NECHAKO RIVER FRY EMERGENCE PROJECT 1998

NECHAKO FISHERIES CONSERVATION PROGRAM
Technical Report No. M97-6

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ABSTRACT

The Nechako Fisheries Conservation Program has conducted a chinook salmon (*Oncorhynchus tshawytscha*) fry emergence trapping project in the upper Nechako River since 1990 to monitor the incubation environment in the river. This year was characterized by higher than usual flows during the period of fry emergence. Emergent chinook fry were sampled by four Inclined Plane Traps (IPTs) at km 19 of the Nechako River from March 10 to May 15, 1998. Approximately 50% of the fry had emerged by April 20. There was one main peak of emergence (number of fry counted), between April 14 and April 23. The index of fry emergence as estimated from the proportion of the total flow sampled by the IPTs was 884,467 chinook, equivalent to an emergence success of 94 % when the estimated egg deposition above the trapping site the previous fall was taken into account. This is much higher than for the years 1990 to 1996, when indices of emergence success ranged from 42 to 57 %, and may reflect an inability of the index of fry emergence to respond to higher flows, as the traps did not sample proportionately the river flow as it increased. Nevertheless, the significant correlation between the index of fry emergence and the number of spawners the previous year validates the use of the index. The year-to-year comparisons of index values thus provide insights on the quality of the incubation environment in the last eight years. The mark recapture estimates of number of emerging fry was 959,244 ± 177,861 , which overlaps that of the index of fry emergence.

Emergent fry in 1998 were of similar average length, weight, and development index to those of previous years. Chinook from the margin traps tended to be slightly heavier than those from the mid-channel, and chinook which emerged at night were smaller and lighter than those sampled during the day. The incidental catch of the IPTs was the lowest in both percent and absolute numbers observed in all years of the program. The most common species were longnose dace (*Rhinichthys cataractae*), leopard dace (*Rhinichthys falcatus*) and redside shiners (*Richardsonius balteatus*). Overall the 1998 results from the fry emergence trapping program indicate that the quality of the incubation environment in the upper Nechako River does not show any degradation from previous years and appears to be stable.

INTRODUCTION

The Nechako Fisheries Conservation Program (NFCP) initiated the chinook salmon (*Oncorhynchus tshawytscha*) fry emergence trapping project in 1990. It is part of the Early Warning Monitoring Program developed by the NFCP Technical Committee. With juvenile outmigration, it is one of two secondary monitoring projects aiming at providing information about the quality of salmonid rearing habitat in the Nechako River. The specific objectives of the program are to monitor changes in the quality of the incubation environment in the upper Nechako River by developing an index of fry emergence timing and abundance and to get an index of egg-to-fry survival. The project also monitors the average size and condition of the fry, as sudden changes in fry condition may also reflect changes in the quality of the incubation environment of the Nechako River.

There were forced spills from the Nechako Reservoir during the period of emergence in 1990 and 1991, but flow conditions were generally consistent from 1992 to 1996. A forced release during the 1997 emergence period provided an opportunity to assess the effect of the increased flows on the index and estimate of emergence success. The increased flows in 1997 carried on through the spawning and incubation periods. Flows during the first part of the 1998 sampling period were also higher than usual.

METHODS

Study Site

Four 2 x 3 m Inclined Plane Traps (IPTs) were installed near Bert Irvine's Lodge, 19 km downstream from Kenney Dam (Figure 1). The traps were suspended from a cable strung across the river channel. Temporary cable anchors were designed and constructed on site.

The position and location of the traps were the same as in the previous years except in 1990 when they were positioned differently at the same site. The four traps were positioned on a line across the river channel, one on each river margin (IPTs 1 and 4), and two mid-channel (IPTs 2 and 3; Figure 2).

The left margin trap (IPT 1) was approximately 15 m from the shore with a 27 m diversion wing angled from the inshore edge of the trap to the shore 22 m upstream. The right margin trap (IPT 4) was approximately 4 m from the shore with an 9.6 m diversion wing angled from its inshore edge to the shore 9 m upstream. The margin traps rested on the river bed, in approximately 0.5 m of water. Operation of the traps started on March 10 and continued until May 15, 1998.

Nechako River - Physical Data

Mean daily water temperatures were measured by Water Survey of Canada (WSC) at the study site (WSC station # 08JA017). Daily water temperature data from the peak of spawning in September 1997 were used to estimate the probable time of emergence based on Accumulated Thermal Units (ATUs). Most chinook fry are expected to emerge from the gravel by approximately 1,000 ATUs (Wangaard and Burger 1983; March and Walsh 1987; Shepherd 1984). Thus ATUs serve as an indicator of the start of the fry emergence program. Daily flows were recorded at the study site and at Skins Lake Spillway (WSC station # 08JA013), and are reported as preliminary data.

Sampling Program

The IPTs and wings were cleaned of debris as necessary and the catches sampled twice a day, morning and evening. Water temperatures and staff gauge measurements were recorded daily at the traps. All fish found in the traps were identified to species and counted. A subsample of a maximum of 10 chinook per trap were anaesthetized with Metomadate (MS-222) and measured to the nearest 1.0 mm (fork length) and to the nearest 0.01 g (wet weight) at each sampling period. All fish caught were released downstream of the traps. Bams' (1970) development index (KD) was calculated for the measured fry:

$$(1)\ K_D = \frac{10\ \sqrt[3]{\text{weight in mg}}}{\text{length in mm}}$$

Index of Fry Emergence

The index of fry emergence was calculated using daily catches, flows in the Nechako River below Cheslatta Falls and the volume sampled by each trap. The flow in the Nechako River below Cheslatta Falls was available as preliminary data from Water Survey of Canada. The volume of discharge sampled by each trap was determined by measuring the cross sectional area of the trap mouth and the average velocity at three points across the mouth of each IPT. The volume of discharge sampled by each of the margin traps was estimated as the sum of the discharge through the IPT and the discharge diverted by the diversion wings. Wing discharge was estimated by measuring the upstream cross sectional area created by the diversion wing, and recording several velocities along a line perpendicular to the shore extending from the upstream edge of the diversion wing to the point opposite the junction of the trap and the downstream end of the diversion wing. Velocity was measured with a Swoffer Model 2100 current velocity meter and measurements were taken every second day when possible. An index of the total number of emerging chinook moving downstream past the IPTs was estimated from the proportion of discharge sampled by each IPT:

$$(2)\quad N_i = n_i\,(V_i / v_i)$$

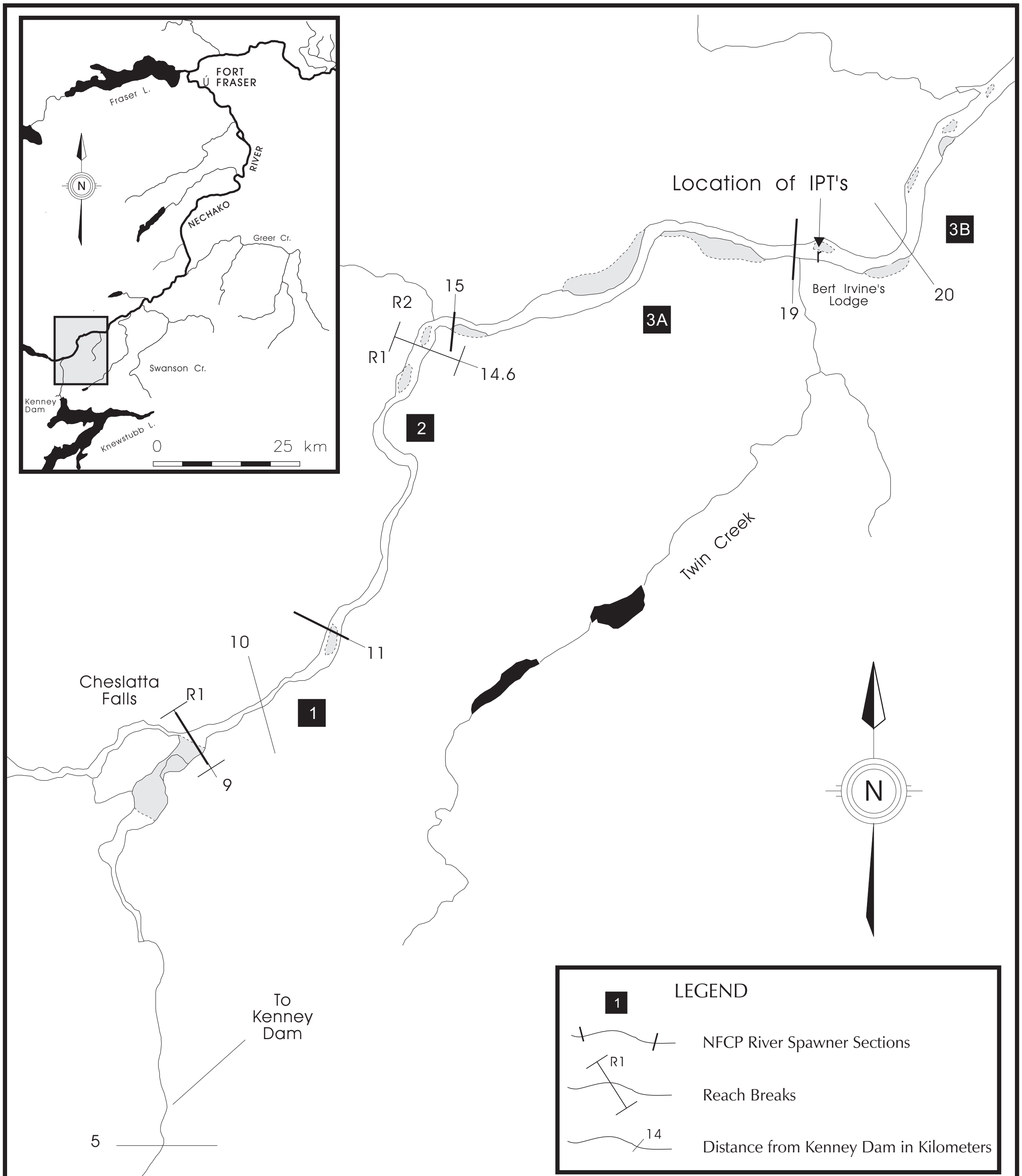
where N_i = expanded number of fish,

n_i = number of fish observed,

V_i = total river flow,

v_i = flow through trap,

and i = the *ith* sampling date.



Nechako Fisheries Conservation Program

Map # M97-6FG1

0 4 KM

FIGURE 1. Location of fry emergence sampling, km 19 Nechako River.

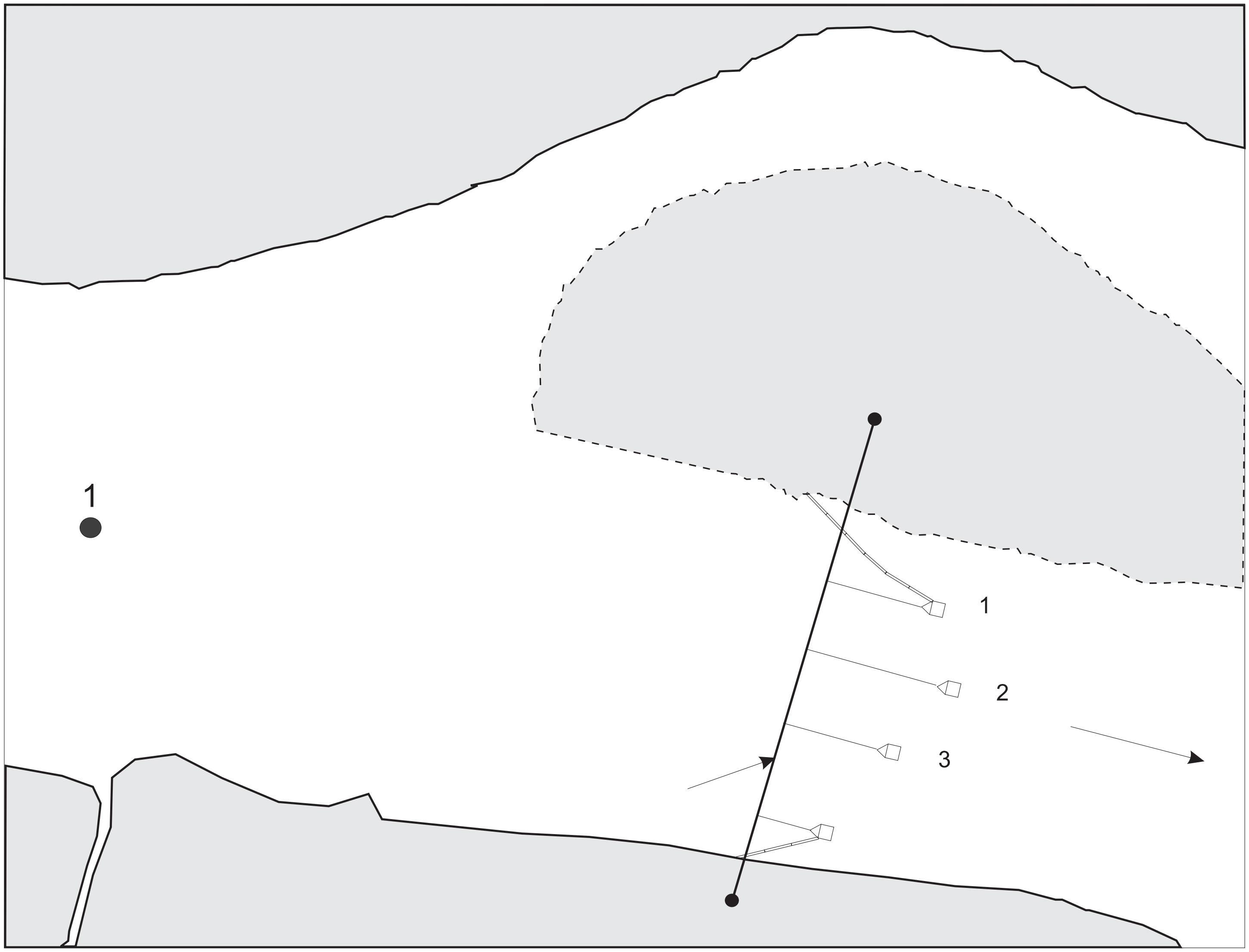


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Figure 2: **Location** of Inclined Plane Traps (IPT) at km19 (Bert Irvine's) of the Nechako River

Because statistical independence among IPTs could not be assumed (IPTs are not replicates), a combined fry emergence estimate was calculated for each day. This estimate is the sum of all four IPTs' estimated catches expanded by the water volume filtered by each IPT. It was equivalent to an estimate weighted by the volume filtered:

(3) Index of fry emergence =
$\Sigma (N_i * v_i)$ for all traps / $\Sigma (v_i$ of all traps)

As the sampling program progressed in the season, the risk increased of including already emerged fry, as opposed to emerging fry, in the calculation of the fry emergence index. Already emerged fry may have established residence along the banks in the vicinity of the IPTs, and their inclusion in the calculation was judged to be undesirable, as it would overestimate the index (some fry could be captured and counted twice or more). A more conservative approach was to base the index of fry emergence only on fry which have just emerged from the substrate.

