NECHAKO RIVER FRY EMERGENCE PROJECT 2010

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For:

NECHAKO FISHERIES CONSERVATION PROGRAM

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EXECUTIVE SUMMARY

The Nechako Fisheries Conservation Program (NFCP) previously conducted a chinook salmon (*Oncorhynchus tshawytscha*) fry emergence trapping project in the upper Nechako River from 1990 to 2002 to monitor the incubation environment in the river. Results from those years indicated that there was a strong relationship between the index of emergent fry and the number of spawners the previous year (NFCP Technical Data Review, 2005). In 2007, the NFCP Technical Committee decided that based on the strength of the statistical relationships and the apparent stability of in-river habitat conditions (NFCP, 2007), these was no need to undertake the project on an annual basis, however it would be prudent to reassess the quality of the incubation environment after a period of time. To this end the trapping project was conducted again in 2010 (commissioned by Rio Tinto Alcan) to confirm that the incubation environment in the river has remained stable. In 2010, emergence peaked in early May, consistent with previous years. Accumulated Thermal Units (ATUs) at the time of 50% emergence (May 3) was 1000, slightly higher than the 12-year average (1991-2002) of 907 (range of 829 to 1,004).

The index of fry emergence, calculated by scaling the catch from each trap based on the proportion of the total discharge each trap sampled, for 2010 was 495,170. The index of emergence success was 51% when the estimated egg deposition above the trapping site the previous fall was taken into account (it is estimated that 170 females spawned above the trapping site in the fall of 2009). Emergent success was lower than the average of all years sampled (65%) but was greater than 4 of the 12 years on record. The data from 2010 maintained the positive correlation (r^2 = 0.86) that had been developed from the previous years of the study between the index and the number of spawners in the river above the trap site the previous year. This confirms that the conditions within the incubation environment have not exhibited any detectable change over the period of time since the past data collection period.

Emergent fry in 2010 were of similar average length (38 mm), weight (0.42 g), and development index (K_D; 2.0) to those of previous years.

Mark-recapture measurements provided an estimate of 1,462,960 ± 716,290 chinook fry. The 2010 data point fell within the range of mark recapture estimates developed over the period of the program. In addition the relationship between the two indices, fry emergence and mark-recapture continues to be strong (r^2 = 0.85).

Species other than chinook made up 6.5 % of the total number of fish sampled in the four inclined plane traps. The most common incidental species were 0+ sockeye salmon (*Oncorhynchus nerka*, 36.1% of the incidental catch), largescale suckers (*Catastomus macrocheilus*; 28.6% of the incidental catch), and longnose dace (*Rhinichthys falcatus*, 22.4% of the incidental catch).

Overall, results from the 2010 fry emergence trapping program were consistent with those that have been observed historically. The index of fry emergence was consistent with the number of spawners observed upstream of the trapping site the previous year based on the established relationship. The date of 50% emergence was similar to previous years, typical morphological characteristics for fry were observed, and typical incidental catch (both species composition and abundance) was recorded. These results suggest that the conditions within the incubation environment of the upper Nechako River have not changed since the historic data collection period.

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 put in place to detect change in freshwater life history components of Nechako Chinook salmon associated with flow changes resulting from river regulation (NFCP Technical Data Review, 2005). Along with the juvenile outmigration project, 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; to monitor egg-to-fry survival using this index; and to monitor the average size and condition of emerging chinook fry. While the index calculated is not a true estimate of the population (cf. Methods), large deviations in the index from year to year may serve as an indication of a change in the quality of the incubation environment of the Nechako River. The project was run continuously from 1990 to 2002 and a strong relationship of spawners to emergent fry was developed that indicated high quality and stable incubation conditions. The NFCP TC decided that continuance of the project annually was not necessary, however it would be prudent to redo the project after several years as a check on the continued stability of the upper Nechako incubation environment. To this end the NFCP commissioned the 2010 project.

METHODS

Study Site and traps

Four 2 x 3 m IPTs were installed near Bert Irvine's Lodge, 19 km downstream from Kenney Dam (**Figure 1**). The traps were attached to a cable suspended across the river channel. The position and location of the traps were the same as in the previous years (1991- 2002). The four traps were positioned on a ¾" cable across the river channel, one stationary trap on each river margin (IPTs 1 and 4), and two floating traps in mid-channel (IPTs 2 and 3, **Figure 1 & 2**).

The left margin trap (IPT 1) was approximately 17 m from the shore with a 19 m diversion wing angled from the inshore edge of the trap to the shore upstream. The right margin trap (IPT 4) was approximately 6 m from the shore with an 8 m diversion wing angled from its inshore edge to the shore upstream. The margin traps were stationary on the riverbed, in approximately 0.5 m of water, and the diversion wing and trap location was adjusted according to flows to maintain 0.5 m water depth. As flows increased, the distance of the trap from shore and the length of the diversion wing decreased. By the end of the sampling period the left margin traps (IPT 1) was 15 m from shore and the right margin trap (IPT 4) was just over 3 m from shore. The mid channel traps were floating traps set-up on a pulley system so that they could be pulled into shore for trap check. The mid-channel traps required pontoon adjustments when discharge and debris load increased.

The field portion of the project was initiated on March 9, with all 4 traps fishing by March 10th. Sampling continued until May 22nd when all four traps were removed.

Nechako River - Physical Data

Daily mean water temperatures at the trapping site have historically been measured by a data logger maintained by the Water Survey of Canada (WSC) at the base of Cheslatta falls (WSC station # 08JA017). However, for 2010 no data from that station was available for the period of December 16th, 2009 to April 15th, 2010. A Tidbit data logger was installed at the study site by Triton for the period of March 13th to May 22nd, 2010 to record daily minimum, maximum and mean temperatures over the trapping period. In the past, daily mean water temperature has been used to calculate Accumulated Thermal Units (ATUs), the running total of degrees Celsius averaged over each day from the peak of chinook spawning in mid-September to the end of the fry emergence project. Most chinook fry are expected to emerge from the gravel following approximately 1,000 ATUs exposure (March and Walsh 1987; Shepherd 1984). Thus ATUs can serve as an indicator for timing the start of the fry emergence program. In order to calculate ATUs for 2009/2010 the mean daily water temperatures from 2006/2007, 2007/2008, and 2008/2009 were used to estimate the mean daily water temperature for the period when data were missing between December 16th, 2009 to April 15th, 2010. In the upper Nechako, water temperatures during the winter are typically between 0 and 1°C and it is reasonable to expect that conditions in 2009/2010 would be similar to that of previous years. In terms of ATU, the contribution of temperatures from that period is minimal due to the low temperatures and therefore would not be expected to affect the results substantially.

The WSC station at Cheslatta Falls has also been relied upon to provide discharge data during the trapping period. However, since the station was not functioning until April 16th, 2010 the release discharge from the Skins Lake Spillway (SLS) had to be used to approximate river discharge for the period of March 9th to April 16th. Prior to freshet in 2010, which typically occurs in May, it was estimated that the SLS contributes more than 90% of the discharge to the upper Nechako River, based on those dates for which data from both sources was available. Therefore using the SLS data in early spring to approximate the Nechako discharge was considered appropriate. WSC data was available for the remainder of the trapping period after April 16th. All flow data are considered preliminary.

Sampling Program

The IPTs were cleaned of debris and catches sampled twice a day during the morning (08:00) and evening (19:00). At the start of the program trap cleanings corresponded to the two trap check times, but as water temperature increased, the sloughing of diatoms also increased which plugged the incline planes and shortened the fishing time between cleanings. Water temperature was measured during each trap check with a maximum/minimum thermometer and staff gauge measurements were recorded daily at the traps. The latter measurements were recorded as a backup for the flow measurements at the Skins Lake Spillway.

The mid-channel traps were pulled to shore for each trap check. All fish found in the traps were placed in buckets and the mid-channel traps were then returned to their fishing position. Captured fish were taken to a weighing trailer for identification to species, age class (juvenile or adult), and enumeration. For each sampling period, a subsample of a maximum of 10 chinook per trap were anaesthetized with clove oil, measured to the nearest 1.0 mm (fork length) and weighed to the nearest 0.01 g (wet weight). Sampled fish were allowed to recover from the anesthetic and then released downstream of the traps.

Bams' (1970) development index (K_D) 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 of water sampled by each trap. The volume of discharge sampled by each trap was determined by measuring the cross sectional area of the water flowing into the trap mouth and the average velocity at three points across the mouth of each IPT (left edge, center, right edge), which was measured every second day for the duration of the sampling period. 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 into the traps by the diversion wings. Wing discharge was estimated by measuring the upstream cross-sectional area created by the diversion wing, and recording velocities at 0.5 – 1 m intervals 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 generally were taken every second day.

The total number of emerging chinook moving downstream past the IPTs, which constitutes the index of fry emergence, was estimated from the proportion of total river discharge sampled by each IPT as:

(2) $N_i = n_i (V_i/v_i)$

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.

Because statistical independence among IPTs could not be assumed (the 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 / Σ (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 undesirable, as it would overestimate the index (some fry could be captured and counted more than once). A more conservative approach was to only base the index on newly emerged fry.

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 therefore result in an increase in the variance in wet weight of fry caught in the IPTs. The date at which growing fry were considered to comprise a significant portion of the catch was determined to be the point at which the variability in pooled wet weights was significantly affected by the addition of the next day's samples (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. To separate growing fish from emergent fry after the cut-off date, the proportion of fry subsampled that were smaller than the limit was determined. For all days after the cut-off date, the daily index of emergence was multiplied by this percentage. For example, if 90% of the fish subsampled were smaller or equal than the upper limit, 90% of the catches after the cut-off date were used in the calculation of the index of fry emergence.

Estimates of Emergence Success

The proportion of the chinook salmon escapement that spawned above the study site (river sections 1, 2 and section 3A) was obtained from the Nechako River spawner enumeration data (unpublished data, Department of Fisheries and Oceans). The Area-Under-the-Curve (AUC) 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). The emergence success is the total daily weighted population index divided by the number of spawning females times the fecundity, expressed as a percentage.

Trap Efficiency/Mark Recapture Estimates

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 discharge sampled by the traps. Another method of inferring fry abundance is to calculate trap efficiency from mark-recapture trials. These trials were conducted as a second method of calculating a fry emergence index.

For each trial, chinook fry were collected from the four IPTs and held in a live well for a maximum of five days. Chinook fry from the live box were counted and transferred into an aerated container, where they were stained with Bismark brown for two hours. They were then transferred to transport containers and held for a couple of hours prior to release. Mortalities were noted and subtracted from the total released. Fry were evenly released across the width of the river at dusk at km 18.3 (0.5 km upstream of the IPTs).

Several marked fish were retained in the live well to observed dye intensity over time (retained fish were subtracted from the total released). These fish were visually compared with supposed recaptured fish to confirm similar coloration. This comparison was especially useful as the dye faded, several days after the release. On subsequent sampling days, the number of marked chinook recaptured in each trap was noted along with the total catch of unmarked fish. Marked fry were not included in the total catch that was used for the emergence index.

Trap efficiency was calculated as the ratio of the number of recaptured fry to the number of released fry. The estimated population index was the average of the number of chinook fry estimated at each trial weighted 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 K_D) were determined through factorial ANOVAs. Linear regression was used to analyze the relationship between variables (r^2). The significance level was set at $P<0.05$ for all tests.

RESULTS AND DISCUSSION

Nechako River - Physical Data

The operation of IPT's for the 2010 fry emergence program extended from March 9th to May 22nd, 2010. Mean daily water temperatures in the Nechako River September 1st, 2009 to May 22nd, 2010 (end of fry emergence project) are shown in **Figure 3**. In general, temperatures in September and October of 2009 and March to May of 2010 tended to the warmer than that of the three previous years. During the incubation period, the mean daily water temperatures ranged from 20°C in September to 0°C in mid-December. At the start of the trapping period (March 13th) mean daily water temperatures were 1°C and had increased to 9.4°C by the end (May 22nd). The estimated ATUs for the fry emergence period ranged from 792 to 1,177. The predicted peak of fry emergence based on achieving the threshold of 1,000 ATUs was on May 2nd which was the date the actual peak occurred. However there was also an earlier peak which occurred on April 17 at an ATU of 908.6. The date at which 50% of fry had emerged was on May 3, at 1009 ATUs. This is the highest ATUs at 50% emergence recorded over the previous 12 years of the monitoring (1991-2002) (**Table**

1). During that period the range of ATUs at the date of 50% emergence was between 829 and 1,004, with an average of 907.

