

Quamichan Lake Stocking Assessment, 2004

**Region 1, Nanaimo
Nanaimo/Cowichan Planning Unit**

Prepared by:

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1.0 Introduction

1.1 Objective

Quamichan Lake, in the Nanaimo/Cowichan planning unit, was assessed in the fall of 2004 as part of a stocking evaluation of Vancouver Island lakes. These assessments were carried out with the purpose of determining the overall effectiveness of past stocking efforts and/or to determine future actions in the lake stocking program.

The Quamichan Lake assessment will focus on:

- effectiveness of the current stocking plan in providing adequate numbers of trout of suitable size to sustain the fishery
- current level of natural recruitment of trout in the lake
- condition factor, size at age and age structure of the trout population in the lake
- presence and relative abundance of other fish species
- future considerations for the Quamichan Lake fish stocking and management program

1.2 Background

Quamichan Lake was previously assessed by provincial fisheries staff in 1951, 1972 and 1994. The lake is located approximately 2.5 km northeast of Duncan and lies in the Coastal Douglas Fir Biogeoclimatic Zone, within the South Island Forest District. The lake is situated at an elevation of 26 m in Management Zone 1-04. The surface area is 313 ha and the perimeter is 8.348 km. The lake has a maximum depth of 9.1 m. Cutthroat trout and rainbow trout have been stocked in the lake between 1917 and 2004. The entire stocking record can be seen in Appendix A. Table 1 lists the last 2 years of stocking data.

Table 1. Stocking history of Quamichan Lake over the last 2 years.

Year	Species (Stock)	Number	Stage	Size (g)	Clip
2003/03/05	Cutthroat Trout (Taylor)	80	Adult	850.98	---
2003/03/14	Cutthroat Trout (Taylor)	141	Adult	839.77	---
2003/04/08	Cutthroat Trout (Taylor)	68	Adult	839.78	---
2003/05/09	Cutthroat Trout (Taylor)	3863	Yearling	46.73	---
2003/05/13	Cutthroat Trout (Taylor)	286	Adult	359.84	---
2003/05/13	Cutthroat Trout (Taylor)	40	Adult	1000	Adipose
2003/05/13	Cutthroat Trout (Taylor)	20	Adult	839.75	---
2003/10/03	Cutthroat Trout (Taylor)	2018	Fingerling	14.02	---
2004/05/04	Cutthroat Trout (Taylor)	281	Adult	305.4	---
2004/05/13	Cutthroat Trout (Taylor)	1022	Yearling	39.53	---
2004/05/13	Cutthroat Trout (Taylor 3N)	660	Yearling	44.7	Adipose
2004/05/13	Cutthroat Trout (Taylor)	250	Yearling	53.2	Right Maxillary

2.0 Methods and Materials

Quamichan Lake was one of 45 lakes selected in Vancouver Island Region for assessment of the current lake stocking plan, in a 3-year project funded by the Freshwater Fisheries Society of BC, through the Small Lakes Management and Conservation Initiative.

Fish were sampled in the fall of 2004. At that time water transparency, temperature and oxygen data were collected. The 1981 assessment report included reconnaissance information, so that was not repeated in this assessment.

A previously constructed bathymetric map was used to locate the deepest part of the lake as well as select locations to set the floating and sinking gill nets (Figure 1). Depth measurements were obtained using a Lowrance X-65 sounder. The temperature-oxygen profile and Secchi depth readings were taken near the deepest part of the lake (survey site, Figure 1, Appendix B). The temperature-oxygen profile was obtained using a model 51B YSI meter with a 30 m long cable on the sensor.

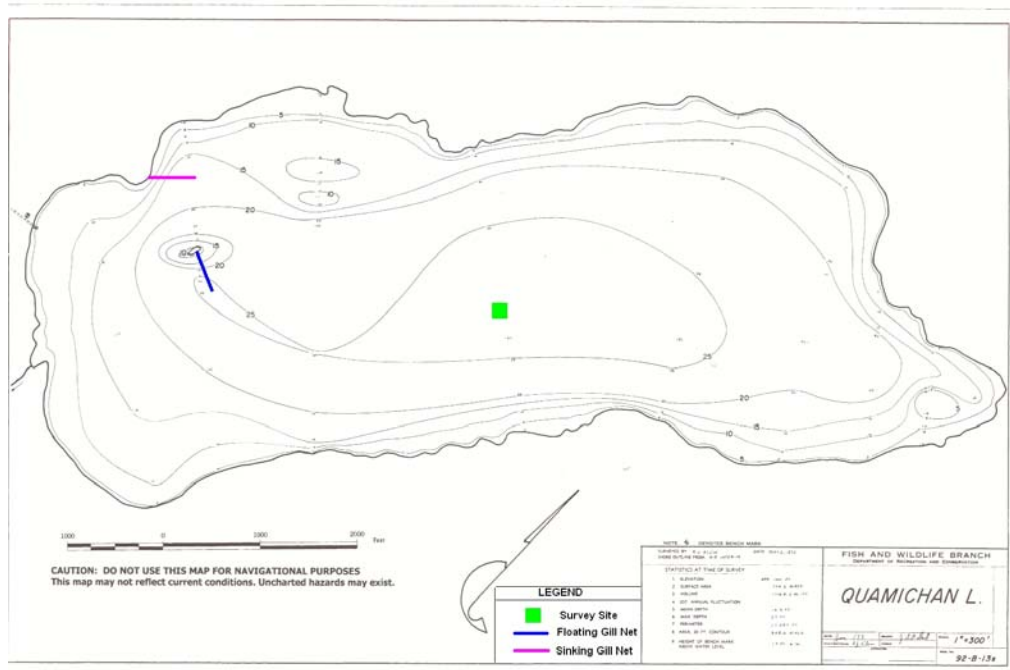


Figure 1. A bathymetric map of Quamichan Lake showing the survey site location and the positions of the floating and sinking gill nets.

