	17
May	0.0-9.9	0.0000	0.0000	4	0.0000	0.0000	4
	10.0-19.9	1.5729	1.3799	26	0.0233	0.1189	26
	20.0-29.9	2.1202	1.3556	38	0.0160	0.0983	38
	30.0-39.9	1.1728	1.1530	16	0.0276	0.1105	16
	50.0-59.9	0.7736	0.7422	19	0.0000	0.0000	19
	70.0-79.9	1.6242	1.1706	16	0.0000	0.0000	16
	80.0-89.9	0.5246	0.6437	16	0.0218	0.0871	16
June	0.0-9.9	0.0000	0.0000	3	0.0000	0.0000	3
	10.0-19.9	1.3046	0.7542	26	0.0000	0.0000	26
	20.0-29.9	0.6817	0.6982	33	0.0000	0.0000	33
	30.0-39.9	0.0954	0.2102	10	0.0000	0.0000	10
	50.0-59.9	0.0606	0.1917	10	0.0000	0.0000	10
	70.0-79.9	1.0815	0.5844	15	0.0000	0.0000	15
	80.0-89.9	0.4041	0.3500	3	0.0000	0.0000	3
July	0.0-9.9	0.0000	0.0000	1	0.0000	0.0000	1
	10.0-19.9	0.3449	0.6901	13	0.0000	0.0000	13
	20.0-29.9	0.4184	0.6404	8	0.0000	0.0000	8
	30.0-39.9	0.0000	0.0000	1	0.0000	0.0000	1
Oct./Nov.	0.0-9.9	0.4904	0.5663	4	0.0000	0.0000	4
	10.0-19.9	0.3413	0.4710	26	0.0000	0.0000	26
	20.0-29.9	0.2609	0.4402	38	0.0000	0.0000	38
	30.0-39.9	0.2664	0.4413	16	0.0000	0.0000	16
	50.0-59.9	0.4711	0.5799	19	0.0000	0.0000	19
	70.0-79.9	0.4475	0.5931	16	0.0000	0.0000	16
	80.0-89.9	0.1731	0.3854	17	0.0000	0.0000	17

Appendix 3 (continued)
Mean Monthly Electrofishing Catch-per-unit-effort (CPUE) of Juvenile Chinook Salmon by 10 km Intervals of the Nechako River, 1997

Date	Distance (km) from Kenney Dam	0+ $\log_e$(CPUE+1) mean	0+ SD	0+ n	1+ $\log_e$(CPUE+1) mean	1+ SD	1+ n
Night							
April	0.0-9.9	0.0000	0.0000	4	0.4185	0.4118	4
	10.0-19.9	0.3453	0.7280	26	0.4404	0.6384	26
	20.0-29.9	1.7890	0.7528	38	0.7079	0.8855	38
	30.0-39.9	1.6004	0.9420	15	0.0498	0.1929	15
	50.0-59.9	2.0386	0.7470	17	0.4351	0.8564	17
	70.0-79.9	0.7237	0.8079	16	0.6390	0.7367	16
	80.0-89.9	0.2922	0.4587	16	1.0132	0.8369	16
May	0.0-9.9	0.2452	0.4904	4	0.0000	0.0000	4
	10.0-19.9	2.7845	0.9436	26	0.2294	0.4497	26
	20.0-29.9	2.5776	0.9837	38	0.5079	0.5369	38
	30.0-39.9	1.4201	1.0746	16	0.0467	0.1868	16
	50.0-59.9	1.2477	0.9889	19	0.2097	0.5890	19
	70.0-79.9	2.8813	0.6619	16	0.0379	0.1515	16
	80.0-89.9	1.8278	1.1200	15	0.2795	0.4353	15
June	0.0-9.9	0.0000	0.0000	2	0.0000	0.0000	2
	10.0-19.9	3.2201	0.8893	24	0.0000	0.0000	24
	20.0-29.9	2.5883	0.7705	30	0.0000	0.0000	30
	30.0-39.9	1.3243	1.1930	10	0.0000	0.0000	10
	50.0-59.9	1.0252	0.6602	11	0.0551	0.1828	11
	70.0-79.9	2.3993	0.7211	14	0.0000	0.0000	14
	80.0-89.9	0.0000	0.0000	3	0.0000	0.0000	3
July	0.0-9.9	0.0000	0.0000	1	0.0000	0.0000	1
	10.0-19.9	2.6960	0.6553	12	0.0000	0.0000	12
	20.0-29.9	1.7557	0.9413	8	0.0000	0.0000	8
	30.0-39.9	0.0000	0.0000	1	0.0000	0.0000	1
Oct. / Nov.	0.0-9.9	1.3248	0.9005	4	0.0000	0.0000	4
	10.0-19.9	1.5458	0.9973	26	0.0000	0.0000	26
	20.0-29.9	1.6857	0.8842	38	0.0000	0.0000	38
	30.0-39.9	1.3297	0.6549	16	0.0000	0.0000	16
	50.0-59.9	1.7816	0.7739	17	0.0000	0.0000	17
	70.0-79.9	1.3217	0.7709	16	0.0000	0.0000	16
	80.0-89.9	1.3682	0.9290	16	0.0000	0.0000	16

Appendix 4

Daily Catches of Juvenile Chinook Salmon by Rotary Screw Traps, and Index of Outmigrants, at Diamond Island Nechako River, 1997

Appendix 4. Daily catch of juvenile chinook salmon by rotary screw traps, and index of outmigrants at Diamond Island, Nechako River, 1997.

