

Clowhom Project Water Use Plan

Fish Productivity Monitoring

Implementation Year 4

Reference: COMMON-2

Fish Productivity Monitoring Year 4 Data Summary 2010

Study Period: September 16 to October 6, 2010

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Executive Summary

The Clowhom Lake Fish productivity monitoring study was developed and initiated in 2006 to assess and track changes in fish productivity. Recently, it has been speculated that fish productivity had decreased following the impoundment of Clowhom Lake in 1956. This decrease may be a result of loss in productive littoral habitat, but little data exists to support this hypothesis. As a result a 20-year monitoring plan designed to track change in fish productivity through sampling of rearing populations was developed and implemented in 2006 with sampling to occur every 2 years throughout the 20-year study.

In the fall of 2010, the third sampling period was completed. The upper and lower basins were again netted using both sinking and floating nets and a drift net. The shoreline was also trapped using baited minnow traps. All captured fish were identified, enumerated, measured and scales collected for aging. Data was recorded and filed for comparison to future years.

Results of the 2010 sampling revealed 3 salmonid species and 2 non-salmonids utilizing the lake. The salmonid samples included Rainbow and Cutthroat trout and Kokanee salmon. The rainbow sample included 5 age classes (1+, 2+, 3+, 4+ and 5+) and the cutthroat trout sample yielded 2 age classes (3+ and 4+). Two age classes (1+ and 2+) of Kokanee salmon were also caught. In addition to the salmonids, sticklebacks and prickly sculpin were caught along the shoreline using minnow traps. The total catch in 2010 was 29 salmonids.

In addition to the sampling of fish a swim survey of the lower reach of the Clowhom River was completed on October 6, 2010. This swim focused on documenting use of habitats by salmonids. There was only one salmonid observed during the swim and its identity was not confirmed.

The 2010 sampling data provides the third year of this multi year project and the year for the compilation of the first 5-year summary report. As data continues to be collected it will be reviewed against preceding years and the summary analysis reports. All comparisons will be within the context of measureable changes in population status and health.

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1.0 Introduction

In 2006, the Sechelt First Nation and BC Hydro began the first year of a 20-year monitoring program documenting fish productivity in the Clowhom Lake reservoir. The monitoring program was implemented following recommendations made during the water use planning (WUP) process. In an earlier study by *Bruce* (2004) a decrease in reservoir productivity was reported following the impoundment and creation of Clowhom Lake in 1956. As a result of the earlier results, BC Hydro developed the fish productivity-monitoring program, addressing concerns and bottlenecks to production.

The monitoring program addresses specific management questions that include:

- Does fish productivity change through time following the WUP implementation?
- Is any observed change correlated with changes in effective littoral zone changes?
- Is the population of salmonids in Clowhom lake recruitment limited and what role does the river play?
- If no change is observed what is the reason for the decline initially?
- Do operation based solutions exist for the reservoir that would benefit fish productivity?

The purpose of this report is to present data collected in the third sample year that was completed in the fall of 2010.

