MONITORING OF WATER-SOURCE LAKES IN THE ALPINE DEVELOPMENT PROJECT: 1999-2002

Final Report

September 2003

Prepared by:

MJM Research
1012 Shoreland Drive
Lopez Island, WA

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
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and

Anadarko Petroleum Corp.
1200 Timberloch Place
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Lawrence L. Moulton
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ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

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Anadarko Petroleum Corp.
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Executive summary

Lakes L9312 and L9313 provide the permanent water supply for the Alpine development. Both of the water-source lakes support fish, as was first documented by baseline studies beginning in 1995. A series of permits have been issued by Alaska Department of Fish and Game (ADF&G) that allow water withdrawal from the lakes under restrictions intended to protect fish residing within the lakes. The sampling in 2001 represented the third year of a 5-year monitoring program required by the ADF&G permit. The objectives of this study were to conduct required monitoring for fish presence and compare the 2001 catch patterns to those observed in previous years.

Monitoring of the water-source lakes consisted of sampling with fyke nets combined with physical measurements. Water chemistry measurements obtained in conjunction with fish sampling included surface measures (depth = 0.5 ft) of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. During winter 2000/2001, additional water chemistry measurements were obtained by URS, Inc. as part of a ConocoPhillips Alaska study on the effects of water withdrawal on delta lakes. In winter 2001/2002, similar measurements were conducted by Michael Baker Jr., Inc.

Water use has varied considerably in the two lakes over the last four winters. Water use during winter 2001/2002 was less that during winter 2000/2001 for both lakes. Lake L9312 was used heavily during winter 2000/2001, with over 26 million gallons removed between September and June, but only 14.3 million gallons (about 14% of the minimum winter volume) were used the following winter. Slightly over 2.2 million gallons (nearly 12% of the minimum winter volume) were used from L9313 in winter 2001/2002.

Lake L9312 (U6.1)

Water Chemistry. The lake experienced some flooding during the 2002 break-up. Specific conductance at the lake edge has not shown any consistent trend since sampling began in 1995. During winter 2002, there was no evidence of oxygen depression in late winter, with dissolved oxygen levels remaining above 9 mg/l into early April.

Biological Observations. Fyke net sampling conducted July 22-29, 2002 produced a catch of 206 fish from 5 species, while sampling conducted August 21-27 produced 772 fish from 8 species. Through 2002, a total of 11 species has been recorded from the lake. As in previous years, least cisco was again the most numerous species caught in 2002. The July catch rate of least cisco was about double the July catch rates from 1999 and 2001, but was substantially less than the high July catches of 2000. Catch rates of least cisco in August 2002 were about three times higher than in August 2000 and 2001.

In 2002, as in 2001, the captured least cisco were small, with age-0 and 1 fish being most abundant. The lake was recharged by flow from the Sakoonang Channel in 2002, thus it is not known if the high catch of age-0 fish indicates successful spawning in fall 2001 or immigration. The lack of small broad whitefish and humpback whitefish, as seen in lake L9313, may indicate that the least

cisco were produced within the lake.

Catch rates of fish other than least cisco were mixed in 2002 when compared to previous years , with no discernible pattern to the catches. Eleven tagged fish were released in 2002 – 2 each for least cisco, broad whitefish and humpback whitefish, and 5 round whitefish. No tagged fish from previous years were caught.

Lake L9313 (T6.1)

Water Chemistry. Specific conductance in L9313 decreased about 18% from that recorded in 2001. Specific conductance had been increasing steadily in this lake since monitoring began in 1995; this was the first recorded decrease. The high levels of dissolved solids compared to lake L9312 are likely related to more frequent influence from the river because of the lower elevation.

There was again evidence of oxygen depression in L9313 during winter 2001/2002. Dissolved oxygen reached levels during early April that are lethal to fish (0.0-0.1 mg/l). Water removal during winter 2001/2002 from the lake was about 13% of the volume deeper than 7 feet – removals of this magnitude are not expected to affect dissolved oxygen. Low oxygen levels were also observed in this lake in 2000/2001 when there was no water removal. This lake appears prone to naturally low oxygen levels during late winter, possibly related to the shallowness of the lake.

Biological Observations. Fyke net sampling conducted July 22-29, 2002 and again during August 21-27 both produced catches of 1,701 fish from 6 species. Ninespine stickleback, least cisco and broad whitefish were the most abundant species, with Alaska blackfish, humpback whitefish and round whitefish also caught.

Least cisco caught during 2002 included a broader range of sizes than has previously been seen in this lake, and included fish in the adult size range. In 1999 and 2000, catches were composed of juveniles but mature fish had been caught in 2001 and some earlier years.

One of 4 least cisco tagged in 2001 was recaptured during 2002. This individual was released on July 22, 2001 and recaptured on the same day in 2002. This recapture is direct evidence that at least some fish survived the low dissolved oxygen levels recorded in April. Six least cisco and eighteen broad whitefish were tagged and released in L9313 during 2002.

Sampling in lake L9313 prior to 1999 indicated few fish resided in the lake. The high catches of age-2 and 3 least cisco in 1999 and their subsequent disappearance, along with the highly variable length distribution, likely indicate that fish enter and leave the lake annually during high water. At present, it is unclear whether or not the young least cisco caught in this lake during 2001 and 2002 represent successful spawning or immigration from the river. With the large numbers of broad whitefish and humpback whitefish (neither of which spawn in lakes), it is likely that most of the smaller fish entered the lake during breakup.

Summary: There are no indications that the fish populations in lakes L9312 and L9313 have been substantially damaged by water withdrawals through 2002. Similarly, there have been no changes in water chemistry that can be definitively assigned to effects of water withdrawal. Lake L9313 appears to be marginal as wintering habitat because of depressed oxygen levels in late winter. Despite low oxygen levels that approached 0 mg/l in April 2002, some fish survived the winter. It is probable that one location for measuring water chemistry is not providing a representative sample of conditions throughout the lake.

The highly variable size structure of least cisco in this lake, as well as young from species that do not spawn in lakes, indicate that the population is transitory and is likely subject to high rates of immigration and emigration on an annual basis. This is in contrast to lake L9312, which appears to support a reproducing population of stunted least cisco, round whitefish, Alaska blackfish and slimy sculpin. While other species are caught in L9312, the numbers tend to be low, indicating less immigration than in L9313.

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INTRODUCTION

Two lakes, designated L9312 (or U6.1) and L9313 (or T6.1), provide the permanent water supply for the Alpine development (Figures 1 and 2). Two naming conventions are used to identify the lakes in the Colville Delta region – one name conveys information on initial sampling and the investigator responsible for the sampling, the other name conveys information on location within the North Slope Emergency Response grid (Moulton 1998).

A series of permits have been issued by Alaska Department of Fish and Game (ADF&G) that allow water withdrawal from the lakes under restrictions intended to protect fish residing within the lakes (Appendix C). These permits have been modified as information on the lakes has improved and as project needs have changed. A permit stipulation added to the March 30, 1999 amendments was that each lake would be monitored for fish presence at least twice during the ice-free season for a period of three years. On September 1, 2000, an additional modification specified that the fish monitoring be continued for a minimum of 5 years. This report summarizes results of the first four years of monitoring.

Fish populations in the lakes have been surveyed several times since 1995, when baseline studies specific to the Alpine Development began (Moulton 1997). Both of the water-source lakes support fish, with eleven species identified from L9312 and seven identified from L9313 (Moulton 1999, 2000).

The objectives of this study were to continue monitoring for fish presence in each water source lake and compare the 2002 catch patterns to those observed in previous years. Results of the 1999 through 2001 monitoring are reported in Moulton (1999, 2000, 2002).