	RST		RST No. 1:						RST No. 2:						RST No. 3:						Total:			
	staff	River	Trap	Percent			Population		Trap	Percent			Population		Trap	Percent			Population				Population	
	gage	flow	flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		Catch:		estimate:	
Date	(cm)	(m^3/s)	(m^3/s)	sampled	1+	0+	1+	0+	(m^3/s)	sampled	1+	0+	1+	0+	(m^3/s)	sampled	1+	0+	1+	0+	1+	0+	1+	0+
Day																								
05-Apr	91.0	63.4	1.1	1.7	0	0	0	0	1.1	1.7	0	1	0	58	0.7	1.1	0	3	0	264	0	4	0	87
06-Apr	91.0	63.4	1.1	1.7	0	1	0	58	1.1	1.7	0	1	0	58	0.7	1.1	0	0	0	0	0	2	0	43
07-Apr	91.0	63.4	1.1	1.8	0	0	0	0	1.1	1.7	0	0	0	0	0.8	1.3	0	2	0	152	0	2	0	41
08-Apr	91.0	63.4	1.1	1.8	0	0	0	0	1.1	1.7	0	0	0	0	0.8	1.3	0	1	0	76	0	1	0	21
09-Apr	91.5	64.0	1.1	1.8	0	0	0	0	1.1	1.7	0	0	0	0	0.8	1.3	0	0	0	0	0	0	0	0
10-Apr	92.0	64.6	1.1	1.7	0	0	0	0	1.1	1.7	0	0	0	0	0.8	1.2	0	2	0	170	0	2	0	43
11-Apr	92.5	65.1	1.2	1.9	0	0	0	0	1.2	1.8	0	2	0	112	0.8	1.2	0	4	0	347	0	6	0	124
12-Apr	95.5	68.7	1.2	1.8	0	0	0	0	1.2	1.7	0	0	0	0	0.8	1.1	0	0	0	0	0	0	0	0
13-Apr	96.0	69.3	1.2	1.8	0	0	0	0	1.2	1.7	0	0	0	0	0.8	1.1	0	0	0	0	0	0	0	0
14-Apr	98.0	71.7	1.2	1.7	0	0	0	0	1.2	1.6	0	0	0	0	0.8	1.0	0	5	0	477	0	5	0	114
15-Apr	101.0	75.4	1.2	1.6	0	0	0	0	1.2	1.5	0	0	0	0	0.8	1.0	0	7	0	703	0	7	0	168
16-Apr	103.0	77.9	1.3	1.7	0	0	0	0	1.2	1.6	0	1	0	63	1.0	1.3	0	9	0	670	0	10	0	217
17-Apr	107.0	83.1	1.3	1.6	0	0	0	0	1.2	1.5	0	1	0	67	1.0	1.3	0	13	0	1031	0	14	0	323
18-Apr	110.0	87.0	1.3	1.5	0	4	0	259	1.2	1.4	0	4	0	280	1.2	1.4	0	16	0	1167	0	24	0	552
19-Apr	111.5	89.0	1.3	1.5	0	6	0	397	1.2	1.4	0	4	0	286	1.2	1.3	0	16	0	1194	0	26	0	612
20-Apr	114.0	92.3	1.3	1.4	0	4	0	277	1.3	1.4	0	3	0	212	1.2	1.3	0	21	0	1655	0	28	0	678
21-Apr	117.0	96.4	1.3	1.4	0	11	0	797	1.3	1.4	0	8	0	590	1.2	1.2	0	38	0	3127	0	57	0	1442
22-Apr	119.5	99.9	1.3	1.3	0	1	0	76	1.2	1.2	0	4	0	329	0.9	0.9	1	21	108	2276	1	26	29	754
23-Apr	123.0	104.8	1.3	1.2	1	1	80	80	1.2	1.2	0	3	0	259	0.9	0.9	0	24	0	2730	1	28	30	852
24-Apr	126.0	109.1	1.3	1.2	0	4	0	334	1.2	1.1	0	6	0	539	0.9	0.8	0	13	0	1539	0	23	0	729
25-Apr	130.5	115.7	1.3	1.1	0	5	0	442	1.2	1.0	0	5	0	477	0.9	0.8	0	20	0	2511	0	30	0	1008
26-Apr	139.0	128.5	1.3	1.0	0	4	0	393	1.2	1.0	0	7	0	727	1.1	0.9	0	8	0	905	0	19	0	663
27-Apr	146.0	139.5	1.3	0.9	0	5	0	533	1.2	0.9	0	4	0	451	1.1	0.8	0	10	0	1228	0	19	0	720
28-Apr	150.0	145.9	1.1	0.8	0	7	0	920	1.1	0.7	0	8	0	1080	1.1	0.8	0	18	0	2333	0	33	0	1452
29-Apr	151.0	147.5	1.1	0.8	0	11	0	1461	1.1	0.7	0	13	0	1774	1.1	0.8	0	17	0	2228	0	41	0	1823
30-Apr	150.5	146.7	1.3	0.9	0	14	0	1571	1.2	0.8	0	4	0	494	0.7	0.5	0	16	0	3138	0	34	0	1538
01-May	150.0	145.9	1.3	0.9	0	12	0	1339	1.2	0.8	0	5	0	615	0.7	0.5	1	25	195	4876	1	42	45	1890
02-May	150.0	145.9	1.3	0.9	0	4	0	436	1.2	0.8	0	8	0	962	1.0	0.7	0	19	0	2852	0	31	0	1284
