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Snorkel Survey of Trout and Char in the Canadian Skagit River 2010

Prepared for:

Skagit Environmental Endowment Commission
Ministry of Environment
1610 Mount Seymour Road
North Vancouver, B.C.
V7G 2R9

Prepared by:

R.J. Anaka and K.J. Scott
Scott Resource Services Inc.
31856 Silverdale Avenue
Mission, B.C.
V2V 2K9

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Acknowledgements

Scott Resource Services Inc. (SRS) thanks the Skagit Environmental Endowment Commission (SEEC) for funding this study. SRS would also like to thank Duane Jesson and Iain Lunn of the Ministry of Natural Resource Operations and Pete Caverhill (SEEC) for their support, guidance and technical assistance during the study. Thanks to Poul Bech for assisting the SRS team during the field component of the project. Duane Jesson and Pete Caverhill reviewed earlier drafts of the report and provided useful comments.

1.0 INTRODUCTION

SRS was contracted by the Skagit Environmental Endowment Commission (SEEC) to undertake a fish stock assessment of the Canadian Skagit River. The purpose of this project was to collect and report on current trout/char biological and population information on the Canadian Skagit River, with comparisons made to past results. This report documents the results of the 2010 snorkel survey of trout and char in the Canadian Skagit River.

The 2010 stock assessment involved enumerating rainbow trout (*Oncorhynchus mykiss*) and char species (*Salvelinus*) from the Skagit River downstream of the Sumallo River confluence, by snorkelling. The objective of the snorkel survey was to determine the number, size and spatial distribution of rainbow trout and char. Annual counts were undertaken between 1982 and 1994, and an isolated survey was completed in 1998. The 2010 survey was the second of three consecutive stock assessment surveys scheduled for the Skagit River. The first of the consecutive surveys was completed in 2009 (Anaka et al. 2010b). Completing three consecutive annual surveys will allow for the creation of trend data on fish supply, the first such trend data since 1994. A major analysis of the data from 2009, 2010 and 2011, including comparisons with historical snorkel survey results will be presented in the final report in 2011.

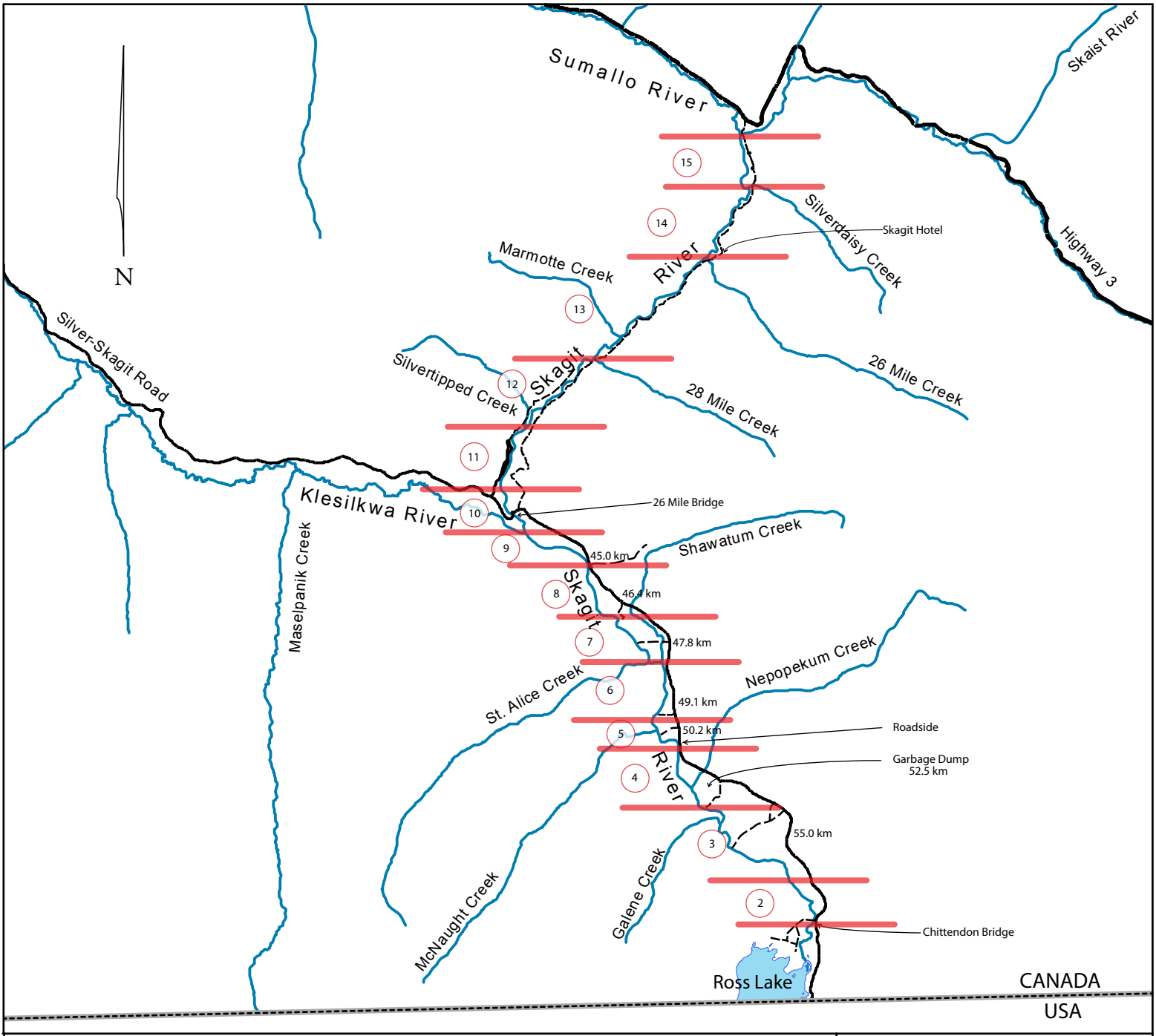
In total, 14 sections (36.9 km), of the Canadian Skagit River were surveyed, from the confluence of the Sumallo River and Skagit River to Chittenden Bridge (Figure 1) on the lower river near Ross Lake. The snorkel survey was conducted by SRS staff from September 7, 2010 to September 11, 2010. The weather during the float was mixed with rain, sun and cloud. In response to weather changes, visibility in the river varied from moderate to good (from 5 m to 10 m) during the survey. Water temperature was taken daily during the survey and ranged from 6°C on September 7, 2010 to 8°C on September 11, 2010.