METHODS

Monitoring of the water-source lakes consisted of sampling with fyke nets combined with physical measurements. Sampling was by fyke net because the objective 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 past years, beginning in 1995, a variety of gear types were tested to evaluate the fish populations in delta lakes (see Appendix B-1 for a list of gear used and resulting catches). Based on those catches, it was decided to use only fyke nets because they sampled the entire range of species and allowed live release of captured fish.

Net locations identified in 1999 as the most appropriate monitoring sites (Moulton 1999) were reoccupied for the 2000 through 2002 sampling (Figures 3 and 4). As set forth in the monitoring stipulations, sampling was conducted during two periods: July 22-29 and August 21-27. Fish were measured and released, with no fish retained for laboratory analysis. Duration of each set was recorded in order to calculate catch rates.

In 2002, fish greater than 180 mm were tagged to obtain information on residence time within the lake and potentially allow for estimating population size. Floy FF-94 anchor tags (monofilament = 1/2 inch, vinyl = 3/4 inch) were applied to broad whitefish and least cisco exceeding 180 mm fork length.

Water chemistry measurements obtained at the two lakes included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* surface measurements taken at the fyke net station in each lake with a YSI Model 85 meter. A sample was returned to the field office to measure pH and turbidity. PH was measured with either a Corning pH meter or an Oaktron pH Tester III. Turbidity was measured with an H.F. Scientific DRT15CE turbidity meter. In addition to the measurements taken at the fyke net, profiles of the same parameters were measured in 1 m increments at the deepest location in each lake in August 2002.

Bathymetric data were collected in 2002 using methods described by MBJ (2003) to provide a consistent approach to estimating water volumes. In 2002, location and depth were recorded on a Lowrance Model LCX-15MT integrated GPS/depth sounder. Location and depth were recorded at approximately 1-2 second intervals. Ten transects were run on lake L9312 and 14 were recorded on lake L9313. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on geo-referenced aerial photography obtained June 30, 1999. Contours were plotted in 1 foot intervals on the aerial photograph of the surveyed lakes. The surface area of each contour was obtained, then the volume was estimated using the formula for truncated cones:

V = h/3*(A1+A2+(A1*A2) (1/2))

Where h = vertical depth of the stratum, A1 = area of the upper surface, and A2 = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

RESULTS AND DISCUSSION

History of Water Withdrawal

Lake L9312 is a 111-acre lake containing approximately 323 million gallons of water (previous reports use a surface area of 100 acres based on USGS base maps – the 111 acres is based on digitizing the surface area from June 1999 aerial photography). An estimated 100.5 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. Over 31% of the lake volume is deeper than 7 feet (Figure 5).

Lake L9313 is a 78-acre lake containing approximately 174 million gallons of water (previous reports use a surface area of 69 acres based on USGS base maps – the 78 acres is based on digitizing the surface area from June 1999 aerial photography). An estimated 19.4 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. About 11% of the lake volume is deeper than 7 feet (Figure 6).

Water use has varied considerably in the two lakes over the last three winters as permit conditions have been modified (Table 1). The initial water use permits that designated the lakes as permanent water sources, issued March 30, 1999, allowed 15% of the estimated minimum winter volume to be removed. The volume allowed for removal was increased to 30% of the minimum winter volume on January 27, 2000.

During summer 2000, staff gauges were installed in the lakes to allow direct measure of the water surface elevation. Both lakes were flooded during break-up 2000 and the water surface elevations observed after the lakes stabilized were set as benchmarks to monitor water use. Water withdrawals were to cease when the water surface elevation reached 7.0 ft in L9312 and 5.8 ft in L9313. The permitted removals were also amended to reflect new estimates of lake volumes.

In L9312, 87% of the permitted withdrawal was used in winter 1998/1999, while only 15% was used in 1999/2000. Use exceeded 81% of the permitted withdrawal in 2000/2001, but was only 44% of the permitted amount in 2001/2002. To date, the withdrawals represent between 3% and 26% of the minimum winter volume.

In L9313, only 3% of the permitted withdrawal volume was used in 1998/1999, with 74% used in 1999/2000. No water was used from L9313 in winter 2000/2001 because the water surface elevation fell below the permitted level (5.8 ft) prior to ice formation in the fall. Investigation of the apparent loss of water determined that the low staff gauge reading was caused by frost-induced movement of the staff gauge, not loss of water from the lake. For 2001/2002, about 21% of the permitted withdrawal was used. To date, the withdrawals represent between 1% and 48% of the minimum winter volume. The apparent high use in 2000/2001, which amounted to 48% of the minimum winter volume, occurred prior to freeze-up.

Lake L9312 (U6.1)

Water Chemistry. Water chemistry parameters measured in association with fish sampling since 1995 are summarized in Table 2. Flooding during break-up in 2000 appeared to decrease specific conductance, as there was a 29% decrease between July 1999 and July 2000. Specific conductance in L9312 during July increased slightly (7%) between 2000 and 2001. The lake was apparently not flooded during the 2001. MBJ (2002) report that the lake was fully recharged by overflow from the

Sakoonang Channel in 2002. Specific conductance has not shown any consistent trend since sampling began in 1995 (Figure 7).

Unlike winter 2001, there was little evidence of oxygen depression during 2002, with the minimum levels recorded on April 6 in excess of 9 mg/l (Tables 3 and 4).

Biological Observations. Fyke net sampling conducted July 22-29, 2002 produced a catch of 206 fish from 5 species, while sampling conducted August 21-27 produced 772 fish from 8 species (Table 5). As in previous years, least cisco was again the most numerous species caught in 2002, representing 89% of the non-stickleback catch. The July catch rate of least cisco (17.1 fish per day) was about double the July catch rates from 1999 and 2001, but was substantially less than the high July catches of 2000 (Figure 8). Catch rates of least cisco in August 2002 were about three times higher than in August 2000 and 2001.

The least cisco in 2000 likely represented many age groups (based on length frequency analysis – Appendix B), because the lengths ranged from 60 to 220 mm. In 2002, as in 2001, the captured least cisco were smaller, with age-0 and 1 fish being most abundant (Figure 9). Few larger fish were caught, with only 2 over 190 mm. The lake was recharged by flow from the Sakoonang Channel in 2002 (MBJ 2002), thus it is not known if the high catch of age-0 fish indicates successful spawning in fall 2001 or immigration. The lack of small broad whitefish and humpback whitefish, as seen in lake L9313, may indicate that the least cisco were produced within the lake.

Catch rates of fish other than least cisco were mixed in 2002 when compared to previous years, with no discernible pattern to the catches (Table 5, Figure 8). Eleven tagged fish were released in 2002 – 2 each for least cisco, broad whitefish and humpback whitefish, and 5 round whitefish. No tagged fish from previous years were caught.

Lake L9313 (T6.1)

Water Chemistry. Specific conductance in L9313 decreased about 18% from that recorded in 2001 (Table 2, Figure 7). Specific conductance had been increasing steadily in this lake since monitoring began in 1995; this was the first recorded decrease. The high levels of dissolved solids compared to lake L9312 are likely related to more frequent influence from the river because of the lower elevation. L9313 is flooded annually during spring break-up, while L9312 is only occasionally flooded.

There was again evidence of oxygen depression in L9313 during winter 2001/2002 (Tables 4 and 6). Dissolved oxygen reached levels during early April that are lethal to fish (0.0-0.1 mg/l). Water removal during winter 2001/2002 from the lake was about 13% of the volume deeper than 7 feet – removals of this magnitude are not expected to affect dissolved oxygen. Low oxygen levels were also observed in this lake in 2000/2001 (2.0-2.5 mg/l on April 18, 2001) when there was no water removal. This lake appears prone to naturally low oxygen levels during late winter, possibly related to the shallowness of the lake.