It should be noted that temperatures between December 16th and the start of the trapping program were estimates based on historical data. Since temperatures in 2009/2010 before and after this period were warmer then the historical data it is likely that temperatures may also have been slightly warmer through the winter, resulting in the date at which 1000 ATUs was achieved potentially being earlier. Comparison of the mean daily temperature from September 1st to December 15th, 2009 with the mean value from 2006-2008 for the same period showed that on average the temperatures in 2009 were 14% higher. Increasing the estimated temperatures by that amount for the period of December 16th to March 12th (which were estimated from 2006-2008 data due to lack of WSC data) only resulted in a one day change in the date at which 1000 ATUs were achieved (May 1st vs. May 2nd). Similarly the ATUs on the date of 50% emergence (May 3rd) only increased from 1009 to 1016.

The releases from SLS (March 1 – May 31), the discharge measured by WSC below Cheslatta Falls (April 12 – May 31) and the staff gauge records at the trap site (March 9 to May 22) are shown in **Figure 4**. Releases from SLS were maintained at approximately 32 m^3/s from March 1 to April 22, after which they were increased to 48 – 50 m^3/s for the remainder of the trapping program. The discharge at Bert Irvine's for the period of record increased from 32 m^3/s on April 12 to 54 m^3/s by May 31. Staff gauge readings taken at Bert Irvine's from March 9 to April 12 averaged at 0.4 m. Readings then steadily increased to a peak of 0.55 m on May 7, and remained at that level until the traps were removed on May 22. As observed during previous years of the program, there is a clear correlation between the Nechako River discharge and the staff gauge readings.

Fry Emergence

Trap catches

From March 9 to May 22, 2010, a total of 27,610 fry were caught in the four inclined plane traps (**Figure 5**). The majority (81.2%) of chinook fry were captured in the margin traps, with IPT 1 (right margin) accounting for 37.5% of the catch and IPT 4 (left margin) accounting for 43.7%. Most of the chinook fry (93.3%) were captured at night. The ratio of fish captured in margin traps and fish captured at night is consistent with previous years.

The pattern of emergence was bi-modal, and skewed to the right (e.g. more fish emerging later in the trapping program). This pattern is not uncommon and has been documented by approximately one half of the projects conducted from 1990 to 2002. (NFCP Fry Emergence reports 1990 to 2002). The first peak emergence occurred on April 17 with a total of 1,242 fry captured. Numbers then decreased until May 1 when they rapidly increased to a peak of 1,489 fry on May 2 (**Figure 6**). Numbers of emergent fry then decreased steadily for the remainder of the trapping program. The median capture date, when 50% of the total catch had been captured, was May 3. The decrease in numbers between the two peaks corresponded to the period of increasing freshet flows, however it is unclear whether there is a causal relationship. A similar pattern occurred in 1991, 1993, 1996, and 1999 and in several other years the peak in emergence ended as flows increased. A detailed review of the historical datasets would be required to assess whether or not emergence timing is correlated to discharge and whether or not there is a biological significance.

Index of Fry Emergence

The fry emergence index was calculated by scaling the catch from each trap based on the proportion of the total discharge each trap sampled. The indices calculated from each of the four traps ranged from 221,203 to 1,067,128 chinook fry, while the overall index (weighted by the volume of water sampled by each trap) was 495,170 (**Appendix 1**). Due to lack of data from the WSC station prior to April 15th, the SLS discharge was used in the index calculation. This value, while providing a close approximation to the actual discharge, is likely lower than the actual value since it does not take into account inflow to the system between the SLS and Cheslatta Falls. Therefore the resulting index calculation is considered a conservative estimate.

The variation in wet weight of chinook fry began to differ significantly after May 21st, which was the second to last day of sampling. Analysis of the data revealed that inclusion of wet weights measured after May 21st increased the variance significantly ($p=0.005$). It was determined that 45% of the fry captured on May 22nd were post emergent, and an adjustment to the daily index of emergence was required for that date (**Figure 7**).

Trap Efficiency/Mark Recapture Estimates

Three mark-recapture trials were conducted during the 2010 trapping season (April 14 and 26, and May 15). The individual mark-recapture estimates increased over the course of the emergence period from 737,494 (April 14th) to 2,797,329 (April 26th) to 2,965,519 (May 15th) (**Table 3**). The average trap efficiency for the three trials was 1.9% and the average population estimate was 1,462,960 ± 716,290. This estimate was considerably higher than the index of fry emergence (495,170), however that was consistent with the trend observed in the historical data that shows the mark-recapture estimate higher than the index in 10 of the previous 11 years. Further, the index has only been within the bounds of the 95% confidence interval of the mark-recapture estimate 5 of the previous 11 years (**Table 4**). This suggests that the mark-recapture estimate may be biased high whereas the index estimate tends to be more conservative.

Review of the historical data shows there is a strong correlation between the mark-recapture and index estimates (r^2 = 0.85, **Figure 9**). Considering that both indices are estimated independently, this suggests that even though one estimate tends to be high and one low, they reasonably reflect the year to year estimates of emergence success and do provide the ability to assess trends in fry emergence. As mentioned in previous reports (e.g. NFCP 2002), the years 1998 and 1997 appear to be outliers (they were forced spill years), and if they are removed from the data set, the correlation increases from an r^2 of 0.85 to 0.97 ($P< 0.01$). These outliers are apparent in the flow expansion estimate but are not evident in the mark-recapture estimates suggesting that perhaps the mark recapture methodology is more robust in a more variable flow regime.

<u>Relationship between Escapement and Index of Fry Emergence</u>

The index of fry emergence was significantly correlated with the number of female spawners above the study site (**Figure 10**, r^2 = 0.86), which indicates that the index reliably reflects fry abundance. In 1997 and 1998 the index appeared to have been affected by the higher than usual flow conditions in the river, and the indices were approximately twice as high as would be expected from the number of spawners. If these two years are excluded, the correlation increases to 0.93. The 2010 results are very similar to that of previous year suggesting that the overall condition of spawning and incubation habitat within the system has not changed and remains good.

As mentioned in previous reports (e.g. Triton 2002), the index of fry emergence through flow likely overestimates the true number of fry because the traps are not sampling the same proportion of the river as it increased. This is particularly noticeable in forced spill years (1997, 1998), but likely is also a factor during years with higher than normal flows resulting from precipitation or rapid snow melt. In addition, the calculation of the index assumes an equal distribution of the juvenile chinook in the water column and across the river, and equal weight is given to each trap. This is despite the fact that the shore traps generally catch more fish than the mid-channel traps. Nevertheless, the significant correlation between the index of fry emergence and the number of spawners the previous year shows that the index reflects real biological processes and specifically that fry production is correlated with spawner abundance. Furthermore, the year to year comparisons of the index values provide a valuable tool to assess the quality of the incubation environment.

<u>Emergence Success</u>

The number of female chinook spawners above the study site in September 2009 was estimated at 170. Based on 5,769 eggs/spawner (Jaremovic and Rowland 1988), the potential number of eggs deposited was 980,730 which, based on the index of fry emergence calculated from the percent volume sampled, translated into an emergence success of 51%. The mean emergence success for the previous years of the fry emergence program (1991-2002) was 65%, however removing 1997 and 1998 which had higher than usual discharges and emergent success estimates substantially higher than any of the years on record (100% and 94%, respectively), lowers the mean to 59%. Excluding 1997 and 1998, the 2010 value was greater than 4 of the previous 10 years on record (**Table 5**).

Morphological Data

Average morphological parameters for emerging fry are shown in **Table 6**. **Table 7** shows the results of ANOVAs on the effects of time of emergence, trap position, and their interaction on fork length, wet weight and development index (K_D). In terms of fork length, the difference between traps was significant ($f = 8.1$; $p < 0.001$) with larger fish tending to occur in the shore traps (IPT #1 and 4; **Figure 11**). The effect of emergence time was only slightly significant ($f = 3.98$; $p = 0.046$) with larger fish emerging during the day for traps 1 and 4, and at night for trap 3. No difference in length was observed at trap 2 between day and night. Comparison of wet weights showed a significant effect of trap ($f = 16.02$; $p < 0.001$) as well as time of emergence ($f = 7.95$; $p = 0.005$). The trends observed were the same as for fork length. In particular, fish captured in traps 1 and 4 were heavier than those caught in traps 2 and 3 while the comparison between day and night showed that fish in traps 1 and 4 were smaller at night, whereas fish in trap 3 were larger. Fish in trap 2 did not differ in weight between day and night. However, the variance in wet weight was lower than the variance in length resulting in more strongly significant differences. Lastly, the development index showed a significant effect of both trap ($f = 14.8$; $p < 0.001$) and time of emergence ($f = 5.52$; $p < 0.019$). Given that the index is calculated from both length and weight it is not surprising that it follows that same pattern with the shore traps being greater than the mid channels for fish that emerged during the day. However, fish that emerged at night had the same development index regardless of what trap they were captured in.

Average length, weight and development index of emergent fry have not varied much in the years of the program (**Figure 12**). The 2010 results lie within the range of variation of the previous year's which supports the assertions of a stable incubating environment.

Incidental Catch

A total of 1,918 fish (6.5 % of the total catch) other than chinook were captured in the traps (**Table 8**). Most of the incidental catch (93%) was taken at night and in the margin traps (53.0% IPT 4; and 29% IPT 1). The fish most often captured were 0+ sockeye salmon (*Oncorhynchus nerka*, 36.1% of the incidental catch), largescale suckers (*Catastomus macrocheilus*; 28.6%), longnose dace (*Rhinichthys falcatus*, 22.4%), nothern pikeminnow (*Ptychocheilus oregonensis*, 4.6%), redside shiners (*Richardsonius balteatus*, 2.8%), leopard dace (*Rhinichthys cataractae*, 2.5%), and sculpins (*Cottus spp*., 1.3%).

The prevalence of the various species considered as incidental catch is similar to other years, in that no species rarely captured in the IPT's (e.g. burbot) were prevalent in 2010.

Conclusions

The fry emergence project completed in 2010 after an 8 year hiatus provided comparative data on emergence timing, abundance and biological data to NFCP monitoring projects run from 1990 through 2002. The index of fry emergence calculated through flow expansion appeared to reflect the biological processes as evidenced by the strong relationship between the spawners and the index. The mark-recapture estimate also continued to reflect biological processes but appears to be more robust to flow variation. The trends, from index of fry emergence to morphological characteristics of emerging fry, indicate that the incubation environment in the Nechako River has been stable over the period of 1991 to 2010.

REFERENCES

Bams, R.A. 1970. Evaluation of a revised hatchery method tested on pink and chum salmon fry. J. Fish. Res. Board Can. 27: 1429-1452.

Beacham, T. D. and C. B. Murray. 1993. Fecundity and egg size variation in North American Pacific salmon (*Oncorhynchus*). J. Fish Biol. 42:485-508.

Healey, M. C. and W. R. Heard. 1984. Inter- and intra-population variation in the fecundity of chinook salmon (*Oncorhynchus tshawytscha*) and its relevance to life history theory. Can. J. Fish. Aquat. Sci. 41:476-483.

Jaremovic, L., and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Can. MS Report Fish. Aquat. Sci. 1963: 135 p.

March, B.E., and M.G. Walsh. 1987. Salmonid culture. Fundamentals and practice for British Columbia. Faculty of Agricultural Sciences, University of British Columbia, Vancouver, B.C.

Nechako Fisheries Conservation Program. 2002. Nechako River Fry Emergence Project, 2001. Nechako Fisheries Conservation Data Report M00-5

Nechako Fisheries Conservation Program. 2005. Nechako Fisheries Conservation Program Technical Data Review 1988 – 2002.

Shepherd, B.G. 1984. The biological design process used in the development of federal government facilities during phase 1 of the salmonid enhancement program. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1275.