1.1 Objectives

The objectives of the Fish Supply component of the 2010 stock assessment of the Canadian Skagit River were to:

1. Count total rainbow trout and char.
2. Categorize rainbow trout and char observed by size class (<10 cm; 10 to 20 cm; 20 to 30 cm; 30 to 40 cm; >40 cm).
3. Compare distribution of rainbow trout and char by species and location.
4. Calculate abundance indices for rainbow trout and char within the assessed section of the river.
5. Provide observations and comments affecting trout/char abundance and distribution.
6. Analyze and compare results to previous snorkel surveys on the BC Upper Skagit.

This report addresses objectives 1 through 5 for the current year's data. Objective 6 (analyze and compare results with previous studies) will be included after the 2011 assessment is complete.



Legend

Section number	Description
15	Sumallo River to Silverdaisy Creek
14	Silverdaisy Creek to Skagit Hotel
13	Skagit Hotel to 28 Mile Creek
12	28 Mile Creek to Silvertipped Creek
11	Silvertipped Creek to 26 Mile Bridge
10	26 Mile Bridge to Klesilkwa River
9	Klesilkwa River to 45 km
8	45 km to 46.4 km
7	46.4 km to Shawatum Creek
6	Shawatum Creek to fuel dump
5	Fuel dump to roadside
4	Roadside to garbage dump
3	Garbage dump to 56 km
2	56km to Chittenden Bridge

Highway 3
Gravel Road
Trail
Lake
Creek

0 5 10
km

Overview of the study area. Note that many of the smaller creeks have been omitted to simplify the map.

Map features modified from TRIM and other BC Government base data. Projected in NAD 83, UTM 10.

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Figure 1. Sections sampled during the snorkel survey of the Canadian Skagit River, 2010.

2.0 METHODS

2.1 Field data collection

Field data was collected consistent with standard procedures previously employed to survey this portion of the Skagit River drainage (Burrows and Neuman, 1995). The survey team consisted of a senior project manager, contract biologist and field technician. The survey team was organized into floaters and a shore or boat tender to ensure floater safety. To maximize data consistency from previous years, the river was divided into the same sections. Each section was sampled once by floating through it and counting all rainbow trout and char observed by total length size class. Floaters were equipped with a wet suit, snorkel, mask and personal underwater slate to record observations. The tender was equipped with data sheets for summarizing the information as the float was conducted. The shore tender carried safety gear and was responsible for ensuring that the floaters progressed as a unit.

Prior to starting the survey, floaters were visually orientated to the size classes by using pieces of wood dowel cut to the appropriate size class lengths. The pieces of dowel were placed in the Sumallo River, upstream of the first survey section, where floaters observed them. Each morning, prior to floating a given section, the wood dowels were used to re-calibrate the floaters' ability to judge size class length. Safety procedures and emergency response plans were also reviewed prior to commencing the survey.

To minimize duplication of counts, each floater was assigned a lane in the river and only recorded fish observed in that lane. The number of floaters in the water varied between 2 and 3 (average 2) depending on the width of the wetted channel through the area being surveyed (Photographs 1, 2, 3 and 4). For Sections 15 through 12, the narrower portion of the river, the survey team was comprised of 2 floaters and one tender. For Sections 11 through 5 the survey team was comprised of 3 floaters and 2 tenders, and for Sections 4 through 2 the survey team included 2 floaters and one tender (Table 1). The tender was responsible for overall communications between each of the floaters so they could be informed of any potential hazards and progress as a unit. The team stopped frequently and collectively reviewed their counts. If a large number of fish were observed within a given location, the said location was re-floated to confirm fish numbers. Once a consensus was reached, the tender recorded the counts on the appropriate section of the data sheet (Appendix 1) and the survey team proceeded to float the next section of river. The counts were separated by section to be consistent with previous surveys and to simplify the data analysis.

2.2 Field data analysis

The analysis of the field data was undertaken according to those procedures previously utilized by Burrows and Neuman (1995). This included the calculation of abundance indices which refers to the number of fish by species observed per kilometre per floater. Abundance indices were calculated using the following formula:

Abundance Index = Fish Count by Species for Section / (Section Length (km) x Floater Equivalent).

The section lengths used for the snorkel survey were determined by Burrows and Neuman (1995). Although it has been determined that some of Burrows and Neumans' (1995) section lengths are erroneous, we have continued their use in this study for the purpose of comparison with previous studies. To adjust for the corrected lengths, further investigation into the possible errors would be required, as would a recalculation of parameter estimates presented in the previously completed studies. This work was beyond the scope of the current study.

For the purposes of this survey, the floater equivalent used for this analysis was 2, based on an average of 2 floaters.

