Bulkley River Watershed
Overwintering Study
2007-2008

prepared by

Brenda Donas and Natalie Newman, RPBio.
Department of Fisheries and Oceans
Smithers, B.C.

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Executive Summary

An overwintering study was conducted from November 2007 to March 2008 in the Bulkley River watershed in north-central British Columbia. The study area includes Byman, McQuarrie, Barren and Richfield Creeks, located in the lower portion of the Upper Bulkley watershed upstream of the confluence of the Morice and Bulkley rivers near Houston, B.C. and Waterfalls Creek (a tributary to Mission Creek), located at the Village of New Hazelton, B.C. This study focused on monitoring species composition and fish condition at sites that were index sites during the Bulkley/Morice Watershed Overwintering Studies conducted from 1998 – 2001. This over-wintering monitoring was conducted to provide background data to assist Habitat Management staff and Resource Restoration staff in liaising with various agencies and proponents when work is to be conducted in areas of the Upper Bulkley and Mission Creek watershed study areas.

Species composition, fork length and weight data were collected when possible. Catch per unit effort (CPUE) data and condition of fish was collected over the winter at each site. Winter and spring habitat assessments were also completed at each site over the winter.

This report focuses primarily on the reporting of data collected during this study (2007/2008), although some comparisons have been made to the previous year's study (2005/2006 and 2006/2007).

Upper Bulkley Sites

Winter habitat assessments found all sites to have sufficient water depth and dissolved oxygen (DO) throughout the winter. The overwintering habitat at the Barren site, located immediately upstream of the highway culvert, had greatly improved from no overwintering habitat that was noted in the previous years' study (06/07). The lack of overwintering habitat at Barren Creek in 2006/07 was likely due to extensive dredging activity upstream and downstream of the culvert in the summer of 2006, coupled with extremely low water levels immediately before freeze up in November 2006.

Overall, species composition at the Upper Bulkley sites consisted of coho salmon (*Onchorhynchus kisutch)* and Rainbow trout (RBT)/steelhead (sthd) (*Onchorhynchus mykiss).* All sites were consistently sampled during the study, and total catch consisted primarily of RBT/sthd at the Byman, Richfield and McQuarrie Creek sites, while both coho and RBT/sthd juveniles were caught at the Barren Creek site. The Barren Creek site had the highest proportion of coho captured of all the sites.

Coho and RBT/sthd captured at the Upper Bulkley sites were mostly in the greater than 80 mm length categories. There seemed to be an absence of fry of the year i.e. specifically coho in the less than or equal to 80 mm fork length category. For most sites it was not possible to analyze mean condition factor (FCC) of coho salmon from the beginning to end of winter since the numbers captured were low. The mean condition factor of the less than or equal to 80 mm category coho at Barren was 1.28 at the beginning of winter. The mean condition factor of the

greater than 80 mm coho at Barren was 1.07 at the beginning of winter and 1.04 at the end of winter, which suggests this site provides good overwintering habitat for coho.

The mean FCC for RBT/sthd at Barren in the greater than 80 mm fork length category was 1.11 in both Nov. and April sample dates. RBT/sthd in the less than 80 mm fork length category was not captured at Barren in the Nov. or April sample dates. The mean FCC for RBT/sthd at Byman in the greater than 80 mm fork length category was 1.02 on Nov. 22/07 and 1.08 on April 1, 2008. RBT/sthd in the less than 80 mm fork length category was not captured on Nov. 22, 2007 and only 1 was captured on April 1, 2008. The mean condition factor data indicates that both Barren and Byman provide good overwintering habitat for RBT/sthd, especially in the greater than 80 mm fork length category.

The CPUE for coho salmon at the beginning of winter differed among the four sites in the upper Bulkley watershed. The highest CPUE for coho at the beginning of winter was at Barren (10.7 coho/trap), whereas the lowest was at Richfield and Byman (0 coho/trap). CPUE for coho at Barren was also the highest at the end of winter (5.3 coho/trap).

The CPUE for RBT/STHD decreased at Byman from 4/trap at the beginning of winter to 1/trap at the end of winter. The Barren site had the most RBT/STHD captured at the beginning and middle sample dates of all the sites, but CPUE decreased at this site to just over 1/trap at the end of winter. At Richfield, the CPUE increased from 2/trap at the beginning to over 4/trap at the end of winter. McQuarrie had the lowest CPUE (0/trap) for RBT/STHD at the beginning of winter of all the sites, but increased to over 1/trap at the middle and end of winter sample dates.

Waterfalls Creek Sites

Habitat assessments found all four sites to have sufficient water depth, DO and potential for migration throughout the winter.

Two species were captured at the Waterfalls Creek sites, including coho salmon and Dolly Varden char (*Salvelinus malma*). High numbers of coho were captured at all four sites, likely due to adult and fry stocking enhancement in the system. On the whole, there were much fewer Dolly Varden captured at the Waterfalls Creek sites during this study as well as in 2006/07, compared to the 2005/06 study. It should be noted that cutthroat trout (*Oncorhynchus clarki*) were not captured during this study. Cutthroat trout were documented in low numbers during the 2005/06 and 2006/07 studies.

A large proportion of coho captured at the site 1 were less than or equal to 80 mm. The proportion of coho in the two length categories appeared to be similar for sites 2-4, where a higher proportion of coho in the greater than 80 mm category were captured on Nov. 20/07, where as a higher proportion of coho in the less than or equal to 80 mm category were captured on Jan. 17/08 and March 27/08.

At site 1, the mean FCC appeared to decrease over the winter, from 1.18 (Nov. 20) to 1.05 (March 27) for less than or equal to 80 mm coho. Similarly, the mean FCC for greater than 80 mm coho decreased from 1.08 in Nov. to 0.97 at the end of March. At site 2, the mean FCC

decreased for both the less than or equal to 80 mm coho and greater than 80 mm coho, where coho decreased from 1.21 (Nov. 20) to 1.01 (March 27), and from 1.02 (Nov. 20) to 0.92 (March 27), respectively. At site 3, the mean FCC increased for the less than or equal to 80 mm coho from 1.04 to 1.07, and decreased for the greater than 80 mm coho from beginning (1.04) to end (0.98) of winter. The culvert pool of site 4 had a minimal decrease in mean FCC for both category coho from Nov. and March where it was lowest for the greater than 80 mm coho at the end of winter (0.98). Overall, the mean FCC from beginning to end of winter at all four sites indicates that these sites provide good overwintering habitat for coho.

There was a relatively even proportion of Dolly Varden captured at site 1 that were either less than or equal to 80 mm or greater than 80 mm in length. Low numbers of DV were captured at site 2 in both length categories. The majority of DV captured at site 3 were of the greater than 80 mm category, and there was a substantial increase in DV over the winter where 9 DV were captured on Nov. 20/07 and 24 DV were captured on March 27/08. The majority of DV captured at site 4 were of the greater than 80 mm category.

The mean condition factor for DV at the beginning of winter at site 1 was 1.12 for the $\leq$ 80mm DV and 0.94 for the >80 mm DV, and end of winter could not be calculated due to low numbers. The mean condition factor for site 2 has not been calculated since only 1 DV in total was captured. There appeared to be a marked decrease in mean FCC over the winter for the > 80 mm DV at sites 3 and 4, where it decreased from 0.99 to 0.88 (site 3) and 0.98 to 0.85 (site 4).

At Waterfalls Creek, the CPUE for coho salmon decreased overall from beginning to end of winter at sites 1-4. The CPUE for coho was highest at site 1 and lowest overall at site 4 over the winter. On the whole the CPUE for coho at all sites in 2007/08, and in 2006/07, far exceeded the CPUE for DV, which was not always the case in 2005/06.

The CPUE at site 3 of Waterfalls Creek increased the most over the winter of the 4 sites sampled, where it ranged from 3.7/trap to 12.0 DV/trap. Overall, the CPUE for DV was greatest at the end of winter, as compared to beginning of winter, at sites 2 - 4. Site 1 showed a slight decrease in CPUE for DV over the winter sample dates.

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Acknowledgements

The overwintering study of 2007/2008 was conducted by the Department of Fisheries and Oceans Canada (DFO), Smithers, B.C. Brenda Donas designed the project, based on previous years of overwintering sampling conducted by Brenda Donas (DFO) in conjunction with SKR Consultants Ltd. Brenda Donas, Patty Menning and Leaf Thunderstorm conducted field sampling. Data was entered by Brenda Donas, Patty Menning and Leaf Thunderstorm. Data analysis and reporting was conducted by Brenda Donas and Natalie Newman.

1.0 INTRODUCTION

The 2007/2008 overwintering program was used to monitor species composition and fish condition within the study area (i.e., Byman, Barren, McQuarrie, Richfield and Waterfall Creek) located in the Bulkley River watershed. Culvert pools, as well as other pools were areas of focus. The Waterfall Creek monitoring sites were the same index sites monitored during the 1998 – 2001 overwintering study (Donas and Saimoto. 2001b).

The Bulkley River watershed is utilized by several species of pacific salmon (coho, Chinook, sockeye, pink salmon) and steelhead, which have been in decline (Houston Chapter of the Steelhead Society of B.C. 1990, BCCF 1997, 1998, Holtby and Finnegan 1998). Declines in salmon stocks are generally attributed to over-exploitation of the stocks, decreased ocean or freshwater survival or a combination of these (Hillborn and Walters 1992, Walters 1995, Slaney *et al.* 1996, Slaney and Zaldokas 1997, Bradford and Irvine 2000). Decreased survival of juveniles in freshwater is often attributed to habitat degradation (National Research Council 1992, Johnston and Slaney 1996, Slaney and Zaldokas 1997, BCCF 1998). Winter survival has been considered to be one potential bottleneck in salmonid production in several systems (Bustard and Narver 1975, Swales *et al.* 1986, Dolloff 1987, Koning and Keeley 1997) since winter is generally a more stressful time for fish with resultant starvation, energy loss, declines in fish health and survival (Bustard and Narver 1975, Dolloff 1987, Cagnelli and Gross 1997) (Donas and Saimoto 2001a).

The long-term objectives of the Bulkley overwintering studies are to:

- determine changes in species abundance during the winter,
- document changes in weight, length and condition of species at sites examined,
- document changes in habitat such as reduction in available habitat over the course of the winter,
- document any changes to the quality of overwintering habitat due to low water levels as compared to previous years measurements at the same sites.

This report documents the results of the overwintering study from November 2007 to March 2008. Sampling was conducted in November, January and March as those months would be representative of pre-winter, mid- winter and end of winter conditions. Previous overwintering study measurements were conducted during each month of winter in the 1998-2001, and 2005-2006 studies.

2.0 STUDY AREA

The Bulkley River is a major tributary to the Skeena River, located in north-central British Columbia. The Bulkley River drains into the Skeena River near the Village of Hazelton, B.C. The study area includes Byman, McQuarrie, Barren and Richfield Creeks, located in the Upper Bulkley watershed upstream of the confluence of the Morice and Bulkley rivers near Houston, B.C. (Figure 1). The study area also includes Waterfall Creek, a tributary to Mission Creek, at the Village of New Hazelton, B.C. Waterfall Creek is located in the lower Bulkley River Watershed (Figure 2).

Figure 1. Locations of sites sampled in the Upper Bulkley Watershed.

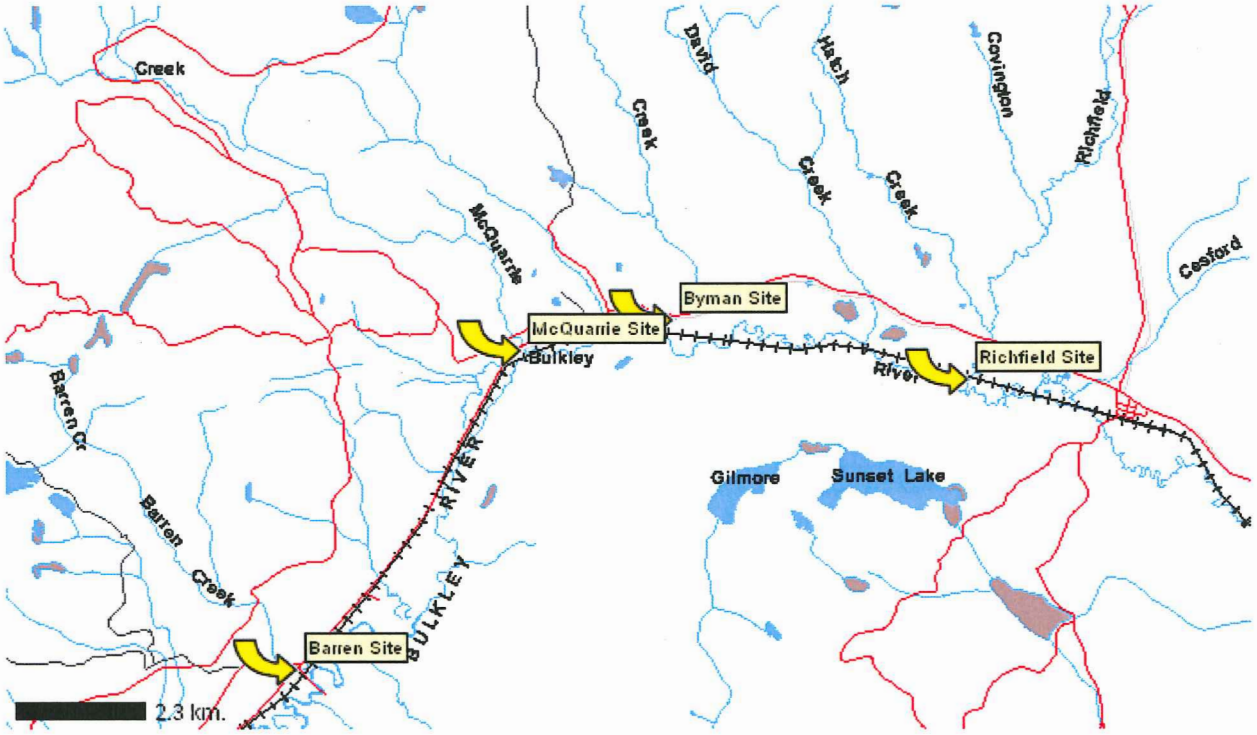
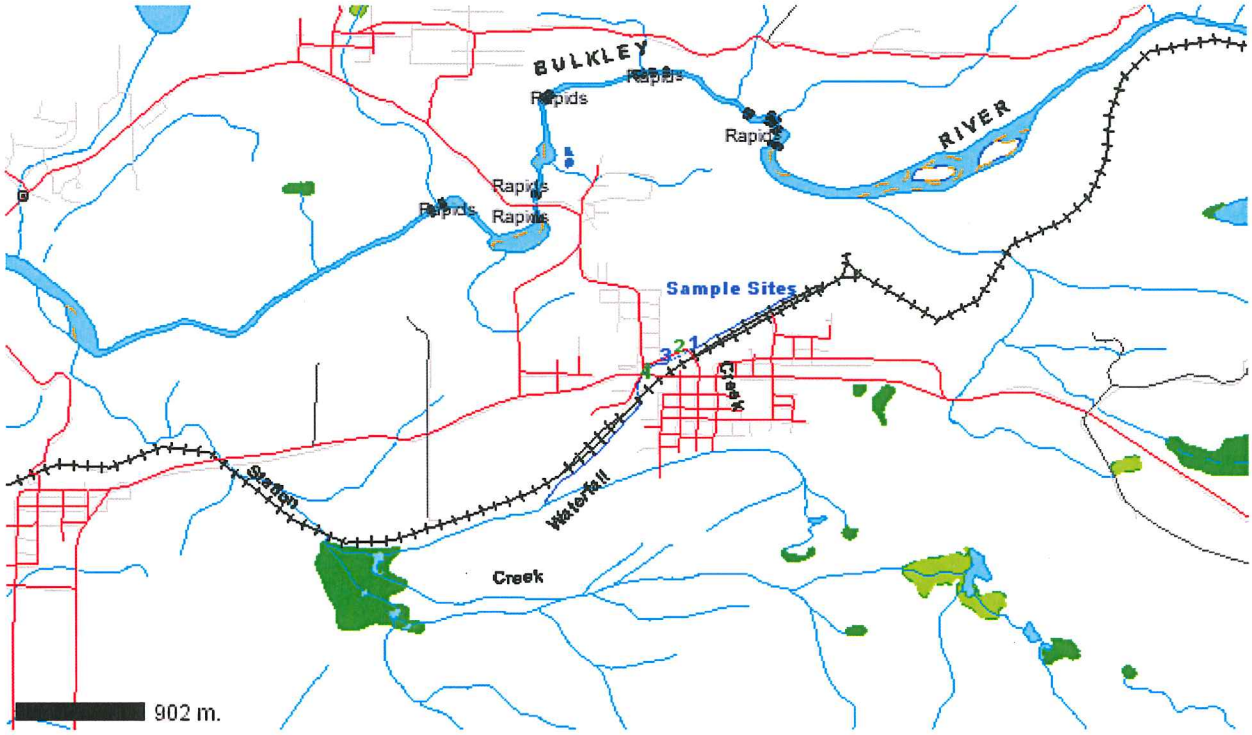


Figure 2. Locations of sites 1-4 sampled in the Lower Bulkley Watershed (Waterfall Creek).



3.0 MATERIALS AND METHODS

3.1 Habitat Assessment

Sites were selected based on accessibility of sites to salmonids and ease of access during winter sampling. Many of the sites were at culvert pools at road crossings. Sample site locations are illustrated in Figures 1 and 2. All sites located on Barren, Byman, McQuarrie and Richfield Creek are drained by the Upper Bulkley River watershed, and are found within the portion of the watershed accessible to salmonids (downstream of falls). Most of these sites were either located upstream or downstream of culverts situated along the Highway 16 corridor and one site was located under a railway bridge. The Waterfalls Creek sites in New Hazelton are located in the Lower Bulkley River watershed, and were sampled for continuity with the previous years of sampling (Donas and Saimoto 1999, 2000, 2001).

3.1.1 Winter Assessments

Changes in physical and chemical parameters (Table 1) were recorded monthly for each sample site using a data form designed for overwintering sampling (Appendix 1). Monthly physical and chemical data were collected by removing ice from the limnological/trapping station by hand with an axe.

These data include air temperature, pH, water temperature, ice thickness, snow depth, dissolved oxygen, and water depth.

Table 1. Physical and chemical parameters recorded on a monthly basis for each site during the overwintering study.

	Parameter	Unit/Categories	Method
General site description			
	Air temperature	Celsius	truck thermometer
	Ice Cover	percent	visual estimate
	Stream Flow	None, Low, Moderate, High	visual estimate
	Potential for fish migration	None, Low, Moderate, High	visual estimate
Limnological station	water depth	centimeters	meter stick
	ice thickness	centimeters	meter stick
	clarity of ice	None, Low, Moderate, High	visual estimate
	snow depth	centimeters	meter stick
	water temperature	Celsius	OxyGuard D. O. Meter
	turbidity	None, Low, Moderate, High	visual estimate
	Dissolved Oxygen	ppm	Oxyguard
	pH	pH units	Hanna H 19812

3.2.2 Summer Assessments

The physical characteristics were evaluated at each site prior to the onset of winter. These site assessments were conducted from July to August 2007, using an updated data form designed for the project (*Appendix 2*). The data form was updated from the spring assessment form used in the 2006/07 overwintering study, in order to be more consistent with the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnson_NT1996.pdf). Habitat measurements were documented for all sites (Table 2).

Table 2. Physical parameters recorded in the field for each site sampled in April 2007, immediately after ice thaw.

	Parameter	Unit/Categories	Methods
pool, glide or riffle	Length of habitat unit	meter	hipchain
	Wetted width	meter	hipchain
	Bankfull width	meter	hipchain
	Max. wetted depth (at deepest point)	centimeter	Meter stick
	Depth at trap cluster location	centimeter	Meter stick
	Depth at riffle crest (at pool outlet)	centimeter	Meter stick
	Residual pool depth	centimeter	N/A
	Total % of wetted area covered	percent	Visual estimate
	Cover % breakdown (adds to 100%)		
	Cobble proportion of site	percent	Visual estimate
	Boulder proportion of site	percent	Visual estimate
	SWD (<10cm diameter)	percent	Visual estimate
	LWD (>10cm diameter)	percent	Visual estimate
	Undercut Banks	percent	Visual estimate
	Instream Vegetation	percent	Visual estimate
	Overhanging Vegetation	percent	Visual estimate

	Parameter	Unit/Categories	Methods
	Deep Pools	percent	Visual estimate
	Bed Material (adds to 100%)		
	% fines (< 2mm)	percent	Visual estimate
	% gravel (2-64 mm)	percent	Visual estimate
	% cobble (64-256 mm)	percent	Visual estimate
	% boulder (>256mm)	percent	Visual estimate
	% bedrock	percent	Visual estimate
	Description of other habitat features, impacts or restoration opportunities.	N/A	N/A

3.2 Fish Sampling

Low water temperatures and thick ice cover precluded the use of electrofishers, since electrofishing at water temperatures below 4°C can be harmful to salmonids. Fish sampling was conducted by setting minnow traps baited with roe in nylon bags at each of the sample sites during each sampling period (beginning, middle and end of winter). The minnow traps were left for 24 hours. Fish were recovered from the traps, anesthetized with Alka Seltzer and baking soda, identified to species, measured (fork length ± 1.0 mm), weighed (± 0.1 g using an Acculab V1200 electronic balance) and released back into the habitat. Due to difficulties encountered with estimates of population size in the winter of 1998/1999 (Donas and Saimoto 1999), no mark-recapture estimates were conducted in the winter of 2007/2008. Attempts were made to standardize the trapping intensity by considering the surface area of the site and it was assumed that a cluster of three traps would attract juvenile salmonids within a 50 m^2 surface area.

Trapping intensity at each site changed through the winter, in some cases, due to decreased pool depth in the latter portion of winter. Total catch and particularly catch per unit effort (i.e. catch per trap) was used as an indicator of fish abundance, as suggested in previous studies (Swales *et al.* 1986).

3.3 Fish Fork Length, Size and Condition

Fulton's condition factor was calculated for sampling dates where both length and weight of the fish were recorded. Fulton's condition factor (equation 4) is useful where growth is isometric, and/or if the fish to be compared are of approximately the same length (Ricker 1975, Bagenal 1978). Fulton's condition factor provides a measure of fatness of the fish, which is expected to reflect a fish's health.

Equation 4: $K = 10^5 (w / l^3)$

where: K = Fulton's condition factor
w = weight (g)
l = length (mm)

4.0 RESULTS

4.1 Habitat Assessment

Sites chosen in 2007 were at pools associated with road culvert crossings and other pools or glides that were expected to be suitable for overwintering habitat. Most of the sites were also monitored during the 2006/07 study. Four sites on tributaries to the Upper Bulkley watershed, and four sites in the Waterfall Creek mainstem (a tributary to Mission Creek) were sampled. The distribution of sites among general habitat types is summarized in Table 3. Winter and summer habitat assessment forms are located in Appendices 1 and 2, respectively.

4.1.1 Summer Assessments

Summer assessments were conducted at all eight sites in July and August 2007. Five of the eight sites could be characterized as pool habitat and the remaining three sites as glides. The surface area, width and depth of all sites are summarized in Table 4.

4.1.1.1 Surface Area, Width and Depth

A total of eight sites were sampled in July and August 2007. Sites ranged in surface area from 25.7m^2 to 196.8 m^2. One of the Waterfall Creek sites, site 2, had the largest surface area (196.8 m^2). The average surface area of the Upper Bulkley sites was 87.4 m^2 (SD=62.2). The average surface area of the Waterfalls Creek sites was 104.8 m^2 (SD=61.9). It should be noted that sites 1 and 2 of Waterfalls Creek were situated in the same 110 meter long glide, where site 1 was situated at the upper end of the glide and site 2 was situated at the lower end of the glide. The total length of the glide was assumed to be 16.7 meters based on an attraction distance of 8.3m upstream of a cluster of three traps and 8.3m downstream of a cluster of traps.

Wetted width of all the sites ranged from 4.5 to 12.3 meters. Wetted width averaged 7.4 m (SD=3.22) at the Upper Bulkley sites, and 8.1 m (SD=3.29) at the Waterfalls Creek sites. Maximum depths of all the sites ranged from 68.5 to 200 centimeters. The maximum depths averaged 80.1 cm (SD=16.5 cm) at the Upper Bulkley sites, and 65.3 cm (SD=24.8 cm) at the Waterfalls Creek sites.

4.1.1.2 Habitat, Substrate and Cover

The majority of the habitat sampled consisted of pools (n=5) and the remainder consisted of glides (n=3). Sites sampled had estimated gradients ranging between 0-1 percent. The dominant substrate type at 60% of the sites was fines, and the others were dominated by either gravels, cobble or boulders. The highest proportion of boulders was found at Waterfalls Creek site 4, primarily due to rip-rap along the banks that dislodged to the channel bed. The glide type habitat of Sites 1 and 2 of Waterfall Creek consisted predominately of fines. At the Byman Creek and

McQuarrie Creek sites 60% to 80% of the bed material was made up of a combination of gravels and cobble with some boulders.

Cover was provided primarily by deep pools, cobbles, and boulders. Small woody debris was present at Waterfall Creek Sites 1-4 (2-5%). Cover provided by LWD was present in a small amount (~2-5%) at Byman and Waterfall Creek Site 4. Cover was provided in smaller amounts by instream vegetation and overhanging vegetation at some of the sites; however, this cover would not be present during the winter.

Table 3. Site description and sampling times during the Bulkley River overwintering study, November 2007 to March 2008.

	Site # or Name	Location	Habitat	Surface Area (m^2)	Dates (07/08)
Upper Bulkley River Trib's	McQuarrie*	just downstream of highway 16, upstream of CNR crossing	Culvert pool, cobble	95	Nov., Jan., March
	Byman*	downstream side of highway 16 crossing	Culvert pool, cobble	184	Nov., Jan., March
	Barren*	upstream side of highway 16 crossing. This pool was dredged in September 2005 and September 2006.	Dredged pool, fines/gravel	25.7	Nov., Jan., March
	Richfield	Pool underneath the CNR bridge, located about 200 m upstream of the confluence with the Upper Bulkley.	Glide, all bed material present other than bedrock	45	Nov., Jan., March
Waterfalls Creek (Lower Bulkley)	Site 1*	Located approx. 1 km upstream of Highway 16 culvert, just downstream of a beaver dam. This is the uppermost site sampled, and is located adjacent to railway tracks.	Glide, fines	81.6	Nov., Jan., March
	Site 2*	Located approx. 800 m upstream of Highway 16 culvert, just upstream of a beaver dam. This site is also located adjacent to railway tracks.	Glide, fines	196.8	Nov., Jan., March
	Site 3*	Located approx. 500 m upstream of Highway 16 culvert, just upstream of a riffle. Site located adjacent to road.	Pool, fines/cobble/boulder	78.0	Nov., Jan., March
	Site 4*	Located just downstream of culvert crossing of road to landing. This site is located approximately 200 m downstream of Highway 16 culvert.	Culvert pool, cobble.	62.8	Nov., Jan., March

([1] also see Figure 1 and 2 for site locations
* indicates sites also sampled in the winter of 1999 – 2001, 2005/06 and 2006/07)

Table 4. Surface Area, Wetted Width and Maximum Depth of all sites sampled in July 2007.

	Barren	Byman	McQuarrie	Richfield	Waterfalls Site 1	Waterfalls Site 2	Waterfalls Site 3	Waterfalls Site 4
Wetted Width (m)	4.5	11.8	7.8	5.6	5.9	12.3	5.1	9.1
Max. Depth (cm)	116	200	101	77	83	115	68.5	88
Surface Area (m^2)	25.7	184	95	45	81.6	196.8	78.0	62.8

4.1.2 Winter Assessments

Some variability in air and water temperature, dissolved oxygen, pH, water depth, ice cover and thickness, and snow depth were observed among the sites sampled during the winter. Turbidity remained clear throughout the winter at all sites. Quantitative data recorded during the winter sampling at the sites are summarized in Table 5. Ranges, means and variability of conditions recorded during the winter assessments at all the sites are also provided in Table 5. Refer to Appendix 1 for detailed information.

Air temperature throughout the study ranged from a low of -20°C to a high of 2°C. It was not possible to individually sample juveniles on all sample dates. Individual sampling was not conducted when air temperature was below -10°C. Water temperature ranged from 0.1°C to 2°C, with the highest water temperatures recorded at site 1 of Waterfalls Creek.

The recorded pH across all sites was within safe limits for salmonids and ranged from 6.7 to 8.5 with a mean of 7.3. Dissolved oxygen (DO) levels were also within safe limits for salmonids and were greater than 10 ppm for all sites throughout the sample period. Minimum water depth (27 cm) was recorded at site 3 of Waterfalls Creek on January 16, 2007. Maximum water depth (112 cm) was recorded at site 1 of Waterfalls Creek on January 16, 2007.

Stream flow ranged from low to moderate at all sites, with high flows noted at the Byman site on Nov. 21, 2007. The potential for fish migrating in and out of the pools at the upper Bulkley sites ranged anywhere from low to high, with the high potential for migration at the Byman Creek, Richfield Creek and McQuarrie Creek sites. The potential for fish migrating in or out of glides or pools at sites 1-4 of Waterfalls Cr. was high, not including site 4 on Jan. 16, 2008 where it was low.

Ice cover throughout the winter at the Upper Bulkley sites, other than Barren, ranged from 1%-100%. Ice thickness appeared to be greatest at Richfield Cr. (23 cm on January 14, 2008). Overall ice thickness was lowest at Barren (0 to 1.0 cm), possibly due to ditch water flowing in on the right bank side of the pool. Maximum ice cover and thickness at the Waterfall creek sites ranged from 90-100% and 3.8-20 cm during the November and January sampling dates. In March, the ice cover and thickness was greatest at site 2 Waterfalls Creek (70%; 13.9cm) and lowest at Waterfalls site 3 (2%, 2cm). Snow depth at all the sites ranged from 0 – 81 cm.

Table 5. Summary of winter assessment results at all sites sampled from November 2007 to March 2008.

Variable	N	Minimum	Maximum	Mean	Standard Deviation
Air Temperature	24	-8°C*	2^0C	-2.8^{0}C	3.8^{0}C
Water Temperature	24	0.1^{0}C	2^0C	0.5^{0}C	0.7^{0}C
Dissolved Oxygen	24	10.4 ppm	14.0 ppm	12.9 ppm	0.9
pH	24	6.7	8.5	7.3	0.4
Water Depth (cm)	24	32 cm	112 cm	68.3 cm	23.2
Ice Thickness (cm)	24	0 cm	23 cm	5.4 cm	7
Ice Cover (%)	24	0%	100%	46%	40
Snow Depth (cm)	24	0 cm	81 cm	18.1	21.4

N=Number of times the variable was recorded over the course of the winter study.
*Air Temperature was approximately -20^{0}C at the Upper Bulkley sites on the fish sampling day.

4.1.3 Changes in Habitat During the Winter

The change in habitat at sites in the Upper and Lower Bulkley tributaries is presented in the following sections for comparison purposes. Water depth, ice thickness and dissolved oxygen measurements are graphed for each site (Figures 3 and 5). Ice cover and snow depth varied throughout the winter and have been graphed for each site (Figures 4 and 6). The pH remained relatively consistent throughout the winter. Air temperature varied throughout the winter since some sites were sampled during warm or cold spells. Only minor decreases in water temperatures occurred at all sites throughout the winter (Refer to data sheets in Appendix 2 for more detailed information).

4.1.3.1 Upper Bulkley tributary Sites

Water depths at Barren, Byman, McQuarrie and Richfield are presented in Figure 3. Water depths at all sites remained greater than 30 cm throughout the winter. The depths overall were greatest at Barren and the lowest at Richfield. The lowermost depth was recorded at Richfield in January 2008. The dissolved oxygen (DO) was consistently greater than 12 ppm at all sites. Ice thickness appeared to vary substantially over the winter, where it was found to be greatest at all sites, other than Barren, during the January 2008 sampling date.

Ice cover that was recorded on March 31, 2008 was greatest for all sites other than Richfield where its ice cover was greatest on January 14, 2008 (Figure 4). Overall, snow depth for all the sites appeared to be greatest on January 14, 2008.

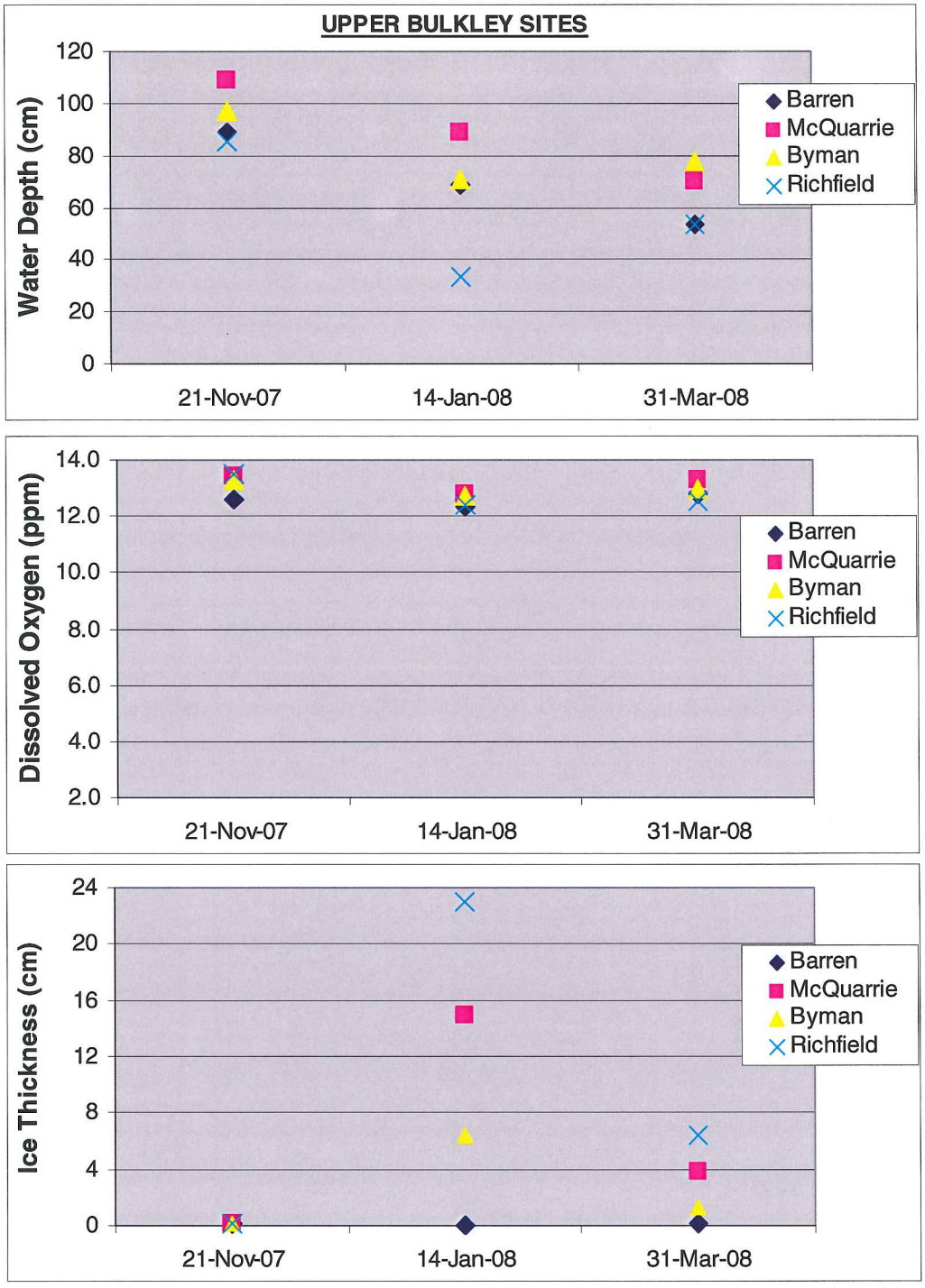


Figure 3. Water Depth, Dissolved Oxygen and Ice Thickness at the Upper Bulkley Tributary sites (2007/08).

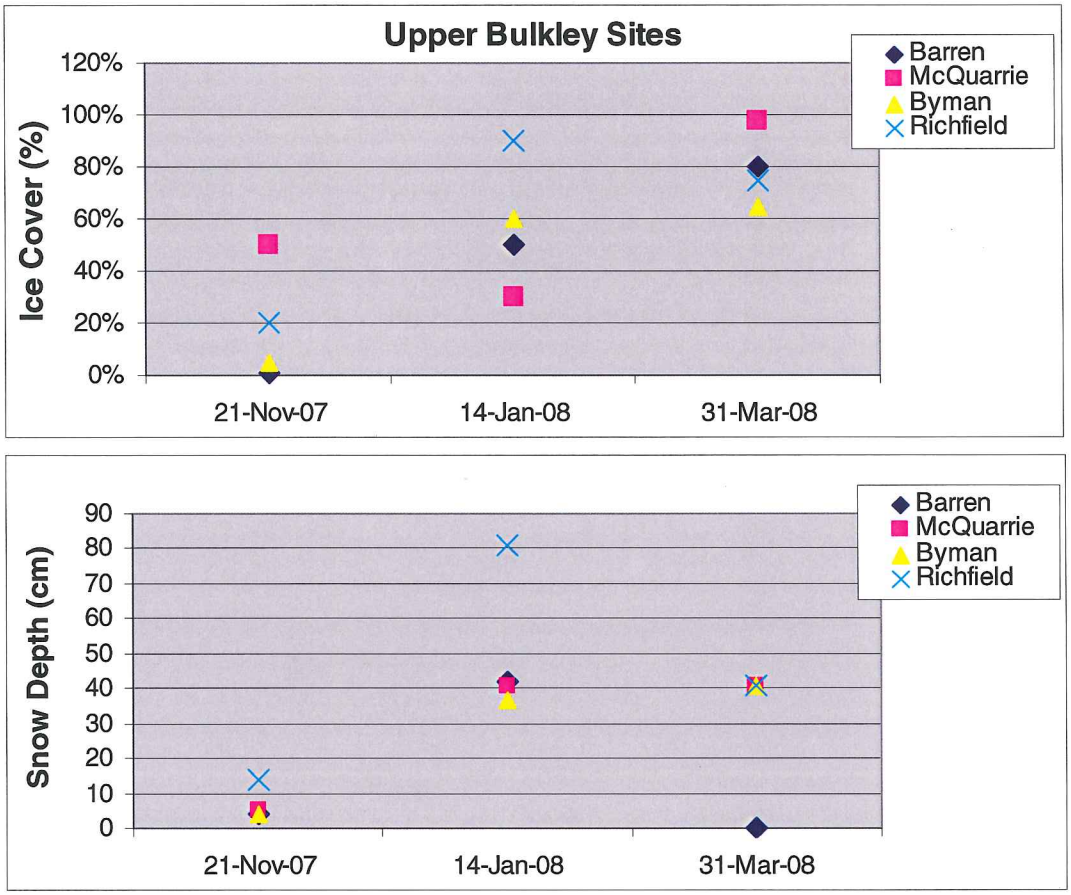


Figure 4. Ice Cover and Snow Depth recorded at the Upper Bulkley Tributary sites (2007/08).

4.1.3.2 Lower Bulkley tributary sites

Water depths varied throughout the winter at all Waterfalls Creek sites. The greatest depth was recorded at site 1 and the lowest depth was recorded at site 3, on January 16, 2008, respectively. Sites 1-4 had water depths greater than 20 cm throughout the winter. The dissolved oxygen of all four sites appeared to decrease throughout the winter, with the most marked decrease noted at site 4 (Figure 5). Ice thickness appeared to be greatest for all sites on January 16. 2008.