Fish sampling was done with overnight gillnet sets of one floating and one sinking, standard experimental gang nets. The nets were each 91.2 m long, 2.4 m deep and consisted of six, 15.2 m long panels of different mesh sizes (25, 76, 51, 89, 38 and 64 mm stretch mesh). The floating gill net was set to cover shoal areas and extend over open water. The sinking gill net was set where it would extend into a deeper part of the lake (Figure 1). The nets were set with the smallest mesh-size panel near shore and extended roughly perpendicular to the contours. Both nets were set late in the day, left overnight,

and were retrieved the following morning. A summary of the gillnet sets is given in Appendix C.

Data recorded from the gillnet catch included length (cm), weight (g), sex, stage of gonad maturity, stomach contents and parasite presence, for all trout captured. The catch record is listed in Appendix D, and photographs of the catch are in Appendix E.

Scales were sampled from all trout. Scales were removed from the area between the posterior edge of the dorsal fin and the lateral line, approximately 2 scale rows above the lateral and placed between labelled glass microscope slides. A contractor, Bob Hamaguchi, read the scales to determine age. Printed copies of each scale sample, with contractor's determination of annuli indicated, are presented in Appendix F.

Condition factor, length-age, and length-weight relationships were calculated separately for each species of trout. Condition factor was calculated using the following equation:

$$K = \frac{100000W}{L^3}$$

where W represents weight in grams and L represents length in millimetres.

3.0 Results

3.1 Temperature-Oxygen Profile

Quamichan Lake has a maximum depth of 9.1 m. The temperature-oxygen profile shows the entire water column is well mixed, with no thermocline present at the time of survey (Figure 2). Temperature values were uniform at 12.5°C from the surface, to 8 m. Oxygen levels were at or near saturation above 7 meters, but dropped rapidly to near anoxic conditions at 8 m. Oxygen levels ranged from 8.0 mg/L, at the surface, to 7.2 mg/L at 7 m. At 8 m, oxygen levels dropped to 1.8 mg/L.

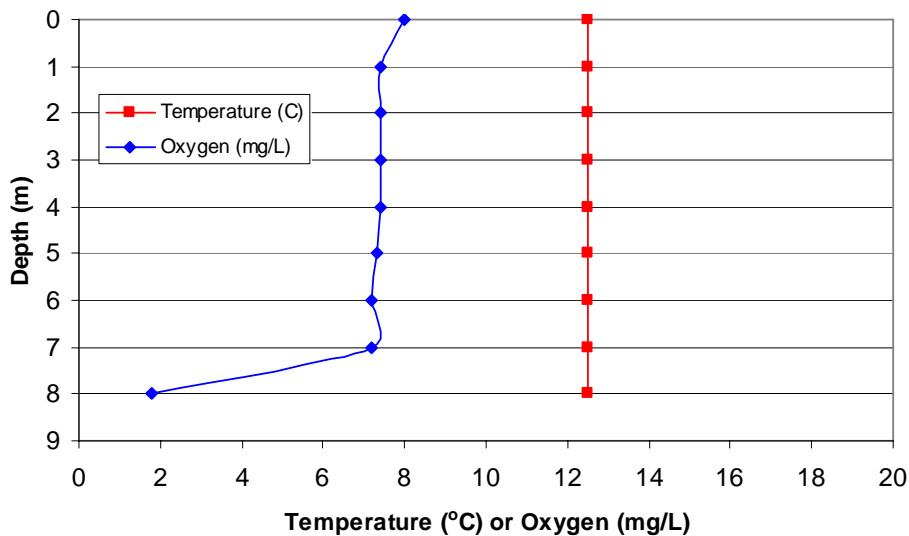


Figure 2. Temperature-oxygen profile of Quamichan Lake, October 25, 2004.

3.2 Netting Data

A total of 11 cutthroat trout, 23 sculpin, 137 catfish, and 700 pumpkinseed sunfish were captured in the floating and sinking gill nets in Quamichan Lake (Table 2). The length distribution of cutthroat trout ranged from 11.5 cm to 13.5 cm. None were clipped. The length distribution of sculpin ranged from 8.9 cm to 17.0 cm. The length distribution of catfish ranged from 9.0 cm to 30.0 cm. Pumpkinseed sunfish length distribution ranged from 7.0 cm to 16.0 cm.

Table 2. Summary of catch from the floating and sinking gill nets in Quamichan Lake.

Species	Sample Size	% of Catch	Size Range	Mean Length (cm)	Mean Weight (g)	Mean K Value	K Value Std. Dev.	Sex Ratio (M:F:U)
Cutthroat Trout	11	1.3	11.5 cm – 13.5 cm 14 g – 26 g	12.5	20.5	1.0304	0.0943	0:0:11
Sculpin	23	2.6	8.9 cm – 17.1 cm 8 g – 106 g	11.3	26.7	1.4444	0.2446	---
Brown Catfish	137	15.7	9.0 cm – 30.0 cm 10 g – 248 g	22.7	220.8	1.2442	0.0705	---
Pumpkinseed Sunfish	700	80.4	7.0cm – 16.0cm 8 g – 106 g	7.2	9.5	2.3361	0.0656	---

The length-frequency distribution, by age class, of cutthroat trout sampled in Quamichan Lake is shown in Figure 3. Of the eleven cutthroat sampled, one was aged as 0+ and ten were aged as 1+.