FIGURES

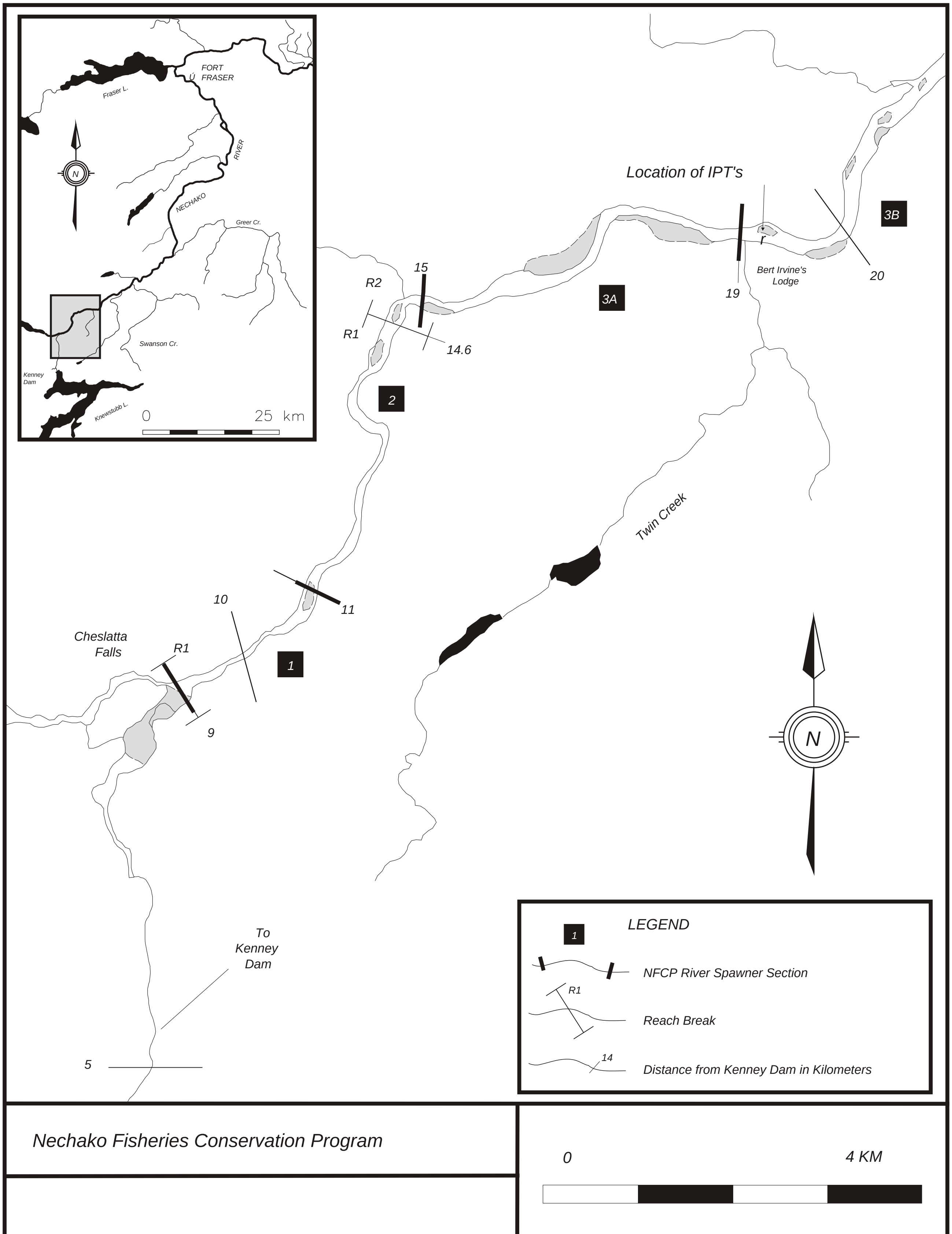
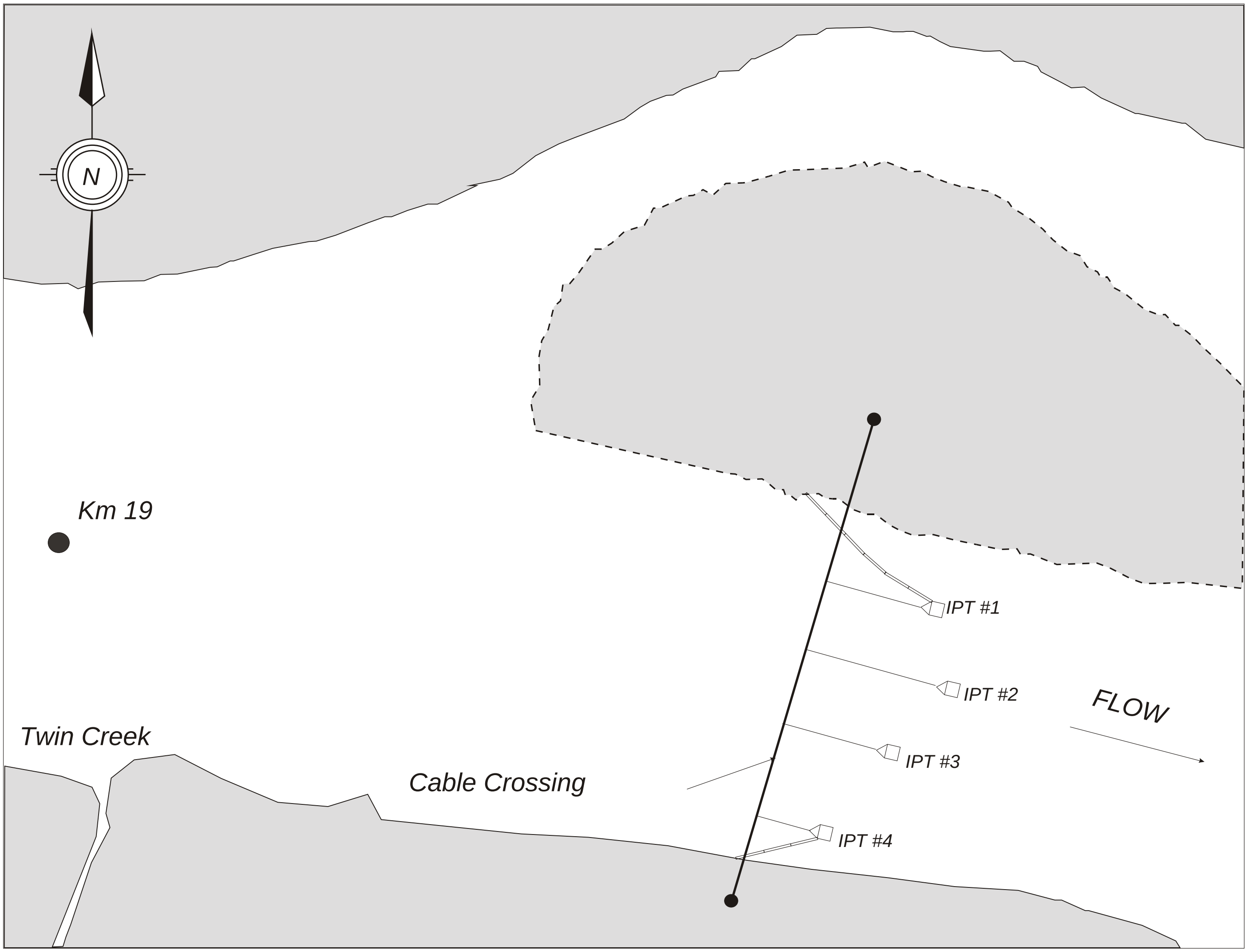


FIGURE 1. Location of fry emergence sampling, Bert Irvine's, km 19 of the Nechako River.



Nechako Fisheries Conservation Program

Scale ~1:1200

Figure 2: Location of Inclined Plane Traps (IPT) at Bert Irvine's, km 19 of the Nechako River, 20(2010

Figure 3. Mean daily water temperatures of the Nechako River at Bert Irvine's (km 19), September to May, 2006 - 2010 (preliminary data from WSC). Accumulated thermal units (ATU) calculated from the date of peak spawning (Sept. 16th, 2009).

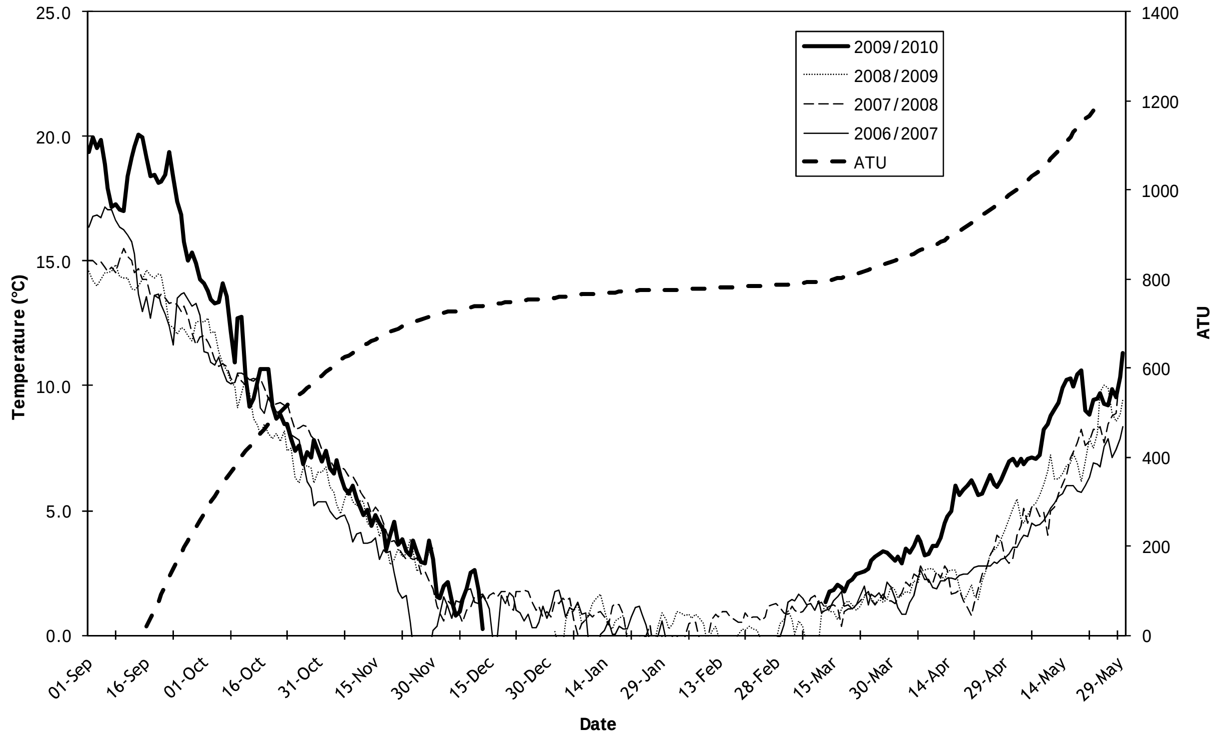
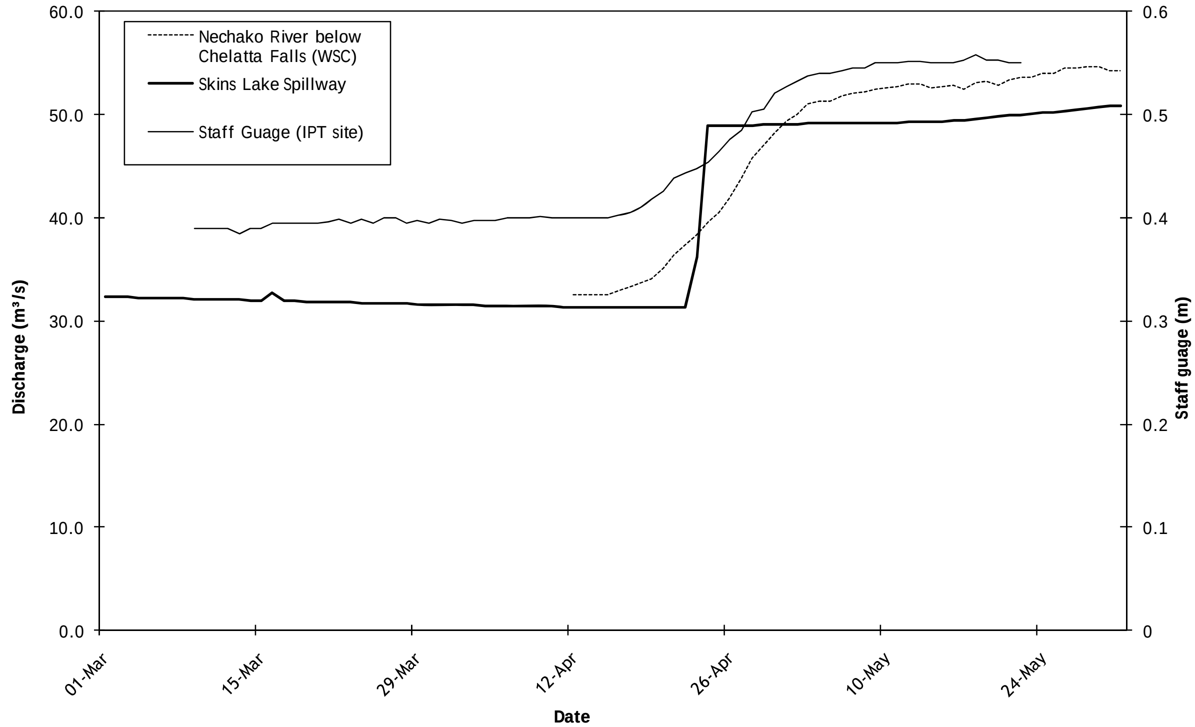


Figure 4. Daily discharge of the Nechako River at Bert Irvine's (km 19) and Skins Lake Spillway releases, March to May, 2010 (Preliminary data from WSC). (note: WSC data not available prior to April 12th, 2010)