To separate emerging fry from already emerged ones, the date at which post-emergent fry started to make a significant contribution to the number of fry caught in the IPTs was inferred from examination of the variance in wet weight. This was based on the assumption that already emerged fry have started to feed, and are thus heavier than emerging fry. Their pooling with emerging fry should result in an increase in the variance in wet weight of fry caught in the IPTs. The cutoff date was considered to be the point at which the variability in pooled wet weights was significantly affected by the addition of the next day's samples, as determined by an F-test ($P<0.05$). The mean pooled wet weight of all the chinook fry sampled to this date plus one standard deviation was considered to be the upper limit of mean wet weight of newly emergent fry. The proportion of fry subsampled that were smaller than that limit was then determined after the cut-off date so that for each day after the cut-off date, the daily index of emergence was multiplied by this percentage. For example, if 50% of the fish subsampled after the cut-off date were smaller or equal than the upper limit, 50% of the catches were used in the calculation of the index of fry emergence after that date.

Estimates of Emergence Success

The percent of chinook salmon spawning above the study site (river sections 1, 2 and section 3A) were obtained from the Nechako River spawner enumeration data (unpublished data, Department of Fisheries and Oceans). The Area-Under-the-Curve estimate of the total number of spawners in the river was multiplied by the percent of spawners in these river sections to obtain an estimate of the numbers of chinook spawners in the upper river.

To estimate the potential number of chinook eggs deposited upstream of the traps, the total number of spawning females was assumed to be one half of the population above the study site. A mean fecundity of 5,769 eggs per female was assumed, based on data from Jaremovic and Rowland (1988) on Nechako chinook (N = 8, range = 5,000 to 7,200, standard deviation = 869).

Trap Efficiency

The index of the number of emergent fry relies on the accuracy of the assessment of the proportion of the population sampled by the IPTs and is based on the proportion of the total river flow sampled by the traps. Another method of inferring fry abundance is to calculate trap efficiency through mark-recapture trials. Three such trials were conducted on March 24, April 5, and April 19, 1998. For each trial, chinook fry caught in the IPTs were held in a live box for a maximum of 4 days or until there were over 1,500. They were then transferred into an aerated staining container where they were stained with Bismark brown for 2 hours. Stained fry were transferred to transport containers and any mortalities were noted and subtracted from the total released. Fry were released at dusk at km 18.3 (0.5 km upstream of the IPTs). On subsequent sampling days, the number of marked chinook recaptured in each trap was noted along with the total catch (marked and unmarked). The time between mark-recapture trials was sufficient to ensure previously marked fish would not bias the next trial. Trap efficiency was calculated as the ratio of the number of recaptured fry to the number of released fry. The estimated population was the average of the number of chinook fry estimated at each trial weighed by the number of fry released at each of these trials.

Statistical Analyses

The influence of time of day and trap location on the biological variables (fork length, wet weight, and KD) were determined through factorial ANOVAs. If the ANOVA indicated a significant effect, t-tests were used to test the effect of time of day (day vs. night) on each trap, and one-way ANOVAs were used to test the effect of trap position for each time period. LSD tests ($P<0.05$ level of significance) were used as a *posteriori* tests to determine which traps differed.

RESULTS AND DISCUSSION

Nechako River - Physical Data

Mean daily water temperatures in the Nechako River and ATUs from September 10, 1997 (peak spawning period) to May 30, 1998 are provided in Figure 3. During the incubation period, the mean daily water temperatures ranged from 0.1°C (in December 1997 and January 1998) to 16.1°C (September 1997). The ATUs for the fry emergence period (March 10 to May 15) ranged from 917 to 1,191. The predicted peak of fry emergence at 1,000 ATUs was on April 15 whereas the observed peak occurred on April 20 at 1,019 ATUs. This falls within the range of previous years of the program, when ATUs at that date have been between 840 and 1,004, with an average of 910. It thus appears that the 1,000 ATUs figure is a reasonably good predictor of fry emergence.

The releases from Skins Lake Spillway and the flows measured below Cheslatta Falls from March 1 to May 31, 1998, are shown in Figure 4. Flows in 1998 were steady at approximately 54 m^3/s from March 1 to April 19, and higher than the average for that time of year (Figure 5). Flows from the Nechako Reservoir began to increase from April 19 to May 09 to a maximum of 68.6 m^3/s, an increase of 22.5% over 20 days. By the end of May, discharges at km 19 had gone down to 62.1 m^3/s, well within the range of flows observed during previous years of the program. The percentage of the flow sampled by the IPTs did not remain constant, however: IPT 1 increased the relative proportion of flow it sampled by 11% during the fry emergence period, going from sampling 1.6 to 1.7% of the Nechako flow, whereas the other IPTs decreased theirs as the river flows increased (proportional decreases of -47, -46 and -28% for IPTs 2, 3 and 4 respectively, Figure 6). All IPTs combined averaged a proportional decrease of the flow they sampled of 27 % (absolute decrease of 0.2%) from start to end of the sampling. This means that the index of fry emergence is likely to overestimate the number of emerging fry.

Fry Emergence

Trap catches

The distribution of chinook 0+ caught among the four IPTs is summarized in Table 1. Of the 33,178 chinook fry enumerated, 23,248 (70 %) were sampled by the margin traps, and the right margin trap (IPT 4) accounted for approximately 40 % of the total (Figure 7). Most of the chinook (95 %) emerged at night. There was one main peak of emergence in 1998, with 41 % of the chinook counted between April 14 and April 23 (Figure 8). The pattern of daily discharge is also shown in Figure 8. The observed peak of emergence occurred on April 20, 1998 (1,019 ATUs), and the date by which 50% of the fry had emerged was April 16, 1998 (1,004 ATUs). IPTs 2 and 3 ceased to operate after May 13 due to overwhelming debris accumulation.

The index of emergent fry during the trapping period was estimated from the number of fry counted and the percentage of the flow sampled. The date at which post-emergent fry started to make a significant contribution to the number of fry caught in the IPTs was inferred from examination of the variance in wet weight pooled over time, which did not increase significantly until May 01, 1998 (F test, Figure 9). After that date, it was estimated that 41.5 % of the fry caught in the traps were one standard deviation heavier than the average wet weight of emergent fry, and the calculation of the daily index for each trap was reduced by this proportion. The indices for each of the four traps ranged from 593,252 to 1,724,643 chinook fry, while the overall estimate (weighted by the volume of water sampled by each trap) was 884,467 (Appendix 1). This is the second highest index calculated during the project, second only to 1997 (Table 2).

Figure 3
Mean Daily Water Temperatures of the Nechako River Below Cheslatta Falls, 1997 and 1998 (preliminary data from WSC) and Accumulated Thermal Units (ATU) from Peak of Spawning

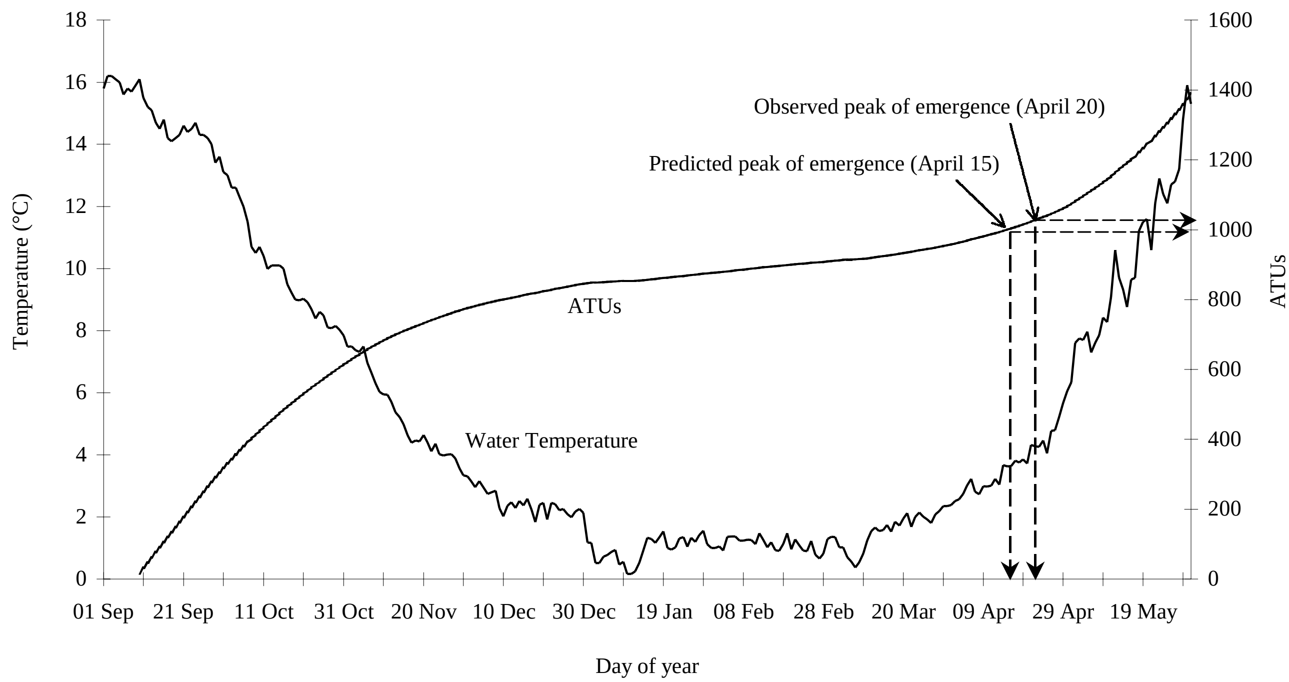


Figure 4
Daily Discharge of the Nechako River Below Cheslatta Falls, March to May 1998 (preliminary data from WSC)

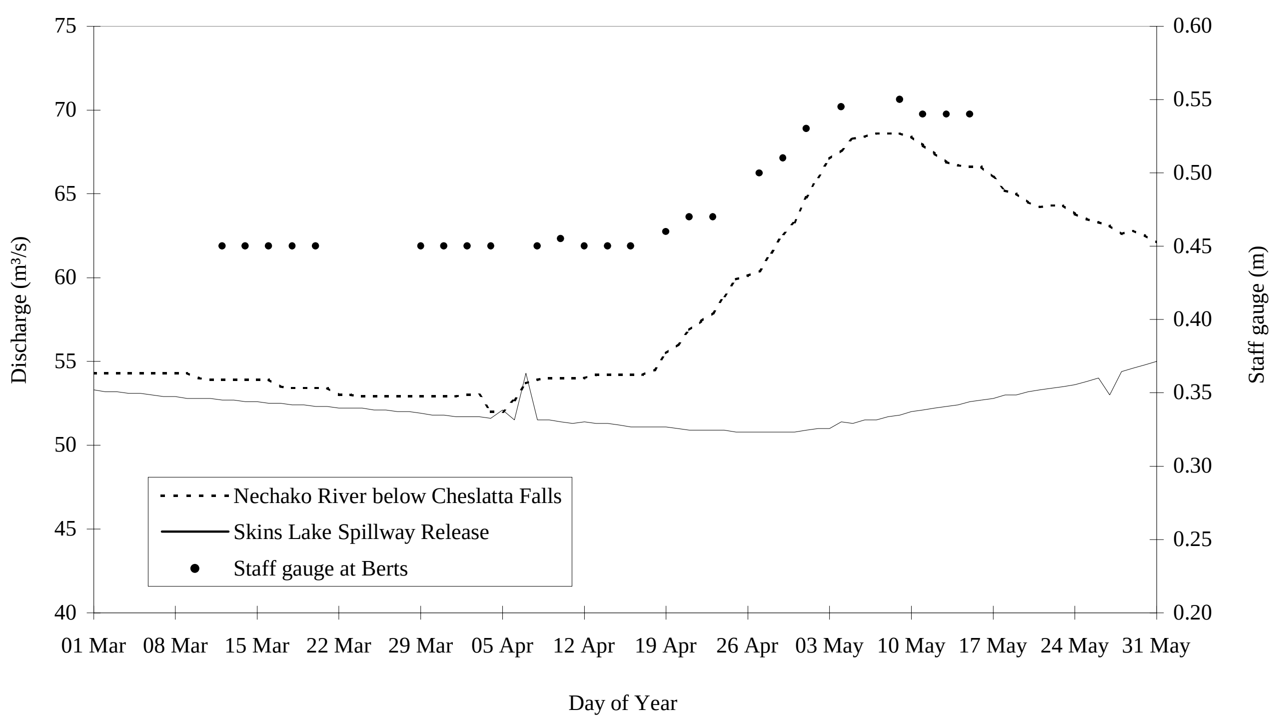


Figure 5
Average, Minimum and Maximum Daily Discharge of the Nechako River Below Cheslatta Falls for the Period for March through May, 1988 to 1997 and Flows Observed in 1998

