

ALPINE DEVELOPMENT PROJECT FISH SURVEY-1999

Final Report

November 1999



Prepared by:

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Lopez Island, WA**

Prepared for:

**ARCO Alaska, Inc.
700 G Street
Anchorage, AK**

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EXECUTIVE SUMMARY

Sampling for fish was conducted in 5 lakes within the Alpine Development Area during summer 1999, with a three separate objectives.

Objective 1: Identify sites that can be used for long-term monitoring in lakes T6.1 (L9313) and U6.1 (L9312), which are to serve as the water sources for the Alpine Development.

Objective 2: Identify fish species that are likely to require passage through the swale west of the Alpine runway during high water.

Objective 3: Investigate fish populations in lakes W5.1 (L9323) and W5.3 to evaluate possible effects of water withdrawal during winter 1998/1999. Lake W5.1 (L9323) was over-drawn (the withdrawal exceeded the permitted volume) and lake W5.3 was not covered under the 1998/1999 permits.

A site suitable for efficient fyke net sampling was identified on both water source lakes. The site on lake T6.1 (L9313) is on the north end of the lake near the Alpine pad, while the site on lake U6.1 (L9312) is on the eastern side. Six fish species have been identified from each lake.

Fourteen fish species have been identified as using the lake complex downstream of the swale and are thus likely to use the swale for passage when it is available. Chum salmon juveniles were identified for the first time in the Alaskan Beaufort Sea region – they were rearing in the small lake immediately west of the Alpine runway. Other species included the complex of fishes commonly caught within delta channels and tapped lakes, including broad whitefish, least cisco, humpback whitefish, round whitefish, arctic grayling and rainbow smelt.

The lakes that were investigated for possible effects of excess water withdrawal showed no discernable effects – the species composition and size ranges in lake W5.1 (L9323) were similar before and after the water withdrawals of 1998/1999. Lake W5.3 had a relatively high density of large least cisco. Bathymetric surveys indicated the winter water withdrawal was 15% of the volume that would have been permitted if the lake had been permitted the previous year.

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ALPINE DEVELOPMENT PROJECT FISH SURVEY-1999

INTRODUCTION

Sampling was conducted in five lakes to address several fish issues during summer 1999 in the Alpine Development Area (Figure 1). The primary objective was to identify sites that could be used for long-term monitoring of lakes T6.1 (L9313) and U6.1 (L9312), which are being used as water source lakes for the Alpine Development. Both lakes were known to contain fish prior to their being permitted for water withdrawal.

Sampling was also conducted in lake T5.5, a tapped lake that is the downstream end of the swale (Figure 2). The objective of sampling at lake T5.5 was to identify fish that would likely utilize the swale for passage when water levels are high enough to allow passage. Flow through the swale is most likely to occur during the high water level associated with break-up, but the project was not authorized in time to permit sampling during that period.

Sampling was conducted on two additional lakes in the Alpine Development Area. During the 1998/1999 winter, excess water was withdrawn from lake W5.1 (L9323), and water was drawn from lake W5.3, for which no survey data existed. A sampling program was designed to assess whether there are any discernible effects to lake W5.2. Information on bathymetry and fish presence were obtained from unsurveyed lake W5.3 to assess the potential effects of the water withdrawal on fish populations, if present.

METHODS

The biological survey consisted of biological sampling with fyke nets or gill nets combined with physical measurements. The gear type used was dictated by the specific objectives associated with each sampled lake.

Lakes T6.1 (L9313) and U6.1 (L9312) were sampled by fyke net because the sampling objective was to identify sites where long-term monitoring of the fish populations could be accomplished. The goal was to sample fish with non-lethal gear so that the sampling would not be the cause of any observed changes to the populations. In these lakes, fish were measured and released, with no fish retained for laboratory analysis.

Lake T5.5 was similarly sampled with a fyke net because large numbers of fish were expected (lake T5.5 is a tapped lake connected to the Colville Delta river channels, thus allowing free movement of fish) and fyke nets are less selective to the size of fish captured than are gill nets. The fyke net

was placed near the downstream end of the swale (Figure 3). Again, all fish were measured and released, except for two chum salmon smolts. Substantial information has been collected on growth rates and length-weight relationships of the dominant fish species utilizing the channel and tapped lake habitats, thus additional measurements were not needed.

Lakes W5.1 (L9323) and W5.3 were sampled with short-duration gill net sets using a multimesh gill net (120 feet long, six panels of variable mesh, mesh size ranging from 1 to 3.5 inches stretched mesh). These nets have been previously used to collect inventory-level data from lakes throughout the delta and nearby areas. The sets were kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Fish captured were measured and released if not severely injured. Dead or severely injured fish were returned to the laboratory to extract age, sex, maturity and weight information.

Duration of each set for all gear types was recorded to allow calculation of catch rates. Water quality measurements included water temperature, specific conductance or salinity, and dissolved oxygen.

Bathymetric data were collected in lakes W5.2 (L9323) and W5.3 to allow estimating lake volume. Depths were taken with an Eagle SupraPro ID depth sounder. Transect positions were determined by marking the beginning and end locations of the transects on base maps of the lakes. Individual depth measurements were located with a hand-held GPS receiver while traversing the lake with either a boat or float tube. The readings were converted to distance measurements and the resulting points were plotted on the known location of the transect.

Depth measurements were plotted on base maps of each lake. Initial plots of transects obtained during summer appeared erratic because of error caused by U.S. Department of Defense scrambling of the civilian GPS signal. Transects were manually smoothed to better represent the course covered by the boat or float tube.

RESULTS AND DISCUSSION

Biological Observations

Lakes T6.1 (L9313) and U6.1 (L9312). The initial objective was to locate a site where the fyke nets could be fished effectively. These nets require about 75 feet of fairly uniform depth, or depths gradually increasing from about 1 foot to 3 feet over the length of the net to fully extend the lead (50 foot lead + approx. 25 foot long trap). Two fyke net locations were fished on each lake.

Lake T6.1 (L9313) Results

Much of the shoreline along lake T6.1 (L9313) is steep, with minimal littoral area, making fyke nets inefficient. The initial sets (Net A) were made on a narrow sandy shoal on the northwest shore

on July 28 (Figure 3). This shoal was not wide enough to allow full deployment of the lead perpendicular to shore, so the lead was angled to the north. Catches were low (Table 1). On July 30, the net was moved northeast to the Net B location (Figure 3). This location has a broader shoal that allowed maximum extension of the lead and trap, with the trap almost covered with water – an ideal set for maximum efficiency.

Fyke net sampling in T6.1 (L9313) conducted between July 28 and August 4, 1999 produced a catch of 1,104 fish (Table 1). Least cisco and ninespine stickleback were the most abundant species, with Alaska blackfish, broad whitefish, humpback whitefish and round whitefish also caught. Catch rates fluctuated greatly from day-to-day (Table 2). Average catch rates were much higher at the Net B location. The results indicate that the Net B location is preferable as a monitoring site. This location is fortuitous because the site can be accessed by foot from the Alpine Facilities Pad and will not require special access considerations (Figure 4).

The least cisco and whitefish were all juveniles, most probably age 2, with some age 0 and 1 fish also present (based on length frequency analysis – Appendix A). The pattern of catch indicates there may be a single large school of least cisco, with a few broad whitefish and humpback whitefish, cruising around the lake.

Previous sampling in lake T6.1 (L9313) indicated few fish resided in the lake (Table 3), with ninespine stickleback and low densities of least cisco and Alaska blackfish present. The high catches of least cisco in 1999, along with the new records of broad whitefish, humpback whitefish, and round whitefish, likely indicate that fish have entered the lake during a recent high water period possible in 1998 or 1999.

Lake U6.1 (L9312) Results

Lake U6.1 (L9312) has a broad, shallow, sandy shoal that appears to be eroding from dunes along the eastern shore (Figure 3). The fyke was initially set at the northern end of the shoal on July 28, where the water begins to deepen (Net A location). Catches were low (Table 1), so on July 31 the net was moved north to the Net B location, where the emergent vegetation was less dense. Catches immediately increased.

Ninespine stickleback, slimy sculpin and least cisco were the most numerous fish, with round whitefish, broad whitefish and Alaska blackfish also caught. Catch rates were generally higher at the Net B location, although the round whitefish catch rate was higher at Net A (Table 2).

Fish in lake U6.1 (L9312) tended to be larger than those caught in lake T6.1 (L9313), with more age groups represented (Appendix B – based on length frequency analysis). Previous sampling in the lake has shown that the least cisco in this lake are stunted, with many in the 200-220 mm length range sexually mature. This lake likely supports a reproducing population of least cisco.

The locations selected for long term monitoring at the two water source lakes are:

T6.1 (L9313): 70°20.699'N 150°55.913'W

U6.1 (L9312): 70°20.040'N 150°56.362'W

Lake T5.5. The objective of sampling in this lake was to identify those species that are likely to utilize the swale for passage when water levels are high enough to allow fish passage. Lake T5.5 is a small tapped lake on the west side of the Alpine runway (Figure 1). The lake is on the downstream end of the swale and drains in turn into a large tapped lake, S6.1 (L9278), that is connected to the Sakoonang Channel by a long deep channel. Sampling by fyke net in lake S6.1 (L9278) during 1995 revealed use of that lake by least cisco, broad whitefish, humpback whitefish, round whitefish and ninespine stickleback (Table 4). Thirteen species were captured in 1996 when the outlet channel of S6.1 (L9278) was sampled, with least cisco, broad whitefish, and rainbow smelt providing 88% of the catch.

The 1999 sampling covered four days, with a catch of 561 fish representing 9 species (Table 1). Chum salmon was the only species not previously recorded from this tapped lake complex. Catch rates of broad whitefish were similar across all three sampling years, with other species showing varying levels of abundance (Table 4). Most fish were juveniles (Appendix C), which is consistent with previous sampling in delta channels and tapped lakes. Two of the 214 least cisco, and possibly one of the 30 round whitefish were large enough to be mature.

The two chum salmon smolts (i.e. juveniles migrating to sea) was the first known catch of juvenile salmon from the Colville region, and probably the first such catch east of Barrow. Craig and Haldorson (1986), in a review of existing information on Pacific salmon in the Alaskan and Canadian arctic region, note that “no salmon fry of any species have been collected in the study area, even near the Mackenzie River, which is know to support stocks of chum salmon.”