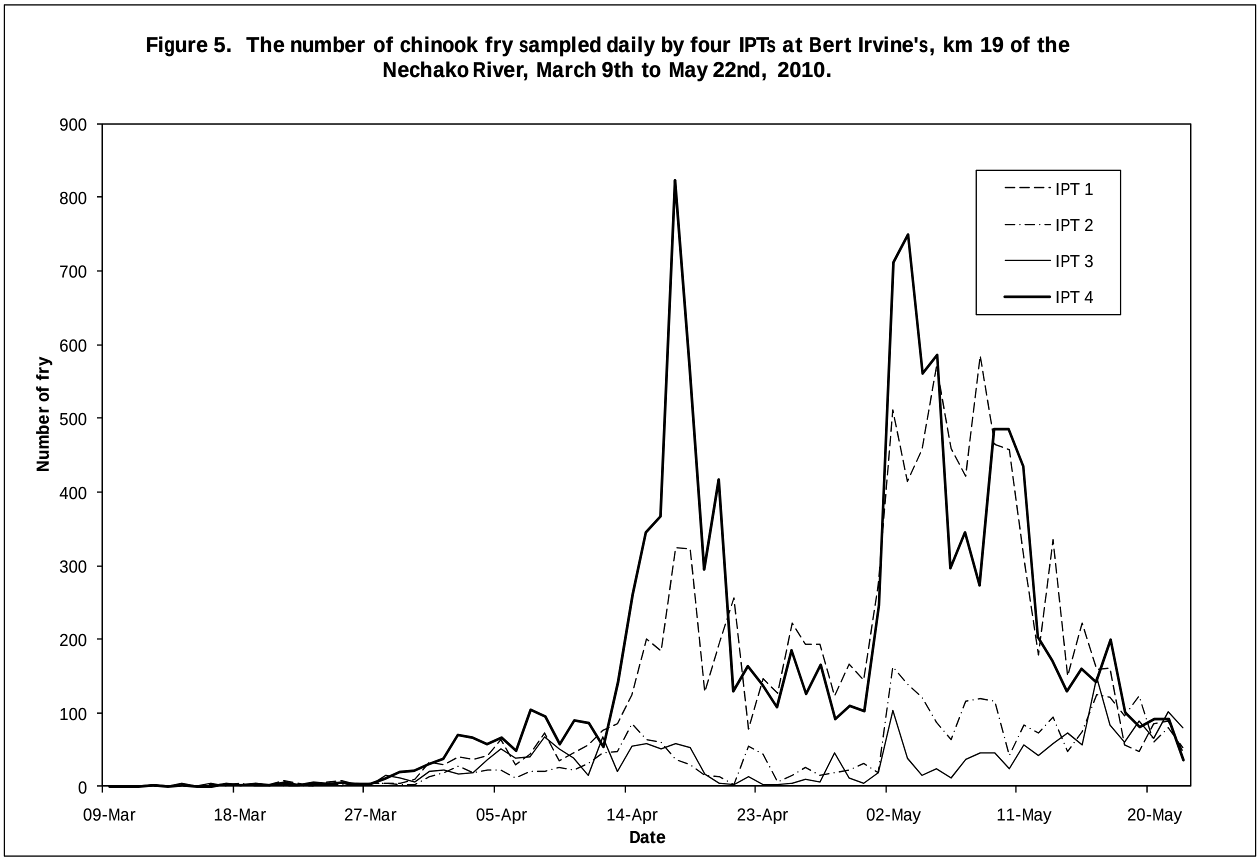


Figure 5. The number of chinook fry sampled daily by four IPTs at Bert Irvine's, km 19 of the Nechako River, March 9th to May 22nd, 2010.
900
800
700
600
500
400
300
200
100
0
Number of fry
09-Mar
18-Mar
27-Mar
05-Apr
14-Apr
23-Apr
02-May
11-May
20-May
Date
IPT 1
IPT 2
IPT 3
IPT 4

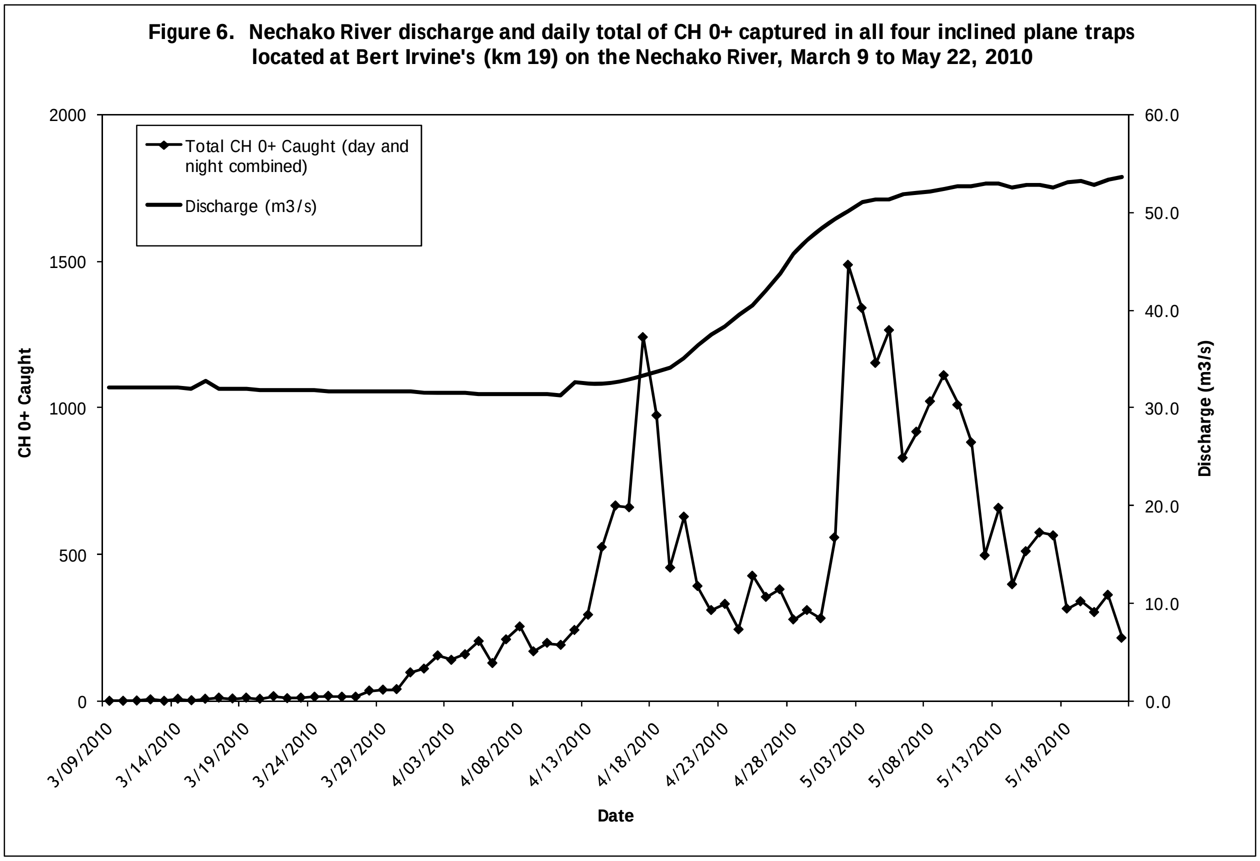
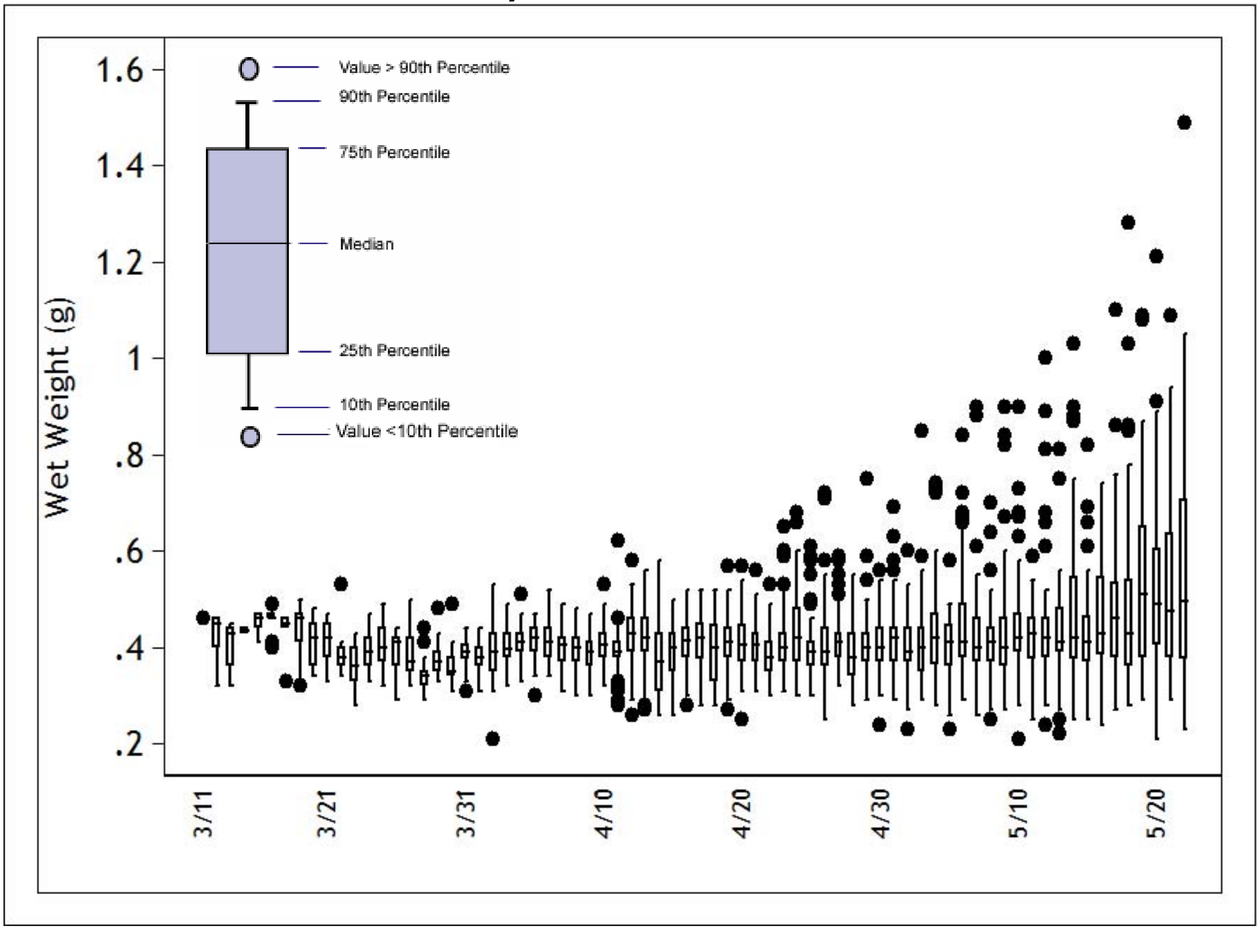


Figure 6. Nechako River discharge and daily total of CH 0+ captured in all four inclined plane traps located at Bert Irvine's (km 19) on the Nechako River, March 9 to May 22, 2010
Total CH 0+ Caught (day and night combined)
Discharge (m3/s)
CH 0+ Caught
Discharge (m3/s)
Date
2000
1500
1000
500
0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
3/09/2010
3/14/2010
3/19/2010
3/24/2010
3/29/2010
4/03/2010
4/08/2010
4/13/2010
4/18/2010
4/23/2010
4/28/2010
5/03/2010
5/08/2010
5/13/2010
5/18/2010

Figure 7. Box plots of wet weight of juvenile chinook caught in IPTs at km 19 (Bert Irvine's), Nechako River, 2010.



