BIOLOGICAL ASSESSMENT OF HABITAT COMPLEXING IN THE NECHAKO RIVER, 1996

NECHAKO FISHERIES CONSERVATION PROGRAM
Data Report No. RM96-3

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ABSTRACT

In response to chinook salmon (*Oncorhynchus tshawytscha*) conservation concerns, and as part of the remedial measures outlined by the Nechako River Working Group (Anon.1987), pilot artificial habitat complexes were installed from 1989 through 1991 in the upper Nechako River. Habitat complexes consisted of instream cover structures (debris bundles and debris catchers), instream channel modification and side channel development. These were compared with natural sites which met similar physical criteria and had a variety of available cover. The goal was to increase the complexity of habitat in the Nechako River to replace and offset any potential habitat losses after the change from the current short term flow regime to the long term flow regime. From 1989 to 1996, fish within the habitat complexes have been sampled annually to assess juvenile chinook use. In addition, a series of emergent fry habitat structures consisting of small coniferous trees anchored along shallow gravel bars were added to the sampling program in 1996. The utilization of these structures by chinook fry and non-target fish species was assessed.

Chinook relative abundance was determined using two techniques: underwater snorkel counts and electrofishing. Indices of chinook relative abundance (fry density and catch per unit effort (CPUE)) were calculated in order to determine the degree with which chinook were associated with the habitat complexes and with natural sites. As well, the length, weight, and condition factor of the chinook sampled and the composition of the fish community at natural and habitat complex sites was described.

The 1996 study season was the eighth consecutive year complex utilization tended to be high even though the amount of habitat represented by the complexes was small compared to the total area of the river. For example, habitat complexes represented 2.5 % of the total area surveyed by snorkel in Reach 2, but 46 % of the chinook 0+ observed in June were associated with complex sites. In comparison, the natural sites represented 2.6 % of the total area surveyed, and only 1 % of the total chinook observed in June. Utilization of the habitat complexes was high, up to 90 % of complex sites in reaches 2 and 4 were observed to be occupied by chinook 0+.

Electrofishing also indicated that the habitat complexes were well used by chinook fry (0+) and chinook pre-smolts (0+ and 1+). When both types of sites were sampled at similar times, artificial habitat complexes were either used as much or more than natural sites. Within habitat complex types, there were no significant differences in utilization of debris bundles or debris catchers in either Reach 2 or Reach 4. Similar trends of complex utilization have been reported in previous Nechako River studies (Triton 1996 a- g).

There were no significant differences in the morphological parameters of length, weight and condition factor for chinook 0+ enumerated in habitat complexes and natural sites within day and night samples. In addition, the structure of the fish communities within complex and natural sites was predominated by cyprinids, catostomidae and chinook 0+.

INTRODUCTION

The Nechako River Working Group (Anon. 1987) recognized that the expected changes in river flows associated with the Kemano Completion Project (KCP) may influence the amount of debris cover habitat available to chinook salmon (*Oncorhynchus tshawytscha*) in the Nechako River. Debris cover provides rearing and overwintering habitat for juvenile chinook salmon. In response to chinook conservation concerns, and as part of the remedial measures outlined by the Nechako River Working Group, pilot artificial habitat complexes were installed from 1989 through 1991 to test complex designs that would increase the complexity of habitat in the Nechako River and could be used to replace and offset any potential habitat losses after the change from the current short term flow regime to the long term flow regime. In 1991 there were 45 habitat complexes installed in Reach 2 and 17 in Reach 4. Over the last 5 years some structures have been lost, damaged, modified or removed resulting in 37 complexes remaining in Reach 2 and 13 complexes remaining in Reach 4 in 1996 (Table 1). In 1996, emergent fry structures were added to the sampling program to determine the potential for enhancing habitat for newly emergent fry in low velocity, shallow water along the river margins.

Since the cancellation of the KCP, assessments are continuing to collect data that will be used in a 10 year review of the program.

Instream habitat complexing techniques have been reviewed by various authors and have been shown to be successful on stream and river systems in Oregon and British Columbia. In particular, debris cover structures appear to provide rearing and overwintering habitat for juvenile chinook (Parkinson and Slaney 1975, Ward and Slaney 1981, Slaney et al. 1994). Buell (1989) suggests that the artificial habitat created should mimic the type of structural material that produces habitat naturally in an area. In the Nechako River, the naturally occurring large woody debris were well utilized (Lister & Associates 1993), and the artificial structures installed were composed primarily of large woody debris (LWD).

Juvenile chinook use of the artificial structures has been assessed annually from 1989 through 1995. Results of these assessments indicate that the habitat complexes on the Nechako River were as well or better utilized than natural sites during all times of the year (Triton 1996 a - g, Ward and Slaney 1993, Slaney

Table 1
Habitat Complex Sites Present in the Nechako River, 1996

		Number Present											
		Reach 2						Reach 4					
Habitat Type	Abbr.	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996
Instream Cover Structures:													
Sweeper	SWPR	9	8	7	7	7	7	12	12	10	10	9	9
Rootwad Sweeper	RS	1	1	1	1	1	1	0	0	0	0	0	0
Rail Debris Catcher	RDC	18	18	17	17	16	16	5	5	5	5	4	4
Pipe-pile Debris Catcher	PDC	1	1	1	1	1	2	0	0	0	0	0	0
Floating Crib	FC	2	2	2	2	2	2	0	0	0	0	0	0
Pseudo Beaver Lodge	PBL	4	4	4	4	2	2	0	0	0	0	0	0
Brush Pile	BP	2	2	2	2	2	1	0	0	0	0	0	0
Instream Channel Modifications:													
Pocket Pool	PP	2	1	1	1	1	1	0	0	0	0	0	0
Point Bar	PB	3	3	3	3	3	3	0	0	0	0	0	0
Side Channel Development:													
Side Channel/Debris Boom	DB	1	1	1	1	1	1	0	0	0	0	0	0
Complexed Side Channel	SC	1	1	1	1	1	1	0	0	0	0	0	0
Totals:		45	42	40	40	37	37	17	17	15	15	13	13

et al. 1994). This report details the results of the assessment in 1996, the eighth year of the project.

METHODS

Study Sites

The project area includes sites within a 25 km section (km 15 - 40) of Reach 2 and a 17 km section (km 72 - 89) of Reach 4 of the Upper Nechako River (Figures 1 and 2). Throughout the study area in reaches 2 and 4, the Nechako River drops 10 to 13 m with an average gradient of 0.06%. Habitat complex sites were established in areas which lacked cover, but had physical characteristics which met the chinook habitat criteria identified by Envirocon (1984): depth greater than 0.4 m, substrate composition predominantly gravel to cobble and velocities from 0.15 to 0.50 $m \cdot s^{-1}$. The natural sites were similarly identified as prime chinook habitat with varying amounts of available cover and physical characteristics within these criteria. All sites are described in Appendix 1.

Habitat complex sites consisted of instream cover structures (debris bundles and debris catchers), instream channel modifications, and side channel development. Debris bundles are complex matrices of whole trees or rafts of logs with branches and smaller debris wedged into them (sweepers, rootwad sweepers, floating cribs, pseudo beaver lodges and brush piles). Debris catchers are triangular arrangements of pipes or rails driven into the substrate which protrude above the high water level and have logs attached to them. Instream channel modifications such as the pocket pool and point bars, as well side channel development with debris booms are present only in Reach 2.

In April 1996, emergent fry structures consisting of 5 evenly spaced, 2 to 3 m tall, spruce, pine or fir trees anchored to the substrate with re-bar were installed at two sites downstream of Bert Irvine's Lodge (RM19.7 and LM20.1). The sites were situated in locations that would be wetted during the Nechako River freshet in May and de-watered after the summer cooling flow period. Each site contained downstream and upstream control plots and a central structure plot. Each plot was 40 m long and 3 m wide and there was no separation between the 3 plots. They were located along shallow gravel bars with water velocities between 0 and 0.2 $m \cdot s^{-1}$, and a maximum depth of 0.2 m.

Nechako River - Physical Parameters

Daily water temperatures and flows of the Nechako River were measured by Water Survey of Canada (WSC) 19 km downstream of Cheslatta Falls (WSC 08JA017). Daily flows were also recorded at Skins Lake Spillway (WSC 08JA013). Both temperature and flows are reported as preliminary data in Appendices 2, 3 and 4.

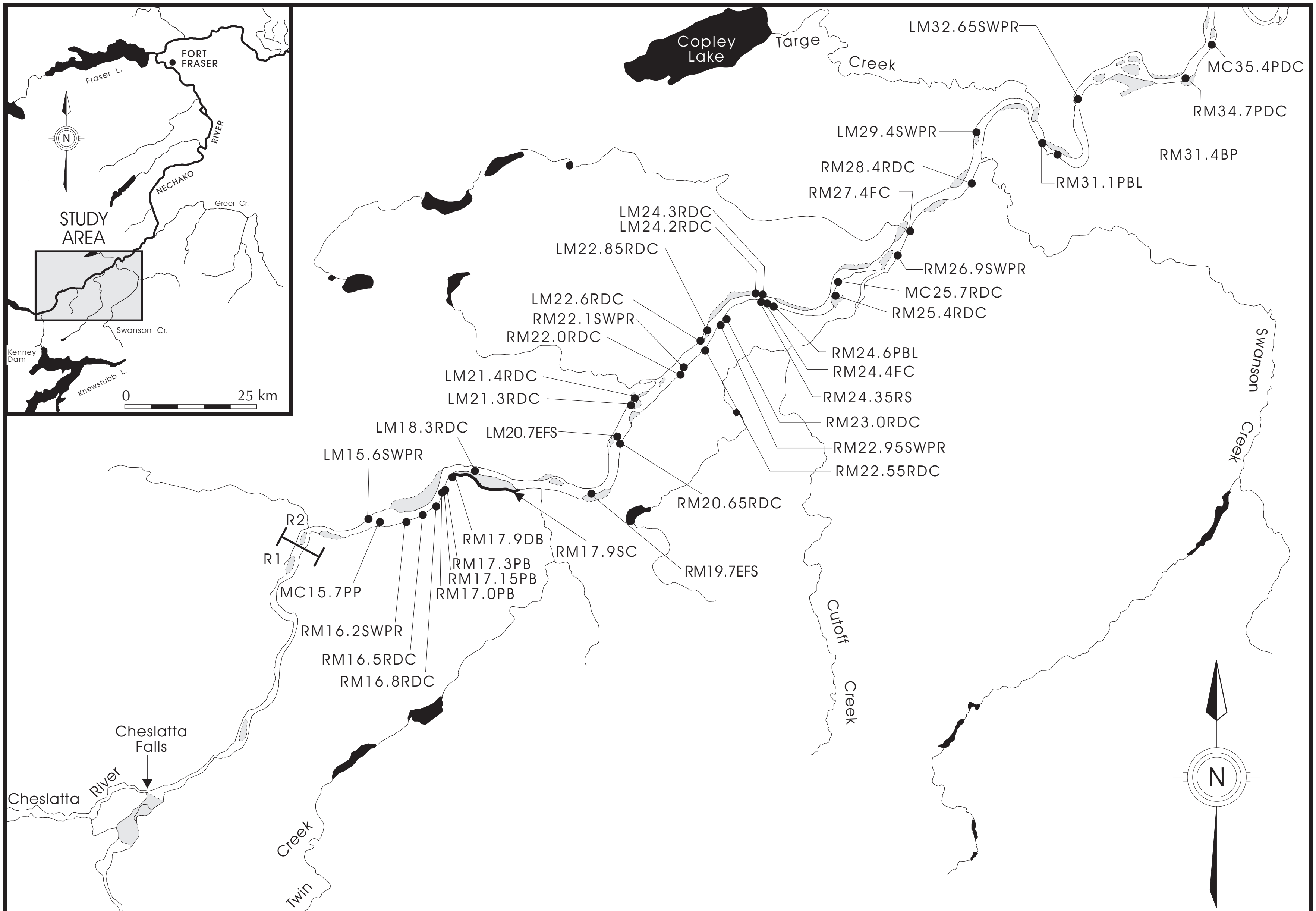
Sampling

The objective of this study was to document juvenile chinook use of the habitat complexes and natural sites. Chinook relative abundance was determined by using two techniques: underwater snorkel surveys and electrofishing. The number of chinook associated with the complexes and natural sites were assessed at three life history stages: overwintered chinook 1+ presmolts; chinook 0+ post-emergent juveniles; and chinook 0+ pre-smolts remaining in the fall to potentially overwinter.

Indices of chinook relative abundance (fry density and catch per unit effort (CPUE)) were calculated to determine the degree to which chinook were associated with the complexes and natural sites. In addition to the measurements of length and weight, Fulton's condition factor (K=weight (g)*100,000*length $(cm)^{-3}$) was calculated (Ricker 1975). As well, the composition of the fish community at complexes and natural sites was described.

Snorkel Surveys

Snorkel surveys were conducted along the entire margins of the study area once during each month for May, June and July. Divers equipped with dry suits and snorkel gear swam the margins of the river and recorded the location and number of fish observed. The range of visibility for detection and identification of fish varied from 0.3 to 3 m. The number of fish observed within each habitat complex and natural site was recorded. The surveys were performed May 26 and 27, June 20, and July 10 in Reach 2, and on May 29, June 22 and July 9 in Reach 4. The side channel was not surveyed by snorkel in May and

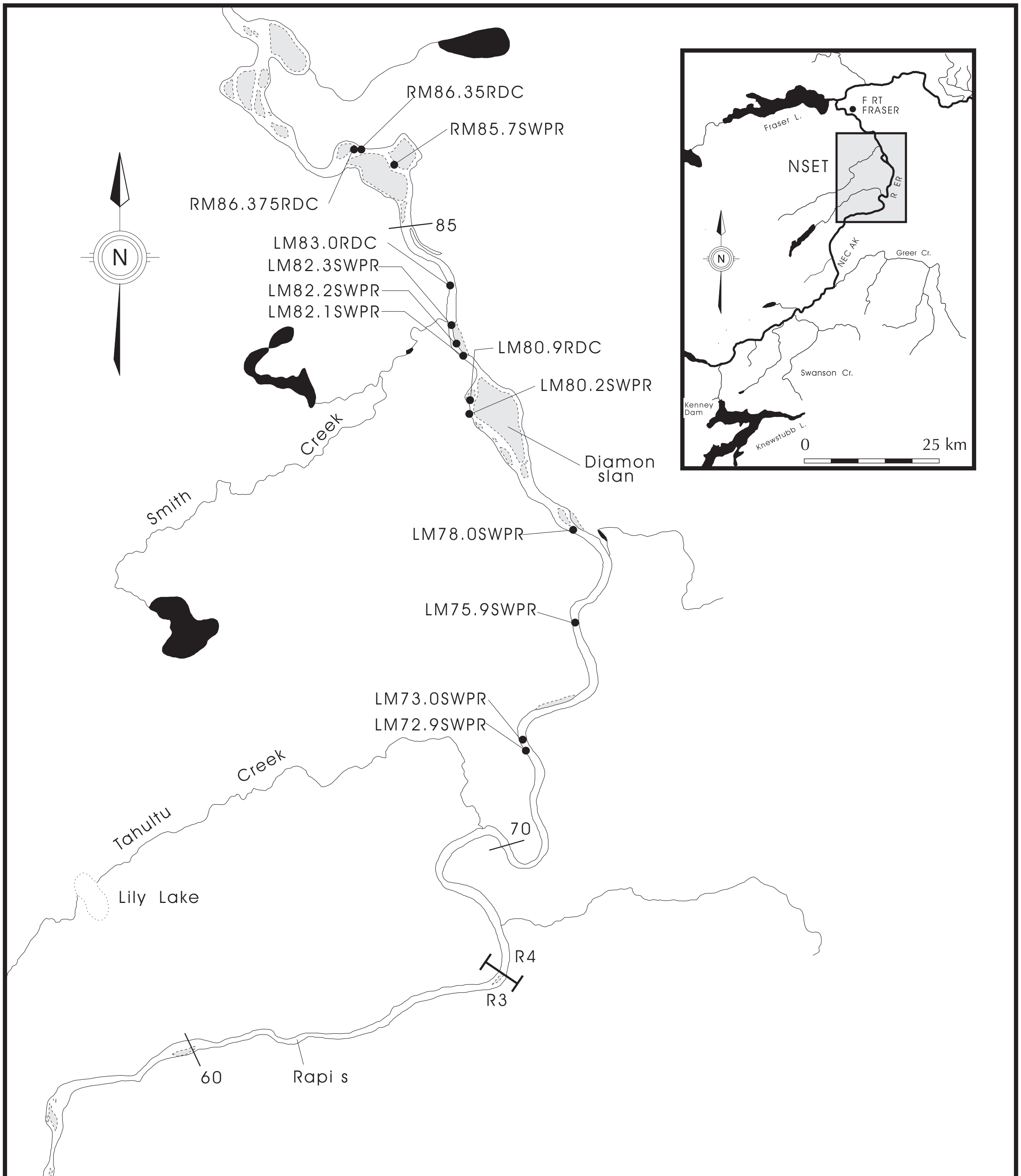


Nechako Fisheries Conservation Program

Map # RM96-3-1

0 5 km

FIGURE 1. HABITAT COMPLEX SITES, REACH 2, NECHAKO RIVER, 1996



Nechako Fisheries Conservation Program

Map # RM96-3-2

0 5 km

FIGURE 2. HABITAT COMPLEX SITES, REACH , NECHAKO RIVER, 1996

June 1996 due to low flows. Fry density (log fry*100 m^{-2}) and the geometric mean number of chinook 0+ observed in habitat complexes were calculated to permit comparison with previous studies.