Lakes W5.1 (L9323) and W5.3. Sampling was conducted to assess the fish populations in these lakes after water withdrawals during the 1998/1999 winter. Lake W5.1 (L9323) had been permitted for a withdrawal of 5,722,290 gallons – the actual withdrawal exceeded this permitted take by 422,290 gallons (ADF&G letter of May 4, 1999 to W. Fowler, ARCO Alaska). An additional 190,000 gallons of water were withdrawn from lake W5.3, although this lake had not been permitted for water withdrawal during the 1998/1999 winter.

Lake W5.1 (L9323) was sampled on July 27, 1999 for 6.1 hours; previous sampling had been for 5.6 hours on July 21, 1996 (Table 5). The same three species (broad whitefish, round whitefish and least cisco) were captured in the same general size range. In 1996, a school of 50 least cisco was caught, while in 1999, only 3 were captured. Such differences in catch rate are expected given the short duration of sampling in a lake of this size. The indication is that the lake still supports populations of species previously identified from the lake.

Lake W5.3, a small (11.5 acre) lake immediately east of the Alpine pipeline, was sampled on July 26, 1999. A gill net set for 2.1 hours captured 19 large least cisco (310-423 mm) (Table 5). The large size and condition of the fish indicated that they were the fast-growing type of least cisco described from the Colville Delta by Moulton (1997). The maximum observed depth of the lake was 13.8 feet, thus the estimated permittable water withdrawal would be 1,263,085 gallons. The unauthorized water withdrawal in 1998/1999 represented 15% of the acceptable water use, thus impacts to fish use were likely minimal.

LITERATURE CITED

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Moulton, L.L. 1997. Colville Delta fish habitat study 1995-1996. Report to ARCO Alaska Inc. Bainbridge Island, WA. 45 p. + appendices.

Moulton, L.L. 1998. Lakes sampled for fish within and near the Colville River delta, Alaska 1979-1998. Report to ARCO Alaska Inc. Bainbridge Island, WA. 513p.

Table 1. Catch by species at Alpine fyke net sampling locations, 1999

Lake T6.1 (L9313)

Species	Net A	Net A	Net B	Net B	Net B	Net B	Net B	Net A	Net B
	Jul 29	Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Aug 4	Total	Total
Least cisco	0	1	1	339	11	623	0	1	974
Broad whitefish	0	0	0	4	0	1	0	0	5
Humpback whitefish	0	0	0	1	0	1	0	0	2
Round whitefish	0	0	0	1	0	1	0	0	2
Alaska blackfish	0	1	3	1	1	0	3	1	8
Slimy sculpin	0	0	0	0	0	0	0	0	0
Ninespine stickleback	7	8	6	5	43	20	22	15	96
Effort (hours):	26.83	24.25	24.12	25.25	25.97	19.28	26.72	51.08	121.33

Lake U6.1 (L9312)

Species	Net A	Net A	Net A	Net B	Net B	Net B	Net B	Net A	Net B
	Jul 29	Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Aug 4	Total	Total
Least cisco	0	2	0	40	9	5	6	2	60
Broad whitefish	0	0	0	0	0	1	4	0	5
Humpback whitefish	0	0	0	0	0	0	0	0	0
Round whitefish	11	1	0	4	3	2	3	12	12
Alaska blackfish	0	0	0	0	1	5	1	0	7
Slimy sculpin	0	2	2	32	28	6	13	4	79
Ninespine stickleback	3	4	13	28	46	53	37	20	164
Effort (hours):	20.25	24.17	24.00	25.28	26.08	19.33	26.30	68.42	97.00

Lake T5.5

Species					Total
	Jul 22	Jul 23	Jul 24	Jul 25	
Chum salmon	1	0	1	0	2
Least cisco	11	32	106	65	214
Broad whitefish	19	43	60	17	139
Humpback whitefish	1	0	0	0	1
Round whitefish	11	7	10	1	29
Arctic grayling	0	1	3	1	5
Rainbow smelt	1	0	0	2	3
Fourhorn sculpin	0	0	0	4	4
Ninespine stickleback	14	52	48	50	164
Effort (hours):	28.08	25.25	28.33	21.33	103.00

Table 2. Catch rate (fish per 24 hours) at Alpine fyke net sampling locations, 1999

Lake T6.1 (L9313)

Species	Net:	Net	Net	Net	Net	Net	Net	Net A	Net B	
		A	A	B	B	B	B	Mean	Mean	
		Jul 29	Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Aug 4	CPUE	CPUE
Least cisco		0.0	1.0	1.0	322.2	10.2	775.4	0.0	0.5	221.8
Broad whitefish		0.0	0.0	0.0	3.8	0.0	1.2	0.0	0.0	1.0
Humpback whitefish		0.0	0.0	0.0	1.0	0.0	1.2	0.0	0.0	0.4
Round whitefish		0.0	0.0	0.0	1.0	0.0	1.2	0.0	0.0	0.4
Alaska blackfish		0.0	1.0	3.0	1.0	0.9	0.0	2.7	0.5	1.5
Slimy sculpin		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ninespine stickleback		6.3	7.9	6.0	4.8	39.7	24.9	19.8	7.1	19.0

Lake U6.1 (L9312)

Species	Net	Net	Net	Net	Net	Net	Net	Net A	Net B
	A	A	A	B	B	B	B	Mean	Mean
	Jul 29	Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Aug 4	CPUE	CPUE
Least cisco	0.0	2.0	0.0	38.0	8.3	6.2	5.5	0.7	14.5
Broad whitefish	0.0	0.0	0.0	0.0	0.0	1.2	3.7	0.0	1.2
Humpback whitefish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Round whitefish	13.0	1.0	0.0	3.8	2.8	2.5	2.7	4.7	2.9
Alaska blackfish	0.0	0.0	0.0	0.0	0.9	6.2	0.9	0.0	2.0
Slimy sculpin	0.0	2.0	2.0	30.4	25.8	7.4	11.9	1.3	18.9
Ninespine stickleback	3.6	4.0	13.0	26.6	42.3	65.8	33.8	6.8	42.1

Lake T5.5

Species	Jul 22	Jul 23	Jul 24	Jul 25	Mean
					CPUE
Chum salmon	0.9	0.0	0.8	0.0	0.4
Least cisco	9.4	30.4	89.8	73.1	50.7
Broad whitefish	16.2	40.9	50.8	19.1	31.8
Humpback whitefish	0.9	0.0	0.0	0.0	0.2
Round whitefish	9.4	6.7	8.5	1.1	6.4
Arctic grayling	0.0	1.0	2.5	1.1	1.2
Rainbow smelt	0.9	0.0	0.0	2.2	0.8
Fourhorn sculpin	0.0	0.0	0.0	4.5	1.1
Ninespine stickleback	12.0	49.4	40.7	56.2	39.6

Table 3. Results of fish sampling in lakes T6.1 (L9313) and U6.1 (L9312) prior to 1999.

Lake T6.1 (L9313)

Species	Fyke Net	Fyke Net	Fyke Net	Gill Net	Gill Net	Fyke Net	Gill Net	Lake Total
	Jul 4 95	Jul 26 95	Aug 11 to 15 1997	Nov 1 95	Aug 8 96	Total	Total	
Least cisco	5	0	4	0	0	9	0	9
Broad whitefish	0	0	0	0	0	0	0	0
Humpback whitefish	0	0	0	0	0	0	0	0
Round whitefish	0	0	0	0	0	0	0	0
Alaska blackfish	6	0	12	0	0	18	0	18
Slimy sculpin	0	0	1	0	0	1	0	1
Ninespine stickleback	63	9	0	0	0	72	0	72
Effort (hours):	23.3	20.7	91.2	20.6	9.1	135.2	120.9	

Lake U6.1 (L9312)

Species	Fyke Net	Fyke Net	Fyke Net	Gill Net	Fyke Net	Gill Net	Lake Total
	Jul 14 95	Jul 26 95	Aug 11 to 15 1997	Nov 2 95	Total	Total	
Least cisco	0	0	1	62	1	62	63
Broad whitefish	0	1	0	5	1	5	6
Humpback whitefish	0	0	0	0	0	0	0
Round whitefish	0	0	0	0	0	0	0
Alaska blackfish	1	0	5	0	6	0	6
Slimy sculpin	1	0	5	0	6	0	6
Ninespine stickleback	10	2	57	0	69	0	69
Effort (hours):	23.9	20.0	116.6	21.7	160.5	138.3	

Table 4. Catch rates (fish per 24 hr) from fyke net sampling in channel and tapped lake complex downstream from Alpine swale, 1995-1999.