Biological Observations. Fyke net sampling conducted July 22-29, 2002 and again during August 21-27 both produced catches of 1,701 fish from 6 species (Table 5). Ninespine stickleback, least cisco and broad whitefish were the most abundant species, with Alaska blackfish, humpback whitefish and round whitefish also caught. Catch rates of least cisco were much higher in July than in August (Figure 11), while broad whitefish, humpback whitefish and Alaska blackfish catches were higher in August.

Least cisco caught during 2002 included a broader range of sizes than has previously been seen in this lake, and included fish in the adult size range (Figure 12). In 1999 and 2000, catches were composed of juveniles but mature fish had been caught in 2001 and some earlier years. The length distribution of young fish in 2002 is remarkably similar to that in 2001, with both ages 0 and 1 represented.

One of 4 least cisco tagged in 2001 was recaptured during 2002. This individual was released on July 22, 2001 and recaptured on the same day in 2002. This recapture is direct evidence that at least some fish survived the low dissolved oxygen levels recorded in April. Six least cisco and eighteen broad whitefish were tagged and released in L9313 during 2002. One broad whitefish and one least cisco released in 2002 were also recaptured after being at liberty for 3 and 35 days, respectively (Appendix Table B-7).

Sampling in lake L9313 prior to 1999 indicated few fish resided in the lake (Appendix Table B-1), with ninespine stickleback and low densities of least cisco and Alaska blackfish present. The high catches of age-2 and 3 least cisco in 1999 and their subsequent disappearance, along with the highly variable length distribution, likely indicate that fish enter and leave the lake annually during high water. At present, it is unclear whether or not the young least cisco caught in this lake during 2001 and 2002 represent successful spawning or immigration from the river. With the large numbers of broad whitefish and humpback whitefish (neither of which spawn in lakes), it is likely that most of the smaller fish entered the lake during breakup.

Sampling during July is conducted during 24-hours of daylight, while sampling in late August includes periods of darkness at night. The catches in late August in both L9312 and L9313 may reflect this difference in daylight pattern. The pattern of daily catch indicates that both slimy sculpin and Alaska blackfish were more active at night (Figures 10 and 13). The few burbot (which avoid light when possible) caught in the lakes have also been caught during August.

CONCLUSIONS

There are no indications that the fish populations in lakes L9312 and L9313 have been substantially damaged by water withdrawals through 2002. Similarly, there have been no changes in water chemistry that can be definitively assigned to effects of water withdrawal. Lake L9313 appears to be marginal as wintering habitat because of depressed oxygen levels in late winter. Despite low oxygen levels that approached 0 mg/l in April 2002, some fish survived the winter. It is probable that one location for measuring water chemistry is not providing a representative sample of conditions throughout the lake.

The highly variable size structure of least cisco in this lake, as well as young from species that do not spawn in lakes, indicate that the population is transitory and is likely subject to high rates of immigration and emigration on an annual basis. This is in contrast to lake L9312, which appears to support a reproducing population of stunted least cisco, round whitefish, Alaska blackfish and slimy sculpin. While other species are caught in L9312, the numbers tend to be low, indicating less immigration than in L9313. In general, catch rates were higher in 2002 than in previous years. There were exceptions to this generality, especially for slimy sculpin and Alaska blackfish in L9312.

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Table 1. Water withdrawal at Alpine Development lakes from freeze-up to break-up, 1999-2002.

Lake Name	Month	1998/1999 (gallons)	1999/2000 (gallons)	2000/2001 (gallons)	2001/2002 (gallons)
L9312					
	June		1,625,100		
	July				
	August				
	September			495,000	
	October			1,786,600	
	November			2,435,320	
	December			2,587,600	6,083,500[1]
	January			8,840,220	1,798,000
	February	9,100,325		1,911,100	3,137,100
	March	1,847,370		1,781,600	3,180,400
	April		947,100	2,153,200	799,167
	May		1,865,161	1,980,200	3,375,833
	Jun			2,379,200	2,011,700
	Total Use	10,947,695	4,437,361	26,350,040	14,302,200
	Minimum Winter Volume[2]	100,545,255	100,545,255	100,545,255	100,545,255
	Percent of Minimum Vol.	10.9%	4.4%	26.2%	14.2%
	Permitted Use[3]	12,600,000	19,000,000	32,360,000	32,360,000
L9313					
	June		1,817,300		
	July		2,226,700		
	August				
	September			2,122,600	
	October				
	November				
	December		765,600		378,120[1]
	January	63,000	1,696,600		362,800
	February	126,000	1,039,800		228,000
	March		1,550,800		1,355,300
	April		843,900		238,200
	May				38,182
	Total Use	189,000	9,940,700	9,404,700[4]	2,222,482
	Minimum Winter Volume[2]	19,384,330	19,384,330	19,384,330	19,384,330
	Percent of Minimum Vol.	1.0%	51.3%	48.5%	11.5%
	Permitted Use[3]	5,600,000	13,400,000	10,340,000	10,340,000

[1] Totals for 4th quarter 2001, not just December.

[2] Volume deeper than 7 feet, based on depth transects obtained during 2002

[3] These permitted use levels were used by ConocoPhillips Alaska, Inc. (formerly ARCO Alaska) for tracking purposes, some of these levels are less than permitted levels found in the ADF&G permits.

[4] 7,282,100 million gallons were used prior to freeze-up

Table 2. Water chemistry parameters measured in conjunction with Alpine Area fish sampling at lake L9312.

Parameter	Date	Mean	Standard Deviation	Number	Range	
Water Temperature (^{o}C)						
	Jul 13, 1995	13.4	--	1	13.4	
	Nov 2, 1995	0.8	0.7	8	0-1.8	(under ice)
	Jul 9-15, 1997	8.3	0.7	5	7.7-9.5	
	Jul 28-Aug 3, 1999	10.4	1.9	7	8.6-13.5	
	Jul 24-29, 2000	10.7	0.8	6	10.0-12.1	
	Aug 16-21, 2000	7.6	0.6	6	6.6-8.5	
	Jul 22-28, 2001	14.2	1.0	7	13.1-15.9	
	Aug 17-23, 2001	6.0	1.1	6	5.2-8.1	
	Jul 22-29, 2002	12.1	2.0	8	9.9-15.4	
	Aug 21-27, 2002	7.1	1.3	6	5.5-8.7	
Dissolved Oxygen (% Saturation)						
	Jul 13, 1995	--	--	0	--	
	Nov 2, 1995	--	--	0	--	
	Jul 9-15, 1997	99.4	6.9	5	90.8-110.0	
	Jul 28-Aug 3, 1999	98.8	0.2	2	98.6-98.9	
	Jul 24-29, 2000	97.4	1.4	4	95.5-99.0	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	94.7	3.1	7	89.7-98.9	
	Aug 17-23, 2001	89.7	8.6	6	76.0-98.7	
	Jul 22-29, 2002	96.4	3.2	8	93.3-103.8	
	Aug 21-27, 2002	97.3	5.0	6	90.8-105.1	
Specific Conductance (µS/cm)						
	Jul 13, 1995	60.0	--	1	60.0	
	Nov 2, 1995	133.2	2.6	8	130.6-137.8	(under ice)
	Jul 9-15, 1997	83.5	0.5	5	82.7-83.9	
	Jul 28-Aug 3, 1999	77.2	1.5	7	76.2-79.5	
	Jul 24-29, 2000	54.8	0.2	6	54.5-55.2	
	Aug 16-21, 2000	55.7	0.4	6	55-56.3	
	Jul 22-28, 2001	58.6	0.7	7	57.1-59.2	
	Aug 17-23, 2001	60.9	0.8	6	60.2-62.0	
	Jul 22-29, 2002	61.6	0.5	8	61.1-62.4	
	Aug 21-27, 2002	62.2	0.3	5	61.8-62.7	
Turbidity (NTU)						
	Jul 21, 2000	8.6	1.4	4	7.5-10.5	
	Aug 15, 2000	4.4	0.9	4	3.9-5.7	
	Jul 22-28, 2001	1.9	0.7	6	1.3-3.0	
	Aug 17-23, 2001	2.3	1.4	6	1.2-4.7	
	Jul 22-29, 2002	1.0	0.3	6	0.7-1.5	
	Aug 21-27, 2002	2.3	1.2	7	1.5-4.9	

Table 3. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9312 during 2002 (data in italics from MBJ 2002).