In July, 1996, high flows led to reduced accessibility, visibility and flooding of some sites. Sites not sampled for these reasons included: LM80.9RDC, LM82.1SWPR, LM82.15CONTROL, LM82.2SWPR, LM82.3SWPR, MC85.6NAT, and RM82.1NAT.

Electrofishing

Single pass electrofishing surveys were conducted in April, May, June, July and November in order to assess the use of complexes by chinook fry during peak rearing periods, appraise overwintering usage and collect samples for length and weight measurements. Sampling was not conducted in August or September because the increased releases of the summer cooling flows restrict access to the complex sites. A Smith-Root Model 15-A electroshocker equipped with a TAS Model QEG 300 gas powered generator was used and voltages typically ranged from 600 to 800 V at 60 Hz. Electrofishing surveys were conducted in Reach 2 on April 15-18, May 17-21, June 11-16, July 3-7 and November 2-4, 1996. Reach 4 was sampled on April 12-14, May 22-23, June 17-19, July 8-9 and November 6, 1996. Each site was sampled once during the day and once during the night in each month. However, during April the side channel was not surveyed, and in July and November several sites were inaccessible to the sampling crew due to very high flows and flooding (Table 2, Appendix 5). Flooding also meant that several of the complex sites were incompletely surveyed (i.e., surveyors could not get to the complexes, but could shock along the shoreline), and these were removed from the CPUE analysis.

Up to 10 fish of each salmonid species were measured to the nearest mm (fork length) and weighed to the nearest 0.01 g (whole wet weight) at each site. The area and the time electrofished were recorded for each site. As well, incidental catches of other species were recorded to provide comparisons of the fish community structure within various site types.

The emergent fry structure sites were sampled before the installation of the structures (April 21) and again approximately every 2 weeks thereafter (to June 16). From May 16 forward the sites were electrofished during both the day and at night. Fish were collected in a 5 gallon bucket for each of the control sites, while fish collected from the structure sites were separated into individual trees. Fish captured between the trees were also counted. All fish were returned to their point of capture once counted and measured.

Statistical Analyses

Due to the their limited number and / or lack of LWD cover features, the pocket pool (n = 1), point bars (n = 3), and side channel (n = 1) with debris boom (n = 1) were not included in the following statistical analyses of CPUE. These structures are treated in a qualitative manner, however the fish sampled within them are included in the length, weight and condition analyses.

Catch per unit effort (CPUE) was calculated for each of the sites sampled and expressed as the catch per square meter (No.fry • m^{-2}) and catch per second (No. fry • $second^{-1}$). Both were multiplied by 10,000 to avoid fractional CPUE. Since the correlation between the CPUE calculated by area and the CPUE calculated by seconds was high (Pearsons correlation coefficient 0.998), further analyses were performed on catch per square meter. The data were log_{10}-transformed to improve homogeneity of variance. The effects of habitat complexes and time of day on the CPUE data and on the length, weight and condition factor of chinook were assessed within each month using one-way analysis of variance. A posteriori tests (Least Squares Difference) were performed to determine the direction of any

Table 2
Number of Sites Electrofished During the Day and Night in Reaches 2 and 4 of the Nechako River, 1996
(natural and complex sites)

	Day					Night				
Reach	April	May	June	July	Nov	April	May	June	July	Nov
2	66	67	67	57	46	66	67	67	54	25
4	33	33	33	24	21	33	33	33	22	15

differences detected. Comparisons with probability values of $P < 0.05$ were considered significant. The effects of type of complex (debris bundles or debris catchers) on fry density and on CPUE were also examined by t-test and one-way analysis of variance.

The relationship between abundance of chinook 0+ and the physical parameters of the complex sites was examined through a stepwise multiple regression. The parameters analyzed for each site included cover area, velocity (shear, approach, through and exit), depth (shear, approach, through and exit), substrate, and the extension from the margin. All physical parameters were measured on May 24 and 25, 1996. The dependent variable (number of chinook) was $\log_{10}$-transformed to improve homogeneity of variance.

For the emergent fry structures, fry density ($fry \cdot m^{-2}$) and CPUE ($fry \cdot second^{-1}$) were calculated for the control plots and the structure plots. Paired t-tests were used to compare the fry density and CPUE of control plots with those in the structure plots for each site. Upstream and downstream controls for each site were averaged for this test. Fry lengths and weights in control and fry structure plots were also compared with t-tests within day and night sampling periods. In addition, the number of chinook fry per structure was compared for the different tree species used as structures for each sampling date.

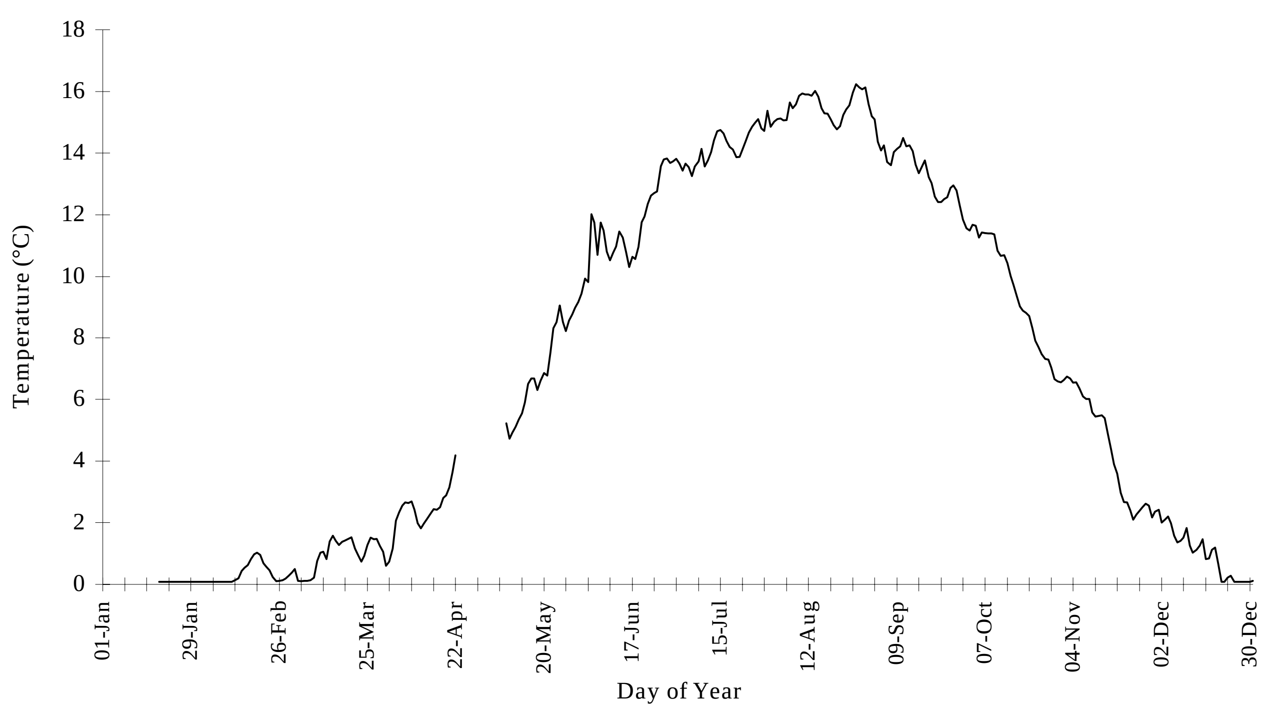
RESULTS

Nechako River - Physical Data

Temperatures of the Nechako River were unavailable from the Water Survey Canada (WSC) station below Cheslatta Falls (WSC #08JA017) from January 1 to January 18, and from April 23 through May 7, 1996. Mean daily water temperatures ranged from 0.3 °C in January to 15.5 °C in August (Figure 3, Appendix 2).

The releases from Skins Lake Spillway and the flows measured below Cheslatta Falls are shown in Figure 4. There were two forced spills in 1996 due to

Figure 3
Mean Daily Water Temperatures of the Nechako River Below Cheslatta Falls, 1996 (WSC 08JA017)
(missing data unavailable)



high reservoir levels. The first began on June 29 and releases were increased to 255 $m^3 \cdot s^{-1}$, resulting in flows below Cheslatta Falls of 270 $m^3 \cdot s^{-1}$ (Appendices 3 and 4). The Summer Temperature Monitoring Program began at the end of July, when flows were maintained at approximately 170 $m^3 \cdot s^{-1}$ until August 20. A second forced spill occurred in October, when releases were stepped up to approximately 225 $m^3 \cdot s^{-1}$ until the middle of November. Flows at Cheslatta Falls peaked at 236 $m^3 \cdot s^{-1}$ on November 9 (Appendices 3 and 4). Releases from Skins Lake Spillway were then decreased to approximately 60 $m^3 \cdot s^{-1}$ for the winter base flows.

Chinook (1+)

Snorkel Surveys

No chinook 1+ were observed in any of the sites during any of the snorkel surveys conducted in 1996. This is similar to results of previous years when very few chinook 1+ have been observed during snorkel surveys of the Nechako River (Triton 1996 a - g).

Electrofishing

In 1996, a total of 238 chinook 1+ were sampled by electrofishing in reaches 2 and 4 of the Nechako River. The 1996 peak count occurred in April when 205 chinook 1+ were counted in both reaches (Table 3). Most of these chinook 1+ were observed during the night (88 % in Reach 2), and most were found in complex sites in Reach 2 (85 %) and in natural sites in Reach 4 (66 %). By the month of June, most of the chinook 1+ had moved out of reaches 2 and 4, and only 2 were recorded, both from complex sites in Reach 2.

Complex Utilization

The variation in monthly chinook CPUE for all sites in Reach 2 is shown in Figure 5. Chinook 1+ use of complex sites at night was consistently greater than for any other site or any other time. The mean (± 1 SD) $\log_{10}$(CPUE +1) ranged from 0.14 ± 0.53 to 1.61 ± 1.33 in April and from 0 to 0.54 ± 0.94 in May (Appendix 6).

A similar pattern was observed in Reach 4, where the complexes and natural sites sampled at night had greater CPUE for chinook 1+ than those sampled during the day (Figure 6). The mean (± 1 SD) $\log_{10}$(CPUE

Figure 4
Mean Daily Flows at Skin's Lake Spillway (WSC 08JA013) and Below Cheslatta Falls (WSC 08JA017), Nechako River, 1996

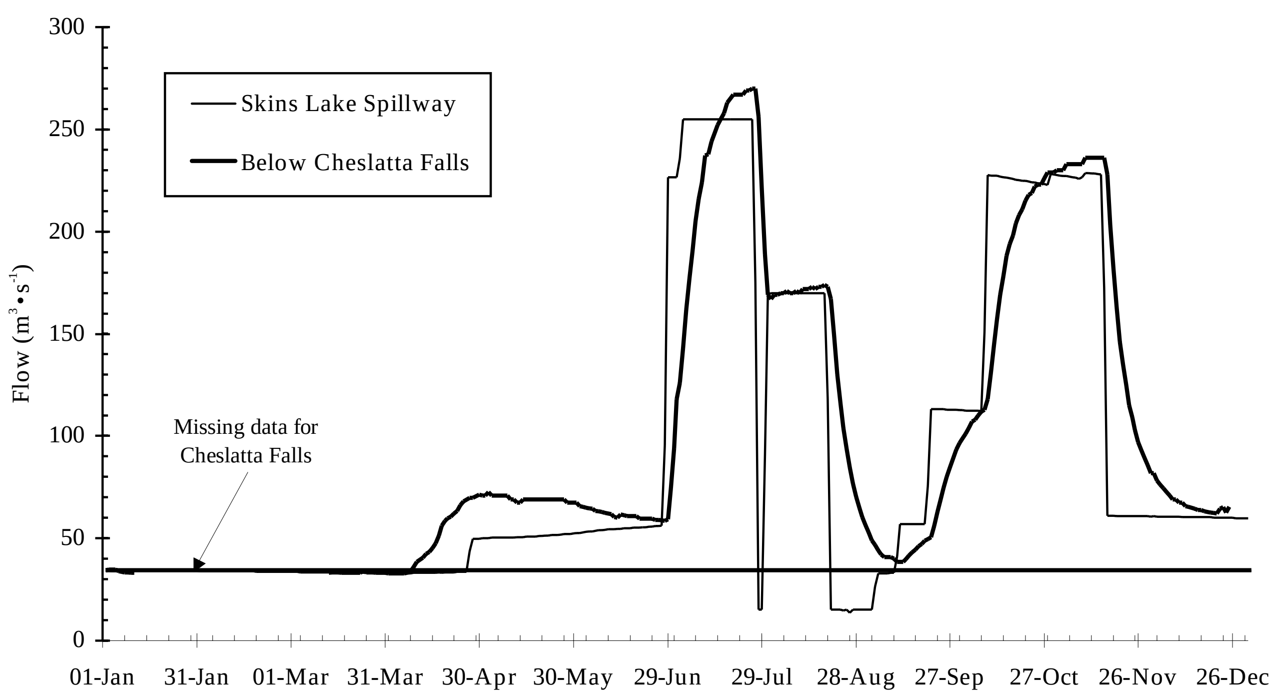


Table 3
Number of Chinook Sampled by Electrofishing in Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996(1)

		Reach 2							Reach 4				
		Complex		Natural		Other (2)		Total	Complex		Natural		Total
	Date	Day	Night	Day	Night	Day	Night	Reach 2	Day	Night	Day	Night	Reach 4
Chinook 1+	April	10	132	3	16	0	6	167	1	11	0	26	38
	May	7	13	1	0	2	2	25	1	2	0	3	6
	June	0	2	0	0	0	0	2	0	0	0	0	0
	July	0	0	0	0	0	0	0	0	0	0	0	0
	Nov.	0	0	0	0	0	0	0	0	0	0	0	0
Chinook 0+	April	166	208	117	190	8	18	707	24	27	80	51	182
	May	367	1811	259	962	161	569	4129	68	214	105	404	791
	June	443	1576	174	616	137	184	3130	14	264	19	365	662
	July	33	440	4	131	22	81	711	0	5	1	34	40
	Nov.	2	2	0	11	0	2	17	0	3	0	3	6

Note: (1) Does not include sites in July and November which were incompletely sampled.
(2) Other includes the side channel with debris boom, the pocket pools and the point bars.

Figure 5
Monthly Mean Log_{10}(CPUE+1) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 2 of the Nechako River 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

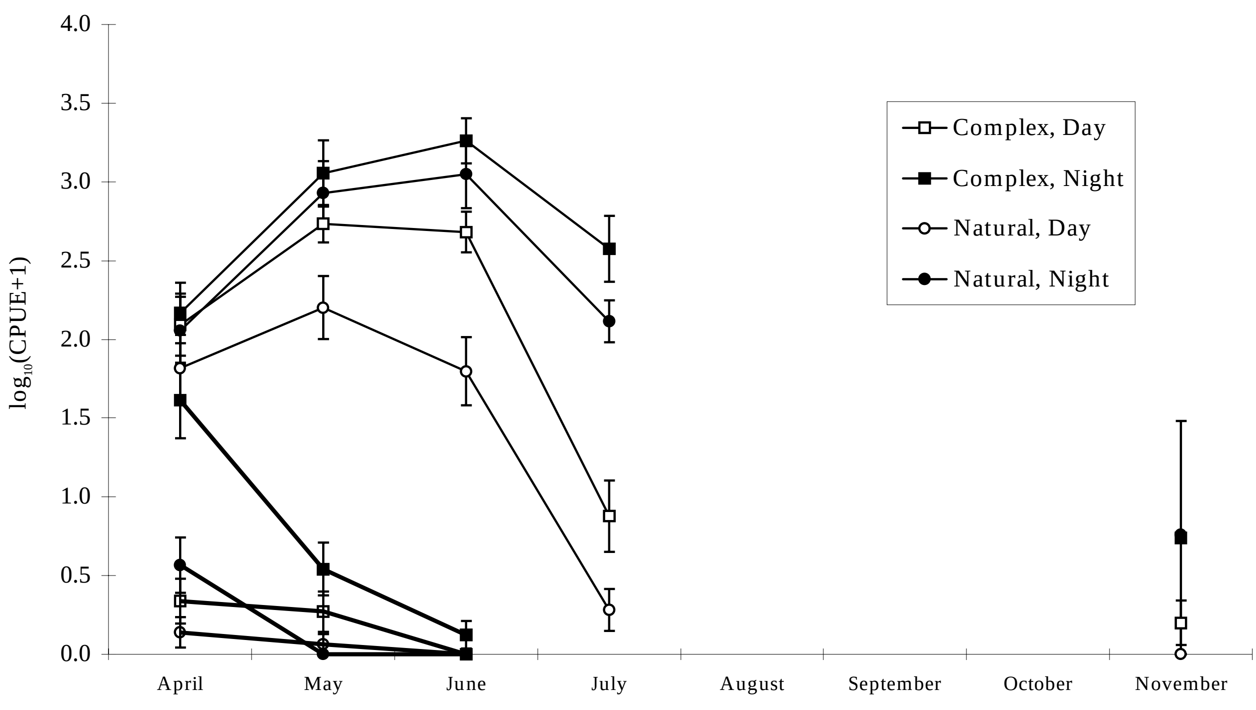
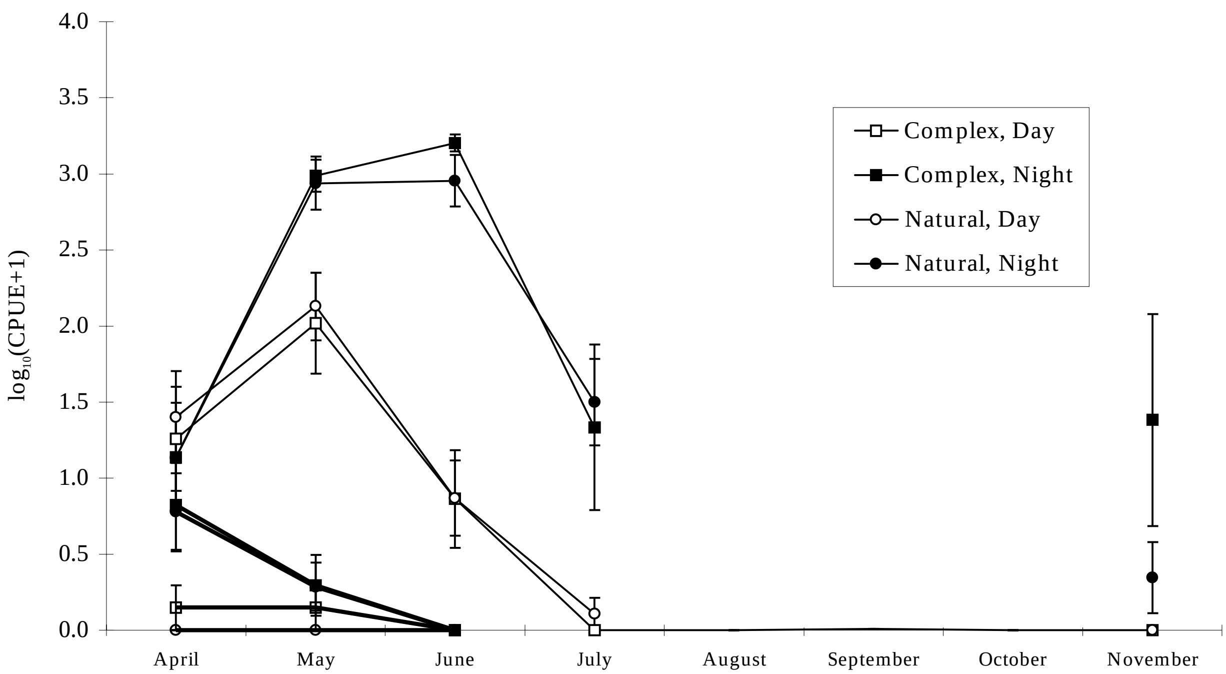