2.0 Study Area

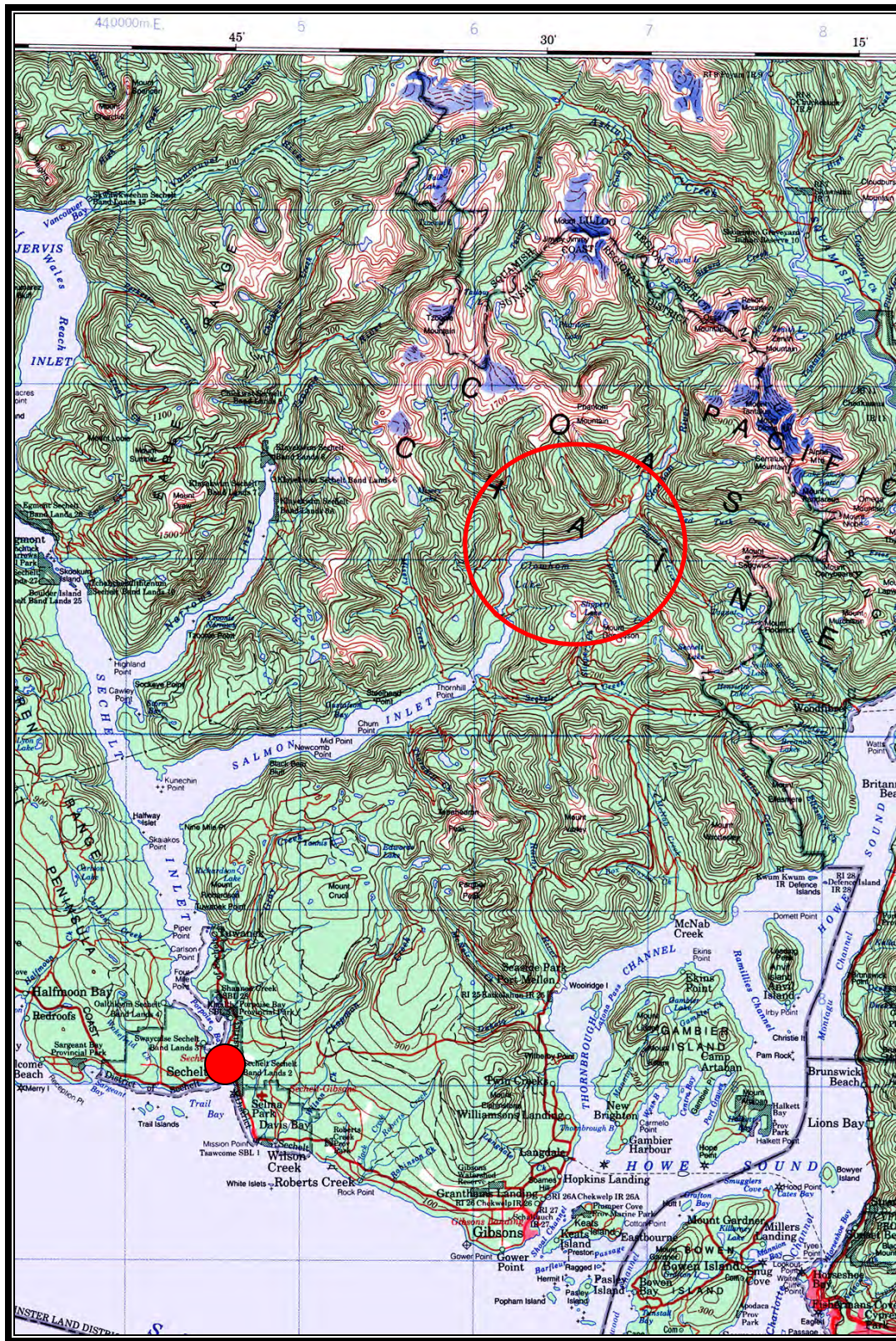
The Clowhom Lake reservoir, measuring approximately 745-ha, is located at the head of Salmon Inlet northeast of Sechelt BC. The study area for this project includes the entire lake and 9 pre-selected sampling sites. The selected sites correspond to locations reported by *Bruce* (2004) and *Bates* (2006, 2008) representing both the upper and lower portion of the reservoir. **Figure 1** shows the location of Clowhom Lake in relation to Sechelt BC.

3.0 Methods

3.1 Fish Collection

A two-person crew completed the fish sampling process between September 16 and 17, 2010. Fish collection was made using gill nets and baited Gee® minnow traps. Gill net configuration was consistent with mesh sizes recommended for BC lake inventories (*RIC*, 1998) and *Bruce* (2004).

As in past years, a total of three net strategies were employed; floating, sinking and drift sets. The floating and sinking sets were anchored near shore and oriented perpendicular to the shoreline. The drift net set was released perpendicular to the lake and mid-line, then allowed to move with the wind and lake currents(s). Gill net sample periods were ranged between 2 to 4-hours depending on ease of retrieval.



All captured salmonids retained for detailed biometric data collection.

In addition to the gill net sets, baited Gee® minnow traps were used to sample habitat near the lake shoreline. These traps were fished in groups of 5, baited with salmon roe that was housed in perforated containers, preventing consumption by the captured fish. All traps were set at mid-day and allowed to fish for approximately 24-hours.

The locations of sample sites were approximately the same as sites sampled in 2006 and 2008 using UTM coordinates determined with a Garmin GPSMap 60CSx handheld receiver. Sample locations are illustrated in **Figure 2**. **Table I** provides the spatial reference points and the gear and soak times for each location.

Table I: Type and set times for the sampling gear used to collect fish samples in the Clowhom Lake Reservoir.

Date	Site ID	UTM		Gear	Set Time			Duration (hr.)
		Northing	Easting		Type	Deployed	Retrieved	
Sept 16	A	5508579	461286	Float GN	Day	9:18	13:10	3:56
	B	5509613	461887	Sink GN	Day	9:40	13:26	3:46
Sept 17	C	5509915	461774	MT	Night	10:00	9:55	23:55
	D	5510722	462958	MT	Night	10:21	10:17	23:56
Sept 17	E	5510961	464552	Float GN	Day	11:08	13:00	1:52
	F	5511065	467434	Sink GN	Day	10:22	14:12	3:50
Sept 17	G	5510897	467399	MT	Night	10:47	10:15	23:28
	H	5512518	467991	MT	Night	11:08	12:02	24:56
Sept 17	I	-	-	Drift GN	Day	11:25	13:55	2:30

Note: GN = gillnet and MT minnow traps (5)

3.2 Fish Biometrics

All captured were enumerated and recorded by collection method. Captured salmonids were identified to species, and the fork length to the nearest millimeter (mm) and wet weight nearest 0.1 gms were measured (Bates, 2008; 2006). Scale samples were collected from representative size ranges of each species following standard scale collection methodology and placed on glass microscope slides. The scales were then compressed with another slide, labeled and stored for future reading. Live fish (those in the Gee traps), were also identified and enumerated then released unharmed. All dead fish collected in gill nets were retained and returned to the lab.