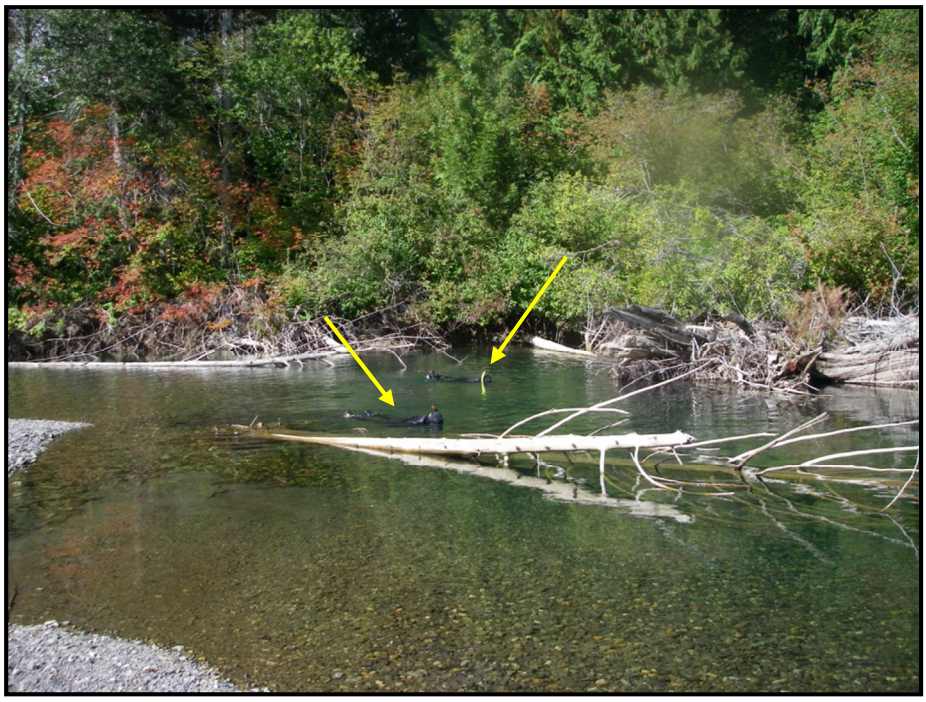
In the final analysis (third year compilation report) 2009 to 2011 population trends to determine the number of catchable rainbow trout (ie. > 20 cm in length) per kilometre will be examined using expansion factors (low and high) previously determined by Burrows and Neuman (1995).

Table 1: Descriptions and associated lengths of the sections floated during rainbow trout and char survey in the Canadian Skagit River, 2010.

Section Number	Section Description	Length (m)	Number of Floaters
15	Sumallo River to Silverdaisy Creek	1,900 m	2
14	Silverdaisy Creek to Skagit Hotel	2,570 m	2
13	Skagit Hotel to 28 Mile Creek	6,010 m	2
12	28 Mile Creek to Silvertipped Creek	3,480 m	2
11	Silvertipped Creek to 26 Mile Bridge	3,310 m	3
10	26 Mile Bridge to Klesilkwa River	740 m	3
9	Klesilkwa River to 45 km	2,490 m	3
8	45 km to 46.4 km	1,980 m	3
7	46.4 km to Shawatum Creek	2,510 m	3
6	Shawatum Creek to Fuel Dump	960 m	3
5	Fuel Dump to Roadside	2,490 m	3
4	Roadside to Garbage Dump	2,860 m	2
3	Garbage Dump to 56 km	2,920 m	2
2	56 km to Chittenden Bridge	2,630 m	2
Total Length Enumerated		**36,850 m**	

Photograph 1: In riffles that tailed out into long deep pools one floater would walk to the bottom of the tail out to count from the bottom while the other floater would float through. This would mitigate double counting startled fish that may swim downstream and then turn back upstream. The floaters are identified by the yellow arrows.

Photograph 2: In areas of boulders and large cobbles which create a step pool flow pattern, fish observation can be difficult. Floaters would observe fish by strategically sliding around the channel substrate and peering from the fast moving water to the slower clearer water.



Photograph 3: Examining a pool with coarse woody debris cover. In areas such as this, one floater would float adjacent to the debris/pool and look in at the debris/pool while the other floater moves in and about the woody debris.

Photograph 4: Two floaters are floating the edge of a deep cut bank run. In this instance one floater floats directly through the run while the second floater parallels the run edge. Both floaters count the same area and compare observations.

3.0 RESULTS

3.1 Fish count

The snorkel survey of the Canadian Skagit River from September 7 to September 11, 2010 included 14 sections of the river, spanning approximately 36.9 km (Table 1). During the survey, a total of 1849 rainbow trout (Table 2) and 1650 char (Table 3) were counted.

No other fish species were detected.

3.1.1 Rainbow trout

The majority (88.6 %) of the rainbow trout were found in the two middle size classes. This included 998 (54 %) in the 30 to 40 cm size class and 640 (34.6 %) in the 20 to 30 cm size class. The remaining rainbow trout were divided between the smallest and largest size classes. This included 166 (9.0 %) in the 10 to 20 cm size class and 45 (2.4 %) in the > 40 cm size class (Figure 2).

Table 2: Summary of rainbow trout counted by section during the snorkel survey of the Canadian Skagit River, September 7 to September 11, 2010.