Figure 6
Monthly Mean Log_{10}(CPUE +1) of Chinook 0+ (light lines and Chinook 1+ (heavy lines) in Reach 4 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.



+1) ranged from 0 to 0.82 ± 1.10 in April, and from 0 to 0.30 ± 0.72 in May (Appendix 6).

In addition, there were no significant differences in the log CPUE of chinook 1+ between bundles and catcher complexes at any time (Appendix 7).

Length, Weight and Condition Factor

Reach 2

Within the day or night sampling periods, there were no significant differences in fork length, weight or condition factor of chinook 1+ from complex and natural sites (Figures 7, 8 and 9). The mean (± 1 SD) lengths for April ranged from 93.6 ± 10.0 to 99.0 ± 7.7 mm, and in May from 97.0 to 105.2 ± 9.5 mm (Appendix 8). The mean (± 1 SD) weights ranged from 11.09 ± 3.42 to 11.48 ± 2.71 g in April, and from 11.63 to 14.65 ± 4.15 g in May (Appendix 9). The range of mean (± 1 SD) condition factors for these months were from 1.17 ± 0.11 to 1.39 ± 0.43 $g \cdot mm^{-3}$ in April, and from 1.23 ± 0.13 to 1.28 ± 0.19 $g \cdot mm^{-3}$ in May (Appendix 10).

Reach 4

Only 44 chinook 1+ were enumerated in Reach 4 in April and May. There were no significant differences in fork length, weight and condition factor of chinook 1+ from complex and natural sites within a sampling period (Figures 10, 11 and 12). Mean (± 1 SD) lengths ranged from 76.0 mm in April to 114.0 ± 4.0 mm in May (Appendix 8), mean (± 1 SD) weights ranged from 6.47 g in April to 17.55 ± 0.04 g in May (Appendix 9), and mean (± 1 SD) condition factors ranged from 1.11 ± 0.16 $g \cdot mm^{-3}$ in April to 1.59 ± 0.39 $g \cdot mm^{-3}$ in May (Appendix 10).

Chinook 0+

Snorkel Surveys

Complex Utilization

The number of chinook 0+ observed by snorkel survey in reaches 2 and 4 in May, June and July, including the percent associated with complex sites, natural sites, and the river margin outside designated sites, is shown in Table 4.

Figure 7
Monthly Mean Fork Length (mm) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 2 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

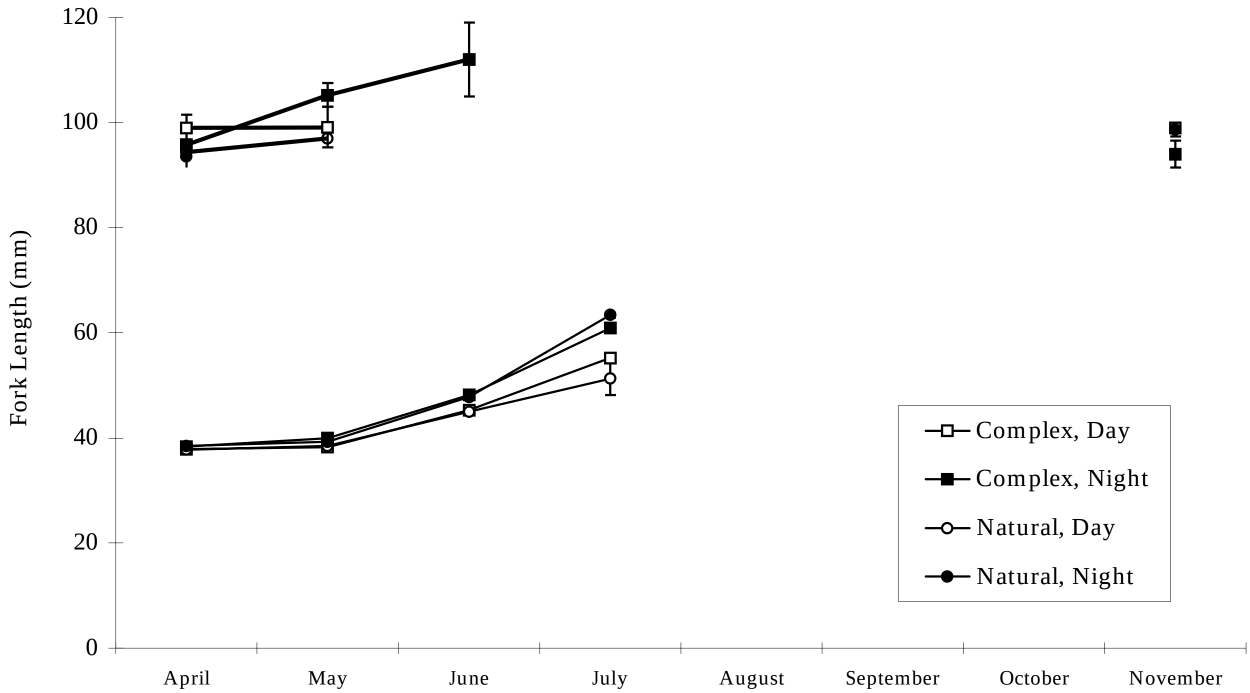


Figure 8
Monthly Mean Wet Weights (g) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 2 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

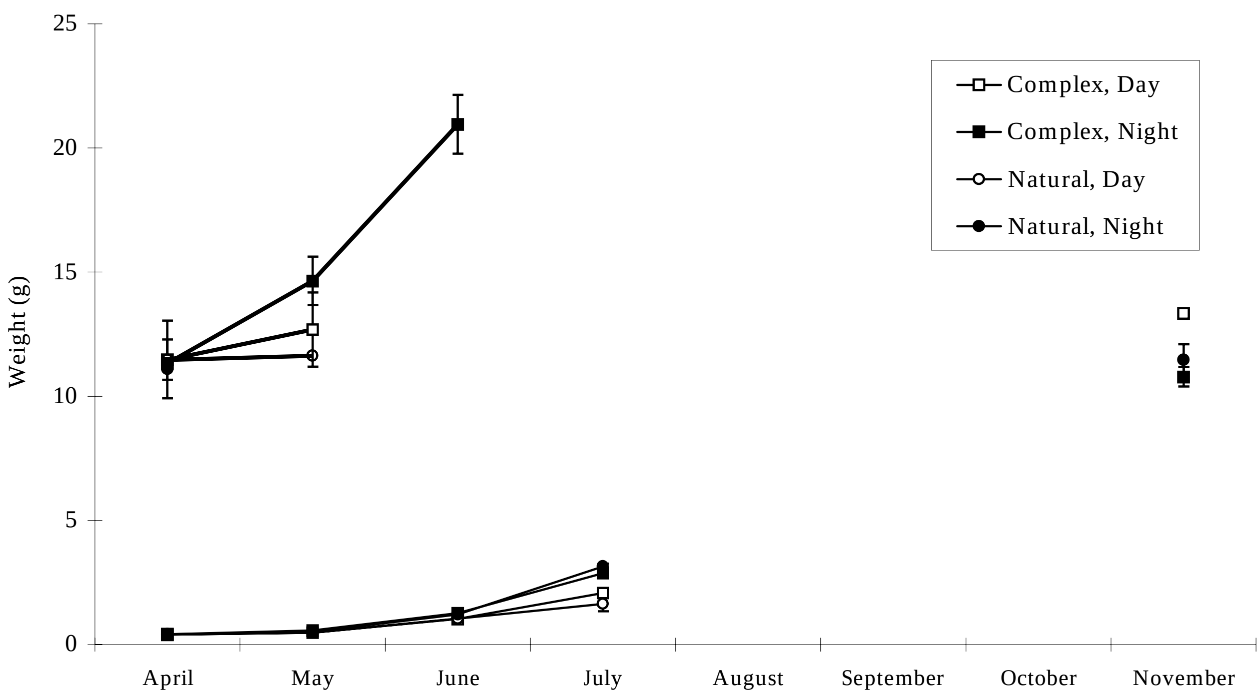


Figure 9

Monthly Mean Condition Factor ($g \cdot mm^{-3}$) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 2 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

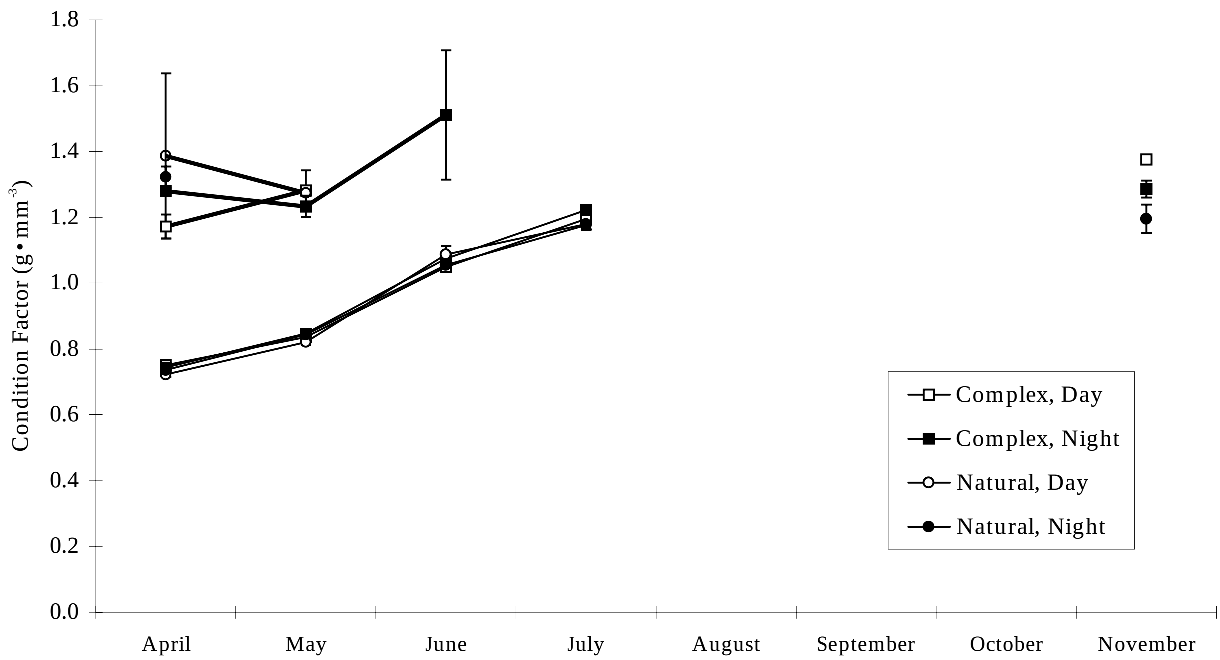


Figure 10

Monthly Mean Fork Length (mm) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 4 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

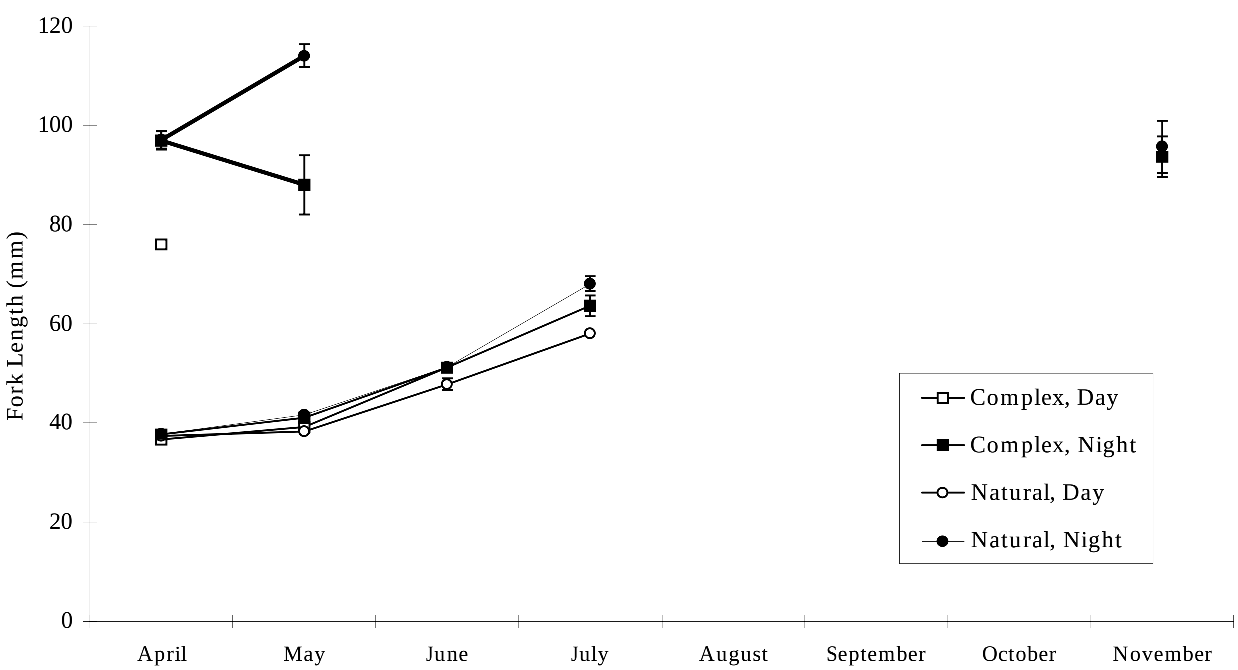


Figure 11
Monthly Mean Wet Weights (g) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 4 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

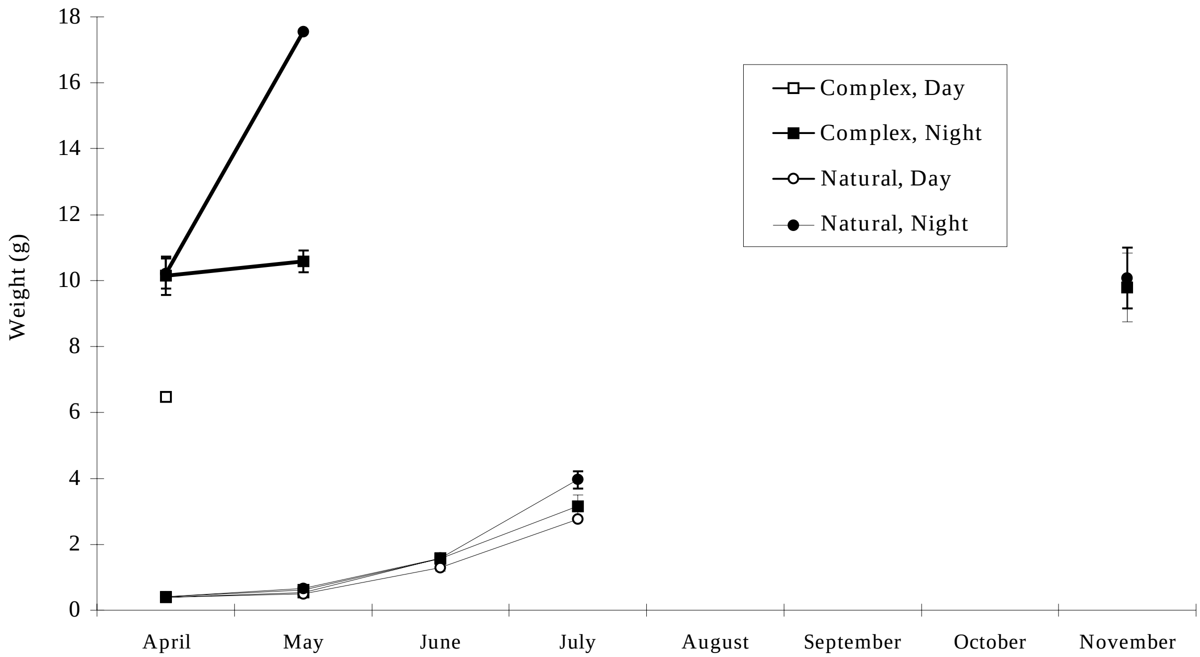


Figure 12
Monthly Mean Condition Factor ($g \cdot mm^{-3}$) of Chinook 0+ (light lines) and Chinook 1+ (heavy lines) in Reach 4 of the Nechako River, 1996. Comparisons between natural and complex sites for catches at night and during the day. Error bars are ± standard error.