Ice cover was recorded to be greatest at all four sites on the Jan. 16, 2008 sampling date (Figure 6). Ice cover and snow depth was minimal at all sites at the beginning and end of winter, except at site 2 where ice cover was recorded to be greater than 60% on March 26, 2008. Snow depth was recorded to be highest at all four sites on Jan. 16, 2008.

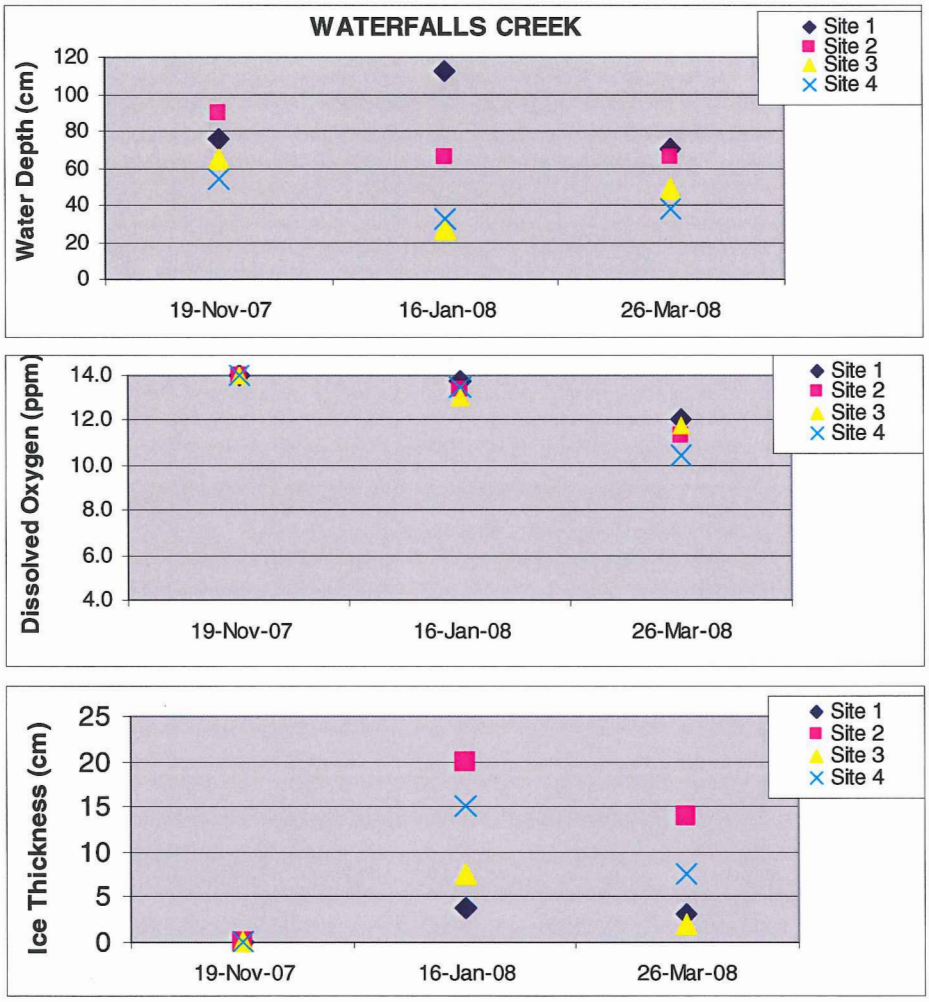


Figure 5. Water Depth, Dissolved Oxygen and Ice Thickness at the Lower Bulkley Tributary sites (2007/08).

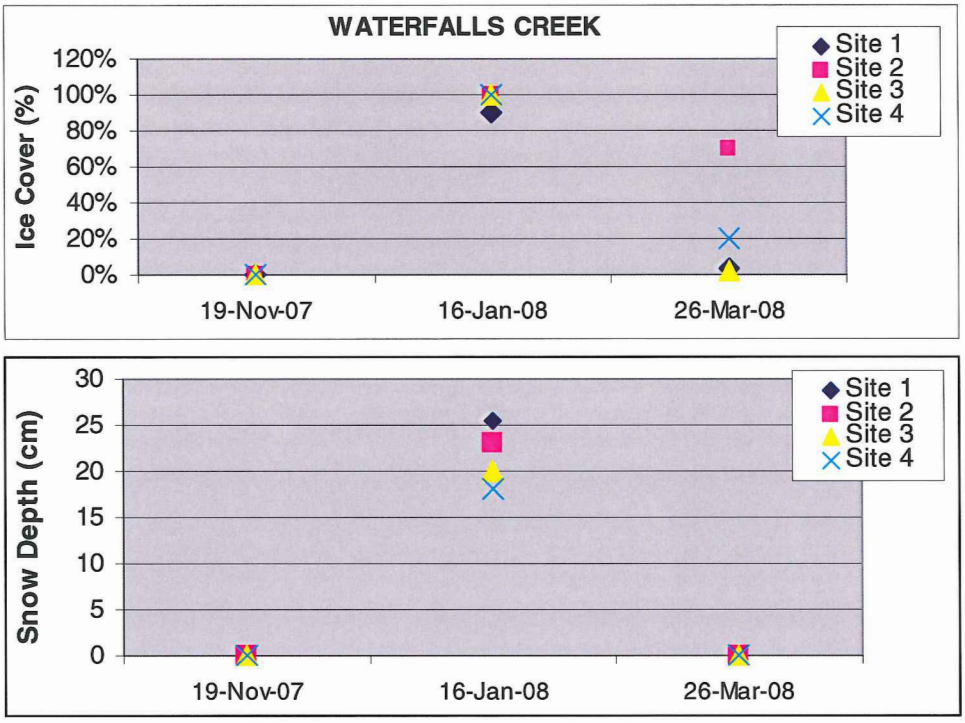


Figure 6. Ice Cover and Snow Depth recorded at the Lower Bulkley Tributary sites (2007/08).

4.2 Fish Sampling

Coho, rainbow trout (RBT)/steelhead (sthd) and Dolly Varden char were captured during the overwintering study. The following sections present fish sampling results for the Upper and Lower Bulkley tributary sites sampled between November 2007 and March 2008.

4.2.1 Upper Bulkley Tributary Sites

Coho and RBT/sthd were captured during the overwintering study conducted at the Upper Bulkley tributary sites between November 2007 and March 2008. The species composition, as well as fish fork length frequencies and condition will be discussed. Appendix 1 contains all the fish capture data for each site throughout the winter sampling program.

4.2.1.1 Species composition

The species composition varied between the four sites and dates sampled at the Upper Bulkley tributary sites (refer to Figures 7 to 10). All four of the Upper Bulkley sites were continuously sampled (i.e., three times) throughout the winter.

A total of 12 RBT/sthd were captured at Byman in November and 15 fish were captured in January with the catch consisting of rainbow trout/sthd (13, 87%), and coho (2, 13%). The catch on April 1, 2008 consisted of 3 RBT/sthd (Figure 7).

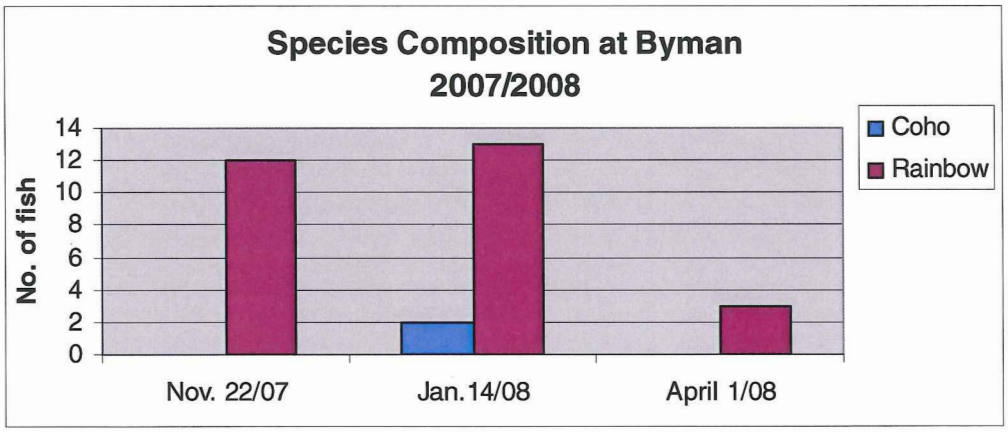


Figure 7. Monthly Species Composition at Byman.

A total of 68 coho and 35 RBT/sthd were captured at the Barren site during the three sampling times. The species composition was fairly similar over all three sample dates, although total numbers (n=20) were less at the end of winter as compared to the beginning of winter sample date (n=47).

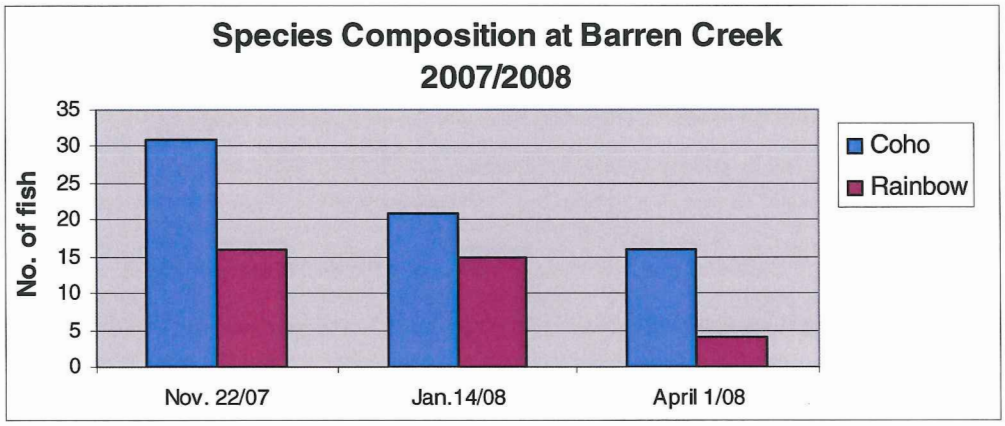


Figure 8. Monthly Species Composition at Barren.

A total of 2 fish were captured at McQuarrie Creek in November and both were coho. The catch increased in January to 3 coho and 5 RBT/sthd (Figure 9). Rainbow trout/sthd were the only species captured at the end of winter (n=4).

Richfield consisted almost exclusively of RBT/sthd (Figure 10). A total of 6 RBT/sthd were captured at Richfield in both November and January. The capture for March was 2 coho and 14 RBT/sthd.

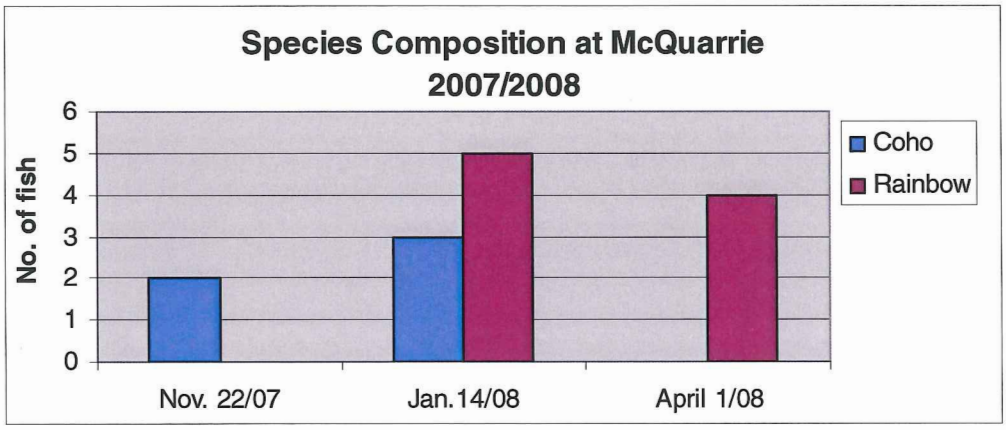


Figure 9. Monthly Species Composition at McQuarrie.

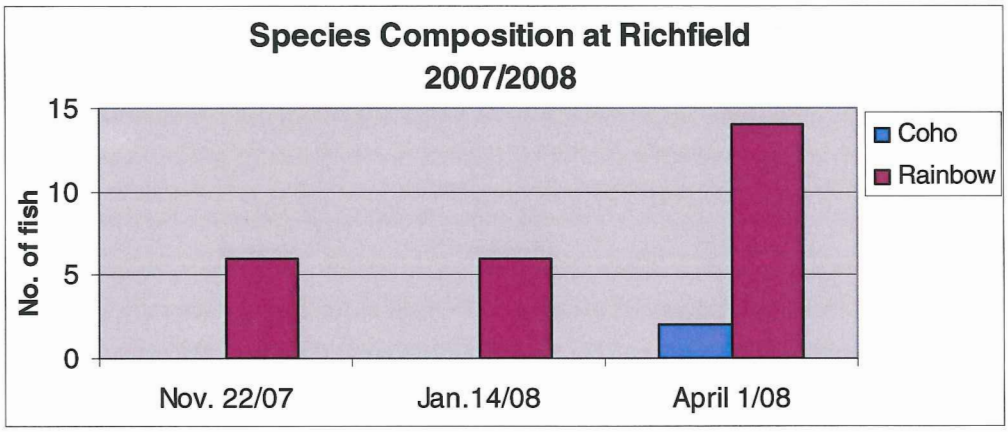


Figure 10. Monthly Species composition at Richfield Creek.

4.2.1.2 Fork Length and Condition Comparisons

Fork length and weight data were collected for salmonids throughout the overwintering study. A total of 77 coho and 98 RBT/sthd trout (39 of the 77 were not weighed due to cold air temp.) were measured at the upper Bulkley tributary sites over the winter. Length, weight and condition data are summarized in the following sections. Coho has been presented in two categories estimated from fork length distributions attained from fish captured at sites at the Upper Bulkley tributary sites from 2005-2008. Based on length frequency distributions of coho, two fork length categories have been created for 80 mm or less coho, and coho greater than 80 mm. It is assumed that RBT/sthd trout have similar fork length categories as coho.

4.2.1.2.1 Coho

Fork length was collected for all the coho and weight data were collected for 57 of the 77 coho captured during the study. Length, weight and condition factor data for sites sampled are provided in Appendix 1. The fork length comparisons for coho salmon have

been presented by month in two fork length categories (i.e., ≤ 80 mm and > 80 mm) for the Barren site.

Figure 11 depicts coho salmon fork length frequency by month for the Barren site since it was the only site in the Upper Bulkley where coho were captured in numbers great enough to analyze. There was a higher number of coho captured that were greater than 80 mm, with the highest frequency of coho (n=31) captured on Nov. 22/07. There were only 12 coho less than 80 mm captured in total, of which 11 were captured on Jan. 14/08. Overall, there was a slight decline in coho numbers from beginning to end of winter sample times at the Barren site.

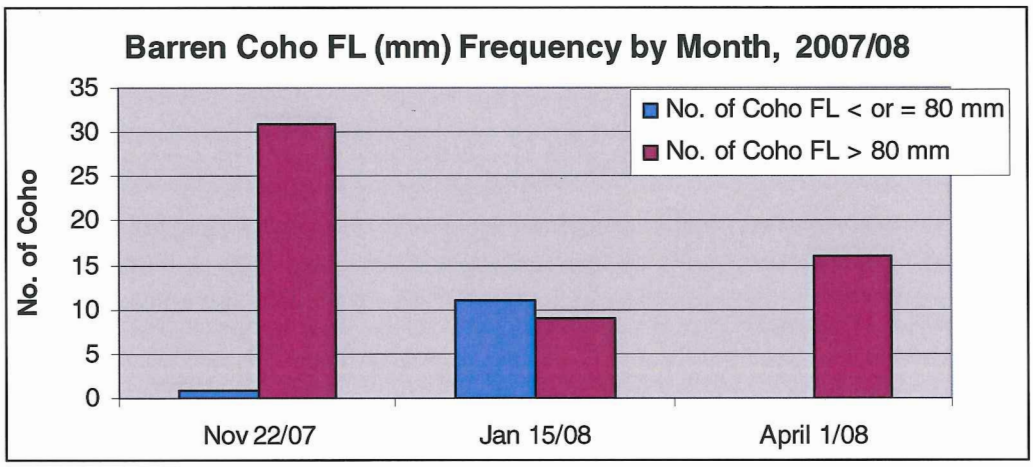


Figure 11. Coho Fork Length (FL) Frequency by month, at the Barren Site (2007/08).

The mean Fulton's condition factor (FCC) by month and fork length (FL) category has been presented for the Barren site only due to low numbers of coho captured at the other three sites (Figure 12). The mean FCC was 1.28 at the beginning of winter for the coho less than or equal to 80 mm. There was no coho captured less than or equal to 80 mm on April 1/08. The mean FCC decreased slightly from 1.07 on Nov. 22/07 to 1.04 on April 1/08 for coho greater than 80 mm.

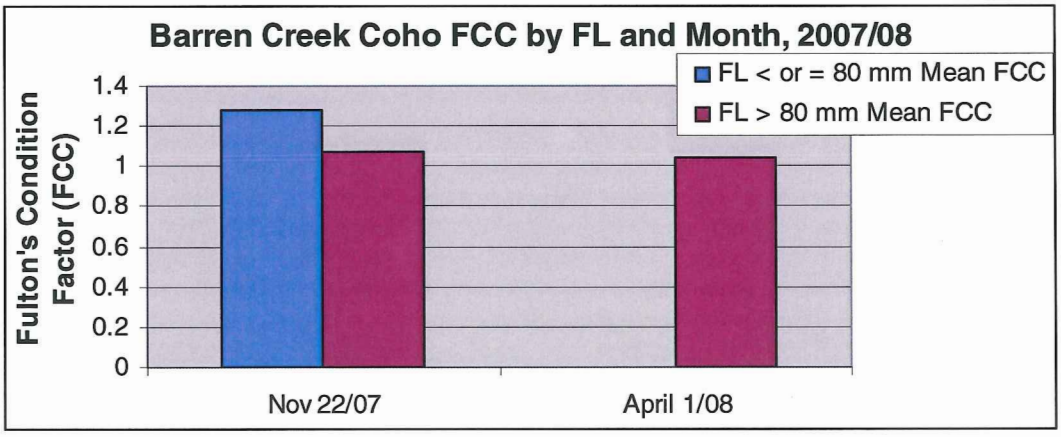


Figure 12. Coho Mean Fulton's Condition Factor (FCC) by Fork Length (FL) and month, for the Barren site (2007/08).

4.2.1.2.2 Rainbow Trout/Steelhead

Fork length was collected for 91 of the 97 RBT/sthd captured and weight data were collected for 58 of the 97 (60%) RBT/sthd. Length, weight and condition factor data for sites sampled are provided in Appendix 1. The fork length comparisons and Fulton's condition factor (FCC) data for RBT/sthd has been presented by month in two fork length categories (i.e., less than 80 mm and greater than 80 mm).

Figures 13 and 14 depict RBT/sthd fork length frequency by month for the Barren and Byman sites. Most of the RBT/sthd was greater than 80 mm at the two sites, with a decrease in numbers beginning, middle to end of winter sample dates.

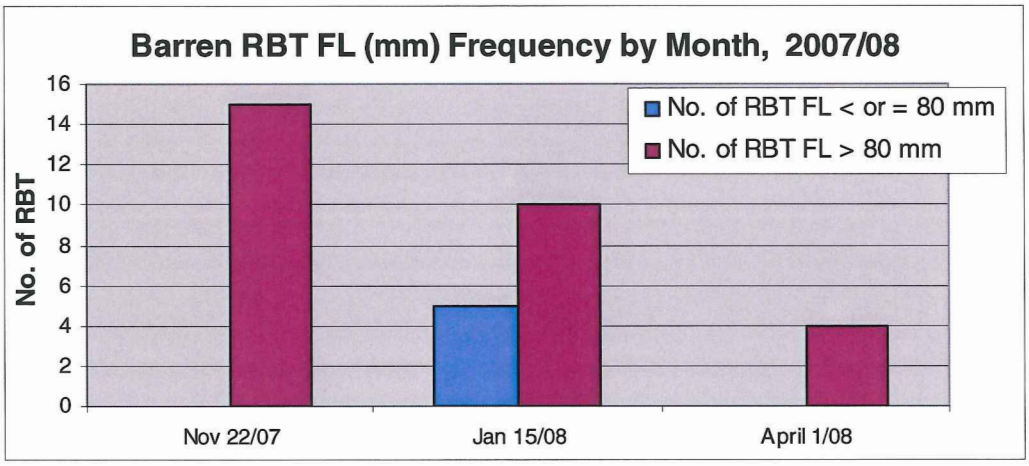


Figure 13. Rainbow Trout Fork Length (FL) Frequency by month, for the Barren site (2007/08).

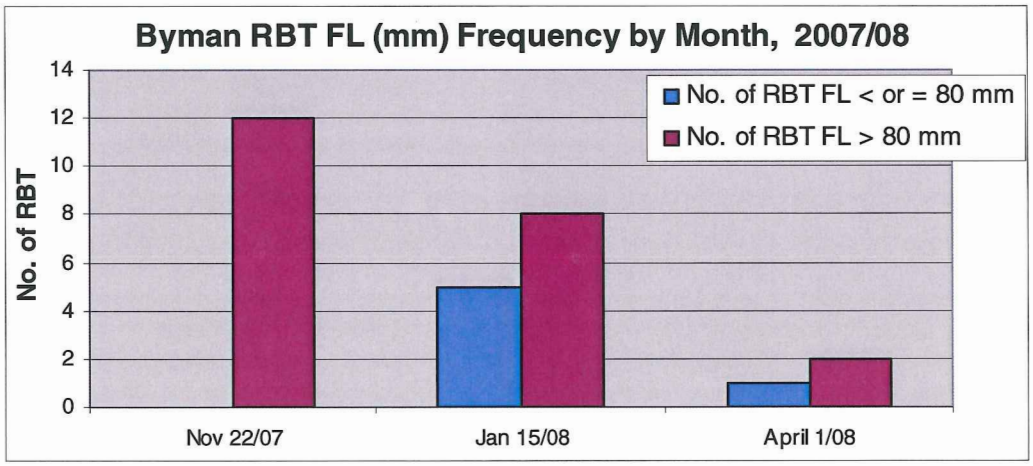


Figure 14. Rainbow Trout Fork Length (FL) Frequency by month, for the Byman site (2007/08).

Figures 15 and 16 depict RBT/sthd fork length frequency by month for the McQuarrie and Richfield sites. The RBT/sthd numbers were low at the McQuarrie site and no apparent trends were noted. There appeared to be an increase in RBT/sthd greater than 80 mm at the Richfield site when comparing the Jan. 15 and April 1 2008 sample dates. Six RBT/sthd were captured in November at Richfield, but are not represented on the graph since they were not measured.

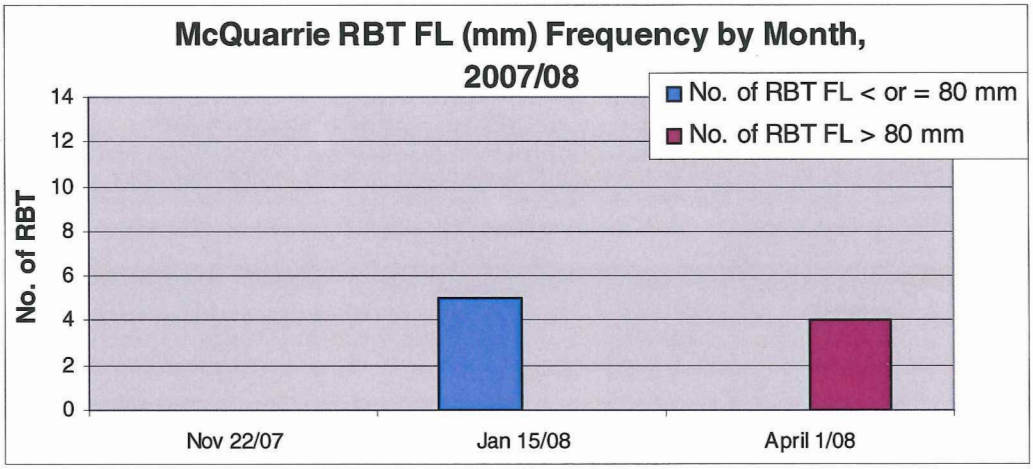


Figure 15. Rainbow Trout Fork Length (FL) Frequency by month, for the McQuarrie site (2007/08).

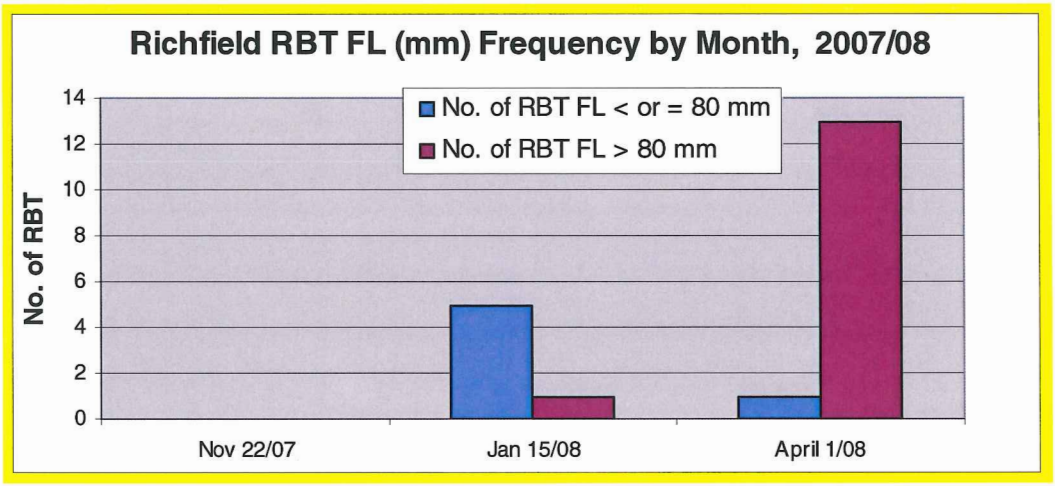


Figure 16. Rainbow Trout Fork Length (FL) Frequency by month, for the Richfield site (2007/08).

Figure 17 and 18 depicts RBT/sthd mean Fulton's condition factor (FCC) by month and fork length (FL) category for Barren and Byman site. The mean FCC for RBT/sthd at Barren in the greater than 80 mm fork length category was 1.11 in both Nov. and April sample dates. RBT/sthd in the less than 80 mm fork length category was not captured in the Nov. or April sample dates. The mean FCC for RBT/sthd at Byman in the greater than 80 mm fork length category was 1.02 on Nov. 22/07 and 1.08 on April 1, 2008. RBT/sthd in the less than 80 mm fork length category was not captured on Nov. 22, 2007 and only 1 was captured on April 1, 2008.

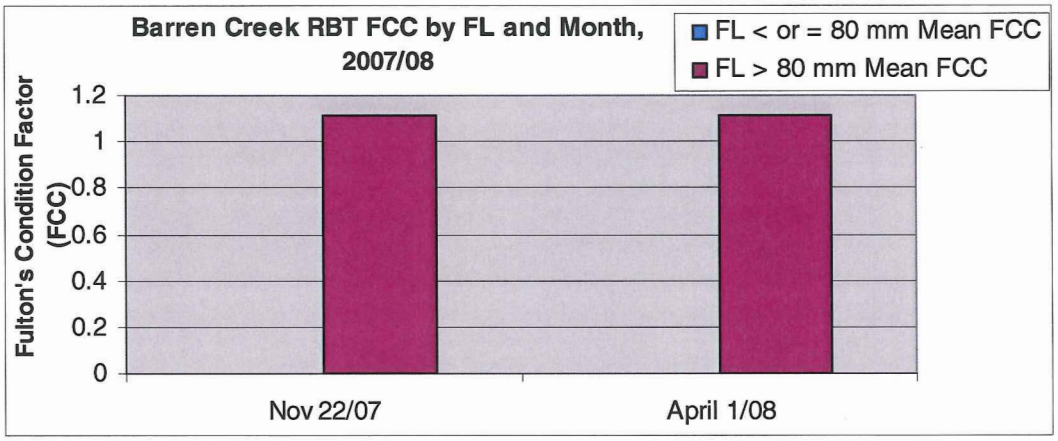


Figure 17. Rainbow Trout Mean Fulton's Condition Factor (FCC) by Fork Length (FL in mm) and month, for the Barren site.

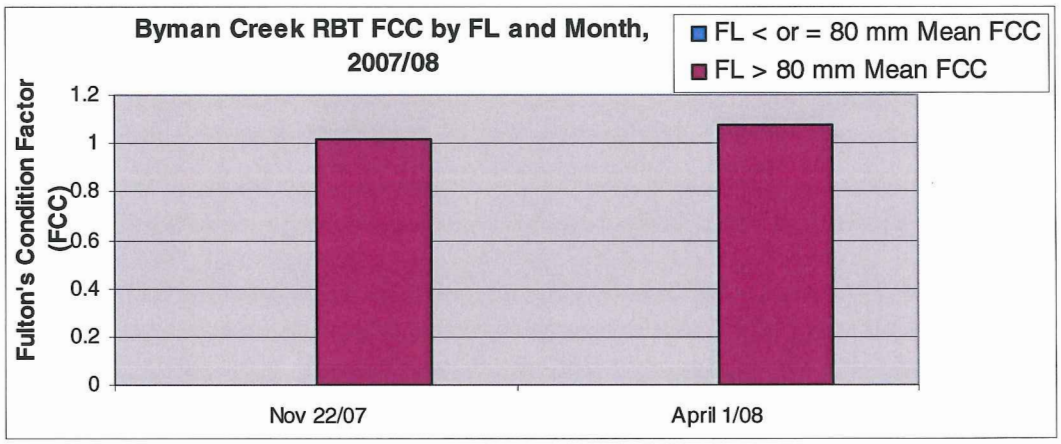


Figure 18. Rainbow Trout Mean Fulton's Condition Factor (FCC) by Fork Length (FL in mm) and month, for the Byman site.

Rainbow trout/steelhead was not captured at the McQuarrie site on Nov. 22/07. On January 16, 2008 five RBT/sthd were captured but not weighed. On April 1, 2008, 4 RBT/sthd were captured in the greater than 80 mm category and the mean FCC was 1.05.

The mean FCC for the greater than 80 mm category RBT/sthd at the Richfield site on April 1, 2008 was 1.03. The numbers were too low to analyze mean FCC for RBT/sthd on other sampling dates.

4.2.3 Lower Bulkley Tributary Sites

Coho and Dolly Varden were captured at Waterfall Creek between November 2007 and March 2008. The species composition, as well as fish fork length frequency and condition will be discussed for all four sites sampled at Waterfalls Creek.

4.2.3.1 Species Composition

The species composition varied between the four sites and dates sampled at Waterfalls Creek (refer to Figures 19-22). Overall, site 1 contained the highest number of fish of all the Waterfall Creek sites. Site 4 contained the lowest number of fish, which may or may not be a function of this site having the smallest volume of all the Waterfall Creek sites and potential for migration being low on January 17/08. On the whole, there were much fewer Dolly Varden than RBT/sthd captured at the Waterfall Creek sites, similar to findings of the 2006/07 study.

A total of 138 fish were captured at site 1 on Nov. 20/07, where the majority were coho (130, 94.0%), and a minor proportion consisted of Dolly Varden (8, 6.0%). The total number of fish captured at site 1 increased slightly from 138 in Nov. to 170 on Jan. 16/2008. The species composition in March was comprised solely of coho salmon, where the numbers (n=43) were much less than the previous two sample dates.

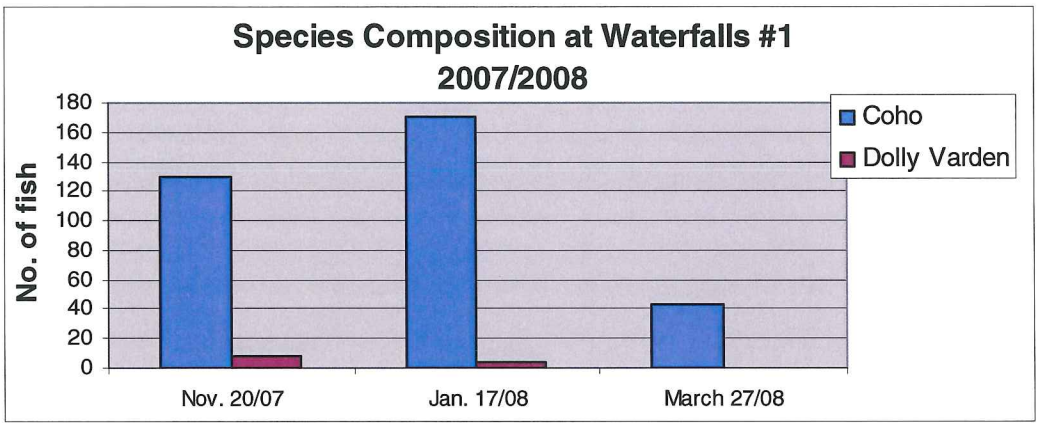


Figure 19. Monthly Species Composition at Waterfall Creek – Site 1 (2007/08).

A total of 133 fish were captured at site 2 on Nov. 20/07, where the majority was coho (132, 99.0%), and the remainder consisted of Dolly Varden (1, 1.0%). The total number of fish captured at site 2 decreased from Nov. 20th to March 27th. Dolly Varden were not captured on Jan. 16/08 and only a very small proportion (n=2) were captured on March 27/08.

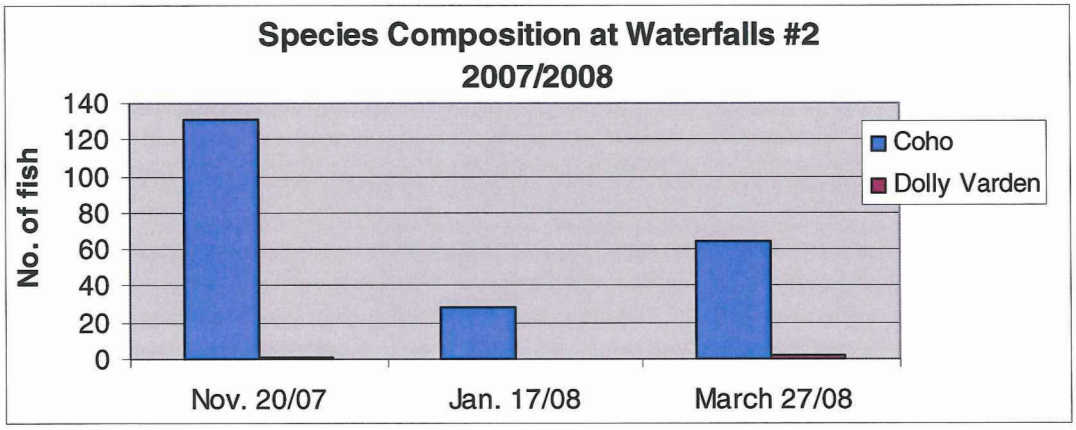


Figure 20. Monthly Species Composition at Waterfall Creek – Site 2 (2007/08).

A total of 88 fish were captured at site 3 on Nov. 20/07, where the amount of coho (77, 88%) was much greater than Dolly Varden (11, 12%). The total number of fish captured at site 3 on Jan. 16/08 dropped to only 34, where the majority captured was coho (32, 94%) and the remainder were Dolly Varden (2, 6%). On March 27/08 the number of fish increased slightly from January and the species composition shifted, where the dominant species was Dolly Varden (24, 65%) and the remainder were coho (13, 35%). On the whole, site 3 had the greatest number of Dolly Varden captured over the winter, of all the sites sampled at Waterfall Creek, similar to the findings documented in the 2006/07 study.

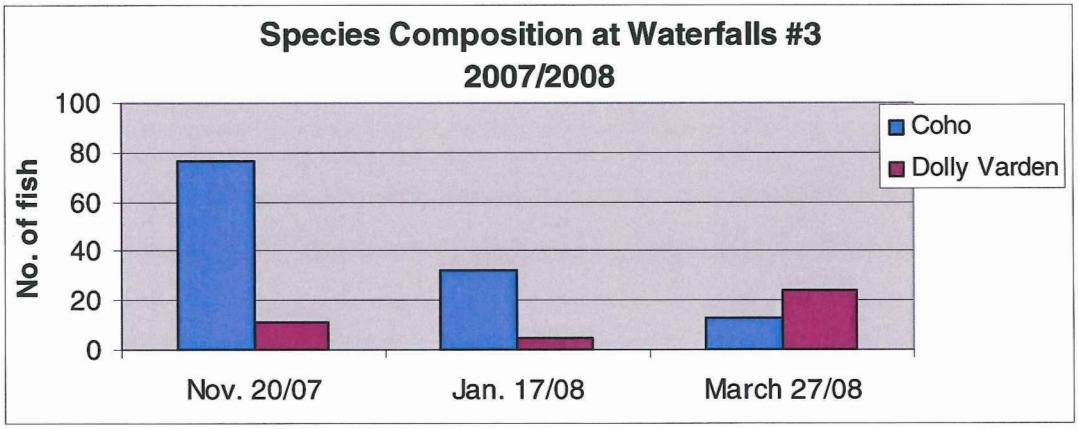


Figure 21. Monthly Species Composition at Waterfall Creek – Site 3 (2007/08).

A total of 69 fish were captured at site 4 on Nov. 20/07, where the amount of coho (64, 93%) was much greater than Dolly Varden (5, 7%). A total of 21 fish was captured on March 27/08, where the majority consisted of coho (14, 67%) and the remainder consisted of Dolly Varden (7, 33%). As indicated, the proportion of coho to Dolly Varden appeared to decrease over the winter.

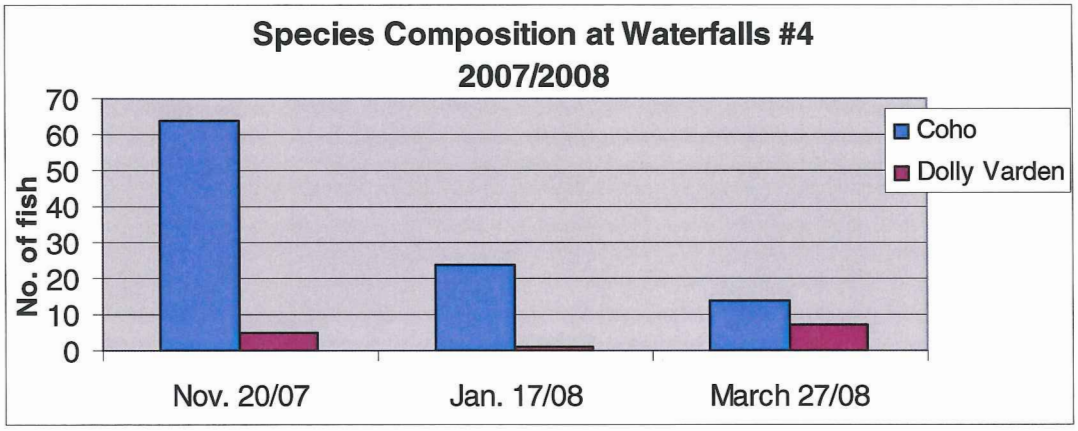


Figure 22. Monthly Species Composition at Waterfall Creek – Site 4 (2007/08).