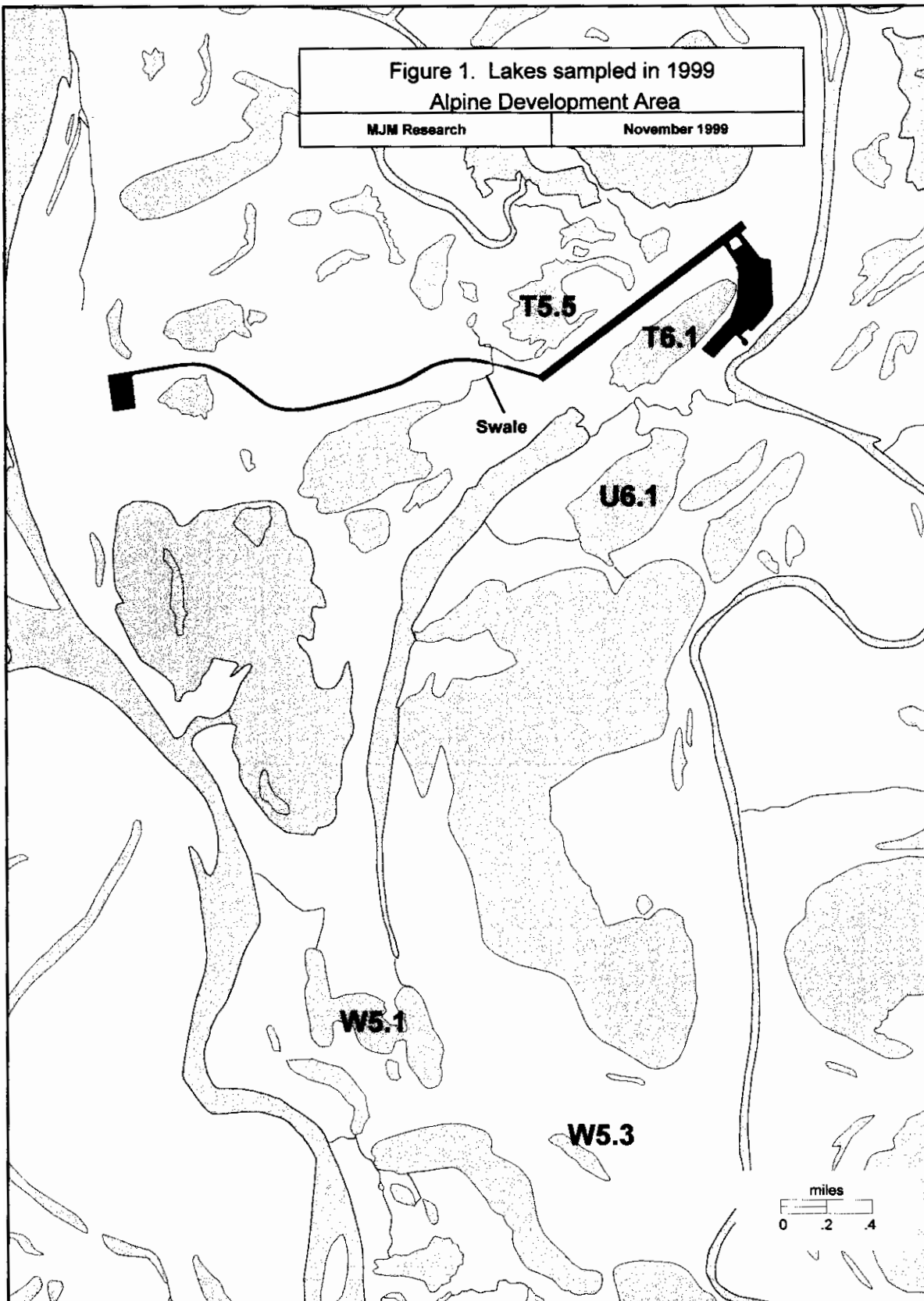
Species	1995 S6.1 (L9278)	1996 Outlet of S6.1	1999 Sampling T5.5
Chum salmon	0.0	0.0	0.5
Broad whitefish	30.6	24.6	32.4
Humpback whitefish	2.0	1.4	0.2
Least cisco	19.8	32.4	49.9
Arctic cisco	0.0	0.0	0.0
Round whitefish	1.0	2.8	6.8
Arctic grayling	0.0	0.0	1.2
Rainbow smelt	0.0	23.2	0.7
Burbot	0.0	0.2	0.0
Longnose sucker	0.0	0.1	0.0
Arctic flounder	0.0	1.9	0.0
Fourhorn sculpin	0.0	2.9	0.9
Threespine stickleback	0.0	0.1	0.0
Ninespine stickleback	4.9	1.9	38.2
Effort (hrs):	24.3	1,232.9	103.0

Table 5. Results of gill netting in lakes W5.1 (L9323) and W5.3 during 1999 and lake W5.1 in 1996.

Lake	Date Sampled	Hours of Netting	Species	Total Catch	Fork Length (mm)
W5.1 (L9323)	7/27/99	6.1	Broad whitefish	1	495
			Least cisco	3	227-305
			Round whitefish	1	153
W5.3	7/26/99	2.1	Least cisco	19	310-423

1996 Results from Lake W5.1

Lake	Date Sampled	Hours of Netting	Species	Total Catch	Fork Length (mm)
W5.1 (L9323)	Jul 21 96	5.6	Broad whitefish	3	400-512
			Least cisco	50	181-319
			Round whitefish	1	217



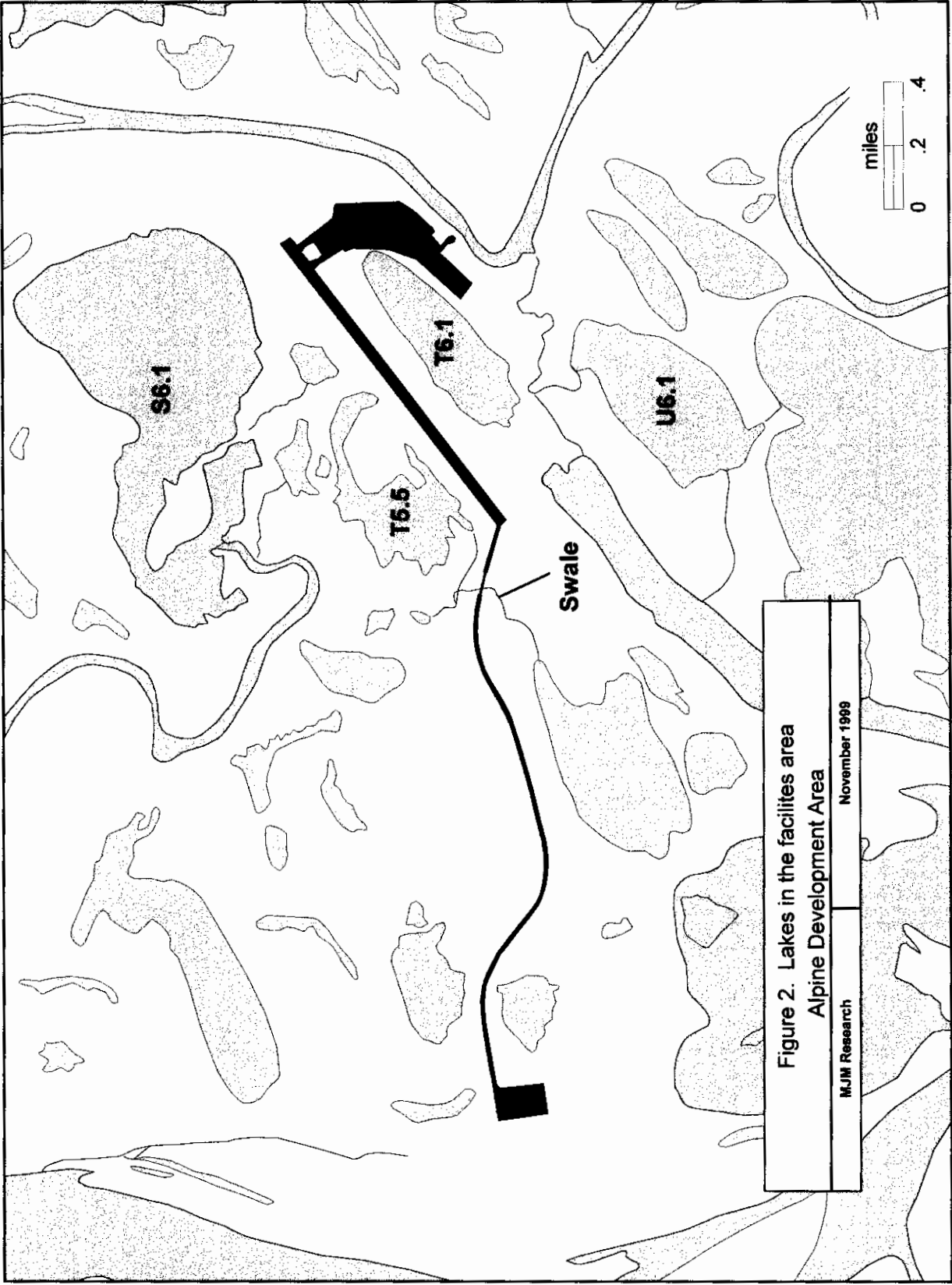




Figure 3. Location of fyke net stations sampled in 1999, Alpine Development Area.
(Note: aerial photography pre-dates placement of Alpine Development pads)



a. Fyke Net at Lake T6.1 (L9313)



b. Fyke Net at Lake U6.1 (L9312)

Figure 4. Fyke net stations selected for long-term monitoring in lakes T6.1 (L9313) and U6.1 (L9312).

Appendix A. Daily length frequencies of fish caught in lake T6.1 (L9313) by fyke net during 1999.

Least cisco					Alaska blackfish					Broad Whitefish							
Fork Length (mm)	Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Total	Fork Length (mm)	Jul 30	Jul 31	Aug 1	Aug 2	Aug 4	Total	Fork Length (mm)	Aug 1	Aug 3	Total
0							0							0			
10							10							10			
20							20							20			
30							30							30			
40				1		1	40							40			
50							50							50			
60							60							60			
70							70		2	1	1		4	70			
80		1	1	1		3	80	1					1	80			
90					3	3	90					3	3	90			
100	1		34	1	86	122	100							100			
110			188	2	356	546	110		1				1	110			
120			101	2	143	246	120							120	1		1
130			6	3	18	27	130							130	2	1	3
140			6	2	18	26	140							140			
150							150							150	1		1
160							160							160			
170							170							170			
180				1		1	180							180			
190							190							190			
200							200							200			
210				1		1	210							210			
220							220							220			
230							230							230			
240							240							240			
250							250							250			
260							260							260			
270							270							270			
280							280							280			
290							290							290			
300							300							300			
310							310							310			
320							320							320			
330							330							330			
340							340							340			
350							350							350			
Total:	1	1	339	11	623*	975	Total:	1	3	1	1	3	9	Total:	4	1	5

*length frequency extrapolated from 240 measured fish

Appendix A. Daily length frequencies of fish caught in lake T6.1 (L9313) by fyke net during 1999.

Humpback whitefish				
Fork	Aug 1	Aug 3	Total	
0				
10				
20				
30				
40				
50				
60				
70				
80				
90	1	1	2	
100				
110				
120				
130				
140				
150				
160				
170				
180				
190				
200				
210				
220				
230				
240				
250				
260				
270				
280				
290				
300				
310				
320				
330				
340				
350				
Total:	1	1	2	

Appendix B. Daily length frequencies of fish caught in lake U6.1 (L9312) by fyke net during 1999.

Round whitefish		Jul 29	Jul 30	Aug 1	Aug 2	Aug 3	Aug 4	Total
Fork Length (mm)								
0								
10								
20								
30								
40								
50								
60								
70								
80								
90								
100								
110								
120		1		1	1			3
130		3						4
140		7		1			1	9
150			1					1
160				1	2			3
170								
180								
190						1		1
200						1		1
210								
220							1	1
230								
240							1	1
250								
260								
270								
280								
290								
300								
310								
320								
330								
340								
350								
360								
370								
380								
390								
400								
410								
420								
430								
440								
450								
460								
470								
480								
Total:		11	1	4	3	2	3	24

Slimy sculpin		Jul 30	Jul 31	Aug 1	Aug 2	Aug 3	Aug 4	Total
Fork Length (mm)								
0								
10								
20								
30								
40								
50								
60		2	1	10	3		3	17
70			1	13	12	2	5	35
80				8	9	3	5	25
90					2	1		3
100								
110								
120								
130								
140								
150								
160								
170								
180								
190								
200								
210								
220								
230								
240								
250								
260								
270								
280								
290								
300								
310								
320								
330								
340								
350								
360								
370								
380								
390								
400								
410								
420								
430								
440								
450								
460								
470								
480								
Total:		2	2	32	28	6	13	83

Appendix C. Daily length frequencies of fish caught in lake T5.5 by fyke net during 1999.