03-May	153.0	150.8	1.3	0.9	0	14	0	1579	1.2	0.8	0	5	0	621	1.0	0.6	0	29	0	4499	0	48	0	2055
04-May	155.5	154.9	1.3	0.9	0	14	0	1622	1.2	0.8	0	7	0	894	1.0	0.6	0	21	0	3347	0	42	0	1847
05-May	159.0	160.8	1.5	1.0	0	12	0	1260	1.4	0.9	0	5	0	577	0.8	0.5	0	11	0	2099	0	28	0	1195
06-May	164.0	169.3	1.5	0.9	0	6	0	663	1.4	0.8	0	9	0	1094	0.8	0.5	0	17	0	3416	0	32	0	1438
07-May	165.5	171.9	1.5	0.9	0	16	0	1796	1.4	0.8	0	12	0	1481	0.8	0.5	0	24	0	4897	0	52	0	2373
08-May	166.5	173.6	1.5	0.9	0	6	0	680	1.4	0.8	0	8	0	997	0.8	0.5	0	21	0	4328	0	35	0	1613
09-May	168.0	176.2	1.5	0.9	1	5	115	575	1.4	0.8	0	15	0	1898	0.8	0.5	0	17	0	3556	1	37	47	1731
10-May	168.0	176.2	1.5	0.9	0	7	0	806	1.4	0.8	0	8	0	1012	0.8	0.5	0	18	0	3766	0	33	0	1544
11-May	168.0	176.2	1.5	0.8	0	8	0	971	1.2	0.7	0	10	0	1496	1.0	0.5	0	14	0	2550	0	32	0	1568
12-May	168.5	177.1	1.5	0.8	0	7	0	854	1.2	0.7	0	8	0	1203	1.0	0.5	0	13	0	2380	0	28	0	1378
13-May	171.5	182.4	1.5	0.8	0	11	0	1379	1.3	0.7	0	6	0	822	1.1	0.6	0	15	0	2427	0	32	0	1491
14-May	174.5	187.8	1.5	0.8	1	9	129	1161	1.3	0.7	0	12	0	1692	1.1	0.6	0	13	0	2165	1	34	48	1631
15-May	174.5	187.8	1.5	0.8	1	6	129	774	1.3	0.7	2	7	282	987	1.1	0.6	0	8	0	1332	3	21	144	1007

Appendix 4. Daily catch of juvenile chinook salmon by rotary screw traps, and index of outmigrants at Diamond Island, Nechako River, 1997.

	RST		RST No. 1:						RST No. 2:						RST No. 3:						Total:			
	staff	River	Trap	Percent			Population		Trap	Percent			Population		Trap	Percent			Population				Population	
	gage	flow	flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		Catch:		estimate:	
Date	(cm)	(m^3/s)	(m^3/s)	sampled	1+	0+	1+	0+	(m^3/s)	sampled	1+	0+	1+	0+	(m^3/s)	sampled	1+	0+	1+	0+	1+	0+	1+	0+
16-May	173.5	186.0	1.4	0.7	3	13	406	1758	1.3	0.7	3	8	430	1145	1.0	0.5	0	30	0	5744	6	51	306	2602
17-May	172.5	184.2	1.4	0.7	0	23	0	3080	1.3	0.7	0	13	0	1843	1.0	0.5	0	14	0	2655	0	50	0	2526
18-May	173.0	185.1	1.4	0.7	0	8	0	1076	1.3	0.7	0	17	0	2422	1.0	0.5	0	11	0	2096	0	36	0	1828
19-May	173.0	185.1	1.5	0.8	1	8	127	1016	1.3	0.7	0	5	0	712	0.5	0.3	0	3	0	1096	1	16	57	907
20-May	172.0	183.3	1.5	0.8	0	6	0	754	1.3	0.7	0	10	0	1411	0.5	0.3	0	4	0	1447	0	20	0	1123
21-May	172.0	183.3	1.4	0.8	0	2	0	264	1.3	0.7	0	3	0	415	0.5	0.3	0	0	0	0	0	5	0	289
22-May	169.0	178.0	1.4	0.8	0	0	0	0	1.3	0.7	0	2	0	269	0.5	0.3	0	1	0	388	0	3	0	168
23-May	168.0	176.2	1.3	0.8	0	1	0	132	1.3	0.8	0	1	0	133	0.5	0.3	0	2	0	724	0	4	0	224
24-May	168.0	176.2	1.3	0.8	0	0	0	0	1.3	0.8	0	0	0	0	0.5	0.3	0	4	0	1447	0	4	0	224
25-May	166.5	173.6	1.4	0.8	0	1	0	123	1.3	0.7	0	0	0	0	0.6	0.4	0	0	0	0	0	1	0	52
26-May	165.5	171.9	1.4	0.8	0	4	0	488	1.3	0.7	0	1	0	136	0.6	0.4	0	0	0	0	0	5	0	259
27-May	166.0	172.8	1.4	0.8	0	1	0	123	1.3	0.7	0	0	0	0	0.6	0.4	0	0	0	0	0	1	0	52