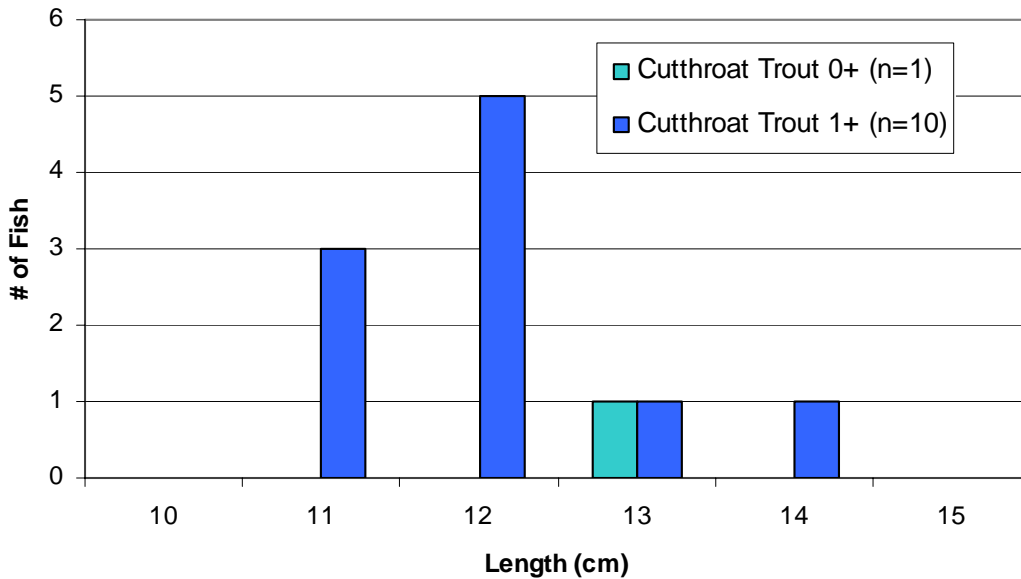


Figure 3. Length-frequency distribution, by age class, of cutthroat in Quamichan Lake, October 26, 2004.

Figure 4 illustrates the length/weight relationship and mean condition factor of all cutthroat captured in Quamichan Lake. The length/weight curve for cutthroat trout in the samples indicates size increased according to the formula $W = 0.943e^{0.244L}$, where W represents weight in grams and L represents length in centimetres. The closeness of fit or R^2 value is equal to 0.846. The mean condition factor for cutthroat was 1.0304.

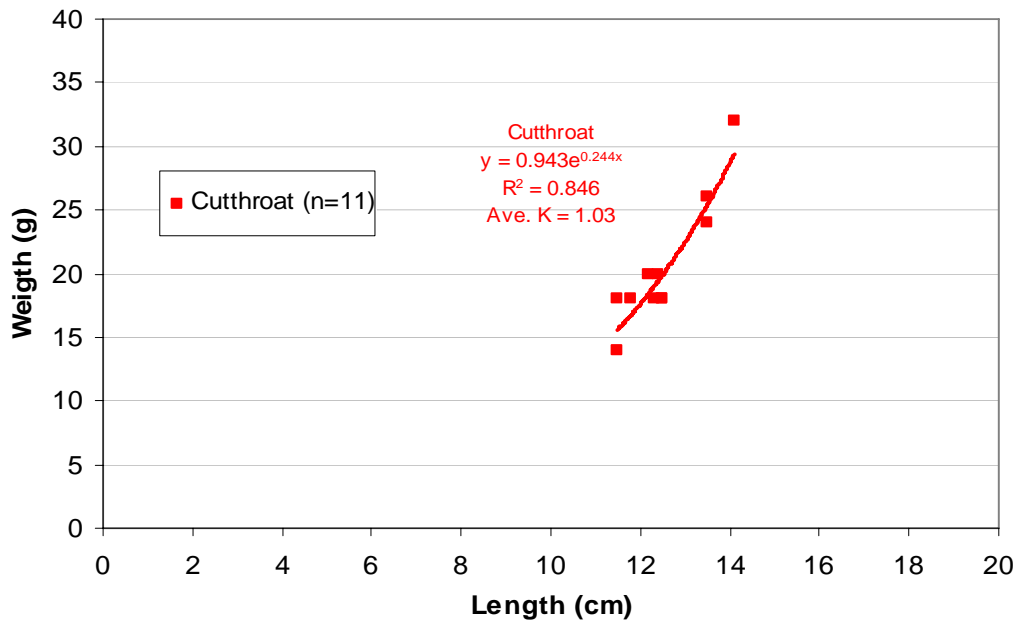


Figure 4. Length/weight relationship and average condition factor of all cutthroat trout, sampled in Quamichan Lake, October 26, 2004.

3.3 Presence/Absence Other Species

Cutthroat trout, brown catfish (formerly brown bullhead) and prickly sculpins found in this assessment of Quamichan Lake are consistent with the BC Fisheries database. Pumpkinseed sunfish are not listed in the BC Fisheries database for this lake.

4.0 Discussion

4.1 Temperature-Oxygen Profile

The temperature-oxygen profile shows a well mixed water column with oxygen values near saturation at the surface. Conditions in the upper 7 m of the water column were suitable for fish health and development at the time of sampling. Below 8 m, oxygen levels were not suitable for trout.