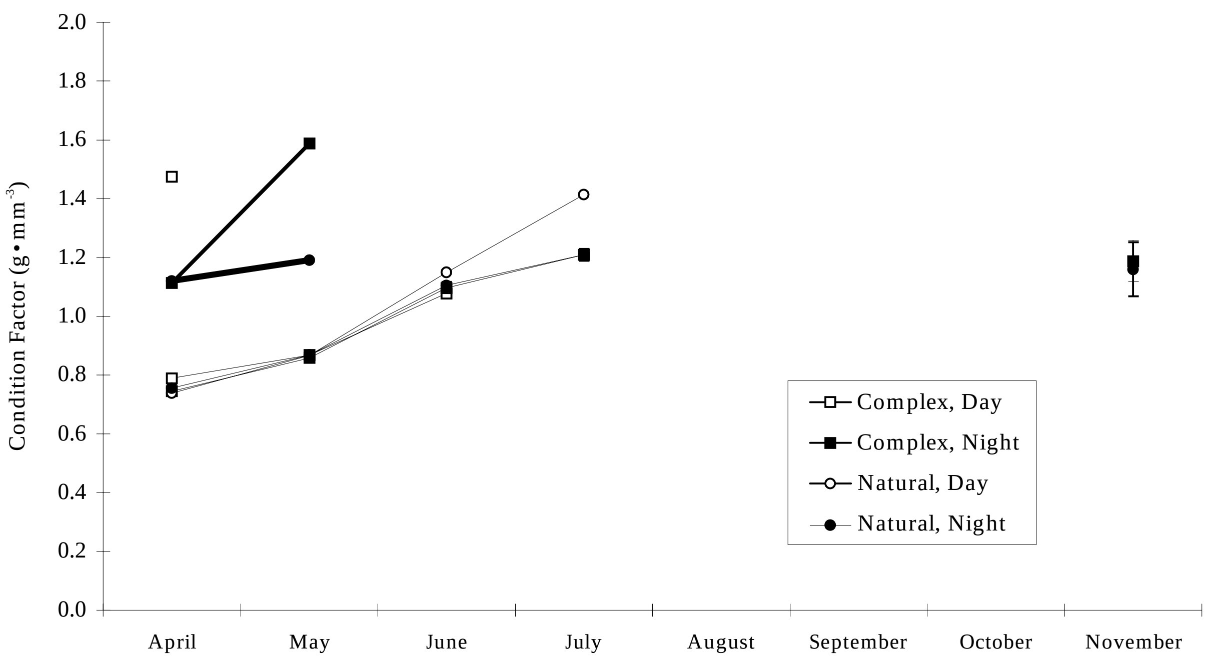


Table 4
The Number of Chinook 0+ Observed During Snorkel Surveys in Reaches 2 and 4, and the Percent Recorded Within Habitat Complex Sites, Natural Sites and River Margins Outside all Designated Sites of the Nechako River, 1996

	Month	Site Types	Sites Sampled Number	Visibility	Chinook 0+ Number	Chinook 0+ Percent	Area surveyed (km²) km²	Area surveyed (km²) Percent
Reach 2	May	Complex	31	2 - 3 m	980	15.1	0.0035	2.7
		Natural	30		27	0.4	0.0034	2.6
		DB, PP, PB	5		110	1.7	0.0006	0.5
		Margins			5377	82.8	0.1206	94.2
		TOTAL	66		6494	100.0	0.1280	100.0
	June	Complex	31	3 m	5508	45.9	0.0038	2.5
		Natural	30		57	0.5	0.0039	2.6
		DB, PP, PB	5		7	0.1	0.0006	0.4
		Margins			6418	53.5	0.1418	94.5
		TOTAL	66		11990	100.0	0.1500	100.0
	July	Complex	31	0.5 m	1249	95.4	0.0006	2.5
		Natural	29		1	0.1	0.0006	2.5
		DB, PB, SC	5		4	0.3	0.0005	1.9
		Margins			55	4.2	0.0233	93.1
		TOTAL	65		1309	100.0	0.0250	100.0
Reach 4	May	Complex	13	1 - 2 m	604	15.3	0.0010	1.6
		Natural	20		184	4.7	0.0017	2.6
		Margins			3161	80.0	0.0613	95.8
		TOTAL	33		3949	100.0	0.0640	100.0
	June	Complex	13	3 m	275	17.5	0.0015	1.6
		Natural	20		174	11.1	0.0025	2.6
		Margins			1118	71.3	0.0920	95.8
		TOTAL	33		1567	100.0	0.0960	100.0
	July	Complex	9	0.5 m	5	29.4	0.0001	1.1
		Natural	18		4	23.5	0.0003	2.5
		Margins			8	47.1	0.0127	96.4
		TOTAL	27		17	100.0	0.0132	100.0

Note: DB Debris Boom; PB Point Bar; SC Side Channel; PP Pocket Pool

Reach 2

In Reach 2, the total number of chinook 0+ observed during the snorkel surveys was 20,248 in 1996 (Table 4). Most of these were observed in June (11,990). Complexes contributed to an average of only 2.6 % of the area surveyed, yet yielded 15 % (May) and 46 % (June) of the total chinook 0+ observed in the river (Table 4). Visibility was particularly poor in July (0.5 m), and most of the chinook 0+ observed in this month were found in the complex sites (95 %). Natural sites made up 2.6 % of the total area surveyed, and accounted for less than 1 % of all the chinook 0+ observed.

Habitat complexes were well used by chinook 0+ in Reach 2; fry were observed in 90 % of the complex sites in the peak month of June. The number of chinook 0+ observed at the complex sites and the resultant density (log(fry*100m^{-2})) for the complex sites are provided in Table 5. Mean fry densities in the complexes peaked in June, with a geometric mean of 131 fry*100m^{-2} . Within complex types, there were no significant differences in log fry densities or utilization rates between debris bundles and debris catchers in any month (t-test, $P < 0.05$).

Reach 4

The total number of chinook 0+ observed in snorkel surveys of Reach 4 was 5,533 (Table 4), with most of these observed in May (3,949). Although the habitat complexes represented only 1.1 % to 1.6 % of the area surveyed, they contributed 15 % to 30 % of the chinook 0+ observed in Reach 4. By comparison, the natural sites represented 2.6 % of the area surveyed, and 5 % to 24 % of the chinook 0+ were observed within them. The majority of the chinook 0+ observed in Reach 4 in May (80 %), June (71 %) and July (47 %) were observed outside the designated complex and natural sites, which represented 96 % of the total area surveyed (Table 4).

The habitat complexes in Reach 4 were also best utilized in June, when chinook 0+ were observed in 77 % of the sites (Table 6). Log fry density was greatest in May, with a mean (± 1 SD) of 2.04 ± 1.48 and a geometric mean of 110 fry*100m^{-2}. In addition, there were no significant differences between log fry density at debris bundle and debris catcher habitat complexes in any month (t-test, $P < 0.05$).

Fish Abundance as a Function of Physical Parameters

In 1996, the density of chinook 0+ was negatively correlated with average exit depth and positively correlated average approach depth (Table 7), accounting for 11 % and 10 % of the variability in chinook 0+ abundance respectively.

Electrofishing

Complex Utilization

A total of 10,375 chinook 0+ were sampled by electrofishing in reaches 2 and 4 of the Nechako River in 1996. The greatest number of chinook 0+ were sampled in May (4,920) and the fewest in November (23) (Table 3).

Reach 2

In Reach 2, the mean monthly CPUE for chinook 0+ sampled at night tended to be greater than those of chinook 0+ sampled during the day from May through November (Figure 5). In April the mean (± 1 SD) $\log^{10}$(CPUE +1) ranged from 1.82 ± 1.17 to 2.17 ± 1.07 (Appendix 11). In May and June the mean (± 1 SD) $\log_{10}$(CPUE+1) ranged from 2.20 ± 1.10 to 3.05 ± 1.18 in May and from 1.80 ± 1.19 to 3.26 ± 0.80 in June (Appendix 11). In July, the mean (± 1 SD) $\log_{10}$(CPUE +1) for this month ranged from 0.28 ± 0.67 to 2.57 ± 1.07. In November, the number of surveys conducted ranged from 3 complexes at night to 22 natural sites during the day, and the mean (± 1 SD) $\log_{10}$(CPUE +1) ranged from 0 to 0.76 ± 1.03 (Appendix 11).

In addition, there were no significant differences in the mean log CPUE of debris bundles and debris catchers within the day or night sampling periods at any time of the year (Appendix 12).

The trends in CPUE for the emergent fry structures are generally similar to the trends in CPUE observed at the other sites in the Nechako River. Seasonally, fry numbers in the structures increased from April through May, and then decreased in June (Table 8). Significantly more fry were found in structure plots than control plots (t-test, $P<0.05$) during both day and night, and within plots more fry were found at night than during the day. Within the emergent fry structure plots, the percent of the total number of chinook fry found within the trees themselves (as opposed to between trees) ranged from 75 to 100 % during the day and from 33 to 65% at night. In addition, there were no detectable differences between the utlization of spruce and pine trees used as emergent fry structures.

Reach 4

In Reach 4, there were no significant differences between the mean log CPUE for chinook 0+ sampled in complex and natural sites within either the day or night time periods, April through July (Figure 6). In April, the mean (± 1 SD) $\log_{10}$(CPUE +1) ranged from 1.13 ± 1.31 to 1.40 ± 1.35, and there were no significant differences between any groups. In May through July, there were significant differences between sites sampled during the day and sites sam-

Table 5
Cover Area of Habitat Complexes and Density of Chinook 0+ Observed in Nechako River Habitat Complex Sites in Reach 2, 1996

Site 1996	Complex	Cover Area (m^2)	May # $CH0^+$	May Density fry / m^2	May Density $\log_{10}(fry \cdot 100m^{-2})$	June # $CH0^+$	June Density fry / m^2	June Density $\log_{10}(fry \cdot 100m^{-2})$	July # $CH0^+$	July Density fry / m^2	July Density $\log_{10}(fry \cdot 100m^{-2})$
Reach 2											
LM15.6SWPR	Sweeper	27.0	0	0.00	0.00	500	18.52	3.27	3	0.11	1.08
RM16.2SWPR	Sweeper	5.0	0	0.00	0.00	45	9.00	2.95	14	2.80	2.45
RM16.5RDC	Rail debris catcher	5.0	0	0.00	0.00	2	0.40	1.61	0	0.00	0.00
RM16.8RDC	Rail debris catcher	9.0	0	0.00	0.00	120	13.33	3.13	1	0.11	1.08
LM18.3RDC	Rail debris catcher	77.0	120	1.56	2.20	1000	12.99	3.11	20	0.26	1.43
RM20.65RDC	Rail debris catcher	135.0	0	0.00	0.00	250	1.85	2.27	40	0.30	1.49
LM21.3RDC	Rail debris catcher	76.5	150	1.96	2.29	250	3.27	2.52	0	0.00	0.00
LM21.4RDC	Rail debris catcher	51.0	0	0.00	0.00	25	0.49	1.70	65	1.27	2.11
RM22.0RDC	Rail debris catcher	93.5	55	0.59	1.78	200	2.14	2.33	250	2.67	2.43
RM22.1SWPR	Sweeper	27.5	8	0.29	1.48	4	0.15	1.19	0	0.00	0.00
RM22.55RDC	Rail debris catcher	50.0	55	1.10	2.05	550	11.00	3.04	100	2.00	2.30
LM22.6RDC	Rail debris catcher	99.0	10	0.10	1.05	400	4.04	2.61	70	0.71	1.86
LM22.85RDC	Rail debris catcher	40.5	0	0.00	0.00	350	8.64	2.94	80	1.98	2.30
RM22.95SWPR	Sweeper	2.5	100	40.00	3.60	16	6.40	2.81	0	0.00	0.00
RM23.0RDC	Rail debris catcher	32.0	1	0.03	0.62	250	7.81	2.89	0	0.00	0.00
LM24.2RDC	Rail debris catcher	180.0	15	0.08	0.97	900	5.00	2.70	235	1.31	2.12
RM24.35RS	Rootwad sweeper	72.0	1	0.01	0.38	7	0.10	1.03	0	0.00	0.00
LM24.3RDC	Rail debris catcher	15.0	0	0.00	0.00	35	2.33	2.37	0	0.00	0.00
RM24.4FC	Floating crib	77.5	0	0.00	0.00	13	0.17	1.25	50	0.65	1.82
RM24.6PBL	Pseudo beaver lodge	37.5	300	8.00	2.90	35	0.93	1.97	250	6.67	2.82
RM25.4RDC	Rail debris catcher	9.0	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
MC25.7RDC	Rail debris catcher	11.3	0	0.00	0.00	160	14.16	3.15	0	0.00	0.00
RM26.9SWPR	Sweeper	1.0	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
RM27.4FC	Floating crib	39.0	20	0.51	1.72	35	0.90	1.96	0	0.00	0.00
RM28.4RDC	Rail debris catcher	102.0	65	0.64	1.81	160	1.57	2.20	70	0.69	1.84
LM29.4SWPR	Sweeper	7.5	0	0.00	0.00	32	4.27	2.63	0	0.00	0.00
RM31.1PBL	Pseudo beaver lodge	15.0	80	5.33	2.73	5	0.33	1.54	0	0.00	0.00
RM31.4BP	Brush pile	2.0	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00

Table 5 (continued)
Cover Area of Habitat Complexes and Density of Chinook 0+ Observed in Nechako River Habitat Complex Sites in Reach 2, 1996

Site 1996	Complex	Cover Area (m^2)	May # $CH0^+$	May Density fry / m²	May Density $log_{10}(fry \cdot 100m^{-2})$	June # $CH0^+$	June Density fry / m²	June Density $log_{10}(fry \cdot 100m^{-2})$	July # $CH0^+$	July Density fry / m²	July Density $log_{10}(fry \cdot 100m^{-2})$
LM32.65SWPR	Sweeper	6.0	0	0.00	0.00	27	4.50	2.65	1	0.17	1.25
RM34.7PDC	Pipe debris catcher	19.5	0	0.00	0.00	120	6.15	2.79	0	0.00	0.00
MC35.4PDC	Pipe debris catcher	180.0	0	0.00	0.00	17	0.09	1.02	0	0.00	0.00
		Mean Cover Area									
Complexes	Mean ± 1 SD $log_{10}(fry \cdot 100m^{-2})$	48.5			0.82 ± 1.1			2.12 ± 0.96			0.92 ± 1.03
	Geometric mean (fry / $100m^2$)				7			131			8
Bundles	Mean ± 1 SD $log_{10}(fry \cdot 100m^{-2})$	26.5			0.99 ± 0.99			1.79 ± 1.79			0.72 ± 0.72
Catchers	Mean ± 1 SD $log_{10}(fry \cdot 100m^{-2})$	65.9			0.71 ± 0.91			2.35 ± 0.83			1.05 ± 1.02

Table 6
Cover Area of Habitat Complexes and Density of Chinook 0+ Observed in Nechako River Habitat Complex Sites in Reach 4, 1996

Site 1996	Complex	Cover Area (m^2)	May # $CH0^+$	May Density fry / m²	May Density $\log_{10}(fry \cdot 100m^{-2})$	June # $CH0^+$	June Density fry / m²	June Density $\log_{10}(fry \cdot 100m^{-2})$	July # $CH0^+$	July Density fry / m²	July Density $\log_{10}(fry \cdot 100m^{-2})$
Reach 4											
LM72.9SWPR	Sweeper	10.0	150	15.00	3.18	20	2.00	2.30	3	0.30	1.49
LM73.0SWPR	Sweeper	2.0	130	65.00	3.81	20	10.00	3.00	0	0.00	0.00
LM75.9SWPR	Sweeper	10.0	205	20.50	3.31	125	12.50	3.10	1	0.10	1.04
LM78.0SWPR	Sweeper	3.8	0	0.00	0.00	2	0.53	1.74	0	0.00	0.00
LM80.2SWPR	Sweeper	2.0	4	2.00	2.30	0	0.00	0.00	0	0.00	0.00
LM80.9RDC	Rail debris catcher	5.0	0	0.00	0.00	0	0.00	0.00	na		na
LM82.1SWPR	Sweeper	7.5	30	4.00	2.60	35	4.67	2.67	na		na
LM82.2SWPR	Sweeper	2.0	15	7.50	2.88	4	2.00	2.30	na		na
LM82.3SWPR	Sweeper	4.0	0	0.00	0.00	4	1.00	2.00	na		na
LM83.0RDC	Rail debris catcher	4.5	35	7.78	2.89	2	0.44	1.66	0	0.00	0.00
RM85.7SWPR	Sweeper	1.0	20	20.00	3.30	0	0.00	0.00	0	0.00	0.00
RM86.35RDC	Rail debris catcher	8.1	15	1.85	2.27	13	1.60	2.21	1	0.12	1.13
RM86.375RDC	Rail debris catcher	9.5	0	0.00	0.00	50	5.26	2.72	0	0.00	0.00
		Mean Cover Area									
Complexes	Mean ± 1 SD $\log_{10}(fry \cdot 100m^{-2})$	6.0			2.04 ± 1.48			1.82 ± 1.12			0.41 ± 0.62
	Geometric mean ($fry / 100m^2$)				110			67			3
Bundles	Mean ± 1 SD $\log_{10}(fry \cdot 100m^{-2})$	5.6			1.48 ± 1.42			1.9 ± 1.16			1.47 ± 0.67
Catchers	Mean ± 1 SD $\log_{10}(fry \cdot 100m^{-2})$	6.8			1.29 ± 1.51			1.65 ± 1.18			0.38 ± 0.65