28-May	166.0	172.8	1.4	0.8	1	1	123	123	1.3	0.7	0	2	0	273	0.6	0.4	0	1	0	266	1	4	52	208
29-May	170.5	180.6	1.3	0.7	0	4	0	572	1.2	0.6	0	0	0	0	0.5	0.3	0	4	0	1543	0	8	0	500
30-May	173.5	186.0	1.3	0.7	0	3	0	442	1.2	0.6	0	0	0	0	0.5	0.3	0	5	0	1985	0	8	0	514
31-May	175.5	189.6	1.6	0.8	0	2	0	240	1.3	0.7	0	0	0	0	0.6	0.3	0	1	0	334	0	3	0	164
01-Jun	178.5	195.0	1.6	0.8	0	3	0	370	1.3	0.7	0	0	0	0	0.6	0.3	0	3	0	1032	0	6	0	338
02-Jun	179.5	196.8	1.5	0.7	0	1	0	135	1.3	0.7	0	0	0	0	0.5	0.2	0	0	0	0	0	1	0	61
03-Jun	180.5	198.6	1.5	0.7	1	0	136	0	1.3	0.6	0	0	0	0	0.5	0.2	0	0	0	0	1	0	61	0
04-Jun	182.5	202.3	1.5	0.8	0	1	0	131	1.5	0.7	0	0	0	0	0.5	0.2	0	0	0	0	0	1	0	58
05-Jun	185.5	207.9	1.5	0.7	0	0	0	0	1.5	0.7	0	0	0	0	0.5	0.2	0	1	0	452	0	1	0	60
06-Jun	189.5	215.4	1.5	0.7	0	1	0	147	1.4	0.6	0	0	0	0	0.4	0.2	0	1	0	491	0	2	0	132
07-Jun	193.5	223.1	1.5	0.7	2	1	304	152	1.4	0.6	0	0	0	0	0.4	0.2	0	3	0	1525	2	4	136	273
08-Jun	197.5	230.8	1.5	0.7	0	0	0	0	1.3	0.6	0	0	0	0	0.6	0.3	0	0	0	0	0	0	0	0
09-Jun	200.5	236.7	1.5	0.6	0	2	0	309	1.3	0.6	0	1	0	181	0.6	0.2	0	0	0	0	0	3	0	207
10-Jun	202.5	240.6	1.5	0.6	0	0	0	0	1.3	0.5	0	0	0	0	0.6	0.2	0	0	0	0	0	0	0	0
11-Jun	206.5	248.6	1.5	0.6	0	0	0	0	1.3	0.5	0	0	0	0	0.6	0.2	0	0	0	0	0	0	0	0
12-Jun	211.0	257.7	1.5	0.6	0	1	0	167	1.3	0.5	0	0	0	0	0.4	0.2	0	0	0	0	0	1	0	80
13-Jun	213.0	261.8	1.5	0.6	0	0	0	0	1.3	0.5	0	0	0	0	0.4	0.1	0	0	0	0	0	0	0	0
14-Jun	215.0	265.9	1.5	0.6	0	2	0	347	1.2	0.5	0	1	0	218	0.4	0.2	0	0	0	0	0	3	0	250
15-Jun	218.0	272.1	1.5	0.6	0	0	0	0	1.2	0.4	0	2	0	445	0.4	0.2	0	0	0	0	0	2	0	171
16-Jun	219.0	274.2	1.5	0.6	0	1	0	179	1.2	0.4	0	1	0	224	0.4	0.2	0	0	0	0	0	2	0	172
17-Jun	220.0	276.3	1.5	0.6	0	3	0	540	1.2	0.4	0	0	0	0	0.4	0.2	0	1	0	643	0	4	0	347
18-Jun	222.0	280.5	1.4	0.5	0	6	0	1203	1.2	0.4	0	1	0	225	0.4	0.1	0	0	0	0	0	7	0	642
19-Jun	223.0	282.6	1.4	0.5	0	2	0	404	1.2	0.4	0	2	0	454	0.4	0.1	0	0	0	0	0	4	0	370
20-Jun	223.5	283.7	1.5	0.5	0	1	0	185	1.3	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	1	0	90
21-Jun	225.5	287.9	1.5	0.5	0	2	0	375	1.3	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	2	0	182
22-Jun	230.0	297.6	1.4	0.5	0	0	0	0	1.2	0.4	0	0	0	0	0.2	0.1	0	0	0	0	0	0	0	0
23-Jun	233.0	304.1	1.4	0.5	0	1	0	216	1.2	0.4	0	0	0	0	0.2	0.1	0	0	0	0	0	1	0	110
24-Jun	236.0	310.6	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0	0
25-Jun	238.0	315.0	1.4	0.4	0	1	0	228	1.2	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	1	0	108
26-Jun	240.0	319.5	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0	0
27-Jun	241.0	321.7	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0	0

Appendix 4. Daily catch of juvenile chinook salmon by rotary screw traps, and index of outmigrants at Diamond Island, Nechako River, 1997.