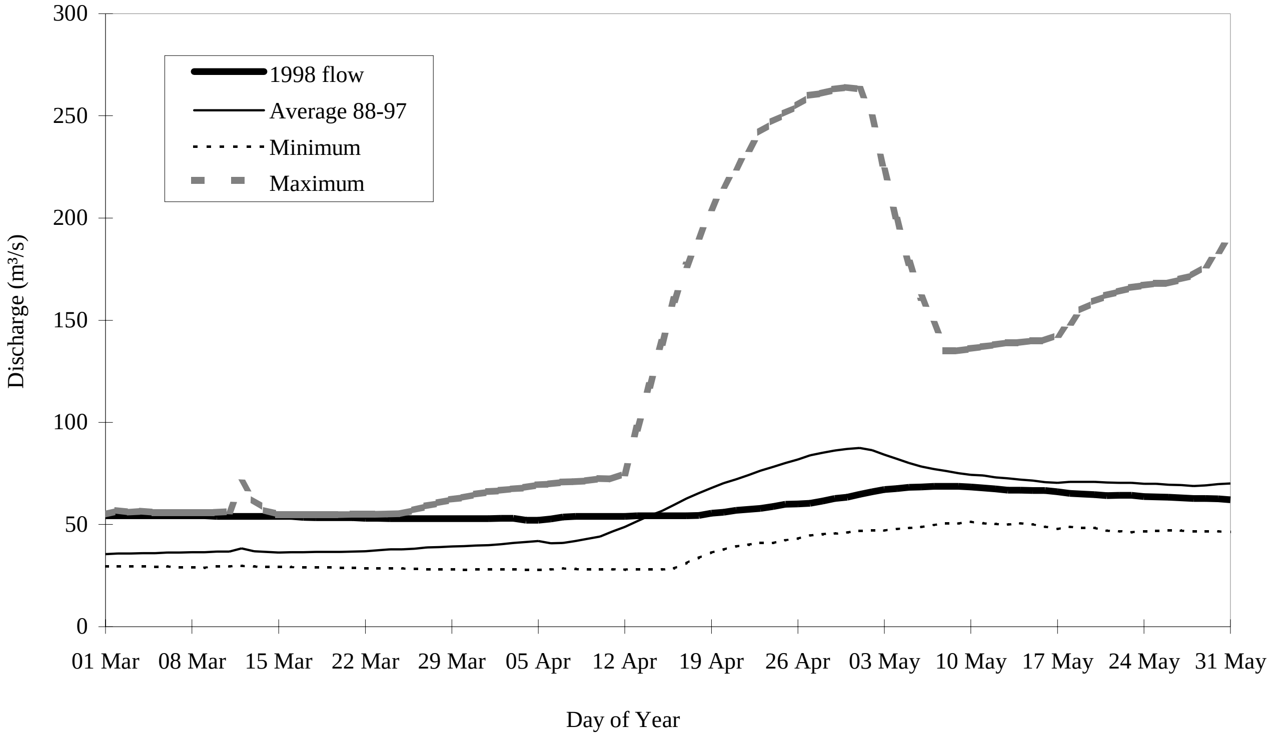


Figure 6
Nechako River Flows Below Cheslatta Falls and Percent of Total Flow Sampled by the Four IPTs, 1998

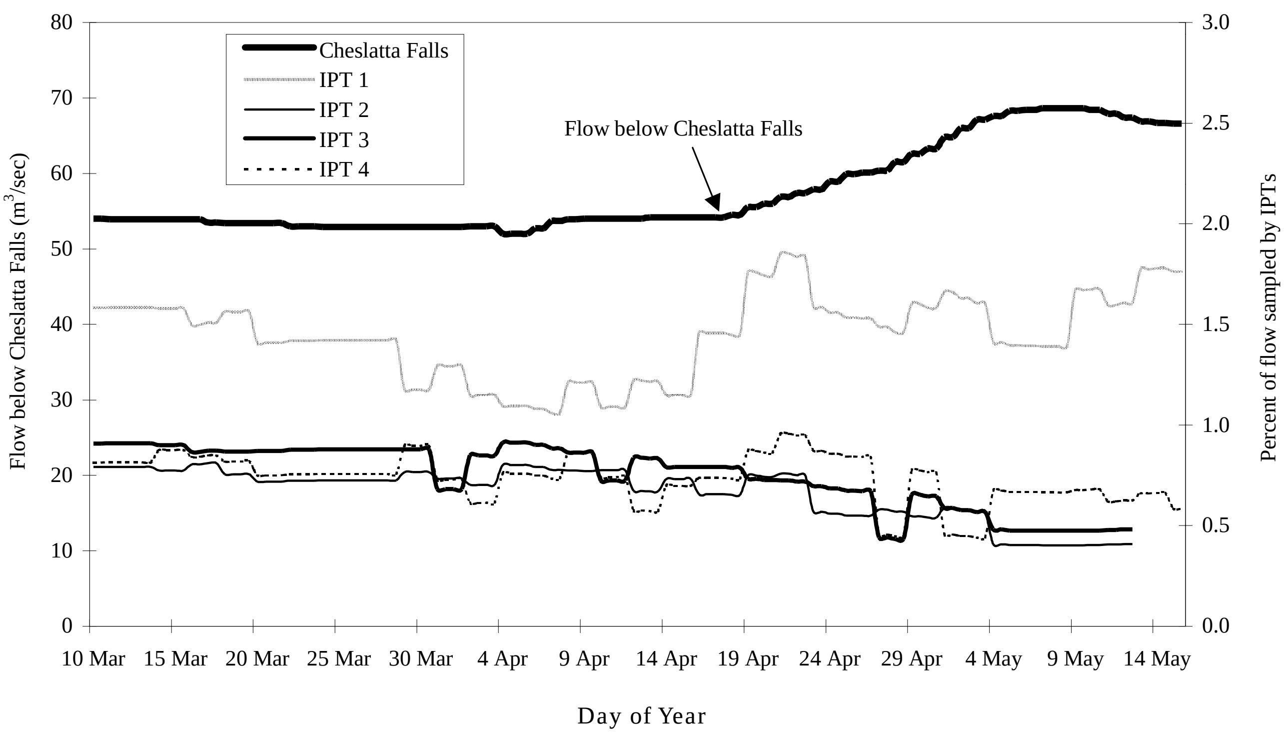


Table 1
Summary of Inclined Plane Trap Catches of Chinook 0+ and the Percentage Contributed by Each Trap to the Total Catch at km 19 of the Nechako River, March 10 to May 15, 1998

		Night (morning check)		Day (evening check)		Overall
Trap Number	Total	Number	Percent	Number	Percent	Percent
1	10,038	9184	27.7	854	2.6	30.3
2	5,273	5029	15.2	244	0.7	15.9
3	4,657	4469	13.5	188	0.6	14.0
4	13,210	12792	38.6	418	1.3	39.8
Total	33,178	31,474	94.9	1,704	5.1	100.0

Mark-recaptures trials

Three mark recapture trials were conducted on March 24, April 5 and 19. The overall trap efficiency, 3.5%, resulted in an estimated population of 959,244 (Table 3). The overall estimate (mean of all three trials weighed by the number of fish released) of emerging fry was 966,745 ± 177,861 (95% confidence interval). This overlaps the index of fry emergence.

Emergence Success

A total of 1,954 chinook salmon were estimated to have spawned in the Nechako River in 1997 (Unpublished, DFO), out of which approximately 16.7% (326) spawned upstream of the trapping site. Assuming a 1:1 sex ratio, 163 females deposited approximately 940,347 eggs, based on an average fecundity of 5,769 eggs per female (Jaromevic and Rowland 1988). In previous years this calculation has resulted in an emergence success ranging from 42.4 % in 1991 to 56.7 % in 1995. The 1997 index, however, generated an emergence success of approximately 101 %. This year's index, with an estimate of 884,467 fry, also generates a very high and improbable emergence success of 94 %.

The greatest source of variability in the calculation of emergence success is in the estimation of the number of emerging fry (index of fry emergence). The main assumptions for that index are that the traps sample the same proportion of the river flows regardless of the total discharge, and that the fry are randomly distributed within the water column. Neither of these assumptions may hold at higher flows. In 1998, as the flow increased, the percentage of the river flow sampled by the traps did remain constant (Figure 6). The index is weighted by the proportion of the discharge sampled, and the decreasing proportion sampled by each trap may result in an inflated index as the flows increase. The precision of the index is therefore affected by river discharge.

Relationship Between Escapement and Index of Abundance

The indices of abundance (estimated number of fry) obtained for the first eight years of the project are significantly correlated with the escapement the previous fall. However, the 1997 and 1998 indices are higher than would be expected from the number of chinook estimated to have spawned upstream of the trap site (Figure 10).

The factors which contribute to the index of emergence, from number and distribution of spawning chinook to trap placement, did not vary significantly in 1997 and 1998 as compared to other years, with the exceptions of flows and chinook catches. The spawner estimates were not unusual in any way, and spawner distribution in the river and residence time were unchanged. In addition, despite the higher flows, channel morphology has not changed according to depth profiles of the river near Bert Irvine's. Winter water temperatures were warmer than average, as would be expected from higher flows. Trap placement has not changed from year to year, and velocities across trap mouths were similar every year. As well, in contrast with the index of fry emergence, the index of outmigrants did not show an unusual increase in 1997 or 1998 (Triton 1997b). Thus the higher indices of fry emergence in 1997 and 1998 are probably related to higher than usual flow conditions in the river during these years.

In conclusion, the index of fry emergence is likely to overestimate the real number of fry because the traps did not sample proportionately the river flow as it increased. The fry were also clearly favouring the margins, whereas the calculation of the index assumes an equal distribution of the juvenile chinook in the water column and across the river, as equal weight is given to each trap. The emergence success is there-

Figure 7
Number of Fry Sampled Daily by IPTs at km 19 of the Nechako River (Bert Irvine's), March to May 1998