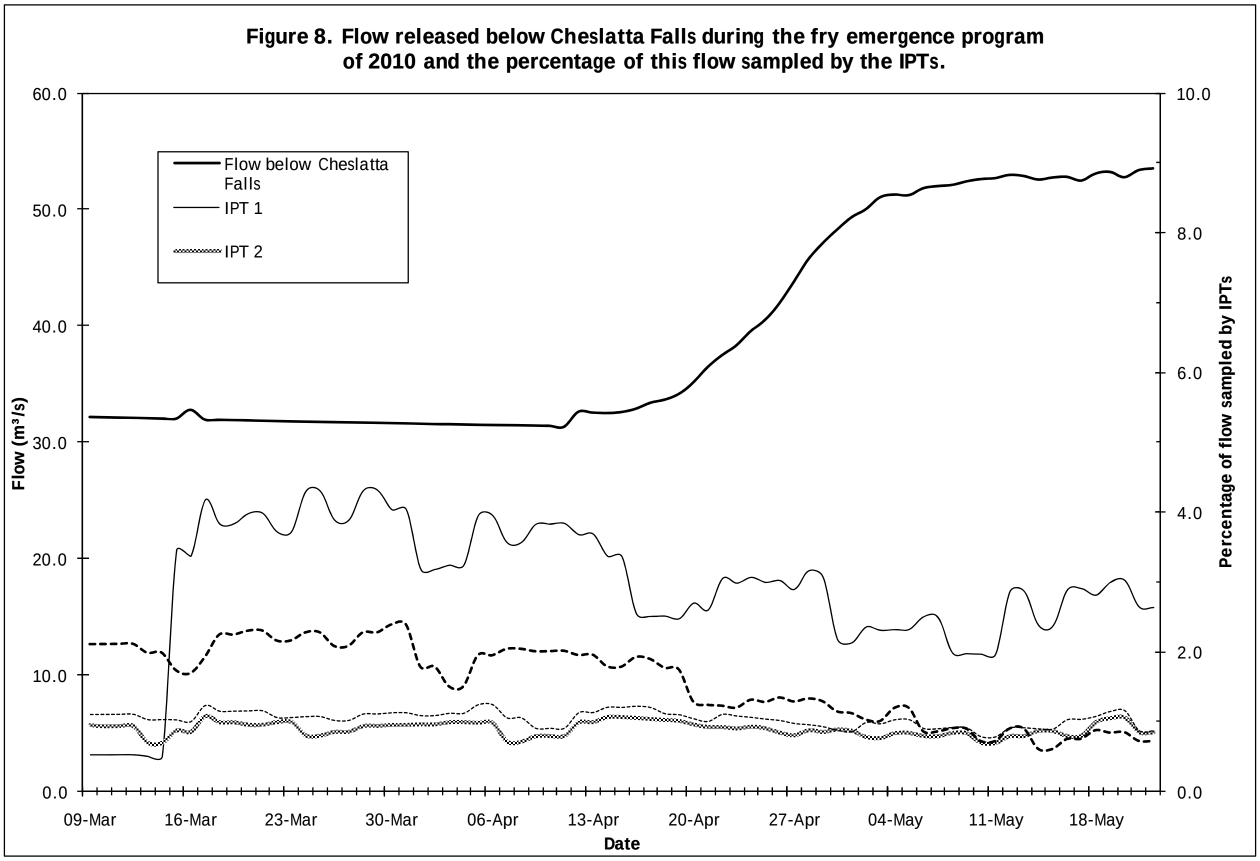
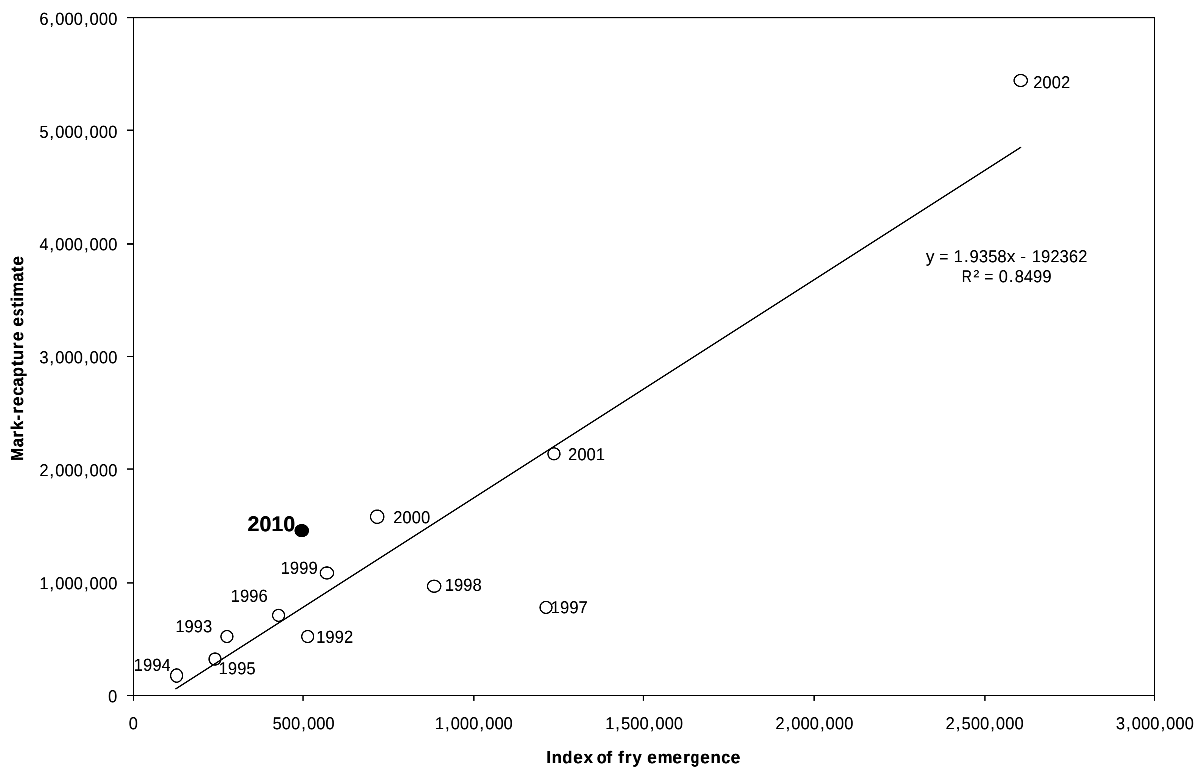


Figure 8. Flow released below Cheslatta Falls during the fry emergence program of 2010 and the percentage of this flow sampled by the IPTs.
Flow below Cheslatta Falls
IPT 1
IPT 2
Flow (m³/s)
Percentage of flow sampled by IPTs
Date
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.0
8.0
6.0
4.0
2.0
0.0
09-Mar
16-Mar
23-Mar
30-Mar
06-Apr
13-Apr
20-Apr
27-Apr
04-May
11-May
18-May

Figure 9. Mark-recapture estimates vs. index of fry emergence, Nechako River, 1992-2002, 2010.



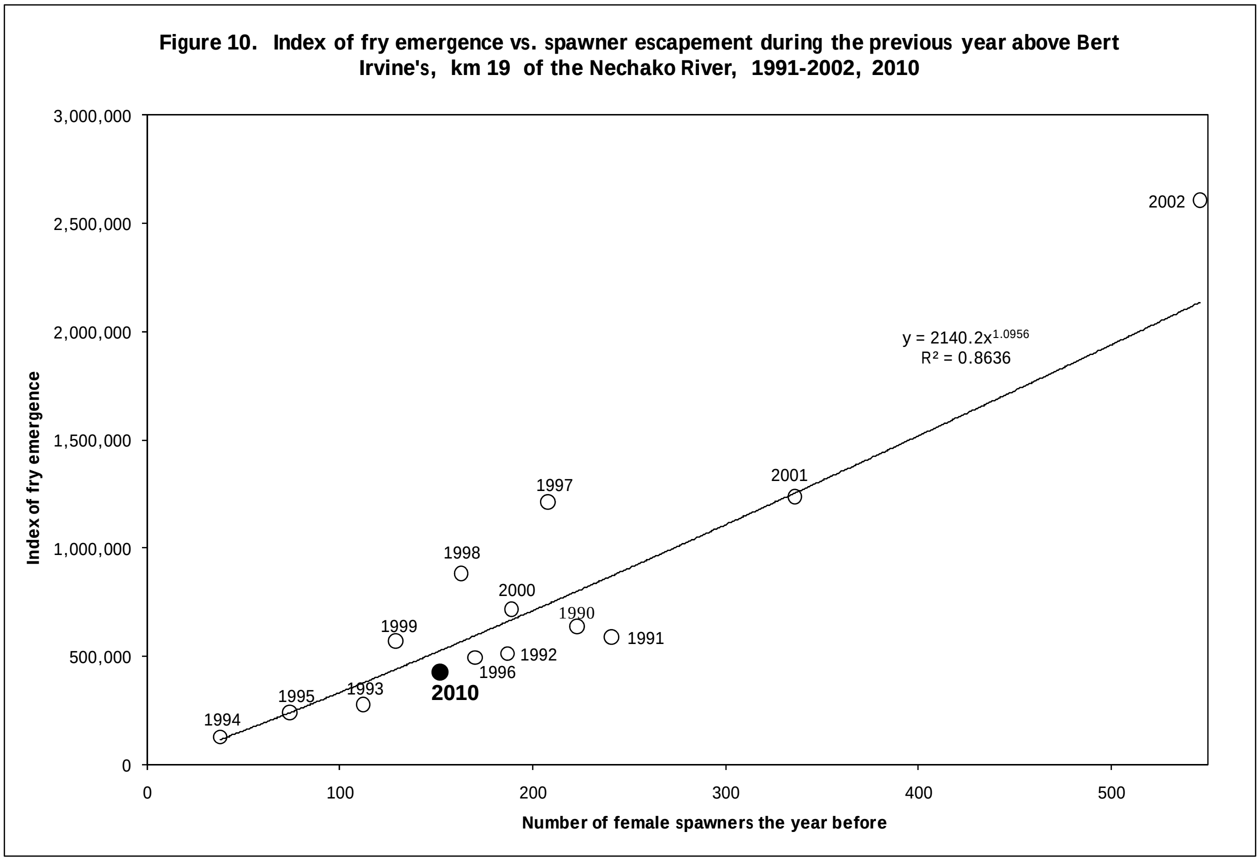
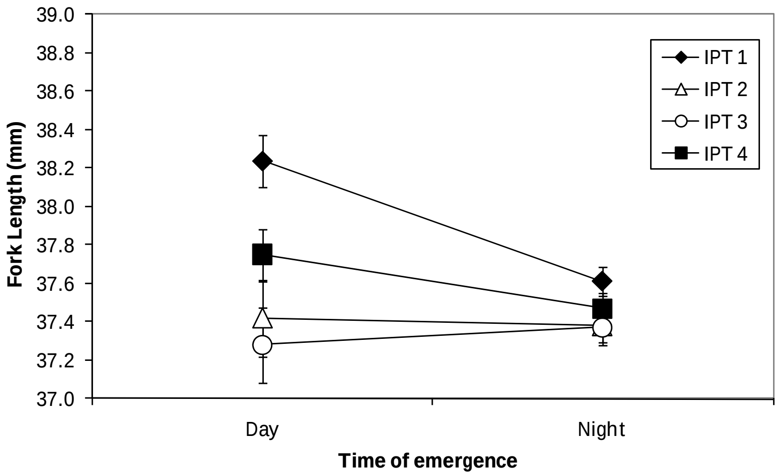
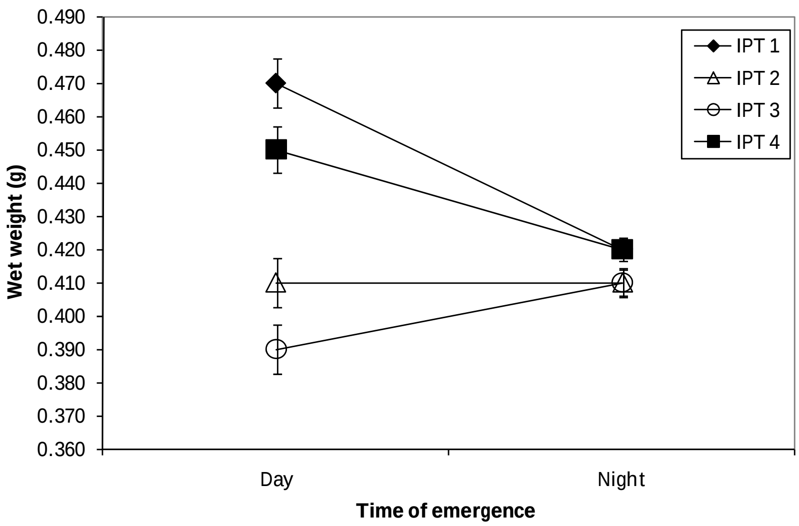


Figure 10. Index of fry emergence vs. spawner escapement during the previous year above Bert Irvine's, km 19 of the Nechako River, 1991-2002, 2010
Index of fry emergence
Number of female spawners the year before
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
0
100
200
300
400
500
y = 2140.2x1.0956
R² = 0.8636
2002
2001
1997
1998
2000
1990
1999
1991
1992
1996
2010
1995
1993
1994

Figure 11. Morphological characters (± se) at each IPT as a function of time of emergence.