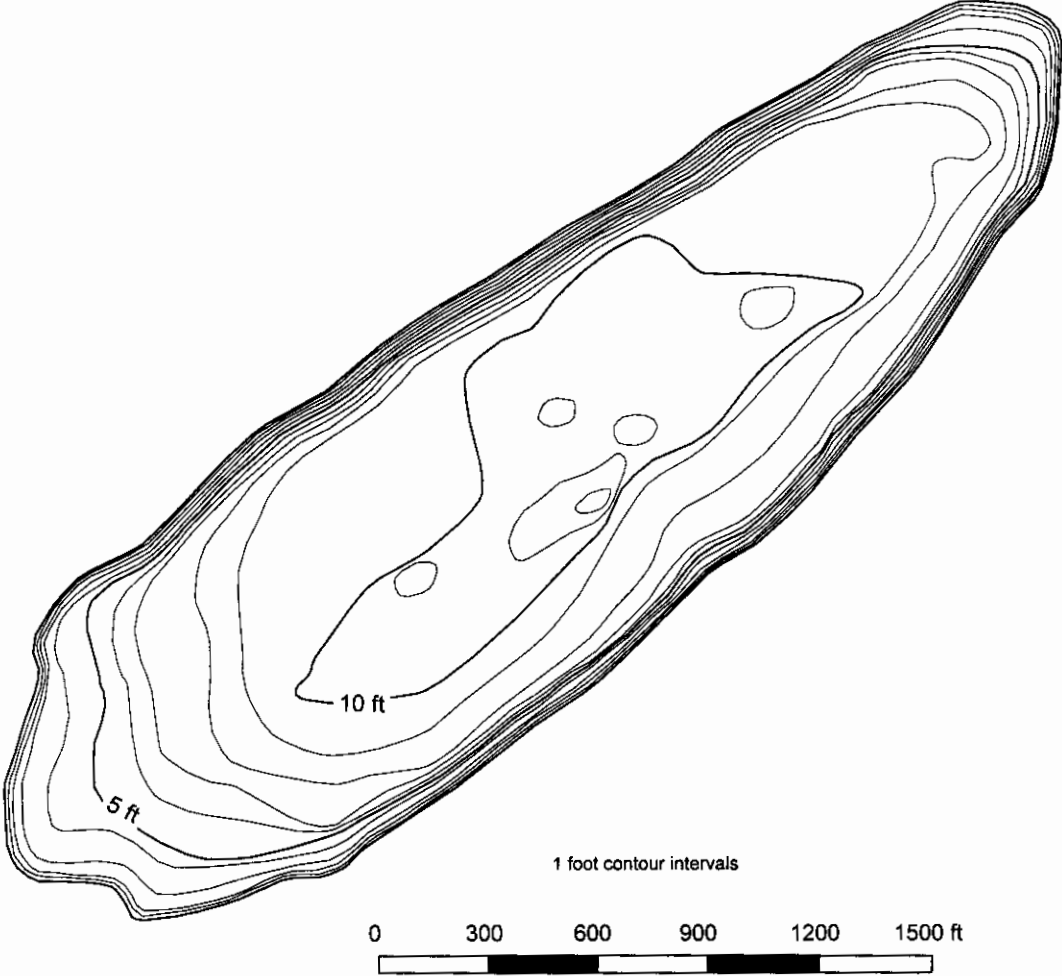
Arctic grayling					Round whitefish					Rainbow smelt					Fourhorn sculpin				
Fork Length (mm)	Jul 23	Jul 24	Jul 25	Total	Fork Length (mm)	Jul 22	Jul 23	Jul 24	Jul 25	Total	Fork Length (mm)	Jul 25	Total	Fork Length (mm)	Jul 25	Total			
0																			
10																			
20																			
30																			
40																			
50																			
60																			
70																			
80						1				1									
90								1		1									
100		1		1		2	1	1	1	5									
110						1				1									
120																			
130		1		1			1			1									
140			1	1		1	2	3		6									
150	1			1		4	1	1		6									
160																			
170						1				1									
180		1		1			1	3		5									
190						1		1		1									
200																			
210																			
220																			
230																			
240																			
250								1		1									
260																			
270																			
280																			
290																			
300																			
310								1		1									
320																			
330																			
340																			
350																			
360																			
370																			
380																			
390																			
400																			
Total:	1	3	1	5	Total:	12	7	10	1	30	Total:	2		Total:	4				

Appendix D. Water quality parameters measured at Alpine Development Area lakes, 1999.

Lake	Date	Water	Dissolved Oxygen		Specific	Salinity (ppt)	pH
		Temperature (°C)	mg/l	Percent Saturation	Conductance µS/cm		
T6.1 (L9313)	Jul 28 99	8.8	12.34	102.2	172		7.82
	Jul 29 99	8.3	11.61	99.1	178		
	Jul 30 99	8.6			170		
	Jul 31 99	9.4			171		
	Aug 1 99	11.4			171		
	Aug 2 99	12.5			177		
	Aug 3 99	12.7			171		
U6.1 (L9312)	Jul 28 99	8.9	11.36	98.6	76		
	Jul 29 99	8.6	11.49	98.9	80		
	Jul 30 99	8.8			76		
	Jul 31 99	9.5			76		
	Aug 1 99	11.4			76		
	Aug 2 99	13.5			79		
	Aug 3 99	12.0			76		
T5.5	Jul 21 99	4.5	12.26	96.4	5,040	2.7	
	Jul 22 99	7.1	11.76	98.1	4,822		7.95
	Jul 23 99	9.1			5,040	2.7	
	Jul 24 99	11.3			4,050	2.2	
	Jul 25 99	11.4			5,120	2.8	

Contour Map of Lake T6.1 (L9313)	
contour data from 1995, 1996 and 1998	
MJM Research	December 1998

Disclaimer: Contours are approximate interpretations of available depth information to estimate lake volume, they should not be used for navigation or design.



Lake T6.1

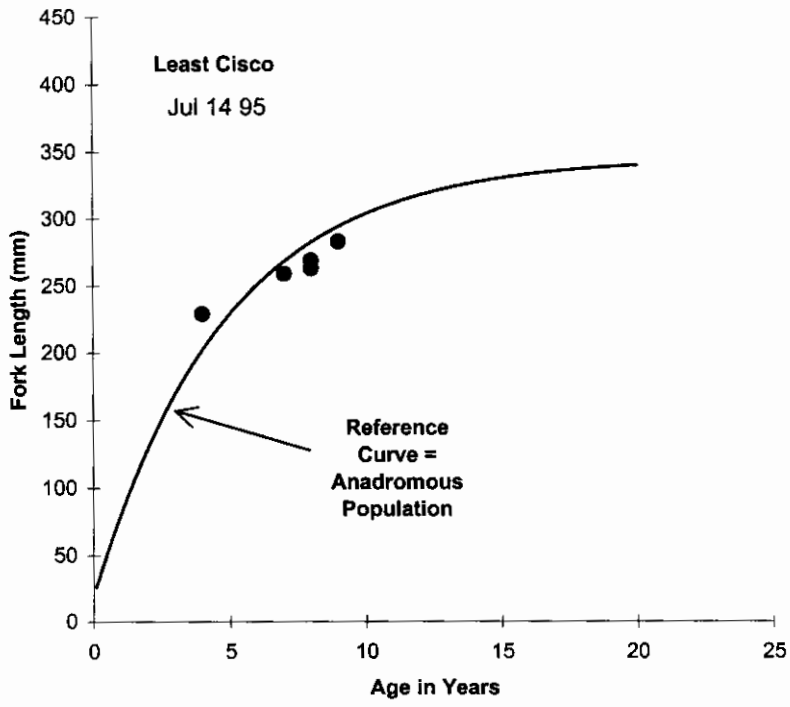
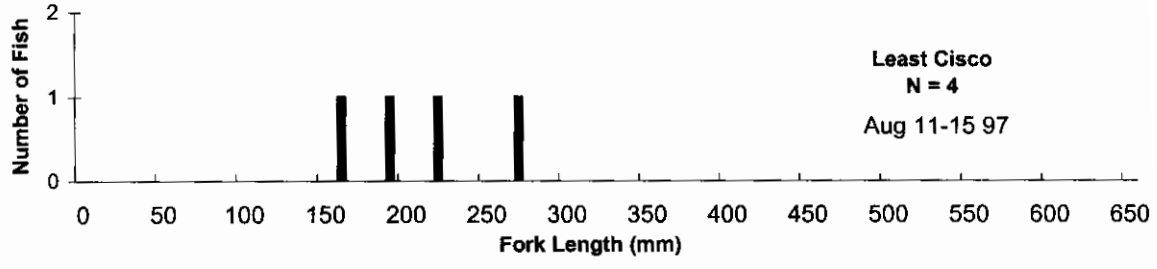
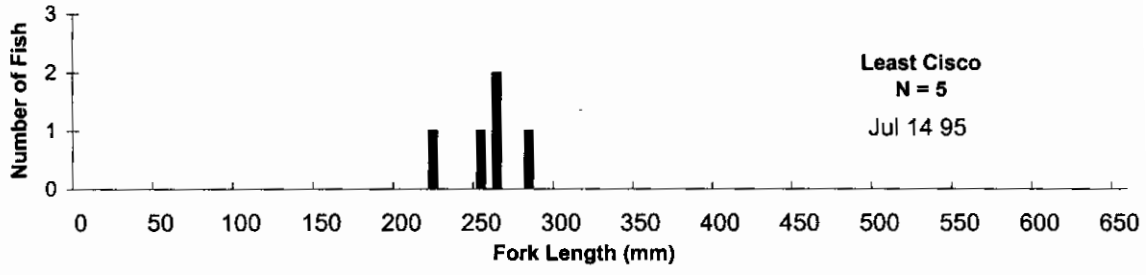
Other Names: L9313
Location: 70°20.52'N 150°56.36'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E, Sect 5
Habitat: Perched Lake (Infrequent Flooding)
Area: 69 acres
Maximum Depth: 12.3 feet
Active Outlet: No
Spec. Conductance: 107 μ S/cm
pH: 7.7
Calculated Volume: 184.6 million gallons (based on depth contours)
Permittable Volume: 6.7 million gallons