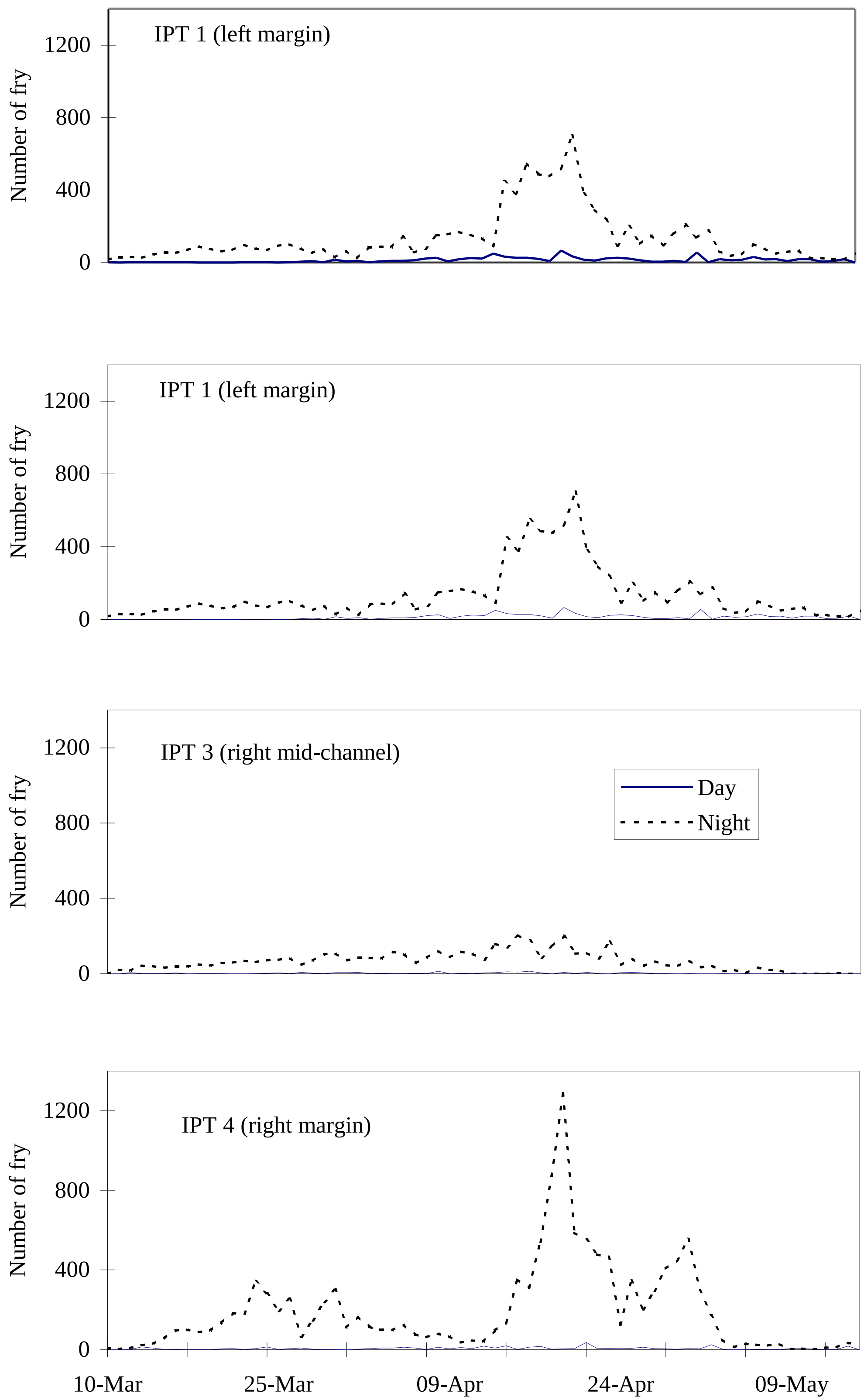
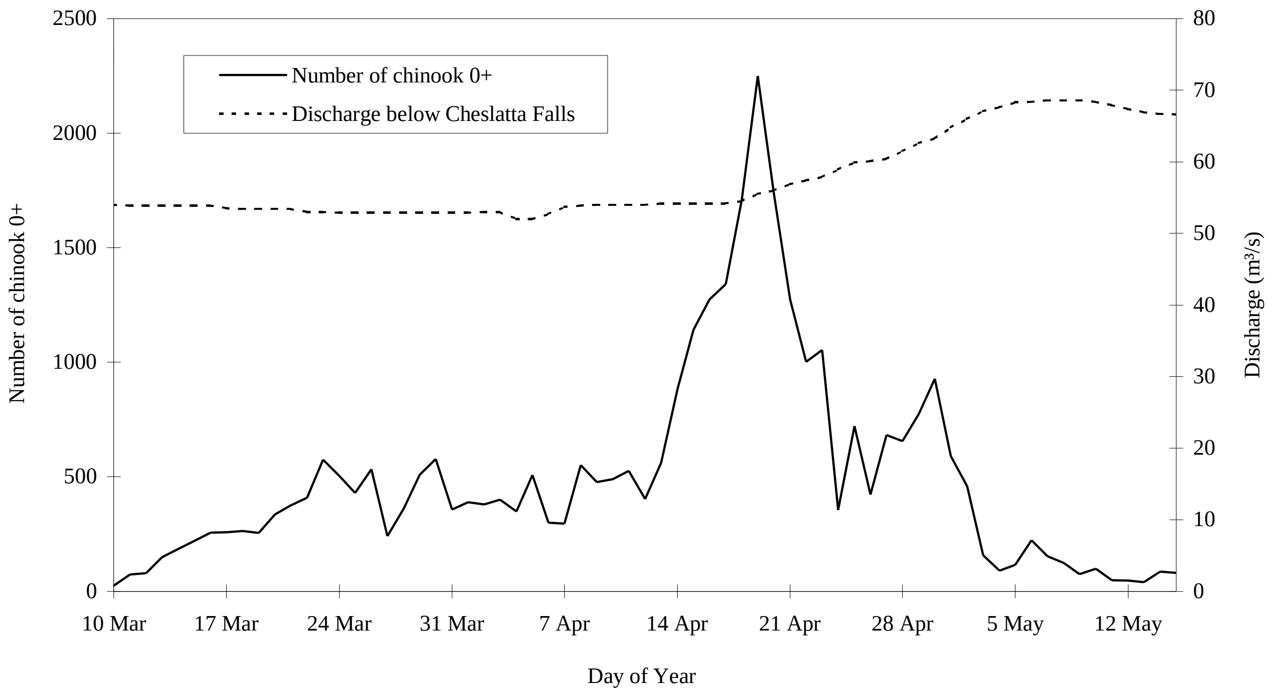


Figure 8
Discharge Recorded Below Cheslatta Falls and Total Number of Chinook Fry Counted by Four IPTs at km 19 of the Nechako River, March 10 to May 15, 1998



fore also overestimated. Nevertheless, the significant correlation between the index of fry emergence and the number of spawners the previous years indicates that it reflects real biological processes. The year-to-year comparisons of index values thus provide a valuable tool to assess the quality of the incubation environment.

Morphological Data

Average morphological parameters for emerging fry sampled by the IPTs are shown in Table 4. Daily mean fork length, weight, and development index are presented in Appendix 2. The results of factorial ANOVAs on the effects of time of day and trap position on chinook fry fork length, wet weight and development index are presented in Table 5. There was a significant effect of time of emergence (day or night) for the development index only, and significant effects of trap position and interaction between the two factors for all three variables. The average morphological parameters for emerging fry in each IPT during each sampling period are shown in Table 6.

The interactions between trap position and time of emergence for fork length for all four traps are shown in Figure 11. There were significant interactions between trap position and time of capture, and there were significant differences in the lengths of chinook fry sampled from the different traps ($P < 0.001$ in both cases, Table 5). The effect of time of emergence, however, was not significant. Trap 1 fish were significantly smaller at night ($t_{425,672} = 4.77$, $P < 0.001$), whereas trap 2 fish were significantly *larger* at night ($t_{233,587} = 3.5$, $P < 0.001$). Fish from traps 3 and 4 did not differ significantly between day and night. The percent difference from day to night ranged from 0.3 % for IPT 4 to 2.3 % for IPT 1.

There were significant interactions between trap position and time of emergence for wet weight, and there were significant differences in the weights of chinook fry sampled from the different traps ($P < 0.001$ in both cases, Table 5). The effect of time of emergence, however, was barely significant. Trap 1 fish were lighter at night ($t_{425,672} = 4.93$, $P < 0.001$), whereas trap 2 fish were heavier at night ($t_{233,587} = 2.5$, $P < 0.001$). Fish from traps 3 and 4 did not differ significantly between

Figure 9
Box Plots of Development Indices, Wet Weights and Fork Lengths of Juvenile Chinook Subsampled in IPTs at km 19 (Bert Irvine's), Nechako River, 1998, as a Function of Sampling Date

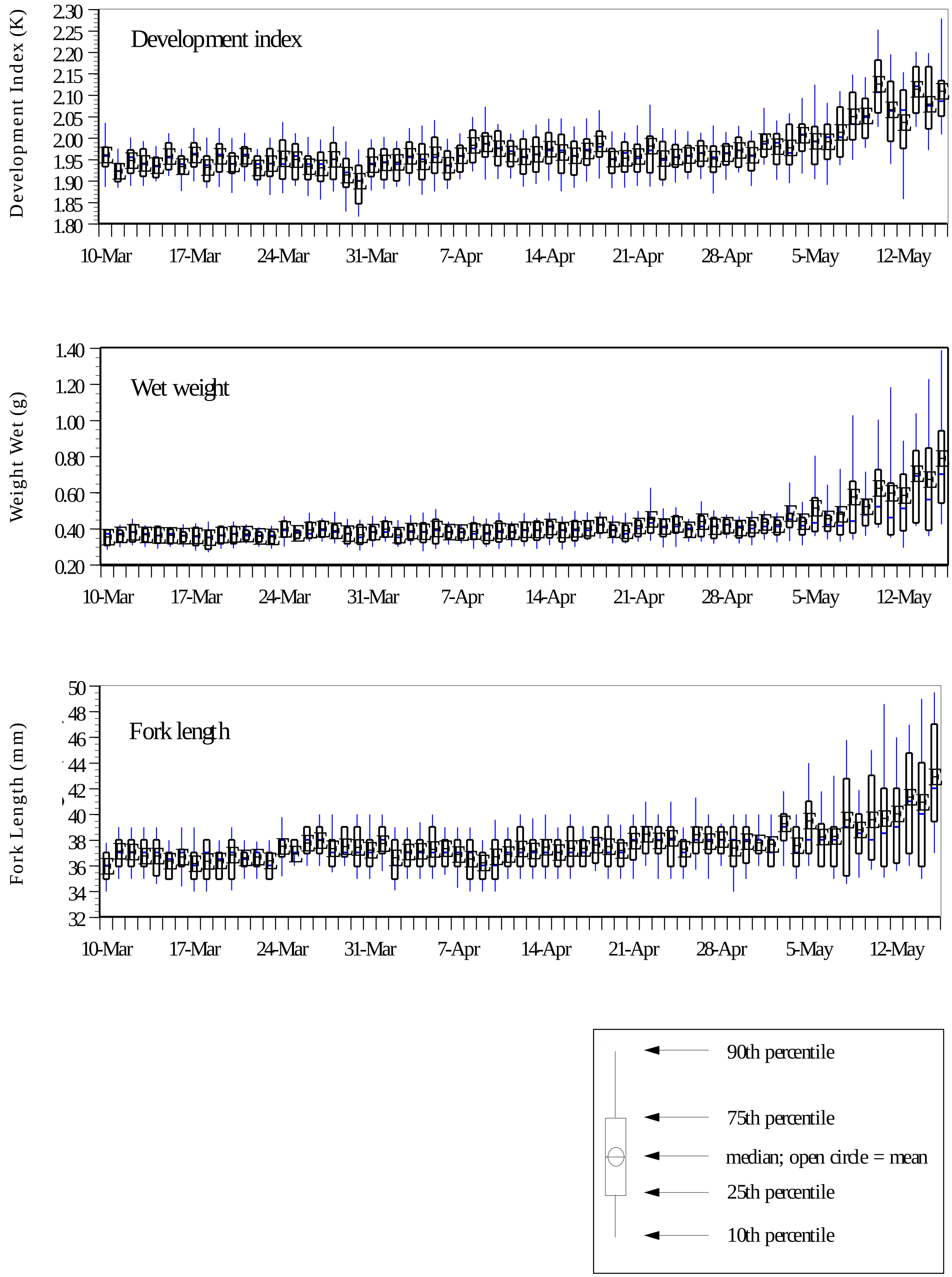


Table 2
Yearly Indices of Emergence, Number of Spawners and Emergence Successes Recorded at or Above Bert Irvine's, Nechako River

Year	Index of fry Emergence	Number of Spawners Above km 19 (*)	# Eggs Produced	Emergence Success
1990	638,120	452	1,303,794	48.9%
1991	589,456	482	1,390,329	42.4%
1992	512,247	373	1,075,919	47.5%
1993	276,613	225	649,013	42.8%
1994	95,420	76	219,222	43.5%
1995	242,058	149	429,791	56.7%
1996	428,663	304	876,888	48.9%
1997**	1,211,894	416	1,199,952	101.0%
1998	884,467	326	940,347	94.1%

(*) number of spawners (females and males) during the preceeding year
(**) forced spill flows approximately three times the usual flows

Table 3
Summary of Mark Recapture Trials on Emergent Chinook Fry at km 19 of the Nechako River (data for all four IPTs combined)

Release	Release Date	Number Released	Number of Days Fish Caught	Number of Recaptures	Trap Efficiency (#recaptured/ # released)	Total Catch	Estimated Population (Total Catch / Trap Efficiency)
1	24-Mar-98	1,745	3	59	3.4%	33,178	981,282
2	05-Apr-98	1,500	5	45	3.0%	33,178	1,105,933
3	19-Apr-98	3,000	4	112	3.7%	33,178	888,696
Overall		6,245		216	3.5%	33,178	959,244
Weighed estimate							966,745
95 % confidence interval						upper	1,144,607
						lower	788,884

day and night. The percent difference from day to night ranged from less than 0.1 % for IPT 4 to 13.9 % for IPT 1.

Time of emergence, trap position and their interaction all had significant effects on the development index (all P < 0.0001, Table 5). As expected from their lower fork length and wet weight, trap 1 fish had lower development indices at night ($t_{425,672} = 6.63$, P< 0.001). Fish from traps 2, 3 and 4 did not differ significantly between day and night. The percent difference from day to night ranged from less than 0.1 % for IPT 2 to 2.0 % for IPT 1.

Overall, the emergent chinook measured in 1998 were very similar to emergent fish measured in previous years in terms of fork length, wet weight and development index (Table 7).

Incidental Catch

The total incidental catch in 1998 was 837 fish, or 2.5 % of the total catch (Appendix 3). This was the lowest incidental catch in all years since the program started (Figure 12). This was also the lowest percent of the total catch made up by incidental species. The percent composition of the incidental species and their rankings in terms of abundance from 1991 to 1998 are shown in Table 8. In 1998, most of the incidental catch was taken at night (89 %) and in the margin traps (34 % in IPT 1, 55 % in IPT 4). The most common fish were longnose dace (*Rhinichthys cataractae*, 0.7 % of the total catch), leopard dace (*Rhinichthys falcatus*, 0.4% of the total catch) and redside shiners (*Richardsonius balteatus*, 0.3 %). Overall, all fish in the incidental catch showed a decline in 1998, with the exception of mountain whitefish.

