

Thetis Lake Stocking Assessment

**Region 1, Nanaimo
Victoria/Gulf Islands Planning Unit
Ministry of Water, Land and Air Protection**

Prepared by:

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1.0 Introduction

1.1 Objective

Thetis Lake, in the Victoria/Gulf Islands planning unit, was assessed in the fall of 2002 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. Results of the Thetis Lake evaluation will focus on:

- effectiveness of past stocking efforts by evaluating fish abundance and observing the level of natural recruitment of both stocked and non-stocked fish
- effectiveness of past stocking efforts by evaluating the current age structure of the population using fish aging techniques
- observations of the presence/absence of non-native fish
- future considerations for the fish stocking and lake management program

1.2 Background

Assessments of Thetis Lake were performed by provincial fisheries staff in 1954 and 1981. Located approximately 10 km west of Victoria, the lake lies in the coastal Douglas fir biogeoclimatic zone within the South Island Forest District. The lake is situated at an elevation of 51.5 m in management unit 1-01. The surface area of the lake is 14.9 ha and the perimeter is 4 km. The lake attains a maximum depth of 11.5 m. The lake has been stocked at total of 85 times from 1935 to 2002. The entire stocking record can be seen in Appendix E. Table 1 lists the last 6 years of stocking data.

Table 1. Stocking history of Thetis Lake over the last 6 years.

Year	Species (Stock)	Number	Stage	Size (g)	Mark
05/03/1997	Rainbow Trout (Fraser Valley)	1000	Catchable	172.4	---
10/03/1997	Cutthroat Trout (Taylor)	1500	Yearling	37.8	---
22/05/1997	Rainbow Trout (Fraser Valley)	500	Catchable	153.9	---
25/09/1997	Rainbow Trout (Fraser Valley)	850	Catchable	152.4	---
04/11/1997	Rainbow Trout (Fraser Valley)	797	Catchable	183.1	---
04/11/1997	Rainbow Trout (Fraser Valley)	353	Catchable	189.1	---
09/03/1998	Cutthroat Trout (Taylor)	2000	Yearling	41.3	---
02/10/1998	Cutthroat Trout (Taylor)	4000	Fingerling	18.4	---
25/03/1999	Cutthroat Trout (Taylor)	2000	Yearling	46.8	---
22/09/1999	Cutthroat Trout (Taylor)	4000	Fingerling	14.6	---
15/03/2000	Cutthroat Trout (Taylor)	2000	Yearling	46.0	---
09/03/2001	Cutthroat Trout (Taylor)	4000	Yearling	38.7	---
13/03/2002	Cutthroat Trout (Taylor)	4000	Yearling	36.2	---

2.0 Methods and Materials

The Vancouver Island lakes included in the evaluation were selected because they were previously stocked and needed assessment, or were potential candidates for future stockings. A list of over 45 lakes was compiled, and 18 were selected by the Region 1 Lakes Biologist to be sampled in the fall of 2002. Thetis Lake had previous reconnaissance work, thus only the standard temperature/oxygen profile and fish sampling procedures were performed.

The lake was assessed by boat, and a Lowrance X65 sounder was used to determine depth measurements. Upon locating the deepest part of the lake, a temperature/oxygen profile was obtained using a model 51B YSI meter. Secchi depth readings were also taken at this location.

Two gill nets, one sinking and one floating, were set in the lake overnight. The gill net sites were selected with the intention of sampling areas with evenly spaced contour lines on a bathymetric map. The floating gill net was set with the intent of covering more shoal area, where as the sinking gill net was set to sample a deeper part of the lake (Figure 1). The floating and sinking gill nets were 90m monofilament experimental gang nets of varying panel sizes. Both nets were anchored with the smallest mesh size panel nearest to shore and extended into the lake.