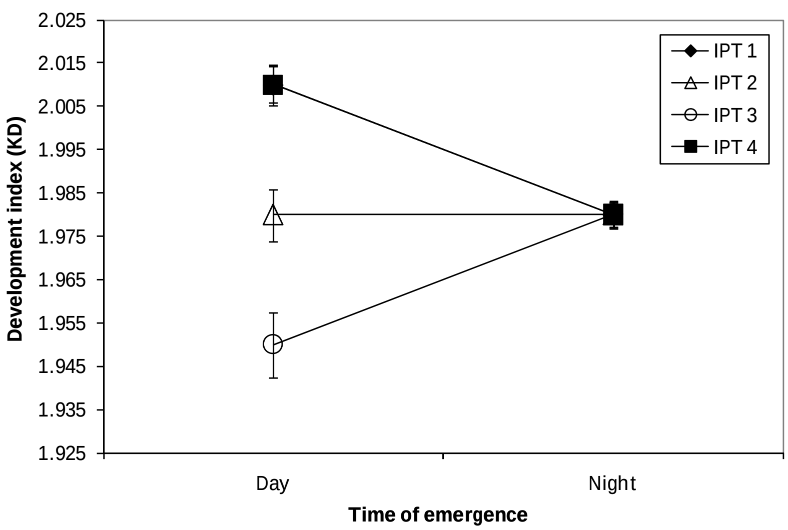
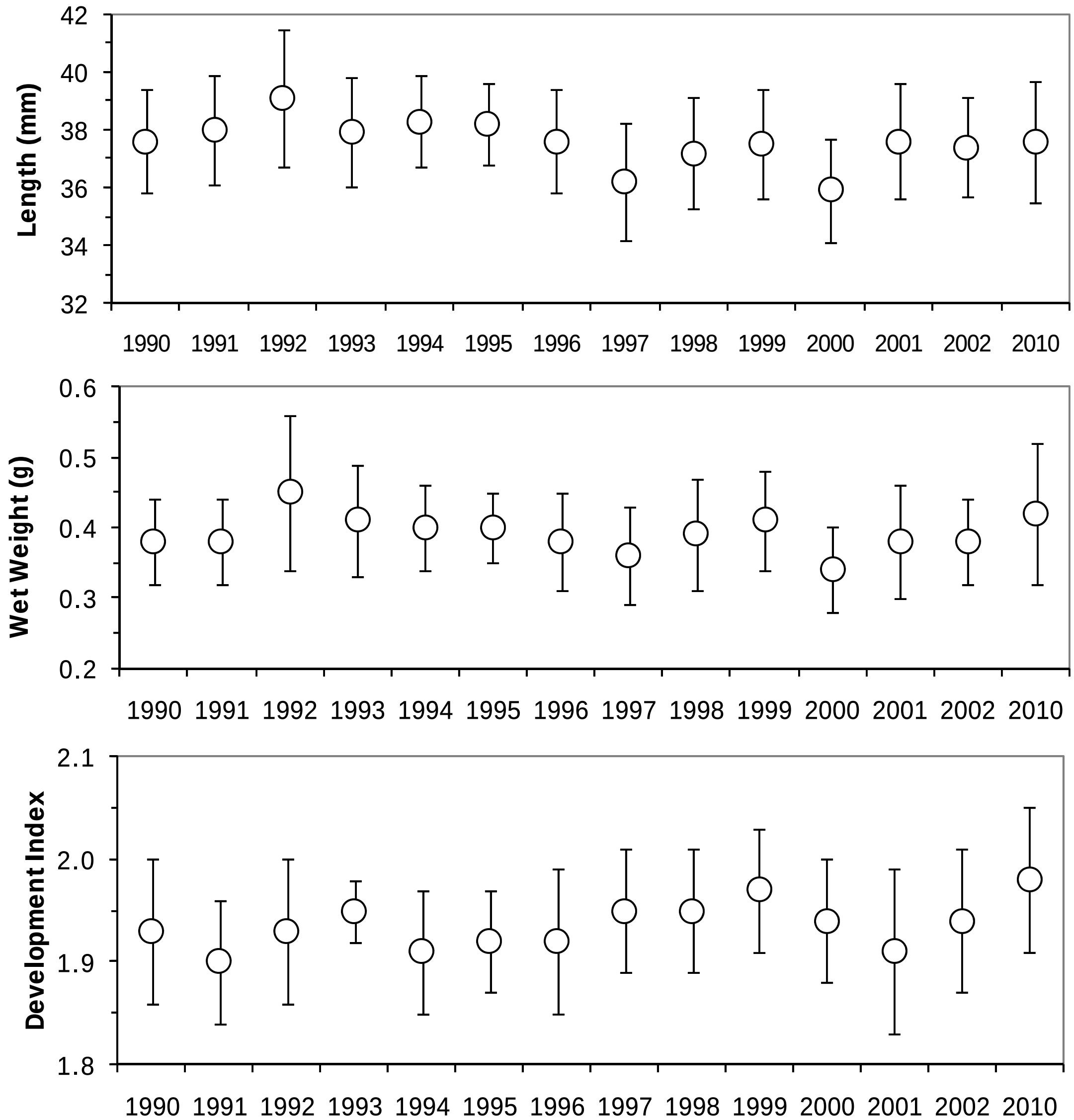


Figure 12. Mean fork length, wet weight and development index (±SD) of emergent chinook fry sampled by IPTs at Bert Irvine's, km 19 of the Nechako River, 1990 - 2002, 2010.



TABLES

Table 1. Accumulated Thermal Units (ATUs) recorded from peak of spawning in the Nechako River at Bert Irvine's (km 19) until the time of 50% of emergence of juvenile chinook captured in inclined plane traps.

Year	Date of 50% of Emergence	ATUs
1990	Apr 13	935
1991	Apr 25	840
1992	Apr 19	903
1993	Apr 22	938
1994	Apr 15	962
1995	Apr 29	856
1996	May 06	887
1997	Apr 30	862
1998	May 01	1,004
1999	Apr 28	962
2000	Apr 25	922
2001	Apr 21	893
2002	May 14	829
2010	May 03	1009

Table 2. Summary of inclined plane trap catches of chinook 0+ and the percent contributed by each trap to the total catch at Bert Irvine's, km 19 of the Nechako River, March 9 to May 22, 2010.

Trap	Night (morning check)		Day (evening check)		Total	Total Percent
	Number	Percent	Number	Percent		
1	9,012	32.6	1,328	4.8	10,340	37.5
2	2,879	10.4	71	0.3	2,950	10.7
3	2,188	7.9	64	0.2	2,252	8.2
4	11,686	42.3	382	1.4	12,068	43.7
Total	25,765	93.3	1,845	6.7	27,610	100.0

Table 3. Summary of mark-recapture trials on emergent chinook fry at Bert Irvine's, km 19 of the Nechako River, 2010.

Date	Number released	Trap number	Number recaptured	Combined efficiency	Total 2010 CH0+ catch	Estimated population
April 17	1,202	1	22	3.74%	27,610	737,494
		2	4			
		3	0			
		4	19			
			45			
April 29	1,925	1	4	0.99%	27,610	2,797,329
		2	4			
		3	1			
		4	10			
			19			
May 13	2,900	1	8	0.93%	27,610	2,965,519
		2	8			
		3	8			
		4	3			
			27			
			Average combined efficiency:	1.89%	**Average Population Estimate:**	1,462,960

Table 4. Comparison of chinook fry estimates values between index of fry emergence and mark-recapture 95% confidence intervals, Nechako River, 1992-2002, 2010. Note: No mark-recapture data available in 1991.

Year	Index of fry emergence	Mark-recapture estimate 95% CI		Overlap?
1992	512,247	733,620	312,069	Y
1993	276,613	626,583	418,254	N
1994	127,947	240,528	112,747	Y
1995	242,058	386,692	254,162	N
1996	428,663	867,689	550,388	N
1997	1,211,894	1,358,870	207,383	Y
1998	884,467	1,144,606	788,884	Y
1999	569,703	1,390,264	771,633	N
2000	716,921	2,265,130	896,571	N
2001	1,235,554	3,407,552	869,979	Y
2002	2,606,654	6,890,512	3,999,334	N
2010	495,170	2,179,251	746,670	N

Table 5. Index of fry emergence and estimated emergence success in the Nechako River above Bert Irvine's (km 19), 1991 - 2002, 2010.

Year	Number of spawners (females) above km 19	Index of fry emergence	Emergence Success (%)*
1991	241	589,456	42.4
1992	187	512,247	47.5
1993	112	276,613	42.8
1994	38	127,947	58.4
1995	74	242,058	56.7
1996	152	428,663	48.9
1997	208	1,211,894	100.1 **
1998	163	884,467	94.1 **
1999	129	569,703	76.6
2000	189	716,921	65.8
2001	336	1,235,554	63.7
2002	546	2,606,654	82.8
2010	170	495,170	50.5

***** Based on an assumed fecundity of 5,769 eggs/female.

****** probably due to overestimation of the index because of higher flows than usual

Table 6. Average morphological parameters for emerging fry captured in the IPTs at Bert Irvines, km 19 of the Nechako River, March - May 2010.

	Trap Number							
	1		2		3		4	
	Day	Night	Day	Night	Day	Night	Day	Night
N	365	595	69	540	64	507	302	598
Mean fork length (mm)	38.24	37.61	37.42	37.38	37.28	37.37	37.75	37.47
SD	2.58	1.79	1.68	2.07	1.57	2.04	2.36	1.89
Mean wet weight (g)	0.47	0.42	0.41	0.41	0.39	0.41	0.45	0.42
SD	0.14	0.08	0.06	0.10	0.06	0.09	0.12	0.09
Mean K_D (g/mm^3)	2.01	1.98	1.98	1.98	1.95	1.98	2.01	1.98
SD	0.08	0.07	0.05	0.07	0.06	0.07	0.08	0.07

N = sample size; SD = standard deviation

Table 7. ANOVAs for morphological characters of chinook fry sampled at km 19 of the Nechako River, 2010. Tests done on ln-transformed values.

Fork Length

Source of variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.011	3.98	0.046
Trap	3	0.023	8.10	< 0.001
Interaction	3	0.007	2.39	0.067
Explained	7	0.021	7.34	< 0.001
Residual	3032	0.002		

Wet weight

Source of variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.327	7.95	0.005
Trap	3	0.660	16.02	< 0.001
Interaction	3	0.372	9.03	< 0.001
Explained	7	0.708	17.20	< 0.001
Residual	3032	0.041		

Development index

Source of variation	Degrees of freedom	Mean square	F	P
Time of emergence	1	0.007	5.52	0.019
Trap	3	0.019	14.8	< 0.001
Interaction	3	0.016	12.63	< 0.001
Explained	7	0.02	16.77	< 0.001
Residual	3032	0.001		

Table 8. Percent of total catch and ranking of incidental species caught in IPTs at Bert Irvine's, km 19 of the Nechako River 1991 - 2002, 2010.

Species		**Percent of total catch**												
		1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2010**
burbot	*Lota lota*	0.12	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
chubbs	*Cyprinidae sp.*	0.00	0.00	0.00	0.19	0.04	0.54	0.20	0.20	0.50	0.30	0.01	0.07	0.05
lake trout	*Salvelinus namaycush*	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.02	0.00	0.00	0.00	0.00	0.00
sucker	*Catostomus sp.*	2.69	2.11	3.11	4.02	3.52	2.09	0.50	0.23	2.03	0.48	0.23	0.56	1.86
leopard dace	*Rhinichthys falcatus*	0.73	1.63	0.75	7.24	3.06	4.07	0.54	0.38	1.30	0.32	0.12	0.20	0.16
longnose dace	*Rhinichthys cataractae*	3.78	2.97	3.23	21.85	4.29	4.24	2.34	0.68	3.69	0.58	0.30	0.45	1.46
mountain whitefish	*Prosopium williamsoni*	0.02	0.66	0.13	0.13	4.21	0.06	0.02	0.24	0.06	0.01	0.01	0.00	0.03
northern pikeminnow	*Ptychocheilus oregonensis*	4.26	1.84	1.68	1.17	1.64	1.41	0.63	0.18	1.49	0.49	0.02	0.16	0.30
rainbow trout	*Oncorhynchus mykiss*	0.00	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02
redside shiner	*Richardsonius balteatus*	4.32	2.54	0.78	3.57	3.12	3.26	1.69	0.31	0.70	0.38	0.09	0.19	0.18
sculpin	*Cottus sp.*	0.56	0.45	0.79	3.11	0.99	0.41	0.42	0.18	0.17	0.23	0.10	0.18	0.08
sockeye salmon	*Oncorhynchus nerka*	0.02	2.15	3.32	0.03	0.89	0.83	0.82	0.05	0.38	0.05	1.16	0.40	2.35
coho salmon	*Oncorhynchus kisutch*	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00
Total		*16.49*	*14.40*	*21.50*	*41.37*	*21.76*	*16.93*	*7.22*	*2.47*	*10.32*	*2.85*	*2.06*	*2.21*	*6.49*

APPENDICES

Appendix 1. Estimates of the numbers of emerging chinook fry, sampled by IPTs at km 19 (Bert Irvine's Lodge), 2010.