Date	RST staff gage (cm)	River flow (m^3/s)	RST No. 1: Trap flow (m^3/s)	RST No. 1: Percent flow sampled	RST No. 1: Catch: 1+	RST No. 1: Catch: 0+	RST No. 1: Population estimate: 1+	RST No. 1: Population estimate: 0+	RST No. 2: Trap flow (m^3/s)	RST No. 2: Percent flow sampled	RST No. 2: Catch: 1+	RST No. 2: Catch: 0+	RST No. 2: Population estimate: 1+	RST No. 2: Population estimate: 0+	RST No. 3: Trap flow (m^3/s)	RST No. 3: Percent flow sampled	RST No. 3: Catch: 1+	RST No. 3: Catch: 0+	RST No. 3: Population estimate: 1+	RST No. 3: Population estimate: 0+	Total: Catch: 1+	Total: Catch: 0+	Total: Population estimate: 1+	Total: Population estimate: 0+
28-Jun	242.0	323.9	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
29-Jun	243.0	326.1	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
30-Jun	244.0	328.4	1.5	0.4	0	0	0	0	1.1	0.3	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0	0
01-Jul	244.0	328.4	1.4	0.4	0	0	0	0	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	0	0	0
02-Jul	245.0	330.6	1.4	0.4	0	0	0	0	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	0	0	0
03-Jul	245.0	330.6	1.4	0.4	0	0	0	0	1.0	0.3	0	1	0	317	0.4	0.1	0	0	0	0	0	1	0	118
04-Jul	244.5	329.5	1.4	0.4	0	0	0	0	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	0	0	0
05-Jul	245.5	331.8	1.4	0.4	0	1	0	241	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	1	0	118
06-Jul	245.0	330.6	1.5	0.5	0	1	0	217	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	1	0	107
07-Jul	245.0	330.6	1.5	0.5	0	0	0	0	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
08-Jul	244.5	329.5	1.5	0.5	0	2	0	432	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	2	0	213
09-Jul	245.0	330.6	1.4	0.4	0	0	0	0	1.1	0.3	0	0	0	0	0.3	0.1	0	1	0	1039	0	1	0	118
10-Jul	243.0	326.1	1.4	0.4	0	0	0	0	1.1	0.3	0	0	0	0	0.3	0.1	0	0	0	0	0	0	0	0
11-Jul	242.0	323.9	1.4	0.4	0	1	0	232	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	1	0	108
12-Jul	241.0	321.7	1.4	0.4	0	0	0	0	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
13-Jul	241.0	321.7	1.4	0.4	0	0	0	0	1.1	0.3	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
Total Day					12	326	1548	39892			5	275	712	35030			2	639	303	103321	19	1240	956	54126
Night																								
05-Apr	91.0	63.4	1.1	1.7	1	5	58	288	1.1	1.7	2	1	115	58	0.7	1.1	0	3	0	264	3	9	65	195
06-Apr	91.0	63.4	1.1	1.7	2	2	115	115	1.1	1.7	1	1	58	58	0.7	1.1	2	2	176	176	5	5	108	108
07-Apr	91.0	63.4	1.1	1.8	2	6	111	334	1.1	1.7	1	4	58	234	0.8	1.3	0	0	0	0	3	10	62	207
08-Apr	91.0	63.4	1.1	1.8	1	8	56	445	1.1	1.7	1	1	58	58	0.8	1.3	2	2	152	152	4	11	83	228
09-Apr	91.0	63.4	1.1	1.8	0	4	0	222	1.1	1.7	0	8	0	468	0.8	1.3	0	0	0	0	0	12	0	249
10-Apr	91.5	64.0	1.1	1.7	3	0	174	0	1.1	1.7	1	5	57	286	0.8	1.2	0	2	0	168	4	7	86	150
11-Apr	91.5	64.0	1.2	1.9	5	4	259	207	1.2	1.8	1	5	55	275	0.8	1.2	2	1	170	85	8	10	163	203
12-Apr	92.0	64.6	1.2	1.9	4	5	209	262	1.2	1.8	3	1	166	55	0.8	1.2	0	5	0	430	7	11	144	226
13-Apr	94.0	66.9	1.2	1.8	1	6	54	325	1.2	1.7	1	5	58	288	0.8	1.1	1	3	89	267	3	14	64	298
14-Apr	95.5	68.7	1.2	1.8	3	6	167	334	1.2	1.7	0	6	0	354	0.8	1.1	0	7	0	640	3	19	65	415
15-Apr	96.0	69.3	1.2	1.8	2	0	112	0	1.2	1.7	1	10	60	596	0.8	1.1	0	10	0	923	3	20	66	440
16-Apr	98.5	72.3	1.3	1.8	6	2	330	110	1.2	1.7	1	16	59	938	1.0	1.4	0	1	0	69	7	19	141	382
17-Apr	102.0	76.7	1.3	1.7	3	7	175	408	1.2	1.6	0	20	0	1243	1.0	1.4	2	5	147	366	5	32	107	682
18-Apr	106.0	81.8	1.3	1.6	2	0	122	0	1.2	1.5	0	21	0	1382	1.2	1.5	2	1	137	69	4	22	87	476
19-Apr	107.0	83.1	1.3	1.6	5	7	309	433	1.2	1.5	2	18	134	1203	1.2	1.4	2	28	139	1950	9	53	198	1165
20-Apr	109.0	85.7	1.3	1.6	1	16	64	1030	1.3	1.5	2	10	131	655	1.2	1.4	3	13	219	951	6	39	135	877
21-Apr	113.0	91.0	1.3	1.5	0	7	0	478	1.3	1.4	0	12	0	835	1.2	1.3	0	27	0	2097	0	46	0	1098
22-Apr	115.0	93.7	1.3	1.4	2	11	143	788	1.2	1.3	1	14	77	1081	0.9	1.0	3	15	305	1525	6	40	163	1088
23-Apr	118.0	97.8	1.3	1.3	3	0	224	0	1.2	1.2	4	11	322	886	0.9	0.9	1	22	106	2335	8	33	227	937
24-Apr	121.0	102.0	1.3	1.3	4	18	312	1403	1.2	1.2	2	15	168	1260	0.9	0.9	0	28	0	3099	6	61	178	1807
25-Apr	124.0	106.2	1.3	1.2	1	15	81	1218	1.2	1.1	0	15	0	1313	0.9	0.9	1	14	115	1614	2	44	62	1358
26-Apr	127.5	111.3	1.3	1.2	2	6	170	510	1.2	1.1	1	6	90	540	1.1	1.0	3	34	294	3330	6	46	181	1390

Appendix 4. Daily catch of juvenile chinook salmon by rotary screw traps, and index of outmigrants at Diamond Island, Nechako River, 1997.