(profiles taken at deepest location in lake)

		Water	Dissolved Oxygen		Specific	
	Depth	Temp.		Percent	Conductance	Turbidity
Date	**(m)**	**(°C)**	**(mg/l)**	**Saturation**	**(µS/cm)**	**(NTU)**
1/16/2002	*1.2*	*0.4*	*16.0*		*151*	*0.3*
	2.1	*1.5*	*14.2*		*134*	*0.5*
	3.0	*2.5*	*9.8*		*126*	*0.4*
2/9/2002	*1.5*	*0.6*	*15.9*		*152*	*1.2*
	2.4	*1.6*	*15.5*		*150*	*1.5*
	3.0	*2.3*	*13.7*		*145*	*2.1*
3/11/2002	*1.5*	*1.3*	*15.4*		*185*	*2.0*
	2.4	*2.1*	*14.3*		*171*	*1.6*
	3.0	*2.6*	*10.0*		*164*	*1.8*
4/6/2002	*2.0*	*2.0*	*9.7*		*159*	*0.6*
	2.9	*2.9*	*9.3*		*152*	*0.6*
8/7/2002	surface	9.7	10.9	96.1	63	1.1
	1.0	9.7	10.8	95.1	63	1.3
	2.0	9.7	10.8	94.8	63	1.2
	3.0	9.7	10.7	94.6	63	1.2
8/14/2002	*1.2*	*9.4*	*11.3*		*68*	*1.1*
	2.1	*9.3*	*11.3*		*70*	*1.3*
	3.0	*9.3*	*11.2*		*71*	*1.2*

Table 4. Variation in specific conductance and minimum winter dissolved oxygen observed at lakes L9312 and L9313 from 1997 to 2002.

Lake	Year	Winter Water Withdrawal (million gals.)	July Specific Conductance[1] (μS/cm)	April Specific Conductance[2] (μS/cm)	April Minimum Dissolved Oxygen[2] (mg/l)
L9312	1997	(no withdrawal)	83.5	--	--
	1998	(no withdrawal)	--	--	--
	1999	10,947,695	77.2	--	--
	2000	2,812,261	54.8	--	--
	2001	26,350,040	58.6	232.1	3.5
	2002	14,302,200	61.6	155.5	9.5
L9313					
	1997	(no withdrawal)	126.2	--	--
	1998	(no withdrawal)	--	--	--
	1999	189,000	172.8	--	--
	2000	5,896,700	167.7	--	--
	2001	0	248.6	798.5	2.2
	2002	2,222,482	202.2	988.4	0.05

[1] Measured at Fyke Net Station

[2] Mean Water Column Value

Table 5. Catches of fish by species from Alpine Area Lakes fyke net sampling, 1999-2002.

	July 1999		July 2000		August 2000		July 2001		August 2001		July 2002		August 2002	
Species	**Number**	**CPUE**	**Number**	**CPUE**	**Number**	**CPUE**	**Number**	**CPUE**	**Number**	**CPUE**	**Number**	**CPUE**	**Number**	**CPUE**
L9312														
Least cisco	62	9.0	1,349	192.3	196	28.4	56	8.1	228	29.1	142	17.1	652	91.9
Arctic cisco	0	0.0	0	0.0	5	0.7	0	0.0	0	0.0	0	0.0	0	0.0
Broad whitefish	5	0.7	5	0.7	4	0.6	7	1.0	0	0.0	1	0.1	7	1.0
Humpback whitefish	0	0.0	27	3.8	15	2.2	1	0.1	1	0.1	0	0.0	4	0.6
Round whitefish	24	3.5	7	1.0	17	2.5	5	0.7	4	0.5	15	1.8	4	0.6
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1
Longnose sucker	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Alaska blackfish	7	1.0	22	3.1	102	14.8	5	0.7	8	1.0	0	0.0	27	3.8
Fourhorn sculpin	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
Slimy sculpin	83	12.0	13	1.9	93	13.5	4	0.6	49	6.3	4	0.5	31	4.4
Ninespine stickleback	184	26.7	729	103.9	368	53.3	89	12.8	75	9.6	44	5.3	46	6.5
Total Catch:	365		2,153		801		167		366		206		772	
Number of Species:	6		8		9		7		7		5		8	
Net Hours:	165.4		168.3		165.7		166.4		187.8		199.7		170.3	
L9313														
Least cisco	975	135.7	0	0.0	5	0.7	48	7.0	5	0.6	342	40.8	62	8.6
Broad whitefish	5	0.7	4	0.6	7	1.0	2	0.3	3	0.4	71	8.5	175	24.4
Humpback whitefish	0	0.0	0	0.0	5	0.7	1	0.1	4	0.5	2	0.2	31	4.3
Round whitefish	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2	0	0.0
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Alaska blackfish	9	1.3	23	3.3	100	14.8	11	1.6	22	2.8	11	1.3	90	12.6
Ninespine stickleback	111	15.5	779	110.2	332	49.3	100	14.6	128	16.2	227	27.1	688	96.0
Total Catch:	1,102		806		450		162		162		655		1,046	
Number of Species:	5		3		6		5		5		6		5	
Net Hours:	172.4		169.7		161.6		164.2		189.1		201.1		172.0	

Table 6. Water chemistry parameters measured in conjunction with Alpine Area fish sampling at lake L9313.

Parameter	Date	Mean	Standard Deviation	Number	Range	
Water Temperature (^{o}C)						
	Jul 13, 1995	13.1	--	1	13.1	
	Oct 31, 1995	0.4	0.4	6	0.0-1.0	(under ice)
	Jul 9-15, 1997	8.0	0.4	5	7.7-8.6	
	Jul 28-Aug 3, 1999	10.2	1.9	7	8.3-12.7	
	Jul 24-29, 2000	10.6	0.4	5	10.3-11.2	
	Aug 16-21, 2000	7.7	0.5	6	6.9-8.5	
	Jul 22-28, 2001	14.2	0.9	7	13.2-15.6	
	Aug 17-23, 2001	5.8	0.7	6	5.0-7.0	
	Jul 22-29, 2002	12.3	2.0	8	10.6-15.7	
	Aug 21-27, 2002	7.2	1.7	7	5.3-9.4	
Dissolved Oxygen (% Saturation)						
	Jul 13, 1995	--	--	0	--	
	Oct 31, 1995	--	--	0	--	
	Jul 9-15, 1997	96.3	2.1	5	93.9-99.1	
	Jul 28-Aug 3, 1999	100.7	2.2	2	99.1-102.2	
	Jul 24-29, 2000	98.6	1.3	3	97.4-100.0	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	92.7	3.8	7	87.0-97.8	
	Aug 17-23, 2001	89.1	9.7	6	78.9-102.6	
	Jul 22-29, 2002	97.6	4.1	8	93.2-104.6	
	Aug 21-27, 2002	96.4	5.1	7	92.6-106.4	
Specific Conductance (μS/cm)						
	Jul 13, 1995	107.0	--	1	107.0	
	Oct 31, 1995	184.1	7.5	6	169.9-189.5	(under ice)
	Jul 9-15, 1997	126.2	2.0	5	123.3-128.5	
	Jul 28-Aug 3, 1999	172.8	3.3	7	170.2-177.9	
	Jul 24-29, 2000	167.7	1.1	5	166.7-169.2	
	Aug 16-21, 2000	174.1	2.5	6	170.3-176.5	
	Jul 22-28, 2001	248.6	4.0	7	244.9-257.3	
	Aug 17-23, 2001	255.6	4.2	6	253.0-263.9	
	Jul 22-29, 2002	202.2	1.9	8	200.6-206.6	
	Aug 21-27, 2002	208.9	1.8	7	207.7-213.0	
Turbidity (NTU)						
	Jul 18, 2000	3.4	0.2	4	3.3-3.6	
	Aug 15, 2000	8.4	4.5	4	5.5-15.0	
	Jul 22-28, 2001	2.9	1.6	7	1.5-6.4	
	Aug 17-23, 2001	2.4	1.7	6	1.4-5.8	
	Jul 22-29, 2002	1.7	1.5	8	0.9-5.3	
	Aug 21-27, 2002	2.8	0.7	7	1.7-3.7	

Table 7. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9313 during 2002 (data in italics from MBJ 2002).