			IPT 1				IPT 2				IPT 3				IPT 4				Combined	
Date	Staff Gauge	Discharge (m^3/s)	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Weighted Index Estimate
3/09/2010	0.39	32.1	0	0.17	0.52%	0.0	0	0.30	0.94%	0.0	0	0.35	1.09%	0.0	0	0.68	2.11%	0.0	0	0.0
3/10/2010	0.39	32.1	0	0.17	0.52%	0.0	0	0.30	0.94%	0.0	0	0.35	1.09%	0.0	0	0.68	2.11%	0.0	0	0.0
3/11/2010	0.39	32.1	0	0.17	0.52%	0.0	0	0.30	0.94%	0.0	1	0.35	1.10%	91.3	0	0.68	2.12%	0.0	1	21.4
3/12/2010	0.39	32.1	1	0.17	0.52%	192.6	1	0.30	0.94%	106.1	2	0.35	1.10%	182.4	1	0.68	2.12%	47.2	5	106.9
3/13/2010	0.385	32.0	0	0.16	0.50%	0.0	0	0.23	0.70%	0.0	0	0.33	1.02%	0.0	0	0.64	1.99%	0.0	0	0.0
3/14/2010	0.39	32.0	0	0.16	0.50%	0.0	2	0.23	0.70%	284.6	4	0.33	1.02%	392.0	1	0.64	1.99%	50.2	7	166.3
3/15/2010	0.39	32.0	0	1.10	3.44%	0.0	1	0.28	0.88%	113.6	1	0.33	1.02%	98.5	0	0.56	1.74%	0.0	2	28.3
3/16/2010	0.395	32.8	0	1.10	3.36%	0.0	2	0.28	0.86%	232.6	5	0.33	0.99%	504.1	0	0.56	1.70%	0.0	7	101.3
3/17/2010	0.395	31.9	4	1.33	4.17%	96.0	3	0.35	1.09%	276.4	1	0.39	1.22%	81.8	3	0.61	1.93%	155.8	11	130.9
3/18/2010	0.395	31.9	1	1.22	3.82%	26.2	4	0.32	1.00%	401.3	2	0.36	1.14%	175.3	1	0.72	2.25%	44.5	8	97.5
3/19/2010	0.395	31.9	4	1.22	3.83%	104.6	2	0.32	1.00%	200.5	1	0.36	1.14%	87.6	4	0.72	2.25%	177.8	11	133.9
3/20/2010	0.395	31.9	2	1.26	3.97%	50.4	2	0.31	0.96%	208.2	1	0.36	1.15%	87.3	2	0.73	2.31%	86.7	7	83.5
3/21/2010	0.3965	31.8	8	1.26	3.97%	201.3	1	0.31	0.96%	104.0	2	0.36	1.15%	174.5	5	0.73	2.31%	216.6	16	190.7
3/22/2010	0.398	31.8	4	1.18	3.71%	107.9	0	0.32	1.00%	0.0	3	0.33	1.05%	286.0	2	0.69	2.16%	92.4	9	113.6
3/23/2010	0.395	31.8	1	1.18	3.71%	26.9	1	0.32	1.00%	99.9	3	0.33	1.05%	285.7	6	0.69	2.17%	277.0	11	138.7
3/24/2010	0.398	31.8	6	1.36	4.29%	139.9	3	0.26	0.81%	372.1	2	0.34	1.06%	188.2	3	0.72	2.28%	131.5	14	165.9
3/25/2010	0.395	31.7	8	1.36	4.29%	186.3	3	0.26	0.81%	371.8	1	0.34	1.06%	94.0	5	0.72	2.28%	219.1	17	201.3
3/26/2010	0.4	31.7	3	1.23	3.88%	77.4	3	0.27	0.86%	348.9	4	0.32	1.01%	396.8	4	0.66	2.09%	191.7	14	178.8
3/27/2010	0.4	31.7	4	1.23	3.88%	103.1	4	0.27	0.86%	464.8	2	0.32	1.01%	198.2	4	0.66	2.09%	191.5	14	178.6
3/28/2010	0.395	31.7	4	1.36	4.30%	93.0	5	0.30	0.94%	529.5	16	0.35	1.10%	1454.1	10	0.72	2.28%	438.5	35	405.8
3/29/2010	0.3975	31.6	5	1.36	4.30%	116.2	2	0.30	0.94%	211.6	11	0.35	1.10%	998.9	20	0.72	2.28%	876.2	38	440.2
3/30/2010	0.395	31.6	10	1.27	4.03%	248.4	2	0.30	0.96%	208.5	7	0.35	1.12%	625.9	21	0.76	2.40%	876.7	40	470.6
3/31/2010	39.75	31.6	33	1.27	4.03%	819.7	13	0.30	0.96%	1355.0	21	0.35	1.12%	1877.7	30	0.76	2.40%	1252.4	97	1141.3
4/01/2010	0.3975	31.6	30	1.00	3.17%	946.4	19	0.31	0.97%	1966.2	23	0.34	1.08%	2135.1	38	0.57	1.79%	2122.3	110	1570.5
4/02/2010	0.395	31.5	40	1.00	3.17%	1260.8	28	0.31	0.97%	2895.0	17	0.34	1.08%	1576.7	70	0.57	1.79%	3906.2	155	2211.1
4/03/2010	0.3975	31.5	36	1.02	3.23%	1114.0	19	0.31	1.00%	1904.5	18	0.35	1.11%	1620.3	67	0.47	1.51%	4449.2	140	2045.0
4/04/2010	0.3975	31.5	42	1.02	3.23%	1298.7	23	0.31	1.00%	2303.6	36	0.35	1.11%	3238.1	58	0.47	1.51%	3848.5	159	2320.7
4/05/2010	0.3975	31.5	64	1.24	3.94%	1623.1	22	0.31	0.99%	2225.5	51	0.39	1.23%	4133.8	67	0.61	1.95%	3432.6	204	2513.1
4/06/2010	0.4	31.5	29	1.24	3.94%	735.2	12	0.31	0.99%	1213.4	39	0.39	1.23%	3159.9	49	0.61	1.95%	2509.4	129	1588.6
4/07/2010	0.4	31.4	44	1.12	3.56%	1237.2	21	0.23	0.72%	2923.4	40	0.33	1.05%	3827.4	105	0.64	2.04%	5135.4	210	2851.6
4/08/2010	0.4	31.4	72	1.12	3.56%	2023.8	20	0.23	0.72%	2783.1	67	0.33	1.05%	6408.6	95	0.64	2.05%	4644.6	254	3447.8
4/09/2010	0.401	31.4	35	1.20	3.82%	917.1	26	0.25	0.80%	3256.1	51	0.28	0.89%	5702.5	57	0.63	2.01%	2835.6	169	2247.5
4/10/2010	0.4	31.4	46	1.20	3.82%	1204.3	23	0.25	0.80%	2878.0	39	0.28	0.90%	4357.1	90	0.63	2.01%	4473.6	198	2631.0
4/11/2010	0.4	31.3	56	1.20	3.83%	1462.3	32	0.25	0.80%	3993.6	16	0.28	0.90%	1782.8	87	0.63	2.02%	4313.1	191	2531.3
4/12/2010	0.4	32.59	76	1.20	3.67%	2071.1	45	0.32	1.00%	4515.9	67	0.37	1.12%	5980.9	54	0.64	1.96%	2760.1	242	3125.5
4/13/2010	0.4	32.52	85	1.20	3.68%	2311.5	47	0.32	1.00%	4706.8	20	0.37	1.12%	1781.6	142	0.64	1.96%	7242.9	294	3789.2
4/14/2010	0.4	32.49	125	1.09	3.36%	3719.3	85	0.35	1.07%	7925.2	54	0.39	1.20%	4506.1	261	0.58	1.79%	14546.7	525	7069.7
4/15/2010	0.4	32.57	201	1.09	3.35%	5995.5	63	0.35	1.07%	5888.6	58	0.39	1.20%	4851.9	345	0.58	1.79%	19276.3	667	9004.3
4/16/2010	0.4025	32.86	184	0.83	2.54%	7248.2	60	0.35	1.06%	5660.1	51	0.40	1.21%	4207.2	366	0.63	1.93%	18985.7	661	9809.2
4/17/2010	0.405	33.37	324	0.83	2.50%	12960.2	37	0.35	1.04%	3544.3	58	0.40	1.19%	4858.5	823	0.63	1.90%	43351.0	1242	18715.7
4/18/2010	0.41	33.65	323	0.84	2.50%	12902.2	30	0.35	1.03%	2911.7	53	0.37	1.10%	4797.9	569	0.60	1.77%	32089.7	975	15206.8

Date	Staff Gauge	Discharge (m^3/s)	IPT 1				IPT 2				IPT 3				IPT 4				Combined	
			CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Volume sampled (m^3/s)	% of discharge sampled	Index	CH 0+ Catch	Weighted Index Estimate
4/19/2010	0.4175	34.13	129	0.84	2.47%	5226.6	15	0.35	1.02%	1476.6	17	0.37	1.09%	1561.0	294	0.60	1.75%	16817.8	455	7198.0
4/20/2010	0.425	35.12	195	0.94	2.69%	7251.4	14	0.34	0.96%	1453.4	4	0.36	1.03%	388.0	416	0.45	1.29%	32294.1	629	10533.2
4/21/2010	43.75	36.44	256	0.94	2.59%	9877.8	3	0.34	0.93%	323.2	3	0.36	0.99%	301.9	130	0.45	1.24%	10471.5	392	6811.4
4/22/2010	44.25	37.47	78	1.14	3.04%	2564.3	55	0.35	0.93%	5920.7	14	0.41	1.10%	1278.0	163	0.46	1.23%	13271.2	310	4925.0
4/23/2010	44.75	38.31	146	1.14	2.97%	4907.7	44	0.35	0.91%	4842.9	2	0.41	1.07%	186.7	139	0.46	1.20%	11571.2	331	5376.7
4/24/2010	45.35	39.54	127	1.21	3.06%	4152.4	7	0.37	0.93%	751.1	3	0.42	1.05%	285.0	107	0.52	1.31%	8142.6	244	3838.3
4/25/2010	46.5	40.50	221	1.21	2.99%	7401.3	16	0.37	0.91%	1758.6	5	0.42	1.03%	486.6	185	0.52	1.28%	14420.3	427	6880.2
4/26/2010	47.6	41.95	194	1.26	3.01%	6440.7	26	0.36	0.85%	3072.1	10	0.42	1.01%	993.4	125	0.56	1.35%	9284.0	355	5715.3
4/27/2010	48.5	43.79	193	1.26	2.89%	6689.2	16	0.36	0.81%	1973.6	7	0.42	0.96%	726.0	165	0.56	1.29%	12793.6	381	6403.5
4/28/2010	50.25	45.71	123	1.44	3.15%	3900.9	19	0.40	0.88%	2150.3	45	0.43	0.95%	4756.8	91	0.61	1.33%	6833.3	278	4402.6
4/29/2010	0.505	47.10	166	1.44	3.06%	5425.0	23	0.40	0.86%	2682.4	12	0.43	0.92%	1307.1	109	0.61	1.29%	8434.4	310	5059.0
4/30/2010	0.52	48.27	144	1.05	2.17%	6641.2	31	0.43	0.89%	3466.8	5	0.42	0.87%	577.9	102	0.55	1.15%	8891.6	282	5556.8
5/01/2010	0.526	49.33	274	1.05	2.12%	12915.7	19	0.43	0.87%	2171.7	18	0.42	0.85%	2126.4	247	0.55	1.12%	22006.9	558	11238.2
5/02/2010	0.5325	50.02	512	1.17	2.35%	21813.1	162	0.39	0.79%	20619.3	103	0.49	0.98%	10514.6	712	0.52	1.03%	69120.6	1489	28954.4
5/03/2010	0.5375	51.06	415	1.17	2.30%	18049.3	139	0.39	0.77%	18060.8	39	0.49	0.96%	4064.3	749	0.52	1.01%	74229.0	1342	26640.2
5/04/2010	0.54	51.30	458	1.19	2.31%	19817.4	121	0.43	0.84%	14368.2	15	0.52	1.02%	1474.1	560	0.61	1.20%	46777.0	1154	21497.8
5/05/2010	0.54	51.24	570	1.19	2.31%	24637.9	87	0.43	0.84%	10320.1	24	0.52	1.02%	2356.1	585	0.61	1.20%	48814.2	1266	23559.6
5/06/2010	0.5425	51.84	459	1.29	2.49%	18402.9	63	0.41	0.80%	7873.2	12	0.46	0.89%	1345.3	296	0.45	0.86%	34328.7	830	16440.1
5/07/2010	0.545	52.03	422	1.29	2.49%	16981.0	115	0.41	0.80%	14424.0	37	0.46	0.89%	4163.0	345	0.45	0.86%	40157.1	919	18269.3
5/08/2010	0.545	52.12	585	1.03	1.98%	29589.8	120	0.44	0.84%	14213.6	45	0.47	0.91%	4964.2	273	0.47	0.91%	30163.6	1023	22081.5
5/09/2010	0.55	52.43	465	1.03	1.97%	23657.1	115	0.44	0.84%	13700.8	46	0.47	0.90%	5104.1	486	0.47	0.90%	54010.7	1112	24142.4
5/10/2010	0.55	52.63	458	1.03	1.96%	23390.2	42	0.37	0.70%	5981.6	25	0.41	0.77%	3232.2	486	0.38	0.72%	67364.7	1011	24331.3
5/11/2010	0.55	52.71	310	1.03	1.96%	15855.9	83	0.37	0.70%	11838.9	56	0.41	0.77%	7251.2	434	0.38	0.72%	60248.7	883	21283.2
5/12/2010	0.551	52.99	179	1.51	2.85%	6272.2	73	0.42	0.80%	9146.3	42	0.48	0.90%	4665.8	203	0.48	0.90%	22555.5	497	9115.6
5/13/2010	0.551	52.90	335	1.51	2.86%	11717.7	95	0.42	0.80%	11881.7	59	0.48	0.90%	6542.7	170	0.48	0.90%	18855.5	659	12065.6
5/14/2010	0.5505	52.59	150	1.25	2.37%	6331.5	47	0.46	0.87%	5381.0	72	0.47	0.89%	8118.3	129	0.32	0.61%	21152.7	398	8397.9
5/15/2010	0.5505	52.76	221	1.25	2.36%	9359.3	74	0.46	0.87%	8500.2	57	0.47	0.88%	6448.3	159	0.32	0.61%	26158.1	511	10817.9
5/16/2010	0.5505	52.82	159	1.52	2.88%	5524.5	125	0.42	0.80%	15646.6	149	0.54	1.02%	14629.4	142	0.40	0.75%	18923.2	575	10558.4
5/17/2010	0.5525	52.50	161	1.52	2.90%	5559.9	122	0.42	0.80%	15177.9	83	0.54	1.02%	8099.5	199	0.40	0.76%	26357.2	565	10311.5
5/18/2010	0.5575	53.11	57	1.49	2.80%	2032.4	96	0.53	1.00%	9601.5	61	0.57	1.07%	5713.6	101	0.47	0.88%	11519.1	315	5479.4
5/19/2010	0.5525	53.25	48	1.59	2.99%	1606.7	123	0.56	1.06%	11654.5	88	0.61	1.14%	7736.2	81	0.45	0.84%	9619.4	340	5645.5
5/20/2010	0.5525	52.79	85	1.59	3.01%	2820.5	61	0.56	1.06%	5729.8	65	0.61	1.15%	5664.7	92	0.45	0.85%	10831.0	303	4987.5
5/21/2010	0.55	53.40	88	1.41	2.63%	3341.3	80	0.46	0.85%	9374.3	102	0.46	0.86%	11865.4	92	0.39	0.72%	12716.1	362	7139.7
5/22/2010	0.55	53.55	47	1.41	2.63%	984.3	53	0.46	0.85%	3425.6	79	0.46	0.86%	5069.0	36	0.39	0.72%	2744.6	215	2338.9
	Total		**10340**			**414760**	**2950**			**338348**	**2252**			**221203**	**12068**			**1067128**	**27610**	**495170**