Dead fish (gill net captures) were dissected and the sex identified based on presence of gonads. The stomachs of each fish was also removed and opened for examination and the contents reported.

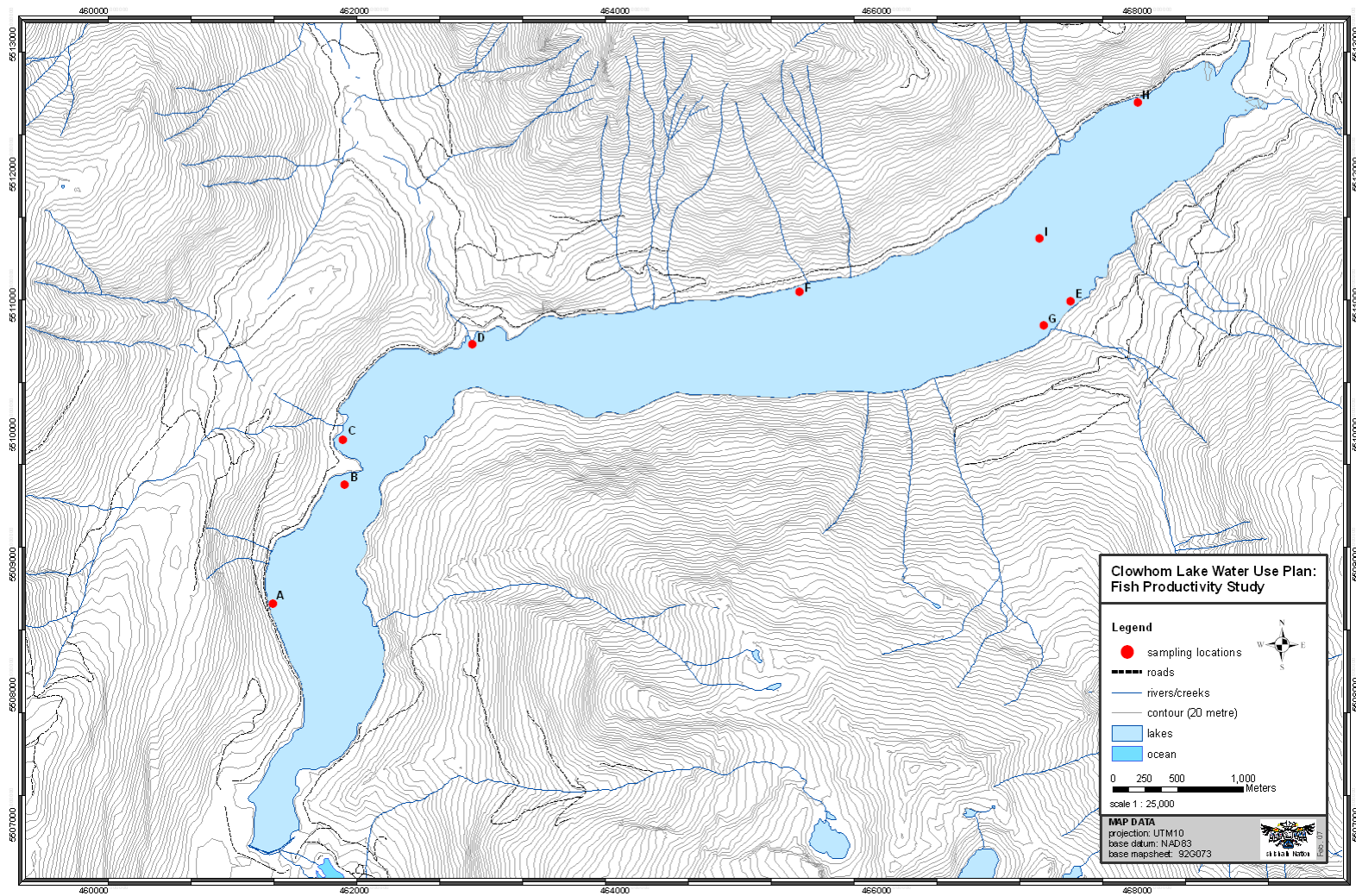


Figure 2: Sample locations selected for the gill net and minnow trapping of fish within Clowhom Lake. Each location is identified along the shoreline with flagging tape (*Bates, 2006*).