The incidental catch patterns reflected those of chinook until 1996, but there was a dissociation in the last two years, coincidental with different flow regimes (Figure 12). This may reflect changes in community composition due to high flows.

Figure 10
Index of Fry Emergence Versus the Spawner Escapement (females only) Above km 19 of the Nechako River During the Previous Year (years are in parentheses)

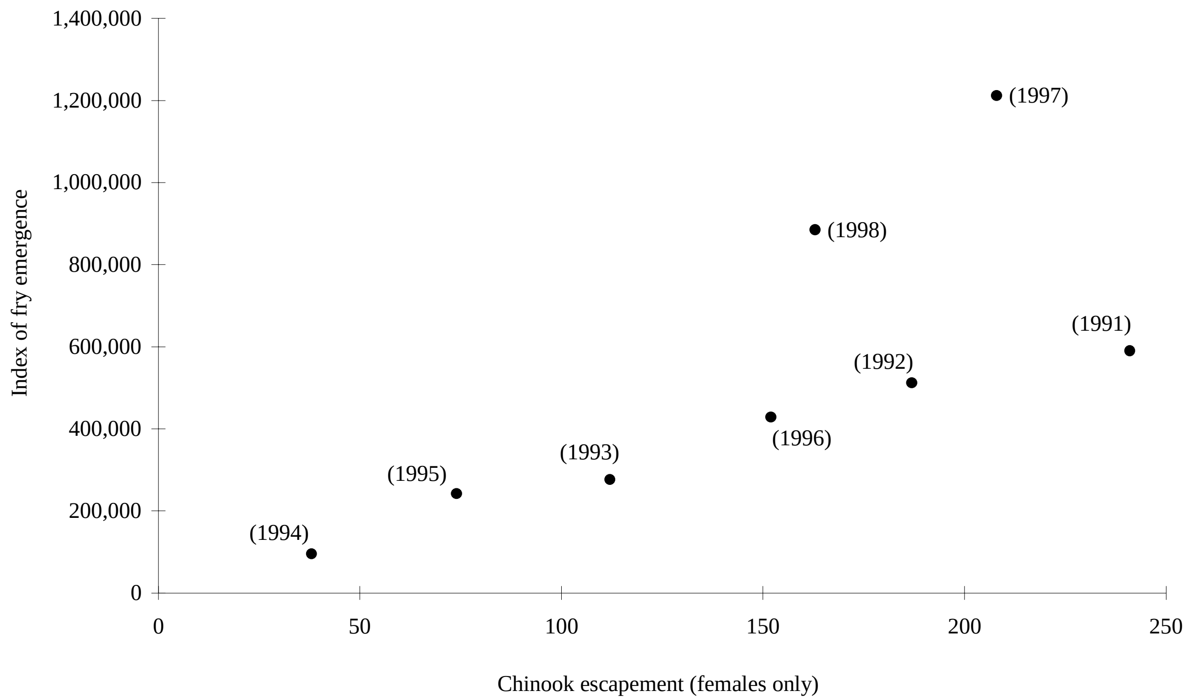


Table 4
Average Morphological Parameters for Emerging Chinook Sampled from the IPTs at km 19, Nechako River, March 10 to May 15, 1998 (N = 3, 637)

	Fork length (mm)	Wet weight (g)	K_D
Mean	37.5	0.41	1.97
Standard Deviation	2.4	0.13	0.07

Table 5
ANOVAs for Morphological Characters of Chinook Fry Sampled at km 19 of the Nechako River

Fork Length

Source of Variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.894	0.16	0.689
Trap	3	302.161	54.134	0.0000
Interaction	3	76.03	13.621	0.0000
Explained	7	143.321	25.677	0.0000
Residual	3629	5.582		

Wet weight

Source of Variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.06	3.775	0.052
Trap	3	1.257	79.722	0.0000
Interaction	3	0.207	13.132	0.0000
Explained	7	0.617	39.152	0.0000
Residual	3629	0.016		

Development index

Source of Variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.06	12.779	0.0000
Trap	3	0.383	81.176	0.0000
Interaction	3	0.054	11.359	0.0000
Explained	7	0.201	42.625	0.0000
Residual	3629	0.005		

Table 6
Average Morphological Parameters for Emerging Fry in the IPTs at km 19 of the Nechako River, 1998
(N is number of chinook, SD is standard deviation)

	Trap No.							
	1		2		3		4	
	Day	Night	Day	Night	Day	Night	Day	Night
N	425	672	233	587	177	577	328	638
Mean Length (mm)	38.7	37.8	36.7	37.2	36.9	37.2	37.6	37.5
SD	3.03	2.83	1.93	1.69	2.12	1.74	2.38	2.52
Mean Weight (g)	0.49	0.43	0.37	0.38	0.38	0.38	0.42	0.42
SD	0.18	0.17	0.07	0.06	0.10	0.06	0.11	0.14
Mean KD	2.01	1.97	1.94	1.94	1.94	1.95	1.98	1.97
SD	0.07	0.08	0.06	0.05	0.06	0.05	0.07	0.08

Figure 11
Morphological Characters (± 1 SEM) at Each IPT as a Function of Time of Emergence

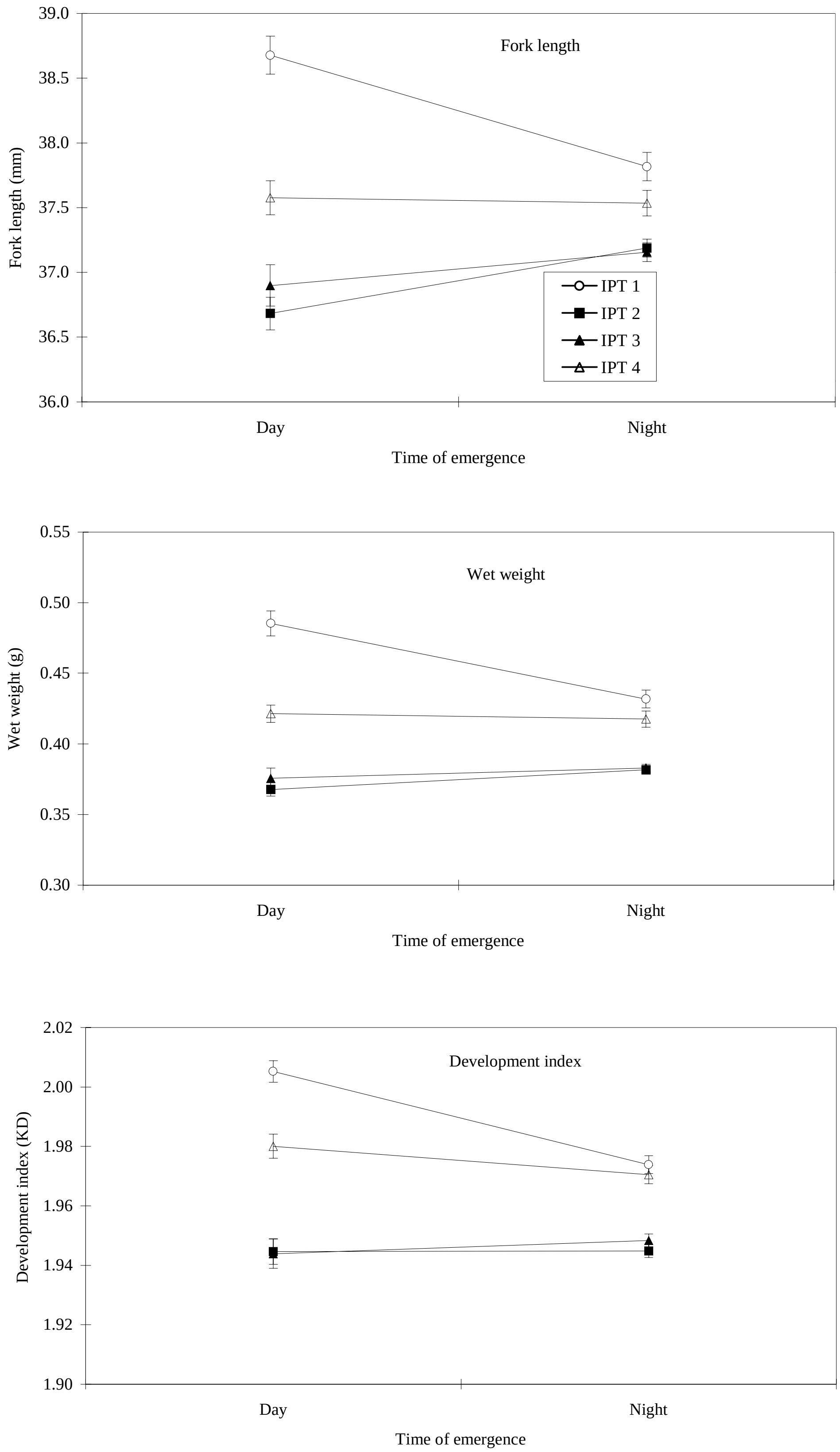


Table 7
Average Fork Length, Wet Weight and Development Index of Emerging Juvenile Chinook
Sampled by Inclined Plane Traps in the Nechako River at km 19
(Standard deviations are in parentheses. Data are for fish captured up to and including cut-off-date)

Year	Cut-off date	Fork length (mm)	Wet weight (g)	KD	N
1998	01-May	37.2 (1.9)	0.39 (0.08)	1.95 (0.06)	3,079
1997	18-May	36.2 (2.0)	0.36 (0.07)	1.95 (0.06)	3,505
1996	—	37.6 (1.8)	0.38 (0.07)	1.92 (0.07)	3,357
1995	09-May	38.2 (1.4)	0.40 (0.05)	1.92 (0.05)	2,261
1994	03-May	38.3 (1.6)	0.40 (0.06)	1.91 (0.06)	2,014
1993	10-May	37.9 (1.9)	0.41 (0.08)	1.95 (0.01)	2,769
1992	09-May	39.1 (2.4)	0.45 (0.11)	1.93 (0.07)	4,684
1991	10-May	38.0 (1.9)	0.38 (0.06)	1.90 (0.06)	3,469
1990	30-Apr	37.6 (1.8)	0.38 (0.06)	1.93 (0.07)	1,564

Figure 12
Comparisons of Incidental and Chinook Fry Catches in IPTs at km 19 of the Nechako River, 1991 - 1998

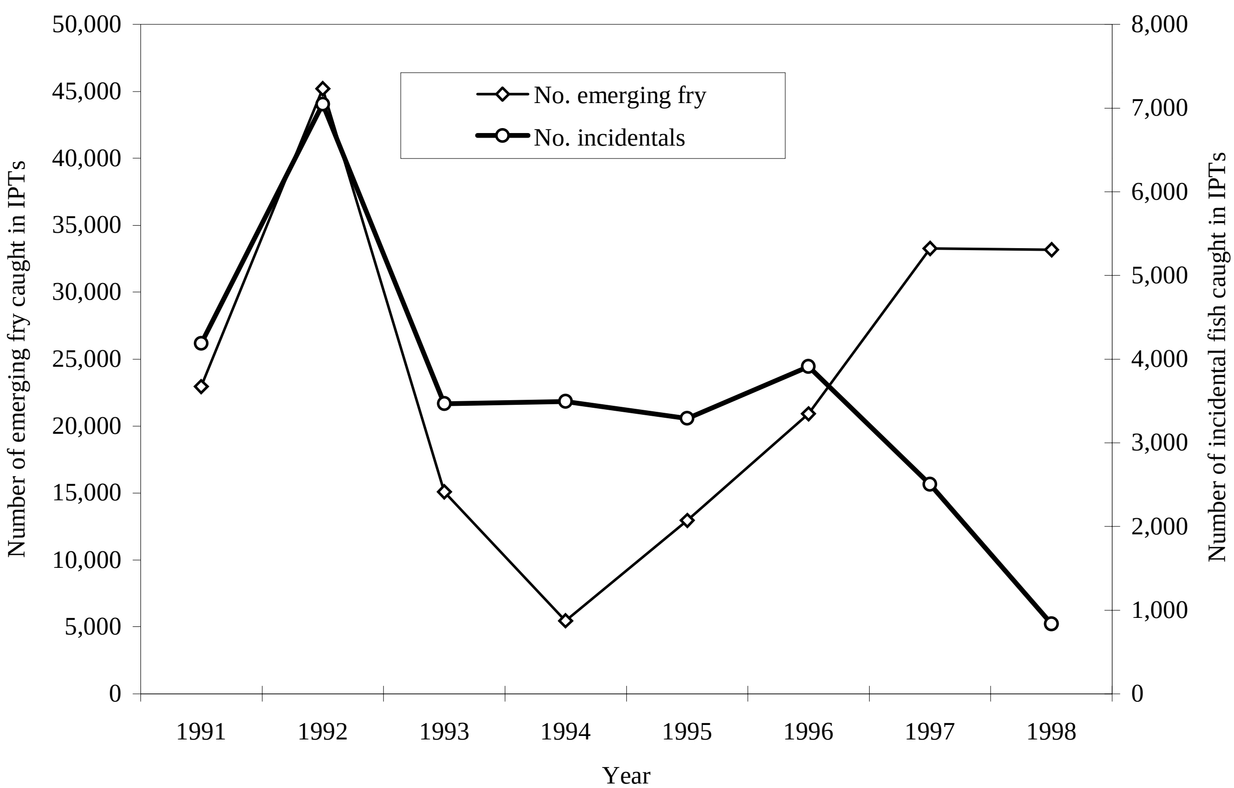


Table 8
Percent of Total Catch and Ranking of Incidental Species Caught in IPTs at km 19 of the Nechako River, 1991 - 1998