Table 7
Stepwise Regressions on Chinook 0+ Abundance at the Habitat Complex Sites in the Nechako River, May 24 - 26, 1996

Dependent Variable	Variable Entered (P<0.05)	Variation Accounted For By Variable (Adjusted R^2)	Total Variation	F-ratio (df)
Log_{10}(Number of chinook 0^+ +1)	Average exit depth (m)	0.11	0.11	4.58(1,28)
	Average approach depth (m)	0.1	0.21	4.84(2,27)

Final Regression Equation:

Log_{10}(Number of chinook 0^+ + 1) = 1.16 + 1.16(Average approach depth) - 1.79(Average exit depth)

Table 8
Summary of Electrofishing Density and CPUE of Chinook Fry at Emergent Fry Structures and Control Sites, Reach 2 Nechako River, 1996

			Site 1 (RM19.7)			Site 2 (LM20.1)		
		Date	Downstream Control	Upstream Control	Structure Plot	Downstream Control	Upstream Control	Structure Plot
Fry density (fry • m²)	Day	4/21/96	0.03	0.03	0.02	0.03	0.03	0.03
		5/1/96	0.10	0.23	0.48	0.05	0.15	0.65
		5/16/96	0.22	0.11	0.64	0.11	0.13	2.29
		5/27/96	0.09	0.33	1.23	0.02	0.13	1.46
		6/16/96	0.03	0.03	0.29	0.04	0.03	0.33
	Night	5/16/96	0.42	0.26	1.80	1.25	0.19	4.06
		5/27/96	0.35	0.38	1.95	0.59	0.50	2.53
		6/16/96	0.09	0.23	0.23	0.22	0.33	0.32
CPUE (fry • second)	Day	4/21/96	0.01	0.01	0.01	0.02	0.02	0.01
		5/1/96	0.04	0.10	0.13	0.03	0.07	0.20
		5/16/96	0.09	0.04	0.14	0.05	0.06	0.38
		5/27/96	0.06	0.17	0.26	0.01	0.05	0.32
		6/16/96	0.01	0.01	0.06	0.03	0.02	0.10
	Night	5/16/96	0.14	0.08	0.35	0.27	0.06	0.62
		5/27/96	0.16	0.18	0.39	0.25	0.24	0.44
		6/16/96	0.04	0.09	0.04	0.14	0.17	0.07

pled at night. The mean (± 1 SD) $\log_{10}$(CPUE +1) ranged from 2.02 ± 1.20 to 2.99 ± 0.38 in May; and from 0.86 ± 1.16 to 3.20 ± 0.20 in June (Appendix 11). In July, the number of sites sampled ranged from 5 to 18, and the mean (± 1 SD) $\log_{10}$(CPUE +1) ranged from 0 to 1.50 ± 1.17 (Appendix 11). In November the mean (± 1 SD) $\log_{10}$(CPUE +1) of complexes sampled at night was significantly greater than that for any other site or time (1.38 ± 1.21) (Appendix 11). However, the number of sites surveyed in November ranged from 3 (complexes at night) to 17 (natural sites during the day). In addition, the mean $\log_{10}$(CPUE +1) for bundles and catchers sampled within a time period was not significantly different at any time (Appendix 12).

Length, Weight and Condition Factor

Reach 2

In 1996 in Reach 2, there were few significant differences between complexes and natural sites in the mean lengths, weights or condition factors of chinook 0+ enumerated by electrofishing during the day or night. However, chinook sampled at night were frequently significantly larger than those sampled during the day throughout the sampling period (Figures 7, 8 and 9). No statistical comparisons between groups were made for July and November due to small sample size.

The chinook 0+ sampled during the day ranged from a mean length (± 1SD) of 37.7 ± 1.7 mm in April to 99.0 mm in November, while those sampled at night had mean lengths (± 1 SD) which ranged from 38.4 ± 1.7 mm (April) to 98.7 ± 8.7 mm (November) (Appendix 8). Day and night differences in mean length were small but significant in all months but November (Figure 7), but there were no significant differences in length between chinook 0+ enumerated at complexes or natural sites within either time period.

Chinook 0+ sampled during the day had mean weights (± 1 SD) ranging from 0.39 ± 0.06 g in April to 13.35 g in November, and those sampled at night ranged from 0.42 ± 0.07 g in April to 11.46 ± 2.20 g in November (Appendix 9). In April, chinook 0+ from natural sites sampled during the day were significantly lighter than all other samples, but the difference was only 0.03 g (7%). In May and June, fish measured at night were significantly heavier than during the day. In July and November the number of chinook sampled varied too greatly between sites to allow statistically significant comparisons to be made.

The mean (± 1 SD) condition factor of chinook 0+ sampled during the day ranged from 0.72 ± 0.07 $g \cdot mm^{-3}$ in April to 1.38 $g \cdot mm^{-3}$ in November, and that for chinook 0+ sampled at night ranged from 0.74 ± 0.07 in April to 1.29 ± 0.15 $g \cdot mm^{-3}$ in November (Appendix 10). In May, June and November, there were no significant differences in the mean condition factor of chinook 0+ between groups (Figure 9).

The lengths and weights of fry sampled in the emergent fry structures were similar to those sampled at other sites on the river (Table 9). There were no significant differences in fry weight or fry length between the control plots and fry structure plots (t-test, $P<0.05$) during the day or night in May. In June, however, fry sampled from the structure plots were significantly longer and heavier than those from the controls during the day (t-test, $P<0.005$), but fry from the control plots were significantly longer at night (t-test, $P=0.03$).

Reach 4

Variations in mean fork length, weight and condition factor of chinook 0+ sampled from complexes and natural sites are shown in figures 10, 11 and 12.

The mean (± 1 SD) fork lengths of chinook 0+ sampled in Reach 4 ranged from 36.6 ± 1.6 mm in April to 95.7 ± 9.1 mm in November (Figure 10, Appendix 8). The mean weights (± 1 SD) of chinook 0+ sampled in Reach 4 of the Nechako River ranged from 0.38 ± 0.05 g in April to 10.08 ± 1.61 g in November (Figure 11, Appendix 9). There were no significant differences between chinook 0+ from complex sites or those from natural sites within day or night sampling periods in any month but May. In May, chinook 0+ from natural sites at night were significantly heavier than any other group (maximum difference of 0.16 g). The mean condition factors of chinook 0+ sampled in Reach 4 ranged from 0.74 ± 0.08 $g \cdot mm^{-3}$ in April to 1.19 ± 0.12 $g \cdot mm^{-3}$ in November at night (Figure 12, Appendix 10). There were no significant differences between any groups in any month.

Table 9

Summary of Lengths (mm) and Wet Weights (g) of Chinook Fry Sampled at Emergent Fry Structures, Reach 2 Nechako River, 1996

(n is the number of fish sampled, SD is the Standard Deviation)

		Day Sampling					Night Sampling				
			Lengths (mm)		Wet Weights (g)			Lengths (mm)		Wet Weights (g)	
	Plot	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
Site 1											
16-May-96	Downstream control	10	38.7	2.6	0.48	0.13	10	40.2	2.7	0.53	0.14
16-May-96	Upstream control	10	38.3	1.2	0.44	0.09	10	38.9	3.6	0.50	0.18
16-May-96	Structures	41	39.6	2.4	0.50	0.13	50	39.1	2.6	0.47	0.11
27-May-96	Downstream control	10	37.8	1.9	0.49	0.11	10	38.5	1.2	0.46	0.08
27-May-96	Upstream control	10	39.5	2.2	0.49	0.13	10	39.1	2.7	0.53	0.16
27-May-96	Structures	50	40.1	2.7	0.57	0.17	50	39.9	2.6	0.54	0.15
15-Jun-96	Downstream control	3	40.1	2.7	0.76	0.30	10	39.8	4.1	0.57	0.25
15-Jun-96	Upstream control	3	40.5	3.2	0.53	0.44	10	44.5	5.7	0.93	0.41
15-Jun-96	Structures	30	46.1	4.2	1.04	0.32	9	39.9	4.6	0.64	0.32
Site 2											
16-May-96	Downstream control	10	38.7	2.3	0.42	0.12	10	39.5	2.2	0.60	0.17
16-May-96	Upstream control	10	39.8	2.7	0.54	0.17	10	40.0	2.7	0.57	0.17
16-May-96	Structures	40	39.8	2.5	0.53	0.13	40	39.4	2.8	0.54	0.16
27-May-96	Downstream control	2	38.5	0.7	0.47	0.08	10	39.0	2.5	0.57	0.18
27-May-96	Upstream control	10	40.1	1.9	0.53	0.10	10	40.7	3.9	0.57	0.18
27-May-96	Structures	43	39.6	2.8	0.52	0.14	50	39.0	3.0	0.53	0.18
15-Jun-96	Downstream control	5	41.2	4.8	0.70	0.25	10	43.8	4.3	0.89	0.30
15-Jun-96	Upstream control	3	36.0	1.0	0.41	0.07	10	47.7	5.7	1.15	0.42
15-Jun-96	Structures	35	42.0	3.7	0.77	0.24	22	41.5	5.8	0.76	0.47

Relative Proportion of Species Identified

Snorkel Surveys

Most of the fish observed by snorkel surveys in reaches 2 and 4 were chinook 0+, followed by cyprinids, salmonids other than chinook and suckers. The cyprinidae observed included redside shiners (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*) (Nelson et. al. 1998) and peamouth (*Mylocheilus caurinus*), as well as longnose and leopard dace (*Rhinichthys cataractae* and *R. falcatus*). Salmonids other than chinook included rainbow trout (*Oncorhynchus mykiss*), mountain whitefish (*Prosopium williamsoni*), and sockeye salmon (*O. nerka*). Suckers observed included both largescale and longnose suckers (*Catostomus macrocheilus* and *C. catostomus*).

Reach 2

In Reach 2, chinook 0+ were the most commonly observed fish in habitat complexes, contributing from 64 % to 85 % of all fish observed (Table 10). In natural sites, on the other hand, chinook were predominant only in June while salmonids other than chinook were dominant in May, and cyprinids dominated in July.

Reach 4

In habitat complexes of Reach 4, chinook 0+ predominated in May (83 % of all fish) and June (50 %) but cyprinids increased in proportion to 53 % in July. At natural sites, chinook 0+ and catostomids were dominant in May, while cyprinids and catostomids predominated in June, and in July cyprinids and salmonids other than chinook were dominant (Table 10).

Electrofishing

Reach 2

During the day and night, cyprinids were predominant at both complexes and natural sites in most months. Chinook 0+ were frequently the next most common fish, and showed increasing percentages May through July at night in both complex and natural sites (Table 11).

Reach 4

As in Reach 2+ cyprinids were dominant in both complexes and natural sites throughout the year. The percent of chinook 0+ increased at night in both complex and natural sites (Table 11).

DISCUSSION

Habitat complexes installed in reaches 2 and 4 of the Nechako River between 1989 and 1991 were intended to enhance habitat for juvenile chinook throughout the year. Monitoring of the utilization of these complexes has occurred annually from 1989 to 1995 and has demonstrated that the complexes were at least as well utilized as the natural sites during both the spring rearing period and during the overwintering period. Results from the 1996 sampling program supported these past monitoring results.

Temperature conditions in the Nechako River during early 1996 were cooler than previous years, and provided the lowest mean monthly temperatures observed for January (0.3°C) to August (15.5°C), 1989 to 1996. The maximum mean monthly temperatures for this period ranged from 1.3°C (January) to 17.7°C (August). The mean monthly temperatures for the remainder of the year were also low, but within the range of previous years.

As well, the observed flows in the Nechako River in 1996 were higher earlier in the summer than in some previous years, as there was a forced spill at the request of the B.C. Comptroller of Water from June through August. Part of these flows coincided with the summer cooling releases, but the early flows affected the July sampling as some of the sites were inaccessible. Another forced spill occurred from October through early December, and this affected the November sampling.

Two survey methods were employed to assess chinook abundance within the habitat complexes and the natural sites in the Nechako River, underwater surveys and electrofishing. Both have been shown to provide accurate indices of relative fish abundance. However, underwater counts of salmon fry when water temperatures are low have been reported as less reliable. Hillman et al. (1992) reported that at temperatures less than 14°C only 50 % of a known number of fish were seen while below 9°C only 20 % were detected. They

Table 10
Percent of Total Fish of Each Species Group Observed by Snorkel Surveys of Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

		Habitat Complexes			Natural sites		
	Species [1]	May	June	July	May	June	July
Reach 2	Chinook 0+	64.0	76.6	84.9	22.0	43.8	3.2
	Salmonids [2]	0.9	1.1	2.2	43.9	11.5	29.0
	Cyprinids	34.4	21.3	11.5	32.5	39.2	45.2
	Cottids	0.0	0.0	0.0	0.0	1.5	0.0
	Catostomids	0.7	1.0	1.4	1.6	3.8	22.6
Total number of fish		1704	7202	1476	123	130	31
Reach 4	Chinook 0+	82.6	50.2	26.3	45.3	16.8	18.2
	Salmonids [2]	0.0	0.9	5.3	0.0	6.6	22.7
	Cyprinids	16.7	47.8	52.6	10.3	46.1	50.0
	Cottids	0.0	0.0	0.0	0.0	0.0	0.0
	Catostomids	0.7	1.1	15.8	44.3	30.5	9.1
Total number of fish		731	548	19	406	1033	22

[1] Key to species

Chinook	
Chinook salmon	*Oncorhynchus tshawytscha*
[2] Salmonids (other than Chinook)	
Sockeye salmon	*Oncorhynchus nerka*
Rainbow trout	*Oncorhynchus mykiss*
Rocky Mountain whitefish	*Prosopium williamsoni*
Bull trout	*Salvelinus confluentus*
Cottids	
Sculpins	*Cottus sp.*
Cyprinids	
Leopard dace	*Rhinichthys falcatus*
Longnose dace	*Rhinichthys cataractae*
Northern pikeminnow	*Ptychocheilus oregonensis*
Redside shiner	*Richardsonius balteatus*
Peamouth Chub	*Mylocheilus caurinus*
Chubb sp.	*Mylocheilus sp.*
Castomids	
Largescale sucker	*Catostomus macrocheilus*

Table 11

The Percent of Total Fish of Each Species Group Electrofished From Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

		Day					Night				
Reach 2		April	May	June	July	Nov.	April	May	June	July	Nov.
Complexes	Chinook 0+	15	21	12	19	10	12	25	54	62	17
	Chinook 1+	1	0	0	0	0	7	0	0	0	0
	Salmonids*	1	1	0	0	0	3	1	1	2	44
	Cyprinids	80	74	83	75	90	76	73	42	33	38
	Cottids	4	4	4	6	0	2	2	4	3	0
	Total number of fish	1189	2521	4658	286	20	1928	9639	3288	861	198
Reach 2 Natural sites	Chinook 0+	17	30	15	5	0	22	30	42	46	25
	Chinook 1+	0	0	0	0	0	2	0	0	0	0
	Salmonids*	0	0	0	1	6	5	0	3	3	38
	Cyprinids	80	63	73	87	88	67	66	51	47	35
	Cottids	3	7	11	7	6	3	3	4	4	2
	Total number of fish	698	898	1251	135	17	866	3268	1574	345	48
Reach 4 Complexes	Chinook 0+	11	30	10	0	0	7	24	43	26	100
	Chinook 1+	0	0	0	0	0	3	0	0	0	0
	Salmonids*	5	1	1	0	0	12	4	9	5	0
	Cyprinids	83	69	83	94	100	77	68	40	47	0
	Cottids	1	0	7	6	0	1	4	9	21	0
	Total number of fish	218	230	144	47	1	377	886	619	19	3
Reach 4 Natural sites	Chinook 0+	16	14	3	3	0	5	21	34	29	25
	Chinook 1+	0	0	0	0	0	3	0	0	0	0
	Salmonids*	0	0	0	0	0	31	1	7	3	17
	Cyprinids	83	84	90	89	100	59	71	48	44	58
	Cottids	1	3	7	9	0	1	7	11	24	0
	Total number of fish	488	769	759	35	2	983	1901	1086	119	12

* Salmonids other than chinook

also report that when small fish (<40 mm), or groups of fish greater than 40 are enumerated, the true abundance tends to be underestimated. Juveniles may move deep into cover and be underestimated at sites with complex cover, particularly at temperatures below 9°C (Hillman et al. 1992, Thurrow 1994). Consequently, the Nechako River snorkel surveys have been modified over the years to include surveys only during months when water temperatures, visibility and fry size are more favorable to achieving accurate indices of chinook use.