4.2.3.2 Fork Length and Condition Comparisons

Fork length and weight data were collected for salmonids throughout the overwintering study. A total of 791 coho and 68 Dolly Varden were captured at the Waterfall Creek sites during the overwintering study. Length, weight and condition data for coho and Dolly Varden are summarized in the following sections.

4.2.3.2.1 Coho

Fork length and weight data was collected for under half of the coho captured at the Waterfall Creek sites since the total catch was so high (n=791). Length, weight and condition factor data for sites sampled are provided in Appendix 1. The fork length comparisons and Fulton's condition factor (FCC) data for coho salmon has been presented by month in two fork length categories (i.e., less than or equal to 80 mm and greater than 80 mm) for each site.

Figure 23 depicts coho salmon fork length frequency by month for sites 1-4 of Waterfall Creek. A large proportion of coho captured at the site 1 were less than or equal to 80 mm. The proportion of coho in the two length categories appeared to be similar for sites 2-4, where a higher proportion of coho in the greater than 80 mm category were captured on Nov. 20/07 where as a higher proportion of coho in the less than or equal to 80 mm category were captured on Jan. 17/08 and March 27/08.

Figure 24 presents mean Fulton's condition factor (FCC) for coho salmon by month and fork length (FL) category for sites 1-4. At site 1, the mean FCC appeared to decrease over the winter, from 1.18 (Nov. 20) to 1.05 (March 27) for less than or equal to 80 mm coho. Similarly, the mean FCC for greater than 80 mm coho decreased from 1.08 in Nov. to 0.97 at the end of March. At site 2, the mean FCC decreased for both the less than or equal to 80 mm coho and greater than 80 mm coho, where coho decreased from 1.21 (Nov. 20) *to* 1.01 (March 27), and from 1.02 (Nov. 20) to 0.92 (March 27), respectively. At site 3, the mean FCC increased for the less than or equal to 80 mm coho and decreased for the greater than 80 mm coho (refer to Table 6). The culvert pool of site 4 had a

minimal decrease in mean FCC for both category coho from Nov. and March (refer to Table 6).

Table 6. Summary of Mean Fulton's Condition Factor for coho at Waterfalls Creek on Nov. 20, 2007 and March 27, 2008.

Site	Species	Fork Length Category	FCC-Mean Nov. 20/07	FCC-Mean Mar. 27/08
1	Coho	≤ 80mm	1.18	1.05
		>80 mm	1.08	0.97
2	Coho	≤ 80mm	1.21	1.01
		>80 mm	1.02	0.92
3	Coho	≤ 80mm	1.04	1.07
		>80 mm	1.04	0.98
4	Coho	≤ 80mm	1.06	1.04
		>80 mm	1.06	0.98

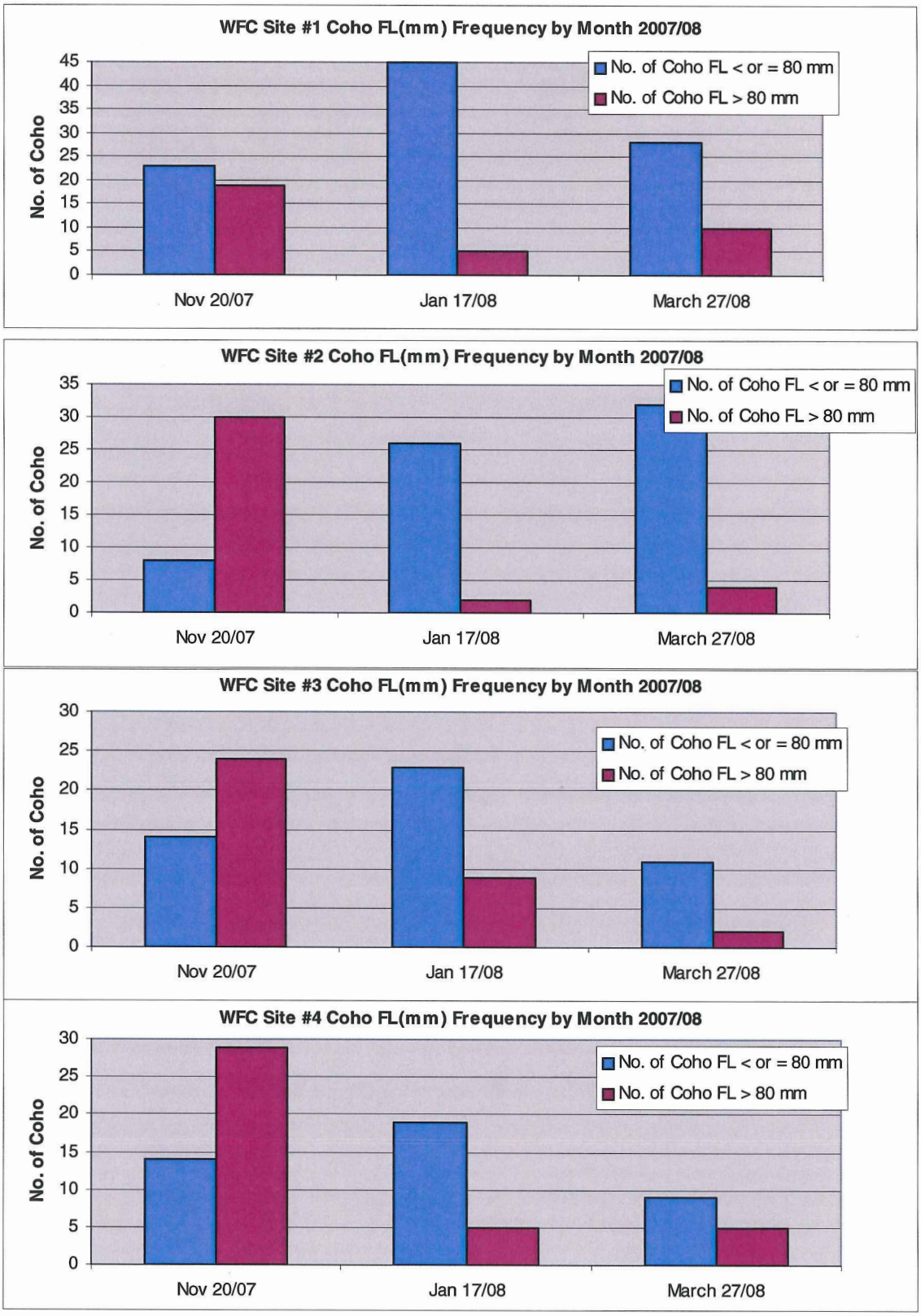


Figure 23. Coho Fork Length Frequency by month for Waterfalls Creek Sites 1-4 (2007/08).

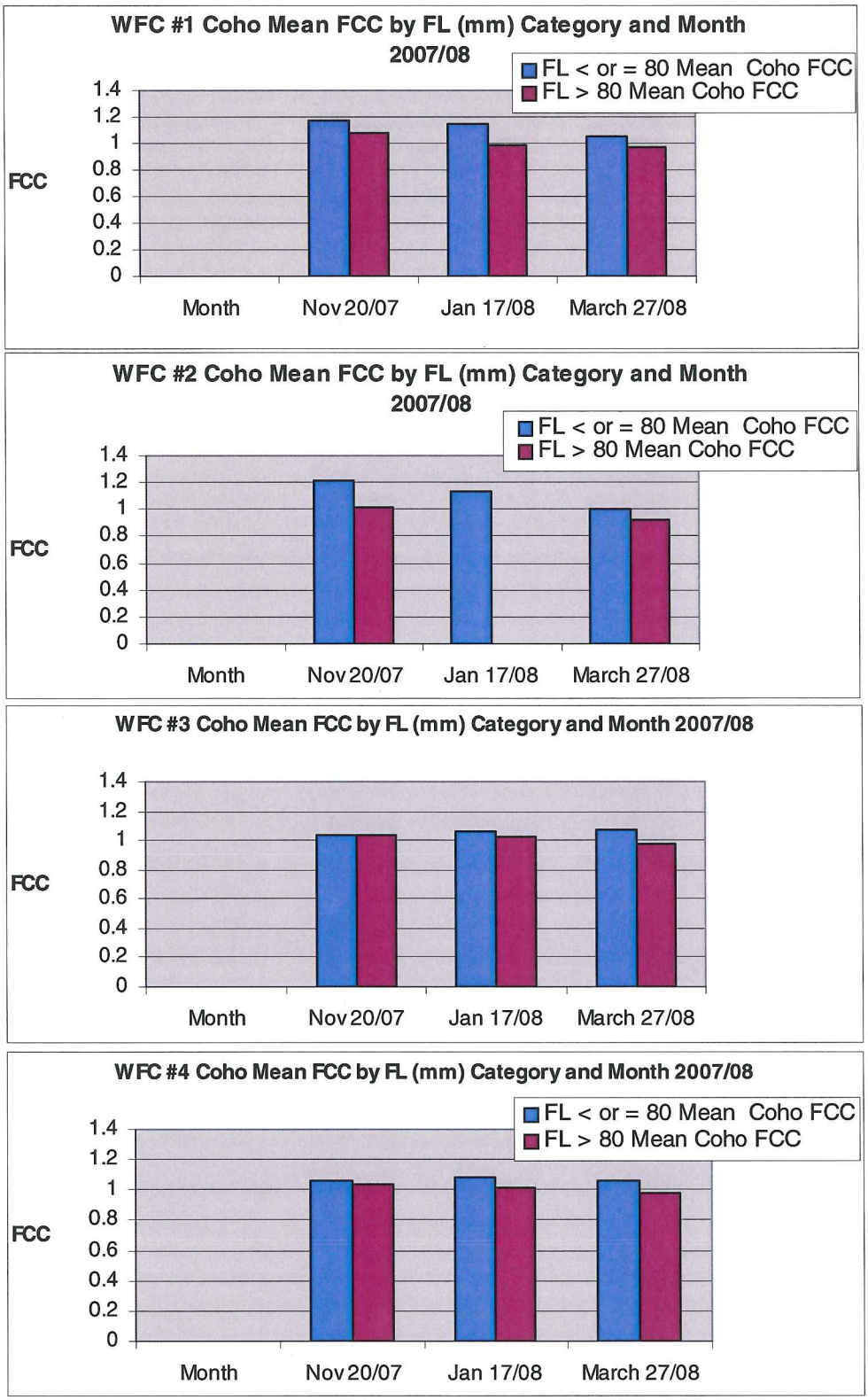


Figure 24. Mean FCC by Fork Length (FL) Category and by month for Coho at Waterfalls Creek Sites 1-4 (2007/08).

4.2.3.2.2 Dolly Varden

Fork length and weight data was collected for the majority of the Dolly Varden (DV) captured during the study of the Waterfalls Creek sites. Length, weight and condition factor data for sites sampled are provided in Appendix 1. The fork length comparisons and Fulton's condition factor (FCC) data for Dolly Varden has been presented by month in two fork length categories (i.e., less than or equal to 80 mm and greater than 80 mm) for each site.

Figure 25 depicts Dolly Varden (DV) fork length frequency by month for sites 1-4 of Waterfalls Creek. There was a relatively even proportion of Dolly Varden captured at site 1 that were either equal to or less than 80 mm or greater than 80 mm in length. Low numbers of DV were captured at site 2 in both length categories. The majority of DV captured at site 3 were of the greater than 80 mm category, and there was a substantial increase in DV over the winter where 9 DV were captured on Nov. 20/07 and 24 DV were captured on March 27/08. The majority of DV captured at site 4 were of the greater than 80 mm category.

Figure 26 presents DV mean Fulton's condition factor (FCC) by month and fork length (FL) category for sites 1, 3 and 4, but not for site 2 since only 1 DV in total was captured. There appeared to be a marked decrease in mean FCC over the winter for the greater than 80 mm DV at sites 3 and 4 (refer to figure 26 or Table 7).

Table 7. Summary of Mean Fulton's Condition Factor for DV at Waterfalls Creek in Nov. 22, 2007 and March 27, 2008.

Site	Species	Fork Length Category	FCC-Mean Nov. 22-07	FCC-Mean March 27-08
1	DV	≤ 80mm	1.12	NA
		>80 mm	0.94	NA
3	DV	≤ 80mm	1.06	NA
		>80 mm	0.99	0.88
4	DV	≤ 80mm	NA	NA
		>80 mm	0.98	0.85

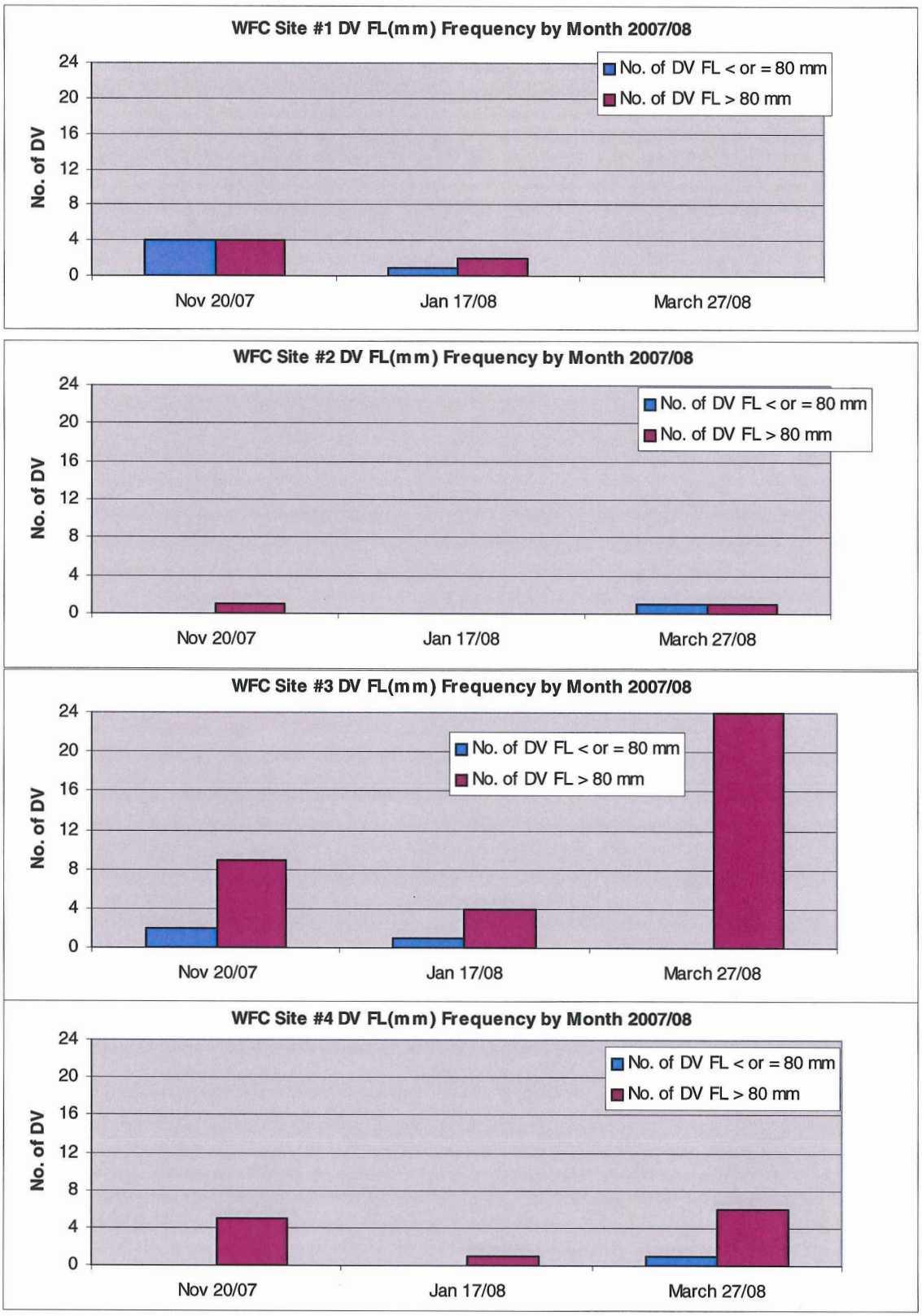


Figure 25. Fork Length (FL) Frequency by Month for Dolly Varden at Waterfalls Creek Sites 1-4 (2007/08).

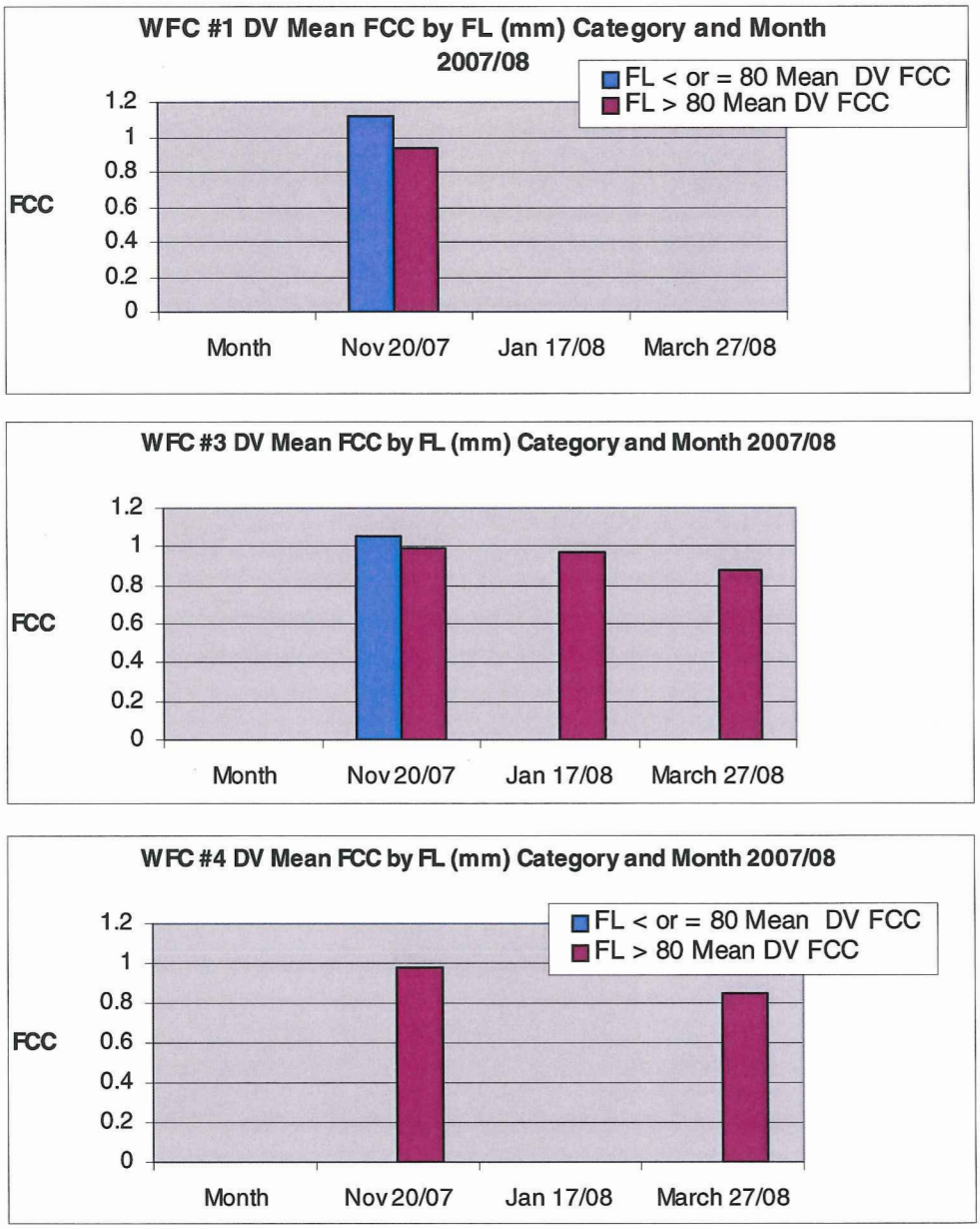


Figure 26. Mean Fulton's Condition Factor by Fork Length (FL) Category for Dolly Varden at Waterfalls Creek Site 1, 3 and 4 (2007/08).

4.3 Density Indices (CPUE)

Fish capture data was used to calculate catch per unit effort (CPUE). Total catch and CPUE during the overwintering study (Nov.-March) is summarized for each of the sites in Table 8.

Total catch and CPUE was highest at Waterfalls Cr. (Site 1) and lowest at the McQuarrie creek site. Total catch over the winter ranged from 14 fish at McQuarrie to 355 at

Waterfalls #1. Coho salmon comprised greater than or equal to 50% of the total catch at the Barren site, and sites 1-4 of Waterfalls Cr. Greater than 50% of the total fish captured at Byman, McQuarrie, and Richfield were RBT/sthd. Dolly Varden were not very abundant at the Waterfalls sites, contrary to what was noted in the 2005/06 study (refer to Table8).

Table 8. Summary of traps catches of juvenile salmonids at each site sampled during the overwintering study (2007/08).

	Site	# Traps Set	Coho Salmon			Rainbow trout/ steelhead			Cutthroat trout			Dolly Varden			All Species	
			C	%	CPUE	C	%	CPUE	C	%	CPUE	C	%	CPUE	C	CPUE
Upper Bulkley Tributaries	Barren	9	69	0.66	7.7	35	0.34	3.9	0	0	0	0	0	0	104	11.6
	McQuarrie	9	5	0.36	0.6	9	0.64	1	0	0	0	0	0	0	14	1.6
	Byman	9	2	0.07	0.2	28	0.93	3.1	0	0	0	0	0	0	30	3.3
	Richfield	9	2	0.07	0.2	26	0.93	2.9	0	0	0	0	0	0	28	3.1
Waterfalls Creek	Site 1	9	343	0.97	38.1	0	0	0	0	0	0	12	0.03	1.3	355	39.4
	Site 2	9	224	0.99	24.9	0	0	0	0	0	0	3	0.01	0.33	227	25.2
	Site 3	8	122	0.75	15.3	0	0	0	0	0	0	40	0.25	5.0	162	20.3
	Site 4	9	102	0.89	11.3	0	0	0	0	0	0	13	0.11	1.4	115	12.7

C=total catch, %=proportion of the total catch, CPUE=mean catch of each species using monthly CPUE data.

The following figures present CPUE data per sampling date, as well as between sites and by species. The CPUE for coho salmon for all the sites sampled for fish are presented in Figures 27-28. The CPUE for Rainbow Trout/sthd is presented for the Upper Bulkley sites in Figure 29. CPUE for Dolly Varden is presented for the Waterfalls Creek sites in Figure 30.

4.3.1 CPUE for Coho

The CPUE for coho salmon at the beginning of winter differed among the four sites in the upper Bulkley watershed (Figure 27). The highest CPUE for coho at the beginning of winter was at Barren (10.7 coho/trap), whereas the lowest was at Richfield and Byman (0 coho/trap). CPUE for coho at Barren was also the highest at the end of winter (5.3 coho/trap).

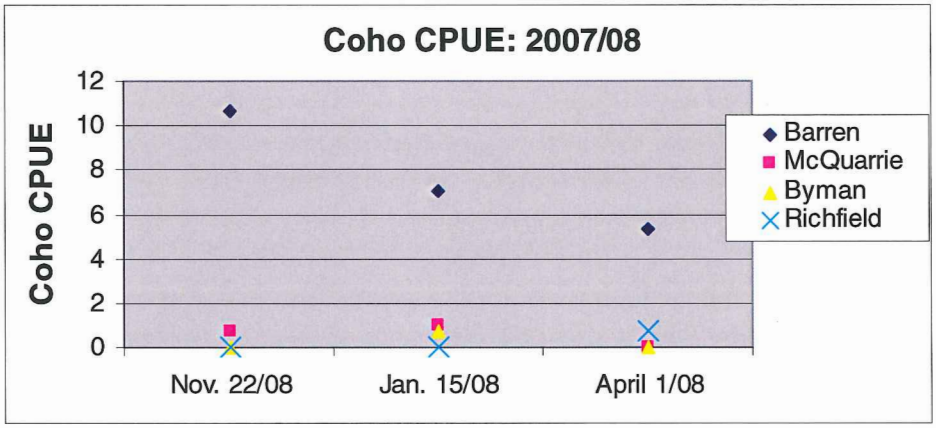


Figure 27. Catch per Unit Effort (CPUE) by month for Coho at Barren, McQuarrie Byman and Richfield sites (2007/08).

At Waterfalls Creek, the CPUE for coho salmon decreased overall from beginning to end of winter at sites 1-4 (Figure 28). The CPUE for coho was highest at site 1 and lowest overall at site 4 over the winter. On the whole the CPUE for coho at all sites in 2007/08, and in 2006/07, far exceeded the CPUE for DV, which was not always the case in 2005/06.

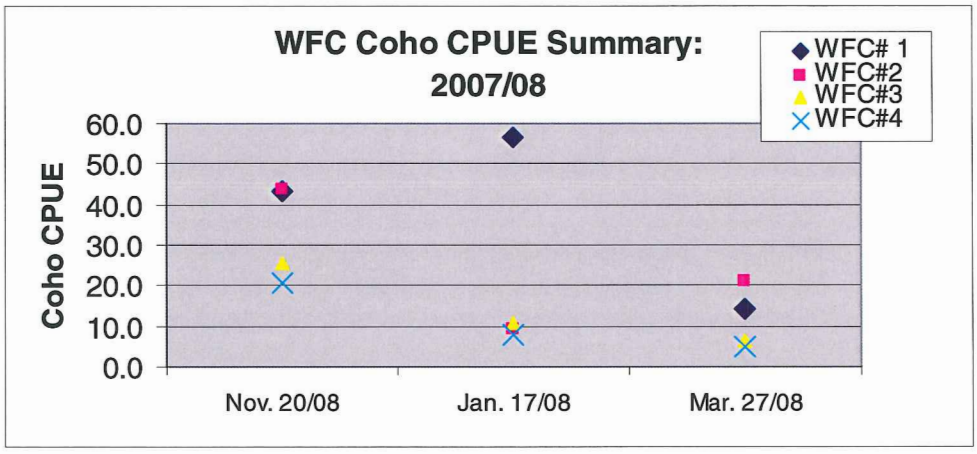


Figure 28. Catch per Unit Effort (CPUE) by month for Coho at the Waterfalls Creek sites (2007/08)

4.3.2 CUPE for Rainbow Trout (RBT)/Steelhead(STHD)

The CPUE for RBT/STHD decreased at Byman from 4/trap at the beginning of winter to 1/trap at the end of winter. The Barren site had the most RBT/STHD captured at the beginning and middle sample dates of all the sites, but CPUE decreased at this site to just over 1/trap at the end of winter. At Richfield, the CPUE increased from 2/trap at the beginning to over 4/trap at the end of winter. McQuarrie had the lowest CPUE (0/trap) for RBT/STHD at the beginning of winter of all the sites, but increased to over 1/trap at the middle and end of winter sample dates (Figure 29).

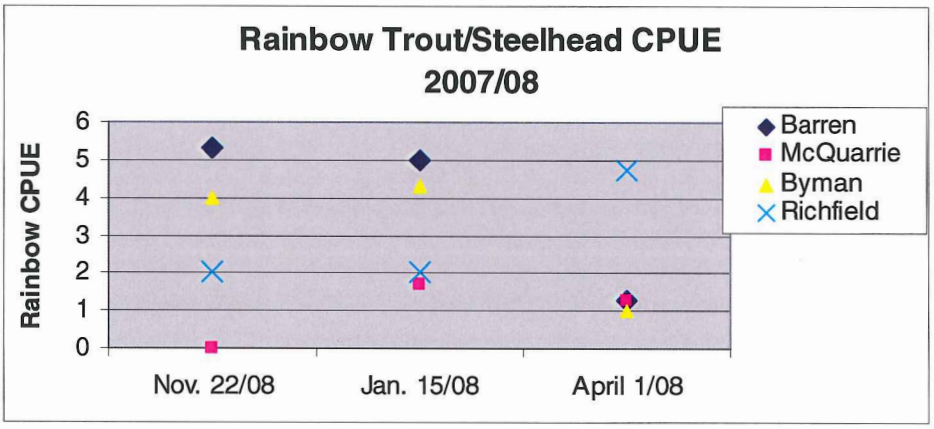


Figure 29. Catch per Unit Effort (CPUE) by month for Rainbow Trout/Steelhead at the Upper Bulkley Sites (2007/08).

4.3.3 CUPE for Dolly Varden (DV)

The CPUE at site 3 of Waterfalls Creek increased the most over the winter of the 4 sites sampled, where it ranged from 3.7/trap to 12.0 DV/trap. Overall, the CPUE for DV was greatest at the end of winter, as compared to beginning of winter, at sites 2 - 4. Site 1 showed a slight decrease in CPUE for DV over the winter sample dates (Figure 30).

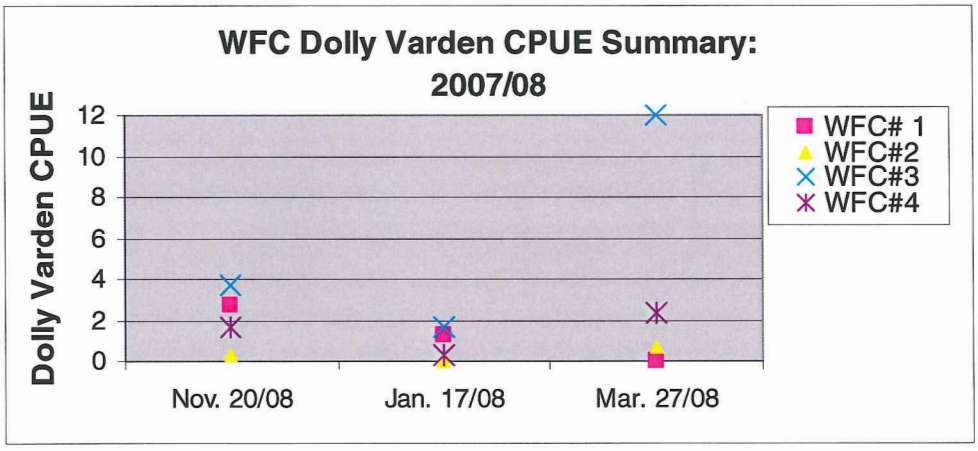


Figure 30. Catch per Unit Effort (CPUE) by month for Dolly Varden at the Waterfalls Creek sites 1-4 (2007/08).

5.0 DISCUSSION & COMPARISON TO 2005/06 and 2006/07

As noted in previous overwintering studies (Donas and Saimoto 2001a, 2001b; Donas and Newman 2006; Donas and Newman 2007), watershed characteristics, as well as habitat types sampled are expected to influence species composition, fish size and condition, and fish densities such as CPUE. Therefore, it can be expected for results to vary as they have between sites of this study. Winter has been documented to be a critical time in the life history of salmonids (Bustard and Narver 1975), since this season can affect fish health and survival (Bustard and Narver 1975, Dolloff 1987). Many habitat types, such as beaver ponds, lakes, mainstems and tributaries have been identified as important overwintering habitat for salmonids (Bustard and Narver 1975, Swales et al. 1986). Within these habitat types, the importance of cobble substrate, deep pools and organic cover have been documented (Bustard and Narver 1975, Swales et al. 1986, Dolloff 1987). Differences in species composition, densities and fish size are expected to occur as a result of habitat composition at the different sample sites. As used in previous overwintering studies (Donas and Saimoto 1999-2001; Donas and Newman 2006; Newman and Donas 2007), the two main indicators of habitat suitability in this study were species density indices (CPUE) and fish size (fork length, weight and condition).

5.1 Winter and Spring Habitat Assessments

Overall, there seemed to be a greater number of fish captured at sites with water depths greater than approximately 50 centimeters or in areas influenced by groundwater.

Habitat assessments of 2007/08 found all the Upper Bulkley sites to have sufficient water depth and dissolved oxygen throughout the winter. Water depths at Byman in 2005/06, 2006/07 and 2007/08 were comparable (Figure 31). The water depth at McQuarrie at the

beginning of winter in 2007/08 (~110 cm) was comparable to the depth measured in 2005/06 (125cm). The water depth at McQuarrie was much lower at the beginning of winter in 2006/07 (40cm), likely due to lower than normal flows before ice-up (Figure 32).

In 2007/08 and 2005/06, the Barren site had water depths greater than 50 cm over the winter, had suitable dissolved oxygen, and bed material consisted primarily of cobbles. Habitat assessments found low water depths and dissolved oxygen levels, as well as lack of cobble substrate, at the Barren site in 2006/07 (Figure 33). The decrease in quality of overwintering habitat at Barren in 2006/07 appeared to be due to the Ministry of Transportation culvert maintenance program, where the pool habitat was dredged both upstream and downstream of the highway crossing in late winter 2006. Lower than normal flows before ice-up may also have been a contributing factor.

The water depths at Richfield were comparable during mid- and late- winter sample dates of 2006/07 and 2007/08. The water depth was greater at the beginning of winter in 2007/08 (~86 cm) than it was in 2006/07 (~55 cm), which could be attributed to lower than normal flows before ice-up (Figure 34). Richfield was not monitored in 2005/06.

Habitat assessments at Waterfalls Creek found sites 1-4 to have sufficient water depth and dissolved oxygen throughout the winter during all three study periods. Figures 35-38 provide a comparison in water depths over time at the Waterfalls Creek sites.

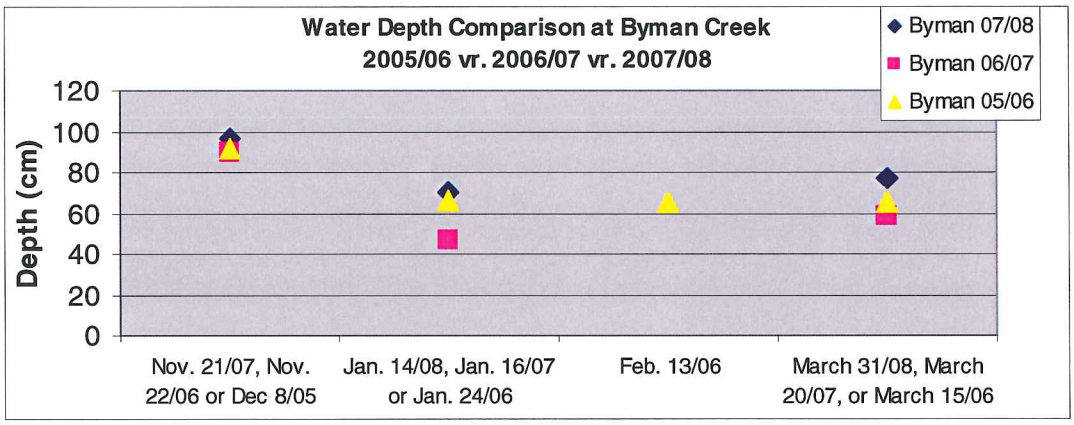


Figure 31. Water Depth Comparison at Byman Creek (2005/06, 2006/07, 2007/08).

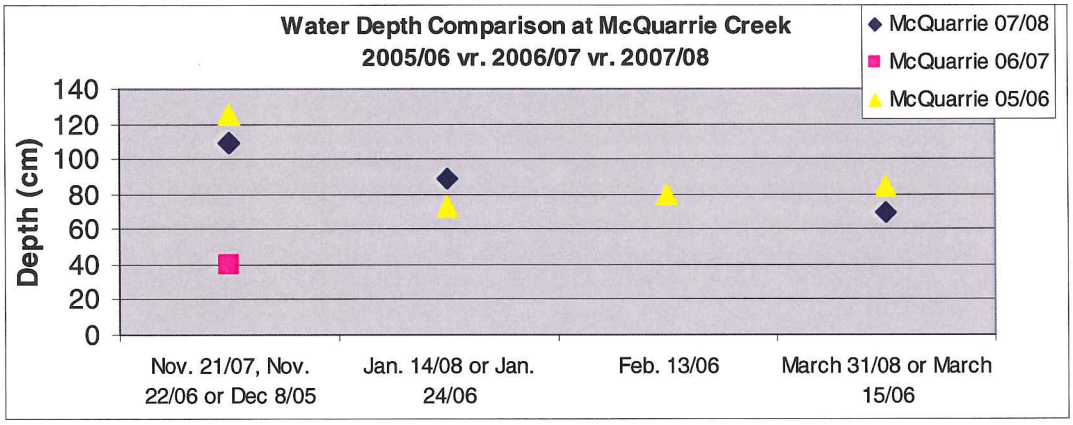


Figure 32. Water Depth Comparison at McQuarrie Creek (2005/06, 2006/07, 2007/08).

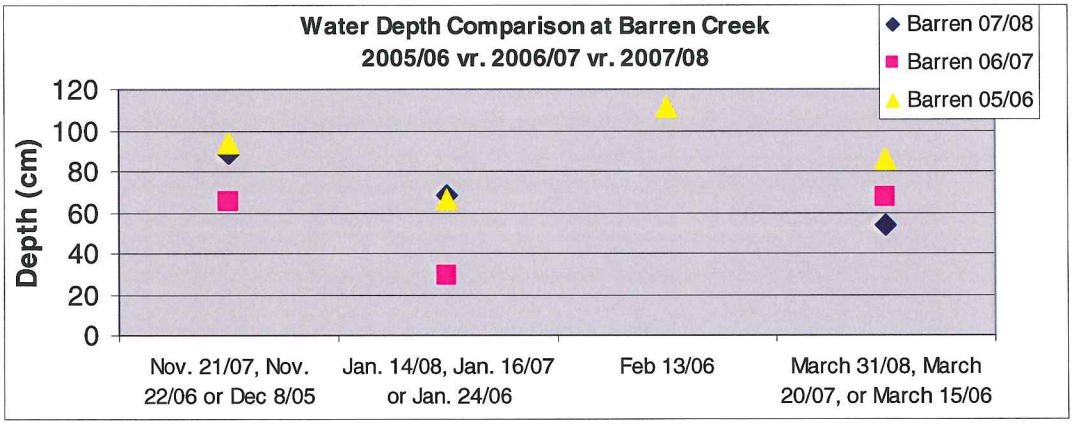


Figure 33. Water Depth Comparison at Barren Creek (2005/06, 2006/07, 2007/08).

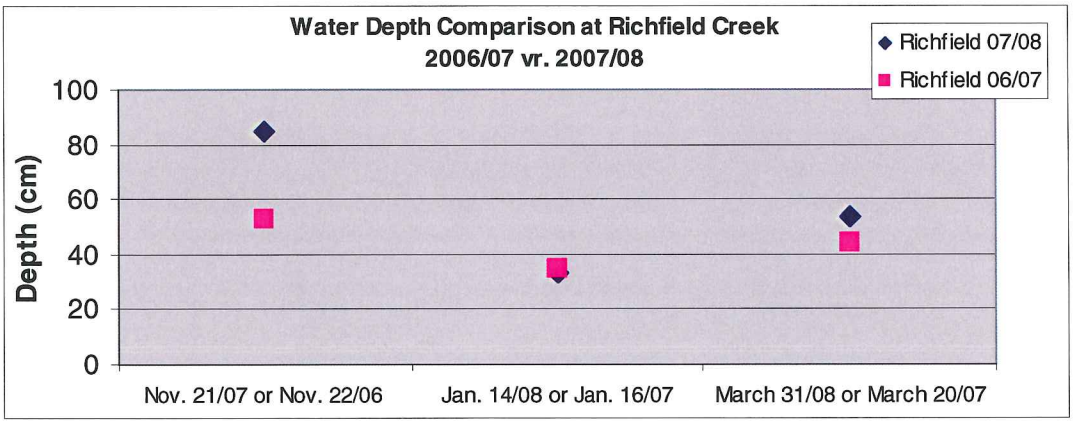


Figure 34. Water Depth Comparison at Richfield Creek (2005/06, 2006/07, 2007/08).