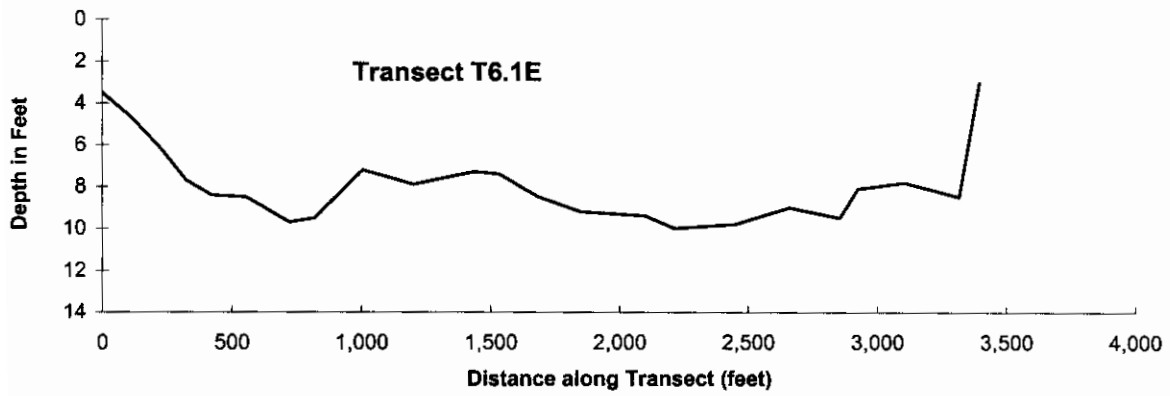
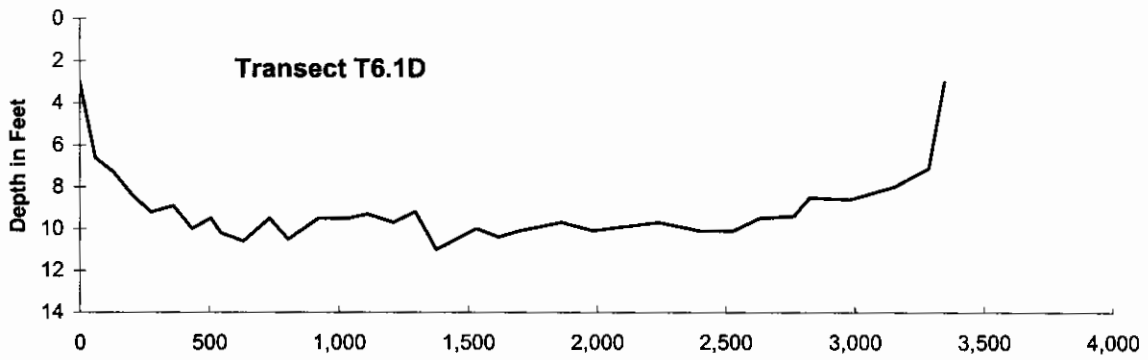
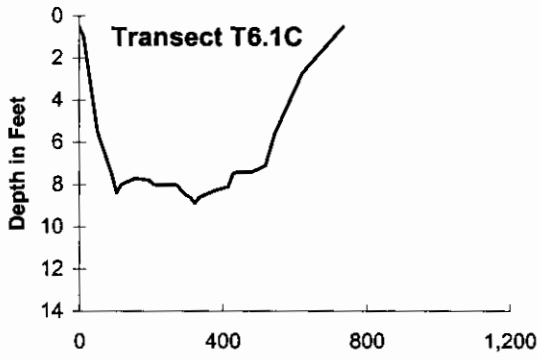
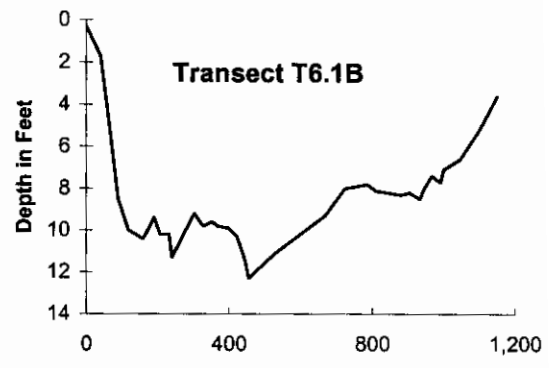
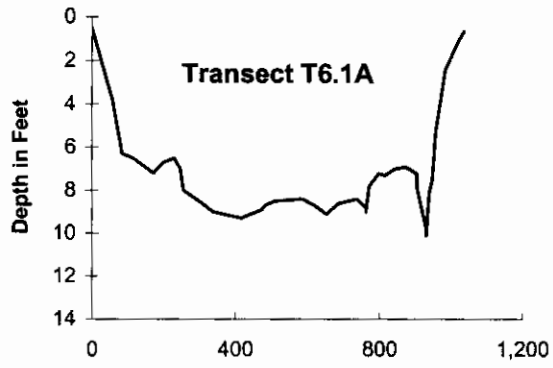
Water Quality:

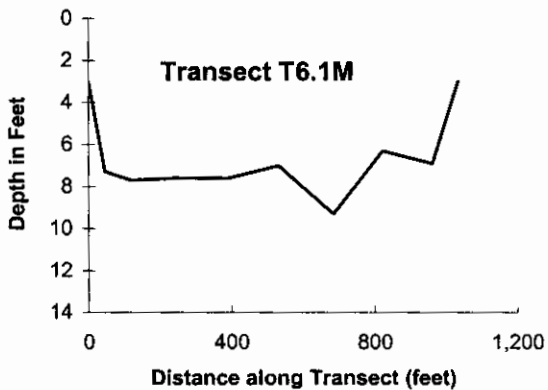
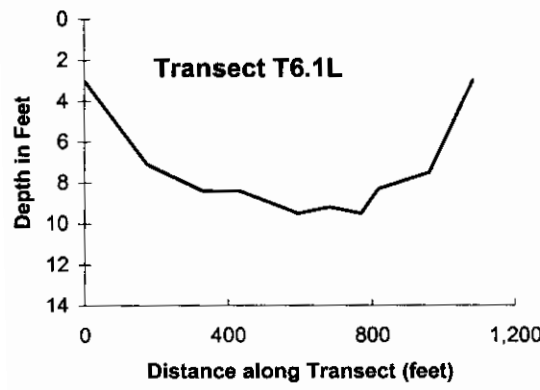
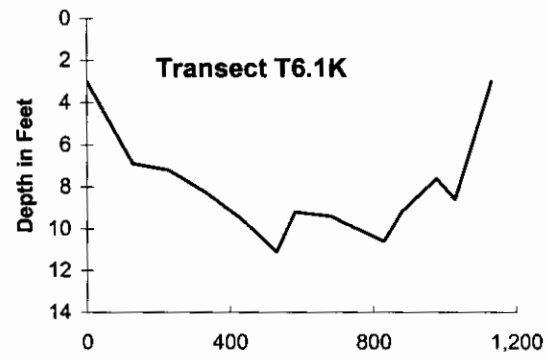
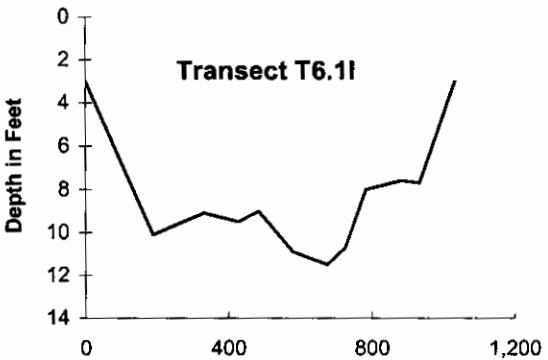
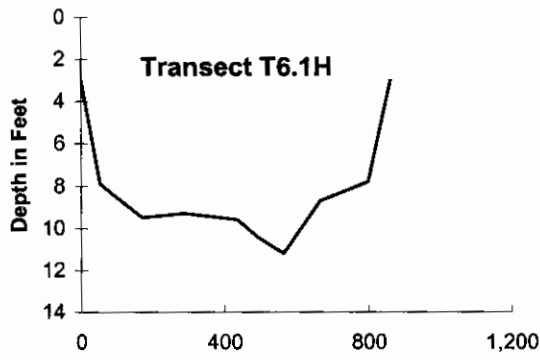
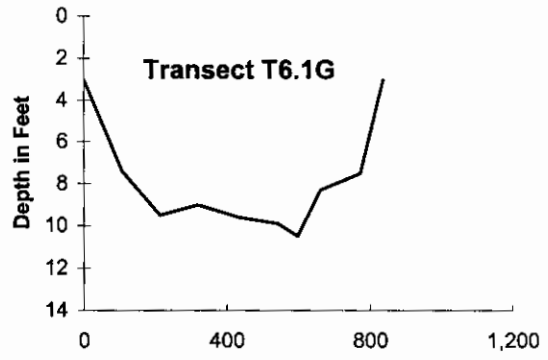
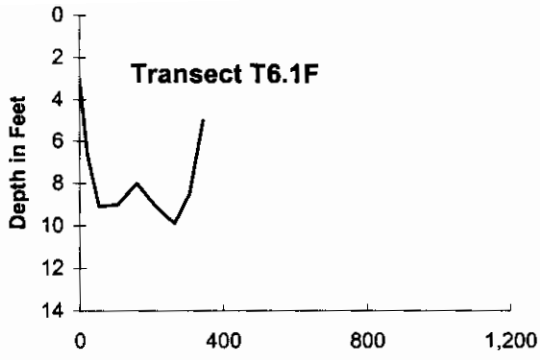
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	19	9.3	3.1	8	33	54	J. Lobdell