Section Number	Rainbow Trout				
	10 to 20 cm	20 to 30 cm	30 to 40 cm	> 40 cm	Total
15	33	18	24	1	**76**
14	53	22	36	5	**116**
13	6	59	145	8	**218**
12	9	60	58	2	**129**
11	3	56	99	9	**167**
10	1	11	13	0	**25**
9	0	27	56	0	**83**
8	15	60	45	7	**127**
7	13	38	39	3	**93**
6	1	18	26	0	**45**
5	0	39	95	1	**135**
4	0	37	123	3	**163**
3	12	115	151	5	**283**
2	20	80	88	1	**189**
Total	**166**	**640**	**998**	**45**	**1849**
Percent of Total	**9.0%**	**34.6%**	**54.0%**	**2.4%**	

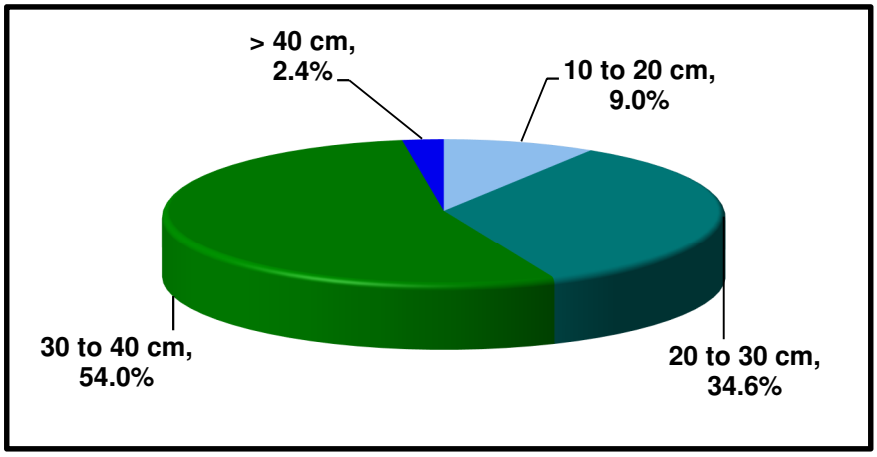


Figure 2. Percentage of rainbow trout by size class counted in the Canadian Skagit River, September, 2010.

3.1.2 Char

Almost all of the char counted (99.6 %) were found to be > 30 cm in length. The majority (1583 or 95.9 %) of these were in the > 40 cm size class while the remaining 61 (3.7 %) were in the 30 to 40 cm size class. Only 1 char (0.1 %) was observed in the 20 to 30 cm size class while only 5 char (0.3 %) in the 10 to 20 cm size class were observed (Figure 3).

During the snorkel survey incidental observation identified that some of the char appeared to be in spawning colours, mostly in the > 40 cm size class. A larger percentage of char in the lower sections were in spawning colour than in the upper sections.

Table 3: Summary of char counted by section during the snorkel survey of Canadian Skagit River, September 7 to September 11, 2010.

Section Number	Char				
	10 to 20 cm	20 to 30 cm	30 to 40 cm	> 40 cm	Total
15	5	0	4	57	**66**
14	0	0	2	4	**6**
13	0	0	0	40	**40**
12	0	1	3	44	**48**
11	0	0	4	51	**55**
10	0	0	0	2	**2**
9	0	0	2	124	**126**
8	0	0	19	222	**241**
7	0	0	2	50	**52**
6	0	0	0	14	**14**
5	0	0	3	180	**183**
4	0	0	0	177	**177**
3	0	0	0	491	**491**
2	0	0	22	127	**149**
Total	**5**	**1**	**61**	**1583**	**1650**
Percent of Total	**0.3%**	**0.1%**	**3.7%**	**95.9%**	

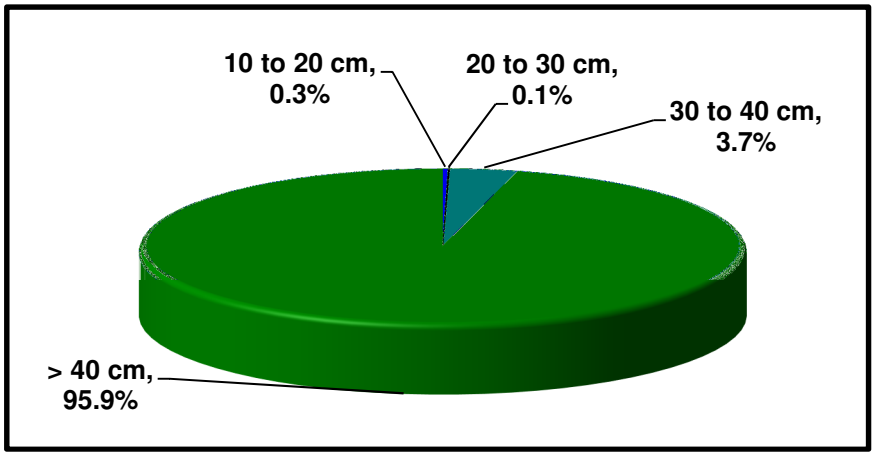


Figure 3. Percentage of char by size class counted in the Canadian Skagit River, September, 2010.

3.2 Fish distribution

The results of the snorkel survey indicated that the distribution of rainbow trout and char varied between species in the upper Canadian Skagit River (Sections 15 through 10), but was relatively similar in the lower portion of the river (Sections 9 through 2) (Tables 2, 3 and Figure 4). In Sections 15 through 10 more rainbow trout were found than char, whereas the numbers of both species were relatively similar in Sections 9 through 2. Rainbow trout were found in nearly equal numbers throughout the sampled area, except for Sections 10 through 6 which had lower numbers of this species of fish. The char population appeared to be most abundant towards the lower sections of the river (Sections 5 through 2).