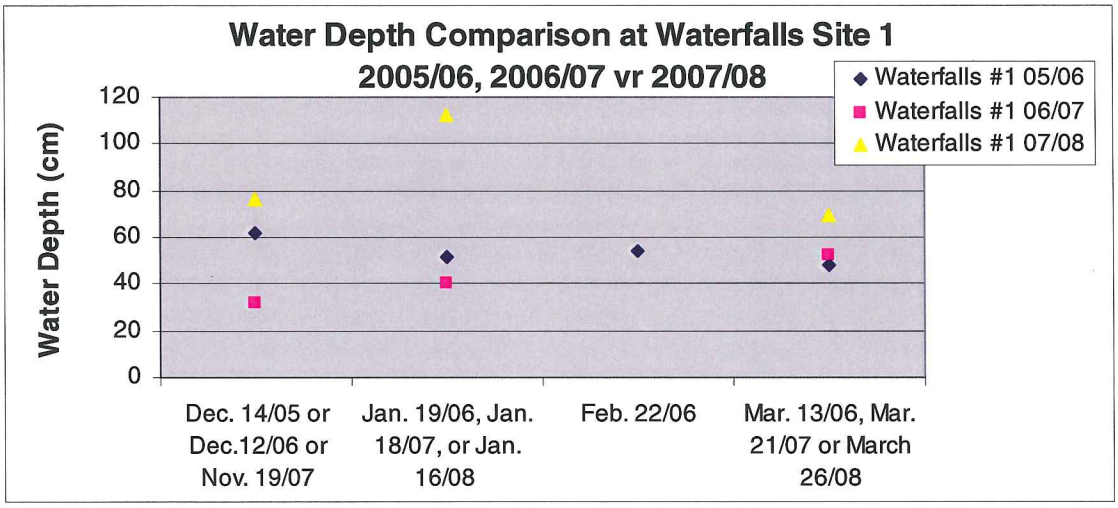


Figure 35. Water Depth Comparison at Waterfalls Site 1 (2005/06, 2006/07, 2007/08).

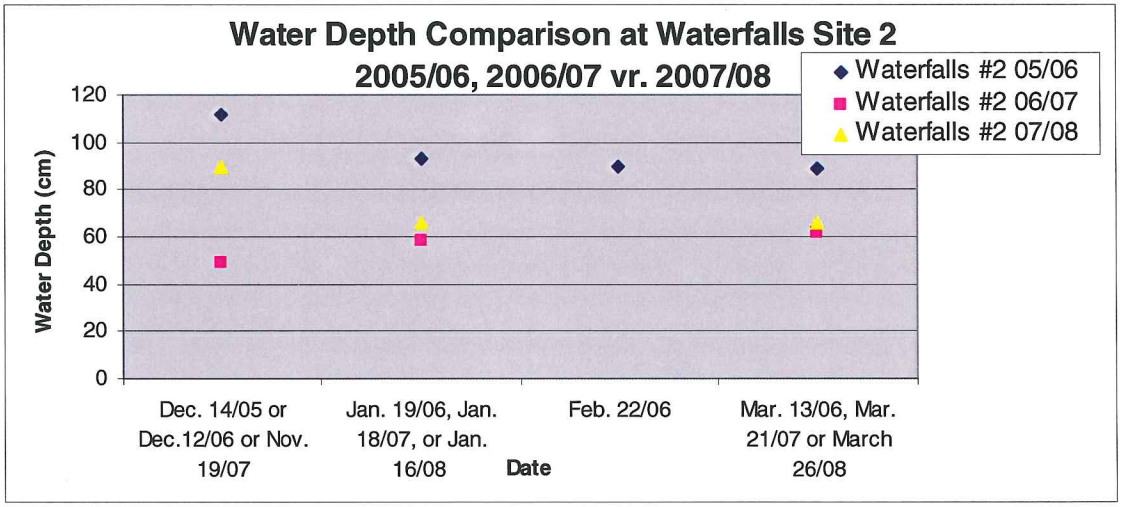


Figure 36. Water Depth Comparison at Waterfalls Site 2 (2005/06, 2006/07, 2007/08).

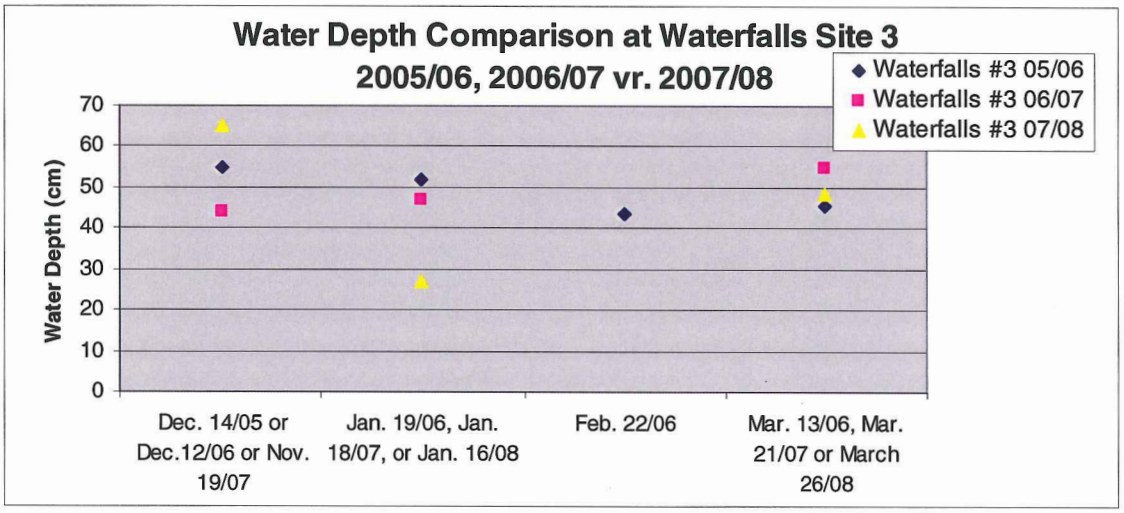


Figure 37. Water Depth Comparison at Waterfalls Site 3 (2005/06, 2006/07, 2007/08).

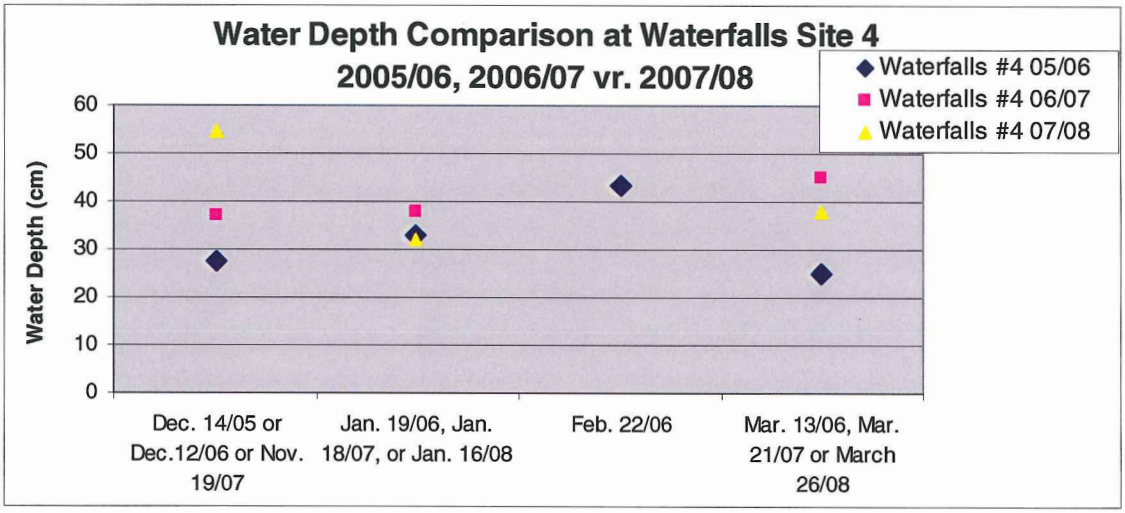


Figure 38. Water Depth Comparison at Waterfalls Site 4 (2005/06, 2006/07, 2007/08).

5.2 Species Composition and Diversity

Upper Bulkley Sites

Coho salmon and RBT/sthd were documented at the Upper Bulkley sites throughout the study. It should be noted that Chinook salmon was also documented at the Byman Creek site during the 2000/2001 overwintering study (Donas and Saimoto 2001a).

The overwintering habitat at Barren during this study improved from what was observed during the 2006/2007 study, where no fish were captured. Barren Creek was extensively dredged upstream and downstream of the highway culvert in late summer 2006 as part of

a Ministry of Transportation Culvert Maintenance Program. The pool that was dredged on the upstream side of Highway 16 has since begun to fill in reducing the amount of available habitat at that site. The Barren site this year contained the highest number of coho of all 4 sites during the three sampling times. On the whole, Barren also contained the highest number of RBT/sthd of all the sites sampled in 2007/08. It should be noted that the Barren site was found to provide good overwintering habitat and contained the highest number of fish, of the three sites sampled in the Upper Bulkley during the 2005/06 winter sampling program, even though dredging occurred upstream of the culvert in September 2005. The figure below depicts a comparison of the number of fish and composition between 2005/06 and 2007/08 (Figure 39).

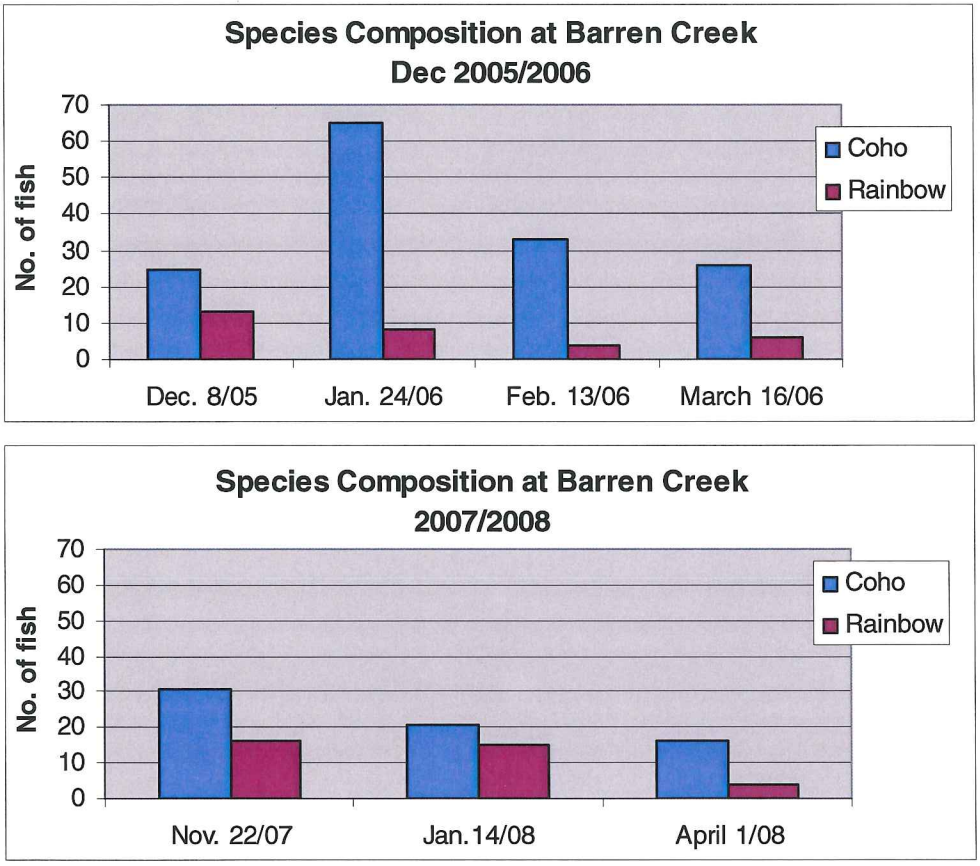


Figure 39. Species Composition at Barren (2005/06, 2006/07 vr. 2007/08).

The McQuarrie site contained the lowest number of fish at the beginning of winter, where only 2 coho were captured, of all the sites sampled on November 22, 2007. The numbers increased slightly on Jan. 14/08 and April 1/08. On the contrary, the McQuarrie site contained the highest number of fish at the beginning of winter in 2006, as compared to the other sites, and both RBT/sthd and coho were captured. The reason for the difference in numbers may have been due to differences in water levels in the McQuarrie Creek system from 2006 to 2007. The water levels were lower in 2006, than in 2007, potentially forcing more fish into the overwintering pool at the culvert outlet. Due to snow plowed onto the site in January and March 2007, the site was inaccessible for trapping. The

majority of fish captured at McQuarrie Creek in 2005/06 was Rainbow Trout/sthd and fairly high numbers, compared to 2006/07 and 2007/08, were captured throughout the winter. The figure below depicts a comparison of the number of fish and composition between 2005/06, 2006/07 and 2007/08 (Figure 40).

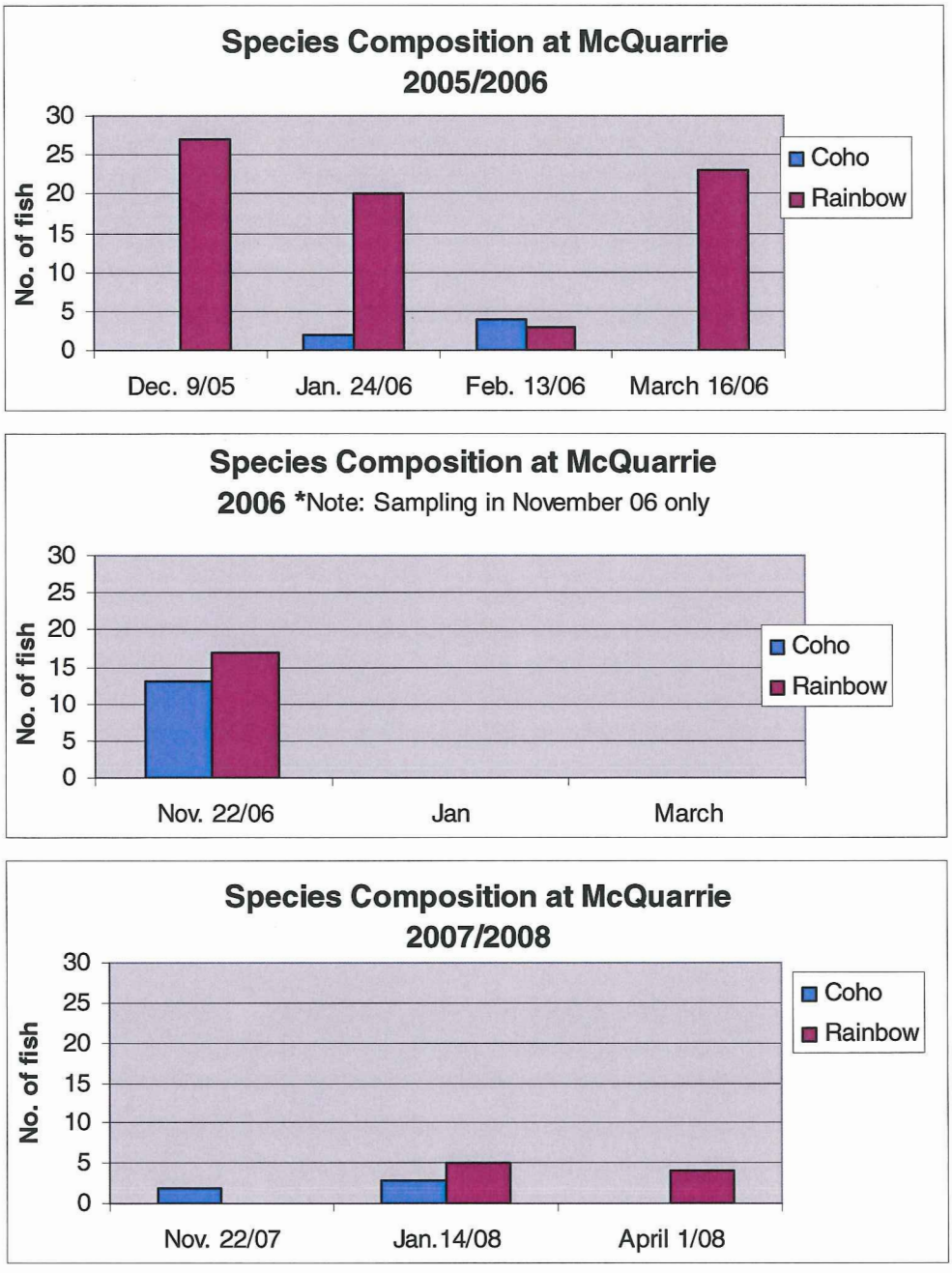


Figure 40. Species Composition at McQuarrie (2005/06, 2006/07 vr. 2007/08).

There was consistently more RBT/STHD than coho captured at the Byman site during each of the winter sampling dates in this years study, which was also found in the 2006/07 and 2005/06 studies. The numbers of RBT/STHD and coho were on the whole

higher in 2005/06 compared to 2006/07, with the exception of March. The low water depths prior to ice-up 2006 may have contributed to the fewer numbers of fish at Byman at beginning and middle of winter in 2006/07. The figure below depicts a comparison of the number of fish and composition between 2005/06, 2006/07 and 2007/08 (Figure 41).

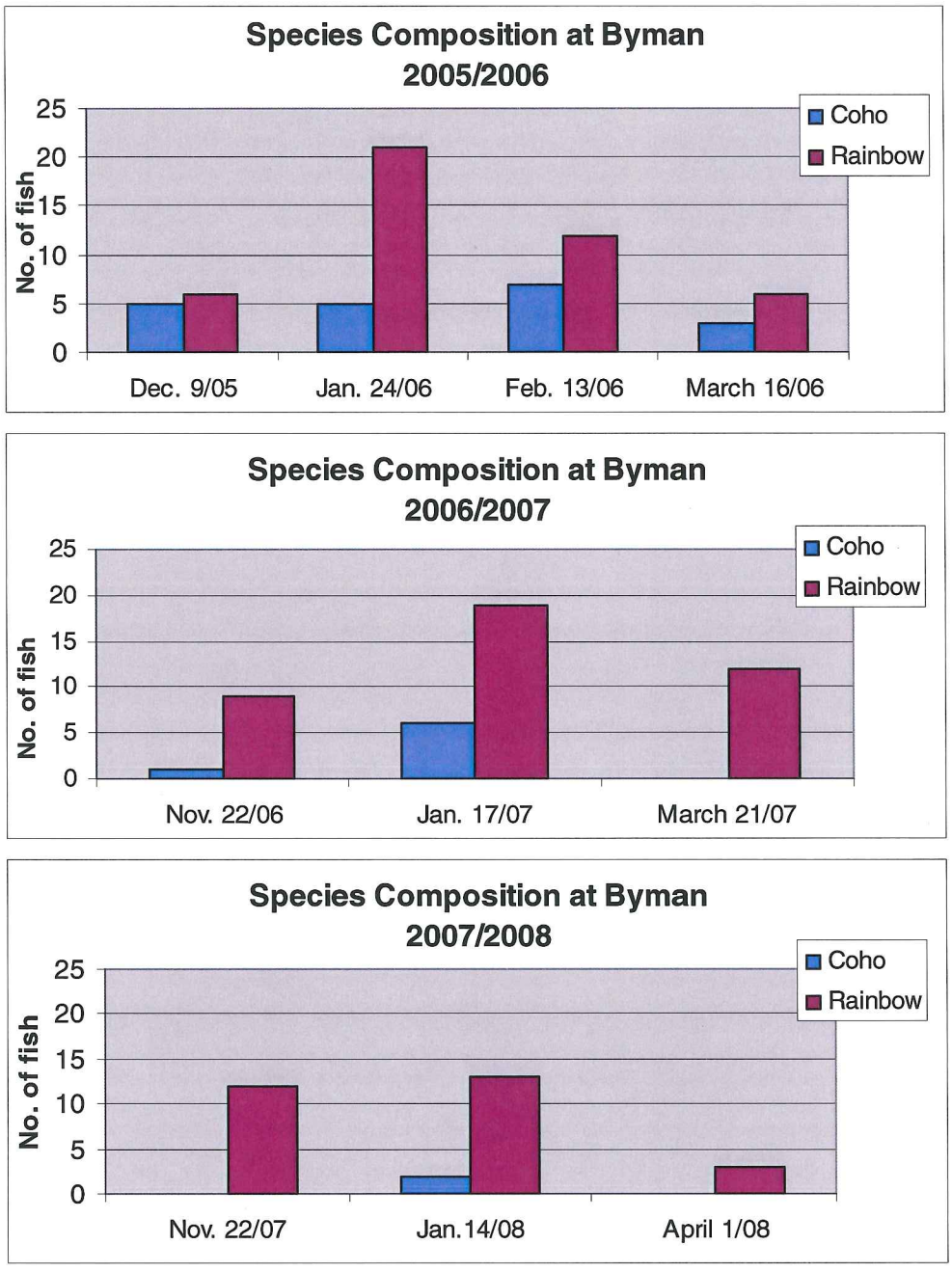


Figure 41. Species Composition at Byman (2005/06, 2006/07 vr. 2007/08).

Richfield consisted almost exclusively of RBT/sthd this year. A total of 6 RBT/sthd were captured at Richfield in both November and January. The capture for March was 2 coho and 14 RBT/sthd. A total of 10 coho were captured during the Nov. sampling date of

2006, which was very different than the 6 RBT/sthd captured on Nov. 22/07. There was no sampling in January or March of 2007 (refer to Figure 42).

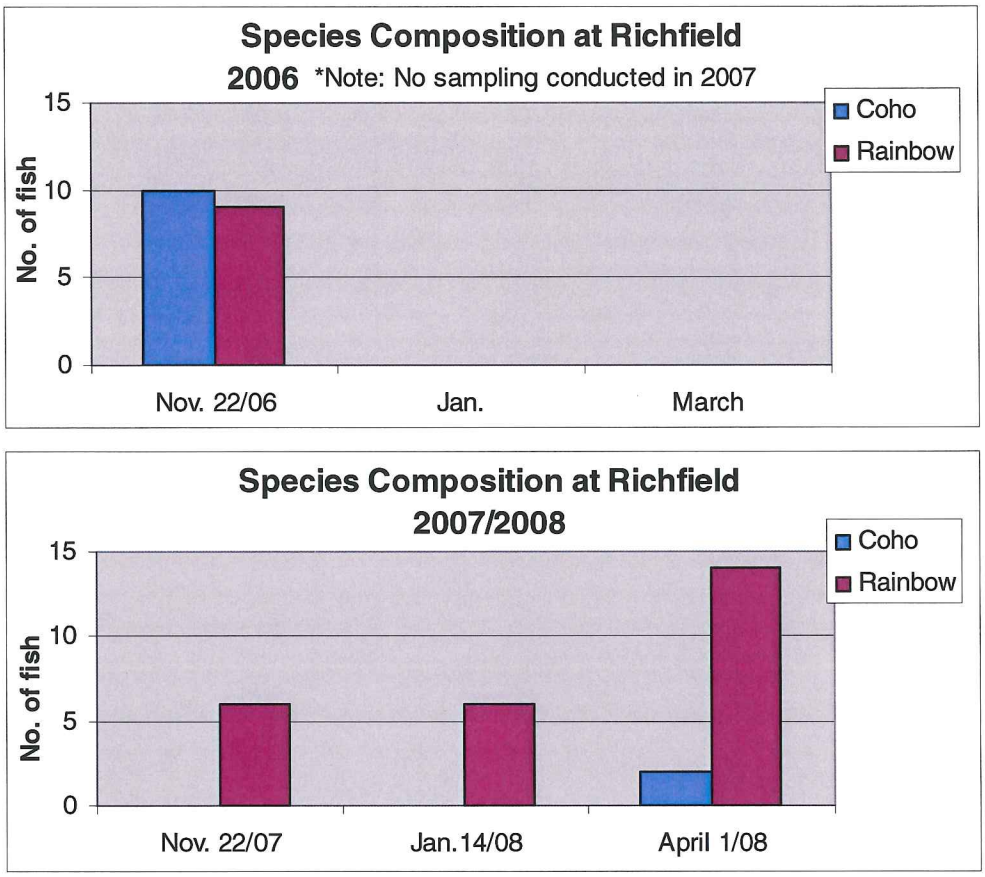


Figure 42. Species Composition at Richfield (2005/06, 2006/07 vr. 2007/08).

Middle Bulkley Sites

The overwintering habitat in the Middle Bulkley (i.e., McKinnon Site 1 and 2, Hydropole 12 and the groundwater channel) was not sampled in 2007/08 due to the loss of deep pool habitat at the McKinnon sites, as well as low water levels noted at Hydropole 12 and the groundwater channel. It is not certain why water levels were low (24 cm deep and limited connectivity to McKinnon Cr.) at the groundwater channel near the end of summer 2007, as well as in January 2008 where no water was present. Further sampling is recommended at the groundwater channel.

Fish sampling was also not conducted at sites 1 and 2 of McKinnon Creek in 2006/07 due to lack of habitat. There was sampling conducted at Hydro pole 12 in 2006/07, but only at the end of winter in March 2007 where only 1 coho and 4 CT were captured. Fish at the groundwater channel site were abundant in 2006/07 and were comprised solely of coho, with fairly large numbers captured throughout the winter sampling dates.

It should be noted that McKinnon Site 1 and 2 and Hydropole 12 provided good overwintering habitat in 2005/06. The groundwater channel was not sampled in 2005/06.

Waterfalls Creek Sites

Two species (i.e., coho and Dolly Varden char) were captured at the Waterfalls Creek sites in 2007/08, where as three species (i.e., coho, Dolly Varden char and a small proportion of cutthroat trout) were documented during the 2006/07 and 2005/06 studies. High numbers of coho were captured in Waterfalls Creek during all three studies, likely due to adult and fry stocking enhancement in the system. On whole, the proportion of Dolly Varden compared to coho at all the sites was much less in 2006/07 and 2007/08, than in 2005/06. The reason for fewer Dolly Varden is not known, but could be due to older resident DV migrating out of Waterfalls Creek, possibly downstream into Mission Creek or the Bulkley River. Further assessments of DV habitat, as well as DV presence/absence, should be conducted in the Mission Cr. System (upstream of the impassable culvert) in the summer 2008. Comparison Graphs for the Waterfalls Creek coho and Dolly Varden captured from 2005-2008 have been provided in Section 5.3-Fork Length and Condition Comparisons and in Section 5.4-Density.

It is difficult to use species composition and diversity as an indicator of overwintering habitat at the sites studied from 2005-08. Additional overwintering sampling at these sites would be beneficial in using species composition/diversity as an indicator in the future.

5.3 Fork Length and Condition Comparisons

The frequency of larger fork length fish is expected to be more prevalent near the end of winter than the smaller less competitive fish since smaller fish are assumed to have less energy reserves (Dolloff 1987). Fulton's condition factor (FCC) is expected to change over the winter, and differ between sites, since the amount of energy loss during the winter is expected to vary between sites (Donas and Saimoto 2001b).

5.3.1 Coho – Upper Bulkley Tributaries

As previously mentioned, there were no fish captured at the Barren site during the 2006/07 study. In 2005/06, a good number of coho greater than 80 mm were captured, and a consistent FCC of greater than 1.0 indicated that the Barren site provided good overwintering habitat for coho. In 2007/08, a good number of coho greater than 80 mm were captured at the beginning of winter; however, numbers seemed to decrease over the winter (Figure 43). The FCC was consistently greater than 1.0 over the 2007/08 winter.

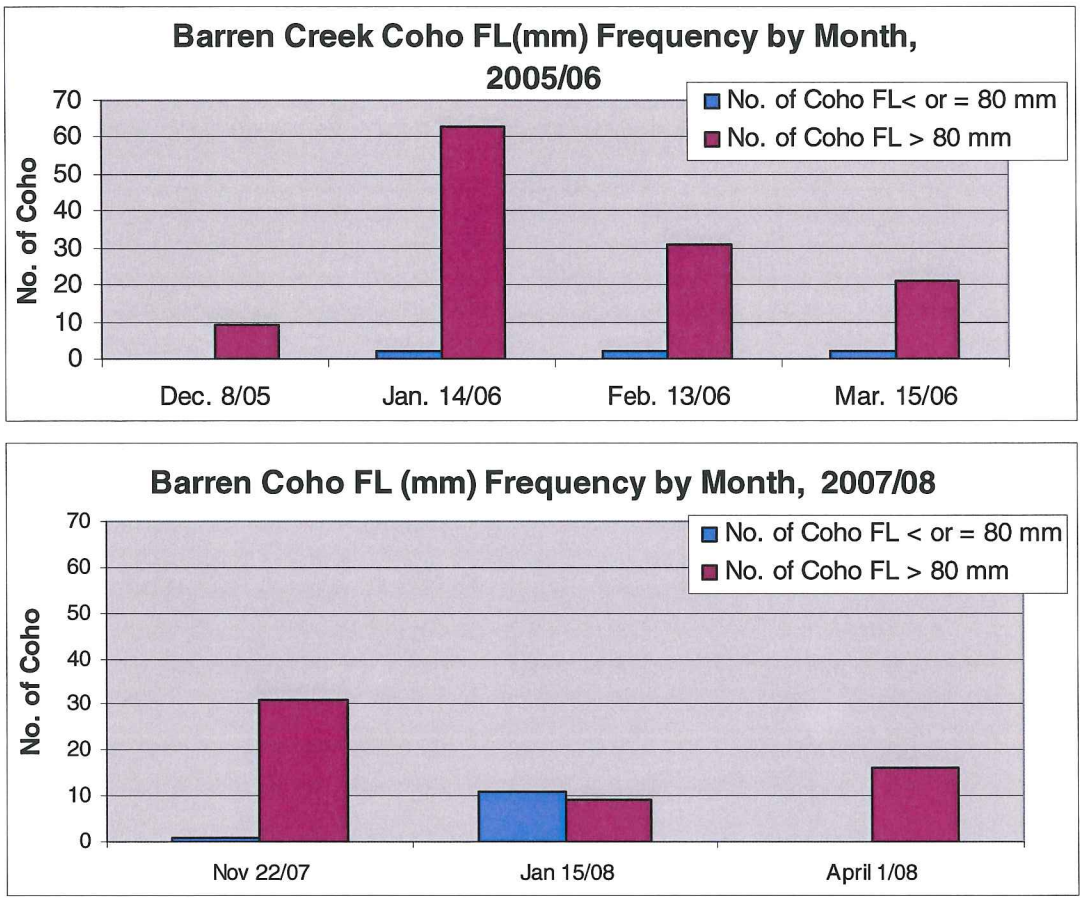


Figure 43. Fork Length Comparisons of Coho at the Barren site from 2005-2008

There were more coho captured at the Byman site in 2005/06 than in 2006/07; however, they were all greater than 80 mm long. There was also a slight decline in coho numbers from beginning to end of winter at Byman in 2005/06 (Figure 44). Overall, the frequency of coho decreased from the beginning to end of winter, which could indicate there was a net migration of coho out of the Byman pool, or some mortality over the winter. The coho were almost non-existent in 2007/08, where only 2 coho were captured throughout the study. The reason for the decrease could be due to various factors, one potentially being due to low flows in the Upper Bulkley in late fall 2006 which may have limited the coho spawner migration into the system which in return could cause lower than normal fry numbers the following winter (2007/08).

There were insufficient numbers of coho captured at the Byman site in 2006/07 (total=7) and 2007/08 (n=2) to analyze the mean Fulton's condition factor (FCC) by month, or to make a comparison to 2005/06.

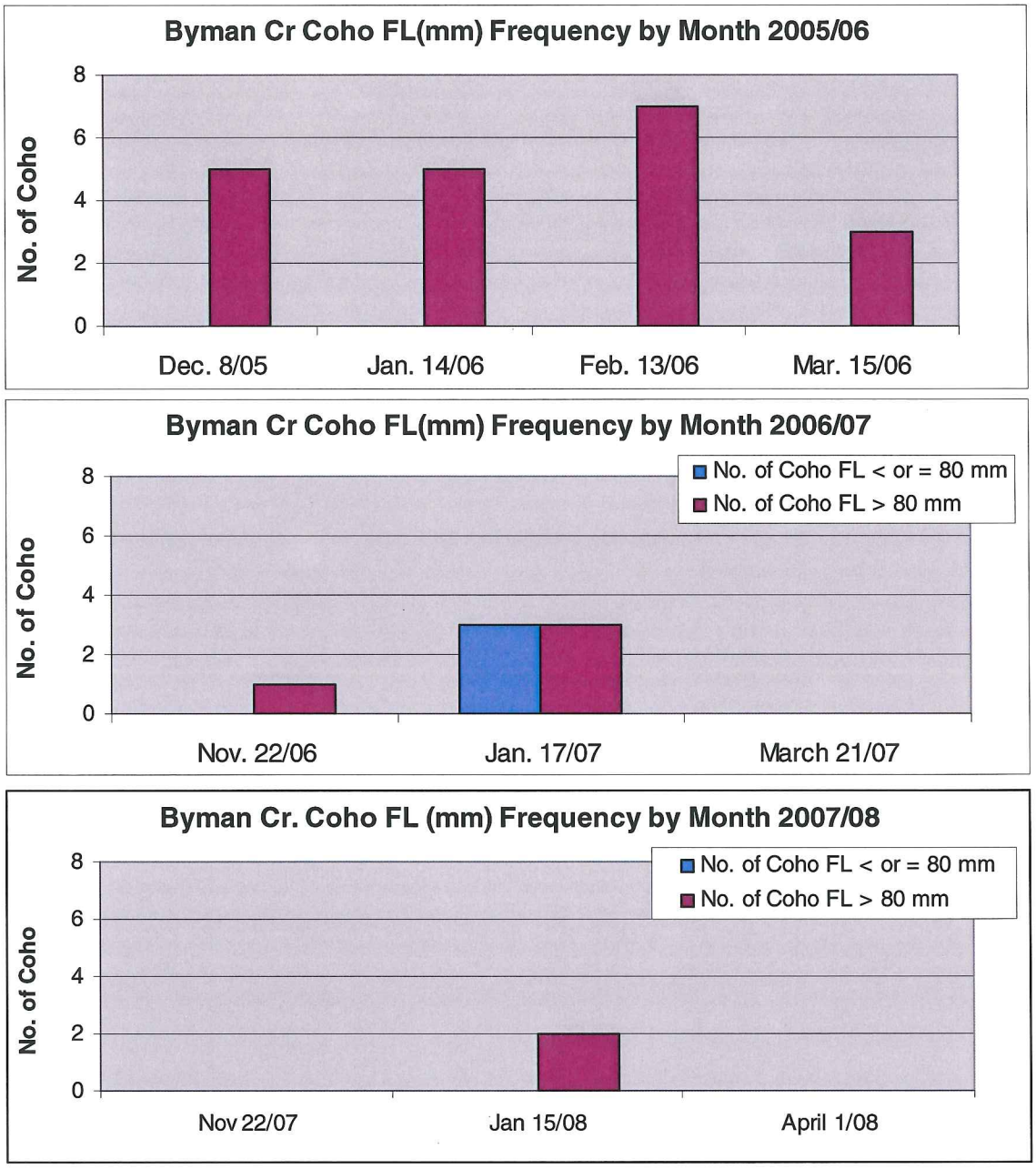


Figure 44. Fork Length Comparisons at the Byman site from 2005-2008.

At the McQuarrie site, fish sampling was conducted only in November during the 2006/07 study. It should be mentioned that more coho were captured on Nov. 22/06 (n=12 in the $\leq$ 80 mm category, n=1 in the > 80 mm category), than the entire winter sampling period in 2005/06 (n=6 in the $\leq$ 80 mm category). The coho numbers in 2007/08 were also low, comparable to what was found in 2005/06 (refer to Figure 45. The reason for higher numbers of coho captured at the beginning of winter 2006 may have been due to low flow conditions forcing larger number of coho into the culvert pool of the site. The FCC for the less than or equal to 80 mm category coho was 1.03 in

November 2006. The FCC for coho in 2005/06 and in 2007/08 was not analyzed since the numbers were low.

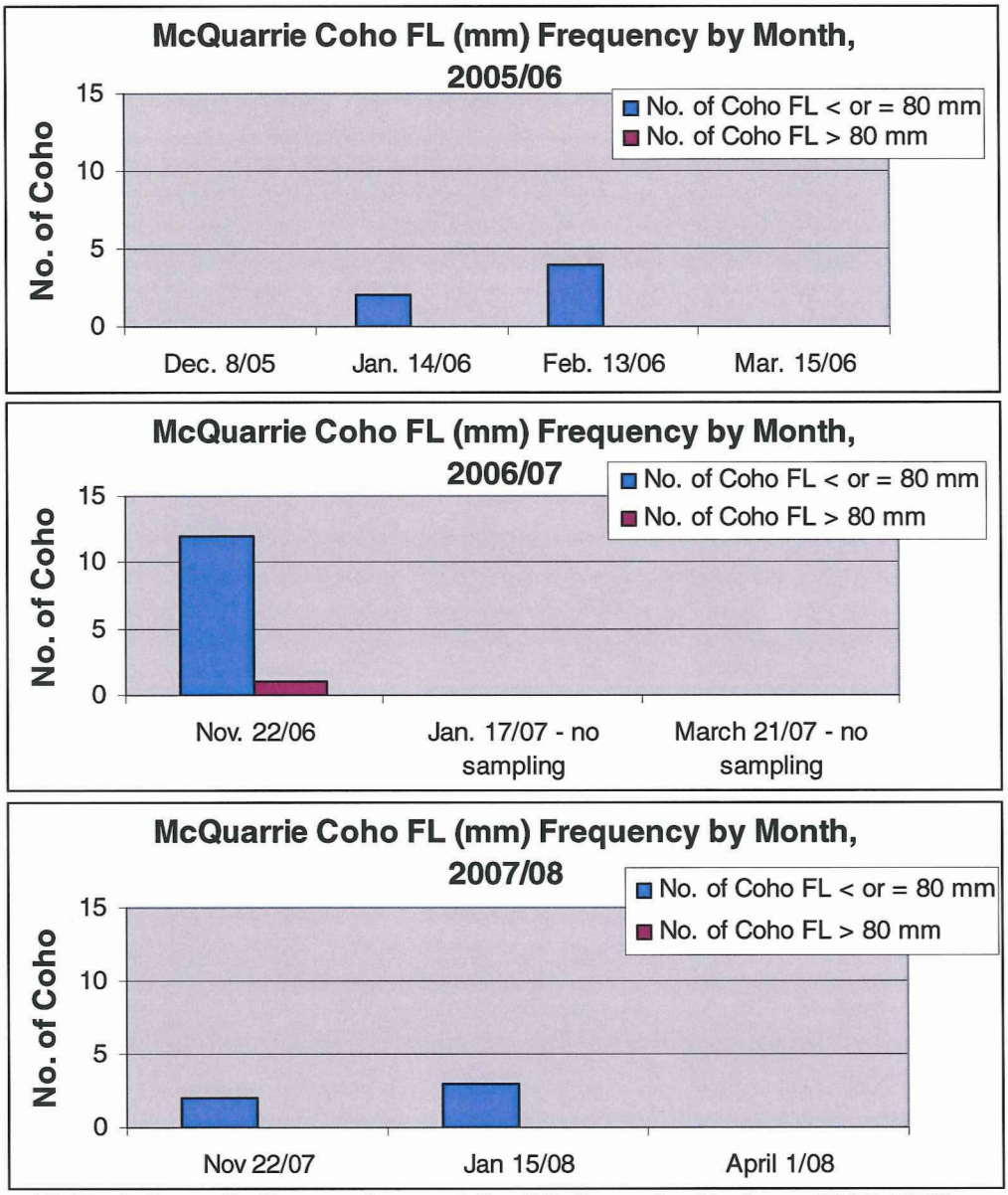


Figure 45. Fork Length Comparisons at the McQuarrie site from 2005-2008.