3.3 Scale Analysis

Scales from all salmonids captured were returned to the lab for reading. Each scale was reviewed under a compound dissecting microscope and a smear selected for clarity. The representative scale(s) is then photographed using a digital camera mounted on the dissecting microscope and the image stored as a JPEG file. The image was read on a desktop computer. The digital images of the scales are attached in Appendix I.

The scale analysis was completed in a similar iterative fashion reported by *Bruce* (2004) and *Bates* (2006 and 2008). The age is reported using the convention n+ values where the '+' denotes a partial year.

3.4 Fish Data Analysis

All captured fish were reported by catch type and will be used to compare catch-per-unit effort in the first 5-year summary report. Biometric data is summarized by captured species with the age class and the condition coefficient (CC) for each species calculated using:

$$\text{Condition Coefficient (CC)} = \text{wet weight (gms)} \times \text{length (cm)}^{-3} \times 100$$

3.5 Lower Clowhom River Salmonid Population Survey

Clowhom Lake supports salmonids that require accessible stream habitat to spawn. The Clowhom River enters the lake at the north end and is characterized by a low gradient reach. On October 6, 2010, a swim survey was conducted using two crewmembers swimming parallel lanes through the length of Clowhom River from the 17-km bridge to the wetland, an approximate 750-m length.

The 2-man team swam side by side within their designated lane. The purpose was to note any salmonids holding in the length of stream from downstream of the bridge to the lake. Ideally the team would detect any Kokanee that may have moved into the lake. All observed salmonids were noted along with the time spent during the swim. If possible the species would also be reported.

4.0 Results/Discussion

4.1 Fish Capture

A total of 119 fish were caught during the sampling period. The total catch was comprised of 3 species of salmonids (24.4%) and 2 non-salmonid species (75.6%) (**Table II**) with the gill nets accounting for 23.5% of the total catch and the minnow traps the balance. All non-salmonid species were caught along the shoreline in minnow traps.

Table II: Species captured in Clowhom Lake sampling, September 16 and 17, 2010.

Salmonids		Non-salmonids	
Common Name	Scientific Name	Common Name	Scientific Name
Cutthroat Trout (CCT)	<i>Oncorhynchus clarki</i>	Prickly sculpin (CAS)	<i>Cottus asper</i>
Rainbow Trout (RB)	<i>O. mykiss</i>	Three-spine stickleback (TSB)	<i>Gasterosteus spp.</i>
Kokanee (KO)	<i>O. nerka</i>		

The total catch was also separated by capture method and the catch reported by sample location (**Table III**). All dead fish caught in the gill nets were retained for dissection.

Table III: Summary of catch by gear type and sample location in Clowhom Lake between September 16 and 17, 2010.

Site	Gear Type	Species	Number
A	Floating GN	Rainbow Trout	11
B	Sinking GN	Cutthroat Trout	3
C	MT	Prickly Sculpin	13
C	MT	Stickleback	14
D	MT	Prickly Sculpin	3
D	MT	Stickleback	24
E	Floating GN	Rainbow Trout	9
E	Floating GN	Kokanee	3
F	Sinking GN	Cutthroat Trout	2
G	MT	Rainbow Trout	1
G	MT	Stickleback	8
H	MT	Prickly Sculpin	2
H	MT	Stickleback	26
I	Drift GN	Kokanee	1

4.2 Fish Biometrics

Nose to fork length and wet weight data were compiled and applied to the appropriate age classes determined from age classes determined in 2006 and 2008. The largest species caught was the cutthroat trout in the sinking gill nets. **Table IV, V and VI** summarize the length-at-age, weight and condition coefficient data for the three species of salmonids captured in 2010. **Figure 3** shows the weight versus length relationship for each salmonid species caught with previous years length and weight data also included. The total sample size in 2010 was 29. This compared to a capture of 23 in 2008 and 19 in 2006. Generally an increase in capture that may be a reflection of the increased soak times used in 2010. It should also be noted that in 2010 the reservoir was drawn down for emergency repairs. This may have resulted in easier capture of salmonids if the fish were congregated at higher densities at the sample sites.

In **Figure 4** the catch per unit effort is shown for each of the years; 2006, 2008 and 2010. These CPUE are broken into the net locations where 1=A, 2=B, 3=E, 4=F and 5=I.

In total only 11 fish were retained for dissection. These fish were examined for gonadal development and sexed accordingly. The stomachs from each was then removed and dissected further. Food items in the stomachs, if present, were identified to broad categories and recorded for future reference.

Table IV: Summary of length-at-age data for the salmonids caught in Clowhom Lake between September 16 and 17, 2010.