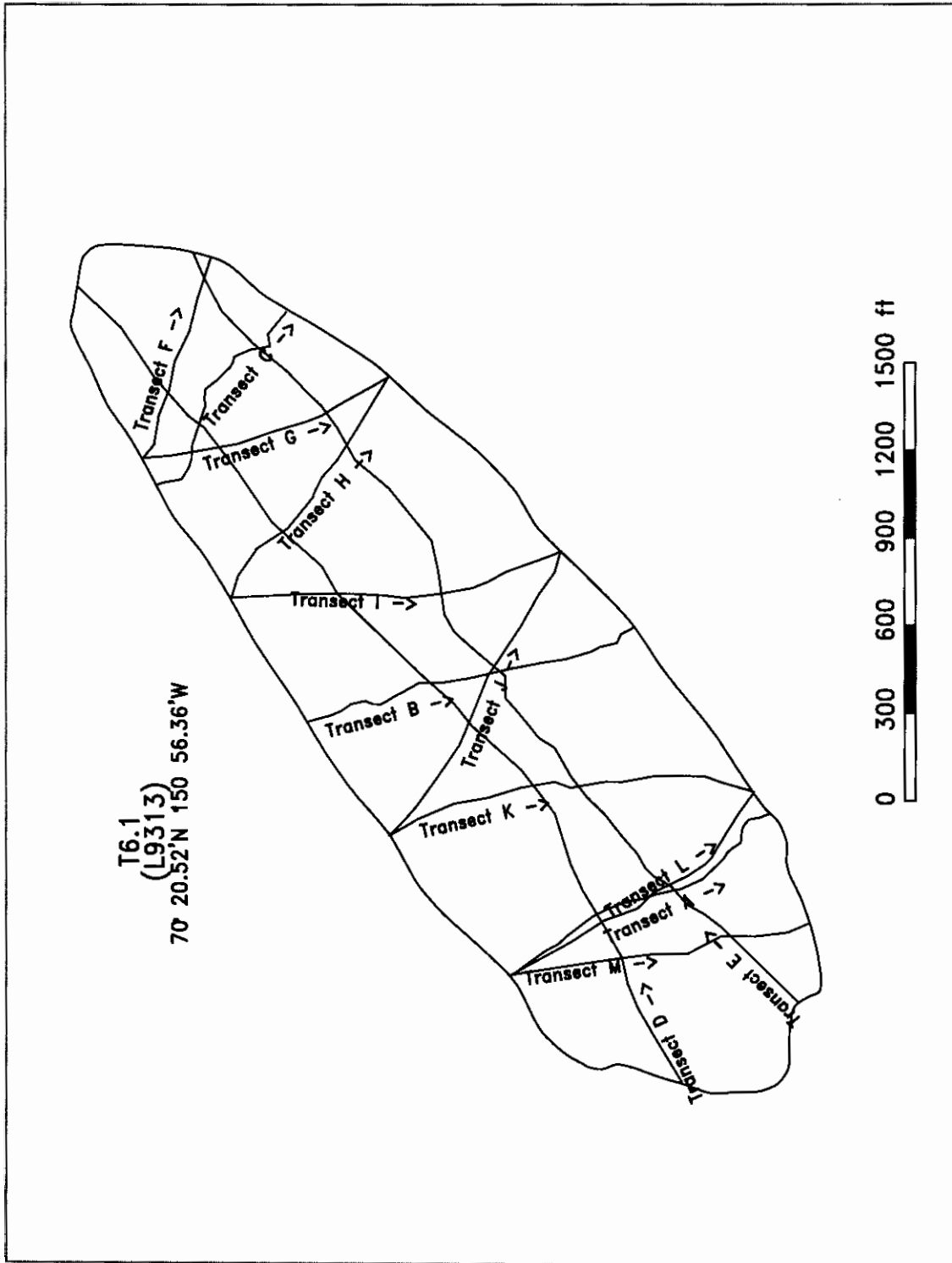
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 14 95	23.3	Least cisco	5	229-283
			Alaska blackfish	6	42-90
			9spine stickleback	63	
Fyke Net	Jul 26 95	20.7	9spine stickleback	9	
Minnow Trap	Jul 15 95	43.2	9spine stickleback	9	
Set Line	Jul 15 95	21.6	None	0	
Set Line	Jul 16 95	24.3	None	0	
Gill Net	Nov 1 95	20.6	None	0	
Gill Net	Aug 8 96	9.1	None	0	
Fyke Net	Aug 11-15 97	91.2	Least cisco	4	167-276
			Alaska blackfish	12	79
			Silmy sculpin	1	
Fyke Net	Jul 28-Aug 4 99	172.4	Least cisco	975	43-216
			Broad whitefish	5	124-152
			Humpback whitefish	2	95, 97
			Round whitefish	2	
			Alaska blackfish	9	70-117
			9spine stickleback	111	









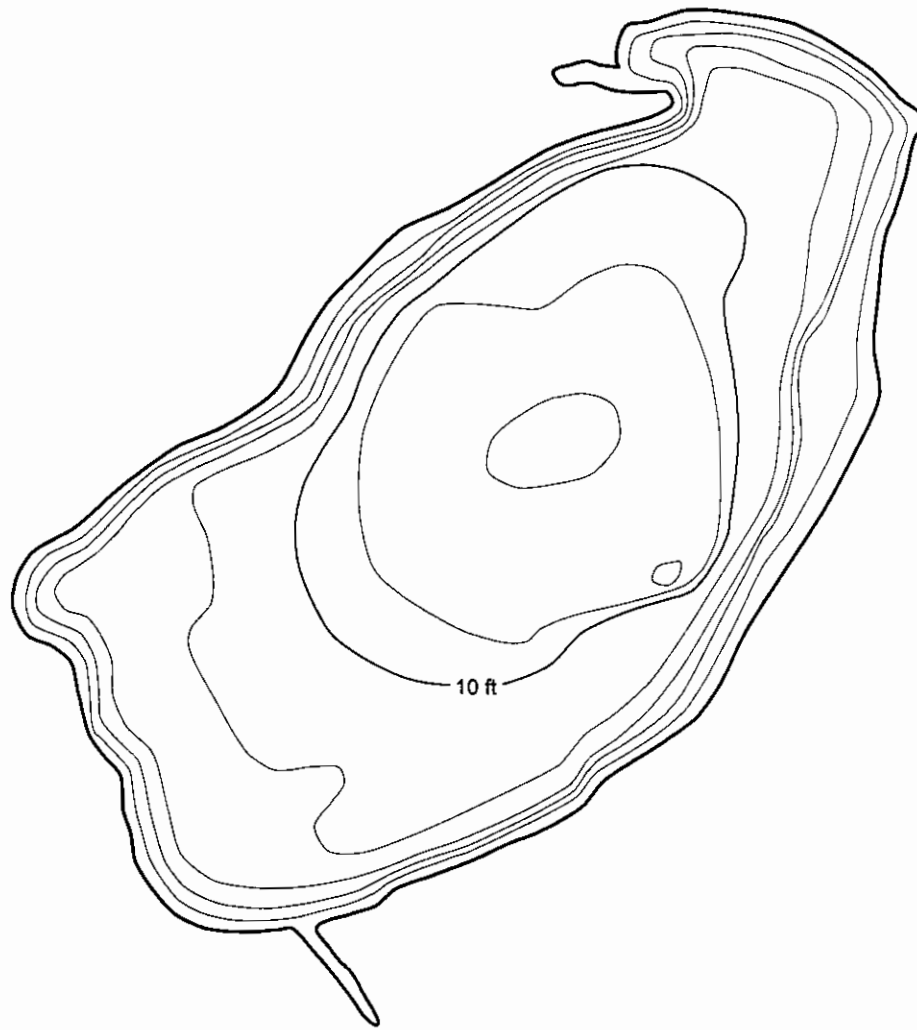
Location of bathymetric transects on lake T6.1 (L9313).

Figure 12. Contour Map of Lake U6.1 (L9312)
depth contours based on 1995, 1997 and 1998 data

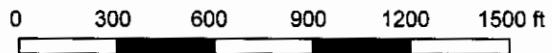
MJM Research

December 1998

Disclaimer: Contours are approximate interpretations
of available depth information to estimate lake volume,
they should not be used for navigation or design.



2 foot contour intervals



Lake U6.1

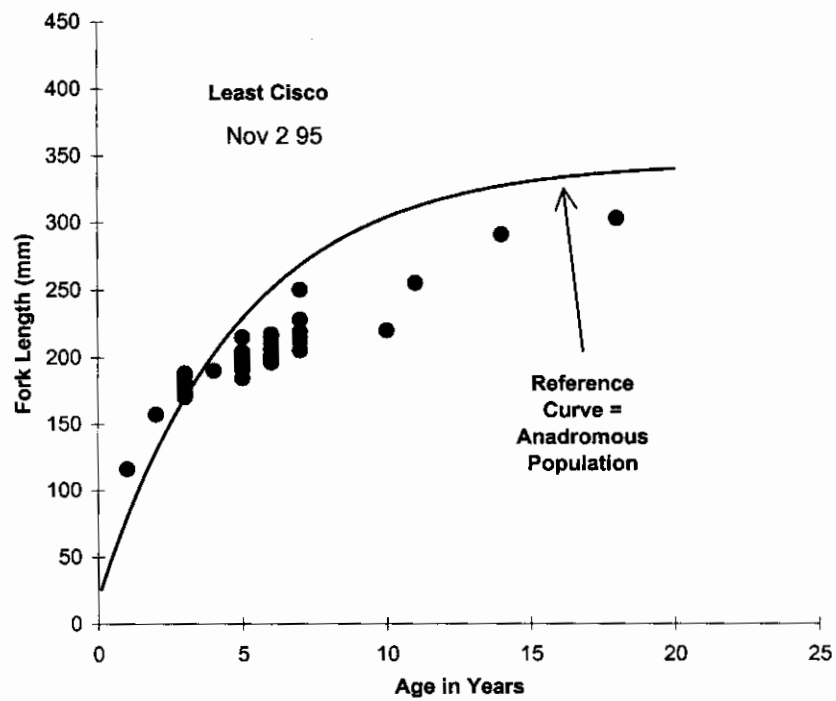
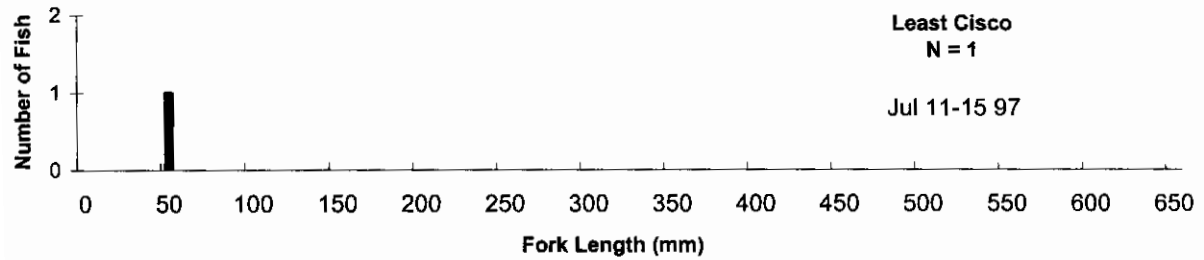
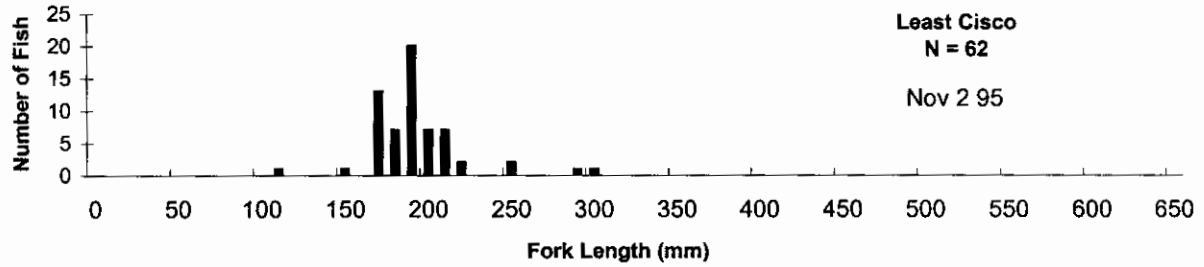
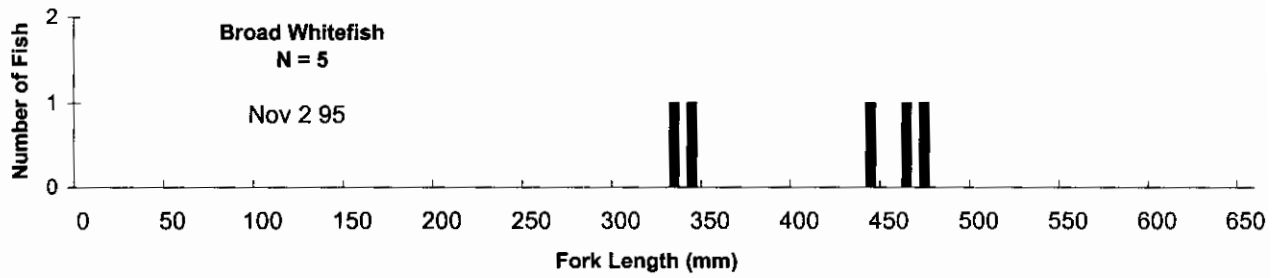
Other Names: L9312
Location: 70°19.91'N 150°56.76'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E, Sect 5
Habitat: Perched Lake (Infrequent Flooding)
Area: 100 acres
Maximum Depth: 14.1 feet
Active Outlet: No
Spec. Conductance: 60 µS/cm
pH: 7.7-8.2
Calculated Volume: 298.0 million gallons
Permittable Volume: 14.2 million gallons