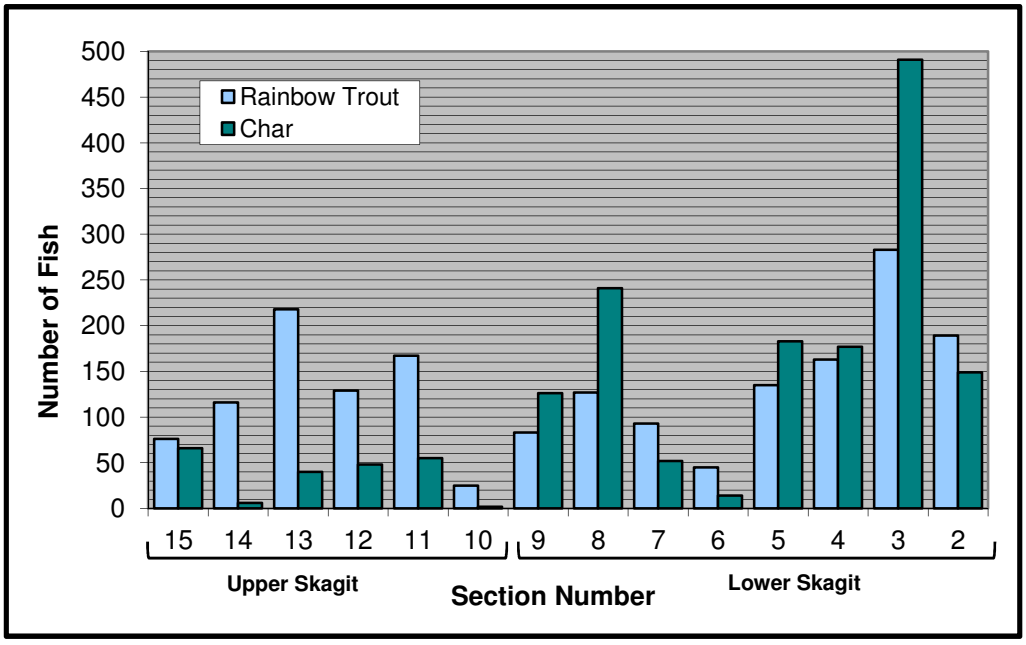


Figure 4. Distribution of rainbow trout and char by section within the Canadian Skagit River, September, 2010.

3.3 Abundance indices

Consistent with the 1998 report (Harper and Scott, 1998a) and similar to Burrows and Neuman's (1995) report, abundance indices (number of fish per kilometre per floater) were calculated for rainbow trout within the assessed sections of the Canadian Skagit River during the 2010 survey (Table 4 and Figure 5). In previous studies abundance indices were not calculated for char, as char were not the focus of the studies and historically have been not observed in large numbers. As illustrated in this report, and in the 2009 stock assessment report (Anaka et al. 2010b), the number of char has increased dramatically. Abundance indices for char have been calculated for this report and can be found in Section 3.3.2.

3.3.1 Rainbow trout abundance indices

The highest abundance of > 40 cm rainbow trout was found in the middle (Sections 11 and 8), upstream in Section 14, and downstream in Section 3 of the Canadian Skagit River. The highest abundance of 30 to 40 cm rainbow trout was found in Sections 5 through 2. The highest abundance was in observed in Sections 8, 3 and 2. The highest abundance of 10 to 20 cm rainbow trout was located in Section 14.

Table 4: Summary of abundance indices for rainbow trout counted in the Canadian Skagit River, September, 2010.

Section Number	Length of Section (km)	10 to 20 cm		20 to 30 cm		30 to 40 cm		> 40 cm		Total Counted	
		No. of RB	Abundance Index	No. of RB	Abundance Index	No. of RB	Abundance Index	No. of RB	Abundance Index	No. of RB	Abundance Index
15	1.90	33	8.68	18	4.74	24	6.32	1	0.26	76	20.00
14	2.57	53	10.31	22	4.28	36	7.00	5	0.97	116	22.57
13	6.01	6	0.50	59	4.91	145	12.06	8	0.67	218	18.14
12	3.48	9	1.29	60	8.62	58	8.33	2	0.29	129	18.53
11	3.31	3	0.45	56	8.46	99	14.95	9	1.36	167	25.23
10	0.74	1	0.68	11	7.43	13	8.78	0	0.00	25	16.89
9	2.49	0	0.00	27	5.42	56	11.24	0	0.00	83	16.67
8	1.98	15	3.79	60	15.15	45	11.36	7	1.77	127	32.07
7	2.51	13	2.59	38	7.57	39	7.77	3	0.60	93	18.53
6	0.96	1	0.52	18	9.38	26	13.54	0	0.00	45	23.44
5	2.49	0	0.00	39	7.83	95	19.08	1	0.20	135	27.11
4	2.86	0	0.00	37	6.47	123	21.50	3	0.52	163	28.50
3	2.92	12	2.05	115	19.69	151	25.86	5	0.86	283	48.46
2	2.63	20	3.80	80	15.21	88	16.73	1	0.19	189	35.93
Total	**36.85**	**166**	**2.25**	**640**	**8.68**	**998**	**13.54**	**45**	**0.61**	**1849**	**25.09**

*Abundance index (No.of rainbow trout per km per floater) = Count for section/(section length (km) x floater equivalent). Floater equivalent = 2.0 (Burrows and Neuman, 1995).