Fish sampling was conducted at the Richfield site during the 2006/07 and 2007/08 studies. Ten coho in the less than or equal to 80 mm category were captured on Nov. 22/07, and the mean FCC was 1.15, indicating a healthy population of coho at the beginning of the winter. Coho were not captured on Jan. 17/07, although it should be mentioned that trap 3 was damaged which may have contained fish. Only 2 coho were captured in 2007/08, all of which were captured on April 1/08 in the greater than 80 mm category (refer to Figure 46). The reason for such low numbers of coho captured at the Richfield site in 2007/08 may have been due to low flows in the Upper Bulkley in late

fall 2006 which may have limited the coho spawners migrating into the system and hence lower fry numbers found the following winter (2007/08).

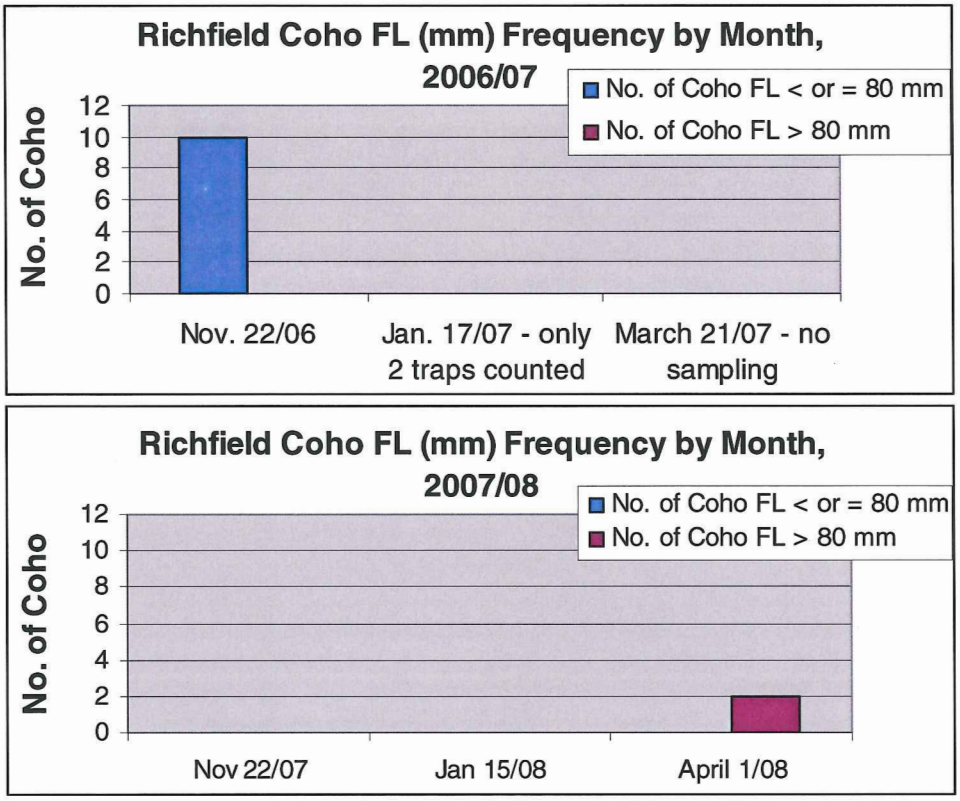


Figure 46. Fork Length Comparisons at the Richfield site from 2006-2008.

5.3.2 Coho – McKinnon Creek

There was no fish sampling conducted at McKinnon sites 1 and 2 in 2006/07 or 2007/08 due to a loss of pool habitat. Sampling was conducted at Hydropole 12, but only at the end of winter in March 2007 where only 1 coho and 4 CT were captured; therefore, it is not possible to make fork length comparisons to 2005/06.

5.3.3 Coho – Waterfalls Creek

A large proportion of coho captured at site 1 in both 2005/06, 2006/07 and 2007/08 of Waterfalls Creek were less than or equal to 80 mm. The greater than 80 mm category coho remained fairly constant throughout the winter in 2005/06, whereas a decline in this category was noted in 2006/07and 2007/08 (Figure 47). These results indicate that site 1 provides fairly stable habitat, with the decline in numbers possibly due to net migration out of the glide in March, although some studies have noted a lack of movement of salmonids during winter (Dolloff 1987, Swales et al. 1986, Giannico and Healey 1998). Due to warmer water temperatures in March younger coho may have migrated to other habitat in the system however, mortality of coho is also a possibility.

Most of the coho captured at the site 2 in 2005/06 were greater than 80 mm, with an overall decline in numbers over the winter with a peak noted in January (Figure 48). Many more coho in the less than or equal to 80 mm category, and less coho in the greater than 80 mm category were captured in 2006/07, than in 2005/06. The coho in both categories remained constant from beginning to end of winter in 2006/07 (Figure 48). Many more coho in the greater than 80 mm category, and less coho in the less than or equal to 80 mm category were captured on Nov. 20/07, similar to what was found in 2005. A shift occurred in Jan. and March of 2008, where the majority of coho captured were in the less than or equal to 80 mm category, contrary to what was found in 2006..

At site 3 in 2005/06, there appeared to be a decline in numbers over the winter however, both fork length categories peaked in January. The peak in numbers in January at sites 2 and 3 in 2005/06 may have been due to net migration of coho to these sites, contrary to studies that indicate salmonids such as coho tend not to move in the winter (Dolloff 1987, Swales et al. 1986, Giannico and Healey 1998). The overall decline of coho over the winter at sites 2 and 3 in 2005/06 may have been due to mortality or migration of coho out of the pools. In 2006/07, the coho numbers in both categories remained fairly constant throughout the winter, with a relatively even distribution of both fork length categories of coho (Figure 49). It is uncertain why coho numbers remained more constant in 2006/07 than in 2005/06, since the potential for migration was moderate to high throughout both winter study periods. It should be mentioned, however, that there were much less Dolly Varden captured in the traps in 2006/07and 2007/08 which may have contributed to coho numbers remaining relatively constant in 2006/07and 2007/08.

All coho captured at site 4 in 2005/06 were of the less than or equal to 80 mm category, with a decrease in numbers from Dec. to Feb. Since potential for migration at site 4 was only moderate in Feb., mortality may explain the decline in coho numbers. There were many more coho captured in both categories in 2006/07 and 2007/08, than in 2005/06 (refer to Figure 50). The reason for the increase in coho in 2006/07 and 2007/08 is not known.

It should be noted that at sites where an overall decline in coho was noted it may have been partly due to these fish being less active and feeding less throughout the winter, in which case some coho may not have entered the traps.

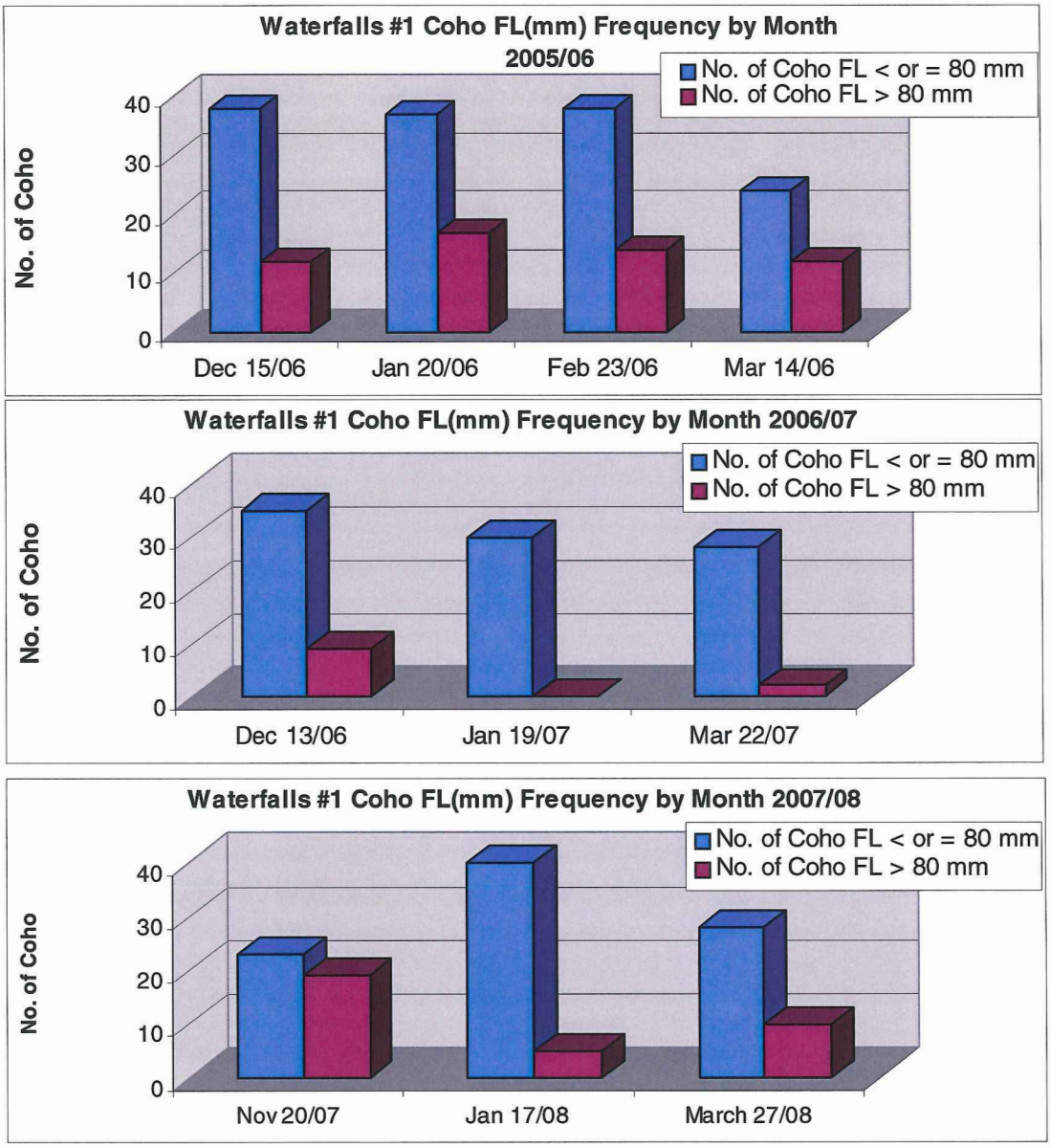


Figure 47. Fork Length Comparisons for Coho at Waterfalls Site#1 (2005/06 vr. 2006/07 vr. 2007/08).

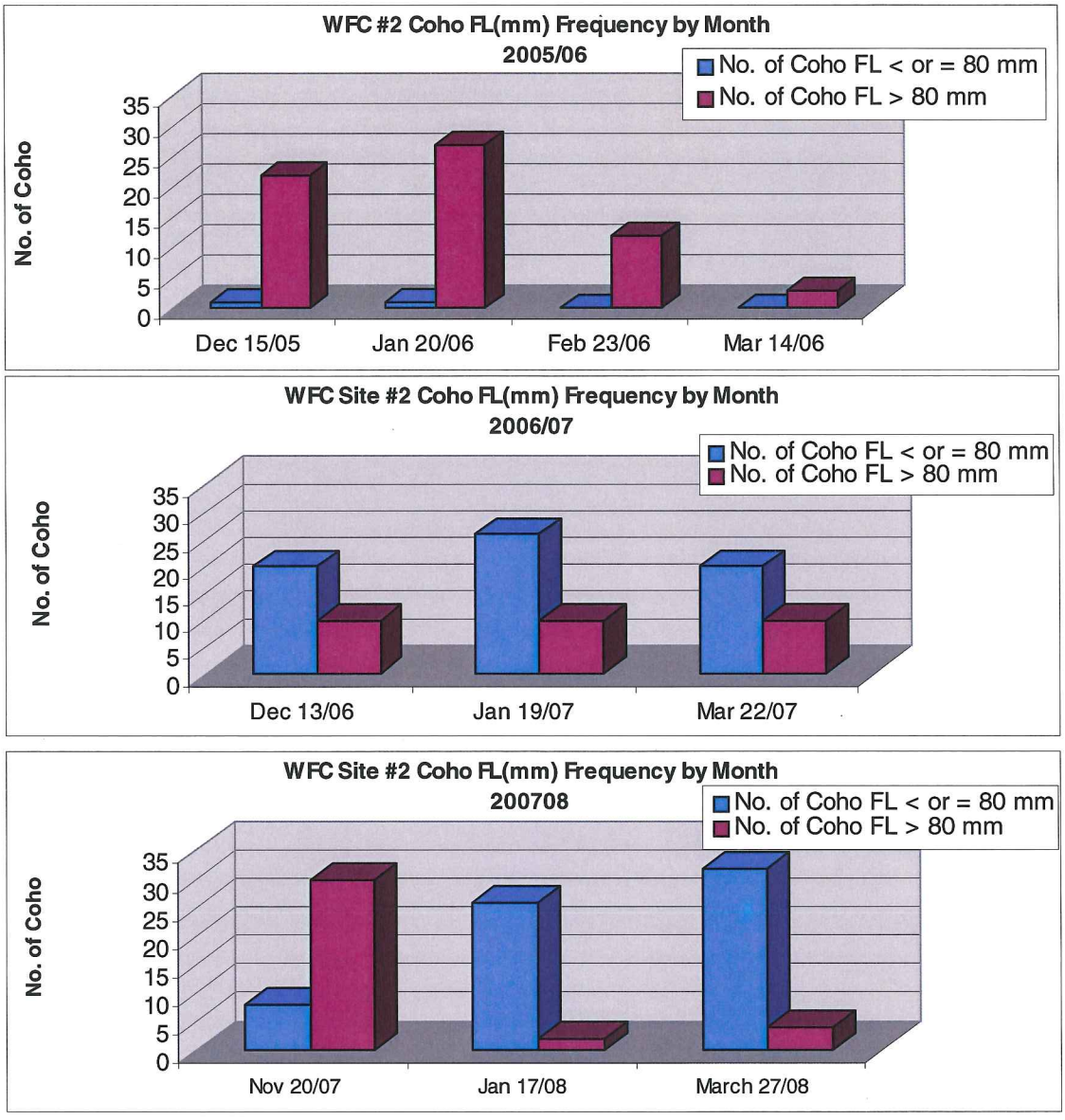


Figure 48. Fork Length Comparisons for Coho at Waterfalls Site#2 (2005/06 vr. 2006/07 vr. 2007/08).

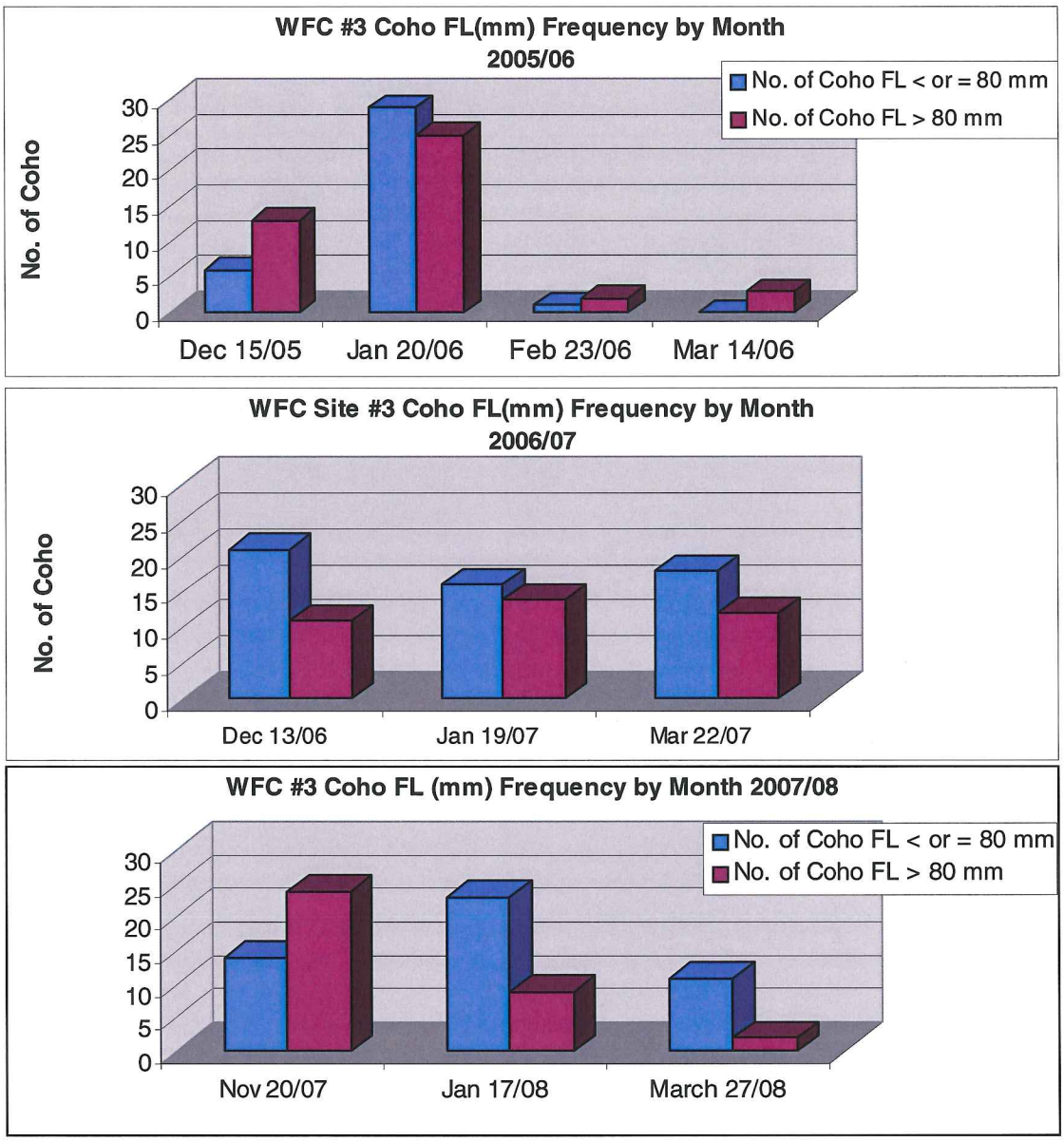


Figure 49. Fork Length Comparisons for Coho at Waterfalls Site#3.

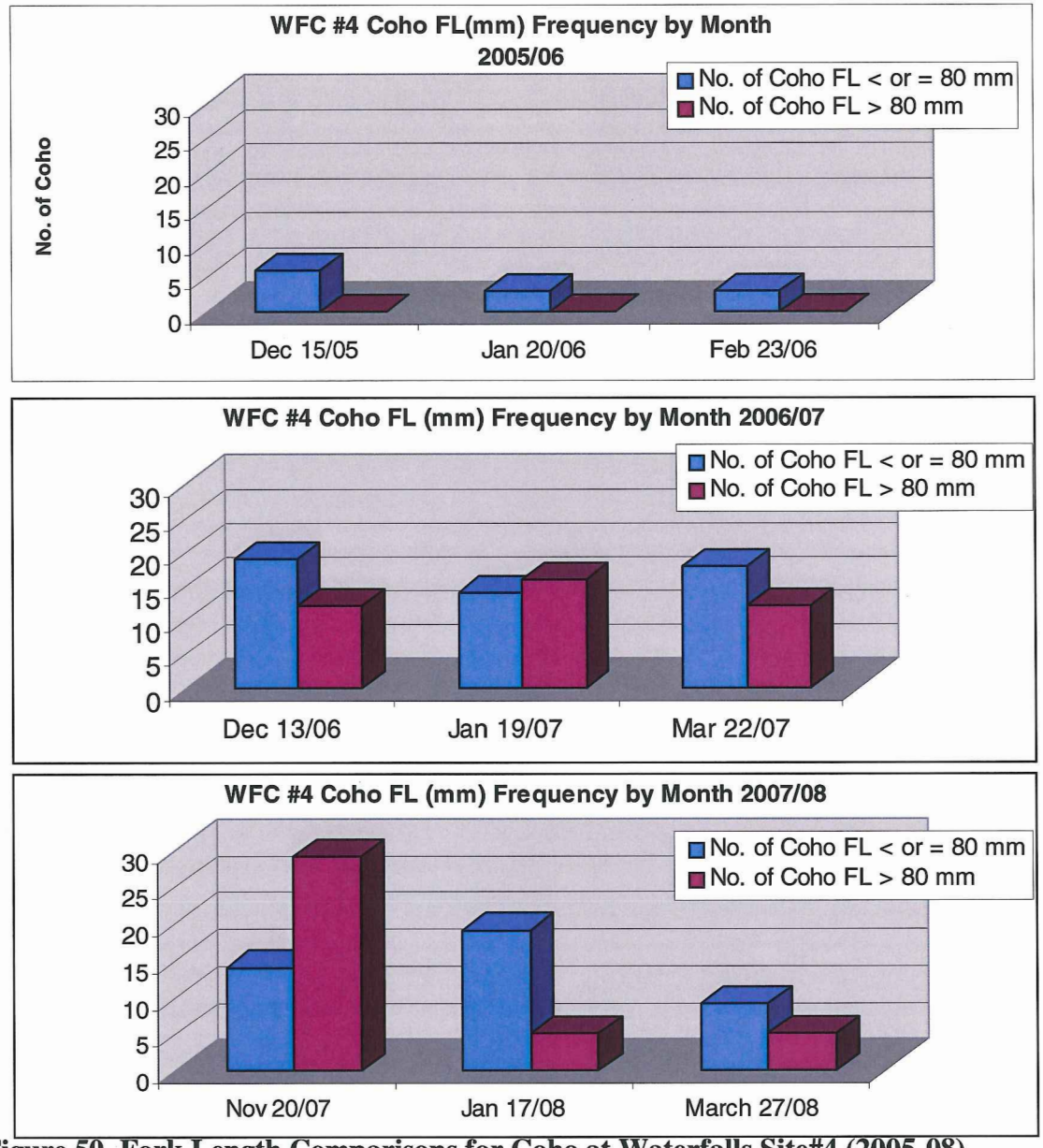


Figure 50. Fork Length Comparisons for Coho at Waterfalls Site#4 (2005-08).

In 2005/06 and 2007/08, the mean FCC for coho in both categories at site 1 decreased slightly over the winter. In 2006/07, the mean FCC at sites 1 and 2 increased over the winter for coho less than or equal to 80 mm long, whereas the mean FCC at sites 1 and 2 for coho greater than 80 mm long decreased.

The mean FCC for coho at site 3 in both categories decreased slightly in 2005/06. In 2006/07, the mean FCC at site 3 increased slightly over the winter for both category coho. The mean FCC at site 3 in 2005/06 was much higher for both category coho at the beginning of winter than in 2006/07. In 2007/08, the mean FCC at site 3 for coho in the less than or equal to 80 mm category increased over the winter, but decreased to just below 1.0 over the winter for the greater than 80 mm coho.

The mean FCC for coho at site 4 in both categories decreased slightly in 2005/06. In 2006/07, the mean FCC at site 4 decreased for both category coho over the winter. A decrease in mean FCC was noted for both category coho at site 4, where only the greater than 80 mm coho decreased to below 1 (i.e., 0.98).

Overall, the coho appeared to be in good condition from beginning to end of winter at all sites throughout the 2005 to 2008 studies where the mean FCC was found to be greater than 0.90 during all sampling dates (refer to Table 9). It should be noted that a slight decline in condition over the winter is to be expected since fish utilize their stored energy reserves to survive the stressful season (Dolloff 1987). It should be noted that an increase in condition of coho at the end of winter in March could be attributed to increases in water temperature and improved environmental condition for feeding and growth (Donas and Saimoto 2001b). It should be noted that the air and water temperature recorded in March 2006 was slightly warmer than the other winter months; however, an increase in these variables did not produce the similar effect as speculated in the previous study (Donas and Saimoto 2001b) since condition of coho declined in March.

Table 9. Comparison of Mean Fulton's Condition Factor for coho at the beginning and end of winter at Waterfalls Creek from 2005-2008.

Date	FCC for Coho WFC Site 1		FCC for Coho WFC Site 2		FCC for Coho WFC Site 3		FCC for Coho WFC Site 4	
2005/06	Beg.	End	Beg.	End	Beg.	End	Beg.	End
< or = 80 mm	1.13	0.93	0.96	na	1.17	1.02	1.21	na
> 80 mm	1.02	0.93	1.08	0.96	1.08	0.95	na	na
2006/07								
< or = 80 mm	1.06	1.11	1.02	1.14	1.00	1.03	1.05	0.99
> 80 mm	1.01	0.96	1.04	0.96	0.98	1.00	1.03	0.91
2007/08								
< or = 80 mm	1.18	1.05	1.21	1.01	1.04	1.07	1.06	1.06
> 80 mm	1.08	0.97	1.02	0.92	1.04	0.98	1.04	0.98

**na = low numbers of coho captured; therefore, mean FCC not calculated.*

5.3.4 Rainbow Trout/Steelhead – Upper Bulkley Tributaries

At the Byman site in 2005/06, there were no apparent trends in RBT/STHD frequency distributions from beginning to end of winter. Potential for migration was high at this site, which could be a factor in the variations from month to month. RBT/sthd has been known to move to different habitat prior to or during the winter (Bustard and Narver 1975, Swales et al. 1986). In both 2006/07 and 2005/06, there were more RBT captured in the > 80 mm category and the numbers peaked in January (Figure 51). The increase in RBT/STHD numbers in Jan. 2007 may have been due to the low/moderate potential for migration out of the pool. In 2007/08, there were also more RBT captured in the > 80 mm category, but the numbers steadily declined over the winter (Figure 51).

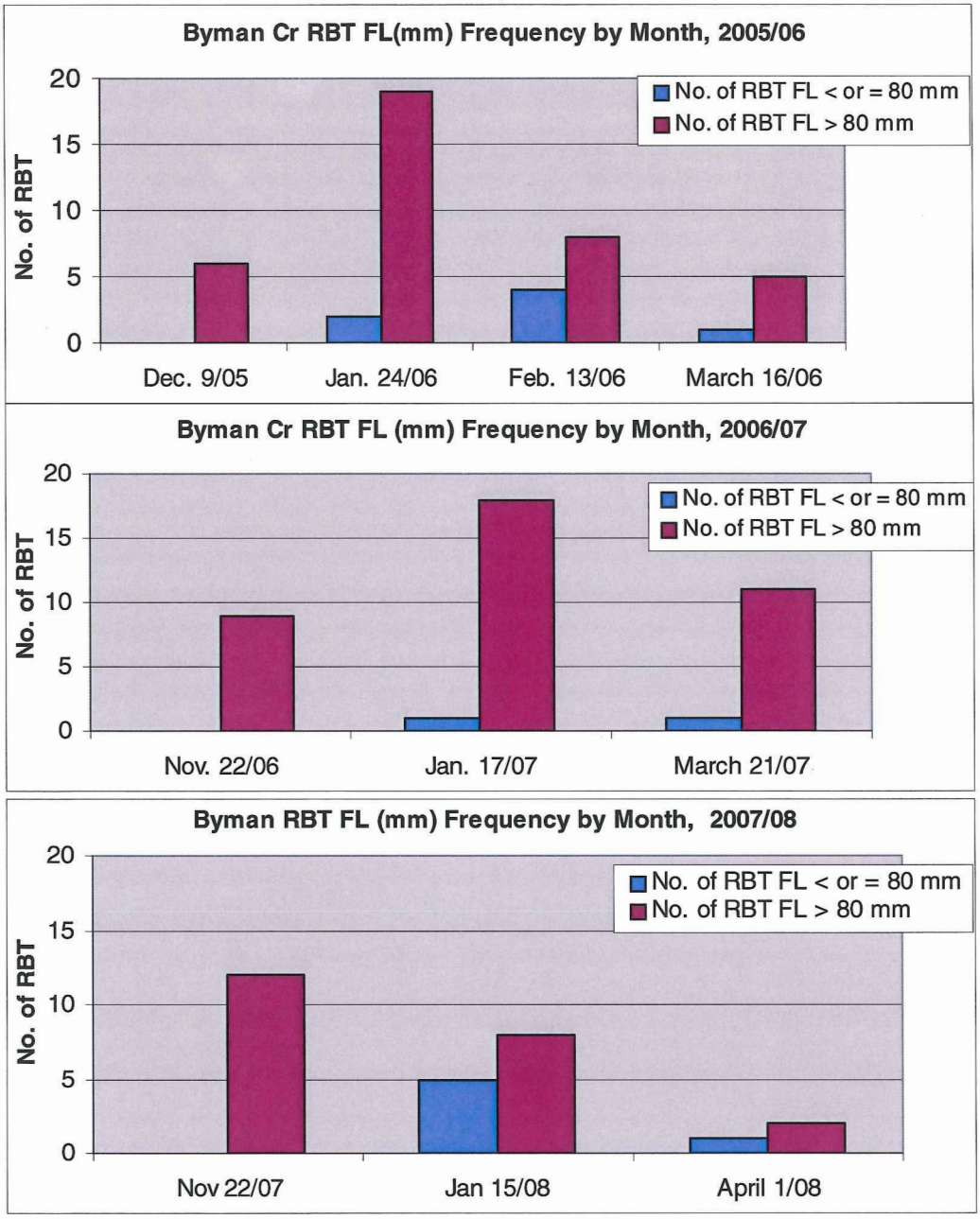


Figure 51. Fork Length Comparisons of RBT/STHD at Byman (2005/06 vr. 2006/07 vr. 2007/08).

A comparison of RBT/STHD frequency distributions from the beginning to end of winter for the Barren site has been presented for 2005/06 and 2007/08 (Figure 52). Fish were not captured at the Barren site in 2006/07 due to poor overwintering habitat caused from a combination of low water flows and dredging. In both 2005/06 and 2007/08 there were more fish captured in the greater than 80 mm category. There was a slight decline in RBT numbers noted from the beginning to end of winter during both studies. The number of RBT captured in 2007/08 were higher overall than in 2005/06.

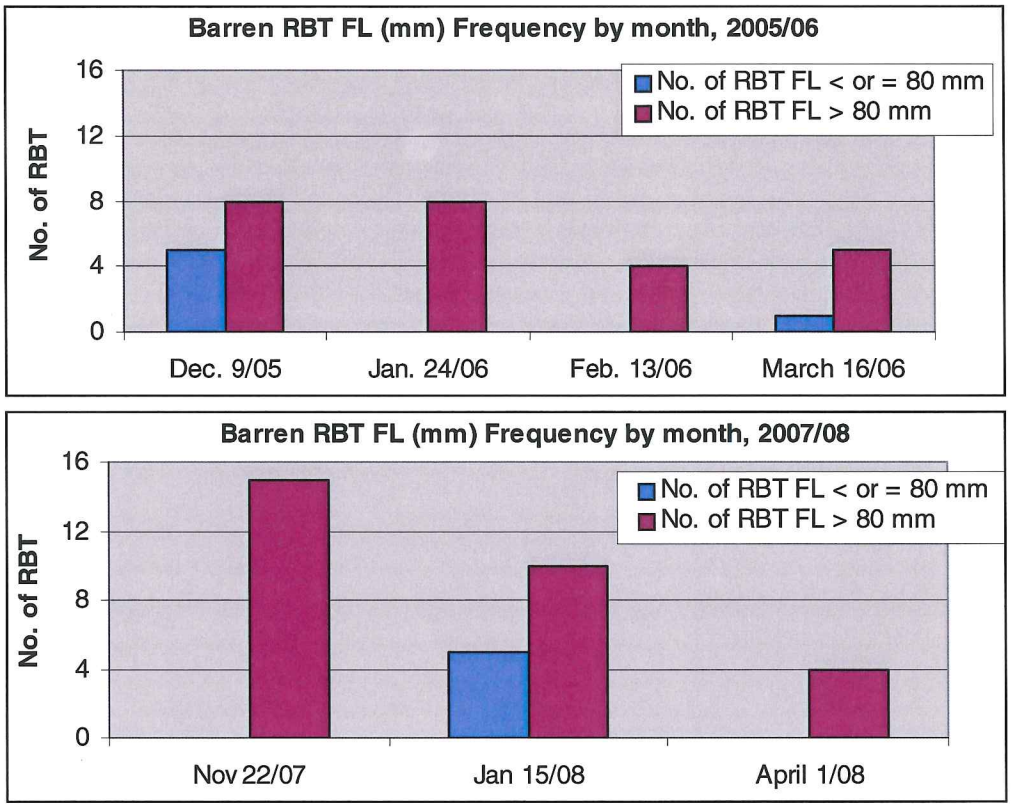


Figure 52. Fork Length Comparisons of RBT/STHD at Barren (2005/06 vr. 2007/08).

A comparison of RBT/STHD frequency distributions from the beginning to end of winter for the McQuarrie site has been presented for 2005-08 (Figure 53). In 2005/06 there were more fish captured in the greater than 80 mm category and there was a slight decline in RBT numbers noted from the beginning to end of winter. The total number of RBT captured in 2005/06 was much higher than what was captured in 2007/08 (Figure 53), and the reason for lower numbers in 2007/08 is not known since the water depths and habitat at the site were similar during both studies. It should be noted that coho numbers in 2007/08 were also low, comparable to what was found in 2005/06. Since sampling was conducted in Nov. only during the 2006/07 study, a comparison to this study has been made to the beginning of winter only. The reason for the decline in RBT numbers at the beginning of winter, namely from Dec. 9/05 (n=27), Nov. 22/06 (n=17) and Nov. 22/07 (n=0), is not entirely known. It should be noted that water depth at the site was lower on Nov. 22/06, as compared to 2005 and 2007. Further sampling is required at this site.

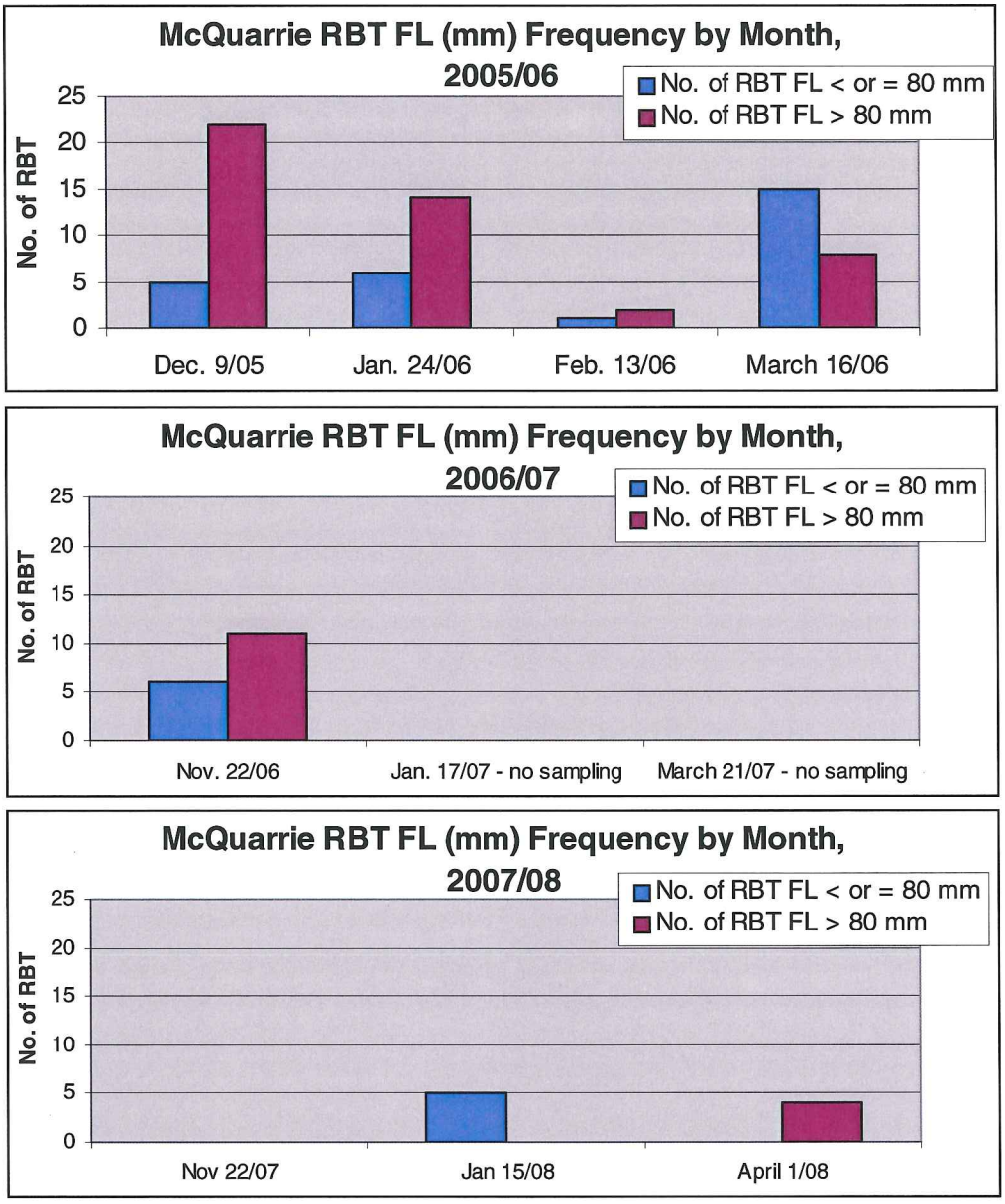


Figure 53. Fork Length Comparisons of RBT/STHD at McQuarrie (2005/06 vr. 2006/07 vr. 2007/08).

Fork length comparisons of RBT at the Richfield site have not been made since continuous sampling and measuring of fish was not conducted throughout the 2006/07 and 2007/08 studies, due to various factors. Comparisons for the Richfield site have been made however in the species composition and diversity section (refer to Section 5.2).

Due to low numbers of RBT/sthd captured in 2005/06 and 2006/07, the mean FCC for RBT/sthd in the less than or equal to 80 mm category has not been analyzed. In 2005/06, the mean FCC for RBT/sthd in the > 80 mm fork length category decreased only slightly from the beginning to end of winter at all three sites, indicating a healthy population of juvenile RBT/sthd (refer to Table 11). A fairly substantial decline in condition of the

juvenile RBT/sthd is to be expected since younger fish are assumed to have less energy reserves to survive adverse conditions than larger, more competitive fish (Cargnelli and Gross 1997). Therefore, the slight decline in condition is not necessarily an indication that Byman, Barren or McQuarrie sites were limiting for overwintering RBT/sthd in 2005/06.

In 2006/07, the Byman site mean FCC for RBT/sthd in the > 80 mm fork length category increased only slightly from 0.96 in Nov. to 0.98 in March. It should be noted that the overall condition of RBT/STHD at the Byman site was lower in 2006/07 than in 2005/06 and 2007/08, which could be an early indicator of RBT/sthd being stressed due to extremely low water levels prior to ice-up in 2006. Beginning of winter condition values are not provided for RBT/sthd in 2007/08; however, end of winter condition factor for RBT/sthd at all the sites was greater than 1.0, indicating that the overwintering habitat was suitable for RBT/sthd (Table 10).

Table 10. Comparison of Mean Fulton's Condition Factor for Rainbow Trout/Steelhead at the beginning and end of winter at the Upper Bulkley sites, 2005-2008.