Apepndix 2. Daily mean fork length, wet weight and development index (KD) for chinook 0+ sampled by IPTs at km 19 of the Nechako River (Bert Irvine's) in 2010.

N: sample size, SD: standard deviation

		Length (mm)		Weight (g)		Development Index	
Date	**Count**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
3/11/2010	1	39.00		0.46		1.98	
3/12/2010	5	37.80	1.92	0.42	0.06	1.97	0.03
3/14/2010	7	37.00	2.24	0.41	0.05	2.00	0.06
3/15/2010	2	38.00	1.41	0.44	0.01	2.00	0.06
3/16/2010	7	38.71	0.49	0.45	0.02	1.98	0.03
3/17/2010	11	39.18	0.87	0.46	0.03	1.97	0.04
3/18/2010	8	37.88	1.25	0.44	0.04	2.00	0.03
3/19/2010	11	38.36	1.36	0.43	0.06	1.97	0.04
3/20/2010	7	37.57	1.51	0.41	0.05	1.98	0.03
3/21/2010	15	37.53	0.92	0.41	0.04	1.98	0.05
3/22/2010	9	36.56	1.01	0.39	0.06	2.00	0.05
3/23/2010	11	36.27	1.27	0.36	0.04	1.96	0.03
3/24/2010	14	37.07	1.07	0.39	0.04	1.97	0.04
3/25/2010	17	37.06	1.30	0.40	0.05	1.99	0.03
3/26/2010	14	36.64	0.84	0.39	0.05	1.99	0.07
3/27/2010	14	37.00	1.30	0.39	0.06	1.97	0.04
3/28/2010	33	36.03	1.19	0.34	0.03	1.94	0.05
3/29/2010	29	36.93	1.25	0.37	0.03	1.95	0.06
3/30/2010	33	36.55	1.00	0.36	0.03	1.95	0.05
3/31/2010	52	37.40	1.03	0.39	0.03	1.95	0.05
4/01/2010	43	37.16	1.17	0.38	0.03	1.95	0.05
4/02/2010	45	37.49	1.77	0.39	0.06	1.95	0.05
4/03/2010	46	37.78	1.33	0.40	0.04	1.95	0.05
4/04/2010	45	37.84	1.21	0.41	0.04	1.96	0.06
4/05/2010	55	37.76	1.15	0.41	0.04	1.96	0.05
4/06/2010	49	37.57	1.58	0.41	0.04	1.98	0.07
4/07/2010	50	37.24	0.94	0.40	0.04	1.97	0.05
4/08/2010	46	37.24	1.14	0.39	0.04	1.97	0.05
4/09/2010	45	36.58	1.14	0.38	0.04	1.99	0.06
4/10/2010	44	37.36	1.28	0.41	0.05	1.98	0.07
4/11/2010	45	37.04	1.31	0.39	0.05	1.97	0.05
4/12/2010	54	36.81	1.40	0.42	0.06	2.03	0.08
4/13/2010	45	37.62	1.45	0.42	0.07	1.98	0.06
4/14/2010	45	36.69	1.86	0.37	0.07	1.96	0.07
4/15/2010	42	37.12	1.47	0.39	0.06	1.96	0.06
4/16/2010	50	37.60	1.39	0.41	0.05	1.97	0.05
4/17/2010	52	37.77	1.49	0.42	0.05	1.97	0.04
4/18/2010	48	37.10	1.49	0.39	0.06	1.96	0.06
4/19/2010	48	37.88	1.59	0.41	0.06	1.96	0.05
4/20/2010	48	37.25	1.55	0.41	0.06	1.99	0.08
4/21/2010	36	37.28	1.54	0.40	0.05	1.98	0.04
4/22/2010	56	36.77	1.24	0.38	0.05	1.97	0.06
4/23/2010	54	37.17	1.63	0.41	0.07	2.00	0.05
4/24/2010	50	37.48	1.49	0.43	0.08	2.01	0.07
4/25/2010	53	37.17	1.54	0.40	0.07	1.98	0.05
4/26/2010	62	37.00	1.79	0.41	0.08	2.00	0.06
4/27/2010	58	37.33	1.36	0.41	0.06	1.99	0.05
4/28/2010	59	36.92	1.57	0.39	0.06	1.97	0.05
4/29/2010	58	36.90	1.64	0.41	0.07	2.00	0.05

Date	Count	Length (mm)		Weight (g)		Development Index	
		Mean	SD	Mean	SD	Mean	SD
4/30/2010	55	37.18	1.61	0.41	0.07	1.99	0.05
5/01/2010	63	37.60	1.75	0.42	0.08	1.98	0.05
5/02/2010	66	37.21	1.76	0.40	0.07	1.98	0.05
5/03/2010	53	37.47	2.14	0.41	0.09	1.98	0.05
5/04/2010	60	37.93	2.04	0.43	0.10	1.98	0.07
5/05/2010	60	37.43	1.78	0.40	0.07	1.96	0.08
5/06/2010	60	38.95	2.27	0.45	0.11	1.95	0.07
5/07/2010	58	38.97	2.07	0.43	0.11	1.92	0.07
5/08/2010	40	38.20	2.29	0.41	0.09	1.94	0.06
5/09/2010	61	38.64	2.86	0.43	0.13	1.94	0.06
5/10/2010	63	38.70	2.24	0.44	0.11	1.96	0.07
5/11/2010	60	38.08	1.96	0.42	0.07	1.96	0.09
5/12/2010	54	37.80	2.56	0.45	0.14	2.01	0.08
5/13/2010	54	37.52	2.12	0.43	0.10	2.00	0.09
5/14/2010	60	37.85	3.18	0.47	0.16	2.03	0.08
5/15/2010	60	37.12	2.21	0.43	0.11	2.01	0.06
5/16/2010	60	37.72	2.50	0.47	0.12	2.04	0.08
5/17/2010	56	38.11	2.83	0.48	0.15	2.03	0.06
5/18/2010	52	37.71	3.29	0.49	0.19	2.05	0.10
5/19/2010	58	38.76	3.20	0.54	0.19	2.07	0.09
5/20/2010	56	38.73	3.24	0.53	0.18	2.06	0.09
5/21/2010	60	38.07	3.47	0.51	0.18	2.07	0.09
5/22/2010	40	39.33	4.47	0.57	0.26	2.06	0.09
Grand Total	**3040**	**37.58**	**2.08**	**0.42**	**0.10**	**1.98**	**0.07**

Appendix 3.

Summary of 2010 IPT catches by month and trap number

			Salmonidae										Catostomidae		Cottidae		Cyprinidae									
Month	**Day/ Night**	**Trap No.**	**CH 1+**	**CH 0+**	**RB A**	**RB J**	**SK 1+**	**SK 0+**	**BT A**	**BT J**	**MW A**	**MW J**	**CSU A**	**CSU J**	**CC A**	**CC J**	**RSC A**	**RSC J**	**NPM A**	**NPM J**	**LNC A**	**LNC J**	**LDC A**	**LDC J**	**PCC A**	**PCC J**
March	D	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
		2	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		4	0	10	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	0	0
	D Total		0	41	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	1	0	0	0	1	0	0
	N	1	0	96	0	0	0	0	0	0	0	0	0	8	1	2	0	0	0	7	1	2	1	1	0	0
		2	0	46	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0
		3	0	69	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	3	1	0	0	0
		4	0	112	0	0	0	0	0	0	0	0	0	19	2	5	0	2	0	31	0	12	1	2	0	0
	N Total		0	323	0	0	0	0	0	0	0	0	0	32	3	7	0	2	0	40	1	19	4	3	0	0
March Total			0	364	0	0	0	0	0	0	0	0	0	33	3	10	0	2	0	41	1	19	4	4	0	0
April	D	1	0	241	0	1	0	5	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0
		2	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		4	0	133	0	0	0	1	0	0	0	0	0	3	0	1	0	0	0	1	0	13	0	0	0	0
	D Total		0	460	0	1	0	6	0	0	0	0	0	4	0	2	0	1	0	1	0	14	0	0	0	0
	N	1	0	3543	0	0	0	35	0	0	0	1	0	49	0	0	0	13	0	13	7	72	0	15	0	5
		2	0	829	0	0	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	2	0	0	0	0
		3	0	851	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	6	0	1	0	0
		4	0	5236	0	1	0	42	0	4	3	4	0	141	0	6	2	10	0	18	0	157	0	11	0	1
	N Total		0	10459	0	1	0	82	0	4	3	5	0	197	0	6	2	23	0	31	7	237	0	27	0	6
April Total			0	10919	0	2	0	88	0	4	3	5	0	201	0	8	2	24	0	32	7	251	0	27	0	6
May	D	1	0	799	0	0	0	42	0	0	0	2	0	5	0	0	0	0	0	0	0	3	0	0	0	0
		2	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		4	0	239	0	0	0	16	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
	D Total		0	1056	0	0	0	58	0	0	0	2	0	5	0	0	0	1	0	0	0	4	0	0	0	0
	N	1	0	5659	0	2	0	169	0	0	0	0	2	102	1	0	0	2	0	2	3	48	0	7	0	2
		2	0	2006	0	0	0	90	0	0	0	0	0	19	0	0	0	2	0	0	1	2	0	1	0	0
		3	1	1268	0	0	0	44	0	0	0	0	0	15	0	0	0	0	0	0	0	5	0	1	0	2
		4	0	6338	0	1	0	244	0	0	0	0	0	171	2	0	0	20	0	14	13	76	0	3	0	5
	N Total		1	15271	0	3	0	547	0	0	0	0	2	307	3	0	0	24	0	16	17	131	0	12	0	9
May Total			1	16327	0	3	0	605	0	0	0	2	2	312	3	0	0	25	0	16	17	135	0	12	0	9
Grand Total			1	27610	0	5	0	693	0	4	3	7	2	546	6	18	2	51	0	89	25	405	4	43	0	15

Key to Species

A	Adults
J	Juveniles
CH	Chinook salmon
RB	Rainbow trout
SK	Sockeye salmon
MW	Mountain whitefish
BT	Bull trout
CSU	Largescale sucker
CC	Sculpin species
RSC	Redside shiner
NPM	Northern pikeminnow
LNC	Longnose dace
LDC	Leopard dace
PCC	Peamouth chubb