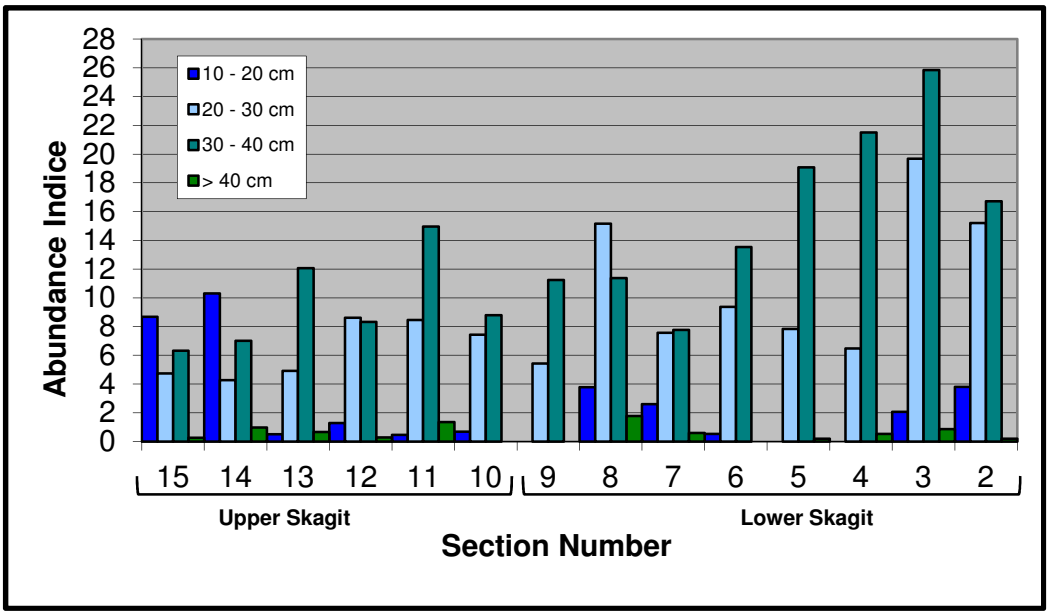


Figure 5: Abundance indices by section for rainbow trout counted in the Canadian Skagit River, September, 2010. Refer to Table 4 for actual numbers of fish used to generate abundance indices.

3.3.2 Char abundance indices

The highest abundance of > 40 cm char was found in the lower (Sections 5 through 2), and the middle (Section 8) of the Canadian Skagit River. Further abundance details are illustrated in Table 5 and Figure 6.

Table 5: Summary of abundance indices for char counted in the Canadian Skagit River, September, 2010.

Section Number	Length of Section (km)	10 to 20 cm		20 to 30 cm		30 to 40 cm		> 40 cm		Total Counted	
		No. of Char	Abundance Index	No. of Char	Abundance Index	No. of Char	Abundance Index	No. of Char	Abundance Index	No. of Char	Abundance Index
15	1.90	5	1.32	0	0.00	4	1.05	57	15.00	66	17.37
14	2.57	0	0.00	0	0.00	2	0.39	4	0.78	6	1.17
13	6.01	0	0.00	0	0.00	0	0.00	40	3.33	40	3.33
12	3.48	0	0.00	1	0.14	3	0.43	44	6.32	48	6.90
11	3.31	0	0.00	0	0.00	4	0.60	51	7.70	55	8.31
10	0.74	0	0.00	0	0.00	0	0.00	2	1.35	2	1.35
9	2.49	0	0.00	0	0.00	2	0.40	124	24.90	126	25.30
8	1.98	0	0.00	0	0.00	19	4.80	222	56.06	241	60.86
7	2.51	0	0.00	0	0.00	2	0.40	50	9.96	52	10.36
6	0.96	0	0.00	0	0.00	0	0.00	14	7.29	14	7.29
5	2.49	0	0.00	0	0.00	3	0.60	180	36.14	183	36.75
4	2.86	0	0.00	0	0.00	0	0.00	177	30.94	177	30.94
3	2.92	0	0.00	0	0.00	0	0.00	491	84.08	491	84.08
2	2.63	0	0.00	0	0.00	22	4.18	127	24.14	149	28.33
Total	**36.85**	**5**	**0.07**	**1**	**0.01**	**61**	**0.83**	**1583**	**21.48**	**1650**	**22.39**

*Abundance index (No.of rainbow trout per km per floater) = Count for section/(section length (km) x floater equivalent). Floater equivalent = 2.0 (Burrows and Neuman, 1995).