Age	Species specific fork length (mm)					
	Rainbow Trout		Cutthroat Trout		Kokanee	
	n	Mean(SD)	n	Mean(SD)	n	Mean(SD)
0+	0	-	0	-	0	-
1+	3	108.3(4.04)	0	-	2	172.5(17.68)
2+	7	150.6(10.83)	0	-	2	195.0(7.07)
3+	6	190.8(13.98)	3	261.0(9.54)	0	-
4+	3	260.0(17.32)	2	306.0(1.41)	0	-
5+	1	300.0	0	-	0	-

Table V: Summary of wet weight data for the salmonids caught in Clowhom Lake between September 16 and 17, 2010.

Age	Species specific wet weight (gms)					
	Rainbow Trout		Cutthroat Trout		Kokanee	
	n	Mean(SD)	n	Mean(SD)	n	Mean(SD)
0+	0	-	0	-	0	-
1+	3	14.43(0.50)	0	-	2	56.30(14.85)
2+	7	39.16(7.80)	0	-	2	89.05(14.78)
3+	6	76.1(14.02)	3	180.0(6.59)	0	-
4+	3	182.9(19.55)	2	270.7(32.53)	0	-
5+	1	268.9	0	-	0	-

Table VI: Summary of condition coefficients for the salmonids caught in Clowhom Lake between September 16 and 17, 2010.

Age	Species specific condition coefficient					
	Rainbow Trout		Cutthroat Trout		Kokanee	
	n	Mean(SD)	n	Mean(SD)	N	Mean(SD)
0+	0	-	0	-	0	-
1+	3	1.14(0.11)	0	-	2	1.09(0.04)
2+	7	1.13(0.05)	0	-	2	1.20(0.06)
3+	6	1.09(0.05)	3	1.00(0.08)	0	-
4+	3	1.04(0.10)	2	0.95(0.11)	0	-
5+	1	1.00	0	-	0	-