Quamichan Lake experienced an extensive fish kill in August 2004 due to depleted oxygen following the die-off of an algal (phytoplankton) bloom. During the summer months, when the lake reaches high temperatures and algal blooms occur, the decomposition of dead algae cells creates a high oxygen demand. Prevailing winds tend to concentrate the algae on the downwind end of the lake, exacerbating the problem there, while at the same time mitigating the situation in the upwind portion of the lake. On previous occasions (August 2003, June 1997), fish kills were relatively localized as fish in other parts of the lake survived. The event in 2004 was more severe than previously documented. Oxygen measurements were made by WLAP Environmental Protection Section approximately one week after the fish kill was reported in August 2004. They indicated that the whole area of the lake was involved (John Deniseger, pers. comm.). The oxygen levels they recorded near the center of the lake are presented in Appendix B. Oxygen levels were 2.3 - 2.5 mg/l. in the upper 2 m and declined rapidly below the thermocline to 1.6 mg/l at 3 m and 0.2 in the 2 m above the bottom.

4.2 Netting Data

The length-frequency distribution of cutthroat trout in the samples indicates their growth is below normal for Vancouver Island lakes. These fish may have recently recruited to the lake from the inlet stream, where growth is expected to be slower than in a lake environment. The mean condition factor appears normal for Vancouver Island cutthroat trout. The one age 0+ individual, whose length falls in the middle of the age 1+ distribution is much larger than expected for a fish that age and that age is likely an error in scale reading.

Pumpkinseed sunfish and brown catfish dominated the samples obtained in this assessment. Neither of these is native to Vancouver Island. Pumpkinseed sunfish did not

appear in gillnet samples from the previous assessment done in 1994. They are now by far the most abundant component of the fish community in Quamichan Lake, followed by brown catfish.

Numbers of pumpkinseed sunfish are extremely high and their average size is small. Although numerous, they are too small to be desirable targets for a recreational fishery.

4.3 Netting Data in Relation to Stocking History

Almost half the CT yearlings released in spring 2004 were “surplus” from other studies and were clipped (660 AD and 250 RM). None of the clipped fish were recovered in the samples suggesting the cutthroat in the samples could be from natural recruitment. This is further supported by the small size of the cutthroat in the samples. Of the eleven cutthroat trout captured in the gill nets in Quamichan Lake, ten were age 1+ and one was possibly 0+ but probably also 1+. Average weight of the unclipped age 1+ fish released in spring 2004 was 39.7g. The average weight of the cutthroat in the gillnet samples, 6 months later, was 20.5g, suggesting strongly that they were too small to be the hatchery fish. It can be inferred they originated from natural recruitment. To further that argument, growth of juvenile trout is typically slower in their rearing streams than it is after they enter the lake. The smaller size of the 1+ fish in the samples would be consistent with them rearing in the stream at the time of the fish kill, and having moved to the lake some time after that event.

None of the clipped hatchery cutthroat released in spring 2004 or any of the larger unclipped hatchery yearlings were recovered in the samples. None of the 281 adult cutthroat stocked in spring 2004 appeared in the samples. Of all cutthroat trout previously stocked in the lake, it appears that none survived the August 2004 fish-kill.

No authorized stocking of spiny rayed fishes has occurred in Quamichan Lake. While brown catfish were reported in previous surveys of the lake dating back to 1951, pumpkinseed sunfish were not previously recorded there. Their presence is apparently due to illegal stocking some time since the lake was last surveyed in 1994.

5.0 Conclusion

This assessment of Quamichan Lake indicates current conditions are satisfactory for sustaining fish in the lake, but that periodic fish kills can deplete the trout population. The removal of natural lakeshore vegetation and development of lawns and pastures in extensive areas around Quamichan Lake have resulted in elevated nutrient loading, and under these circumstances the algal blooms and resulting fish deaths can be expected when extended periods of warm, sunny summer weather occur.

It is probable that the low numbers of cutthroat trout found in the samples originated from natural recruitment. They were possibly resident in the inlet stream at the time of the fish kill and moved to the lake after life-sustaining conditions were restored.

It is apparent that pumpkinseed sunfish, though relatively recently introduced, have become prolific and were largely unaffected by the conditions that killed the trout. Brown catfish also appeared unaffected by the low oxygen conditions.

The number of trout that survived to potentially enter the fishery was low. Continued annual stocking of cutthroat will be necessary to sustain the trout fishery. The high abundance of pumpkinseed sunfish suggests that juvenile cutthroat will experience significant competition for food, which will impact their growth and survival.

6.0 Recommendations

The recommendation by the Regional Lakes Biologist is that stocking of Quamichan Lake should be increased initially to restore the cutthroat numbers depleted by the fish kill. The hatchery has 10,000 fall fingerlings on hand at this time, which should be stocked as scheduled, in fall 2004. They are also anticipating a surplus of 4000 spring yearlings in 2005, and these should also be stocked into the lake to help build up numbers.

Because of the high abundance of pumpkinseed sunfish, consideration should be given to changing the stocking plan to introduce cutthroat at the yearling or even catchable stage in subsequent years.