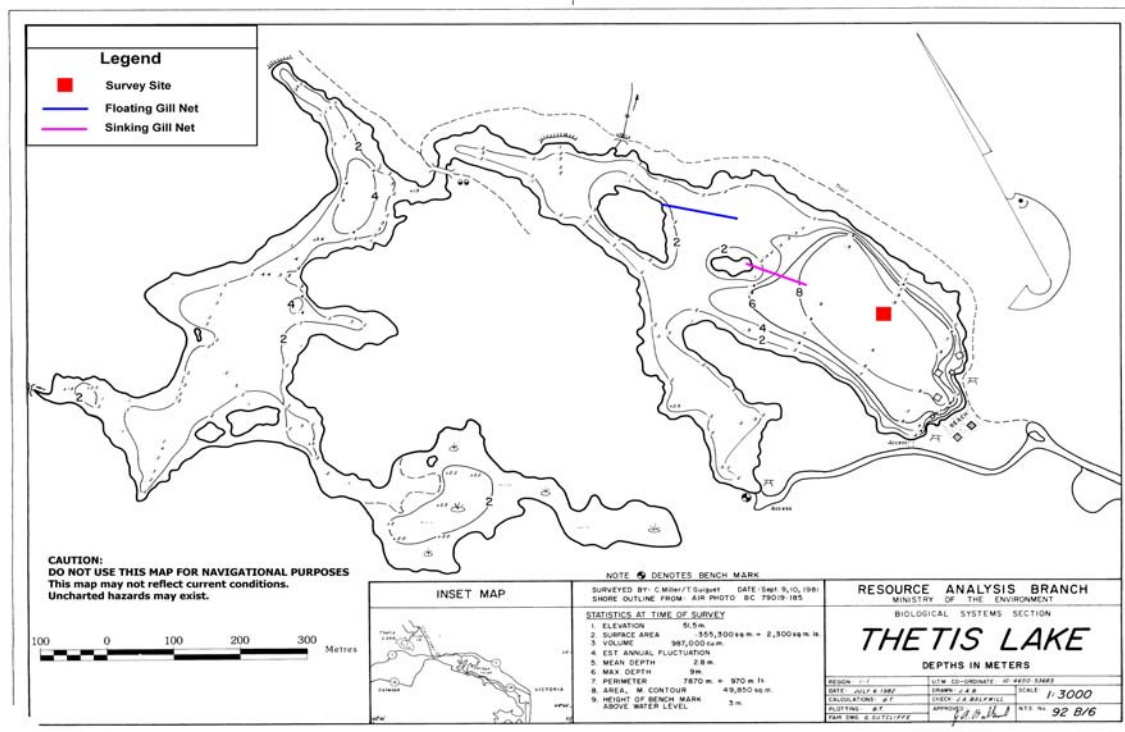


Figure 1. A bathymetric map of Thetis Lake showing the survey site and position of the floating and sinking gill nets.

Sampling of the gill net catch consisted of attaining lengths (cm), weights (g), determining sex, maturity, and stomach contents of all salmonids captured. In addition, a sample of scales was taken from all cutthroat trout captured and mounted on slides. Columbia Environmental Consulting Ltd. aged the scales by counting the number of annuli that represent different growing seasons. Printed copies of each scale sampled can be seen in Appendix D.

3.0 Results

3.1 Temperature-Oxygen Profile

Figure 2 illustrates the temperature-oxygen profile for Thetis Lake on October 30, 2002. Thetis Lake is relatively shallow, less than 12 meters deep, with a large amount of shoal area (Figure 1). The temperature-oxygen profile of the lake shows uniformity through all levels, a characteristic typically seen in well-mixed lakes (Figure 2 and Appendix A). Temperature values decrease from 11.2°C at the surface to 11.0°C at the depth of 9 meters. The oxygen levels in the lake fluctuate between 11.0 mg/L and 10.9 mg/L to a depth of 8 meters. At 9 meters the dissolved oxygen rapidly decreases to 1.1mg/L indicating a deep anoxic water layer.

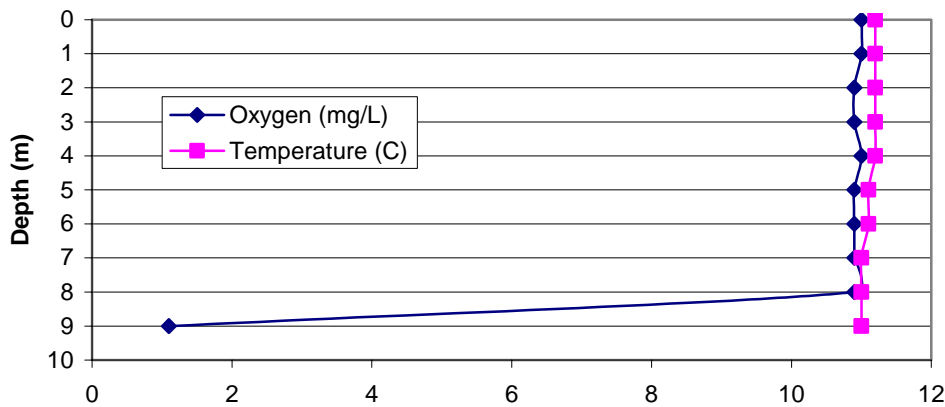


Figure 2. Temperature-oxygen profile of Thetis Lake on October 30, 2002.