Species		Percent of total catch 1991	1992	1993	1994	1995	1996	1997	1998
longnose dace	*Rhinichthys cataractae*	3.78	2.97	3.23	21.85	4.29	4.24	2.34	0.68
leopard dace	*Rhinichthys falcatus*	0.73	1.63	0.75	7.24	3.06	4.07	0.54	0.38
redside shiner	*Richardsonius balteatus*	4.32	2.54	0.78	3.57	3.12	3.26	1.69	0.31
mountain whitefish	*Prosopium williamsoni*	0.02	0.66	0.13	0.13	4.21	0.06	0.02	0.24
largescale sucker	*Catostomus macrocheilus*	2.69	2.11	3.11	4.02	3.52	2.09	0.50	0.23
chubbs	*Mylocheilus sp.*	0.00	0.00	0.00	0.19	0.04	0.54	0.20	0.20
northern pikeminnow	*Ptychocheilus oregonensis*	4.26	1.84	1.68	1.17	1.64	1.41	0.63	0.18
sculpin	*Cottus sp.*	0.56	0.45	0.79	3.11	0.99	0.41	0.42	0.18
sockeye salmon	*Oncorhynchus nerka*	0.02	2.15	3.32	0.03	0.89	0.83	0.82	0.05
lake trout	*Salvelinus namaycush*	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.02
burbot	*Lota lota*	0.12	0.00	0.00	0.01	0.00	0.00	0.00	0.00
rainbow trout	*Salmo gairdneri*	0.00	0.03	0.01	0.00	0.01	0.00	0.00	0.00
Total		16.49	14.40	21.50	41.37	21.76	16.93	7.22	2.47

		Ranking 1991	1992	1993	1994	1995	1996	1997	1998
longnose dace	*Rhinichthys cataractae*	3	1	2	1	1	1	1	1
leopard dace	*Rhinichthys falcatus*	5	6	7	2	5	2	5	2
redside shiner	*Richardsonius balteatus*	1	2	6	4	4	3	2	3
mountain whitefish	*Prosopium williamsoni*	8	7	8	8	2	9	10	4
largescale sucker	*Catostomus macrocheilus*	4	4	3	3	3	4	6	5
chubbs	*Mylocheilus sp.*	-	-	-	7	9	7	8	6
sculpin	*Cottus sp.*	6	8	5	5	7	8	7	7
northern pikeminnow	*Ptychocheilus oregonensis*	2	5	4	6	6	5	4	8
sockeye salmon	*Oncorhynchus nerka*	10	3	1	9	8	6	3	9
burbot	*Lota lota*	7	-	-	10	-	-	-	-
lake trout	*Salvelinus namaycush*	-	-	-	-	-	-	9	-
rainbow trout	*Salmo gairdneri*	-	9	9	-	10	-	-	-

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APPENDIX 1
Estimates of Emerging Chinook Fry Counted at km 19
(Bert Irvine's Lodge), 1998

Appendix 1. Estimates of the numbers of emerging chinook fry, counted at km 19 (Bert Irvine's Lodge), 1998.
Blanks indicate that the traps were not fishing during the period
Italicized estimates are adjusted by 58.5% to represent that portion of the catch which is newly emerged.

				IPT 1				IPT 2				IPT 3				IPT 4				Total	
Date	D/N	Staff gauge (cm)	Flows below Cheslatta Falls (m^3/s)	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Total Catch	Daily weighted index estimate
10-Mar	D	45	54.0	0.85	1.58	1	63	0.43	0.79	0	0	0.49	0.91	0	0	0.44	0.81	0	0	1	24
10-Mar	N	45	54.0	0.85	1.58	17	1,075	0.43	0.79	0	0	0.49	0.91	0	0	0.44	0.81	6	738	23	562
11-Mar	D	45	53.9	0.85	1.58	0	0	0.43	0.79	0	0	0.49	0.91	0	0	0.44	0.81	0	0	0	0
11-Mar	N	45	53.9	0.85	1.58	30	1,893	0.43	0.79	19	2,400	0.49	0.91	21	2,310	0.44	0.81	4	491	74	1,805
12-Mar	D	45	53.9	0.85	1.58	2	126	0.43	0.79	1	126	0.49	0.91	6	660	0.44	0.81	1	123	10	244
12-Mar	N	45	53.9	0.85	1.58	31	1,956	0.43	0.79	12	1,516	0.49	0.91	17	1,870	0.44	0.81	9	1,104	69	1,683
13-Mar	D	45	53.9	0.85	1.58	2	126	0.43	0.79	1	126	0.49	0.91	2	220	0.44	0.81	14	1,718	19	463
13-Mar	N	45	53.9	0.85	1.58	26	1,641	0.43	0.79	39	4,927	0.49	0.91	43	4,730	0.44	0.81	22	2,700	130	3,171
14-Mar	D	45	53.9	0.85	1.58	1	63	0.42	0.77	0	0	0.49	0.90	1	111	0.47	0.88	9	1,028	11	267
14-Mar	N	45	53.9	0.85	1.58	44	2,787	0.42	0.77	60	7,762	0.49	0.90	40	4,445	0.47	0.88	30	3,428	174	4,216
15-Mar	D	45	53.9	0.85	1.58	1	63	0.42	0.77	1	129	0.49	0.90	1	111	0.47	0.88	1	114	4	97
15-Mar	N	45	53.9	0.85	1.58	55	3,483	0.42	0.77	69	8,926	0.49	0.90	33	3,667	0.47	0.88	59	6,742	216	5,234
16-Mar	D	45	53.9	0.81	1.50	1	67	0.43	0.80	1	124	0.47	0.87	4	462	0.45	0.84	3	356	9	224
16-Mar	N	45	53.9	0.81	1.50	54	3,606	0.43	0.80	59	7,339	0.47	0.87	38	4,389	0.45	0.84	97	11,516	248	6,185
17-Mar	D	45	53.5	0.81	1.51	1	66	0.43	0.81	1	123	0.47	0.87	0	0	0.45	0.85	2	236	4	99
17-Mar	N	45	53.5	0.81	1.51	70	4,640	0.43	0.81	44	5,432	0.47	0.87	39	4,471	0.45	0.85	101	11,902	254	6,288
18-Mar	D	45	53.4	0.83	1.56	0	0	0.40	0.76	1	132	0.46	0.87	2	231	0.44	0.82	1	122	4	100
18-Mar	N	45	53.4	0.83	1.56	88	5,636	0.40	0.76	34	4,501	0.46	0.87	49	5,647	0.44	0.82	88	10,760	259	6,471
19-Mar	D	45	53.4	0.83	1.56	0	0	0.40	0.76	3	397	0.46	0.87	1	115	0.44	0.82	2	245	6	150
19-Mar	N	45	53.4	0.83	1.56	75	4,803	0.40	0.76	33	4,369	0.46	0.87	43	4,956	0.44	0.82	97	11,861	248	6,197
20-Mar	D	45	53.4	0.75	1.41	0	0	0.38	0.72	1	139	0.47	0.87	1	115	0.40	0.75	4	534	6	160
20-Mar	N	45	53.4	0.75	1.41	62	4,404	0.38	0.72	76	10,587	0.47	0.87	56	6,431	0.40	0.75	136	18,146	330	8,809
21-Mar	D	45	53.4	0.75	1.41	0	0	0.38	0.72	5	697	0.47	0.87	0	0	0.40	0.75	5	667	10	267
21-Mar	N	45	53.4	0.75	1.41	69	4,901	0.38	0.72	52	7,244	0.47	0.87	60	6,890	0.40	0.75	184	24,551	365	9,744
22-Mar	D	45	53.0	0.75	1.42	2	141	0.38	0.72	2	277	0.47	0.88	0	0	0.40	0.76	2	265	6	159
22-Mar	N	45	53.0	0.75	1.42	98	6,909	0.38	0.72	53	7,328	0.47	0.88	69	7,865	0.40	0.76	182	24,102	402	10,651
23-Mar	D	45	53.0	0.75	1.42	2	141	0.38	0.72	9	1,244	0.47	0.88	1	114	0.40	0.76	5	662	17	450
23-Mar	N	45	53.0	0.75	1.42	77	5,428	0.38	0.72	75	10,370	0.47	0.88	62	7,067	0.40	0.76	343	45,423	557	14,758
24-Mar	D	45	52.9	0.75	1.42	1	70	0.38	0.72	3	414	0.47	0.88	3	341	0.40	0.76	14	1,851	21	555
24-Mar	N	45	52.9	0.75	1.42	68	4,785	0.38	0.72	61	8,418	0.47	0.88	71	8,077	0.40	0.76	283	37,407	483	12,773
25-Mar	D	45	52.9	0.75	1.42	0	0	0.38	0.72	5	690	0.47	0.88	4	455	0.40	0.76	1	132	10	264
25-Mar	N	45	52.9	0.75	1.42	93	6,544	0.38	0.72	56	7,728	0.47	0.88	74	8,418	0.40	0.76	196	25,907	419	11,080
26-Mar	D	45	52.9	0.75	1.42	2	141	0.38	0.72	1	138	0.47	0.88	2	228	0.40	0.76	6	793	11	291
26-Mar	N	45	52.9	0.75	1.42	101	7,107	0.38	0.72	83	11,454	0.47	0.88	81	9,215	0.40	0.76	257	33,970	522	13,804
27-Mar	D	45	52.9	0.75	1.42	4	281	0.38	0.72	4	552	0.47	0.88	8	910	0.40	0.76	9	1,190	25	661
27-Mar	N	45	52.9	0.75	1.42	77	5,418	0.38	0.72	26	3,588	0.47	0.88	48	5,461	0.40	0.76	65	8,592	216	5,712
28-Mar	D	45	52.9	0.75	1.42	7	493	0.38	0.72	7	966	0.47	0.88	3	341	0.40	0.76	3	397	20	529
28-Mar	N	45	52.9	0.75	1.42	52	3,659	0.38	0.72	72	9,936	0.47	0.88	70	7,963	0.40	0.76	147	19,430	341	9,018
29-Mar	D	45	52.9	0.62	1.18	1	85	0.41	0.77	5	653	0.46	0.88	2	228	0.47	0.90	1	112	9	242
29-Mar	N	45	52.9	0.62	1.18	75	6,381	0.41	0.77	79	10,315	0.46	0.88	104	11,843	0.47	0.90	241	26,890	499	13,430
30-Mar	D	45	52.9	0.62	1.18	15	1,276	0.41	0.77	7	914	0.46	0.88	6	683	0.47	0.90	2	223	30	807
30-Mar	N	45	52.9	0.62	1.18	28	2,382	0.41	0.77	107	13,970	0.46	0.88	107	12,185	0.47	0.90	305	34,031	547	14,722
31-Mar	D	45	52.9	0.68	1.29	6	464	0.39	0.73	2	272	0.36	0.68	6	881	0.39	0.73	0	0	14	407
31-Mar	N	45	52.9	0.68	1.29	63	4,876	0.39	0.73	96	13,066	0.36	0.68	72	10,568	0.39	0.73	112	15,371	343	9,981