Appendix A – Stocking History

Stocking History of Quamichan Lake

Year	Species	Stock	Number	Size (g)	Stage	Clip
2004/05/13	Cutthroat Trout	TAYLOR	250	53.2	YEARLING	Right Maxillary
2004/05/13	Cutthroat Trout	TAYLOR 3N	660	44.7	YEARLING	Adipose
2004/05/13	Cutthroat Trout	TAYLOR	1022	39.53	YEARLING	
2004/05/04	Cutthroat Trout	TAYLOR	281	305.4	ADULT	
2003/10/03	Cutthroat Trout	TAYLOR	2018	14.02	FINGERLING	
2003/05/13	Cutthroat Trout	TAYLOR	20	839.75	ADULT	
2003/05/13	Cutthroat Trout	TAYLOR	40	1000	ADULT	Adipose
2003/05/13	Cutthroat Trout	TAYLOR	286	359.84	ADULT	
2003/05/09	Cutthroat Trout	TAYLOR	3863	46.73	YEARLING	
2003/04/08	Cutthroat Trout	TAYLOR	68	839.78	ADULT	
2003/03/14	Cutthroat Trout	TAYLOR	141	839.77	ADULT	
2003/03/05	Cutthroat Trout	TAYLOR	80	850.98	ADULT	
2002/05/15	Cutthroat Trout	TAYLOR	409	42.25	YEARLING	
2002/05/08	Cutthroat Trout	TAYLOR	4638	56.81	YEARLING	
2002/05/02	Cutthroat Trout	TAYLOR	214	309.85	ADULT	
2002/04/29	Cutthroat Trout	TAYLOR	44	1000	ADULT	
2002/04/18	Cutthroat Trout	TAYLOR	268	1000	ADULT	
2002/03/28	Cutthroat Trout	TAYLOR	104	1000	ADULT	
2002/03/26	Cutthroat Trout	TAYLOR	147	1000	ADULT	
2002/02/27	Cutthroat Trout	TAYLOR	153	1018.45	ADULT	
2001/10/01	Cutthroat Trout	TAYLOR	9642	19.75	FINGERLING	
2001/09/21	Cutthroat Trout	TAYLOR	1000	17.81	FINGERLING	
2001/05/11	Cutthroat Trout	TAYLOR	553	52.76	YEARLING	
2001/05/09	Cutthroat Trout	TAYLOR	265	304.15	ADULT	
2000/11/06	Cutthroat Trout	TAYLOR	6000	12.8	FINGERLING	
2000/09/14	Cutthroat Trout	TAYLOR	6000	15.6	FINGERLING	
2000/04/20	Cutthroat Trout	TAYLOR	2105	42.95	YEARLING	
1999/09/28	Cutthroat Trout	TAYLOR	10000	15.65	FINGERLING	
1999/06/29	Cutthroat Trout	TAYLOR	440	74.77	YEARLING	
1998/10/06	Cutthroat Trout	TAYLOR	5017	20.44	FINGERLING	
1998/09/25	Cutthroat Trout	TAYLOR	4000	17.63	FINGERLING	
1998/03/09	Cutthroat Trout	TAYLOR	2000	42.94	YEARLING	
1997/09/30	Cutthroat Trout	TAYLOR	9128	16.42	FINGERLING	
1997/06/23	Cutthroat Trout	TAYLOR	929	56.49	YEARLING	
1997/05/26	Rainbow Trout	FRASER VALLEY	500	179.28	CATCHABLES	
1997/03/21	Rainbow Trout	FRASER VALLEY	1500	166.78	CATCHABLES	
1996/09/18	Cutthroat Trout	TAYLOR	1064	16.26	FINGERLING	
1996/05/27	Rainbow Trout	FRASER VALLEY	632	157.1	CATCHABLES	
1996/05/18	Rainbow Trout	FRASER VALLEY	300	143.67	CATCHABLES	
1996/05/10	Cutthroat Trout	TAYLOR	7323	46.51	YEARLING	
1996/03/20	Rainbow Trout	FRASER VALLEY	368	169.57	CATCHABLES	
1996/03/11	Rainbow Trout	FRASER VALLEY	700	157.43	CATCHABLES	
1995/10/03	Rainbow Trout	FRASER VALLEY	2000	184.7	CATCHABLES	
1995/09/29	Cutthroat Trout	TAYLOR	5489	15.08	FINGERLING	
1995/09/27	Cutthroat Trout	TAYLOR	5000	14.65	FINGERLING	
1995/05/25	Rainbow Trout	FRASER VALLEY	1000	136.46	CATCHABLES	
1995/05/03	Rainbow Trout	PENNASK	3000	17.55	YEARLING	
1995/03/27	Rainbow Trout	FRASER VALLEY	1000	141.36	CATCHABLES	
1994/11/01	Cutthroat Trout	PAQ	10000	34.72	FINGERLING	
1994/10/28	Rainbow Trout	FRASER VALLEY	1168	181.85	CATCHABLES	
1994/05/11	Rainbow Trout	PENNASK	3000	22.59	YEARLING	
1994/03/14	Rainbow Trout	FRASER VALLEY	2000	107.53	CATCHABLES	
1993/09/23	Cutthroat Trout	TAYLOR	10000	10.52	FINGERLING	
1993/05/29	Rainbow Trout	FRASER VALLEY	2000	133.33	CATCHABLES	
1993/05/25	Rainbow Trout	TUNKWA	3000	5.83	YEARLING	
1992/09/28	Cutthroat Trout	PAQ	11043	34.31	FINGERLING	
1992/05/13	Rainbow Trout	FRASER VALLEY	2000	142.86	CATCHABLES	
1992/03/09	Cutthroat Trout	PAQ	3683	59.52	YEARLING	
1992/03/03	Cutthroat Trout	PAQ	3817	53.48	YEARLING	

Stocking History of Quamichan Lake (continued)