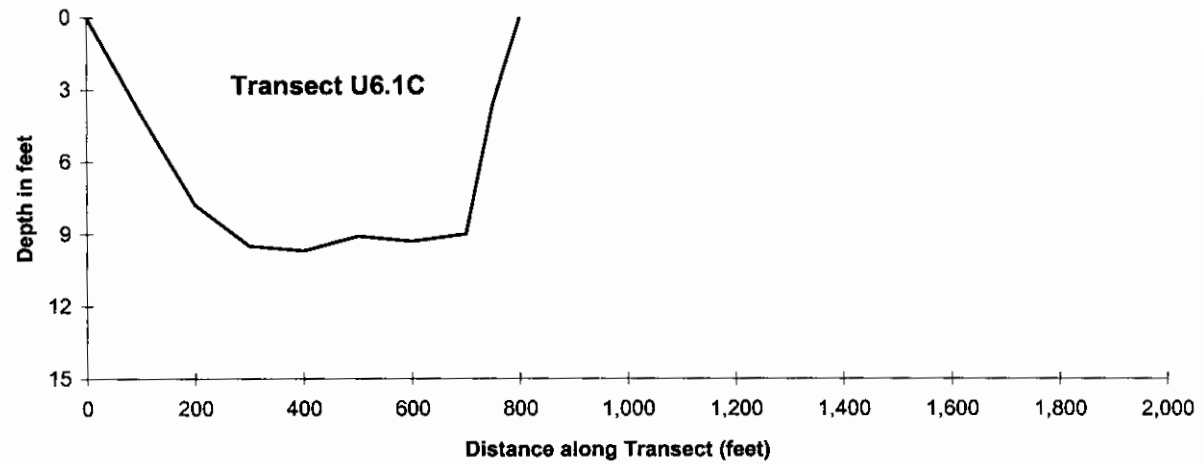
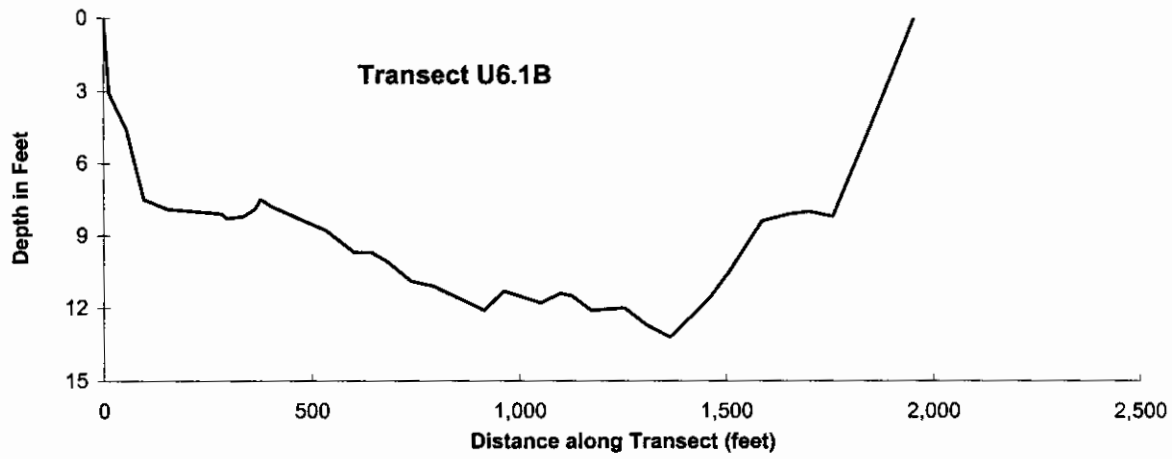
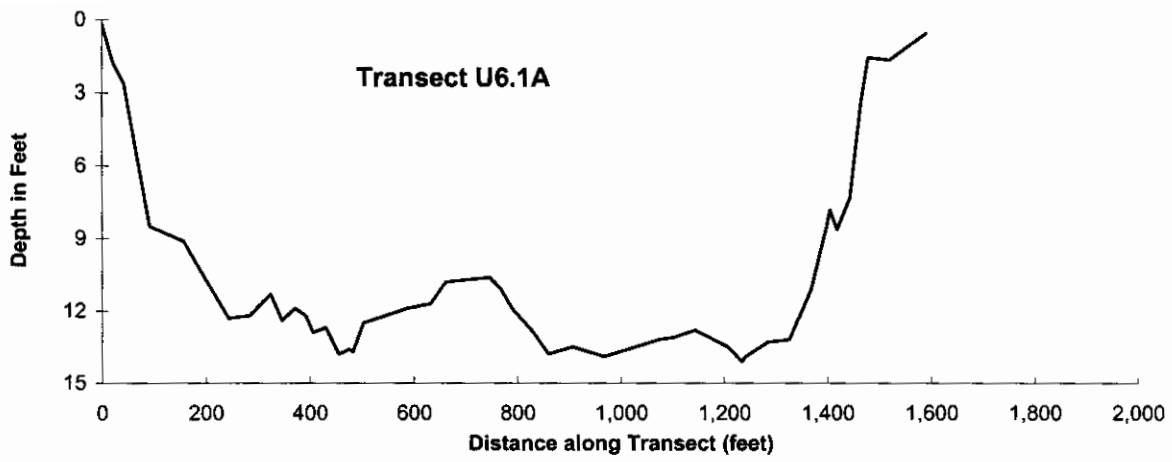
Water Quality:

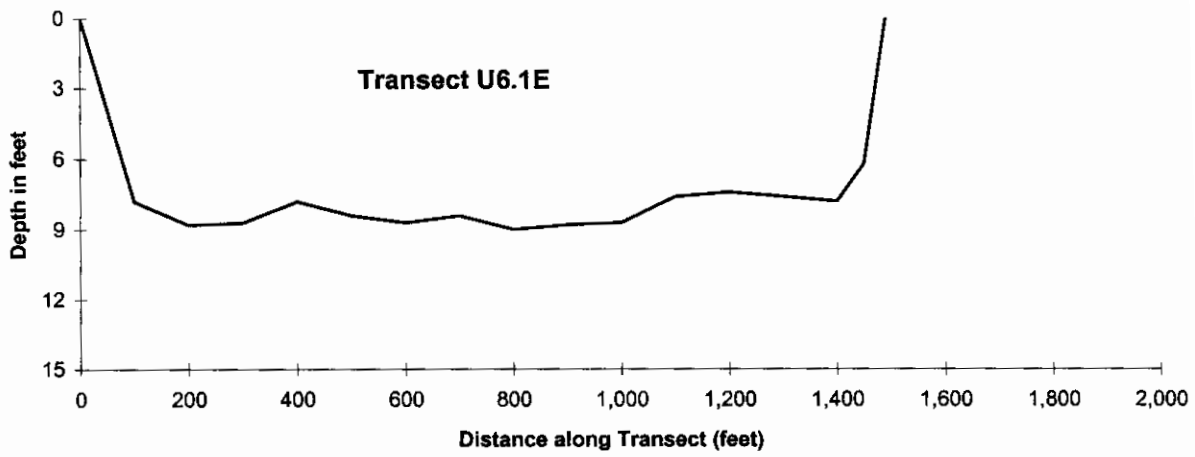
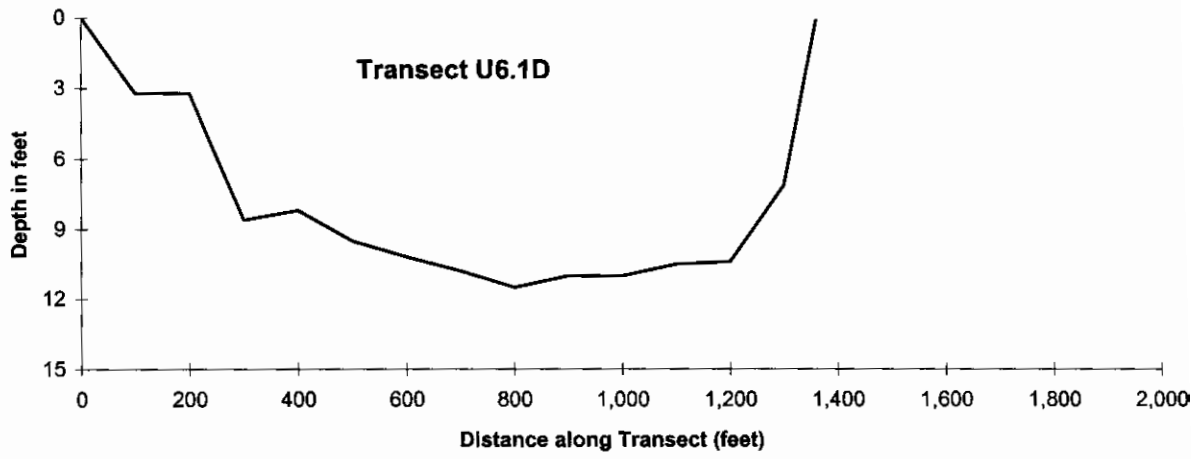
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	8	4.5	2.1	7.2	27	150	J. Lobdell