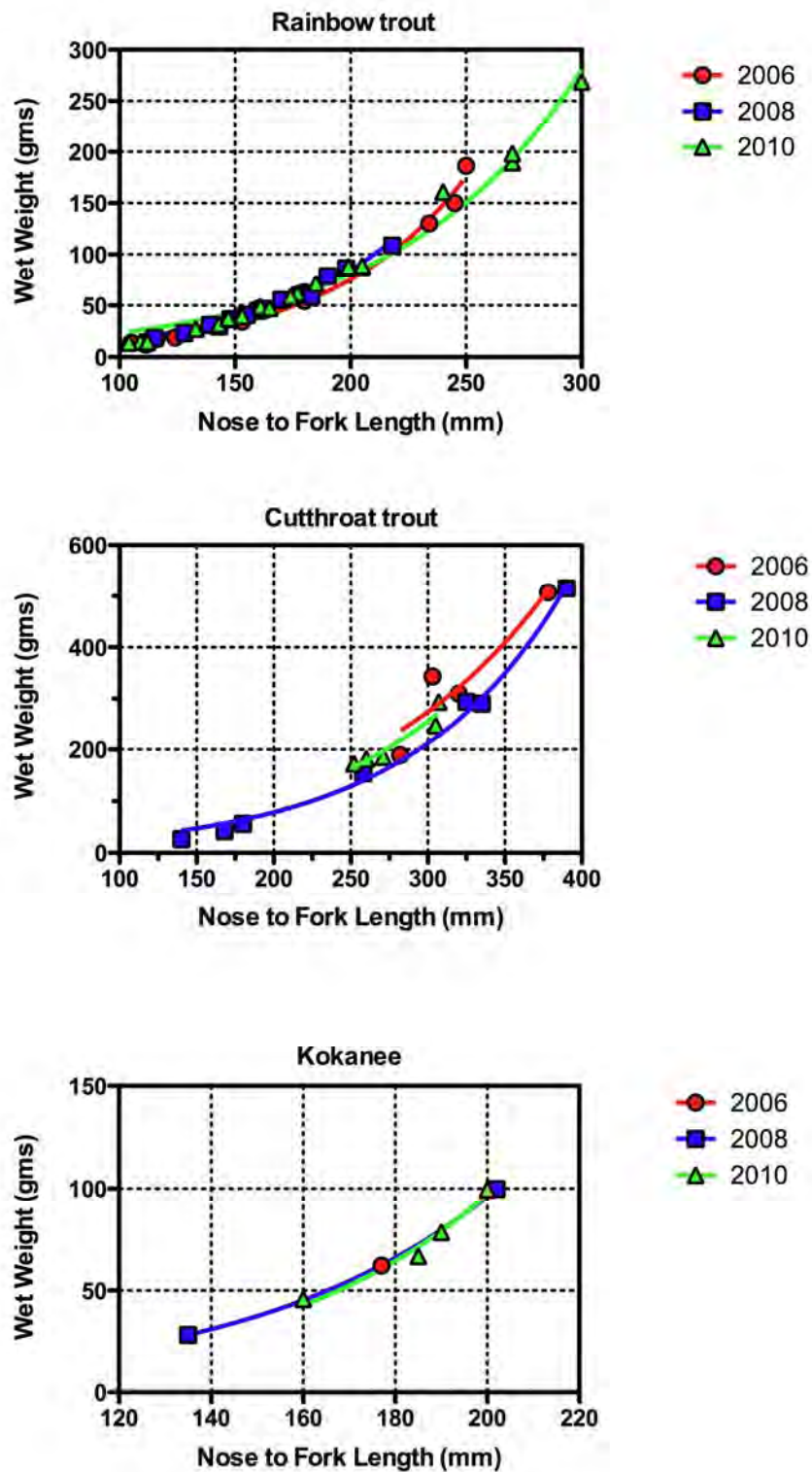


Figure 3: Length versus weight relationships for salmonids captured in Clowhom Lake reservoir between September 16 and 17, 2010.

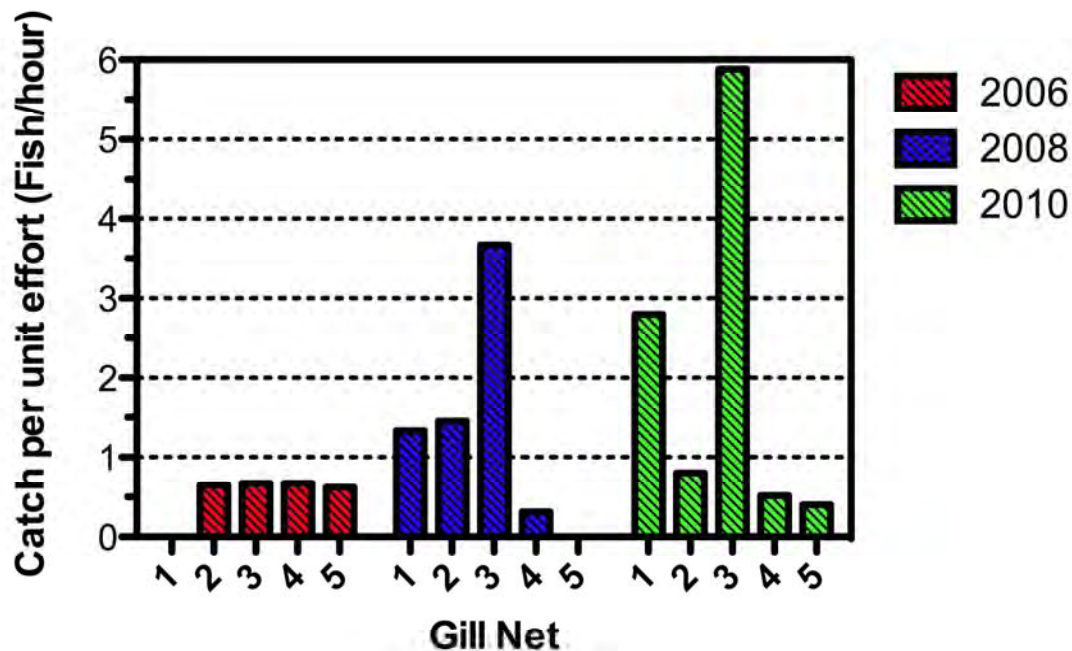


Figure 4: Gill net catch per unit effort (CPUE) in each year of Clowhom Lake sampling.

4.3 Scale Analysis

Scales collected from salmonids caught in the gill nets were photographed and archived as digital images. These are included in Appendix I and will be reviewed with scale images from previous years (2006 and 2008). While the age structure is not expected to change, the small sample sizes, combined from each sample year allow the development of a more reliable age class structure by species.

4.4 Stomach Analysis

In 2010 the stomachs from each dead salmonid caught in the gill nets was removed and examined. The larger cutthroat trout all had Three spine Stickleback in their stomachs. The Kokanee examined did not have any identifiable foodstuffs while the smaller trout, including the rainbow appeared to be feeding on terrestrial life stages including ants and dipterans.

4.3 Lower Clowhom River Salmonid Population Survey

On October 6, 2010 a two-person crew swam a 700-m length of Clowhom River below the 17-km bridge toward the wetland located at the northeast end of the lake. The swim

was divided into 3 sections and each diver drifted through a lane repeating the drift 3 times. There was only one salmonid observed during this effort. As previously reported this length of stream provides little suitable rearing habitat but good spawning near the bridge. It was concluded that the area does not provide significant rearing opportunities and is likely avoided because of the lack of suitable cover.