	RST		RST No. 1:						RST No. 2:						RST No. 3:						Total:			
	staff	River	Trap	Percent			Population		Trap	Percent			Population		Trap	Percent			Population				Population	
	gage	flow	flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		Catch:		estimate:	
Date	(cm)	(m³/s)	(m³/s)	sampled	1+	0+	1+	0+	(m³/s)	sampled	1+	0+	1+	0+	(m³/s)	sampled	1+	0+	1+	0+	1+	0+	1+	0+
27-Apr	133.5	120.1	1.3	1.1	4	4	367	367	1.2	1.0	1	10	97	971	1.1	0.9	2	5	212	529	7	19	228	620
28-Apr	143.0	134.7	1.1	0.8	0	11	0	1335	1.1	0.8	1	8	125	997	1.1	0.8	2	2	239	239	3	21	122	853
29-Apr	148.0	142.7	1.1	0.8	1	1	128	128	1.1	0.8	0	10	0	1320	1.1	0.8	1	5	127	634	2	16	86	688
30-Apr	150.5	146.7	1.3	0.9	1	6	112	673	1.2	0.8	1	12	124	1483	0.7	0.5	0	6	0	1177	2	24	90	1086
01-May	151.0	147.5	1.3	0.9	0	18	0	2030	1.2	0.8	1	8	124	994	0.7	0.5	1	43	197	8481	2	69	91	3139
02-May	150.5	146.7	1.3	0.9	0	14	0	1536	1.2	0.8	1	9	121	1088	1.0	0.7	0	25	0	3774	1	48	42	1999
03-May	150.0	145.9	1.3	0.9	0	3	0	327	1.2	0.8	0	14	0	1683	1.0	0.7	0	35	0	5254	0	52	0	2154
04-May	150.5	146.7	1.3	0.9	0	18	0	1975	1.2	0.8	0	25	0	3022	1.0	0.7	0	38	0	5736	0	81	0	3373
05-May	154.5	153.3	1.5	1.0	1	4	100	400	1.4	0.9	1	8	110	880	0.8	0.5	0	27	0	4912	2	39	81	1587
06-May	157.0	157.4	1.5	1.0	1	8	103	822	1.4	0.9	0	27	0	3051	0.8	0.5	0	92	0	17191	1	127	42	5307
07-May	161.5	165.0	1.5	0.9	0	18	0	1939	1.4	0.8	2	11	237	1303	0.8	0.5	1	90	196	17629	3	119	131	5213
08-May	165.0	171.0	1.5	0.9	2	0	223	0	1.4	0.8	0	5	0	614	0.8	0.5	0	33	0	6699	2	38	91	1725
09-May	166.0	172.8	1.5	0.9	1	7	113	790	1.4	0.8	0	3	0	372	0.8	0.5	0	15	0	3076	1	25	46	1146
10-May	167.0	174.5	1.5	0.9	0	11	0	1253	1.4	0.8	0	26	0	3257	0.8	0.5	1	22	207	4557	1	59	46	2733
11-May	168.0	176.2	1.5	0.8	1	0	121	0	1.2	0.7	2	5	299	748	1.0	0.5	1	7	182	1275	4	12	196	588
12-May	168.0	176.2	1.5	0.8	0	4	0	485	1.2	0.7	0	3	0	449	1.0	0.5	0	24	0	4372	0	31	0	1519
13-May	168.0	176.2	1.5	0.8	2	2	242	242	1.3	0.8	2	11	265	1456	1.1	0.6	0	32	0	5002	4	45	180	2026
14-May	169.0	178.0	1.5	0.8	2	8	245	979	1.3	0.7	3	4	401	535	1.1	0.6	1	9	158	1421	6	21	273	955
15-May	172.5	184.2	1.5	0.8	5	1	633	127	1.3	0.7	5	3	692	415	1.1	0.6	0	5	0	817	10	9	471	424