Electrofishing has also been shown to be an effective technique for fish enumeration (Zalewski and Cowx 1990), especially in shallow areas, with coarse substrate and higher water velocities (Heggenes et al. 1990). As with snorkel surveys, however, electrofishing has been found to be less reliable when temperatures are low. Several studies have shown that fish tend to move deep into cover at low water temperatures (Bjorn 1971, Bustard and Narver 1975a and 1975b, and Cunjak and Power 1986), particularly during the daytime. Juveniles deep into the cover are difficult to electroshock as they move only a short distance before galvanonarcosis is achieved, therefore reducing the ability to draw fish out of the cover to be enumerated (Zalewski and Cowx 1990).

More juvenile chinook were observed within complex and natural sites by snorkel surveys during May and June than by electrofishing. This may be due to several factors. Snorkel observations are more accurate than electroshocking in deep waters (Zalewski and Cowx 1990, Thurrow 1994). In addition, divers in the Nechako River have noted that when large schools are encountered at complexes they tend to congregate near the shear zone created by the debris, and the fright response of schooling fish has been shown to make capture of large schools by electroshocking more difficult (Zalewski and Cowx 1990).

Habitat complexes have consistently shown as high or higher utilization by juvenile chinook in comparison to natural areas in the Nechako River (Triton 1996 a-g). In 1996, snorkel surveys showed that complexes were well utilized: up to 90 % of the complexes were used in Reach 2 during the peak of the survey. In previous years this rate ranged from 72 % in 1994 to 97 % in 1993. Habitat complexes also harboured 46% of the total chinook observed by snorkel during the peak month, in spite of contributing only 2.6% of the area surveyed. In previous years this value has ranged from 47 to 74% for habitat complexes in Reach 2. However, the electrofishing CPUE from complexes was similar to that of natural sites, with some small differences between night and day samples. In past years the electrofishing CPUE for habitat complexes has at times been significantly greater than at natural sites. This has not occurred in the 1995 or 1996 surveys.

The number of chinook 0+ observed in complexes in past years has been correlated primarily with cover area, but average approach depth and average exit depth have also contributed in some years (Triton 1996 a - g). In 1996, average approach depth and average exit depth were the principal independent variables, perhaps due to the higher flow regime experienced during the summer.

Newly installed emergent fry structures were also well utilized by chinook fry compared to control sites in 1996. Fry density was approximately 5 times greater in the structured plots than in the control plots. As in other sampling in the river, more fry were observed at night than during the day in both control and complexed sites. It is interesting to note that within the complexed plot, fish appeared to be more evenly distributed between the tree structures and the spaces between the trees at night than during the day.

Most of the chinook pre-smolts (0+ and 1+) sampled in both Reach 2 and 4 during November and April by electrofishing were found in complex sites, which suggests that the artificial structures might be selected by juvenile chinook as overwintering habitat. Chinook are thought to move deep into complex cover and to become relatively dormant during the winter (Hillman and Griffith 1987, Cunjak and Power 1986). This is also consistent with previous years results (Triton 1996 a- g).

There were generally no significant differences in the morphological parameters of length, weight and condition factor for chinook 0+ enumerated in complexes and natural sites within day and night samples. There were some differences, however, between day and night samples, and fish measured at night were slightly larger than those sampled during the day.

The structure of the fish communities within complex and natural sites varied with season, time of day and sampling method. Snorkel surveys indicated that chinook were the predominant members of the community of complex sites in Reach 2 during the spring, followed by cyprinids, and suckers. Natural sites in reaches 2 and 4 were predominantly composed of cyprinids. Electrofishing indicated that cyprinids were the predominant members of the community throughout the season, followed by chinook 0+ and suckers. These differences are probably due to the large numbers of smaller (<50 mm) cyprinids sampled by shocking and their tendency to occupy shallow habitats less accessible to divers (Hillman et al. 1992). The proportion of the community represented by chinook 0+ is relatively high from April to July, then is reduced in November, reflecting the outmigration of the chinook juveniles after the spring.

In summary, the 1996 results are consistent with previous years results, and show that habitat complexes are at least as well utilized as the natural sites on the Nechako River. In addition, snorkel surveys showed a high percent utilization of the complexes by chinook fry in the months prior to large scale outmigration from the upper Nechako River. The complexes also appear to provide habitat for overwintering chinook. Species composition in the complexes and natural sites varied monthly and according to method of observation. Chinook in complexes and natural sites were of similar fork length, weight and condition factor.

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APPENDIX 1

Site List for the Biological Assesment of Habitat Complexing, Nechako River, 1996

Appendix 1
Site List for the Biological Assesment of Habitat Complexing, Nechako River, 1996

Site Name	Site Type	Reach	km from Kenney Dam	Margin	Description
Reach 2					
LM15.6SWPR	Complex	2	15.6	Left Margin	Rail Anchored Sweeper
MC15.7PP	Complex	2	15.7	Mid Channel	Pocket Pool
RM16.2SWPR	Complex	2	16.2	Right Margin	Rail Anchored Sweeper
RM16.3CONTROL	Natural	2	16.3	Right Margin	Natural Site near RM16.2SWPR
RM16.5RDC	Complex	2	16.5	Right Margin	Rail Debris Catcher
RM16.8RDC	Complex	2	16.8	Right Margin	Rail Debris Catcher
LM17.0CONTROL	Natural	2	17	Left Margin	Natural Site near RM17.0PB
RM17.0PB	Complex	2	17	Right Margin	Point Bar
RM17.15PB	Complex	2	17.15	Right Margin	Point Bar
RM17.3PB	Complex	2	17.3	Right Margin	Point Bar
RM17.9DB	Complex	2	17.9	Right Margin	Debris Boom
RM17.9SC	Complex	2	17.9	Right Margin	Side Channel
LM18.3RDC	Complex	2	18.3	Left Margin	Rail Debris Catcher
RM20.65RDC	Complex	2	20.65	Right Margin	Rail Debris Catcher
LM21.3RDC	Complex	2	21.3	Left Margin	Rail Debris Catcher
LM21.35CONTROL	Natural	2	21.35	Left Margin	Natural Site near LM21.3RDC
LM21.4RDC	Complex	2	21.4	Left Margin	Rail Debris Catcher
RM22.0RDC	Complex	2	22	Right Margin	Rail Debris Catcher
RM22.1SWPR	Complex	2	22.1	Right Margin	Rail Anchored Sweeper
RM22.55RDC	Complex	2	22.55	Right Margin	Rail Debris Catcher
LM22.6RDC	Complex	2	22.6	Left Margin	Rail Debris Catcher
LM22.7CONTROL	Natural	2	22.7	Left Margin	Natural Site near LM22.7RDC
LM22.75CONTROL	Natural	2	22.75	Left Margin	Natural Site near LM22.8RDC
LM22.85RDC	Complex	2	22.85	Left Margin	Rail Debris Catcher
RM22.9NAT	Natural	2	22.9	Right Margin	Natural Site
RM22.95SWPR	Complex	2	22.95	Right Margin	Rail Anchored Sweeper
RM23.0RDC	Complex	2	23	Right Margin	Rail Debris Catcher
RM23.2NAT	Natural	2	23.2	Right Margin	Natural Site
LM24.15CONTROL	Natural	2	24.15	Left Margin	Natural Site near LM24.2RDC
LM24.2RDC	Complex	2	24.2	Left Margin	Rail Debris Catcher
LM24.3RDC	Complex	2	24.3	Left Margin	Rail Debris Catcher
RM24.3CONTROL	Natural	2	24.3	Right Margin	Natural Site near RM24.35RS
RM24.35RS	Complex	2	24.35	Right Margin	Rootwad Sweeper
RM24.4FC	Complex	2	24.4	Right Margin	Floating Crib
RM24.5CONTROL	Natural	2	24.5	Right Margin	Natural Site near RM24.6PBL
RM24.6PBL	Complex	2	24.6	Right Margin	Pseudo Beaver Lodge
RM24.8CONTROL	Natural	2	24.8	Right Margin	Natural Site near RM24.6PBL
RM25.4RDC	Complex	2	25.4	Right Margin	Rail Debris Catcher
MC25.7RDC	Complex	2	25.7	Mid Channel	Rail Debris Catcher
RM25.8NAT	Natural	2	25.8	Right Margin	Natural Site
LM26.6NAT	Natural	2	26.6	Left Margin	Natural Site
RM26.8CONTROL	Natural	2	26.8	Right Margin	Natural Site near RM26.9SWPR
RM26.9SWPR	Complex	2	26.9	Right Margin	Rail Anchored Sweeper
RM27.3CONTROL	Natural	2	27.3	Right Margin	Natural Site near RM27.4FC
RM27.4FC	Complex	2	27.4	Right Margin	Floating Crib
LM27.5NAT	Natural	2	27.5	Left Margin	Natural Site
RM28.3NAT	Natural	2	28.3	Right Margin	Natural Site
RM28.4RDC	Complex	2	28.4	Right Margin	Rail Debris Catcher

Appendix 1 (continued)
Site List for the Biological Assesment of Habitat Complexing, Nechako River, 1996

Site Name	Site Type	Reach	km from Kenney Dam	Margin	Description
Reach 2					
LM28.6NAT	Natural	2	28.6	Left Margin	Natural Site
LM29.3CONTROL	Natural	2	29.3	Left Margin	Natural Site near LM29.4SWPR
LM29.4SWPR	Complex	2	29.4	Left Margin	Rail Anchored Sweeper
RM31.0CONTROL	Natural	2	31	Right Margin	Natural Site near LM31.1PBL
RM31.1PBL	Complex	2	31.1	Right Margin	Pseudo Beaver Lodge
RM31.4BP	Complex	2	31.4	Right Margin	Brush Pile
RM32.0NAT	Natural	2	32	Right Margin	Natural Site
RM32.05NAT	Natural	2	32.05	Right Margin	Natural Site
LM32.6CONTROL	Natural	2	32.6	Left Margin	Natural Site near LM32.65SWPR
LM32.65SWPR	Complex	2	32.65	Left Margin	Hand Anchored Sweeper
LM33.3NAT	Natural	2	33.3	Left Margin	Natural Site
LM33.4NAT	Natural	2	33.4	Left Margin	Natural Site
RM34.5CONTROL	Natural	2	34.5	Right Margin	Natural Site near RM34.7PDC
RM34.7PDC	Complex	2	34.7	Right Margin	Pipe-pile Debris Catcher
MC35.4PDC	Complex	2	35.4	Mid Channel	Pipe-pile Debris Catcher
RM35.8NAT	Natural	2	35.8	Right Margin	Natural Site
LM37.3NAT	Natural	2	37.3	Left Margin	Natural Site
LM37.35NAT	Natural	2	37.35	Left Margin	Natural Site
LM37.7NAT	Natural	2	37.7	Left Margin	Natural Site
Reach 4					
LM72.9SWPR	Complex	4	72.9	Left Margin	Hand Anchored Sweeper
LM72.95CONTROL	Natural	4	72.95	Left Margin	Natural Site near LM72.9SWPR
LM73.0SWPR	Complex	4	73	Left Margin	Hand Anchored Sweeper
LM73.1NAT	Natural	4	73.1	Left Margin	Natural Site
LM73.5NAT	Natural	4	73.5	Left Margin	Natural Site
LM73.6NAT	Natural	4	73.6	Left Margin	Natural Site
RM74.0NAT	Natural	4	74	Right Margin	Natural Site
RM74.1NAT	Natural	4	74.1	Right Margin	Natural Site
LM75.6CONTROL	Natural	4	75.6	Left Margin	Natural Site near LM75.9SWPR
LM75.9SWPR	Complex	4	75.9	Left Margin	Hand Anchored Sweeper
LM75.95NAT	Natural	4	75.95	Left Margin	Natural Site
LM76.4NAT	Natural	4	76.4	Left Margin	Natural Site
LM76.9NAT	Natural	4	76.9	Left Margin	Natural Site
LM78.0SWPR	Complex	4	78	Left Margin	Hand Anchored Sweeper
MC78.0NAT	Natural	4	78	Mid Channel	Natural Site
LM79.2NAT	Natural	4	79.2	Left Margin	Natural Site
LM80.2SWPR	Complex	4	80.2	Left Margin	Hand Anchored Sweeper
LM80.9RDC	Complex	4	80.9	Left Margin	Rail Debris Catcher
RM81.3NAT	Natural	4	81.3	Right Margin	Natural Site
LM82.1SWPR	Complex	4	82.1	Left Margin	Rail Anchored Sweeper
RM82.1NAT	Natural	4	82.1	Right Margin	Natural Site
LM82.15CONTROL	Natural	4	82.15	Left Margin	Natural Site near LM82.2SWPR
LM82.2SWPR	Complex	4	82.2	Left Margin	Rail Anchored Sweeper
LM82.3SWPR	Complex	4	82.3	Left Margin	Hand Anchored Sweeper
LM82.7NAT	Natural	4	82.7	Left Margin	Natural Site
LM82.9CONTROL	Natural	4	82.9	Left Margin	Natural Site near LM83.0RDC

Appendix 1 (continued)
Site List for the Biological Assesment of Habitat Complexing, Nechako River, 1996

Site Name	Site Type	Reach	km from Kenney Dam	Margin	Description
Reach 2					
LM83.0RDC	Complex	4	83	Left Margin	Rail Debris Catcher
RM83.7NAT	Natural	4	83.7	Right Margin	Natural Site
MC85.6NAT	Natural	4	85.6	Mid Channel	Natural Site
RM85.7SWPR	Complex	4	85.7	Right Margin	Rail Anchored Sweeper
RM86.35RDC	Complex	4	86.35	Right Margin	Rail Debris Catcher
RM86.375RDC	Complex	4	86.375	Right Margin	Rail Debris Catcher
LM88.5NAT	Natural	4	88.5	Left Margin	Natural Site

APPENDIX 2

Mean Daily Water Temperatures (°C) Recorded from Nechako River Below Cheslatta Falls (WSC 08JA017), 1996

Appendix 2
Mean Daily Water Temperatures (°C) Recorded from Nechako River
Below Cheslatta Falls (WSC 08JA017), 1996

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	-	0.1	0.4	0.7	-	9.4	13.8	15.0	15.2	11.6	6.6	2.4
2	-	0.1	0.5	1.2	-	9.9	13.7	15.1	15.1	11.5	6.7	2.0
3	-	0.1	0.1	2.1	-	9.8	13.4	15.1	14.4	11.7	6.7	2.1
4	-	0.1	0.1	2.3	-	12.0	13.7	15.1	14.1	11.6	6.5	2.2
5	-	0.1	0.1	2.6	-	11.7	13.5	15.1	14.2	11.3	6.6	2.0
6	-	0.1	0.1	2.7	-	10.7	13.3	15.6	13.7	11.4	6.4	1.6
7	-	0.1	0.1	2.6	-	11.7	13.6	15.5	13.6	11.4	6.1	1.4
8	-	0.1	0.2	2.7	5.2	11.5	13.7	15.6	14.0	11.4	6.0	1.4
9	-	0.1	0.8	2.4	4.7	10.8	14.1	15.9	14.1	11.4	6.0	1.5
10	-	0.1	1.0	2.0	4.9	10.5	13.6	15.9	14.2	11.3	5.6	1.8
11	-	0.1	1.1	1.8	5.1	10.8	13.8	15.9	14.5	10.8	5.4	1.3
12	-	0.1	0.8	2.0	5.4	11.0	14.0	15.9	14.2	10.7	5.5	1.0
13	-	0.2	1.4	2.1	5.5	11.4	14.4	15.9	14.2	10.7	5.5	1.1
14	-	0.4	1.6	2.3	5.9	11.3	14.7	16.0	14.1	10.4	5.4	1.3
15	-	0.5	1.4	2.4	6.5	10.8	14.7	15.8	13.6	10.0	4.9	1.5
16	-	0.6	1.3	2.4	6.7	10.3	14.6	15.5	13.3	9.7	4.4	0.8
17	-	0.8	1.4	2.5	6.7	10.6	14.4	15.3	13.6	9.4	3.9	0.8
18	-	1.0	1.4	2.8	6.3	10.6	14.2	15.3	13.8	9.0	3.6	1.1
19	0.1	1.0	1.5	2.9	6.6	11.0	14.1	15.1	13.2	8.9	3.0	1.2
20	0.1	1.0	1.5	3.1	6.9	11.8	13.9	14.9	13.0	8.8	2.7	0.7
21	0.1	0.7	1.2	3.6	6.8	11.9	13.9	14.8	12.6	8.7	2.7	0.1
22	0.1	0.6	0.9	4.2	7.5	12.4	14.1	14.9	12.4	8.3	2.4	0.1
23	0.1	0.5	0.7	-	8.3	12.6	14.4	15.2	12.4	7.9	2.1	0.2
24	0.1	0.2	0.9	-	8.5	12.7	14.7	15.4	12.5	7.7	2.3	0.3
25	0.1	0.1	1.3	-	9.0	12.8	14.9	15.5	12.6	7.5	2.4	0.1
26	0.1	0.1	1.5	-	8.5	13.6	15.0	16.0	12.9	7.3	2.5	0.1
27	0.1	0.1	1.5	-	8.2	13.8	15.1	16.2	13.0	7.3	2.6	0.1
28	0.1	0.2	1.5	-	8.6	13.8	14.8	16.1	12.8	7.0	2.6	0.1
29	0.1	0.3	1.2	-	8.8	13.7	14.7	16.1	12.3	6.7	2.2	0.1
30	0.1	-	1.1	-	9.0	13.7	15.4	16.1	11.8	6.6	2.4	0.1
31	0.1	-	0.6	-	9.2	-	14.8	15.6	-	6.6	-	0.1
Mean	0.1	0.3	0.9	2.4	7.0	11.6	14.2	15.5	13.5	9.5	4.4	1.0
Minimum	0.1	0.1	0.1	0.7	4.7	9.4	13.3	14.8	11.8	6.6	2.1	0.1
Maximum	0.1	1.0	1.6	4.2	9.2	13.8	15.4	16.2	15.2	11.7	6.7	2.4
SD	0.00	0.31	0.51	0.73	1.47	1.26	0.56	0.43	0.86	1.81	1.75	0.76