Year	Species	Stock	Number	Size (g)	Stage	Clip
1991/10/30	Rainbow Trout	BADGER	1757	46.1	YEARLING	
1991/10/23	Cutthroat Trout	TAYLOR	2000	14.29	FINGERLING	
1991/09/13	Rainbow Trout	BADGER	1500	34.27	YEARLING	
1991/03/13	Cutthroat Trout	PAQ	10000	34.38	YEARLING	
1990/10/11	Steelhead	COWICHAN	1324	3.4	FRY	
1990/04/27	Cutthroat Trout	TAYLOR	9978	26.2	YEARLING	
1989/11/15	Rainbow Trout	TUNKWA	1079	48.3	YEARLING	
1989/10/06	Rainbow Trout	TUNKWA	924	37.9	YEARLING	
1989/09/28	Steelhead	COWICHAN	13353	3.6	FALL FRY	
1989/09/26	Rainbow Trout	TUNKWA	795	10.3	YEARLING	
1989/04/05	Cutthroat Trout	TAYLOR	7992	42.6	YEARLING	
1988/09/30	Steelhead	COWICHAN	11379	4	FALL FRY	
1988/03/01	Cutthroat Trout	TAYLOR	10000	38.3	UNKNOWN	
1987/04/01	Rainbow Trout	TUNKWA	5000	10.4	UNKNOWN	
1987/03/01	Cutthroat Trout	TAYLOR	6000	31.7	UNKNOWN	
1986/07/01	Cutthroat Trout	TAYLOR	295	645.2	UNKNOWN	
1986/03/01	Cutthroat Trout	TAYLOR	10000	35.2	UNKNOWN	
1985/03/01	Cutthroat Trout	TAYLOR	5455	29.2	UNKNOWN	
1984/03/01	Cutthroat Trout	TAYLOR	10000	21.7	UNKNOWN	
1983/06/01	Cutthroat Trout	TAYLOR	536	500	UNKNOWN	
1982/05/01	Cutthroat Trout	TAYLOR	1000	66.6	UNKNOWN	
1982/03/01	Cutthroat Trout	TAYLOR	1440	185.57	UNKNOWN	
1982/03/01	Cutthroat Trout	TAYLOR	2630	99.28	UNKNOWN	
1981/03/01	Cutthroat Trout	TAYLOR	5700	52.6	UNKNOWN	
1980/05/01	Cutthroat Trout	TAYLOR	7400	83	UNKNOWN	
1978/01/01	Cutthroat Trout	TAYLOR	3200	48	UNKNOWN	
1978/01/01	Cutthroat Trout	TAYLOR	5600	11	UNKNOWN	
1976/01/01	Cutthroat Trout	BROOD(SALMON)	1700	14.2	UNKNOWN	
1974/01/01	Cutthroat Trout	BROOD	5000	15	FINGERLING	
1968/01/01	Cutthroat Trout	WASH.	5000	15	FINGERLING	
1965/01/01	Cutthroat Trout	CORVALLIS	5400	15	FINGERLING	
1963/01/01	Rainbow Trout	CALIFORNIA	2665	0	YEARLING	
1959/01/01	Rainbow Trout	OREGON	8100	5	FINGERLING	
1955/01/01	Cutthroat Trout	SFH	4650	0	FINGERLING	
1954/01/01	Cutthroat Trout	SFH	2000	0	FRY	
1952/01/01	Cutthroat Trout		5000	0	FINGERLING	
1952/01/01	Rainbow Trout	PENNASK	3000	0	FINGERLING	
1951/01/01	Rainbow Trout	PETERHOPE	10000	0	FINGERLING	
1949/01/01	Rainbow Trout	PINANTAN	10000	0	FINGERLING	
1948/01/01	Rainbow Trout	PAUL	10000	0	FINGERLING	
1947/01/01	Rainbow Trout	PAUL	10000	0	FINGERLING	
1946/01/01	Rainbow Trout	KNOUFF	6394	0	FINGERLING	
1944/01/01	Rainbow Trout	PINANTAN	5000	0	FINGERLING	
1943/01/01	Rainbow Trout	PINANTAN	8000	0	FINGERLING	
1942/01/01	Rainbow Trout	PINANTAN	10000	0	FINGERLING	
1940/01/01	Rainbow Trout	PINANTAN	20000	0	FINGERLING	
1939/01/01	Rainbow Trout	PINANTAN	5057	0	FINGERLING	
1938/01/01	Rainbow Trout	PINANTAN	5118	0	FINGERLING	
1936/01/01	Rainbow Trout		2970	0	YEARLING	
1935/01/01	Rainbow Trout	PINANTAN	10000	0	EYED EGG	
1928/01/01	Rainbow Trout	PINANTAN	25000	0	FRY	
1927/01/01	Rainbow Trout	PINANTAN	40000	0	FRY	
1925/01/01	Rainbow Trout	PINANTAN	48000	0	FRY	
1922/01/01	Cutthroat Trout	COWICHAN	2000	0	FRY	
1922/01/01	Rainbow Trout	PAUL	20000	0	FRY	
1921/01/01	Cutthroat Trout	COWICHAN	5000	0	FRY	
1917/01/01	Cutthroat Trout	COWICHAN	6000	0	FRY	

Appendix B – Temperature-Oxygen Data

Locality: Quamichan Lake
Date: October 25, 2004
Time: 14:21
Weather: Raining, overcast, moderate wind, 10°C
Secchi: 1.2 m
Surface pH: 8
Bottom Depth: 9.1 m

Depth (m)	Oxygen (mg/L)	Temperature (oC)
surface	8.0	12.5
1.0	7.4	12.5
2.0	7.4	12.5
3.0	7.4	12.5
4.0	7.4	12.5
5.0	7.3	12.5
6.0	7.2	12.5
7.0	7.2	12.5
8.0	1.8	12.5

Quamichan Lake, August 2004 – Data from WLAP Environmental Protection Section, taken approximately 1 week after a major fish kill was reported.