(profiles taken at deepest location in lake)

		Water	Dissolved Oxygen		Specific	
Date	Depth (m)	Temp. (°C)	(mg/l)	Percent Saturation	Conductance (µS/cm)	Turbidity (NTU)
1/16/2002	*1.4*	*0.6*	*10.8*		*573*	*0.6*
	2.3	*1.9*	*9.5*		*623*	*0.6*
2/9/2002	*1.6*	*1.1*	*7.1*		*764*	*1.1*
	2.5	*2.1*	*6.0*		*723*	*1.1*
3/12/2002	*1.8*	*1.7*	*3.8*		*805*	*1.1*
	2.7	*2.2*	*2.8*		*836*	*1.2*
4/7/2002	*2.1*	*1.4*	*0.1*		*910*	*0.9*
	2.4	*2.1*	*0.0*		*1066*	*0.9*
5/11/2002	*2.1*	*3.1*	*4.0*		*894*	*13.9*
8/3/2002	surface	15.3	10.0	99.3	176	0.9
	1.0	15.2	9.9	98.9	176	0.9
	2.0	15.1	9.9	98.6	176	0.9
	3.0	15.1	9.7	97.7	176	0.7
8/14/2002	*1.4*	*9.5*	*11.4*		*241*	*1.0*
	2.3	*9.4*	*11.4*		*244*	*1.6*

Figure 1. Location of the Alpine Development in the Colville River delta.

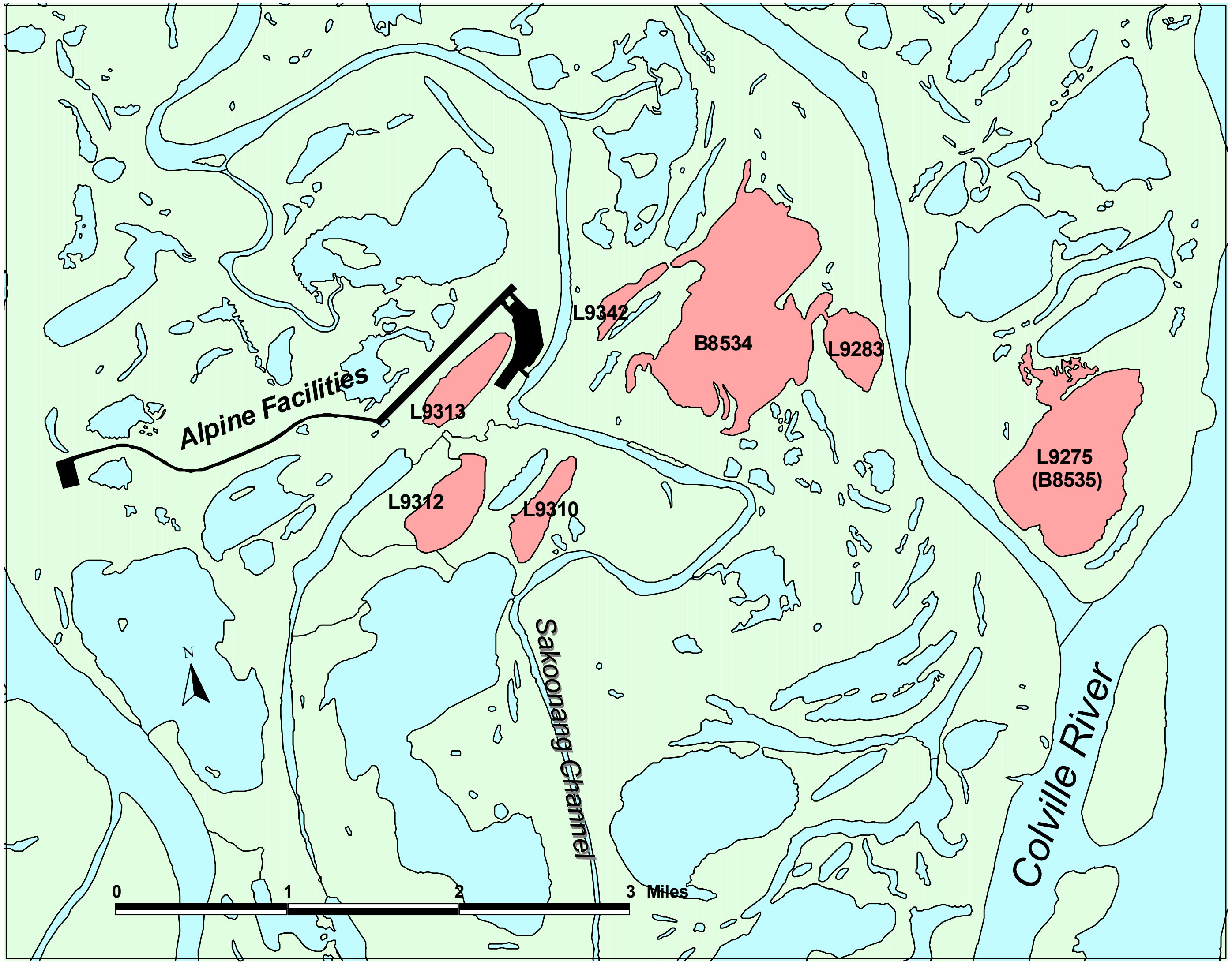


Figure 2. Lakes L9312 and L9313 used as permanent water sources for the Alpine Development.