APPENDIX 3

Preliminary Flow Data for Nechako Fisheries Conservation Program from Skins Lake Spillway (WSC 08JA017), 1996

Appendix 3
Preliminary Flow Data for Nechako Fisheries Conservation Program
from Skins Lake Spillway (WSC 08JA017), 1996

	Skins Lake Spillway (m^3s^{-1})											
Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	34.1	34.0	33.5	32.9	50.0	52.6	226.5	169.9	15.1	112.6	227.4	60.7
2	34.0	34.0	33.5	32.9	50.0	52.8	226.5	169.9	15.1	112.5	227.2	60.6
3	34.0	34.0	33.5	32.9	50.1	53.1	236.0	169.9	26.4	112.4	227.0	60.6
4	34.0	34.0	33.4	32.8	50.2	53.3	254.9	169.9	32.9	112.4	226.8	60.6
5	34.0	33.9	33.4	32.8	50.2	53.5	254.9	169.9	32.9	112.3	226.6	60.6
6	34.0	33.9	33.4	32.8	50.2	53.7	254.9	169.9	32.9	112.3	226.2	60.6
7	34.0	33.9	33.4	32.8	50.3	53.8	254.9	169.9	32.9	112.3	225.9	60.5
8	34.0	33.9	33.3	32.9	50.3	54.0	254.9	169.9	33.1	150.8	226.7	60.5
9	34.0	33.9	33.3	33.0	50.4	54.1	254.9	169.9	33.1	227.6	228.8	60.5
10	34.0	33.9	33.3	33.0	50.4	54.3	254.9	169.9	41.0	227.5	228.7	60.4
11	34.0	33.8	33.3	33.1	50.4	54.4	254.9	169.9	57.0	227.4	228.5	60.4
12	34.1	33.8	33.3	33.1	50.5	54.5	254.9	169.9	57.0	227.3	228.4	60.4
13	34.2	33.8	33.3	33.1	50.5	54.6	254.9	169.9	57.0	226.8	228.2	60.3
14	34.2	33.8	33.3	33.2	50.6	54.7	254.9	169.9	57.0	226.6	228.0	60.3
15	34.2	33.8	33.3	33.2	50.7	54.9	254.9	169.9	57.0	226.4	172.1	60.3
16	34.2	33.8	33.2	33.2	50.7	54.9	254.9	169.9	57.0	226.2	61.1	60.3
17	34.1	33.8	33.2	33.3	50.8	55.0	254.9	169.9	57.0	225.9	61.0	60.2
18	34.1	33.8	33.2	33.2	50.9	55.1	254.9	169.9	57.0	225.4	61.0	60.2
19	34.1	33.7	33.2	33.3	51.0	55.2	254.9	118.3	57.0	225.1	60.9	60.2
20	34.1	33.7	33.2	33.4	51.1	55.3	254.9	15.0	75.8	224.9	60.9	60.1
21	34.1	33.7	33.2	33.4	51.2	55.4	254.9	15.0	113.3	224.8	60.9	60.1
22	34.1	33.7	33.1	33.4	51.3	55.5	254.9	15.0	113.2	224.5	60.9	60.1
23	34.1	33.7	33.1	33.5	51.5	55.6	254.9	15.0	113.2	224.1	60.8	60.1
24	34.1	33.7	33.1	33.6	51.6	55.8	254.9	14.6	113.1	224.0	60.8	60.0
25	34.1	33.6	33.0	33.6	51.7	55.9	254.9	15.1	113.1	223.6	60.8	60.0
26	34.1	33.6	33.0	33.7	51.9	56.0	254.9	13.5	113.0	223.5	60.7	60.0
27	34.1	33.6	33.0	43.7	52.0	56.2	174.9	15.1	113.0	223.3	60.8	59.9
28	34.1	33.6	33.0	49.8	52.1	95.5	15.1	15.1	112.9	222.7	60.7	59.9
29	34.0	33.5	32.9	49.8	52.2	226.5	15.1	15.1	112.8	228.2	60.7	59.8
30	34.0		32.9	49.9	52.4	226.5	90.9	15.1	112.7	227.9	60.7	59.8
31	34.0		32.9		52.5		169.3	15.1		227.6		59.7
Mean	34.1	33.8	33.2	35.2	51.0	67.4	226.3	108.2	67.1	197.7	142.3	60.2
Minimum	34.0	33.5	32.9	32.8	50.0	52.6	15.1	13.5	15.1	112.3	60.7	59.7
Maximum	34.2	34.0	33.5	49.9	52.5	226.5	254.9	169.9	113.3	228.2	228.8	60.7

APPENDIX 4

Preliminary Flow Data for Nechako Fisheries Conservation Program Below Cheslatta Falls (WSC 08JA017), 1996

Appendix 4
Preliminary Flow Data for Nechako Fisheries Conservation Program
Below Cheslatta Falls (WSC 08JA017), 1996

Nechako River below Cheslatta Falls (m^3s^{-1})

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	34.4	na	na	32.8	70.9	65.7	93.8	167.0	52.9	98.8	230.0	81.9
2	34.4	na	na	32.8	70.9	65.4	118.0	169.0	49.0	101.0	230.0	78.2
3	34.7	na	na	32.8	72.6	64.9	126.0	169.0	46.7	104.0	233.0	76.3
4	34.7	na	na	32.8	70.9	64.7	143.0	170.0	44.2	107.0	233.0	74.5
5	34.7	na	na	32.8	70.9	64.5	162.0	170.0	42.2	108.0	233.0	72.6
6	34.0	na	na	32.8	70.9	63.5	177.0	171.0	40.9	110.0	233.0	70.9
7	33.7	na	na	33.0	70.9	63.2	191.0	170.0	40.9	112.0	233.0	69.1
8	33.3	na	na	33.6	70.9	63.0	205.0	170.0	40.7	113.0	233.0	69.1
9	33.3	na	na	35.9	70.9	62.3	216.0	171.0	40.0	118.0	236.0	67.4
10	33.1	na	na	38.4	69.1	62.0	224.0	170.0	38.6	131.0	236.0	67.4
11	33.1	na	na	39.5	69.1	61.8	237.0	172.0	38.5	145.0	236.0	65.7
12	na	na	na	40.6	67.4	60.4	238.0	172.0	38.5	157.0	236.0	65.5
13	na	na	33.1	42.4	67.4	60.1	244.0	172.0	39.8	169.0	236.0	64.9
14	na	na	33.3	43.4	69.1	61.5	248.0	173.0	41.6	178.0	236.0	64.3
15	na	na	33.3	45.1	69.1	61.3	252.0	172.0	43.1	188.0	236.0	64.0
16	na	na	33.3	47.5	69.1	60.9	255.0	173.0	44.5	194.0	228.0	64.0
17	na	na	33.1	51.4	69.1	60.8	258.0	173.0	46.1	198.0	203.0	63.2
18	na	na	33.1	56.2	69.1	60.8	263.0	174.0	47.3	204.0	182.0	62.8
19	na	na	33.1	58.4	69.1	60.8	265.0	173.0	48.8	208.0	163.0	62.5
20	na	na	33.1	59.9	69.1	59.6	267.0	167.0	49.6	211.0	146.0	62.3
21	na	na	33.1	60.6	69.1	59.6	267.0	149.0	50.6	215.0	135.0	62.1
22	na	na	33.1	62.0	69.1	59.6	267.0	130.0	56.2	218.0	125.0	64.5
23	na	na	33.1	63.5	69.1	59.6	267.0	116.0	63.0	219.0	115.0	65.2
24	na	na	34.0	66.2	69.1	59.6	269.0	104.0	69.1	222.0	109.0	62.5
25	na	na	33.3	68.1	69.1	59.1	269.0	93.8	74.6	223.0	103.0	65.5
26	na	na	33.3	68.9	69.1	59.1	270.0	84.6	80.0	223.0	97.0	na
27	na	na	33.3	69.8	69.1	58.7	270.0	76.7	84.6	226.0	93.1	na
28	na	na	33.1	69.8	67.4	58.4	256.0	70.3	89.1	229.0	89.3	na
29	na	na	33.1	70.7	67.4	59.2	221.0	64.9	93.4	229.0	85.6	na
30	na		33.1	71.4	67.4	74.5	189.0	60.4	96.4	229.0	81.9	na
31	na		33.1		67.4		169.0	56.4		230.0		na
Mean	33.9		33.2	49.8	69.3	61.8	222.5	142.7	54.4	174.8	182.2	67.5
Minimum	33.1		33.1	32.8	67.4	58.4	93.8	56.4	38.5	98.8	81.9	62.1
Maximum	34.7		34.0	71.4	72.6	74.5	270.0	174.0	96.4	230.0	236.0	81.9

APPENDIX 5

Number of Electrofishing Samples at Each Site During the Day and Night, Nechako River, 1996

Appendix 5
Number of Electrofishing Samples at Each Site During the Day and Night, Nechako River, 1996

			Day					Night				
Reach	Km	Complex	April	May	June	July	Nov	April	May	June	July	Nov
2	15.6	SWPR	1	1	1	1	1	1	1	1	1	0
2	15.7	PP	1	1	1	0	0	1	1	1	0	0
2	16.2	SWPR	1	1	1	1	1	1	1	1	1	0
2	16.3	CONTROL	1	1	1	1	1	1	1	1	1	1
2	16.5	RDC	1	1	1	1	0	1	1	1	1	0
2	16.8	RDC	1	1	1	1	1	1	1	1	1	0
2	17	CONTROL	1	1	1	1	1	1	1	1	1	1
2	17	PB	1	1	1	1	1	1	1	1	1	1
2	17.15	PB	1	1	1	1	1	1	1	1	1	1
2	17.3	PB	1	1	1	1	1	1	1	1	1	1
2	17.9	DB	1	1	1	1	1	1	1	1	1	0
2	17.9	SC	0	1	1	1	1	0	1	1	1	0
2	18.3	RDC	1	1	1	1	1	1	1	1	1	0
2	20.65	RDC	1	1	1	1	0	1	1	1	1	0
2	21.3	RDC	1	1	1	1	1	1	1	1	1	0
2	21.35	CONTROL	1	1	1	1	1	1	1	1	1	1
2	21.4	RDC	1	1	1	1	0	1	1	1	1	0
2	22	RDC	1	1	1	1	1	1	1	1	1	0
2	22.1	SWPR	1	1	1	1	1	1	1	1	1	0
2	22.55	RDC	1	1	1	1	1	1	1	1	1	0
2	22.6	RDC	1	1	1	1	1	1	1	1	1	0
2	22.7	CONTROL	1	1	1	1	1	1	1	1	1	1
2	22.75	CONTROL	1	1	1	1	1	1	1	1	1	1
2	22.85	RDC	1	1	1	1	0	1	1	1	1	0
2	22.9	NAT	1	1	1	1	1	1	1	1	1	1
2	22.95	SWPR	1	1	1	1	1	1	1	1	1	0
2	23	RDC	1	1	1	0	0	1	1	1	0	0
2	23.2	NAT	1	1	1	1	1	1	1	1	1	1
2	24.15	CONTROL	1	1	1	1	1	1	1	1	1	1
2	24.2	RDC	1	1	1	1	0	1	1	1	1	0
2	24.3	CONTROL	1	1	1	1	1	1	1	1	1	1
2	24.3	RDC	1	1	1	0	0	1	1	1	1	0
2	24.35	RS	1	1	1	1	1	1	1	1	1	0
2	24.4	FC	1	1	1	1	1	1	1	1	1	0
2	24.5	CONTROL	1	1	1	1	1	1	1	1	1	1
2	24.6	PBL	1	1	1	1	0	1	1	1	1	0
2	24.8	CONTROL	1	1	1	1	1	1	1	1	1	1
2	25.4	RDC	1	1	1	0	0	1	1	1	0	0
2	25.7	RDC	1	1	1	0	0	1	1	1	0	0
2	25.8	NAT	1	1	1	0	0	1	1	1	0	0
2	26.6	NAT	1	1	1	0	0	1	1	1	0	0

Appendix 5 (continued)
Number of Electrofishing Samples at Each Site During the Day and Night, Nechako River, 1996

			Day					Night				
Reach	Km	Complex	April	May	June	July	Nov	April	May	June	July	Nov
2	26.8	CONTROL	1	1	1	1	1	1	1	1	1	1
2	26.9	SWPR	1	1	1	1	1	1	1	1	1	1
2	27.3	CONTROL	1	1	1	1	0	1	1	1	0	0
2	27.4	FC	1	1	1	1	1	1	1	1	1	0
2	27.5	NAT	1	1	1	1	1	1	1	1	1	0
2	28.3	NAT	1	1	1	1	1	1	1	1	1	1
2	28.4	RDC	1	1	1	1	1	1	1	1	1	0
2	28.6	NAT	1	1	1	1	1	1	1	1	1	1
2	29.3	CONTROL	1	1	1	1	0	1	1	1	1	0
2	29.4	SWPR	1	1	1	0	1	1	1	1	1	0
2	31	CONTROL	1	1	1	1	0	1	1	1	0	0
2	31.1	PBL	1	1	1	1	0	1	1	1	0	0
2	31.4	BP	1	1	1	1	0	1	1	1	0	0
2	32	NAT	1	1	1	1	1	1	1	1	1	1
2	32.05	NAT	1	1	1	1	1	1	1	1	1	1
2	32.6	CONTROL	1	1	1	1	1	1	1	1	1	1
2	32.65	SWPR	1	1	1	1	1	1	1	1	1	1
2	33.3	NAT	1	1	1	1	1	1	1	1	1	0
2	33.4	NAT	1	1	1	1	1	1	1	1	1	0
2	34.5	CONTROL	1	1	1	1	0	1	1	1	0	0
2	34.7	PDC	1	1	1	1	1	1	1	1	1	1
2	35.4	PDC	1	1	1	1	1	1	1	1	1	0
2	35.8	NAT	1	1	1	1	1	1	1	1	1	1
2	37.3	NAT	1	1	1	0	0	1	1	1	0	0
2	37.35	NAT	1	1	1	0	0	1	1	1	0	0
2	37.7	NAT	1	1	1	1	1	1	1	1	1	1
Total			66	67	67	57	46	66	67	67	54	25
4	72.9	SWPR	1	1	1	1	1	1	1	1	1	1
4	72.95	CONTROL	1	1	1	1	1	1	1	1	1	1
4	73	SWPR	1	1	1	1	1	1	1	1	1	1
4	73.1	NAT	1	1	1	1	1	1	1	1	1	1
4	73.5	NAT	1	1	1	1	1	1	1	1	1	1
4	73.6	NAT	1	1	1	1	1	1	1	1	1	1
4	74	NAT	1	1	1	1	1	1	1	1	1	1
4	74.1	NAT	1	1	1	1	1	1	1	1	1	1
4	75.6	CONTROL	1	1	1	1	1	1	1	1	1	1
4	75.9	SWPR	1	1	1	1	1	1	1	1	1	1
4	75.95	NAT	1	1	1	1	1	1	1	1	1	1
4	76.4	NAT	1	1	1	1	1	1	1	1	1	1
4	76.9	NAT	1	1	1	1	1	1	1	1	1	1

Appendix 5 (continued)
Number of Electrofishing Samples at Each Site During the Day and Night, Nechako River, 1996

Reach	Km	Complex	Day					Night				
			April	May	June	July	Nov	April	May	June	July	Nov
4	78	NAT	1	1	1	1	0	1	1	1	0	0
4	78	SWPR	1	1	1	0	0	1	1	1	0	0
4	79.2	NAT	1	1	1	1	1	1	1	1	1	1
4	80.2	SWPR	1	1	1	1	0	1	1	1	1	0
4	80.9	RDC	1	1	1	0	0	1	1	1	0	0
4	81.3	NAT	1	1	1	1	1	1	1	1	1	1
4	82.1	NAT	1	1	1	1	1	1	1	1	1	0
4	82.1	SWPR	1	1	1	0	0	1	1	1	0	0
4	82.15	CONTROL	1	1	1	0	0	1	1	1	0	0
4	82.2	SWPR	1	1	1	0	0	1	1	1	0	0
4	82.3	SWPR	1	1	1	1	0	1	1	1	0	0
4	82.7	NAT	1	1	1	1	1	1	1	1	1	0
4	82.9	CONTROL	1	1	1	1	1	1	1	1	1	0
4	83	RDC	1	1	1	0	1	1	1	1	1	0
4	83.7	NAT	1	1	1	1	1	1	1	1	1	0
4	85.6	NAT	1	1	1	1	1	1	1	1	1	0
4	85.7	SWPR	1	1	1	0	0	1	1	1	0	0
4	86.35	RDC	1	1	1	1	0	1	1	1	0	0
4	86.375	RDC	1	1	1	0	0	1	1	1	0	0
4	88.5	NAT	1	1	1	0	0	1	1	1	0	0
Total			33	33	33	24	21	33	33	33	22	15