DEPTH (m)	OXYGEN (mg/l)	TEMPERATURE (°C)
0.5	2.5	23.6
1.0	2.4	23.6
2.0	2.3	23.5
3.0	1.6	23.4
4.0	1.6	23.3
5.0	0.4	20.2
6.0	0.2	18.5
7.0	0.2	17.9

Appendix C – Net Set Information

NETTING SITE #1

Type:	Floating monofilament gill net
Date Set:	October 25, 2004
Time Set:	1452 hours
Date Lifted:	October 26, 2004
Time Lifted:	0900 hours
Total Time:	18 hrs 8 min
Shallow End Depth:	0.5 m
Shallow End Substrate:	organics, aquatic plants
Deep End Depth:	7.4 m
Maximum Depth Along Net:	7.4 m

NETTING SITE #2

Type:	Sinking monofilament gill net
Date Set:	October 25, 2004
Time Set:	1513 hours
Date Lifted:	October 26, 2004
Time Lifted:	1000 hours
Total Time:	18 hrs 47 min
Shallow End Depth:	1.6 m
Shallow End Substrate:	organics
Deep End Depth:	5.6 m
Maximum Depth Along Net:	5.6 m

Appendix D – Catch Record

Floating Gill Net

#	Species	Fish Characteristics						Sample Type	Stomach Contents					Comments
		Fork Length (cm)	Weight (g)	Sex	Maturity	Mark	Age		Bottom Organisms	Plankton	Terrestrial	Fish	Volume (full) empty	
1	CT	12.4	20	?	IMM	NO	1+							
1	BH	28.8	348											
2	BH	24.5	206											
3	BH	13.0	30											
4	BH	12.5	26											
5	BH	11.2	18											
6	BH	9.6	12											
7	BH	9.8	12											
8	BH	9.8	12											
9	BH	9.4	12											
10	BH	11.0	16											
11	BH	10.0	10											
12	BH	10.0	12											
13	BH	11.6	22											
14	BH	10.0	12											
15	BH	10.0	12											
16	BH	9.0	10											
17	BH	11.0	14											
18	BH	10.4	14											
19	BH	12.2	22											
20	BH	9.8	10											
21	BH	11.0	18											
22	BH	10.2	12											
23	BH	10.3	12											
24	BH	10.0	10											
25	BH	10.3	14											
26	BH	10.0	12											
27	BH	10.5	14											
28	BH	9.8	12											
29	BH	9.8	12											
30	BH	9.5	10											
31	BH	10.4	12											
32	BH	10.4	12											

In the floating gillnet there was a total of 261 small pumpkinseed sunfish with a mean length and weight of 7 cm and 8 g.

IMM	immature	R	ripe	LM	left maxillary clip	NO	no clip	CT	cutthroat trout
MG	maturing	SP	spent	AD	adipose clip	M	male	PM	pumpkinseed sunfish
MT	mature	?	not obvious	RM	right maxillary clip	F	female	BH	catfish (general)
								CC	sculpin (general)

Appendix E – Photos



Picture 1. Looking southwest from survey site.



Picture 2. Looking northeast from survey site.



Picture 3. Algal bloom along shore of island.



Picture 4. Algal bloom along shore of island.



Picture 5. Looking north from boat launch site.



Picture 6. Cutthroat from floating gill net catch.



Picture 7. Brown catfish from floating gill net catch.



Picture 8. Pumpkinseed sunfish and one sculpin from floating gill net catch.



Picture 9. Cutthroat from sinking gill net catch.



Picture 10. Prickly sculpin from sinking gill net catch.



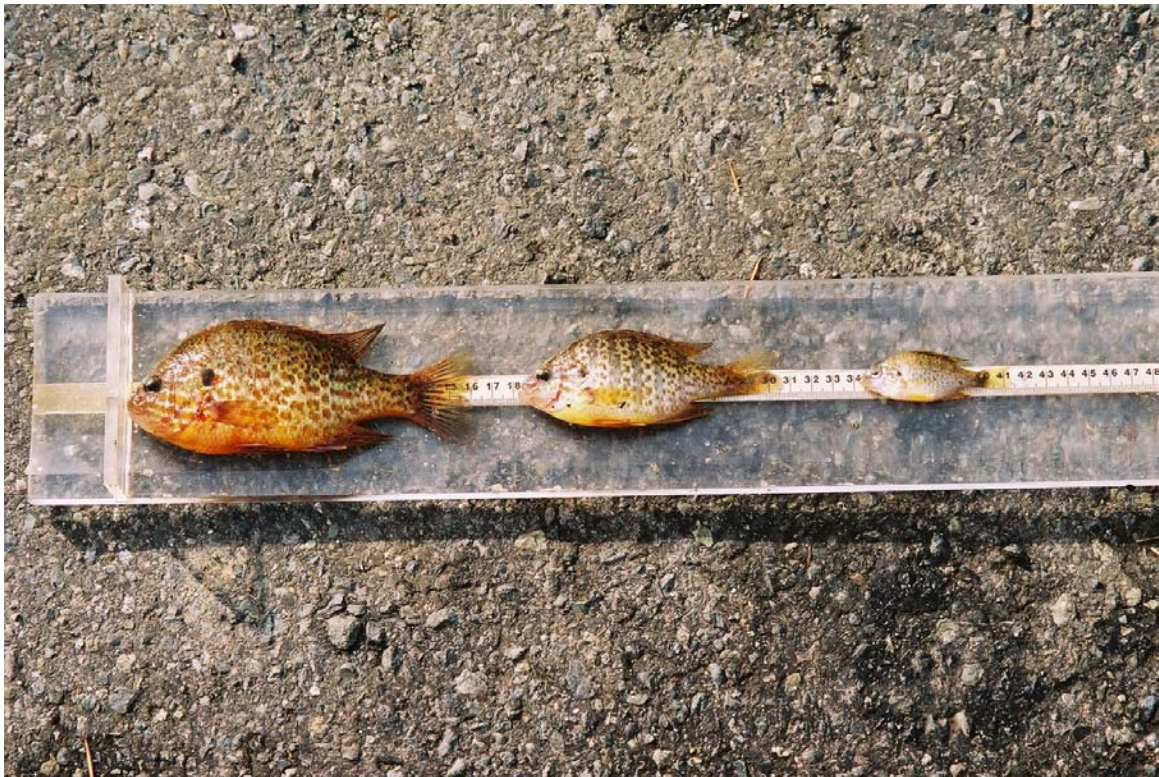
Picture 11. Brown catfish from sinking gill net catch.