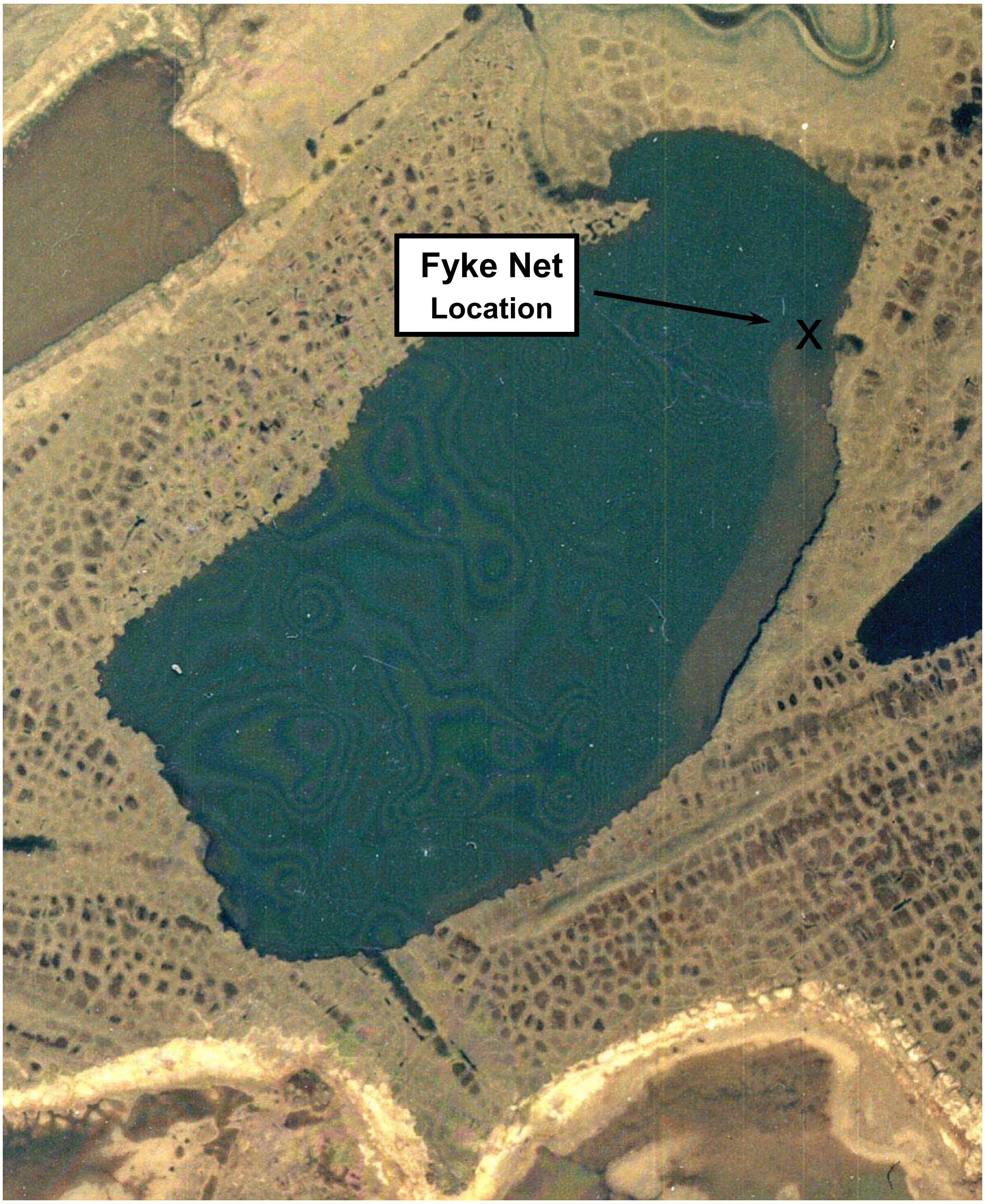


Figure 3. Fyke net station used for long-term monitoring in lake L9312.

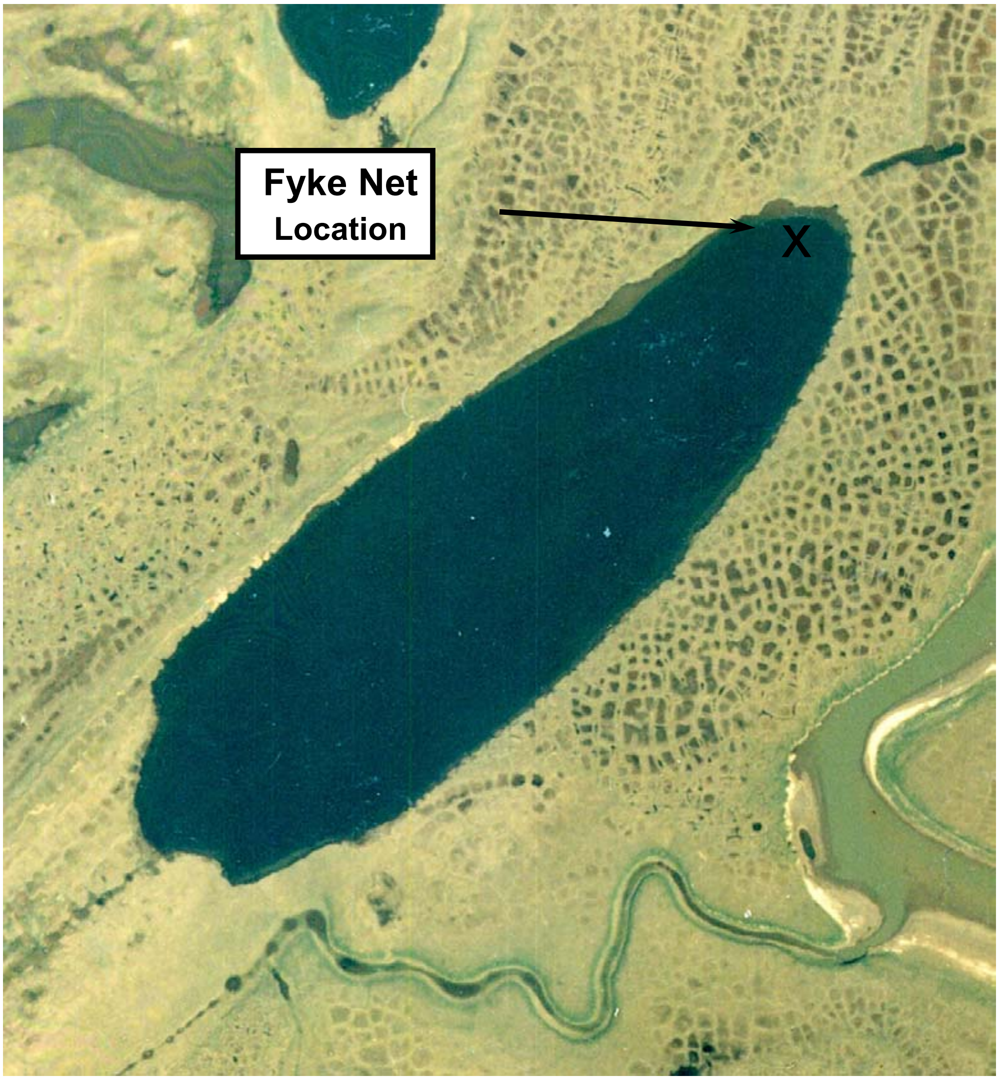


Figure 4. Fyke net station used for long-term monitoring in lake L9313.