3.2 Netting Data

A total of 46 fish were captured in the floating and sinking gill nets in Thetis Lake (Table 2). Species by percentage included cutthroat trout (4.3%), small mouth bass (15.2%), pumpkinseed sunfish (39.2%), brown bullhead (37.0%) and prickly sculpin (4.3%). The data from each net set can be seen in Appendix B, while photos of the catch are in Appendix C. The size distribution of Thetis Lake cutthroat trout varied between 27.4 cm and 30.1 cm. The male to female sex ratio was 2:0.

Table 2. Summary of catch from the floating and sinking gill net sets in Thetis Lake.

Species	Sample Size	Size Range (cm)	Ave. K Value	K Value Std. Dev.	Sex Ratio (M:F)
Cutthroat Trout	2	27.4 - 30.1	0.995	0.10	2:0
Small Mouth Bass	7	30.6 - 37.3	n/a	n/a	n/a
Pumpkinseed Sunfish	18	6.4 - 16.8	n/a	n/a	n/a
Brown Bullhead	17	9.7 - 22.4	n/a	n/a	n/a
Prickly Sculpin	2	14.2 - 21.3	n/a	n/a	n/a

Figure 3 shows the length-frequency distribution, by age, of all cutthroat trout captured in Thetis Lake. As only two fish were captured, no conclusions can be made about the age distribution. The two fish captured were both from the 2+ age class. The size at age of the two fish captured does appear normal for cutthroat trout in fairly productive lakes on Vancouver Island.

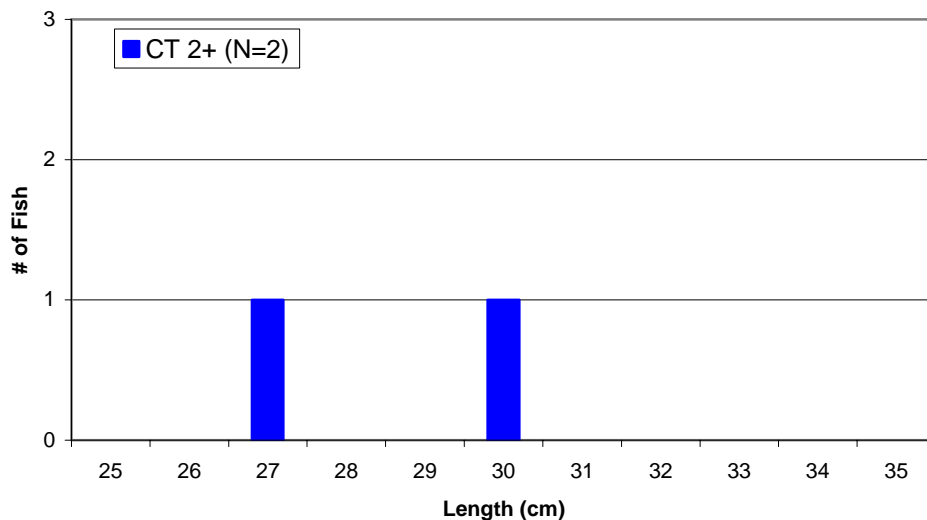


Figure 3. Length-frequency distribution, by age, for cutthroat trout in Thetis Lake in the fall of 2002.

Figure 4 displays the length/weight relationship and the average condition factor for the cutthroat trout captured in Thetis Lake. The weight of the sampled population increases according to the formula $W = 2.5115e^{0.1579L}$, where W represents weight in grams and L represents length in centimeters. The equation for cutthroat trout has a closeness of fit or R^2 value equal to 1 and a calculated average condition factor of 0.995. It should be noted that the confidence in these parameters are low given a sample size of only two fish.