Picture 12. Close-up up brown catfish from sinking gill net catch.



Picture 13. Pumpkinseed sunfish from sinking gill net catch.



Picture 14. Close-up of pumpkinseed sunfish from floating gill net catch.

Appendix F – Scale Readings

Quamichan LK
FGN 1



1x



Quamichan LK. 1
Sinking GN



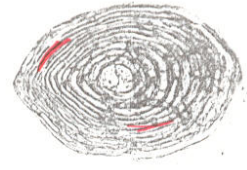
1*





Quamichan LK 2
Sinking GN

1+



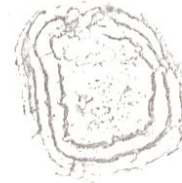
Quamichan LK 3
Sinking GN

1+



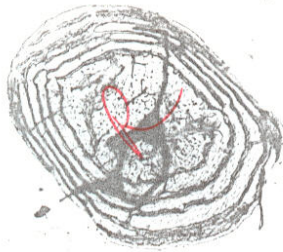
Quamichan LK
Sinking GN

1X



Quamichan LK5
Sinking GN

1+



Quamichan LK 6
Sinking GN



1x



Quamichan LK 7
Sinking GN



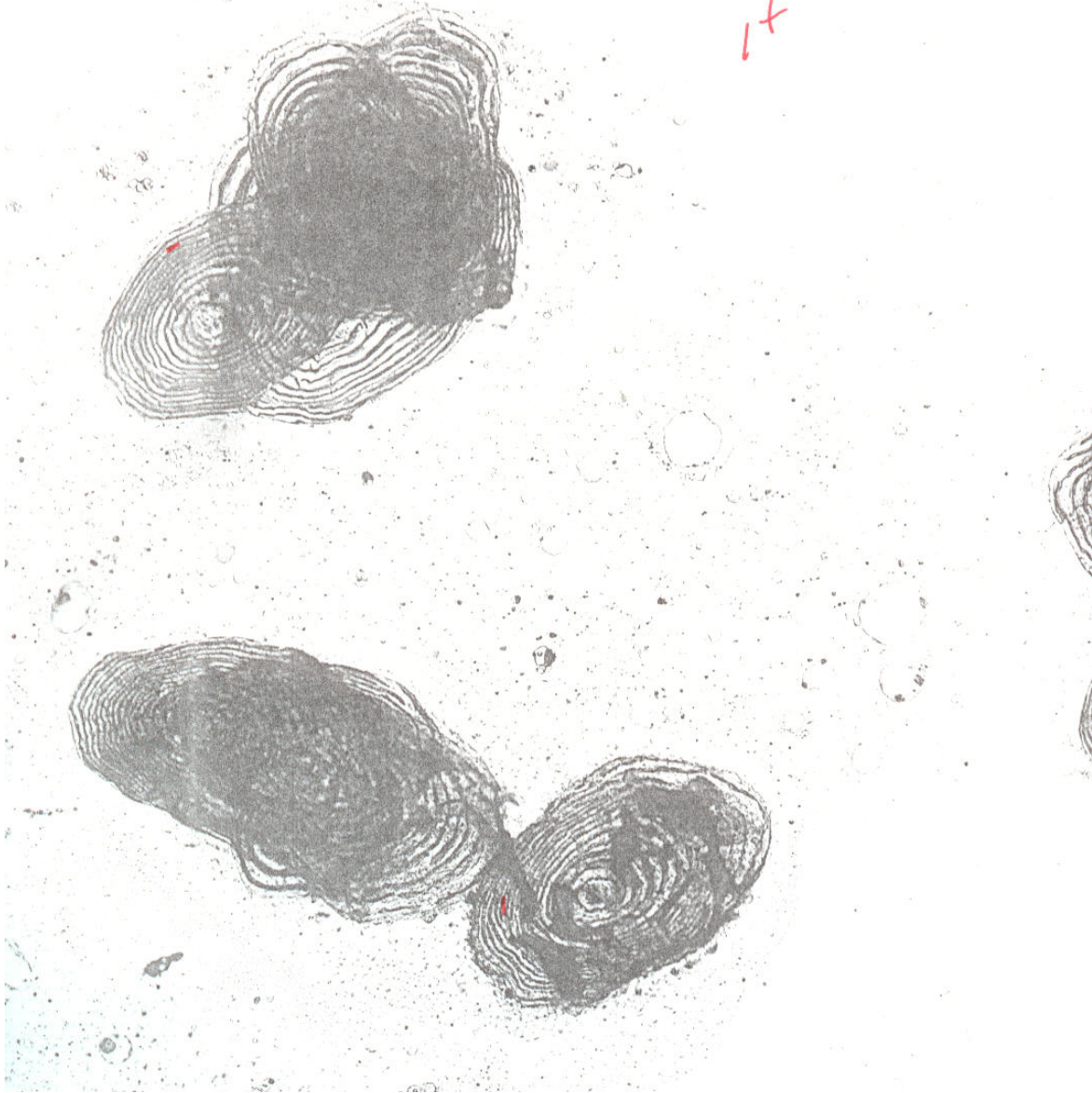
Quamichan LK 8
Sinking GN

1+



Quamichan LK 9
Sinking GN

1+



Quamichan LK 10
Sinkling GN