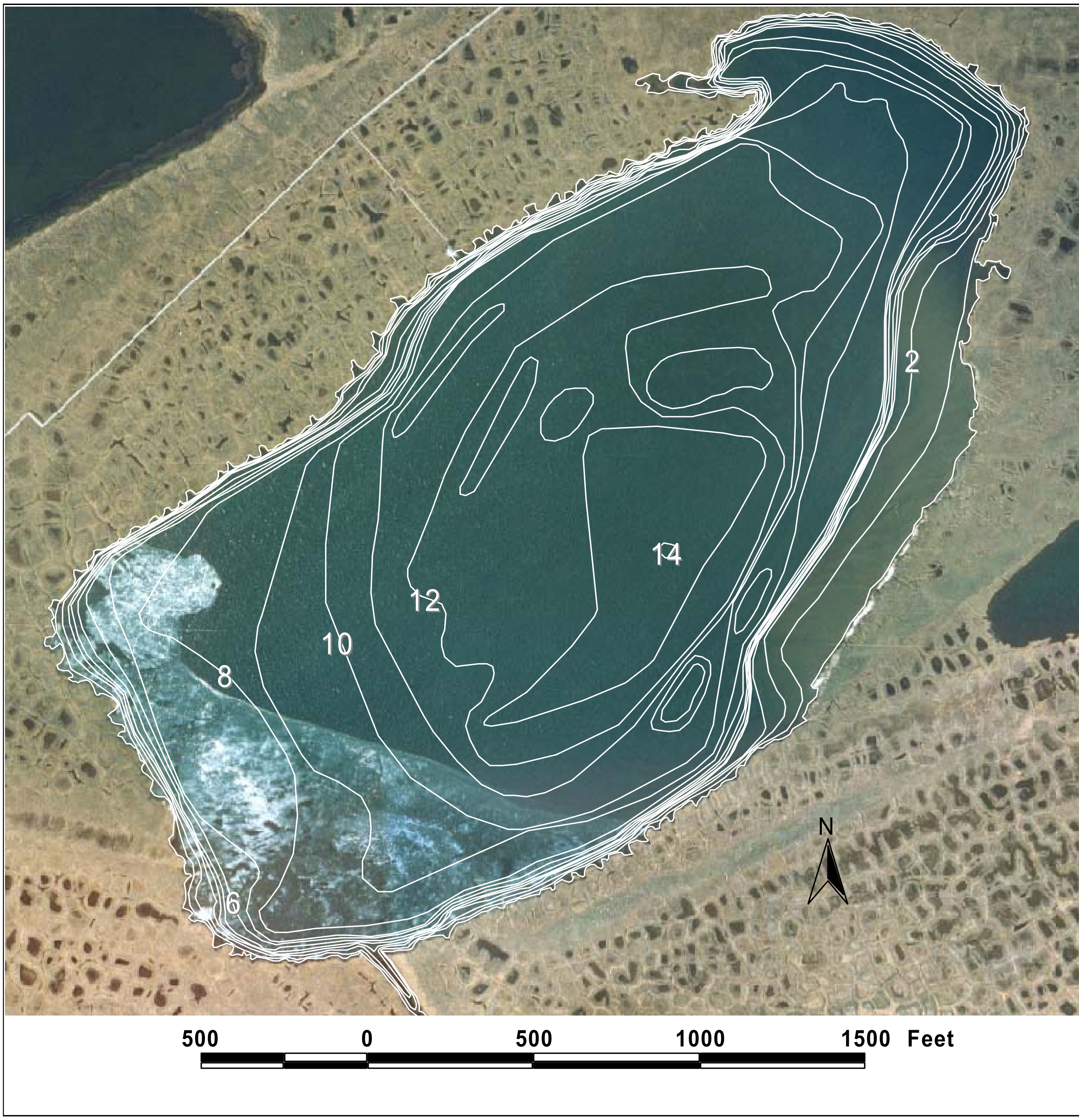


Figure 5. Bathymetric contours (in 1 foot intervals) for lake L9312 based on depth survey of July 28, 2002.

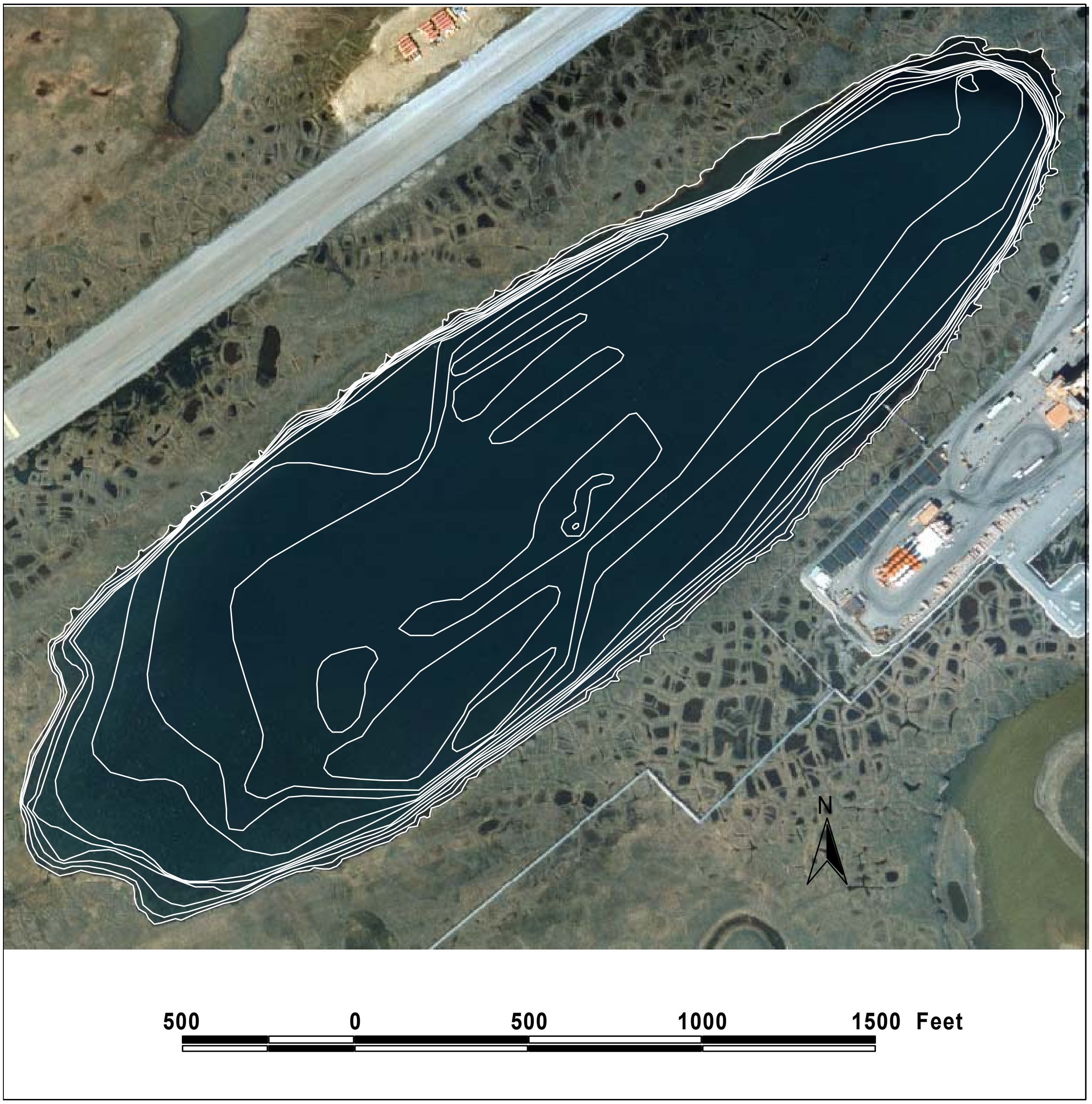
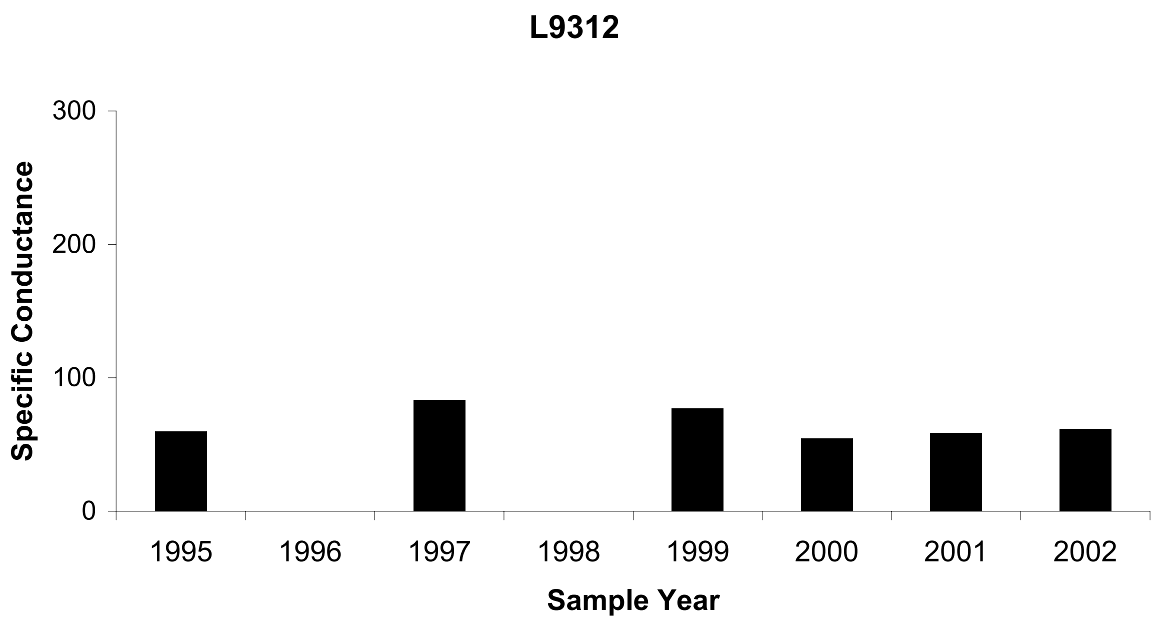


Figure 6. Bathymetric contours (in 1 foot intervals) for lake L9313 based on depth survey of July 28, 2002.