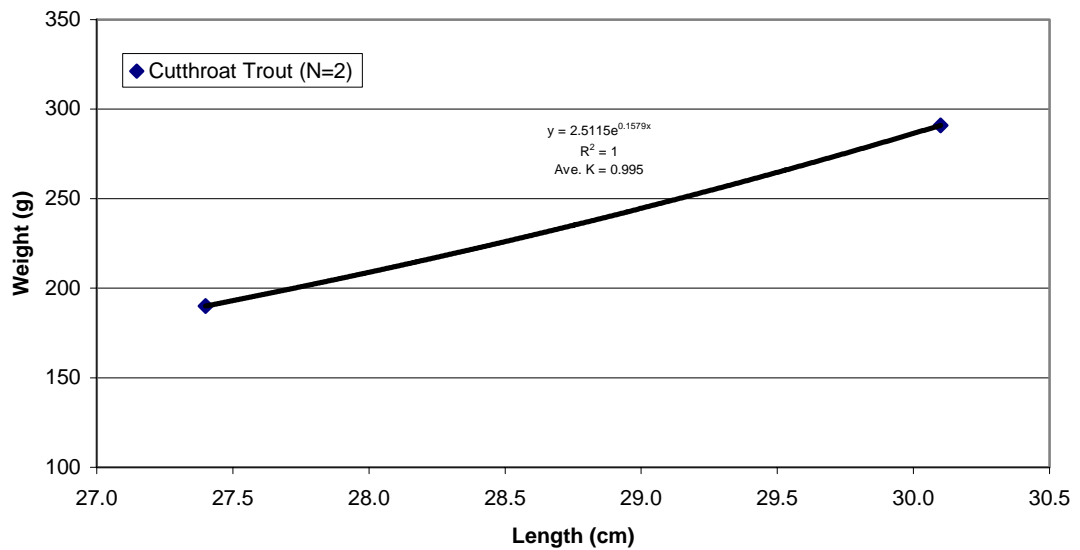


Figure 4. Length-weight relationship of cutthroat trout in Thetis Lake in the fall of 2002.

3.3 Presence/Absence of Non-Native Species

Cutthroat trout, small mouth bass, pumpkinseed sunfish, brown bullhead and prickly sculpin were captured in the gill nets set in Thetis Lake. All species noted have been seen in the historical record. The presence of these species is also consistent with the BC Fisheries database. No new introductions of non-native species were observed in Thetis Lake.

4.0 Discussion

4.1 Temperature-Oxygen Profile

The temperature-oxygen profile for Thetis Lake shows homogeneous levels through almost all depths. The profile shows both temperature and dissolved oxygen levels ideally suited for fish development. High water temperature levels can cause problems if values are in excess of 20°C. Thetis Lake is deep enough where temperature values are not likely to exceed this critical level. Conversely, temperature values during winter periods are not likely low enough to cause extreme ice formation and/or oxygen depletion due to its low elevation.

4.2 Netting Data

Few conclusions about the age distribution of cutthroat trout in Thetis Lake can be made as only two fish were captured. The data shows that both fish are two years of age, and that no older fish were captured. This is likely due to the heavy fishery that occurs on Thetis Lake along with increased levels of competition amongst all species. The presence of the high number of coarse fish in the lake likely affects the number of cutthroat trout present through both prey-predator interactions as well as competition. The length-weight relationship for Thetis Lake cutthroat trout appears normal with an equation that is represented by a good R^2 value or closeness of fit. It should be noted, however, that the length-weight equation, R^2 value, and the average condition factor only represents 2 fish and therefore are not statistically valid.

4.3 Netting Data in Relation to Stocking History

Because Thetis Lake has been stocked annually for many years with unmarked fish, it is difficult to determine conclusively if the fish are of hatchery origin. Considering the very small number of the trout caught in the gill nets, it appears little recruitment occurs. It is likely that the population of cutthroat trout in Thetis Lake is predominately dependant upon stocking.

5.0 Conclusion

The overall assessment of Thetis Lake is poor given the number of cutthroat trout captured. The physical conditions appear positive, however the competitive nature of the lake may make establishing a good cutthroat trout fishery difficult. The lack of cutthroat trout in the gill nets suggests that the annual level of stocking is not adequate, especially given the amount of fishing pressure it receives. There appears to be no natural recruitment in the lake, as no juveniles were captured in the gill net sets, thus making the lake solely dependent upon stocking to keep the fishery alive.

6.0 Recommendations

The recommendation by the regional lakes biologist is to increase stocking from 4,000 to 6,000 cutthroat trout yearlings per year. It is hoped that this amount of stocking will provide a more successful fishery. The key to determining the success of this stocking change is future monitoring sessions aimed at determining the current population structure of the lake. Thus it is also recommended that lake assessments be performed to evaluate the progress.