16-May	174.5	187.8	1.4	0.7	4	4	546	546	1.3	0.7	3	0	434	0	1.0	0.5	0	7	0	1353	7	11	361	567
17-May	174.0	186.9	1.4	0.7	3	1	408	136	1.3	0.7	0	3	0	432	1.0	0.5	0	13	0	2501	3	17	154	871
18-May	172.5	184.2	1.4	0.7	1	8	134	1071	1.3	0.7	4	5	567	709	1.0	0.5	0	5	0	948	5	18	253	909
19-May	172.5	184.2	1.5	0.8	3	2	379	253	1.3	0.7	3	2	425	284	0.5	0.3	0	4	0	1454	6	8	339	452
20-May	173.0	185.1	1.5	0.8	0	5	0	635	1.3	0.7	1	5	142	712	0.5	0.3	0	4	0	1461	1	14	57	794
21-May	172.0	183.3	1.4	0.8	0	0	0	0	1.3	0.7	0	2	0	277	0.5	0.3	0	2	0	799	0	4	0	231
22-May	172.0	183.3	1.4	0.8	0	0	0	0	1.3	0.7	1	0	138	0	0.5	0.3	0	2	0	799	1	2	58	115
23-May	170.0	179.7	1.3	0.7	1	2	135	270	1.3	0.7	0	2	0	271	0.5	0.3	0	0	0	0	1	4	57	228
24-May	168.5	177.1	1.3	0.8	1	1	133	133	1.3	0.7	1	0	133	0	0.5	0.3	0	1	0	364	2	2	113	113
25-May	168.0	176.2	1.4	0.8	1	1	125	125	1.3	0.7	0	3	0	418	0.6	0.4	1	2	272	543	2	6	106	318
26-May	168.0	176.2	1.4	0.8	1	1	125	125	1.3	0.7	0	3	0	418	0.6	0.4	0	5	0	1358	1	9	53	478
27-May	167.0	174.5	1.4	0.8	1	0	124	0	1.3	0.7	0	4	0	552	0.6	0.4	1	3	269	807	2	7	105	368
28-May	165.0	171.0	1.4	0.8	0	1	0	121	1.3	0.7	0	3	0	406	0.6	0.4	0	5	0	1317	0	9	0	464
29-May	165.0	171.0	1.3	0.7	0	1	0	135	1.2	0.7	0	0	0	0	0.5	0.3	0	2	0	730	0	3	0	177
30-May	168.5	177.1	1.3	0.7	1	1	140	140	1.2	0.7	0	1	0	153	0.5	0.3	0	4	0	1513	1	6	61	367
31-May	171.5	182.4	1.6	0.9	1	1	115	115	1.3	0.7	0	2	0	278	0.6	0.3	0	0	0	0	1	3	53	158
01-Jun	174.5	187.8	1.6	0.8	2	1	237	119	1.3	0.7	0	0	0	0	0.6	0.3	0	2	0	662	2	3	109	163
02-Jun	175.5	189.6	1.5	0.8	2	1	260	130	1.3	0.7	1	0	147	0	0.5	0.3	1	1	390	390	4	2	234	117
03-Jun	178.5	195.0	1.5	0.7	1	0	134	0	1.3	0.7	1	2	151	302	0.5	0.2	0	1	0	401	2	3	121	181
04-Jun	179.5	196.8	1.5	0.8	2	0	255	0	1.5	0.7	0	3	0	403	0.5	0.2	0	2	0	857	2	5	113	284
05-Jun	181.5	200.5	1.5	0.8	0	0	0	0	1.5	0.7	0	1	0	137	0.5	0.2	0	0	0	0	0	1	0	58
06-Jun	183.5	204.2	1.5	0.7	1	0	139	0	1.4	0.7	0	0	0	0	0.4	0.2	0	3	0	1396	1	3	62	187
07-Jun	187.5	211.7	1.5	0.7	0	4	0	576	1.4	0.6	0	2	0	310	0.4	0.2	0	2	0	965	0	8	0	517
08-Jun	191.5	219.2	1.5	0.7	0	1	0	143	1.3	0.6	0	0	0	0	0.6	0.3	0	1	0	374	0	2	0	128

Appendix 4. Daily catch of juvenile chinook salmon by rotary screw traps, and index of outmigrants at Diamond Island, Nechako River, 1997.