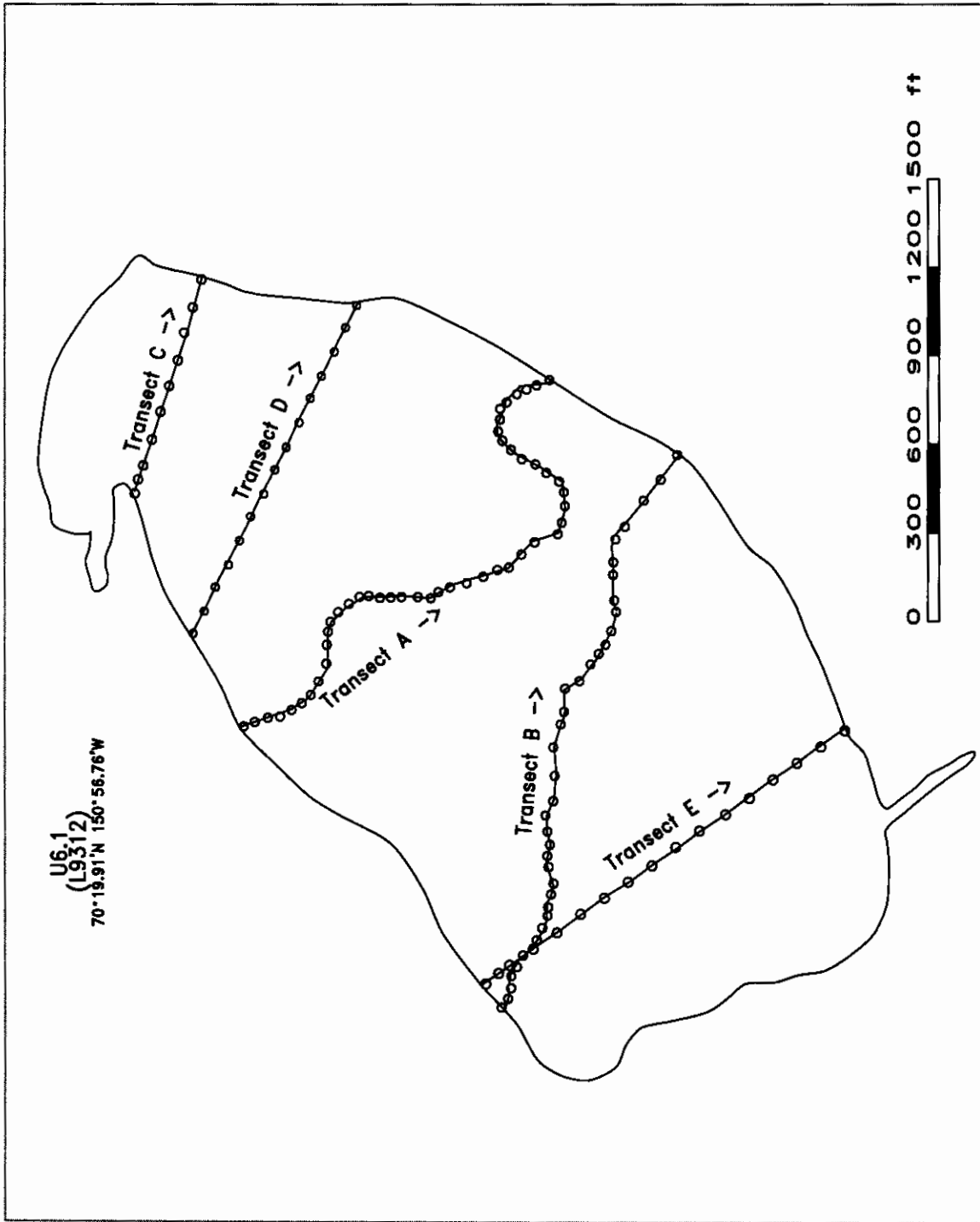
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Fyke Net	Jul 14 95	23.9	Alaska blackfish	1	
			Slimy sculpin	1	
			9spine stickleback	10	
Fyke Net	Jul 26 95	20.0	Broad whitefish	1	428
			9spine stickleback	2	
Minnow Trap	Jul 14 95	48.6	Slimy sculpin	2	
			9spine stickleback	1	
Set Line	Jul 14 95	23.5	None	0	
Gill Net	Nov 2 95	21.7	Least cisco	62	116-303
			Broad whitefish	5	334-470
Fyke Net	Jul 11-15 97	116.6	Least cisco	1	56
			Alaska blackfish	5	70
			Slimy sculpin	8	38-84
			9spine stickleback	57	
Fyke Net	Jul 28-Aug 4 99	165.4	Least cisco	62	80-234
			Broad whitefish	5	146-477
			Round whitefish	24	123-233
			Alaska blackfish	7	80-109
			Slimy sculpin	83	47-81
			9spine stickleback	184	

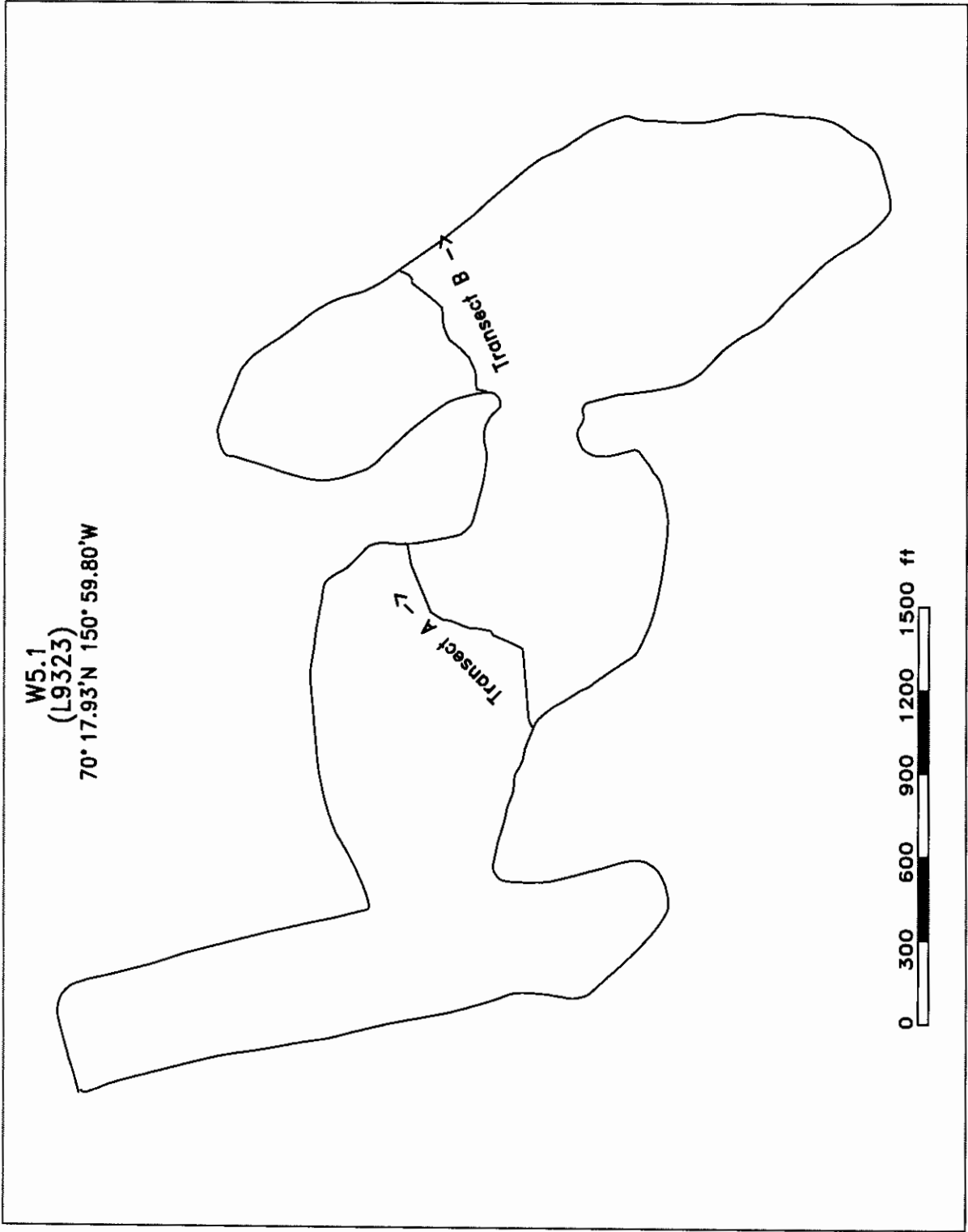








Location of bathymetric transects on lake U6.1 (L9312).



Location of bathymetric transects on lake W5.1 (L9323).

Lake W5.1

Other Names: L9323
Location: 70°17.93'N 150°59.80'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4E, Sect 24
Habitat: Perched Lake (Infrequent Flooding)
Area: 84 acres
Maximum Depth: 11.0 feet
Active Outlet: No
Spec. Conductance: 74 μ S/cm
Calculated Volume: 99.4 million gallons
Permittable Volume: 5.4 million gallons

Water Quality:

Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	4	2.8	1.5	4.3	17	53	J. Lobdell

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 96	5.6	Broad whitefish	3	400-512
			Round whitefish	1	217
			Least cisco	50	181-319
Gill Net	Jul 27 99	6.1	Broad whitefish	1	495
			Least cisco	3	227-305
			Round whitefish	1	153