APPENDIX 6

Mean, Maximum and Minimum log_{10}(CPUE +1) for Chinook 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 6

Mean, Maximum and Minimum log_{10}(CPUE +1) for Chinook 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Complex Sites		Natural Sites		Complex Sites		Natural Sites	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
April	Mean	0.34	1.61	0.14	0.57	0.15	0.82	0.00	0.78
	n	31	31	30	30	13	13	20	20
	Maximum	2.62	3.18	2.22	2.62	1.93	2.70	0.00	2.92
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.79	1.33	0.53	0.97	0.53	1.10	0.00	1.12
May	Mean	0.27	0.54	0.06	0.00	0.15	0.30	0.00	0.29
	n	31	31	30	30	13	13	20	20
	Maximum	2.40	2.40	1.93	0.00	1.93	1.93	0.00	2.05
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.72	0.94	0.35	0.00	0.53	0.72	0.00	0.70
June	Mean	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00
	n	31	31	30	30	13	13	20	20
	Maximum	0.00	1.93	0.00	0.00	0.00	0.00	0.00	0.00
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX 7

Mean, Maximum and Minimum $\log_{10}$(CPUE +1) for Chinook 1+ Electrofished During the Day and Night from Debris Bundles and Debris Catcher Habitat Complex Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 7

Mean, Maximum and Minimum log_{10}(CPUE +1) for Chinook 1+ Electrofished During the Day and Night from Debris Bundles and Debris Catcher Habitat Complex Sites in Reaches 2 and 4 of the Nechako River, 1996

(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Bundles		Catchers		Bundles		Catchers	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
April	Mean	0.20	0.74	0.43	2.24	0.21	0.68	0.00	1.16
	n	13	13	18	18	9	9	4	4
	Maximum	2.62	2.70	2.22	3.18	1.93	2.22	0.00	2.70
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.73	1.17	0.84	1.08	0.64	1.02	0.00	1.37
May	Mean	0.16	0.15	0.35	0.83	0.21	0.43	0.00	0.00
	n	13	13	18	18	9	9	4	4
	Maximum	2.13	1.93	2.40	2.40	1.93	1.93	0.00	0.00
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.59	0.53	0.80	1.07	0.64	0.85	0.00	0.00
June	Mean	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00
	n	13	13	18	18	9	9	4	4
	Maximum	0.00	0.00	0.00	1.93	0.00	0.00	0.00	0.00
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00

APPENDIX 8

Mean, Maximum and Minimum Fork Length (mm) of Chinook 0+ and 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 8
Mean, Maximum and Minimum Fork Length (mm) of Chinook 0+ and 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996
(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Complex		Natural		Complex		Natural	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
Chinook 1+									
April	Mean	99.0	95.7	94.3	93.6	76.0	96.9	na	97.1
	n	10	125	3	16	1	11	0	17
	Maximum	112.0	110.0	100.0	109.0	76.0	107.0	na	107.0
	Minimum	87.0	75.0	91.0	73.0	76.0	88.0	na	83.0
	SD	7.7	6.4	4.9	10.0	na	6.0	na	7.5
May	Mean	99.1	105.2	97.0	na	na	88.0	na	114.0
	n	9	18	1	0	0	2	0	3
	Maximum	123.0	117.0	97.0	0.0	0.0	94.0	na	118.0
	Minimum	82.0	85.0	97.0	0.0	0.0	82.0	na	110.0
	SD	11.7	9.5	na	na	na	8.5	na	4.0
June	Mean	na	112.0	na	na	na	na	na	na
	n	0	2	0	0	0	0	0	0
	Maximum	0.0	119.0	0.0	0.0	0.0	0.0	na	0.0
	Minimum	0.0	105.0	0.0	0.0	0.0	0.0	na	0.0
	SD	na	9.9	na	na	na	na	na	na
Chinook 0+									
April	Mean	37.8	38.4	37.7	38.5	36.6	37.7	37.4	37.8
	n	146	166	111	142	24	27	54	48
	Maximum	41.0	44.0	41.0	43.0	39.0	40.0	43.0	45.0
	Minimum	32.0	34.0	34.0	34.0	33.0	34.0	32.0	35.0
	SD	1.9	1.7	1.7	1.7	1.6	1.5	1.8	1.7
May	Mean	38.2	40.0	38.4	39.3	39.3	41.1	38.3	41.7
	n	248	305	148	239	57	102	88	169
	Maximum	47.0	49.0	48.0	48.0	49.0	50.0	46.0	50.0
	Minimum	29.0	33.0	32.0	34.0	34.0	34.0	32.0	34.0
	SD	2.5	2.8	2.4	2.7	3.4	3.6	2.9	4.3
June	Mean	45.3	48.1	45.0	47.8	51.2	51.1	47.8	51.2
	n	246	329	94	255	14	129	19	175
	Maximum	59.0	67.0	70.0	70.0	68.0	72.0	57.0	73.0
	Minimum	30.0	36.0	34.0	35.0	43.0	39.0	39.0	40.0
	SD	4.8	5.3	5.6	5.3	7.5	6.7	5.3	6.6
July	Mean	55.2	60.9	51.3	63.4	na	63.6	58.0	68.1
	n	49	223	4	101	0	5	1	34
	Maximum	76.0	81.0	57.0	84.0	0.0	70.0	58.0	87.0
	Minimum	42.0	44.0	45.0	40.0	0.0	57.0	58.0	50.0
	SD	6.5	6.9	6.1	8.1	na	4.7	na	8.4
November	Mean	99.0	94.0	na	98.7	na	93.7	na	95.7
	n	1	34	0	12	0	3	0	3
	Maximum	99.0	105.0	0.0	113.0	0.0	100.0	0.0	106.0
	Minimum	99.0	77.0	0.0	88.0	0.0	86.0	0.0	89.0
	SD	na	7.5	na	8.7	na	7.1	na	9.1

APPENDIX 9

Mean, Maximum and Minimum Weight (g) of Chinook 0+ and 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 9
Mean, Maximum and Minimum Weight (g) of Chinook 0+ and 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996
(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Complex		Natural		Complex		Natural	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
Chinook 1+									
April	Mean	11.48	11.32	11.48	11.09	6.47	10.15	na	10.21
	n	10	125	3	16	1	11	0	17
	Maximum	17.24	16.91	14.23	18.16	6.47	13.66	0.00	13.05
	Minimum	7.97	5.33	8.82	5.20	6.47	7.52	0.00	7.04
	SD	2.57	2.15	2.71	3.42	na	1.94	na	1.88
May	Mean	12.70	14.65	11.63	na	na	10.59	na	17.55
	n	9	18	1	0	0	2	0	3
	Maximum	23.56	22.72	11.63	0.00	0.00	10.92	0.00	17.59
	Minimum	8.86	8.61	11.63	0.00	0.00	10.26	0.00	17.51
	SD	4.48	4.15	na	na	na	0.47	na	0.04
June	Mean	na	20.96	na	na	na	na	na	na
	n	0	2	0	0	0	0	0	0
	Maximum	0.00	22.15	0.00	0.00	0.00	0.00	0.00	0.00
	Minimum	0.00	19.76	0.00	0.00	0.00	0.00	0.00	0.00
	SD	na	1.69	na	na	na	na	na	na
Chinook 0+									
April	Mean	0.41	0.42	0.39	0.42	0.39	0.40	0.38	0.41
	n	146	166	111	142	24	27	54	48
	Maximum	0.57	0.65	0.55	0.64	0.49	0.49	0.49	0.75
	Minimum	0.26	0.26	0.27	0.30	0.27	0.27	0.28	0.30
	SD	0.07	0.07	0.06	0.07	0.06	0.05	0.05	0.07
May	Mean	0.48	0.56	0.47	0.53	0.54	0.62	0.50	0.66
	n	248	305	148	239	57	102	88	169
	Maximum	0.94	1.33	0.98	1.08	1.33	1.24	0.89	1.52
	Minimum	0.15	0.25	0.26	0.27	0.29	0.22	0.26	0.29
	SD	0.13	0.18	0.13	0.17	0.20	0.21	0.15	0.28
June	Mean	1.03	1.26	1.05	1.22	1.58	1.57	1.29	1.57
	n	246	329	94	255	14	129	19	175
	Maximum	2.15	3.48	4.12	3.78	3.80	5.14	2.01	4.70
	Minimum	0.30	0.40	0.30	0.37	0.69	0.62	0.59	0.56
	SD	0.38	0.50	0.52	0.51	0.86	0.77	0.47	0.72
July	Mean	2.08	2.87	1.64	3.15	na	3.16	2.76	3.96
	n	49	223	4	101	0	5	1	34
	Maximum	5.33	6.57	2.16	7.74	0.00	4.32	2.76	8.30
	Minimum	0.80	0.88	1.08	0.59	0.00	2.24	2.76	1.98
	SD	0.80	1.02	0.57	1.20	na	0.76	na	1.52
November	Mean	13.35	10.78	na	11.46	na	9.79	na	10.08
	n	1	34	0	12	0	3	0	3
	Maximum	13.35	14.56	0.00	14.69	0.00	11.09	0.00	11.70
	Minimum	13.35	5.46	0.00	8.55	0.00	7.73	0.00	8.48
	SD	na	2.27	na	2.20	na	1.80	na	1.61

APPENDIX 10

Mean, Maximum and Minimum Condition Factor ($g \cdot mm^{-3}$) of Chinook 0+ and 1+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 10
Mean, Maximum and Minimum Condition Factor (g•mm^{-3}) of Chinook 0+ and 1+
Electrofished During the Day and Night from Habitat Complex and Natural Sites
in Reaches 2 and 4 of the Nechako River, 1996
(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Complex		Natural		Complex		Natural	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
Chinook 1+									
April	Mean	1.17	1.28	1.39	1.32	1.47	1.11	na	1.12
	n	10	125	3	16	1	11	0	17
	Maximum	1.33	1.62	1.89	1.53	1.47	1.42	0.00	1.35
	Minimum	0.98	0.99	1.13	1.01	1.47	0.96	0.00	0.86
	SD	0.11	0.12	0.43	0.13	na	0.16	na	0.16
May	Mean	1.28	1.23	1.27	na	na	1.59	na	1.19
	n	9	18	1	0	0	2	0	3
	Maximum	1.74	1.42	1.27	0.00	0.00	1.86	0.00	1.32
	Minimum	1.14	0.99	1.27	0.00	0.00	1.31	0.00	1.07
	SD	0.19	0.13	na	na	na	0.39	na	0.12
June	Mean	na	1.51	na	na	na	na	na	na
	n	0	2	0	0	0	0	0	0
	Maximum	0.00	1.71	0.00	0.00	0.00	0.00	0.00	0.00
	Minimum	0.00	1.31	0.00	0.00	0.00	0.00	0.00	0.00
	SD	na	0.28	na	na	na	na	na	na
Chinook 0+									
April	Mean	0.75	0.74	0.72	0.74	0.79	0.75	0.74	0.76
	n	146	166	111	142	24	27	54	48
	Maximum	1.14	1.02	0.90	1.00	1.03	0.83	0.92	1.26
	Minimum	0.58	0.55	0.53	0.47	0.66	0.67	0.51	0.45
	SD	0.08	0.08	0.07	0.07	0.08	0.04	0.08	0.10
May	Mean	0.84	0.85	0.82	0.84	0.87	0.86	0.87	0.87
	n	248	305	148	239	57	102	88	169
	Maximum	1.33	1.28	1.31	1.30	1.14	1.23	1.21	1.28
	Minimum	0.49	0.60	0.39	0.63	0.40	0.54	0.66	0.53
	SD	0.11	0.11	0.12	0.12	0.13	0.12	0.12	0.14
June	Mean	1.05	1.07	1.09	1.05	1.08	1.10	1.15	1.10
	n	236	329	94	255	14	129	19	175
	Maximum	2.02	2.50	2.42	1.34	1.25	1.39	2.12	2.40
	Minimum	0.75	0.40	0.75	0.64	0.87	0.64	0.93	0.57
	SD	0.13	0.14	0.25	0.11	0.10	0.11	0.32	0.16
July	Mean	1.20	1.22	1.18	1.18	na	1.21	1.41	1.21
	n	49	223	4	101	0	5	1	34
	Maximum	1.68	1.69	1.23	1.59	0.00	1.26	1.41	1.66
	Minimum	0.97	0.68	1.14	0.84	0.00	1.13	1.41	1.01
	SD	0.14	0.13	0.04	0.11	na	0.05	na	0.12
November	Mean	1.38	1.29	na	1.20	na	1.19	na	1.16
	n	1	34	0	12	0	3	0	3
	Maximum	1.38	1.52	0.00	1.40	0.00	1.29	0.00	1.29
	Minimum	1.38	0.97	0.00	0.96	0.00	1.06	0.00	0.98
	SD	na	0.15	na	0.15	na	0.12	na	0.16

APPENDIX 11

Mean, Maximum and Minimum log_{10}(CPUE +1) of Chinook 0+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 11

Mean, Maximum and Minimum $\log_{10}$(CPUE +1) of Chinook 0+ Electrofished During the Day and Night from Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Complex Sites		Natural Sites		Complex Sites		Natural Sites	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
April	Mean	2.09	2.17	1.82	2.06	1.26	1.14	1.40	1.13
	n	31	31	30	30	13	13	20	20
	Maximum	3.20	3.45	3.10	3.47	2.88	2.92	3.43	3.18
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	1.10	1.07	1.17	1.13	1.24	1.30	1.35	1.31
May	Mean	2.73	3.05	2.20	2.93	2.02	2.99	2.13	2.94
	n	31	31	30	30	13	13	20	20
	Maximum	3.68	4.38	3.75	4.15	3.10	3.65	3.09	3.65
	Minimum	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00
	SD	0.66	1.18	1.10	0.95	1.20	0.38	0.99	0.78
June	Mean	2.68	3.26	1.80	3.05	0.86	3.20	0.87	2.96
	n	31	31	30	30	13	13	20	20
	Maximum	3.89	4.43	3.81	3.80	2.77	3.52	2.70	3.57
	Minimum	0.00	0.00	0.00	2.22	0.00	2.88	0.00	0.00
	SD	0.72	0.80	1.19	0.40	1.16	0.20	1.11	0.76
July	Mean	0.88	2.57	0.28	2.11	0.00	1.33	0.11	1.50
	n	26	26	26	23	6	5	18	17
	Maximum	2.92	3.93	1.93	3.28	0.00	2.22	1.93	2.92
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	1.16	1.07	0.67	1.06	0.00	1.22	0.45	1.17
November	Mean	0.20	0.74	0.00	0.76	0.00	1.38	0.00	0.35
	n	19	3	22	19	4	3	17	12
	Maximum	1.93	2.22	0.00	2.43	0.00	2.22	0.00	2.22
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	0.61	1.28	0.00	1.03	0.00	1.21	0.00	0.81

APPENDIX 12

Mean, Maximum and Minimum $\log_{10}$(CPUE +1) of Chinook 0+ Electrofished During the Day and Night from Debris Bundle and Debris Catcher Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

Appendix 12

Mean, Maximum and Minimum log_{10}(CPUE +1) of Chinook 0+ Electrofished During the Day and Night from Debris Bundle and Debris Catcher Habitat Complex and Natural Sites in Reaches 2 and 4 of the Nechako River, 1996

(n is number of samples, SD is standard deviation)

		Reach 2				Reach 4			
		Bundles		Catchers		Bundles		Catchers	
Month	Statistics	Day	Night	Day	Night	Day	Night	Day	Night
April	Mean	2.06	2.34	2.12	2.04	1.61	1.43	0.48	0.48
	n	13	13	18	18	9	9	4	4
	Maximum	3.20	3.37	3.20	3.45	2.88	2.92	1.93	1.93
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SD	1.22	0.86	1.04	1.20	1.23	1.37	0.96	0.96
May	Mean	2.78	2.99	2.70	3.10	2.17	3.03	1.68	2.91
	n	13	13	18	18	9	9	4	4
	Maximum	3.68	4.11	3.59	4.38	3.10	3.65	2.40	3.32
	Minimum	1.93	0.00	0.00	0.00	0.00	2.40	0.00	2.62
	SD	0.47	1.08	0.78	1.27	1.26	0.42	1.14	0.30
June	Mean	2.77	3.25	2.62	3.27	1.00	3.23	0.56	3.14
	n	13	13	18	18	9	9	4	4
	Maximum	3.89	4.43	3.69	3.96	2.77	3.43	2.22	3.52
	Minimum	1.93	1.93	0.00	0.00	0.00	2.88	0.00	2.92
	SD	0.55	0.69	0.83	0.89	1.21	0.18	1.11	0.27
July	Mean	0.76	2.94	0.98	2.31	0.00	1.67	0.00	0.00
	n	12	11	14	15	5	4	1	1
	Maximum	2.92	3.93	2.82	3.57	0.00	2.22	0.00	0.00
	Minimum	0.00	2.22	0.00	0.00	0.00	0.00	0.00	0.00
	SD	1.16	0.56	1.19	1.27	0.00	1.11	na	na
November	Mean	0.19	1.11	0.21	0.00	0.00	1.38	0.00	na
	n	10	2	9	1	3	3	1	0
	Maximum	1.93	2.22	1.93	0.00	0.00	2.22	0.00	na
	Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
	SD	0.61	1.57	0.64	na	0.00	1.21	na	na