5.0 Conclusion

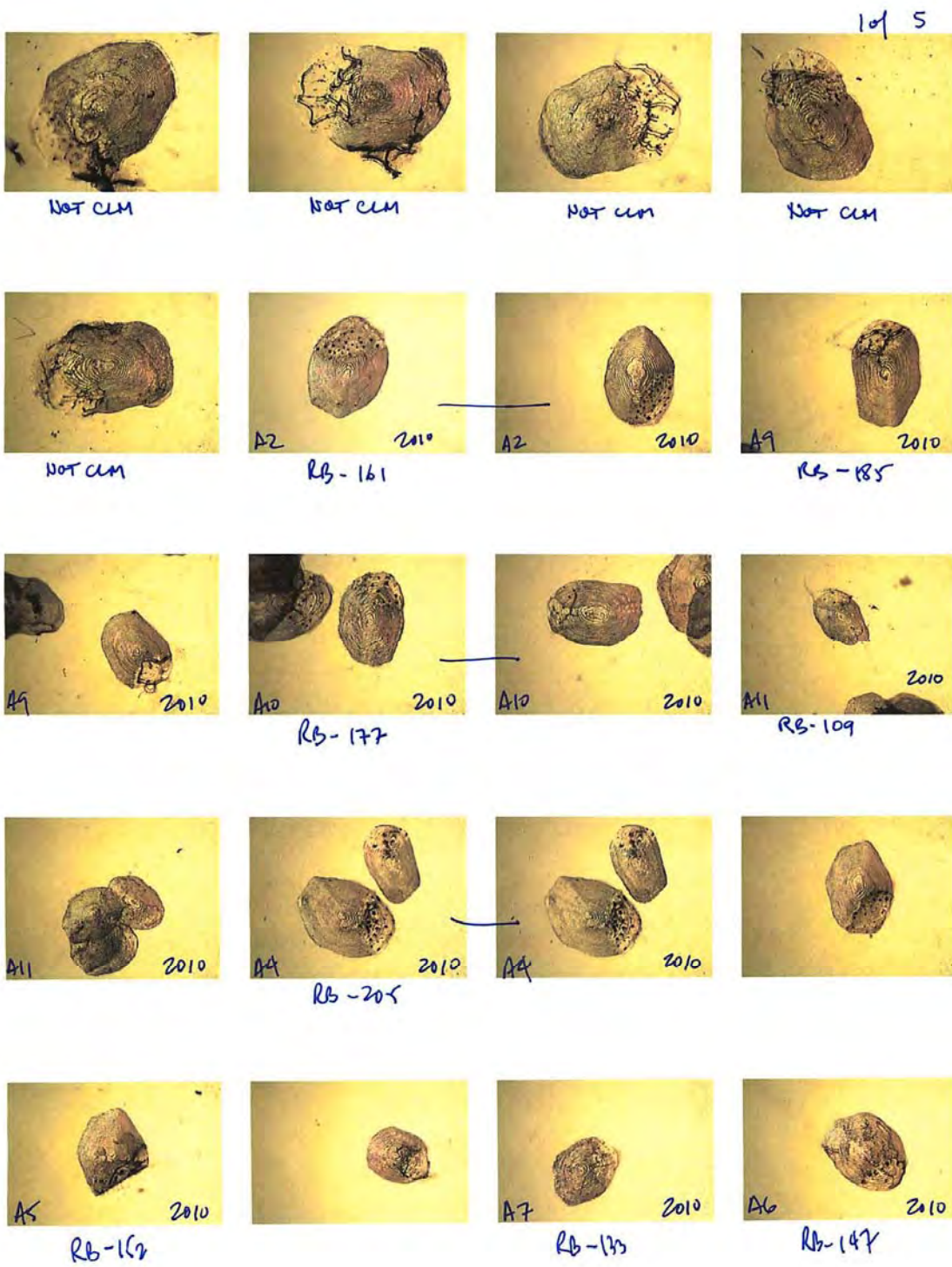
The completion of the third season of salmonid sampling marks the end of the first 5-year rotation defined under the terms of Reference for this project. As a result the data collected in 2006, 2008 and 2010 will be summarized and presented in a summary document. The delivery for this data analysis report is July 15, 2011.