Date	FCC for RBT Byman		FCC for RBT Barren		FCC for RBT McQuarrie		FCC for RBT Richfield	
2005/06	Beg.	End	Beg.	End	Beg.	End	Beg.	End
< or = 80 mm	na	na	na	na	na	na	Not sampled in 2005/06	
> 80 mm	1.09	1.04	1.09	1.03	1.08	1.03		
2006/07								
< or = 80 mm	na	na	na	na	na	na	na	na
> 80 mm	0.96	0.98	na	na	na	na	na	na
2007/08								
< or = 80 mm	na	1.02	na	1.11	na	na	na	na
> 80 mm	na	1.08	na	1.11	na	1.05	na	1.03

**na = low numbers of RBT captured; therefore, mean FCC not calculated.*

5.3.5 Dolly Varden – Waterfalls Creek

Overall, the number of Dolly Varden (DV) captured in the traps has decreased substantially since the 2005/06 and 2000/01 studies. It is not certain why the number of DV captured in 2006/07 and 2007/08 was substantially less at all the sites than previous overwintering studies conducted on Waterfalls Creek (see Section 5.2 Species Composition and Diversity).

In 2005/06, almost all DV captured at site 1 were greater than 80 mm category, where they increased from beginning to end of winter, although only 2 DV were captured in January. The increase in DV overall may have been due to net immigration to this glide since potential for migration was noted to be high at site 1. In 2006/07, the number of DV captured was substantially less than in 2005/06, where only 9 DV were captured, all

of which were caught at the beginning of winter (Figure 54). In 2007/08, the number of DV captured was also substantially less than in 2005/06. It should be noted that there was a fairly even amount of DV captured in both categories in 2007/08 (Figure 54).

In 2005/06, all of the DV captured at site 2 were greater than 80 mm long, with an overall decrease in numbers from beginning to end of winter. Migration to and from this glide could explain differences in numbers for each month since a high potential for migration was noted. In addition, some mortality may have occurred near the end of winter. All the DV captured in 2006/07 were also greater than 80 mm long, with an overall decrease in numbers over the winter. The proportion of DV captured in 2006/07 was substantially less than what was captured in 2005/06. The proportion of DV captured in 2007/08 was even less than what was captured in 2006/07 (Figure 55).

In 2005/06, there was an overall increase in the number of DV at site 3 over the winter and both fork length categories peaked in January. Migration to and from this glide due to high potential for migration at this site may have contributed to a peak in January. There was also an increase in the number of DV over the winter in 2006/07, where the number of DV at the end of winter was similar to 2005/06 (Figure 56). The total number of DV captured at site 3 was the highest of all the sites sampled from 2005-2008. It should be noted however that the proportion of DV captured in 2006/07and 2007/08 was substantially less than what was captured in 2005/06 (Figure 56).

In 2005/06, DV captured at site 4 were of the greater than 80 mm category, with a decrease noted over the winter. Net migration out of the pool or mortality may have contributed to the decline in DV at site 4 since it had only a moderate potential for migration in Feb. A likely net migration out of the pool occurred in January due to high potential for migration noted during this month. In 2006/07, DV captured at site 4 were also of the greater than 80 mm category, with an increase noted over the winter. The proportion of DV captured in 2006/07 and 2007/08 was less than what was captured in 2005/06, especially at the beginning of winter (Figure 57).

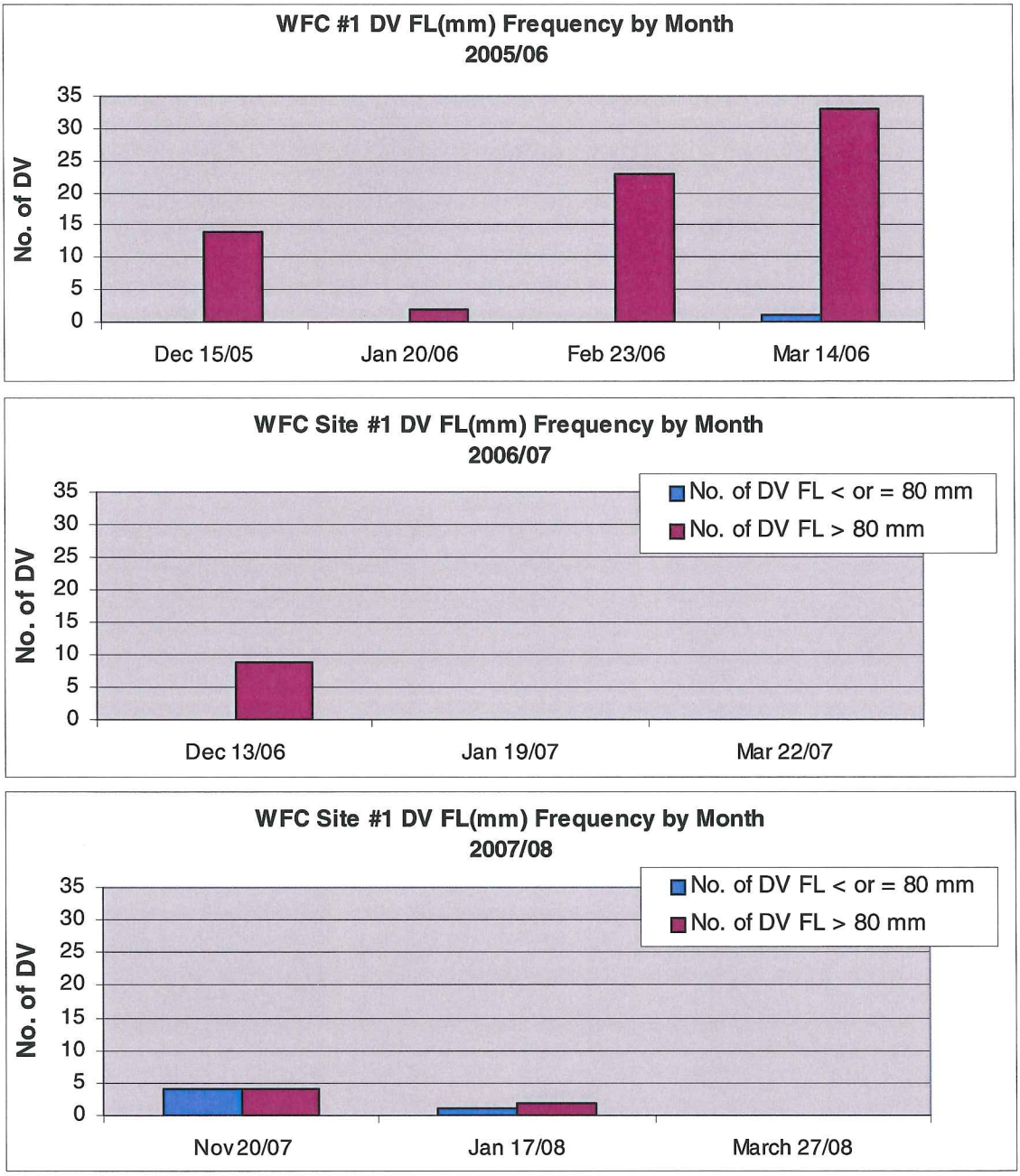


Figure 54. Fork Length Comparisons of DV at Waterfalls#1 (2005/06 vr. 2006/07 vr. 2007/08).

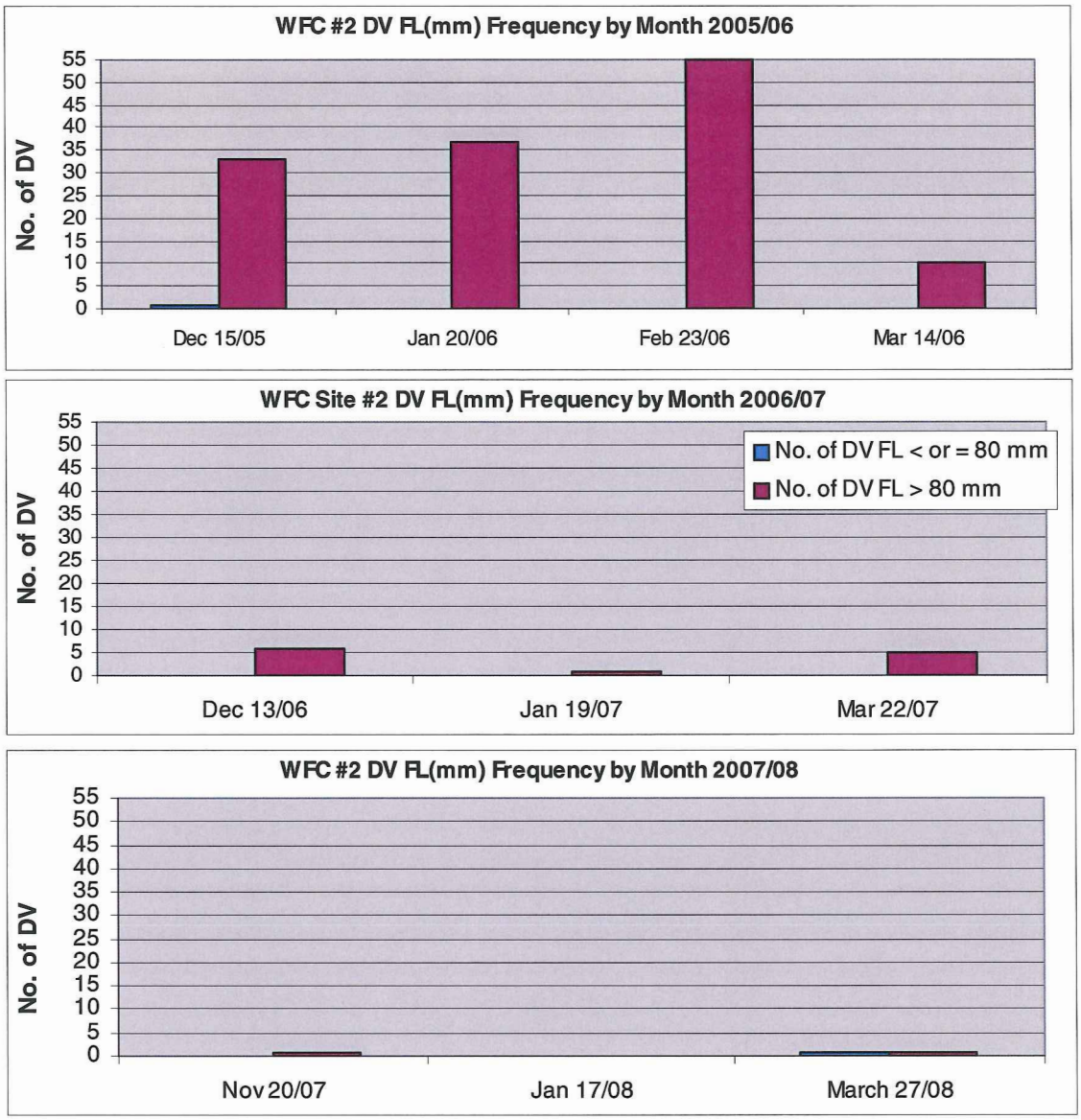


Figure 55. Fork Length Comparisons of DV at Waterfalls#2 (2005/06 vr. 2006/07 vr. 2007/08).

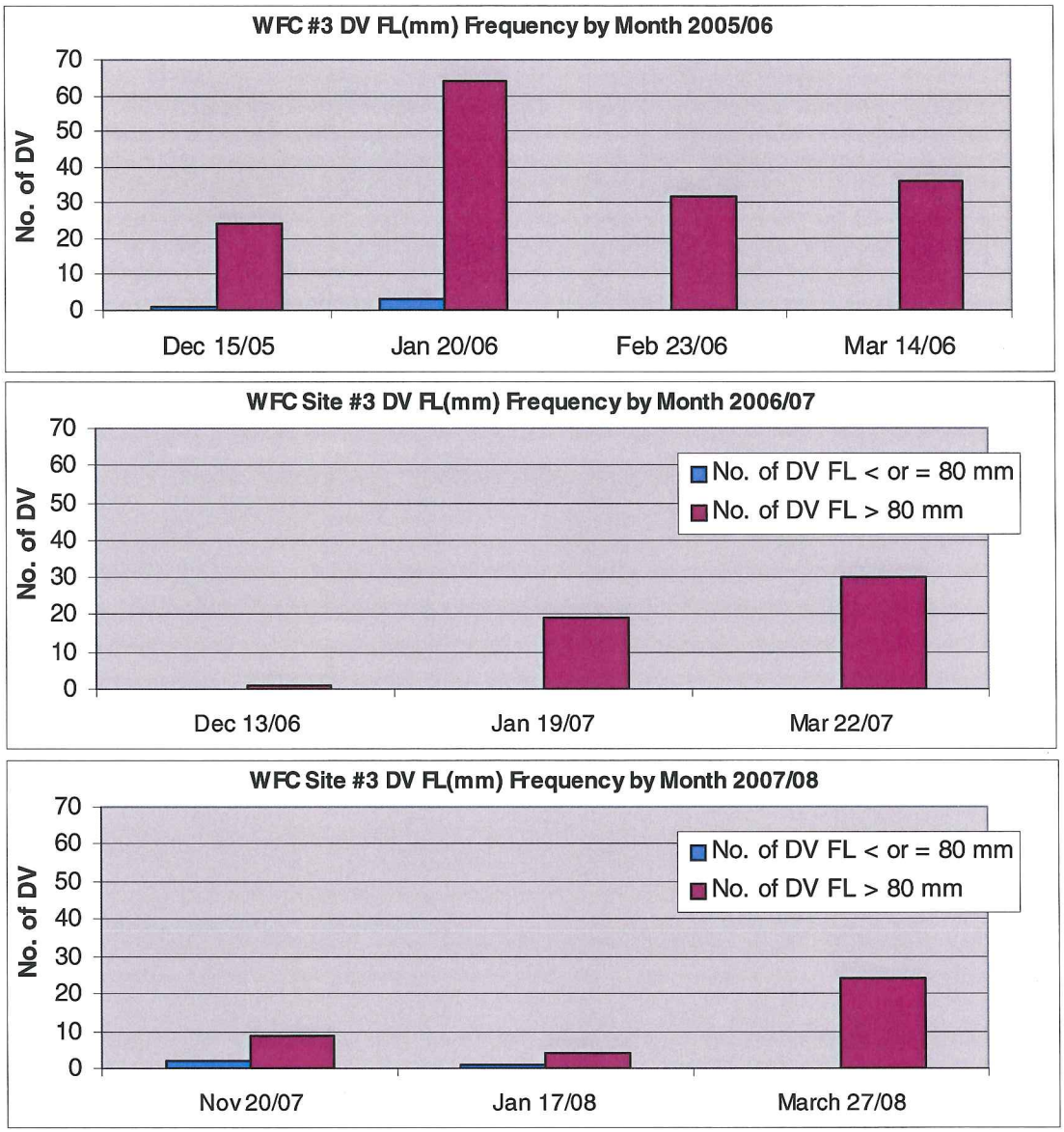


Figure 56. Fork Length Comparisons of DV at Waterfalls#3 (2005/06 vr. 2006/07 vr. 2007/08).

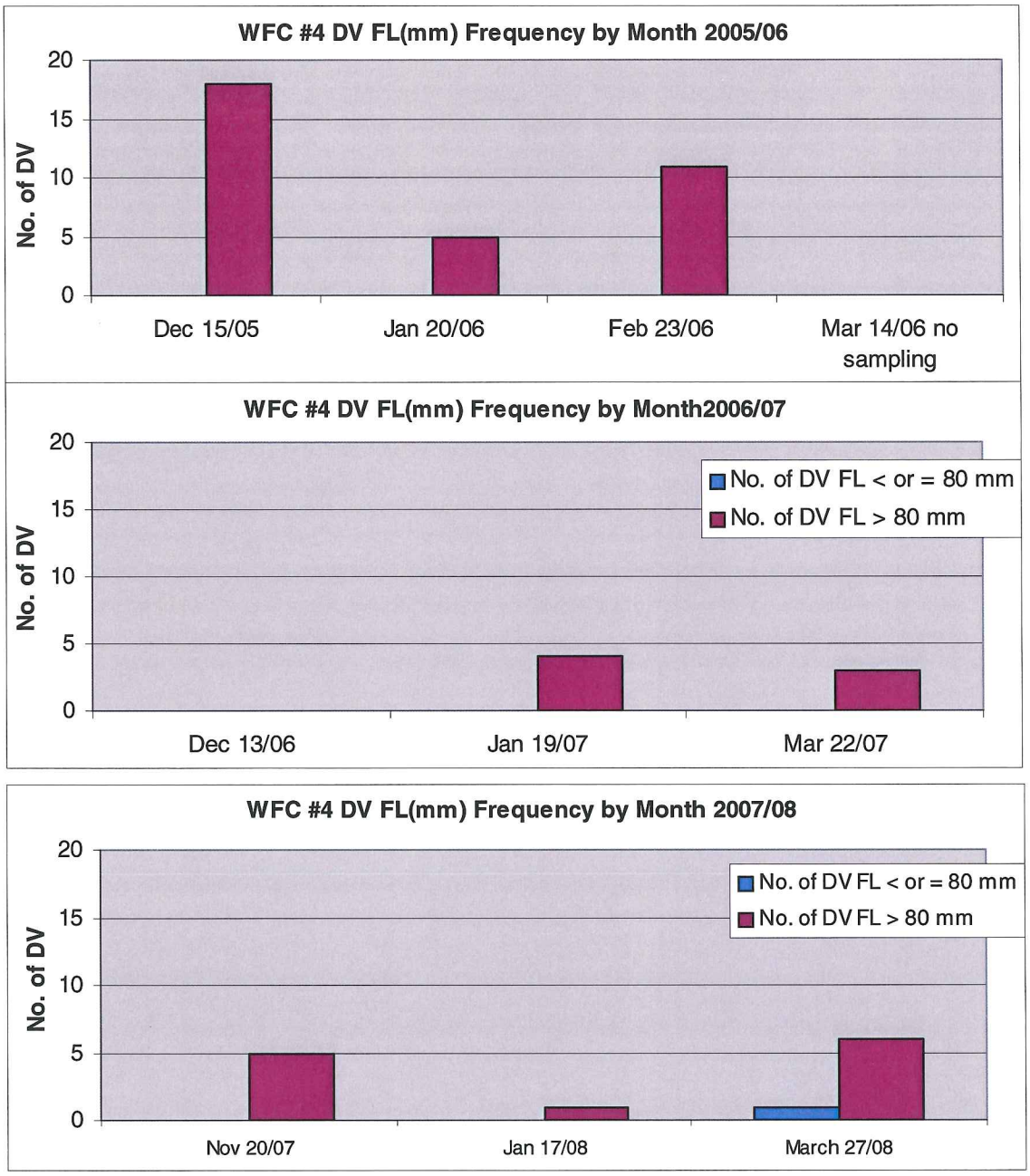


Figure 57. Fork Length Comparisons of DV at Waterfalls#4 (2005/06 vr. 2006/07 vr. 2007/08).

In 2005/06, the condition (mean FCC) of the greater than 80 mm DV decreased from the beginning to end of winter for all four sites (refer to Table 11). The decrease in mean FCC indicates that winter is difficult for the DV in the system, which is to be expected for all salmonids. Due to low numbers of DV captured at Sites 1, 2 and 4 in 2006/07, it was not possible to calculate the monthly mean FCC for DV. At site 3, the mean FCC was calculated for the end of winter only where it was 0.89, which was slightly lower than what was found in 2005/06 where the mean FCC was 0.92. In 2007/08, the mean

FCC for the less than or equal to 80 mm DV decreased from beginning to end of winter at sites 1 and 3. Low numbers of DV were captured in 2007/08 at sites 2 and 4, therefore condition comparisons from beginning to end of winter have not been made.

Table 11. Comparison of Mean Fulton's Condition Factor for Dolly Varden at the beginning and end of winter at Waterfall Creek from 2005-2008.

Date	FCC for DV WFC Site 1		FCC for DV WFC Site 2		FCC for DV WFC Site 3		FCC for DV WFC Site 4	
2005/06	Beg.	End	Beg.	End	Beg.	End	Beg.	End
< or = 80 mm	na	0.98	na	na	na	na	na	na
> 80 mm	0.95	0.85	0.98	0.90	1.05	0.92	0.94	na
2006/07								
< or = 80 mm	na	na	na	na	na	na	na	na
> 80 mm	na	na	na	na	na	0.89	na	na
2007/08								
< or = 80 mm	1.12	0.94	na	na	1.06	0.99	na	0.98
> 80 mm	na	na	na	na	na	0.88	na	0.85

*na= low numbers of DV captured; therefore, mean FCC not calculated.

5.4 Density (CPUE)

5.4.1 CPUE for Coho

Overall, the CPUE for coho has been relatively low during all study periods from 2005-08 at the Byman site, where it did not exceed 2.5 coho/trap. The CPUE for coho at Byman in 2005/06 was overall higher than 2006/07 and 2007/08. In 2006/07, the CPUE for coho was highest on Jan.17/07 (2 coho/trap); however, beginning and end of winter CPUE for coho was very low to none. The CPUE for coho was the lowest in 2007/08 (i.e., less than 1 coho/trap), compared the previous two study periods (Figure58).

The CPUE for coho at Barren in 2005/06 was higher than the latter two study periods, other than at the beginning of winter, where the CPUE for coho was highest at Barren (10.67 coho/trap) on Nov. 22/07 (Figure 59). The CPUE at Barren at the beginning and end of winter in 2006/07 was the lowest of all the sites (0 coho/trap), due to low water depth in combination with low dissolved oxygen. It should be noted that dredging upstream and downstream of the culvert at Barren site in summer 2006, coupled with extremely low water prior to ice-up, likely caused poor overwintering habitat at Barren during the 2006/07 study period.

The CPUE for coho at McQuarrie at the beginning and end of winter in 2005/06 was 0 coho/trap and middle of winter CPUE for 2005/06 was very similar to what was found in 2007/2008 (Figure 60). The highest CPUE for coho recorded during all sampling dates from 2005-08 was at the beginning of winter at McQuarrie in 2006 (4.3 coho/trap). Middle and end of winter CPUE is absent for McQuarrie in 2007 due to inaccessibility of the site for trapping (high snow levels).

Finally, CPUE for coho at Richfield site was no more than 3.3 coho/trap over the two study periods spanning from 2006-2008. The CPUE for coho decreased from beginning to middle of winter in 2006/07, where as CPUE for coho increased from the beginning to end of winter in 2007/08 (Figure 61).

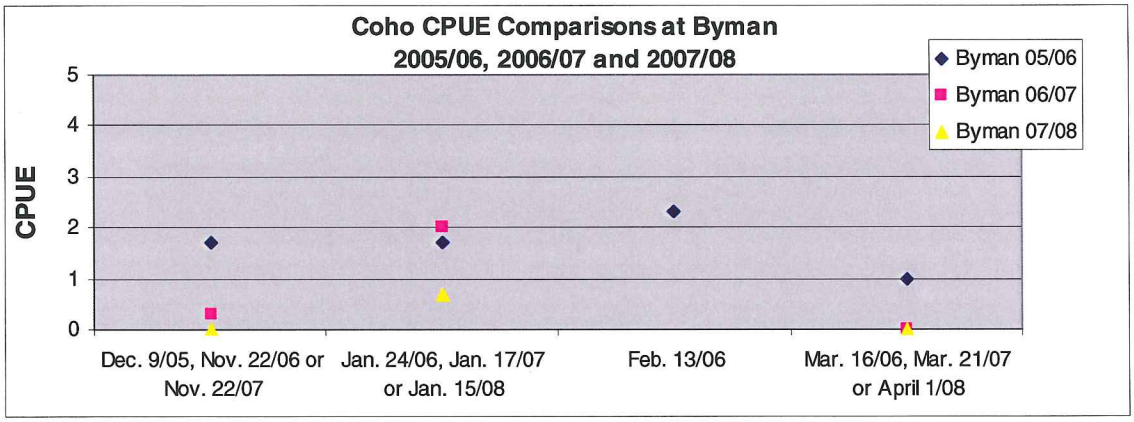


Figure 58. Coho CPUE Comparisons at Byman (2005-08).

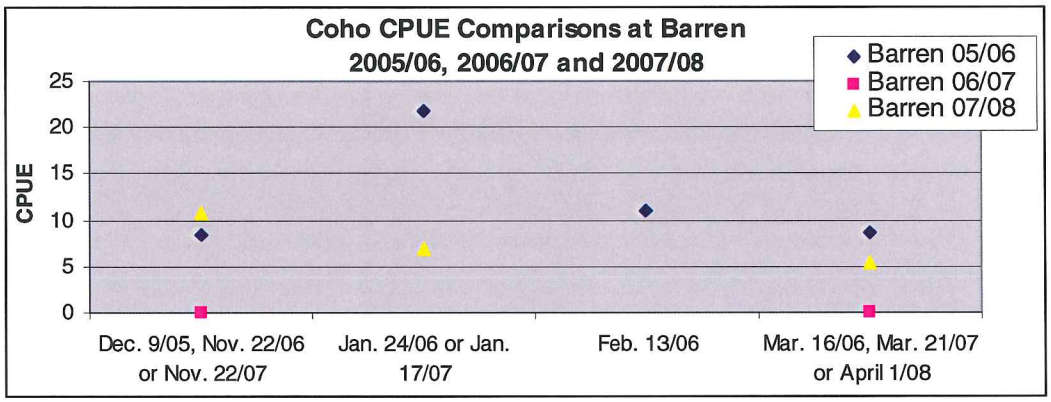


Figure 59. Coho CPUE Comparisons at Barren (2005-08).

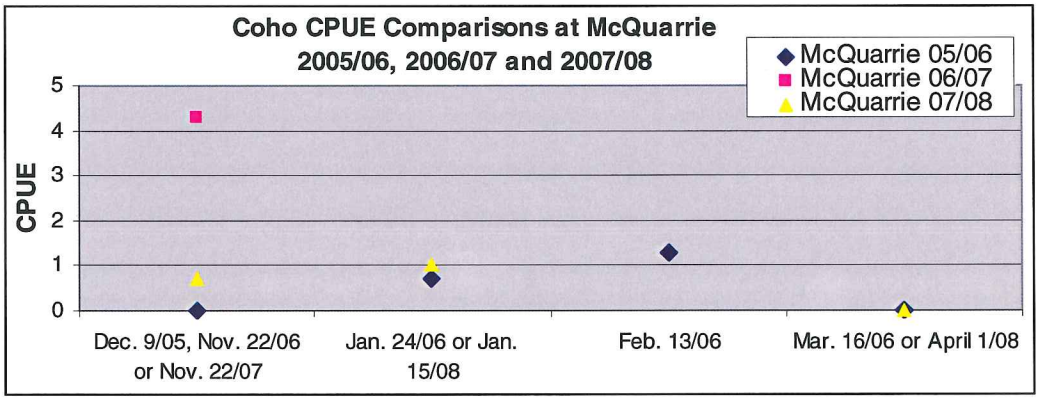


Figure 60. Coho CPUE Comparisons at McQuarrie (2005-08).

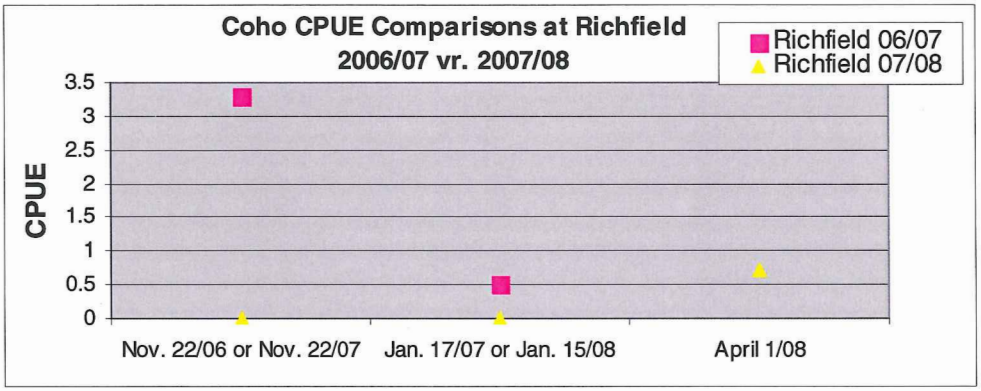


Figure 61. Coho CPUE Comparisons at Richfield (2006-08).

At Waterfall Creek Site 1, the CPUE for coho salmon decreased overall from beginning to end of winter during all three study periods (Figure 62). The CPUE for coho was always highest at sites 1 and 2 during the three study periods. From 2005-08, the CPUE for coho at sites 1 and 2 decreased overall from the onset to end of winter (Figures 62 and 63). This could have been due to a high potential for migration at sites 1 and 2, which were located in pool/glide habitat with a total length of about 300m.

The lowest CPUE for coho was found at either site 3 or 4 over the winters spanning from 2005-08. On the whole the CPUE for coho in 2007/08, at all 4 sites throughout the winter, exceeded the CPUE for coho in 2005/06 and 2006/07 (Figures 62 to 65). The higher numbers of coho in 2007/08, as well as in 2006/07, may have been due to the low CPUE of DV at the sites.

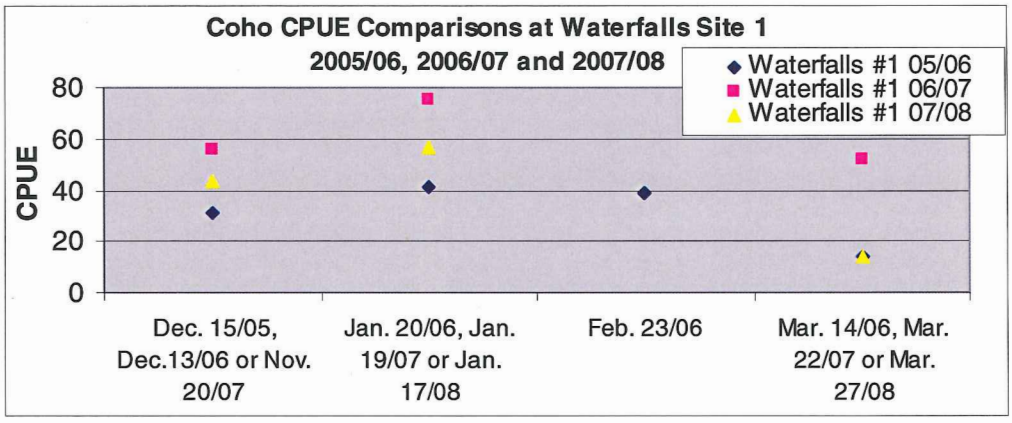


Figure 62. Coho CPUE Comparisons at Waterfalls Site 1 (2005-08).

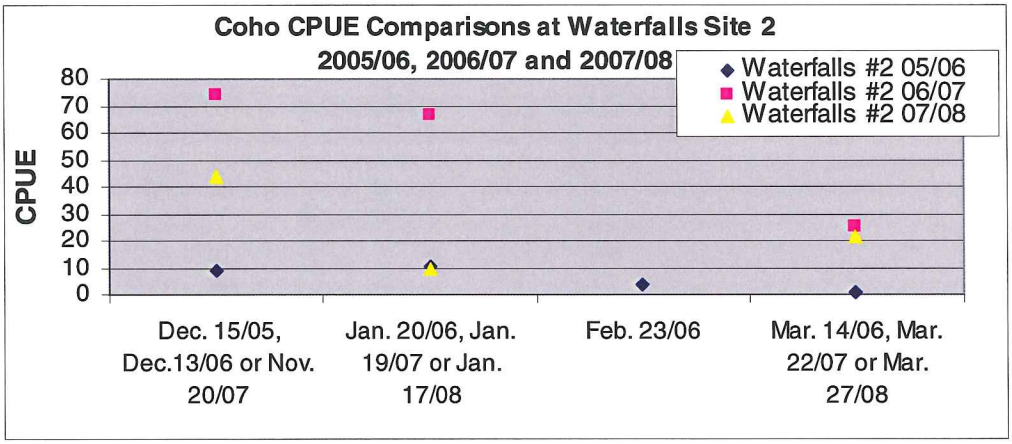


Figure 63. Coho CPUE Comparisons at Waterfalls Site 2 (2005-08).

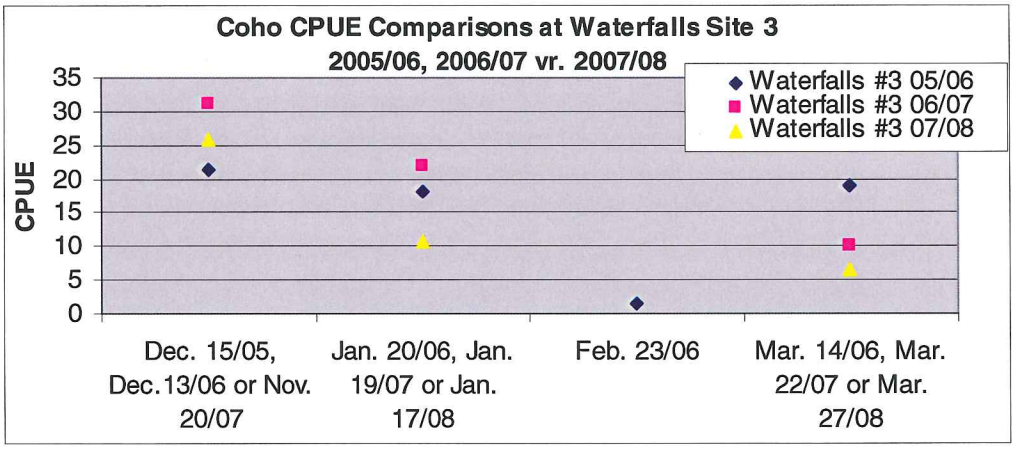


Figure 64. Coho CPUE Comparisons at Waterfalls Site 3 (2005-08).

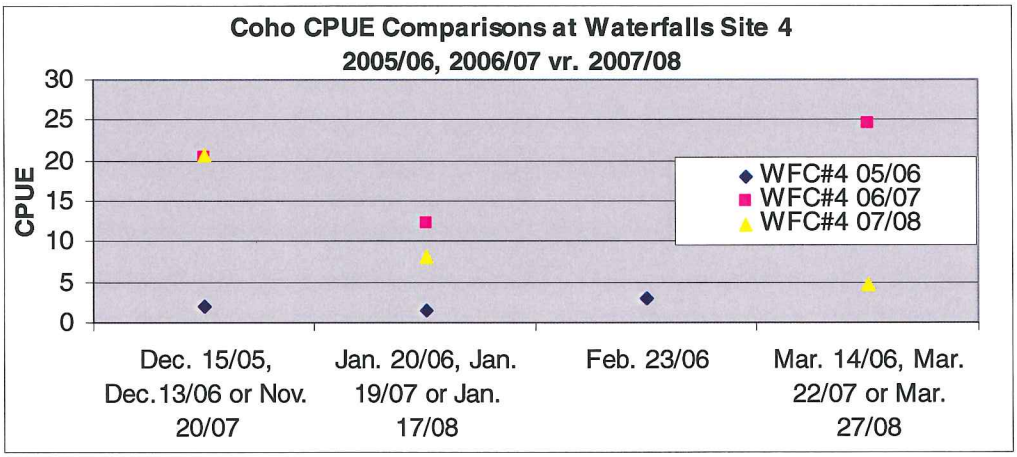


Figure 65. Coho CPUE Comparisons at Waterfalls Site 4 (2005-08).

5.4.2 CPUE for Rainbow Trout/Steelhead

In 2006/07, the CPUE for RBT/sthd increased at Byman from 3/trap at the beginning of winter to 6/trap at the end of winter. As a comparison of RBT/sthd CPUE at Byman between 2005/06 and 2006/07, CPUE was similar in Dec. and Jan.; however, CPUE at the end of winter was higher in 2006/07 than in 2005/06 (Figure 66). In addition, CPUE for RBT/STHD was highest at the beginning of winter 2007 (4/trap); however, CPUE dropped off to be lowest in 2008, compared to the other two study periods, during middle to end of winter (Figure 66).

In 2005/06, CPUE for RBT/sthd at the Barren site was the most consistent of the three sites (1.3-4.3/trap), which could be attributed to the Barren site having the lowest potential for migration of the 3 sites. The Barren site had no RBT/STHD captured in 2006/07. In 2007/08, the CPUE for RBT/sthd at the beginning and middle of winter sample dates was slightly higher than what was found in 2005/06; however, the end of winter CPUE of RBT/sthd was lower in 2008 than what was found in 2006 (Figure 67).

In 2005/06, the CPUE for RBT/sthd at the beginning of winter at McQuarrie was 9.0/trap, which was the highest of all sites sampled in 2005/06 and highest recorded CPUE for RBT/sthd since 2005. In 2006/07, McQuarrie had the highest CPUE for RBT/sthd (5.7/trap) at the beginning of winter of all the sites. McQuarrie was not sampled in the middle or end of winter in 2006/07 due to snow plowed onto the site making it inaccessible for trapping. In 2007/08 the CPUE for RBT/sthd was the lowest ever recorded since 2005 (Figure 68). The reason for such low numbers of RBT/sthd in 2007/08 is not known.

At Richfield in 2006/07, the CPUE for RBT/sthd decreased from 3/trap at the beginning to 0/trap at the middle of winter. In 2007/08, the CPUE for RBT/sthd increased over the winter from 2/trap to over 4/trap (Figure 69).

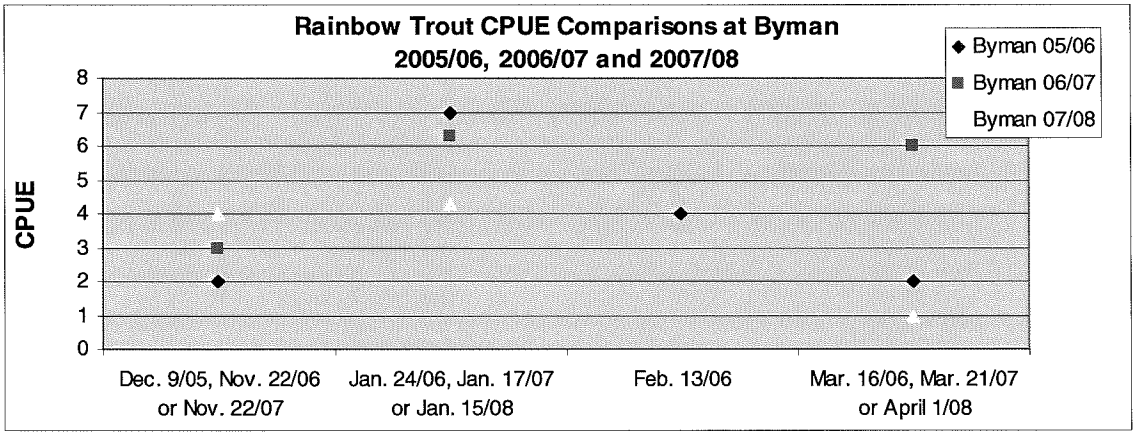


Figure 66. RBT/Sthd CPUE Comparisons at Byman (2005-08).