Appendix

Appendix A – Temperature-Oxygen Profile

Locality:	Thetis Lake
Date:	October 30, 2002
Bottom Depth (m):	11.5
Secchi Depth (m):	6.0
Weather:	Sunny, cold, and slightly windy

Depth (m)	O ₂ (mg/L)	Temperature (°C)
Surface	11.0	11.2
1.0	11.0	11.2
2.0	10.9	11.2
3.0	10.9	11.2
4.0	11.0	11.2
5.0	10.9	11.1
6.0	10.9	11.1
7.0	10.9	11.0
8.0	10.9	11.0
9.0	1.1	11.0

Appendix C – Photos



Picture 1. Thetis Lake, looking southwest from the center of the lake. October 31, 2002



Picture 2. Thetis Lake, looking southeast from the center of the lake. October 31, 2002



Picture 3. Thetis Lake looking east from the center of the lake. October 31, 2002



Picture 4. Thetis Lake, looking northwest from public beach access. October 31, 2002



Picture 5. Thetis Lake, floating gill net catch. October 31, 2002



Picture 6. Thetis Lake, sinking gill net catch. October 31, 2002

Appendix D – Scale Readings



Scale Sample #1 – Floating gill net CT 30.1cm 291g age 2+



Scale Sample #2 – Floating gill net CT 27.4cm 190g age 2+

Appendix E – Stocking History

Release Date	Species	Stock	Stage	Number	Avg Size (g)	Mark
01/01/1935	Rainbow Trout	UNKNOWN	Unknown	3,643	0.0	
01/01/1936	Rainbow Trout	UNKNOWN	Fry	40,000	0.0	
01/01/1936	Rainbow Trout	UNKNOWN	Unknown	3,810	0.0	
01/01/1937	Rainbow Trout	UNKNOWN	Unknown	5,000	0.0	
01/01/1938	Rainbow Trout	PINANTAN	Fingerling	10,000	0.0	
01/01/1939	Rainbow Trout	PINANTAN	Fingerling	10,000	0.0	
01/01/1940	Rainbow Trout	PINANTAN	Fingerling	45,000	0.0	
01/01/1941	Rainbow Trout	PINANTAN	Yearling	500	0.0	
01/01/1941	Rainbow Trout	PINANTAN	Fingerling	30,250	0.0	
01/01/1942	Rainbow Trout	PINANTAN	Fingerling	30,000	0.0	
01/01/1943	Rainbow Trout	PAUL	Fingerling	19,000	0.0	
01/01/1943	Rainbow Trout	PAUL	Fingerling	20,000	0.0	
01/01/1945	Rainbow Trout	KNOUFF	Fingerling	5,150	0.0	
01/01/1946	Rainbow Trout	KNOUFF	Fingerling	25,840	0.0	
01/01/1947	Rainbow Trout	PAUL	Fingerling	13,801	0.0	
01/01/1947	Rainbow Trout	PAUL	Fingerling	10,226	0.0	
01/01/1948	Rainbow Trout	PAUL	Fingerling	20,000	0.0	
01/01/1949	Rainbow Trout	PINANTAN	Fingerling	15,000	0.0	
01/01/1950	Rainbow Trout	PAUL	Fingerling	5,000	0.0	
01/01/1950	Rainbow Trout	PETERHOPE	Fingerling	15,000	0.0	
01/01/1952	Cutthroat Trout		Fingerling	5,000	0.0	
01/01/1955	Rainbow Trout	SWALWELL	Fingerling	35,000	0.0	
01/01/1956	Cutthroat Trout	SFH	Fingerling	6,600	15.0	
01/01/1962	Rainbow Trout	WASHINGTON	Yearling	6,895	30.0	
01/01/1964	Rainbow Trout	PENNASK	Fingerling	310	15.0	
01/01/1965	Cutthroat Trout	CORVALLIS	Fingerling	3,420	15.0	
01/01/1967	Cutthroat Trout	OREGON	Fingerling	4,345	15.0	
01/01/1969	Cutthroat Trout	OREGON	Fingerling	3,975	15.0	
01/01/1978	Cutthroat Trout	TAYLOR	Unknown	2,800	11.0	
01/06/1980	Rainbow Trout	PENNASK	Unknown	3,000	16.0	LV
01/05/1981	Rainbow Trout	NRT PREMIER	Unknown	3,000	4.2	
01/05/1983	Rainbow Trout	NRT PREMIER	Unknown	3,000	3.0	
01/06/1984	Rainbow Trout	PREMIER DR	Unknown	1,000	11.8	
01/04/1986	Rainbow Trout	FRASER VALLEY	Unknown	2,000	127.4	
01/03/1987	Rainbow Trout	FRASER VALLEY	Unknown	1,000	166.7	
01/05/1987	Rainbow Trout	FRASER VALLEY	Unknown	6,165	5.0	
01/04/1988	Rainbow Trout	FRASER VALLEY	Unknown	2,500	138.9	
01/12/1988	Rainbow Trout	FRASER VALLEY	Unknown	2,500	138.9	
03/04/1989	Cutthroat Trout	TAYLOR	Yearling	1,500	41.8	
10/04/1989	Rainbow Trout	FRASER VALLEY	Catchable	2,500	125.0	
11/09/1989	Rainbow Trout	FRASER VALLEY	Catchable	2,500	135.1	
22/03/1990	Cutthroat Trout	TAYLOR	Yearling	1,516	35.0	
15/06/1990	Rainbow Trout	FRASER VALLEY	Catchable	2,500	227.3	
25/10/1990	Rainbow Trout	FRASER VALLEY	Catchable	2,500	119.0	
15/03/1991	Cutthroat Trout	TAYLOR	Yearling	1,500	34.6	