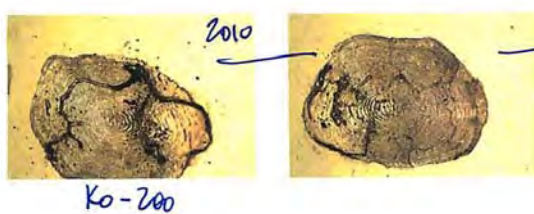
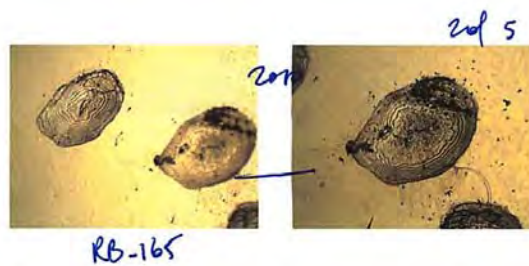
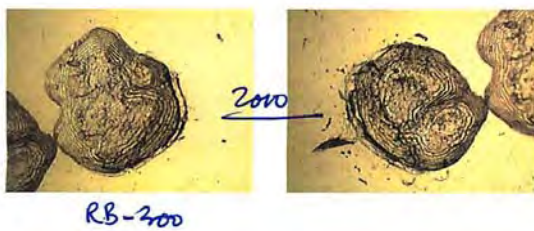
6.0 References

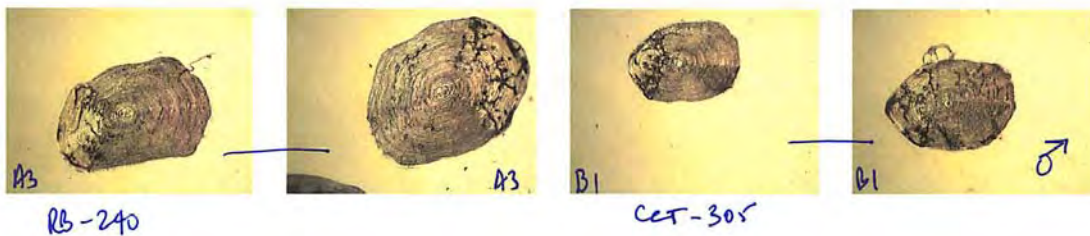
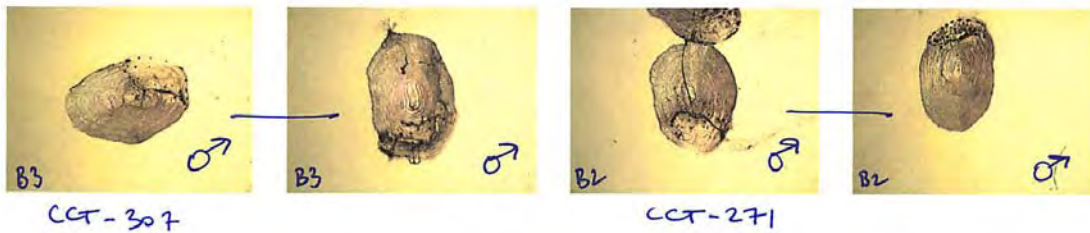
- Resource Inventory Committee (1998) Reconnaissance Fish and habitat inventory: Standards and procedures. BC Ministry of Fisheries, Victoria, BC.
- Bates, D.J. 2008. Clowhom Lake Water Use Plan. Fish Productivity Monitoring – Year 2. Shíshálh Nation and FSCI Biological Consultant.
- Bates, D.J. 2006. Clowhom Lake Water Use Plan. Fish Productivity Monitoring – Year 1. Shíshálh Nation and FSCI Biological Consultant.
- Bruce, James, 2004. Results of fish studies – Clowhom Lake Water Use Plan. BC Hydro Technical Note Com-FTC-TN-001. Burnaby, BC.
- Johnston, N.T. and Slaney, P.A. 1996. Fish habitat assessment procedures. Watershed Restoration Technical Circular No. 8. B.C. Ministry of Environment, Lands and Parks and Ministry of Forests, Victoria, B.C.

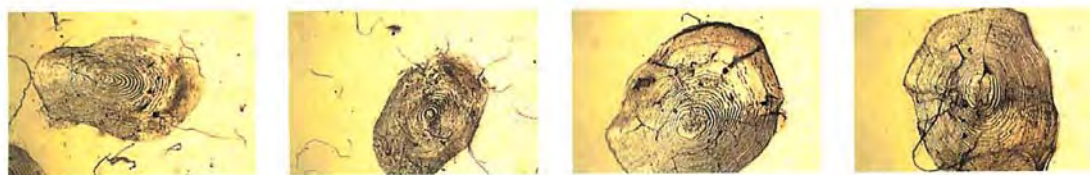
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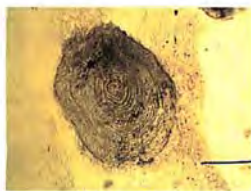
Appendix I: Digital images of the scales collected from select salmonids caught in gill nets during the 2010 sample season. The age information is used to designate captured fish to suitable age classes.











KO-135mm



KO



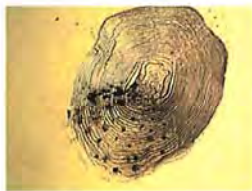
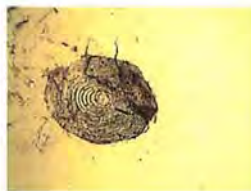
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CCT-325



2010



CCT-336mm



2010