Appendix 1

Date	D/N	Staff gauge (cm)	Flows below Cheslatta Falls (m^3/s)	IPT 1 Volume sampled (m^3/s)	IPT 1 % of total volume sampled	IPT 1 Actual Catch	IPT 1 Index estimate	IPT 2 Volume sampled (m^3/s)	IPT 2 % of total volume sampled	IPT 2 Actual Catch	IPT 2 Index estimate	IPT 3 Volume sampled (m^3/s)	IPT 3 % of total volume sampled	IPT 3 Actual Catch	IPT 3 Index estimate	IPT 4 Volume sampled (m^3/s)	IPT 4 % of total volume sampled	IPT 4 Actual Catch	IPT 4 Index estimate	Total Catch	Total Daily weighted index estimate
01-Apr	D	45	52.9	0.68	1.29	10	774	0.39	0.73	1	136	0.36	0.68	7	1,027	0.39	0.73	3	412	21	611
01-Apr	N	45	52.9	0.68	1.29	25	1,935	0.39	0.73	90	12,250	0.36	0.68	86	12,623	0.39	0.73	167	22,919	368	10,708
02-Apr	D	45	53.0	0.61	1.15	2	174	0.37	0.70	8	1,138	0.45	0.85	1	118	0.33	0.61	5	815	16	483
02-Apr	N	45	53.0	0.61	1.15	85	7,398	0.37	0.70	79	11,237	0.45	0.85	84	9,893	0.33	0.61	115	18,737	363	10,951
03-Apr	D	45	53.0	0.61	1.15	6	522	0.37	0.70	10	1,422	0.45	0.85	3	353	0.33	0.61	8	1,303	27	815
03-Apr	N	45	53.0	0.61	1.15	87	7,572	0.37	0.70	106	15,078	0.45	0.85	80	9,422	0.33	0.61	100	16,293	373	11,253
04-Apr	D	45	52.0	0.57	1.09	9	823	0.42	0.80	2	249	0.47	0.91	1	109	0.39	0.76	9	1,186	21	589
04-Apr	N	45	52.0	0.57	1.09	85	7,768	0.42	0.80	26	3,243	0.47	0.91	117	12,810	0.39	0.76	99	13,051	327	9,165
05-Apr	D	45	52.0	0.57	1.09	9	823	0.42	0.80	9	1,122	0.47	0.91	2	219	0.39	0.76	12	1,582	32	897
05-Apr	N	45	52.0	0.57	1.09	145	13,252	0.42	0.80	99	12,347	0.47	0.91	104	11,387	0.39	0.76	127	16,742	475	13,313
06-Apr	D	45	52.7	0.57	1.08	13	1,204	0.42	0.79	6	758	0.47	0.90	3	333	0.39	0.75	9	1,202	31	881
06-Apr	N	45	52.7	0.57	1.08	56	5,187	0.42	0.79	80	10,112	0.47	0.90	56	6,214	0.39	0.75	76	10,154	268	7,613
07-Apr	D	45	53.7	0.57	1.06	22	2,076	0.42	0.78	5	644	0.47	0.88	2	226	0.39	0.73	1	136	30	868
07-Apr	N	45	53.7	0.57	1.06	75	7,078	0.42	0.78	42	5,409	0.47	0.88	86	9,724	0.39	0.73	63	8,577	266	7,699
08-Apr	D	45	53.9	0.65	1.21	26	2,146	0.42	0.77	7	906	0.47	0.86	14	1,623	0.46	0.86	12	1,394	59	1,591
08-Apr	N	45	53.9	0.65	1.21	149	12,298	0.42	0.77	142	18,369	0.47	0.86	120	13,910	0.46	0.86	80	9,292	491	13,241
09-Apr	D	45.5	54.0	0.65	1.21	6	496	0.42	0.77	9	1,166	0.47	0.86	0	0	0.46	0.86	4	465	19	513
09-Apr	N	45.5	54.0	0.65	1.21	156	12,899	0.42	0.77	146	18,922	0.47	0.86	88	10,219	0.46	0.86	67	7,796	457	12,347
10-Apr	D	45.5	54.0	0.59	1.09	19	1,743	0.42	0.77	6	775	0.39	0.73	3	414	0.40	0.74	11	1,485	39	1,171
10-Apr	N	45.5	54.0	0.59	1.09	168	15,415	0.42	0.77	127	16,394	0.39	0.73	118	16,269	0.40	0.74	37	4,995	450	13,511
11-Apr	D	45	54.0	0.59	1.09	25	2,294	0.42	0.77	14	1,807	0.39	0.73	2	276	0.40	0.74	5	675	46	1,381
11-Apr	N	45.4	54.0	0.59	1.09	153	14,039	0.42	0.77	175	22,590	0.39	0.73	105	14,477	0.40	0.74	47	6,345	480	14,412
12-Apr	D	45	54.0	0.66	1.22	21	1,722	0.36	0.67	4	594	0.45	0.84	4	478	0.31	0.58	18	3,130	47	1,422
12-Apr	N	45	54.0	0.66	1.22	136	11,149	0.36	0.67	103	15,308	0.45	0.84	76	9,086	0.31	0.58	41	7,130	356	10,774
13-Apr	D	45	54.2	0.66	1.22	50	4,114	0.36	0.67	4	597	0.45	0.83	6	720	0.31	0.57	9	1,571	69	2,096
13-Apr	N	45	54.2	0.66	1.22	90	7,405	0.36	0.67	145	21,630	0.45	0.83	159	19,080	0.31	0.57	97	16,930	491	14,915
14-Apr	D	45	54.2	0.62	1.15	32	2,785	0.40	0.73	5	683	0.43	0.79	10	1,265	0.38	0.70	19	2,722	66	1,959
14-Apr	N	45	54.2	0.62	1.15	448	38,984	0.40	0.73	91	12,434	0.43	0.79	141	17,842	0.38	0.70	136	19,484	816	24,218
15-Apr	D	45	54.2	0.62	1.15	27	2,349	0.40	0.73	14	1,913	0.43	0.79	9	1,139	0.38	0.70	2	287	52	1,543
15-Apr	N	45	54.2	0.62	1.15	376	32,719	0.40	0.73	157	21,452	0.43	0.79	203	25,687	0.38	0.70	353	50,573	1089	32,321
16-Apr	D	45	54.2	0.79	1.46	27	1,854	0.36	0.66	3	457	0.43	0.79	13	1,642	0.40	0.74	12	1,630	55	1,511
16-Apr	N	45	54.2	0.79	1.46	548	37,634	0.36	0.66	185	28,205	0.43	0.79	176	22,236	0.40	0.74	310	42,097	1219	33,490
17-Apr	D	45	54.2	0.79	1.46	20	1,374	0.36	0.66	9	1,372	0.43	0.79	5	632	0.40	0.74	17	2,309	51	1,401
17-Apr	N	45	54.2	0.79	1.46	486	33,376	0.36	0.66	178	27,138	0.43	0.79	85	10,739	0.40	0.74	541	73,465	1290	35,440
18-Apr	D	46	54.5	0.79	1.45	8	552	0.36	0.65		0	0.43	0.79		0	0.40	0.73	3	410	11	304
18-Apr	N	45	54.5	0.79	1.45	475	32,801	0.36	0.65	203	31,121	0.43	0.79	147	18,675	0.40	0.73	873	119,206	1698	46,907
19-Apr	D	46	55.5	0.98	1.76	66	3,753	0.42	0.75	14	1,870	0.41	0.73	7	955	0.48	0.87	4	459	91	2,214
19-Apr	N	46	55.5	0.98	1.76	521	29,629	0.42	0.75	149	19,903	0.41	0.73	200	27,295	0.48	0.87	1289	147,978	2159	52,520
20-Apr	D	47	56.0	0.98	1.74	34	1,951	0.42	0.74	5	674	0.41	0.73	2	275	0.48	0.86	6	695	47	1,154
20-Apr	N	47	56.0	0.98	1.74	703	40,340	0.42	0.74	294	39,625	0.41	0.73	107	14,734	0.48	0.86	588	68,111	1692	41,530
21-Apr	D	47	56.9	1.05	1.85	15	810	0.43	0.76	9	1,189	0.41	0.72	8	1,104	0.54	0.96	36	3,766	68	1,585
21-Apr	N	47	56.9	1.05	1.85	379	20,466	0.43	0.76	163	21,526	0.41	0.72	110	15,183	0.54	0.96	554	57,950	1206	28,115
22-Apr	D	48	57.4	1.05	1.84	11	599	0.43	0.75	3	400	0.41	0.72	1	139	0.54	0.95	5	528	20	470
22-Apr	N	48	57.4	1.05	1.84	294	16,016	0.43	0.75	129	17,185	0.41	0.72	81	11,279	0.54	0.95	478	50,439	982	23,094
23-Apr	D	48	57.9	0.92	1.59	23	1,450	0.33	0.57	5	878	0.40	0.70	0	0	0.50	0.87	7	803	35	940
23-Apr	N	48	57.9	0.92	1.59	238	15,000	0.33	0.57	143	25,115	0.40	0.70	171	24,552	0.50	0.87	466	53,441	1018	27,332
24-Apr	D	49	58.9	0.92	1.56	26	1,667	0.33	0.56	1	179	0.40	0.68	6	876	0.50	0.86	5	583	38	1,038

				IPT 1				IPT 2				IPT 3				IPT 4				Total	
Date	D/N	Staff gauge (cm)	Flows below Cheslatta Falls (m^3/s)	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Volume sampled (m^3/s)	% of total volume sampled	Actual Catch	Index estimate	Total Catch	Daily weighted index estimate
24-Apr	N	49	58.9	0.92	1.56	93	5,963	0.33	0.56	52	9,291	0.40	0.68	48	7,011	0.50	0.86	125	14,583	318	8,685
25-Apr	D	48	59.9	0.92	1.53	21	1,369	0.33	0.55	5	908	0.40	0.67	7	1,040	0.50	0.84	7	830	40	1,111
25-Apr	N	48	59.9	0.92	1.53	200	13,041	0.33	0.55	56	10,175	0.40	0.67	78	11,586	0.50	0.84	347	41,169	681	18,916
26-Apr	D	49	60.1	0.92	1.53	13	850	0.33	0.55	6	1,094	0.40	0.67	5	745	0.50	0.84	12	1,428	36	1,003
26-Apr	N	49	60.1	0.92	1.53	103	6,738	0.33	0.55	39	7,110	0.40	0.67	41	6,110	0.50	0.84	204	24,284	387	10,785
27-Apr	D	50	60.4	0.90	1.49	4	269	0.35	0.58	2	345	0.27	0.44	1	227	0.28	0.46	6	1,315	13	439
27-Apr	N	50	60.4	0.90	1.49	152	10,216	0.35	0.58	154	26,596	0.27	0.44	66	14,953	0.28	0.46	297	65,085	669	22,566
28-Apr	D	51	61.5	0.90	1.46	4	274	0.35	0.57	3	528	0.27	0.43	1	231	0.28	0.45	4	893	12	412
28-Apr	N	50	61.5	0.90	1.46	95	6,501	0.35	0.57	96	16,881	0.27	0.43	44	10,150	0.28	0.45	408	91,038	643	22,084
29-Apr	D	51	62.6	1.00	1.60	10	625	0.34	0.55	0	0	0.41	0.65	0	0	0.48	0.77	3	388	13	364
29-Apr	N	51	62.6	1.00	1.60	158	9,871	0.34	0.55	114	20,867	0.41	0.65	41	6,286	0.48	0.77	448	57,957	761	21,303
30-Apr	D	52	63.3	1.00	1.58	3	190	0.34	0.54	5	925	0.41	0.65	2	310	0.48	0.76	5	654	15	425
30-Apr	N	51.5	63.3	1.00	1.58	209	13,203	0.34	0.54	78	14,437	0.41	0.65	69	10,696	0.48	0.76	557	72,864	913	25,843
01-May	D	53	64.8	1.08	1.66	55	3,312	0.38	0.59	3	510	0.38	0.59	0	0	0.30	0.46	4	878	62	1,102
01-May	N	53	64.8	1.08	1.66	138	8,309	0.38	0.59	56	9,524	0.38	0.59	34	5,786	0.30	0.46	300	65,826	528	9,382
02-May	D	55	66.0	1.08	1.63	2	123	0.38	0.58	0	0	0.38	0.58	0	0	0.30	0.45	25	5,587	27	489
02-May	N	53	66.0	1.08	1.63	177	10,855	0.38	0.58	39	6,756	0.38	0.58	42	7,279	0.30	0.45	174	38,886	432	7,819
03-May	D	54.5	67.1	1.08	1.60	18	1,122	0.38	0.57	0	0	0.38	0.57	2	352	0.30	0.44	3	682	23	423
03-May	N	54.1	67.1	1.08	1.60	62	3,866	0.38	0.57	8	1,409	0.38	0.57	13	2,291	0.30	0.44	51	11,588	134	2,466
04-May	D	55	67.6	0.95	1.41	12	851	0.28	0.41	2	491	0.33	0.48	0	0	0.46	0.67	0	0	14	276
04-May	N	54.5	67.6	0.95	1.41	37	2,624	0.28	0.41	8	1,962	0.33	0.48	19	3,952	0.46	0.67	12	1,781	76	1,496
05-May	D	52.1	68.3	0.95	1.40	16	1,146	0.28	0.40	0	0	0.33	0.48	1	210	0.46	0.67	2	300	19	378
05-May	N	54.5	68.3	0.95	1.40	44	3,152	0.28	0.40	18	4,461	0.33	0.48	5	1,051	0.46	0.67	30	4,498	97	1,929
06-May	D	55	68.4	0.95	1.39	31	2,224	0.28	0.40	4	993	0.33	0.48	0	0	0.46	0.67	3	450	38	757
06-May	N	54.5	68.4	0.95	1.39	102	7,318	0.28	0.40	25	6,205	0.33	0.48	33	6,945	0.46	0.67	25	3,754	185	3,684
07-May	D	55	68.6	0.95	1.39	17	1,223	0.28	0.40	0	0	0.33	0.47	1	211	0.46	0.66	1	151	19	379
07-May	N	55	68.6	0.95	1.39	75	5,397	0.28	0.40	17	4,231	0.33	0.47	21	4,433	0.46	0.66	21	3,162	134	2,676
08-May	D	55	68.6	0.95	1.39	18	1,295	0.28	0.40	0	0	0.33	0.47	1	211	0.46	0.66	2	301	21	419
08-May	N	55	68.6	0.95	1.39	49	3,526	0.28	0.40	9	2,240	0.33	0.47	17	3,588	0.46	0.66	28	4,216	103	2,057
09-May	D	55	68.6	1.15	1.67	7	419	0.28	0.40	0	0	0.33	0.47	1	211	0.46	0.68	5	739	13	236
09-May	N	55	68.6	1.15	1.67	59	3,535	0.28	0.40	0	0	0.33	0.47	0	0	0.46	0.68	3	443	62	1,126
10-May	D	55	68.4	1.15	1.67	19	1,135	0.28	0.40	0	0	0.33	0.48	0	0	0.46	0.68	6	884	25	453
10-May	N	54	68.4	1.15	1.67	67	4,002	0.28	0.40	0	0	0.33	0.48	0	0	0.46	0.68	6	884	73	1,322
11-May	D	55	67.9	1.08	1.60	18	1,128	0.28	0.41	0	0	0.33	0.48	1	209	0.42	0.62	3	484	22	415
11-May	N	54	67.9	1.08	1.60	24	1,504	0.28	0.41	0	0	0.33	0.48	0	0	0.42	0.62	2	323	26	491
12-May	D	54	67.4	1.08	1.61	4	249	0.28	0.41	1	245	0.33	0.48	0	0	0.42	0.62	1	160	6	112
12-May	N	54	67.4	1.08	1.61	25	1,555	0.28	0.41	2	489	0.33	0.48	3	622	0.42	0.62	10	1,601	40	749
13-May	D	54	66.9	1.19	1.77	8	451									0.44	0.66	1	152	9	217
13-May	N	53.5	66.9	1.19	1.77	17	959	0.28	0.41	1	243	0.33	0.49	1	206	0.44	0.66	13	1,973	32	562
14-May	D	53.5	66.7	1.19	1.78	18	1,012									0.44	0.66	18	2,724	36	863
14-May	N	53.5	66.7	1.19	1.78	16	900									0.44	0.66	34	5,145	50	1,199
15-May	D	54	66.6	1.17	1.76											0.39	0.58				
15-May	N	54	66.6	1.17	1.76	51	2,893									0.39	0.58	29	4,961	80	1,994
TOTAL						10,038	670,018			5,273	749,230				593,252				1,724,643	33,178	884,467