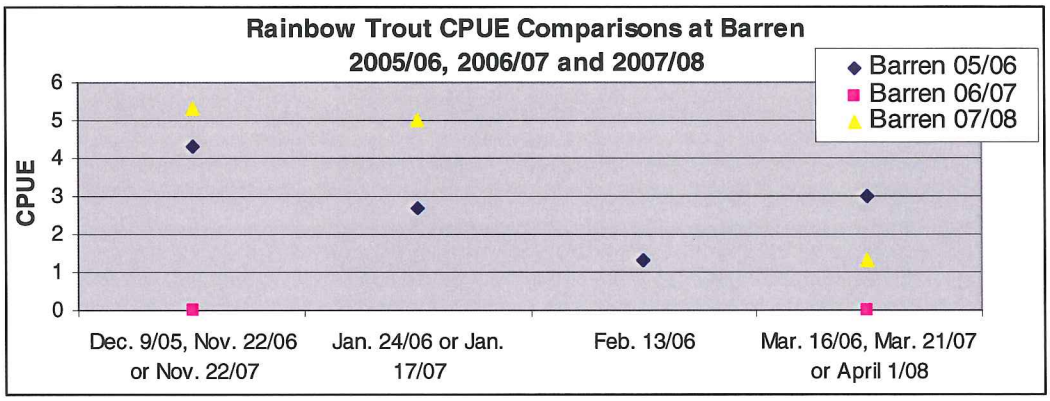


Figure 67. RBT/Sthd CPUE Comparisons at Barren (2005-08).

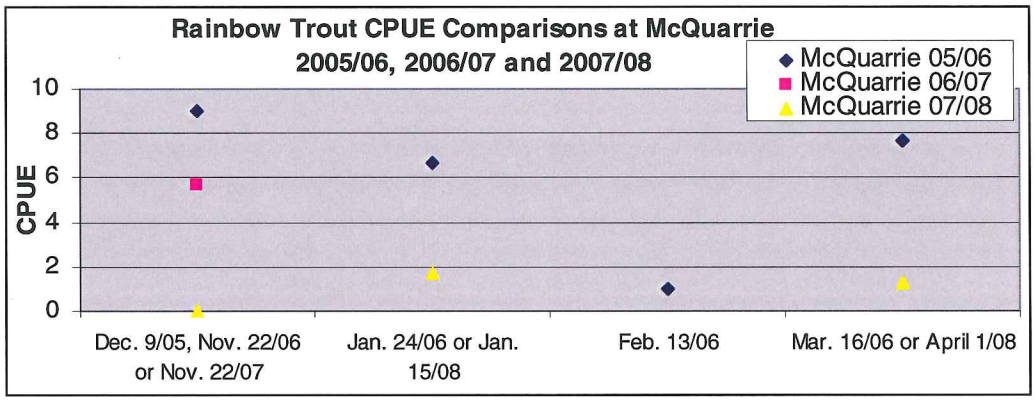


Figure 68. RBT/Sthd CPUE Comparisons at McQuarrie (2005-08).

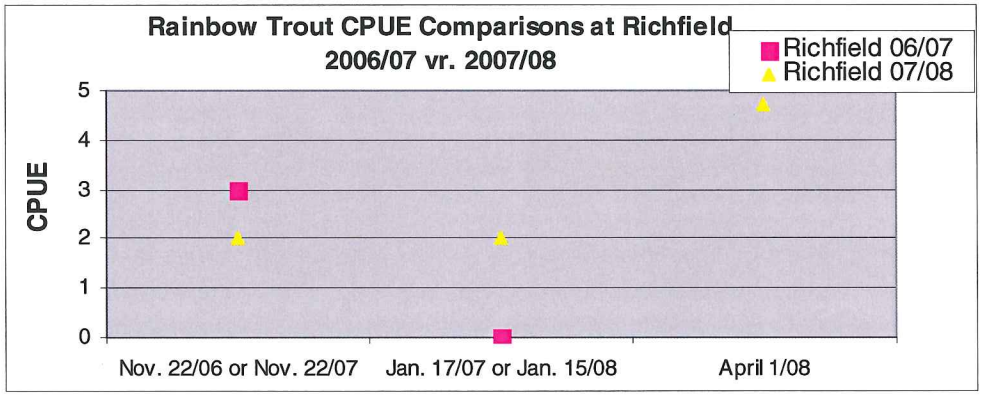


Figure 69. RBT/Sthd CPUE Comparisons at Richfield (2006-08).

5.4.3 CPUE for Dolly Varden

In 2005/06, the CPUE for DV at the Waterfall Creek sites varied over the duration of winter sampling with site 3 having the most consistent CPUE over all sampling dates. High potential for migration most likely affected CPUE for DV. In 2006/07, the CPUE at site 3 of Waterfall Creek increased the most over the winter of the 4 sites sampled.

Overall, the CPUE for DV was greatest at the end of winter, as compared to beginning of winter, at sites 3 and 4. Sites 1 and 2 showed a slight decrease in CPUE for DV over the winter. In conclusion, the CPUE for DV was much lower in 2006/07 and 2007/08, than in 2005/06, at all the sites (Figures 70 to 73). It is not certain why the CPUE for DV was so much lower in the latter two study periods.

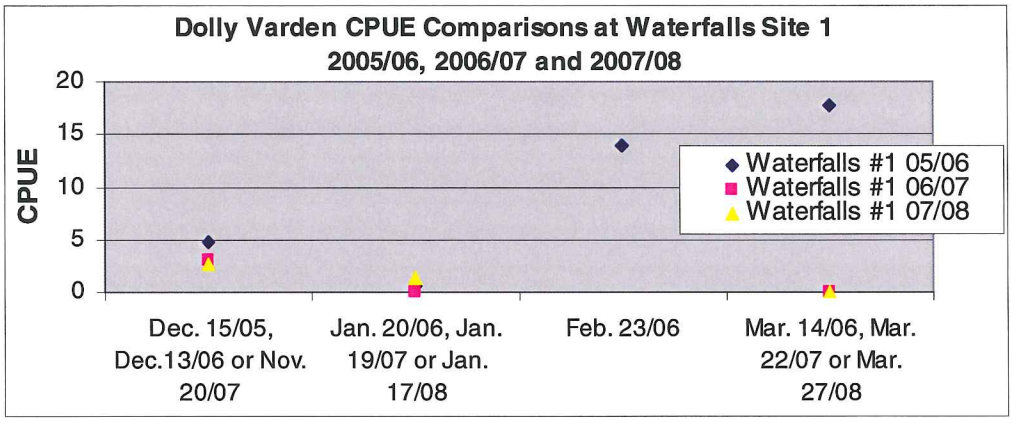


Figure 70. DV CPUE Comparisons at Waterfalls Site 1 (2005-08).

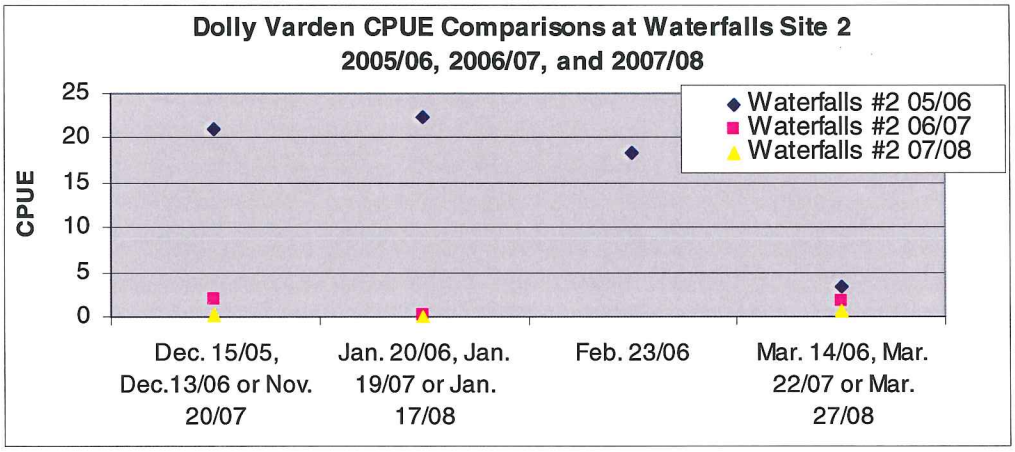


Figure 71. DV CPUE Comparisons at Waterfalls Site 2 (2005-08).

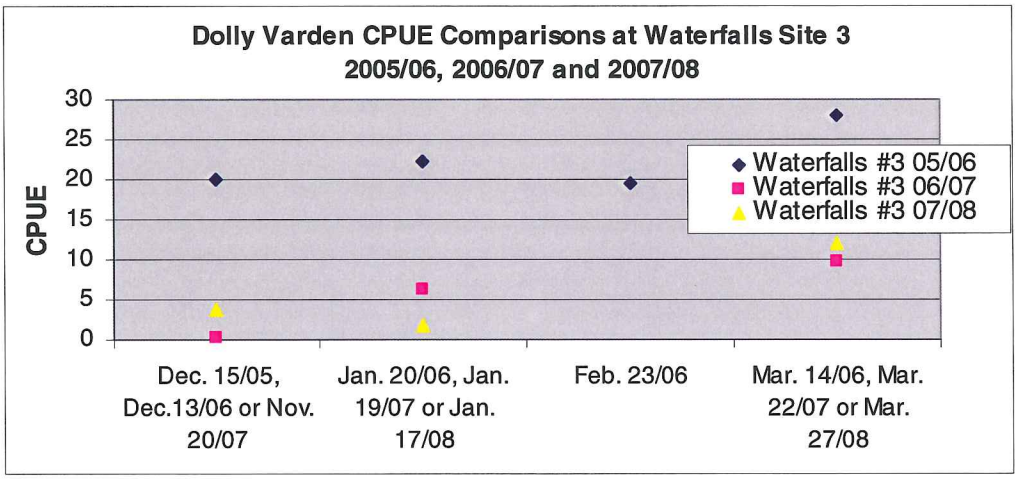


Figure 72. DV CPUE Comparisons at Waterfalls Site 3 (2005-08).

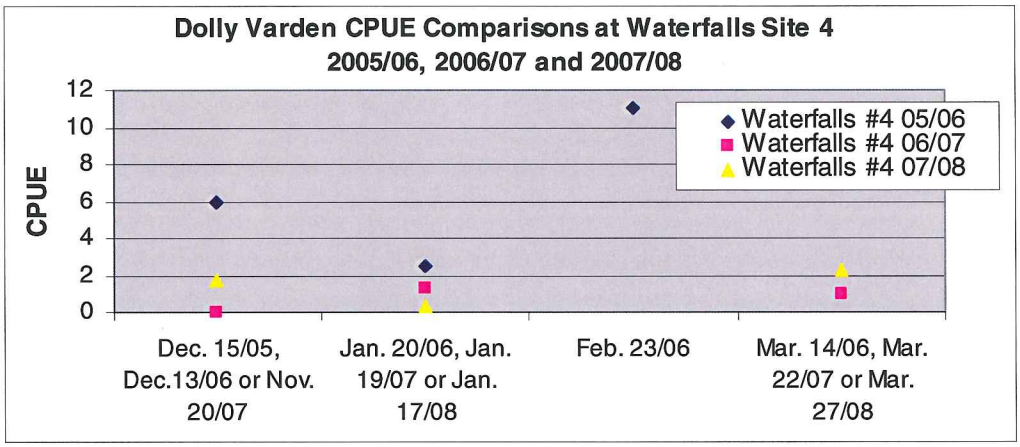


Figure 73. DV CPUE Comparisons at Waterfalls Site 4 (2005-08).

6.0 CONCLUSIONS AND RECOMMENDATIONS

1. Further monitoring, including habitat assessments and overwintering trapping, of all eight sites sampled during this study is recommended to compare CPUE, and fish size and condition with 2005/06, 2006/07 and 2007/08 results.
2. Dolly Varden numbers in Waterfalls Creek have decreased dramatically at the sites sampled in the winter, especially site 1 and 2, since 2005/06; therefore, it is recommended that a stream survey of Waterfalls Cr., and potentially Station Cr., be conducted in order to identify critical Dolly Varden rearing and spawning habitat, as well as possible recent disturbances to DV habitat, upstream of the impassable Culvert. Minnow trapping and angling in the summer 2008 on Waterfalls Creek (i.e., set traps just downstream of the falls) may be beneficial to gain more information on the distribution of Dolly Varden.
3. Find a new system, if funding permits, in addition to Waterfall Creek (Sites 1-4) that has potentially been impacted by the railway and sample in 2008/09 to raise awareness and gain more information.

4. Further habitat rehabilitation at McKinnon Cr. is required. Water levels were too low at both Site 1 (upstream) and Site 2 (downstream) of the culvert, and infilling of the pool with sediment (aggradation) had also occurred in spring/summer of 2006 at Site 1. Minnow trapping was not possible at these sites in 2006/07 or 2007/08 due to low water levels and/or lack of overwintering habitat. Possible replacement of the existing culvert with a larger embedded culvert would be a long term solution to decrease the potential for sediment build-up upstream of the culvert at Site 1. Placement of a refuge pit is also an option at Site 1- McKinnon.
5. The Proctor Road groundwater channel sustained a healthy population of coho juveniles over the 2006/07 winter sampling season which indicated that this site provides critical overwintering habitat. On the contrary, the groundwater channel was not sampled in the winter 2007/08 due to low water levels found near the end of summer 2007 and in January 2008. A rehabilitation project was implemented in July 2008, where the lower 25 m of the groundwater channel was dredged. Monitoring of this channel, including fish sampling, should be implemented through out the summer 2008 and winter 2008/09.
6. Summary of Barren Site: The maintenance program (i.e. dredging) of the Barren Creek site (just upstream of the highway culvert) in the fall of 2005 appeared to be beneficial since the densities of coho were highest at Barren Creek compared to the other two Upper Bulkley sites during the overwintering study of 2005/06. Monitoring in winter 2006/07 found that further dredging upstream and downstream of the highway culvert in late summer 2006 decreased the value of overwintering habitat at the Barren Creek site (i.e., the cobbles were covered by fines, water levels decreased and DO was very low during the middle of winter). Overwintering habitat at the Barren site appeared to recover from the dredging conducted upstream and downstream of the culvert in summer 2006 where the total catch increased dramatically from no fish captured in the winter of 2006/07 to higher numbers of fish captured in 2007/08. It should be noted that water levels were also higher than the extremely low water levels noted prior to ice-up in 2006.
7. Coho numbers appeared to be down at most of the Upper Bulkley sites sampled in 2007/08, other than Barren. The decrease in coho numbers could be due to low flows in the fall 2006, which may have limited upstream spawning migration, especially at the beaver dams on the Upper Bulkley, as observed by DFO staff (i.e., Brenda Donas, Natalie Newman of Smither's OHEB Branch). One would expect that if coho had low spawning success in 2006 that lower numbers of juvenile coho may be found the following winter (i.e., 2007/08).

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Appendix 1
Winter Fish Capture and Habitat Assessment Data

Site Identification

Barren Creek

crew: BD, PM

Sampling Date

21-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-7
Ice Cover	1%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	89
Ice thickness (cm)	skiff
Clarity of Ice	none
Snow Depth (cm)	4
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.6
pH	7.5
Flow (m/s)	n/a

Number of traps set	3

Set Locations

upstream of Hwy 16 culvert
same location as last year

Set duration	overnight

Comments

edge ice present

Juvenile Capture and Sampling Summary

Location Barren Creek
Date 22-Nov-07
crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	31	50	124
rainbow/steelhead	16	85	157

species composition

65	% CO
33	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	3	CO	50	1.6		1.28
GMT	1	3	CO	84	6.5		1.10
GMT	1	1	CO	86	7.7		1.21
GMT	1	3	CO	86	n/a		n/a
GMT	1	1	CO	89	7.3		1.04

GMT	1	1	CO	90	8.3		1.14
GMT	1	1	CO	95	9.2		1.07
GMT	1	1	CO	100	10.5		1.05
GMT	1	2	CO	100	11.3		1.13
GMT	1	3	CO	100	10.0		1.00
GMT	1	1	CO	102	11.7		1.10
GMT	1	2	CO	102	12.0		1.13
GMT	1	1	CO	103	10.2		0.93
GMT	1	3	CO	103	10.7		0.98
GMT	1	1	CO	104	13.0		1.16
GMT	1	2	CO	105	12.3		1.06
GMT	1	2	CO	105	11.8		1.02
GMT	1	1	CO	106	12.6		1.06
GMT	1	2	CO	106	13.0		1.09
GMT	1	3	CO	106	9.1		0.76
GMT	1	3	CO	107	14.2		1.16
GMT	1	1	CO	108	14.0		1.11
GMT	1	2	CO	109	13.6		1.05
GMT	1	3	CO	109	13.9		1.07
GMT	1	3	CO	109	14.1		1.09
GMT	1	2	CO	110	13.0		0.98
GMT	1	3	CO	110	14.1		1.06
GMT	1	2	CO	112	15.3		1.09
GMT	1	2	CO	115	16.8		1.10
GMT	1	2	CO	115	17.0		1.12
GMT	1	3	CO	117	17.6		1.10
GMT	1	2	CO	124	21.1		1.11
GMT	1	1	RB/ST	85	6.6		1.07
GMT	1	3	RB/ST	95	9.7		1.13
GMT	1	2	RB/ST	97	10.8		1.18
GMT	1	1	RB/ST	98	11.4		1.21
GMT	1	3	RB/ST	107	n/a		n/a
GMT	1	1	RB/ST	112	17.0		1.21
GMT	1	3	RB/ST	112	15.1		1.07
GMT	1	2	RB/ST	113	15.6		1.08
GMT	1	2	RB/ST	115	17.1		1.12
GMT	1	2	RB/ST	116	16.6		1.06
GMT	1	3	RB/ST	124	18.2		0.95
GMT	1	3	RB/ST	128	n/a	crinkleback	n/a
GMT	1	2	RB/ST	133	24.4		1.04
GMT	1	3	RB/ST	135	26.5		1.08
GMT	1	3	RB/ST	157	43.9		1.13

Comments:
All fish appear in excellent condition
Last few weights not taken, scale malfunctioning (frozen)
Air temp -9 with a breeze. Ice forming in the buckets.

Trap 1: 1-RB/ST not sampled.
Trap 2: All fish sampled
Trap 3: All fish sampled

Site Identification

Barren Creek

crew: LT, BD

Sampling Date

14-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-3
Ice Cover	50%
Stream Flow	moderate
Potential for Migration	low

Water Depth (cm)	68.5
Ice thickness (cm)	<1
Clarity of Ice	none
Snow Depth (cm)	42
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.3
pH	7.2
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Same location as previous sets.
Center, upstream of highway 16 culvert, right of sandbar near right bank.

Set duration	overnight

Comments

Felt like about -10 with the Windchill.
Highways picked up their blade while they were plowing past the culvert, so there isn't a pile of snow in the creek. Nice.
Jan 15 Air Temp was -20 C at time of trap pick up therefore no ind. Sampling

Juvenile Capture and Sampling Summary

Location Barren Creek
Date 14-Jan-08
crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	21		
rainbow/steelhead	15		

species composition	
58	% CO
42	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	<80	n/a		n/a
GMT	1	1	CO	<80	n/a		n/a
GMT	1	1	CO	<80	n/a		n/a
GMT	1	1	CO	<80	n/a		n/a
GMT	1	1	CO	>80	n/a		n/a

GMT	1	1	CO	>80	n/a		n/a
GMT	1	1	CO	>80	n/a		n/a
GMT	1	1	CO	>80	n/a		n/a
GMT	1	1	CO	>80	n/a		n/a
GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	2	CO	<80	n/a		n/a
GMT	1	2	CO	<80	n/a		n/a
GMT	1	2	CO	<80	n/a		n/a
GMT	1	2	CO	>80	n/a		n/a
GMT	1	2	CO	>80	n/a		n/a
GMT	1	2	RB/ST	~120	n/a		n/a
GMT	1	2	RB/ST	~150	n/a		n/a
GMT	1	2	RB/ST	<80	n/a		n/a
GMT	1	2	RB/ST	>80	n/a		n/a
GMT	1	2	RB/ST	>80	n/a		n/a
GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	CO	>80	n/a		n/a
GMT	1	3	CO	>80	n/a		n/a
GMT	1	3	CO	>80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	>80	n/a		n/a
GMT	1	3	RB/ST	>80	n/a		n/a
GMT	1	3	RB/ST	>80	n/a		n/a
GMT	1	3	RB/ST	>80	n/a		n/a
GMT	1	3	RB/ST	>80	n/a		n/a

Comments:

On trap pick-up day, the weather was sunny but -15° C with a wind, and too cold to weigh and measure the fish. Instead, we estimated the length of the fish as either over or under 80mm, and in a couple of instances, approx length. The ice cover was 95%, with the new ice approximately 2 cm thick and clear. Fish looked to be in good condition.

Trap 1: All fish sampled

Trap 2: All fish sampled. Two RB/ST were very large, fork length approx 120 and 150mm. How did they fit into trap?

Trap 3: All fish sampled

Site Identification

Barren Creek

crew: BD,PM

Sampling Date

31-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-6
Ice Cover	80%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	53.34
Ice thickness (cm)	skiff
Clarity of Ice	none
Snow Depth (cm)	0
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.8
pH	7.6
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Same location as previous sets.
Center, upstream of highway 16 culvert,

Set duration	overnight

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location Barren Creek
Date 01-Apr-08
crew: BD,PM

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	16	84	113
rainbow/steelhead	4	97	139

species composition
80 % CO
20 % RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	84	6.9	um	1.16
GMT	1	2	CO	91	8.6	um	1.14
GMT	1	2	CO	91	8.3	um	1.10
GMT	1	3	CO	92	6.7	um	0.86
GMT	1	2	CO	97	9.0	um	0.99

GMT	1	2	CO	98	9.6	um	1.02
GMT	1	3	CO	98	10.0	um	1.06
GMT	1	3	CO	100	8.9	um	0.89
GMT	1	2	CO	102	11.1	um	1.05
GMT	1	1	CO	103	11.5	um	1.05
GMT	1	2	CO	103	12.2	um	1.12
GMT	1	3	CO	104	11.4	um	1.01
GMT	1	2	CO	106	12.1	um	1.02
GMT	1	1	CO	109	13.5	um	1.04
GMT	1	2	CO	109	12.9	um	1.00
GMT	1	2	CO	113	15.2	um	1.05
GMT	1	3	RB/ST	97	11.1	um	1.22
GMT	1	1	RB/ST	99	10.3	um	1.06
GMT	1	3	RB/ST	111	14.7	um	1.07
GMT	1	1	RB/ST	139	29.6	um	1.10

Comments:
Trap 1: All fish sampled
Trap 2: All fish sampled
Trap 3: All fish sampled

Site Identification

Byman Creek

crew: BD, PM

Sampling Date

21-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-7
Ice Cover	5%
Stream Flow	high
Potential for Migration	high

Water Depth (cm)	97
Ice thickness (cm)	skiff
Clarity of Ice	none
Snow Depth (cm)	4
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	13.3
pH	7.4
Flow (m/s)	n/a

Number of traps set	3

Set Locations

traps set at edge
velocity at last year's location too high

Set duration	overnight

Comments

Visit #1
Skiff ice only on edge habitat.

Juvenile Capture and Sampling Summary

Location Byman Creek
Date 22-Nov-07
crew: BD PM

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	0		
rainbow/steelhead	12	91	140

species composition
% CO
% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	RB/ST	91	7.4		0.98
GMT	1	1	RB/ST	112	14.1		1.00
GMT	1	1	RB/ST	118	16.7		1.02

GMT	1	1	RB/ST	121	16.4		0.93
GMT	1	1	RB/ST	124	21.1		1.11
GMT	1	1	RB/ST	140	24.3		0.89
GMT	1	2	RB/ST	100	13.1		1.31
GMT	1	2	RB/ST	104	11.2		1.00
GMT	1	2	RB/ST	109	14.0		1.08
GMT	1	2	RB/ST	110	11.8		0.89
GMT	1	2	RB/ST	122	16.8		0.93
GMT	1	2	RB/ST	129	22.8		1.06

Comments:
Trap 1: All fish sampled
Trap 2: All fish sampled
Trap 3: No fish caught

Site Identification

Byman Creek

crew: BD, LT

Sampling Date

14-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-3
Ice Cover	60%
Stream Flow	moderate
Potential for Migration	high

Water Depth (cm)	70.5
Ice thickness (cm)	6.4
Clarity of Ice	none
Snow Depth (cm)	36.8
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.7
pH	7.6
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Same location as previous settings.
Below culvert at highway 16 near left bank facing downstream

Set duration	overnight

Comments

Slush covered over the area where traps were set.
Jan 15'th at trap pick-up, the air temp was -20 C therefore no ind. Sampling

Juvenile Capture and Sampling Summary

Location Byman Creek
Date 15-Jan-08
crew: LT, BD

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	2		
rainbow/steelhead	13		

species composition

13	% CO
87	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	>80	n/a		n/a
GMT	1	1	RB/ST	<80	n/a		n/a
GMT	1	1	RB/ST	<80	n/a		n/a

GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	1	RB/ST	>80	n/a		n/a
GMT	1	2	CO	>80	n/a		n/a
GMT	1	2	RB/ST	<80	n/a		n/a
GMT	1	2	RB/ST	<80	n/a		n/a
GMT	1	2	RB/ST	>80	n/a		n/a
GMT	1	2	RB/ST	>80	n/a		n/a
GMT	1	2	RB/ST	>80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a

Comments:
On trap pick-up day, the weather was overcast and -20° C with a breeze. Too cold to weigh and measure the fish. Instead, we estimated the length of the fish as either over or under 80mm.
The pool was 80% iced over.
All fish looked in excellent condition.

Trap 1: All fish sampled
Trap 2: All fish sampled
Trap 3: All fish sampled

Site Identification

Byman Creek

crew: BD, PM

Sampling Date

31-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-8
Ice Cover	65%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	77.47
Ice thickness (cm)	1.27
Clarity of Ice	clear
Snow Depth (cm)	40.64
Water Temp (°C)	0.4
Turbidity	clear
DO (ppm)	13.0
pH	7.4
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Same location as previous settings.

Set duration	overnight

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location Byman Creek
Date 01-Apr-08
crew:

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	0	n/a	n/a
rainbow/steelhead	3	82	126

species composition
0 % CO
100 % RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	RB/ST	126	20.6	um	1.03
GMT	1	1	RB/ST	110	15.0	um	1.13
GMT	1	1	RB/ST	82	5.9	um	1.07

Comments:

Trap 1: All fish sampled
Trap 2: empty
Trap 3: empty

Site Identification

McQuarrie Creek

crew: BD, PM

Sampling Date

21-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-7
Ice Cover	50%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	109
Ice thickness (cm)	skiff
Clarity of Ice	none
Snow Depth (cm)	5
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	13.4
pH	7.6
Flow (m/s)	n/a

Number of traps set	3

Set Locations same as last year

Set duration	overnight

Comments

Visit # 1
Frazzle ice on stream bottom up to approx. 30cm deep.

Juvenile Capture and Sampling Summary

Location McQuarrie Creek
Date 22-Nov-07
crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	2	45	57
rainbow/steelhead	0		

species composition	
100	% CO
	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	45	n/a		n/a
GMT	1	1	CO	57	n/a		n/a

Comments:
Traps were covered in frazzel ice.
Air temp during trap pick-up was - 9, with a breeze.
No weights taken, due to small sample size, malfunctioning scale and icy condition of water.
Trap 1: All fish sampled, Trap 2: no fish, Trap 3: no fish.

Site Identification

McQuarrie Creek

crew: BC, LT

Sampling Date

14-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-4
Ice Cover	30%
Stream Flow	moderate
Potential for Migration	high

Water Depth (cm)	89
Ice thickness (cm)	15
Clarity of Ice	none
Snow Depth (cm)	40.5
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.8
pH	7.2
Flow (m/s)	n/a

Number of traps set	3
Set duration	overnight

Set Locations

Same location as previous sets.
Center pool below culvert at highway 16.

Comments

The snow depth measured at edge of ice, near the bank. Was deeper elsewhere.
One large thin crescent shaped piece of ice broke off and started to drift away.
It jammed up on the bank still covering part of the pool.
Jan 15 - trap pick-up, air temp was -20 C therefore no ind. Sampling

Juvenile Capture and Sampling Summary

Location McQuarrie Creek
Date 15-Jan-08
crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	3		
rainbow/steelhead	5		

species composition
38 % CO
63 % RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a

GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	RB/ST	~50	n/a		n/a
GMT	1	3	CO	~50	n/a		n/a
GMT	1	3	CO	<80	n/a		n/a
GMT	1	3	RB/ST	<80	n/a		n/a

Comments:
On trap pick-up day, the weather was -20° C, overcast with a breeze and too cold to weigh and measure the fish
Instead, we estimated the length of the fish as either over or under 80mm, or close to 50mm (where possible).
The pool was 100% iced over. New ice was 1.5 - 2cm thick, and clear.
Fish looked to be in excellent condition.

Trap 1: All fish sampled
Trap 2: No fish caught.
Trap 3: All fish sampled, appeared to be fry present.

Site Identification

McQuarrie Creek

crew: BD,PM

Sampling Date

31-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-8
Ice Cover	98%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	69.85
Ice thickness (cm)	3.8
Clarity of Ice	clear
Snow Depth (cm)	40.64
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	13.3
pH	7.6
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Same location as previous sets.
Center pool below culvert at highway 16.

Set duration	overnight

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location McQuarrie Creek
Date 01-Apr-08
crew: BD,PM

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	0	n/a	n/a
rainbow/steelhead	4	87	145

species composition
0 % CO
100 % RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	RB/ST	87	7.9	um	1.20
GMT	1	1	RB/ST	145	31.2	um	1.02
GMT	1	1	RB/ST	93	8.7	um	1.08
GMT	1	2	RB/ST	91	6.7	um	0.89

Comments:
Trap 1 and 2: All fish sampled, Trap 3: empty

Site Identification

Richfield Creek

crew: BD, PM

Sampling Date

21-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-7
Ice Cover	20%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	85
Ice thickness (cm)	skiff ice
Clarity of Ice	none
Snow Depth (cm)	14
Water Temp (°C)	0.5
Turbidity	clear
DO (ppm)	13.5
pH	7.2
Flow (m/s)	n/a

Number of traps set	
Set duration	

Set Locations

under CNR bridge
river left (traps at left bank looking d/s)

Comments

Visit #1
Traps set on opposite bank from last year, due to high velocity.

Juvenile Capture and Sampling Summary

Location Richfield Creek
Date 22-Nov-07
crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	0		
rainbow/steelhead	6		

species composition

	% CO
100	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	2	RB/ST				n/a
GMT	1	2	RB/ST				n/a
GMT	1	2	RB/ST				n/a
GMT	1	2	RB/ST				n/a
GMT	1	3	RB/ST				n/a
GMT	1	3	RB/ST				n/a

Comments:
All fish appeared to be in good condition.
No fish measured.

Trap 1: No fish caught
Trap 2: 4-RB/ST
Trap 3: 2-RB/ST

Site Identification

Richfield Creek

crew: LT, BD

Sampling Date

14-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-6
Ice Cover	90%
Stream Flow	moderate
Potential for Migration	high

Water Depth (cm)	33
Ice thickness (cm)	23
Clarity of Ice	none
Snow Depth (cm)	81
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	12.4
pH	7.8
Flow (m/s)	n/a

Number of traps set	3

Set duration	overnight

Set Locations

Under the CNR bridge
traps near left bank looking downstream
2.5 m downstream from previous site
(ice was thinner there)

Comments

Beautiful sunny day.
Only approximately 10 % of the pool area was open water (no ice cover)

Juvenile Capture and Sampling Summary

Location Richfield Creek
Date 15-Jan-08
crew: LT, BD

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
rainbow/steelhead	6		
Coho	0		

species composition

	% CO
100	% RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	RB/ST	< 80	n/a		n/a
GMT	1	1	RB/ST	< 80	n/a		n/a
GMT	1	1	RB/ST	< 80	n/a		n/a
GMT	1	2	RB/ST	< 80	n/a		n/a
GMT	1	2	RB/ST	< 80	n/a		n/a
GMT	1	1	RB/ST	> 80	n/a		n/a

Comments:
On trap pick-up day, the weather was sunny but -20° C and too cold to weigh and measure the fish.
Instead, we estimated the length of the fish as either over or under 80mm.
The ice cover was 100%.
All the fish were lively and looked in excellent condition.

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: No fish caught.

Site Identification

Richfield Creek

crew: BD,PM

Sampling Date

31-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	-8
Ice Cover	75%
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	53.34
Ice thickness (cm)	6.35
Clarity of Ice	none
Snow Depth (cm)	40.64
Water Temp (°C)	0.5
Turbidity	clear
DO (ppm)	12.5
pH	7.3
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Under the CNR bridge

Set duration	overnight

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location Richfield Creek
Date 01-Apr-08
crew: BD, PM

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	2	87	93
rainbow/steelhead	14	78	125

species composition
12.5 % CO
87.5 % RB/ST

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	87	7.3	um	1.11
GMT	1	1	CO	93	7.9	um	0.98
GMT	1	3	RB/ST	78	5.6	um	1.18
GMT	1	1	RB/ST	83	5.5	um	0.96
GMT	1	1	RB/ST	83	6.3	um	1.10
GMT	1	1	RB/ST	84	6.0	um	1.01
GMT	1	3	RB/ST	85	6.5	um	1.06
GMT	1	2	RB/ST	88	6.8	um	1.00
GMT	1	1	RB/ST	93	7.7	um	0.96
GMT	1	1	RB/ST	96	9.4	um	1.06
GMT	1	2	RB/ST	96	9.6	um	1.09
GMT	1	2	RB/ST	96	9.6	um	1.09
GMT	1	1	RB/ST	100	9.9	um	0.99
GMT	1	1	RB/ST	115	14.1	um	0.93
GMT	1	2	RB/ST	123	18.6	um	1.00
GMT	1	1	RB/ST	125	18.2	um	0.93

Comments:
Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: All fish sampled.

Site Identification

Waterfalls Creek Site 1

crew: BD, LT, PM

Sampling Date

19-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	n/a
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	76
Ice thickness (cm)	n/a
Clarity of Ice	n/a
Snow Depth (cm)	n/a
Water Temp (°C)	2
Turbidity	clear
DO (ppm)	14.0
pH	8.5
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfalls Site # 1

Set duration	overnight

Comments

Visit # 1
Used Lamotte Kit for DO.
Marked site with flagging tape, and site number

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site 1
Date 20-Nov-07
Crew: BD, LT, PM

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	130	47	109
dolly varden	8	50	109

species composition	
94	% CO
6	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	47	1.2		1.16
GMT	1	1	CO	47	1.2		1.16
GMT	1	1	CO	47	1.4		1.35

GMT	1	1	CO	49	1.5		1.27
GMT	1	1	CO	50	1.9		1.52
GMT	1	1	CO	50	1.5		1.20
GMT	1	1	CO	51	1.8		1.36
GMT	1	1	CO	53	2.0		1.34
GMT	1	1	CO	55	1.6		0.96
GMT	1	1	CO	56	2.0		1.14
GMT	1	1	CO	59	2.4		1.17
GMT	1	1	CO	62	3.0		1.26
GMT	1	1	CO	62	2.9		1.22
GMT	1	1	CO	63	3.2		1.28
GMT	1	1	CO	65	3.0		1.09
GMT	1	1	CO	66	3.1		1.08
GMT	1	1	CO	67	3.3		1.10
GMT	1	1	CO	68	3.6		1.14
GMT	1	1	CO	70	3.4		0.99
GMT	1	1	CO	70	3.6		1.05
GMT	1	1	CO	73	4.9		1.26
GMT	1	1	CO	77	4.8		1.05
GMT	1	1	CO	77	4.5		0.99
GMT	1	1	CO	81	6.2		1.17
GMT	1	1	CO	83	5.9		1.03
GMT	1	1	CO	83	5.8		1.01
GMT	1	1	CO	83	6.3		1.10
GMT	1	1	CO	84	5.7		0.96
GMT	1	1	CO	86	6.7		1.05
GMT	1	1	CO	86	7.3		1.15
GMT	1	1	CO	86	6.7		1.05
GMT	1	1	CO	87	7.1		1.08
GMT	1	1	CO	87	10.0		1.52
GMT	1	1	CO	88	7.6		1.12
GMT	1	1	CO	89	7.8		1.11
GMT	1	1	CO	90	7.6		1.04
GMT	1	1	CO	90	7.4		1.02
GMT	1	1	CO	91	7.4		0.98
GMT	1	1	CO	96	8.9		1.01
GMT	1	1	CO	97	10.0		1.10
GMT	1	1	CO	102	10.4		0.98
GMT	1	1	CO	109	13.4		1.03
GMT	1	1	DV	50	1.3		1.04
GMT	1	1	DV	51	1.5		1.13
GMT	1	1	DV	52	1.7		1.21
GMT	1	1	DV	66	3.2		1.11
GMT	1	1	DV	88	6.0		0.88
GMT	1	1	DV	93	7.5		0.93
GMT	1	1	DV	107	12.3		1.00
GMT	1	1	DV	109	12.3		0.95

Comments:

Trap 1: All sampled.

Trap 2: 40 coho not sampled.

Trap 3: 48 coho not sampled.

Site Identification

Waterfalls Creek Site # 1

crew: BD, LT, PM

Sampling Date

16-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	90%
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	112
Ice thickness (cm)	3.8
Clarity of Ice	none
Snow Depth (cm)	25.5
Water Temp (°C)	0.2
Turbidity	clear
DO (ppm)	14
pH	7.2
Flow (m/s)	n/a

Number of traps set	3
Set duration	overnight

Set Locations

Waterfall Creek Site # 1
Flagging tape still there.
(same location as previous set)

Comments

Visit # 2
Sunny with a small breeze, a bit of windchill.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 1
Date 17-Jan-08
Crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	170	49	102
dolly varden	4	55	140

species composition	
98	% CO
2	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	49	1.6	um	1.36
GMT	1	2	CO	49	1.2	um	1.02
GMT	1	1	CO	51	1.5	um	1.13
GMT	1	1	CO	51	1.2	um	0.90
GMT	1	2	CO	51	1.5	um	1.13
GMT	1	1	CO	52	1.5	um	1.07

GMT	1	1	CO	52	1.7	um	1.21
GMT	1	1	CO	52	1.6	um	1.14
GMT	1	1	CO	52	1.7	um	1.21
GMT	1	1	CO	52	1.5	um	1.07
GMT	1	1	CO	53	1.7	um	1.14
GMT	1	1	CO	54	1.7	um	1.08
GMT	1	1	CO	54	2.3	um	1.46
GMT	1	2	CO	54	2.0	um	1.27
GMT	1	1	CO	57	2.3	um	1.24
GMT	1	2	CO	57	2.2	um	1.19
GMT	1	2	CO	57	2.0	um	1.08
GMT	1	2	CO	57	2.1	um	1.13
GMT	1	1	CO	58	2.3	um	1.18
GMT	1	1	CO	58	2.2	um	1.13
GMT	1	1	CO	58	2.2	um	1.13
GMT	1	2	CO	58	2.0	um	1.03
GMT	1	1	CO	60	2.8	um	1.30
GMT	1	1	CO	61	2.6	um	1.15
GMT	1	1	CO	61	2.7	um	1.19
GMT	1	1	CO	61	2.4	um	1.06
GMT	1	1	CO	61	2.8	um	1.23
GMT	1	1	CO	61	2.9	um	1.28
GMT	1	1	CO	62	2.8	um	1.17
GMT	1	1	CO	62	3.0	um	1.26
GMT	1	1	CO	62	2.8	R-max	1.17
GMT	1	2	CO	62	2.7	R-max	1.13
GMT	1	1	CO	63	3.6	um	1.44
GMT	1	2	CO	63	2.4	R-max	0.96
GMT	1	2	CO	63	2.4	um	0.96
GMT	1	1	CO	66	4.5	R-max	1.57
GMT	1	2	CO	66	3.0	R-max	1.04
GMT	1	1	CO	67	3.3	um	1.10
GMT	1	1	CO	67	3.2	um	1.06
GMT	1	2	CO	67	2.7	um	0.90
GMT	1	1	CO	68	3.6	R-max	1.14
GMT	1	2	CO	69	3.3	R-max	1.00
GMT	1	1	CO	71	4.2	um	1.17
GMT	1	1	CO	71	4.2	R-max	1.17
GMT	1	1	CO	71	3.9	um	1.09
GMT	1	1	CO	81	5.7	um	1.07
GMT	1	1	CO	87	6.4	um	0.97
GMT	1	1	CO	93	7.7	um	0.96
GMT	1	1	CO	98	8.9	um	0.95
GMT	1	1	CO	102	10.8	um	1.02
GMT	1	2	DV	55	2.0	um	1.20
GMT	1	1	DV	95	8.2	um	0.96
GMT	1	3	DV	140	26.3	um	0.96

Comments:

Breezy, +3 and melting out. Massive amounts of caddis fly larvae in traps.