	RST		RST No. 1:						RST No. 2:						RST No. 3:						Total:			
	staff	River	Trap	Percent			Population		Trap	Percent			Population		Trap	Percent			Population				Population	
	gage	flow	flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		flow	flow	Catch:		estimate:		Catch:		estimate:	
Date	(cm)	(m³/s)	(m³/s)	sampled	1+	0+	1+	0+	(m³/s)	sampled	1+	0+	1+	0+	(m³/s)	sampled	1+	0+	1+	0+	1+	0+	1+	0+
09-Jun	196.5	228.9	1.5	0.7	0	2	0	299	1.3	0.6	0	2	0	350	0.6	0.3	0	0	0	0	0	4	0	267
10-Jun	199.5	234.7	1.5	0.7	0	0	0	0	1.3	0.6	0	0	0	0	0.6	0.2	0	0	0	0	0	0	0	0
11-Jun	201.0	237.7	1.5	0.6	0	0	0	0	1.3	0.6	0	0	0	0	0.6	0.2	0	1	0	406	0	1	0	69
12-Jun	203.5	242.6	1.5	0.6	0	2	0	315	1.3	0.5	0	2	0	377	0.4	0.2	0	0	0	0	0	4	0	302
13-Jun	209.0	253.7	1.5	0.6	0	4	0	659	1.3	0.5	0	1	0	197	0.4	0.2	0	0	0	0	0	5	0	394
14-Jun	211.0	257.7	1.5	0.6	0	1	0	168	1.2	0.5	0	1	0	211	0.4	0.2	0	1	0	599	0	3	0	243
15-Jun	214.0	263.9	1.5	0.6	0	2	0	344	1.2	0.5	0	1	0	216	0.4	0.2	0	0	0	0	0	3	0	248
16-Jun	215.5	266.9	1.5	0.6	0	4	0	696	1.2	0.5	0	4	0	874	0.4	0.2	0	0	0	0	0	8	0	670
17-Jun	218.0	272.1	1.5	0.6	0	1	0	177	1.2	0.4	0	0	0	0	0.4	0.2	0	0	0	0	0	1	0	85
18-Jun	219.0	274.2	1.4	0.5	0	9	0	1764	1.2	0.5	0	4	0	880	0.4	0.2	0	0	0	0	0	13	0	1166
19-Jun	220.5	277.4	1.4	0.5	0	5	0	991	1.2	0.4	0	3	0	668	0.4	0.1	0	0	0	0	0	8	0	726
20-Jun	223.0	282.6	1.5	0.5	0	5	0	919	1.3	0.5	0	0	0	0	0.3	0.1	0	0	0	0	0	5	0	448
21-Jun	223.0	282.6	1.5	0.5	0	1	0	184	1.3	0.5	0	2	0	443	0.3	0.1	0	1	0	820	0	4	0	358
22-Jun	223.5	283.7	1.4	0.5	0	2	0	404	1.2	0.4	0	2	0	490	0.2	0.1	0	0	0	0	0	4	0	412
23-Jun	228.0	293.3	1.4	0.5	0	3	0	626	1.2	0.4	0	0	0	0	0.2	0.1	0	0	0	0	0	3	0	319
24-Jun	231.0	299.7	1.4	0.5	0	2	0	433	1.2	0.4	0	3	0	758	0.3	0.1	0	0	0	0	0	5	0	516
25-Jun	234.5	307.3	1.4	0.5	0	3	0	666	1.2	0.4	0	3	0	777	0.3	0.1	0	0	0	0	0	6	0	635
26-Jun	237.0	312.8	1.4	0.4	0	1	0	226	1.2	0.4	0	3	0	791	0.3	0.1	0	2	0	1880	0	6	0	646
27-Jun	238.5	316.1	1.4	0.4	0	1	0	228	1.2	0.4	0	0	0	0	0.3	0.1	0	1	0	950	0	2	0	218
28-Jun	240.0	319.5	1.4	0.4	0	0	0	0	1.2	0.4	0	0	0	0	0.5	0.1	0	0	0	0	0	0	0	0
29-Jun	241.0	321.7	1.4	0.4	0	6	0	1346	1.2	0.4	0	0	0	0	0.5	0.1	0	0	0	0	0	6	0	627
30-Jun	241.0	321.7	1.5	0.5	0	2	0	437	1.1	0.4	0	1	0	282	0.3	0.1	0	0	0	0	0	3	0	326
01-Jul	243.0	326.1	1.4	0.4	0	3	0	711	1.0	0.3	0	1	0	313	0.4	0.1	0	0	0	0	0	4	0	465
02-Jul	244.0	328.4	1.4	0.4	0	7	0	1671	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	7	0	820
03-Jul	244.0	328.4	1.4	0.4	0	9	0	2149	1.0	0.3	0	3	0	945	0.4	0.1	0	0	0	0	0	12	0	1405
04-Jul	244.5	329.5	1.4	0.4	0	6	0	1437	1.0	0.3	0	3	0	948	0.4	0.1	0	0	0	0	0	9	0	1058
05-Jul	244.5	329.5	1.4	0.4	0	1	0	240	1.0	0.3	0	0	0	0	0.4	0.1	0	0	0	0	0	1	0	118
06-Jul	245.5	331.8	1.5	0.5	0	12	0	2609	1.1	0.3	0	2	0	596	0.5	0.1	0	0	0	0	0	14	0	1499
07-Jul	245.5	331.8	1.5	0.5	0	8	0	1740	1.1	0.3	0	2	0	596	0.5	0.1	0	0	0	0	0	10	0	1071
08-Jul	244.5	329.5	1.5	0.5	0	6	0	1296	1.1	0.3	0	1	0	296	0.5	0.1	0	0	0	0	0	7	0	744
09-Jul	244.5	329.5	1.4	0.4	0	2	0	476	1.1	0.3	0	2	0	598	0.3	0.1	0	0	0	0	0	4	0	470
10-Jul	244.5	329.5	1.4	0.4	0	9	0	2142	1.1	0.3	0	1	0	299	0.3	0.1	0	0	0	0	0	10	0	1175
11-Jul	244.5	329.5	1.4	0.4	0	1	0	236	1.1	0.3	0	3	0	881	0.5	0.1	0	0	0	0	0	4	0	441
12-Jul	242.0	323.9	1.4	0.4	0	11	0	2552	1.1	0.3	0	2	0	577	0.5	0.1	0	0	0	0	0	13	0	1410
13-Jul	241.5	322.8	1.4	0.4	0	6	0	1387	1.1	0.3	0	3	0	863	0.5	0.1	0	0	0	0	0	9	0	973
Total Night					100	446	9024	58624			60	505	6399	58990			37	815	4498	138930	197	1766	7008	79686
Total					112	772	10572	98516			65	780	7110	94020			39	1454	4802	242252	216	3006	7963	133812