APPENDIX 2
Mean Daily Fork Length, Wet Weight and Development Index (K_D) for Chinook 0+ Sampled by IPTs at Km 19 Nechako River (Bert Irvine's Lodge) 1998

Appendix 2
Mean Daily Fork Length, Wet Weight and Development Index (K_D) for Chinook 0+ Sampled by IPTs at Km 19 Nechako River (Bert Irvine's Lodge) 1998

Date	N	Fork Length		WetWeight		K_D	
		Mean	SD	Mean	SD	Mean	SD
10 Mar	17	35.9	1.6	0.35	0.05	1.96	0.05
11 Mar	34	37.1	1.5	0.37	0.05	1.92	0.04
12 Mar	49	37.1	1.5	0.38	0.06	1.95	0.04
13 Mar	55	36.7	1.6	0.36	0.05	1.94	0.04
14 Mar	51	36.7	1.6	0.36	0.05	1.94	0.04
15 Mar	44	36.3	1.3	0.36	0.04	1.96	0.04
16 Mar	49	36.7	1.5	0.36	0.05	1.93	0.05
17 Mar	44	36.1	1.7	0.36	0.06	1.96	0.04
18 Mar	44	36.3	1.9	0.35	0.06	1.93	0.04
19 Mar	46	36.3	1.4	0.36	0.06	1.96	0.05
20 Mar	46	36.8	1.7	0.37	0.06	1.94	0.04
21 Mar	50	36.6	1.2	0.37	0.04	1.96	0.05
22 Mar	46	36.7	1.1	0.36	0.04	1.93	0.05
23 Mar	57	36.4	1.3	0.35	0.05	1.94	0.05
24 Mar	57	37.5	1.5	0.40	0.07	1.95	0.09
25 Mar	50	36.9	1.1	0.37	0.03	1.95	0.05
26 Mar	51	37.7	1.3	0.39	0.06	1.93	0.05
27 Mar	65	37.9	1.3	0.40	0.06	1.93	0.06
28 Mar	60	37.3	1.8	0.39	0.06	1.95	0.06
29 Mar	49	37.5	1.6	0.37	0.06	1.91	0.06
30 Mar	65	37.4	1.9	0.36	0.08	1.90	0.07
31 Mar	53	37.2	2.0	0.38	0.08	1.94	0.06
01 Apr	61	37.7	1.7	0.40	0.06	1.94	0.05
02 Apr	56	36.6	1.8	0.36	0.06	1.94	0.05
03 Apr	67	37.1	1.6	0.39	0.06	1.96	0.06
04 Apr	61	37.1	1.9	0.38	0.08	1.94	0.07
05 Apr	70	37.2	2.1	0.40	0.09	1.96	0.08
06 Apr	68	37.3	1.4	0.38	0.05	1.94	0.05
07 Apr	58	36.8	1.7	0.38	0.05	1.96	0.04
08 Apr	76	36.5	2.1	0.38	0.07	1.98	0.05
09 Apr	58	36.2	1.6	0.38	0.07	1.99	0.06
10 Apr	69	36.7	2.1	0.39	0.08	1.97	0.05
11 Apr	67	36.9	1.5	0.38	0.06	1.96	0.04
12 Apr	68	37.3	1.8	0.39	0.07	1.96	0.05
13 Apr	68	37.1	1.9	0.39	0.07	1.96	0.05
14 Apr	75	37.4	2.0	0.41	0.09	1.97	0.06
15 Apr	71	37.0	1.8	0.39	0.09	1.97	0.07
16 Apr	73	37.3	2.0	0.40	0.08	1.96	0.06
17 Apr	74	37.3	1.8	0.40	0.07	1.97	0.06
18 Apr	51	37.6	1.4	0.42	0.06	1.99	0.05
19 Apr	71	37.5	1.6	0.39	0.06	1.95	0.05
20 Apr	63	37.2	2.4	0.39	0.08	1.95	0.06
21 Apr	76	37.9	2.2	0.41	0.09	1.96	0.05
22 Apr	59	38.4	2.5	0.45	0.13	1.98	0.10

Appendix 2

Mean Daily Fork Length, Wet Weight and Development Index (K_D) for Chinook 0+ Sampled by IPTs at Km 19 Nechako River (Bert Irvine's Lodge) 1998

		Fork Length		WetWeight		K_D	
Date	N	Mean	SD	Mean	SD	Mean	SD
23 Apr	62	37.9	2.3	0.41	0.09	1.95	0.05
24 Apr	62	38.1	2.6	0.42	0.10	1.96	0.06
25 Apr	69	37.3	1.6	0.39	0.07	1.96	0.05
26 Apr	72	38.4	2.5	0.44	0.12	1.96	0.05
27 Apr	53	37.9	2.0	0.41	0.08	1.95	0.06
28 Apr	52	38.0	1.6	0.42	0.06	1.96	0.05
29 Apr	55	37.3	1.9	0.40	0.06	1.97	0.04
30 Apr	55	37.9	2.2	0.42	0.11	1.96	0.07
01 May	57	37.8	2.2	0.43	0.12	1.99	0.05
02 May	52	37.6	2.0	0.42	0.10	1.98	0.06
03 May	41	39.2	2.8	0.48	0.16	1.98	0.07
04 May	50	37.5	2.4	0.44	0.13	2.01	0.07
05 May	49	39.5	3.3	0.51	0.21	1.99	0.09
06 May	57	38.2	2.5	0.45	0.14	1.99	0.08
07 May	52	38.3	3.1	0.48	0.19	2.01	0.08
08 May	51	39.5	4.8	0.57	0.30	2.05	0.09
09 May	26	38.8	2.8	0.52	0.17	2.05	0.07
10 May	32	39.6	3.7	0.62	0.23	2.12	0.09
11 May	26	39.7	4.5	0.60	0.29	2.07	0.10
12 May	31	40.0	4.5	0.58	0.28	2.04	0.10
13 May	31	41.3	4.4	0.70	0.27	2.11	0.07
14 May	40	40.9	5.0	0.67	0.34	2.08	0.10
15 May	20	42.9	4.9	0.79	0.33	2.11	0.10
total	3,637	37.66		0.42		1.97	

APPENDIX 3
Summmary of 1998 IPT Catches by Month and Trap Number

Appendix 3. Summary of 1998 IPT catches by month and trap number.

				Salmonidae														Catostomidae		Cyprinidae										Gadidae		Cottidae	
Month	Day/Night	Trap No.	No. days	CH 0+	CH 1+	CO 0+	CO 1+	SK 0+	SK 1+	RB J	RB A	BT J	BT A	MW J	MW A	LT 1+	LT 0+	CSU A	CSU J	LDC A	LDC J	LNC A	LNC J	NSC A	NSC J	RSC A	RSC J	PCC A	PCC J	BB A	BB J	CC A	CC J
March	D	1	22	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0
March	D	2	22	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March	D	3	22	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
March	D	4	22	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Total				*247*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2*	*1*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*
March	N	1	22	1,353	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	25	1	2	3	0	1	1	2	0	1	0	0	0	3
March	N	2	21	1,205	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	6	0	1	1	0	0	0	0	0	0	0	0	0	3
March	N	3	21	1,197	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	1	0	0	0	0	0	1	1	0	1	0	0	0	1
March	N	4	22	2,964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	26	1	9	10	0	14	4	6	0	5	0	0	1	9
Total				*6,719*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*5*	*0*	*0*	*16*	*58*	*2*	*12*	*14*	*0*	*15*	*6*	*9*	*0*	*7*	*0*	*0*	*1*	*16*
April	D	1	30	562	1	0	0	0	0	0	0	0	0	61	1	0	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	0	1
April	D	2	29	174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	D	3	29	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April	D	4	30	259	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	1	0	0	0	0	3	3
Total				*1,120*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*61*	*1*	*0*	*0*	*0*	*2*	*2*	*0*	*2*	*2*	*0*	*0*	*1*	*2*	*0*	*0*	*0*	*0*	*3*	*4*
April	N	1	30	6,888	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	12	2	16	31	0	6	5	3	1	5	0	0	0	7
April	N	2	30	3,641	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	1	0	0	0	2	0	0	0	5
April	N	3	30	3,087	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	1	0	0	0	1	0	2	0	0	0	2
April	N	4	30	9,090	1	0	0	0	0	0	0	0	0	1	0	0	0	0	34	19	9	33	68	0	37	8	37	0	29	0	0	3	9
Total				*22,706*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*39*	*33*	*11*	*52*	*101*	*0*	*44*	*13*	*41*	*1*	*38*	*0*	*0*	*3*	*23*
May	D	1	14	243	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
May	D	2	11	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May	D	3	13	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May	D	4	14	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total				*337*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*

				Salmonidae														Catostomidae		Cyprinidae										Gadidae		Cottidae	
Month	**Day/Night**	**Trap No.**	**Nb days**	**CH 0+**	**CH 1+**	**CO 0+**	**CO 1+**	**SK 0+**	**SK 1+**	**RB J**	**RB A**	**BT J**	**BT A**	**MW J**	**MW A**	**LT 1+**	**LT 0+**	**CSU A**	**CSU J**	**LDC A**	**LDC J**	**LNC A**	**LNC J**	**NSC A**	**NSC J**	**RSC A**	**RSC J**	**PCC A**	**PCC J**	**BB A**	**BB J**	**CC A**	**CC J**
May	N	1	15	943	0	0	0	5	0	0	0	0	0	6	0	0	0	0	6	10	4	10	19	0	1	1	3	0	5	0	0	1	3
May	N	2	11	183	0	0	0	5	0	0	0	0	0	5	0	0	0	0	3	1	0	1	1	0	0	0	3	0	7	0	0	0	0
May	N	3	11	185	0	0	0	0	0	0	0	0	0	3	0	0	1	0	1	2	0	0	2	0	1	0	4	0	5	0	0	0	0
May	N	4	15	738	0	0	0	7	0	0	0	0	0	3	0	0	0	0	9	1	0	2	6	0	1	0	23	0	6	0	0	2	2
Total				*2,049*	*0*	*0*	*0*	*17*	*0*	*0*	*0*	*0*	*0*	*17*	*0*	*0*	*1*	*0*	*19*	*14*	*4*	*13*	*28*	*0*	*3*	*1*	*33*	*0*	*23*	*0*	*0*	*3*	*5*
Grand Total				*33,178*	*8*	*0*	*0*	*17*	*0*	*0*	*0*	*0*	*0*	*79*	*1*	*6*	*1*	*0*	*79*	*110*	*18*	*79*	*149*	*0*	*62*	*21*	*85*	*1*	*68*	*0*	*0*	*10*	*51*

Key to species

A Adults
J Juveniles

Salmonidae

CH	chinook salmon	*Oncorhynchus tshawytscha*
SK	sockeye salmon	*Oncorhynchus nerka*
RB	rainbow trout	*Oncorhynchus mykiss*
BT	bull trout	*Salvelinus confluentes*
MW	mountain whitefish	*Prosopium williamsoni*
LT	lake trout	*Salvelinus namaycush*

Catostomidae

CSU	largescale sucker	*Catostomus macrocheilus*

Cyprinidae

LDC	leopard dace	*Rhinichthys falcatus*
LNC	longnose dace	*Rhinichthys cataractae*
NSC	northern pikeminnow	*Ptychocheilus oregonensis*
RSC	redside shiner	*Richardsonius balteatus*
PCC	Peamouth chubb	*Mylocheilus caurinus*
CBC	Chubb spp	*Mylocheilus sp.*

Gadidae

BB	burbot	*Lota lota*

Cottidae

CC	sculpin	*Cottus sp.*