8 R-max clipped coho were found with fork lengths ranging from 62mm to 71mm, only one of these 8 fish had a condition factor of less than 1.

Trap 1: All fish sampled, Trap 2: 75 coho and 1 dolly varden not sampled, Trap 3: 45 coho not sampled.

Site Identification

Waterfalls Creek Site # 1

crew: BD, PM

Sampling Date

26-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	2
Ice Cover	3%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	69.85
Ice thickness (cm)	3
Clarity of Ice	none
Snow Depth (cm)	0
Water Temp (°C)	1.3
Turbidity	clear
DO (ppm)	12
pH	6.9
Flow (m/s)	n/a

Number of traps set	3
Set duration	overnight

Set Locations

Waterfall Creek Site # 1
Flagging tape still there.
(same location as previous set)

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 1
Date 27-Mar-08

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	43	51	93
dolly varden	0	n/a	n/a

species composition	
100	% CO
0	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	2	CO	51	1.7	um	1.28
GMT	1	2	CO	57	1.9	R-max	1.03
GMT	1	2	CO	58	2.3	um	1.18

GMT	1	2	CO	58	2.0	um	1.03
GMT	1	1	CO	59	2.0	R-max	0.97
GMT	1	1	CO	60	2.5	um	1.16
GMT	1	2	CO	60	2.4	um	1.11
GMT	1	1	CO	61	2.3	R-max	1.01
GMT	1	1	CO	61	2.4	um	1.06
GMT	1	1	CO	61	2.7	R-max	1.19
GMT	1	1	CO	61	2.4	R-max	1.06
GMT	1	2	CO	61	2.5	um	1.10
GMT	1	1	CO	65	2.8	um	n/a
GMT	1	1	CO	65	2.7	R-max	0.98
GMT	1	2	CO	65	3.1	um	1.13
GMT	1	2	CO	65	3.2	R-max	1.17
GMT	1	1	CO	66	2.9	R-max	1.01
GMT	1	2	CO	66	2.9	R-max	1.01
GMT	1	2	CO	67	3.3	R-max	1.10
GMT	1	1	CO	69	2.9	um	0.88
GMT	1	1	CO	69	3.4	um	1.03
GMT	1	1	CO	70	3.5	um	1.02
GMT	1	2	CO	72	3.7	um	0.99
GMT	1	2	CO	74	3.9	um	0.96
GMT	1	2	CO	75	4.3	um	1.02
GMT	1	1	CO	77	4.4	um	0.96
GMT	1	2	CO	78	4.8	um	1.01
GMT	1	2	CO	80	5.0	R-max	0.98
GMT	1	2	CO	81	5.6	um	1.05
GMT	1	2	CO	84	6.0	um	1.01
GMT	1	2	CO	84	5.6	um	0.94
GMT	1	2	CO	86	6.3	um	0.99
GMT	1	2	CO	89	6.5	um	0.92
GMT	1	2	CO	90	7.3	um	1.00
GMT	1	2	CO	90	7.5	um	1.03
GMT	1	1	CO	91	7.7	um	1.02
GMT	1	1	CO	92	7.1	R-max	0.91
GMT	1	1	CO	93	6.9	um	0.86

Comments:
lots of caddisfly larvae

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: 5 coho not sampled.

Site Identification

Waterfalls Creek Site 2

crew: BD, LT, PM

Sampling Date

19-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	n/a
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	90
Ice thickness (cm)	n/a
Clarity of Ice	n/a
Snow Depth (cm)	n/a
Water Temp (°C)	0.6
Turbidity	clear
DO (ppm)	14
pH	8.1
Flow (m/s)	n/a

Number of traps set	3
Set duration	overnight

Set Locations

Waterfalls Creek Site 2

set at 14:45

Comments

Visit # 1 Marked site with flagging tape, and site number
Used Lamotte Kit for DO.
Beaver dam removed, then rebuilt.
Wetland complex south of railway flooded by beaver.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site 2
Date 20-Nov-07

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	132	56	109
dolly varden	1	87	87

species composition	
99	% CO
1	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	56	2.3		1.31
GMT	1	1	CO	59	2.4		1.17

GMT	1	1	CO	60	2.7		1.25
GMT	1	1	CO	61	3.0		1.32
GMT	1	1	CO	61	2.3		1.01
GMT	1	1	CO	65	3.1		1.13
GMT	1	1	CO	68	3.5		1.11
GMT	1	1	CO	69	4.0		1.22
GMT	1	1	CO	80	7.2		1.41
GMT	1	1	CO	83	5.6		0.98
GMT	1	1	CO	84	6.2		1.05
GMT	1	1	CO	87	6.5		0.99
GMT	1	1	CO	87	6.4		0.97
GMT	1	1	CO	88	6.5		0.95
GMT	1	1	CO	88	6.8		1.00
GMT	1	1	CO	88	7.2		1.06
GMT	1	1	CO	90	6.8		0.93
GMT	1	1	CO	90	7.3		1.00
GMT	1	1	CO	91	7.9		1.05
GMT	1	1	CO	92	8.0		1.03
GMT	1	1	CO	93	7.1	Rmax	0.88
GMT	1	1	CO	93	8.5		1.06
GMT	1	1	CO	94	8.5		1.02
GMT	1	1	CO	94	8.5		1.02
GMT	1	1	CO	95	9.2		1.07
GMT	1	1	CO	96	8.9		1.01
GMT	1	1	CO	96	9.1	Rmax	1.03
GMT	1	1	CO	96	9.3		1.05
GMT	1	1	CO	98	9.6	Rmax	1.02
GMT	1	1	CO	100	10.9		1.09
GMT	1	1	CO	100	9.9		0.99
GMT	1	1	CO	101	9.4		0.91
GMT	1	1	CO	105	13.0		1.12
GMT	1	1	CO	106	11.5		0.97
GMT	1	1	CO	106	13.5		1.13
GMT	1	1	CO	107	12.9		1.05
GMT	1	1	CO	109	13.4		1.03
GMT	1	1	DV	87	7.6		1.15
GMT	1	1	CO	57	n/a		

Comments:
Trap 1: 20 coho not sampled
Trap 2: 55 coho not sampled
Trap 3: 19 coho not sampled

Site Identification

Waterfalls Creek Site # 2

crew: BD, LT, PM

Sampling Date

16-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	100%
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	66
Ice thickness (cm)	20
Clarity of Ice	none
Snow Depth (cm)	23
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	13
pH	6.7
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfall Creek Site # 2
Flagging tape still there.
Just above dam on right bank looking d/s
(same location as previous set)

Set duration	overnight

Comments

Visit # 2
Clouding up, with windchill.
Chopping necessary, but it didn't take long to cut a 2' square hole.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 2
Date 17-Jan-08
Crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	28	50	96
dolly varden	0		

species composition

100	% CO
0	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	2	CO	50	1.3	um	1.04
GMT	1	2	CO	52	1.8	um	1.28
GMT	1	2	CO	52	1.7	um	1.21
GMT	1	3	CO	54	2.1	um	1.33
GMT	1	3	CO	54	1.6	um	1.02
GMT	1	1	CO	56	2.0	um	1.14
GMT	1	2	CO	56	1.9	um	1.08
GMT	1	2	CO	56	1.9	R-max	1.08
GMT	1	2	CO	56	1.8	um	1.02
GMT	1	3	CO	56	2.3	um	1.31
GMT	1	3	CO	56	1.8	um	1.02
GMT	1	2	CO	57	2.1	um	1.13
GMT	1	1	CO	58	2.3	um	1.18
GMT	1	1	CO	59	2.2	um	1.07
GMT	1	1	CO	59	2.8	um	1.36
GMT	1	2	CO	59	2.8	um	1.36
GMT	1	1	CO	60	2.4	um	1.11
GMT	1	1	CO	61	2.6	R-max	1.15
GMT	1	3	CO	61	2.9	um	1.28
GMT	1	1	CO	62	2.6	um	1.09
GMT	1	1	CO	64	2.6	um	0.99
GMT	1	2	CO	65	3.0	um	1.09
GMT	1	2	CO	68	3.8	um	1.21
GMT	1	2	CO	71	4.0	um	1.12
GMT	1	1	CO	72	3.5	um	0.94
GMT	1	2	CO	72	3.3	um	0.88
GMT	1	2	CO	88	6.5	um	0.95
GMT	1	1	CO	96	9.0	R-max	1.02

Comments:
2 large beetles in trap
Lots of caddis fly larvae in traps

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: All fish sampled.

Site Identification

Waterfalls Creek Site # 2

crew: BD, PM

Sampling Date

26-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	2
Ice Cover	70%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	66
Ice thickness (cm)	13.9
Clarity of Ice	none
Snow Depth (cm)	0
Water Temp (°C)	2.6
Turbidity	clear
DO (ppm)	11.3
pH	7.1
Flow (m/s)	n/a

Number of traps set	3
Set duration	overnight

Set Locations

same as Jan
upstream of beaver dam
Flagging tape still there.

Comments

Visit # 3
100's of caddisfly larvae

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 2
Date 27-Mar-08

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	64	49	104
dolly varden	2	n/a	n/a

species composition	
97	% CO
3	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	2	CO	49	1.1	um	0.93
GMT	1	2	CO	53	1.6	R-max	1.07
GMT	1	1	CO	54	1.4	um	0.89

GMT	1	2	CO	54	1.6	um	1.02
GMT	1	2	CO	55	2.0	um	1.20
GMT	1	1	CO	56	1.8	um	1.02
GMT	1	1	CO	56	1.8	um	1.02
GMT	1	1	CO	57	1.6	um	0.86
GMT	1	1	CO	57	1.9	um	1.03
GMT	1	1	CO	58	2.8	um	1.44
GMT	1	2	CO	58	1.7	um	0.87
GMT	1	1	CO	59	1.8	R-max	0.88
GMT	1	2	CO	59	2.2	um	1.07
GMT	1	2	CO	59	2.0	um	0.97
GMT	1	2	CO	59	1.8	um	0.88
GMT	1	1	CO	60	2.1	um	0.97
GMT	1	1	CO	60	2.2	R-max	1.02
GMT	1	2	CO	60	2.4	um	1.11
GMT	1	2	CO	60	2.2	um	1.02
GMT	1	1	CO	61	2.4	um	1.06
GMT	1	2	CO	62	2.0	um	0.84
GMT	1	1	CO	63	2.4	um	0.96
GMT	1	2	CO	63	2.6	um	1.04
GMT	1	2	CO	63	2.7	um	1.08
GMT	1	2	CO	67	3.0	R-max	1.00
GMT	1	2	CO	68	3.1	um	0.99
GMT	1	2	CO	68	3.3	um	1.05
GMT	1	2	CO	72	3.4	um	0.91
GMT	1	2	CO	73	3.8	um	0.98
GMT	1	1	CO	75	4.2	um	n/a
GMT	1	2	CO	80	5.1	um	1.00
GMT	1	1	CO	82	4.9	um	0.89
GMT	1	1	CO	84	5.9	um	1.00
GMT	1	1	CO	87	5.8	um	0.88
GMT	1	2	CO	92	7.7	um	0.99
GMT	1	2	CO	104	9.8	um	0.87

Comments:
Trap 1: All fish sampled.
Trap 2: 15 coho: 1 DV not sampled.
Trap 3: 13 coho:1 DV not sampled

Site Identification

Waterfalls Creek Site 3

crew: BD, LT, PM

Sampling Date

19-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	n/a
Stream Flow	moderate
Potential for Migration	high

Water Depth (cm)	65
Ice thickness (cm)	n/a
Clarity of Ice	n/a
Snow Depth (cm)	n/a
Water Temp (°C)	0.3
Turbidity	clear
DO (ppm)	14
pH	7.4
Flow (m/s)	n/a

Number of traps set	
Set duration	overnight

Set Locations

Waterfalls Crk. Site 3

set at 15:15

Comments

Visit # 1 Marked site with flagging tape, and site number
Used Lamotte Kit for DO.
Site filled in with 6-9 inches of silt due to beaverdam removal near sites #1 and #2 and directly upstream of site #3.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site #3
Date 20-Nov-07

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	77	55	97
dolly varden	11	60	178

species composition	
88	% CO
13	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	63	2.9		1.16

GMT	1	1	CO	63	2.9		1.16
GMT	1	1	CO	64	2.7		1.03
GMT	1	1	CO	81	5.2		0.98
GMT	1	1	CO	84	6.2		1.05
GMT	1	1	CO	86	6.7		1.05
GMT	1	1	CO	87	6.5		0.99
GMT	1	1	CO	87	6.7		1.02
GMT	1	1	CO	87	6.2		0.94
GMT	1	1	CO	87	6.5		0.99
GMT	1	1	CO	89	8.2		1.16
GMT	1	1	CO	91	7.6		1.01
GMT	1	1	CO	91	7.7	Rmax	1.02
GMT	1	1	CO	93	8.5		1.06
GMT	1	1	CO	94	8.0		0.96
GMT	1	1	CO	95	9.2		1.07
GMT	1	1	CO	95	7.2		0.84
GMT	1	1	CO	97	9.4		1.03
GMT	1	1	CO	97	8.5		0.93
GMT	1	1	DV	60	2.0		0.93
GMT	1	1	DV	78	4.4		0.93
GMT	1	1	DV	83	5.8		1.01
GMT	1	1	DV	96	8.4		0.95
GMT	1	1	DV	101	9.7		0.94
GMT	1	1	DV	150	33.6		1.00
GMT	1	2	CO	55	1.9		1.14
GMT	1	2	CO	57	1.8		0.97
GMT	1	2	CO	57	2.2		1.19
GMT	1	2	CO	59	2.3		1.12
GMT	1	2	CO	61	2.5		1.10
GMT	1	2	CO	62	2.7		1.13
GMT	1	2	CO	62	2.6		1.09
GMT	1	2	CO	63	2.9		1.16
GMT	1	2	CO	68	3.7		1.18
GMT	1	2	CO	75	4.8		1.14
GMT	1	2	CO	78	4.8		1.01
GMT	1	2	CO	81	5.4		1.02
GMT	1	2	CO	84	6.4		1.08
GMT	1	2	CO	85	6.2		1.01
GMT	1	2	CO	86	7.1		1.12
GMT	1	2	CO	87	6.9		1.05
GMT	1	2	CO	92	7.4		0.95
GMT	1	2	CO	93	8.8		1.09
GMT	1	2	CO	97	9.8		1.07
GMT	1	3	DV	87	6.0		0.91
GMT	1	3	DV	87	6.3		0.96
GMT	1	3	DV	106	11.5		0.97
GMT	1	3	DV	168	51.9		1.09
GMT	1	3	DV	178	43.5		0.77

Comments:

Trap 1: All fish sampled

Trap 2: 12 coho not sampled

Trap 3: 27 coho not sampled

Site Identification

Waterfalls Creek Site # 3

crew: BD, LT, PM

Sampling Date

16-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	100%
Stream Flow	low
Potential for Migration	high

Water Depth (cm)	27
Ice thickness (cm)	7.5
Clarity of Ice	none
Snow Depth (cm)	20
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	13.0
pH	6.8
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfall Creek Site # 3
Flagging tape still there.
(same location as previous set)

Set duration	overnight

Comments

Visit # 2
Ice was slushy, and not strong.
Took only a few chops to cut a hole.
Breezy.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 3
Date 17-Jan-08
Crew: BD, LT

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	32	51	102
dolly varden	5	62	136

species composition	
86	% CO
14	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	3	CO	51	1.6	um	1.21
GMT	1	1	CO	53	1.8	um	1.21
GMT	1	3	CO	53	1.5	R-max	1.01
GMT	1	1	CO	55	1.9	um	1.14
GMT	1	1	CO	55	1.9	um	1.14
GMT	1	1	CO	56	1.8	um	1.02
GMT	1	3	CO	56	2.0	R-max	1.14
GMT	1	3	CO	56	1.9	um	1.08
GMT	1	3	CO	56	1.9	um	1.08
GMT	1	1	CO	58	2.3	um	1.18
GMT	1	1	CO	58	1.9	um	0.97
GMT	1	2	CO	58	2.0	um	1.03
GMT	1	1	CO	59	2.5	R-max	1.22
GMT	1	2	CO	59	2.3	um	1.12
GMT	1	3	CO	60	2.2	um	1.02
GMT	1	1	CO	61	2.3	um	1.01
GMT	1	3	CO	61	2.2	R-max	0.97
GMT	1	3	CO	61	2.4	R-max	1.06
GMT	1	2	CO	62	2.2	um	0.92
GMT	1	3	CO	67	3.2	um	1.06
GMT	1	1	CO	68	3.0	um	0.95
GMT	1	1	CO	68	3.0	um	0.95
GMT	1	2	CO	68	3.1	um	0.99
GMT	1	2	CO	73	3.6	R-max	0.93
GMT	1	1	CO	75	4.1	um	0.97
GMT	1	2	CO	88	7.4	um	1.09
GMT	1	3	CO	88	7.3	um	1.07
GMT	1	2	CO	89	7.1	um	1.01
GMT	1	1	CO	92	8.0	um	1.03
GMT	1	1	CO	93	7.8	R-max	0.97
GMT	1	3	CO	93	7.8	um	0.97
GMT	1	2	CO	102	10.4	um	0.98
GMT	1	3	DV	62	2.3	um	0.97
GMT	1	2	DV	90	7.4	um	1.02
GMT	1	3	DV	111	12.6	um	0.92
GMT	1	3	DV	132	23.1	um	1.00
GMT	1	2	DV	136	23.3	um	0.93

Comments:
Warm out, ice melting a bit.
A lot of caddis fly larvae.
A wide range of FL for marked fish.

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: All fish sampled.

Site Identification

Waterfalls Creek Site # 3

crew: BD, PM

Sampling Date

26-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	2
Ice Cover	2%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	48.3
Ice thickness (cm)	2
Clarity of Ice	none
Snow Depth (cm)	0
Water Temp (°C)	1.2
Turbidity	clear
DO (ppm)	11.8
pH	6.9
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfall Creek Site # 3
(same location as previous set)

Set duration	overnight

Comments

Visit # 3

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site # 3
Date 27-Mar-08

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	13	53	86
dolly varden	24	85	146

species composition	
35	% CO
65	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	3	CO	53	1.4	um	0.94
GMT	1	1	CO	55	1.8	um	1.08
GMT	1	3	CO	55	1.9	um	1.14
GMT	1	3	CO	55	2.0	R-max	1.20
GMT	1	1	CO	58	2.0	R-max	1.03

GMT	1	3	CO	59	2.2	R-max	1.07
GMT	1	1	CO	60	2.2	R-max	1.02
GMT	1	1	CO	60	2.5	R-max	1.16
GMT	1	3	CO	63	2.5	R-max	1.00
GMT	1	3	CO	66	3.2	R-max	1.11
GMT	1	3	CO	67	3.1	R-max	1.03
GMT	1	3	CO	83	5.5	um	0.96
GMT	1	1	CO	86	6.4	um	1.01
GMT	1	3	DV	85	6.5	um	1.06
GMT	1	3	DV	91	7.3	um	0.97
GMT	1	3	DV	93	7.7	um	0.96
GMT	1	3	DV	94	8.1	um	0.98
GMT	1	3	DV	94	7.7	um	0.93
GMT	1	3	DV	95	6.6	um	0.77
GMT	1	3	DV	95	7.5	um	0.87
GMT	1	1	DV	98	8.1	um	0.86
GMT	1	3	DV	105	9.7	um	0.84
GMT	1	3	DV	107	8.8	um	0.72
GMT	1	1	DV	110	12.3	um	n/a
GMT	1	1	DV	112	13.7	um	0.98
GMT	1	1	DV	112	13.9	um	0.99
GMT	1	3	DV	113	12.2	um	0.85
GMT	1	3	DV	113	11.3	um	0.78
GMT	1	3	DV	115	13.7	um	0.90
GMT	1	3	DV	116	12.0	um	0.77
GMT	1	3	DV	116	14.2	um	0.91
GMT	1	3	DV	118	17.3	um	1.05
GMT	1	3	DV	120	15.2	um	0.88
GMT	1	3	DV	121	14.7	um	0.83
GMT	1	3	DV	126	15.7	um	0.78
GMT	1	3	DV	130	17.0	um	0.77
GMT	1	3	DV	146	26.5	um	0.85

Comments:
trap #2 empty - suspect gap in MT -CPUE should be based on two traps only.

Trap 1: All fish sampled.
Trap 2: empty trap
Trap 3: All fish sampled.

Site Identification

Waterfalls Creek Site 4

crew: BD, LT, PM

Sampling Date

19-Nov-07

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	n/a
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	54.5
Ice thickness (cm)	n/a
Clarity of Ice	n/a
Snow Depth (cm)	n/a
Water Temp (°C)	0.2
Turbidity	clear
DO (ppm)	14
pH	7.2
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfalls Creek Site 4
at Heli-pad
Water depth where traps set was 54.5cm
Traps set on cobble

Set duration	overnight

Comments

Visit # 1. Mud = 47cm deep on margin of stream.
Site silted in on edges of pool.
Lots of tannins in water.
Lamotte test for DO.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site 4
Date 20-Nov-07

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	64	61	112
dolly varden	5	92	152

species composition	
91	% CO
9	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	2	CO	61	2.6		1.15
GMT	1	2	CO	62	2.9		1.22
GMT	1	1	CO	63	3.3		1.32
GMT	1	2	CO	63	2.6		1.04
GMT	1	2	CO	63	2.6		1.04
GMT	1	1	CO	64	3.1		1.18

GMT	1	2	CO	65	3.3		1.20
GMT	1	1	CO	67	3.3		1.10
GMT	1	1	CO	71	3.5		0.98
GMT	1	1	CO	76	3.0		0.68
GMT	1	1	CO	78	n/a		
GMT	1	1	CO	79	5.4		1.10
GMT	1	1	CO	79	3.7		0.75
GMT	1	2	CO	80	6.2		1.21
GMT	1	1	CO	83	6.4		1.12
GMT	1	1	CO	84	6.6		1.11
GMT	1	1	CO	84	6.0		1.01
GMT	1	1	CO	85	6.1		0.99
GMT	1	1	CO	86	5.9		0.93
GMT	1	1	CO	87	6.7		1.02
GMT	1	2	CO	88	6.8		1.00
GMT	1	2	CO	88	7.7		1.13
GMT	1	1	CO	89	8.1		1.15
GMT	1	1	CO	89	7.1		1.01
GMT	1	1	CO	89	7.1		1.01
GMT	1	2	CO	89	7.2		1.02
GMT	1	2	CO	90	8.2		1.12
GMT	1	2	CO	94	8.5		1.02
GMT	1	2	CO	95	9.3		1.08
GMT	1	2	CO	95	9.3		1.08
GMT	1	2	CO	96	9.2		1.04
GMT	1	1	CO	97	9.6		1.05
GMT	1	2	CO	97	8.8		0.96
GMT	1	2	CO	98	8.9	Rmax	0.95
GMT	1	1	CO	99	10.5		1.08
GMT	1	2	CO	99	10.2	Rmax	1.05
GMT	1	2	CO	99	9.1		0.94
GMT	1	2	CO	100	10.1		1.01
GMT	1	2	CO	100	11.1		1.11
GMT	1	2	CO	102	10.9		1.03
GMT	1	2	CO	103	11.3		1.03
GMT	1	1	CO	105	11.4		0.98
GMT	1	2	CO	112	12.8		0.91
GMT	1	1	DV	92	8.0		1.03
GMT	1	1	DV	105	11.8		1.02
GMT	1	2	DV	138	27.2		1.03
GMT	1	1	DV	143	27.1		0.93
GMT	1	1	DV	152	29.2		0.83

Comments:

Trap 1: all fish sampled.

Trap 2: 5 coho not sampled.

Trap 3: 16 coho not sampled.

Site Identification

Waterfalls Creek Site # 4

crew: BD, LT, PM

Sampling Date

16-Jan-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	0
Ice Cover	100%
Stream Flow	low
Potential for Migration	low

Water Depth (cm)	32
Ice thickness (cm)	15
Clarity of Ice	none
Snow Depth (cm)	18
Water Temp (°C)	0.1
Turbidity	clear
DO (ppm)	14
pH	6.9
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfall Creek Site # 4
helipad site, in front of culvert
(same location as previous set)

Set duration	overnight

Comments

Visit # 2
Windy
Approximately 2.5 cm of airspace bewteen bottom of ice and water surface.
Both culverts completely frozen, with no water flow through them.

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site 4
Date 20-Nov-07

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	24	53	95
dolly varden	1	168	168

species composition	
96	% CO
4	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	1	CO	53	1.8	um	1.21
GMT	1	3	CO	54	1.8	um	1.14
GMT	1	1	CO	55	1.7	R-max	1.02
GMT	1	1	CO	56	1.9	um	1.08
GMT	1	1	CO	56	1.9	um	1.08
GMT	1	1	CO	57	n/a	um	n/a
GMT	1	3	CO	59	2.6	um	1.27
GMT	1	1	CO	60	2.1	um	0.97
GMT	1	1	CO	60	3.8	um	1.76
GMT	1	2	CO	60	1.6	um	0.74
GMT	1	1	CO	61	2.1	um	0.93
GMT	1	1	CO	61	2.4	R-max	1.06
GMT	1	3	CO	61	1.9	um	0.84
GMT	1	2	CO	62	3.2	um	1.34
GMT	1	1	CO	64	3.0	R-max	1.14
GMT	1	1	CO	65	2.8	um	1.02
GMT	1	1	CO	66	2.9	um	1.01
GMT	1	1	CO	69	3.5	um	1.07
GMT	1	3	CO	69	3.6	um	1.10
GMT	1	1	CO	86	6.1	um	0.96
GMT	1	3	CO	87	6.7	um	1.02
GMT	1	1	CO	88	7.2	um	1.06
GMT	1	1	CO	90	7.5	um	1.03
GMT	1	1	CO	95	8.8	um	1.03
GMT	1	1	DV	168	45.5	um	0.96

Comments:
Windy on trap pick up day. Cold on the hands.
Largest DV had a notch along the caudal ventral suface and a split in caudal fin.
Possibly due to the large size of the fish, and the small trap opening. The fish looked okay.
The weight of two outliers (see yellow highlighting) was omitted from the averages.

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: All fish sampled.

Only one DV caught.

Site Identification

Waterfalls Creek Site # 4

crew: BD, PM

Sampling Date

26-Mar-08

Atmospheric and Water Conditions

Air Temp (deg Celsius)	2
Ice Cover	20%
Stream Flow	mod
Potential for Migration	high

Water Depth (cm)	38.1
Ice thickness (cm)	7.6
Clarity of Ice	none
Snow Depth (cm)	0
Water Temp (°C)	1.2
Turbidity	clear
DO (ppm)	10.4
pH	6.8
Flow (m/s)	n/a

Number of traps set	3

Set Locations

Waterfall Creek Site # 4
helipad site, in front of culvert
(same location as previous set)

Set duration	overnight

Comments

Visit # 3
edge ice only

Juvenile Capture and Sampling Summary

Location Waterfalls Creek Site 4
Date 27-Mar-08

Species	No. Caught	Min Ln (mm)	Max Ln (mm)
coho	14	42	97
dolly varden	7	62	138

species composition	
67	% CO
33	% DV

Individual Sampling Data

Capture Method	Cluster #	Trap #	Species	FL(mm)	Weight(g)	Mark type	FCC
GMT	1	3	CO	42	1.1	um	1.48
GMT	1	3	CO	64	2.6	um	0.99
GMT	1	2	CO	65	2.7	um	n/a
GMT	1	2	CO	67	2.9	um	0.96
GMT	1	3	CO	68	3.3	um	1.05
GMT	1	2	CO	69	3.3	um	1.00
GMT	1	3	CO	69	2.9	um	0.88
GMT	1	3	CO	69	4.1	R-max	1.25
GMT	1	2	CO	74	3.4	um	0.84
GMT	1	2	CO	84	5.4	um	0.91
GMT	1	2	CO	89	7.6	um	1.08
GMT	1	3	CO	92	7.2	um	0.92
GMT	1	3	CO	93	8.4	R-max	1.04
GMT	1	2	CO	97	8.4	um	0.92
GMT	1	2	DV	62	1.3	um	0.55
GMT	1	3	DV	89	5.7	um	0.81
GMT	1	3	DV	89	5.3	um	0.75
GMT	1	3	DV	90	7.2	um	0.99
GMT	1	1	DV	102	10.1	um	0.95
GMT	1	3	DV	113	10.8	um	0.75
GMT	1	3	DV	138	23.0	um	0.88

Comments:

Trap 1: All fish sampled.
Trap 2: All fish sampled.
Trap 3: All fish sampled.

Appendix 2
Summer Habitat Assessment Data

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	30-Jul-07	**Photos:** no photos taken at this time
Surveyors Initials	GG, LT	
Location	Barren Creek, at the upstream side of Hwy 16 crossing GPS Waypoint "**BarrenHWY**"	
Type of pool (culvert, nonculvert)	culvert	09 U 0660447 6037924

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	5.7	
Habitat Unit Type *(i.e. pool, riffle or glide)*	pool	
Wetted Width (m)	4.5	
Max. Depth (at deepest point) (cm) (estimate if necessary)	116	
Depth at trap cluster location (cm) (estimate if necessary)	97	Origional site filled in with gravel, moved site towards culvert opening 2 m.
Depth of riffle crest (at pool outlet) (if applicable)	n/a	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	0	
Large Woody Debris (>10cm diam)	0	
Instream Vegetation (type,% of area)	1	Grass along edge
Canopy cover (0% - 100%)	0	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	65	
% gravel (2-64 mm) *btwn grain of sand and tennisball*	25	
% cobble (64-256 mm) *btwn tennisball and basketball*	0	
% boulder (> 256 mm) *bigger than a basketball*	10	Riprap
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities

i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.

GMT site filled in with gravel, moved site over a couple m to right in front of culvert on the upstream side of Hwy 16.
DO(ppm)=9.6 pH=7.55 T (degrees C)=11.5
Site has changed since fall 2006, lots of gravel deposited, with a large gravel bar in the center directly above the pool.
On 13-Jul-07 the CO2 was 3-5 ppm (used up 40-43 in water quality test kit), ammonium nitrate zero

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	Jul-30	**Photos:** 2 photos looking upstream at pool
Surveyors initials	GG, LT	looking through culvert
Location	Byman Creek at the Hwy 16 crossing	
Type of pool (culvert, nonculvert)	culvert	**GPS** 09 U 0666835 Waypoint: "**BymanHwy16**" 6044296

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	11.4	
Habitat Unit Type *(i.e. pool, riffle or glide)*	pool	
Wetted Width (m)	13	
Max. Depth (at deepest point) (cm) (estimate if necessary)	>200	deep and turbid, estimated
Depth at trap cluster location (cm) (estimate if necessary)	74	
Depth of riffle crest (at pool outlet) (if applicable)	11.5	
Area of site (m2)	148.2	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	1	
Large Woody Debris (>10cm diam)	1	
Instream Vegetation (type,% of area)	0	
Canopy cover (0% - 100%)	2	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	n/a	fines in pool bottom, couldn't see (felt bottom with feet)(turbid)
% gravel (2-64 mm) *btwn grain of sand and tennisball*	n/a	along edge, where visible, mostly gravel (turbid)
% cobble (64-256 mm) *btwn tennisball and basketball*	n/a	doesn't appear to be much (turbid)
% boulder (> 256 mm) *bigger than a basketball*	n/a	riprap all along Left Bank
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities
i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.

Boulders at edge, with fines and gravel in pool. Too deep for accurate percentages. Cow droppings in creek
T (degrees C) = 11.2 Recommend the addition of large woody debris into pool.
DO (ppm) = 10.8 Culvert slope 4%

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	August 8/07	**Photos:** 1. looking upstream @ culvert
Surveyors Initials	GG	2. looking down at pool from highway
Location	McQuarrie creek pool by highway 16. **WPT location:** 09U0664207 6043634	
Type of pool (culvert, nonculvert)		

Site Measurements

Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	12.1+19.6	19.6m is the distance of the highway culvert which should be included with the total length of the habitat.
Habitat Unit Type *(i.e. pool, riffle or glide)*	Glide	
Wetted Width (m)	6.9	
Max. Depth (at deepest point) (cm) (estimate if necessary)	112	
Depth at trap cluster location (cm) (estimate if necessary)	112	
Depth of riffle crest (at pool outlet) (if applicable)	24	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	3%	
Large Woody Debris (>10cm diam)	0	
Instream Vegetation (type,% of area)	0	
Canopy cover (0% - 100%)	4	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	15	
% gravel (2-64 mm) *btwn grain of sand and tennisball*	40	
% cobble (64-256 mm) *btwn tennisball and basketball*	40	
% boulder (> 256 mm) *bigger than a basketball*	5	
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities

i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.

GMT site filled in with gravel, moved site over a couple m to right in front of culvert on the upstream side of Hwy 16.
DO(ppm)=9.6 pH=7.55 T (degrees C)=11.5
Site has changed since fall 2006, lots of gravel deposited, with a large gravel bar in the center directly above the pool.
On 13-Jul-07 the CO2 was 3-5 ppm (used up 40-43 in water quality test kit), ammonium nitrate zero

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	Jul-17	**Photos:**
Surveyors initials	BD, GG,LT	
Location	Waterfalls creek OW site number 1, beaverdam has been partly removed	
Type of pool (culvert, nonculvert)	nonculvert	

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	30	15m upstream of dam plus 15m downstream of dam
Habitat Unit Type *(i.e. pool, riffle or glide)*	glide	
Wetted Width (m)	5.1	
Max. Depth (at deepest point) (cm) (estimate if necessary)	83	
Depth at trap cluster location (cm) (estimate if necessary)	77	
Depth of riffle crest (at pool outlet) (if applicable)	none	
Area of site (m2)	153	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	5%	part of beaverdam
Large Woody Debris (>10cm diam)	0%	
Instream Vegetation (type,% of area)	40%	
Canopy cover (0% - 100%)	1%	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	100	
% gravel (2-64 mm) *btwn grain of sand and tennisball*	0	
% cobble (64-256 mm) *btwn tennisball and basketball*	0	
% boulder (> 256 mm) *bigger than a basketball*	0	
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities
(i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.)

Beaverdam partially removed.
Beaverdam height is 50cm

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	Jul-17	**Photos:** 2 photos
Surveyors initials	BD, GG, LT	
Location	Waterfalls creek OW site number 2, no culverts. Glide downstream end of beaverdam	
Type of pool (culvert, nonculvert)	nonculvert	

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	15	We only measured 15m upstream of dam.
Habitat Unit Type *(i.e. pool, riffle or glide)*	glide	
Wetted Width (m)	12.3	
Max. Depth (at deepest point) (cm) (estimate if necessary)	115	
Depth at trap cluster location (cm) (estimate if necessary)	115	
Depth of riffle crest (at pool outlet) (if applicable)	38.5	
Area of site (m2)	184.5	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	0	
Large Woody Debris (>10cm diam)	0	
Instream Vegetation (type,% of area)	35	
Canopy cover (0% - 100%)	0	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	100	
% gravel (2-64 mm) *btwn grain of sand and tennisball*	0	
% cobble (64-256 mm) *btwn tennisball and basketball*	0	
% boulder (> 256 mm) *bigger than a basketball*	0	
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities
(i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.)

Beaverdam at downstream edge of site 2.
Dam actively maintained, dam height is 57cm.

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	Jul-17 10:20 AM	**Photos:** 4 photos looking downstream
Surveyors initials	BD, GG, LT	
Location	Waterfalls creek OW site number 4 (helipad) pool on downstream side of culverts (2)	
Type of pool (culvert, nonculvert)	culvert	

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	6.9	
Habitat Unit Type *(i.e. pool, riffle or glide)*	pool	culvert pool, 2 culverts length of culverts are 18.7m meandering
Wetted Width (m)	9.1	
Max. Depth (at deepest point) (cm) (estimate if necessary)	88	
Depth at trap cluster location (cm) (estimate if necessary)	54	right culvert looking downstream
Depth of riffle crest (at pool outlet) (if applicable)	28	
Area of site (m2)	62.79	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	0%	
Large Woody Debris (>10cm diam)	1 piece	edge habitat - not functional at low water
Instream Vegetation (type,% of area)	1%	grasses
Canopy cover (0% - 100%)	40%	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	30	part of pool has filled with silt
% gravel (2-64 mm) *btwn grain of sand and tennisball*	0	
% cobble (64-256 mm) *btwn tennisball and basketball*	50	
% boulder (> 256 mm) *bigger than a basketball*	20	rip-rap falling in from edge of pool
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities
(i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.)

pool at downstream end of helipad culverts
some infilling has occurred due to spring freshet
coho fry visible at time of survey

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)

2007/2008 Overwintering Monitoring - Habitat Description Data

Date	Jul-17	**Photos:** 5 photos
Surveyors initials	BD, GG,LT	
Location	Waterfalls creek OW site number 3, just upstream of new beaverdam	
Type of pool (culvert, nonculvert)	nonculvert	

Site Measurements		**Comments**
Length of habitat unit (m) *e.g. riffle crest-crest, dam-dam, etc.*	15.3	
Habitat Unit Type *(i.e. pool, riffle or glide)*	glide	
Wetted Width (m)	5.1	
Max. Depth (at deepest point) (cm) (estimate if necessary)	68.5	
Depth at trap cluster location (cm) (estimate if necessary)	61	
Depth of riffle crest (at pool outlet) (if applicable)	35	just downstream side of beaverdam
Area of site (m2)	78.03	
Cover % breakdown (adds to 100%)		
Small Woody Debris (<10cm diam)	0	
Large Woody Debris (>10cm diam)	0	
Instream Vegetation (type,% of area)	5	
Canopy cover (0% - 100%)	2	
Undercut Banks (present, absent)	absent	
total length of undercut area	n/a	
average distance undercut from edge	n/a	
Bed Material (adds to 100%)		
% fines (< 2 mm) *grain of sand and smaller*	60	
% gravel (2-64 mm) *btwn grain of sand and tennisball*	2	
% cobble (64-256 mm) *btwn tennisball and basketball*	20	
% boulder (> 256 mm) *bigger than a basketball*	18	
% bedrock	0	

Description of other habitat features, impacts or restoration opportunities
(i.e. beaver dams present, rap-rap present, needs LWD added, banks unstable, etc.)

This pool has infilled with silt since March 2007 sample time.
There is a new beaverdam at downstream end of pool.
Fry visible at time of survey

referenced the Fish Habitat Assessment Procedure (http://www.for.gov.bc.ca/hfd/library/ffip/Johnston_NT1996.pdf)