Appendix E – Stocking History Continued

Release Date	Species	Stock	Stage	Number	Avg Size (g)	Mark
15/05/1991	Rainbow Trout	FRASER VALLEY	Catchable	1,905	113.2	
04/11/1991	Rainbow Trout	FRASER VALLEY	Catchable	2,000	114.9	
05/03/1992	Cutthroat Trout	TAYLOR	Yearling	1,500	41.3	
09/04/1992	Rainbow Trout	FRASER VALLEY	Catchable	800	125.0	
21/05/1992	Rainbow Trout	FRASER VALLEY	Catchable	1,200	138.9	
05/11/1992	Rainbow Trout	TUNKWA	Yearling	469	83.4	
12/11/1992	Rainbow Trout	FRASER VALLEY	Catchable	2,000	107.5	
19/03/1993	Cutthroat Trout	PAQ	Yearling	1,000	34.4	
26/03/1993	Cutthroat Trout	PAQ	Yearling	500	41.1	
16/06/1993	Rainbow Trout	FRASER VALLEY	Catchable	2,000	125.0	
20/09/1993	Rainbow Trout	FRASER VALLEY	Catchable	2,000	164.3	
10/02/1994	Rainbow Trout	FRASER VALLEY	Catchable	2,000	140.8	
18/03/1994	Cutthroat Trout	TAYLOR	Yearling	1,500	40.5	
15/04/1994	Cutthroat Trout	TAYLOR	Yearling	315	41.3	
14/09/1994	Rainbow Trout	FRASER VALLEY	Catchable	1,000	156.2	
27/10/1994	Rainbow Trout	FRASER VALLEY	Catchable	700	172.5	
02/03/1995	Rainbow Trout	FRASER VALLEY	Catchable	1,000	139.3	
09/03/1995	Cutthroat Trout	TAYLOR	Yearling	1,500	35.9	
08/05/1995	Rainbow Trout	FRASER VALLEY	Catchable	1,000	125.8	
01/06/1995	Rainbow Trout	FRASER VALLEY	Catchable	750	140.9	
19/10/1995	Rainbow Trout	FRASER VALLEY	Catchable	641	158.9	
19/10/1995	Rainbow Trout	FRASER VALLEY	Catchable	1,359	169.1	
06/03/1996	Rainbow Trout	FRASER VALLEY	Catchable	1,000	153.2	
18/03/1996	Cutthroat Trout	TAYLOR	Yearling	1,500	34.9	
23/05/1996	Rainbow Trout	FRASER VALLEY	Catchable	1,000	150.9	
02/10/1996	Rainbow Trout	FRASER VALLEY	Catchable	1,000	153.3	
30/10/1996	Rainbow Trout	FRASER VALLEY	Catchable	1,000	178.1	
05/03/1997	Rainbow Trout	FRASER VALLEY	Catchable	1,000	172.4	
10/03/1997	Cutthroat Trout	TAYLOR	Yearling	1,500	37.8	
22/05/1997	Rainbow Trout	FRASER VALLEY	Catchable	500	153.9	
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15/03/2000	Cutthroat Trout	TAYLOR	Yearling	2,000	46.0	
09/03/2001	Cutthroat Trout	TAYLOR	Yearling	4,000	38.7	
13/03/2002	Cutthroat Trout	TAYLOR	Yearling	4,000	36.2	