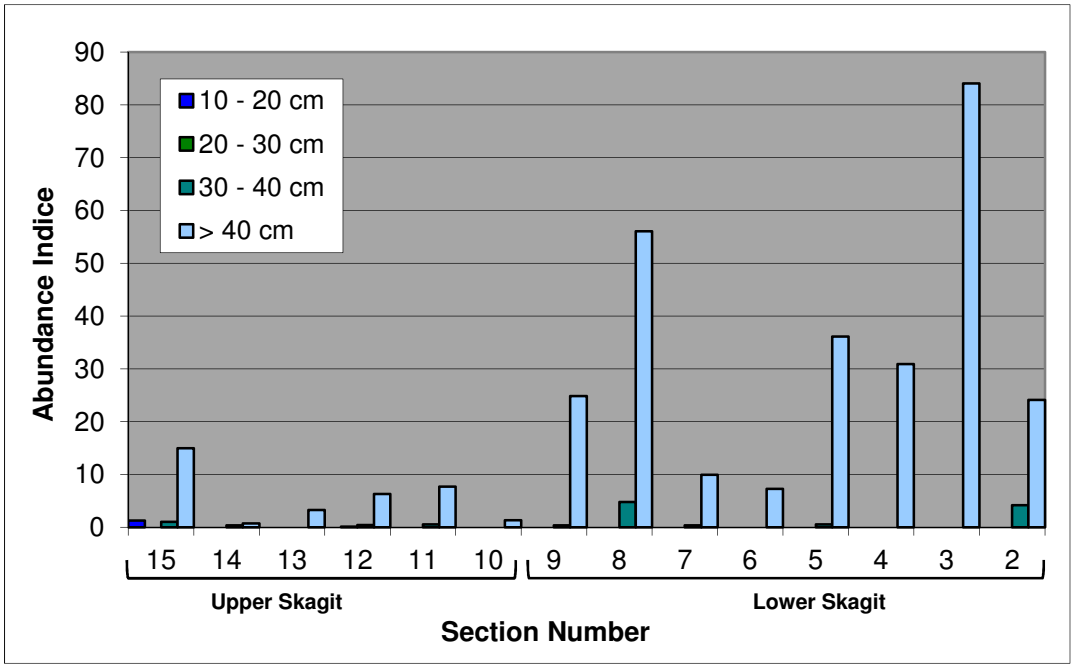


Figure 6: Abundance indices by section for char counted in the Canadian Skagit River, September, 2010. Refer to Table 5 for actual numbers of fish used to generate abundance indices.

3.3.3 Comparison of rainbow trout and char abundance indices

The following figure illustrates the abundance indices of both rainbow trout and char for comparative purposes. Rainbow trout were found in higher abundance than char in the upper Skagit. Whereas, in the lower Skagit River the abundance of char was equal to or greater than rainbow trout in all but three sections (Sections 7, 6 and 2).

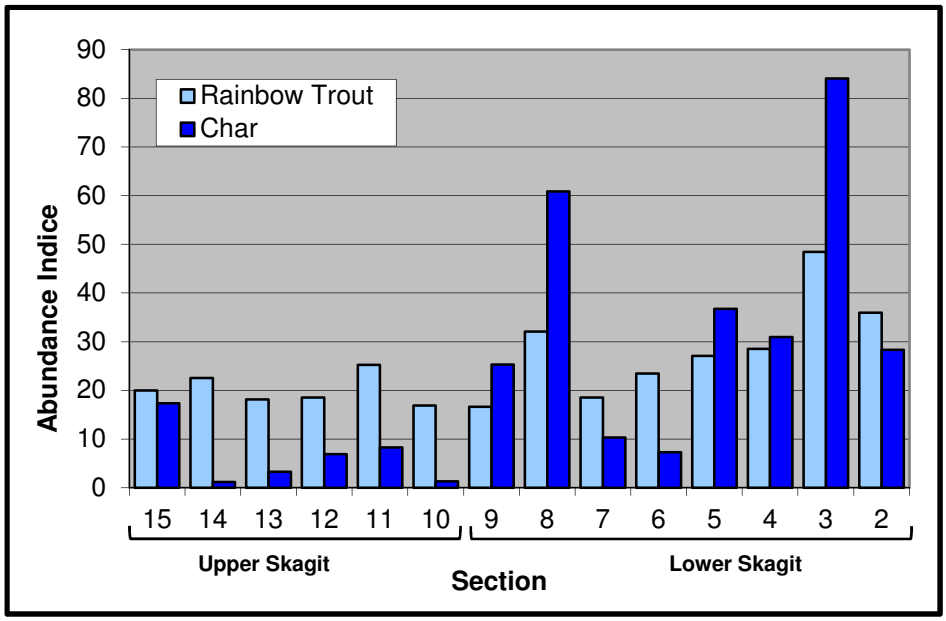


Figure 7: Abundance indices by section for rainbow trout and char counted in the Canadian Skagit River, September, 2010.

3.4 Catchable versus non-catchable fish

To illustrate the availability of catchable fish, the 2010 observed rainbow trout population was grouped into non-catchable (< 20 cm in length) versus catchable (> 20 cm in length), consistent with Burrows and Neuman (1995).

Previous studies have not included analysis of the availability of non-catchable and non-catchable char, due to low numbers of char observed. However, as the 2009 and 2010 surveys observed a substantial increase in the number of char an analysis of the number of catchable versus non-catchable has been completed.

3.4.1 Rainbow trout

The majority of non-catchable rainbow trout were found in the upper two sections (Section 15 and 14); middle two sections (Sections 8 and 7) and last two sections (Sections 3 and 2). While catchable rainbow trout were more evenly distributed than non-catchable, the highest abundances of catchable rainbow trout were found in Sections 11, 8 and 3, and the lowest abundances of catchable rainbow trout were found in Sections 15 and 14 (Figure 6).

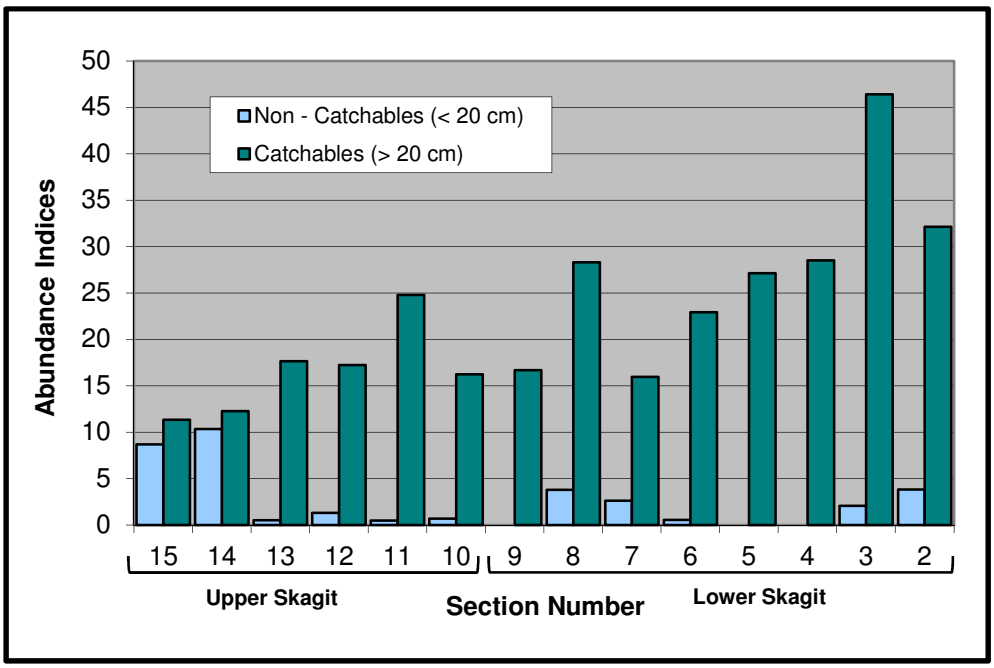


Figure 8: Abundance indices by section for catchable versus non-catchable rainbow trout counted in the Canadian Skagit River, September, 2010.

3.4.2 Char

Of the char observed during the 2010 snorkel survey 99.7 % were > 20 cm in length and considered catchable. Only 5 non-catchable char were observed.

4.0 DISCUSSION

The discussion of results for the 2010 snorkel survey is limited since only one other survey has been completed in the past decade (2009). Since no current data trend exists, inferences drawn from the comparison of the 2009 and 2010 results to earlier studies would be speculation based on only two year's data (i.e. snapshot in time). Following the 2011 snorkel survey, the three years' results will be analyzed and discussed in depth in a final report. This report will also compare these results with findings from past snorkel surveys.

Of interest, sizes of rainbow trout observed in the 2010 snorkel survey were similar to those sampled in the biological and snorkel survey components of the 2009 fish stock assessment study. Of the rainbow trout observed in the 2010 survey 91 % were > 20 cm in length. During the 2009 snorkel survey 87 % of rainbow trout observed were > 20 cm in length, while 98 % of the rainbow trout sampled during the biological portion of the study were > 20 cm in length (Anaka et al. 2010a, and Anaka et al. 2010b).

During the 2009 snorkel survey a greater number of char were observed compared to the 1998 survey. The 2010 survey observed an even greater number of char than that of 2009 and 1998 combined. In 1998, 186 char were observed during the snorkel survey, whereas 957 char were observed during the 2009 snorkel survey, five times greater than the number of char observed in 1998. In the 2010 survey 1650 char were observed, almost 9 times greater than the number observed in 1998 and a 70 % increase from the number of char observed in 2009.

It will be very important to complete the planned three years of snorkel surveys to confirm that the large number of char observed in 2009 and 2010 was not an anomaly. In addition, it would be very valuable to collect char biological data (age class distribution) to assess the characteristics and the stability of the char population. Ideally, this work would be done in conjunction with additional stock assessment surveys and span the lifecycle of a Skagit River/Ross Lake Reservoir char (approximately 7 years). Recommendations for further work will be detailed in the 2011 final report.

5.0 REFERENCES CITED

Anaka, R.J., D. Neufeld and K.J. Scott. 2010a. Biological sampling of rainbow trout in the Canadian Skagit River, 2009. Prepared for Skagit Environmental Endowment Commission, by Scott Resource Services Inc.

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Harper, V.L. and K.J. Scott. 1998a. Snorkel Survey of Trout and Char in the Canadian Skagit River, September, 1998. Prepared for B.C. Ministry of Environment, Lands and Parks by Scott Resource Services Inc., Regional Fish. Rep. No. LM 372.2, 14 p.

Appendix 1: Sample Field Data Sheet, 2010 Snorkel Survey

Duplicate

Skagit River Float Count 2009 / Section 15

10-20	20-30	30-40	40+
Start time: 10:36	09/08/31 RA/JS/DN	Section 15, Symalloo → Silverdaisy	
IIII IIII III	IIII IIII IIII IIII III	IIII IIII IIII III	1C 2C 1C 1R 3C 1R
Start 12:10 09/08/31 RA/JS/DN		Section 14 Silver Daisy → Delacy	
IIII IIII IIII IIII I	IIII IIII IIII IIII IIII	IIII IIII IIII IIII	1C 1C 2C 4C
Side Channel Missed	IIII	I	
2:45 09/08/31	RA, JS, DN	Section 13 Delacy →	28 Mile Creek
II	IIII IIII	IIII IIII IIII IIII	7C 1C 5C 2R
12:00 09/10/01	RA JS DN	Section 13 Delacy →	28 Mile Creek
IIII IIII I	IIII IIII IIII IIII IIII	2C IIII IIII IIII IIII	17C 4C 1C 5C 2C 4C
10 w/10	IIII IIII IIII IIII IIII	IIII IIII IIII 3C 2C 1C	7C 1C 1R 30C 1C
	IIII IIII	IIII IIII IIII IIII	2R 6C
		7C IIII IIII IIII IIII 2C	
3:20 09/09/01	RA, JS, DN Section	12 28 Mile Creek →	Silvertip Creek
(1<10) IIII IIII II	IIII IIII IIII IIII 2C	IIII IIII IIII IIII	13C 40C 1C
	IIII IIII IIII IIII	1C IIII IIII 15C 1	
Start at 4:40 09/09/01	RA, DN, JS	Silvertip Creek to 26 Mile Bridge Section 11	
-Side channel below	ST Creek LJ high sediment load. Poor visibility		
at confluence	and below.		
	III	II	

Sheet 1 of 1