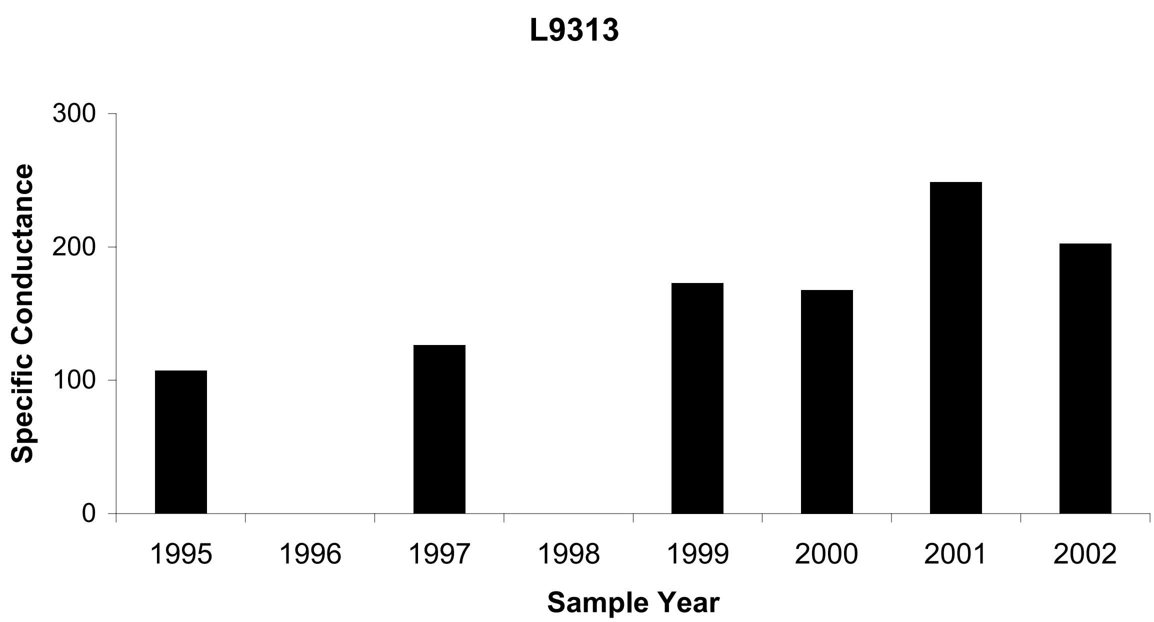


Figure 7. Specific conductance during July (in microS/cm) at two water source lakes in the Alpine Development Area, 1995-2002.

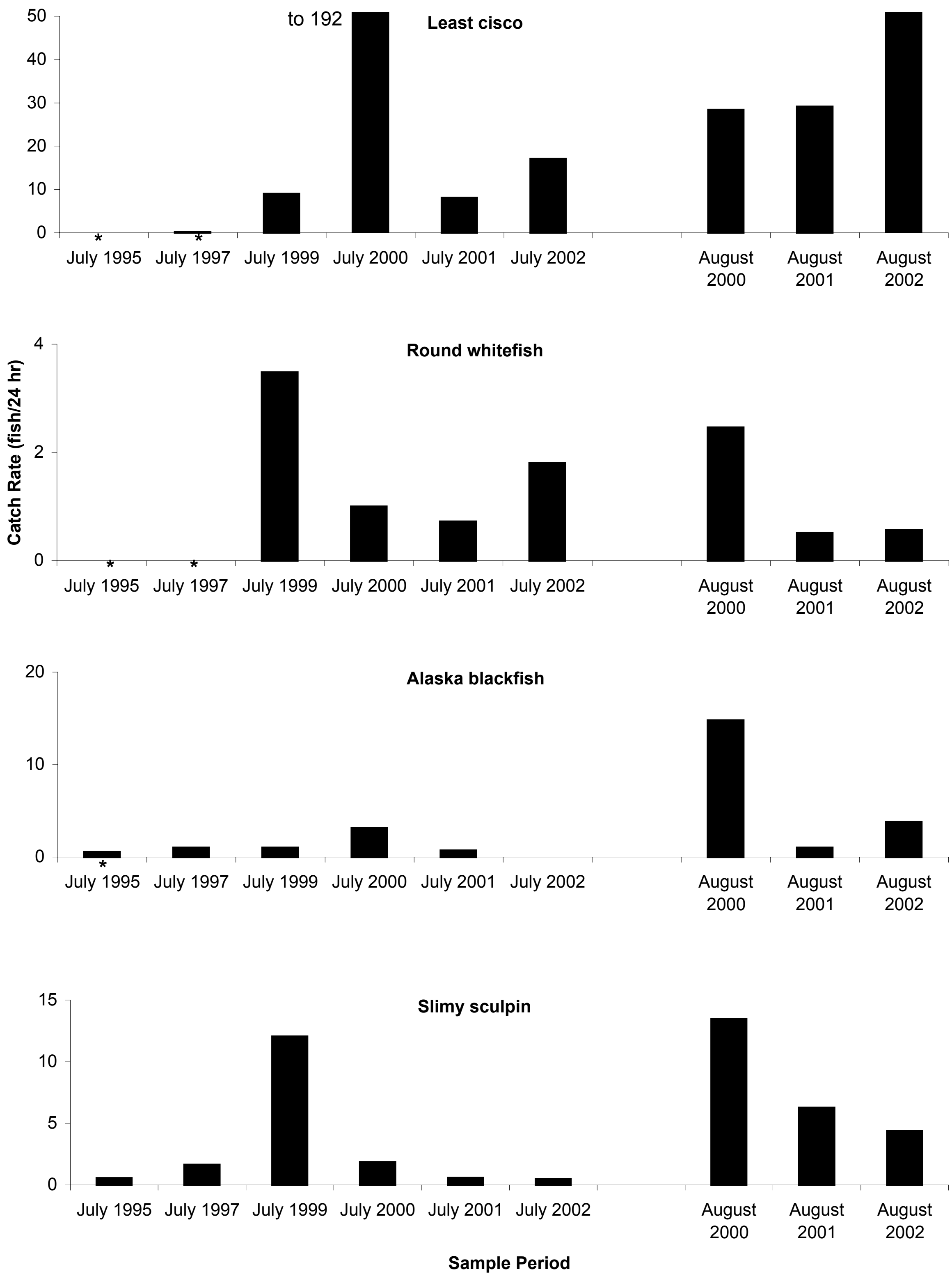


Figure 8. Mean catch rates of selected species in lake L9312, Alpine Development Area, 1995-2002 (* = nets fished in 1995 and 1997 were at different locations).

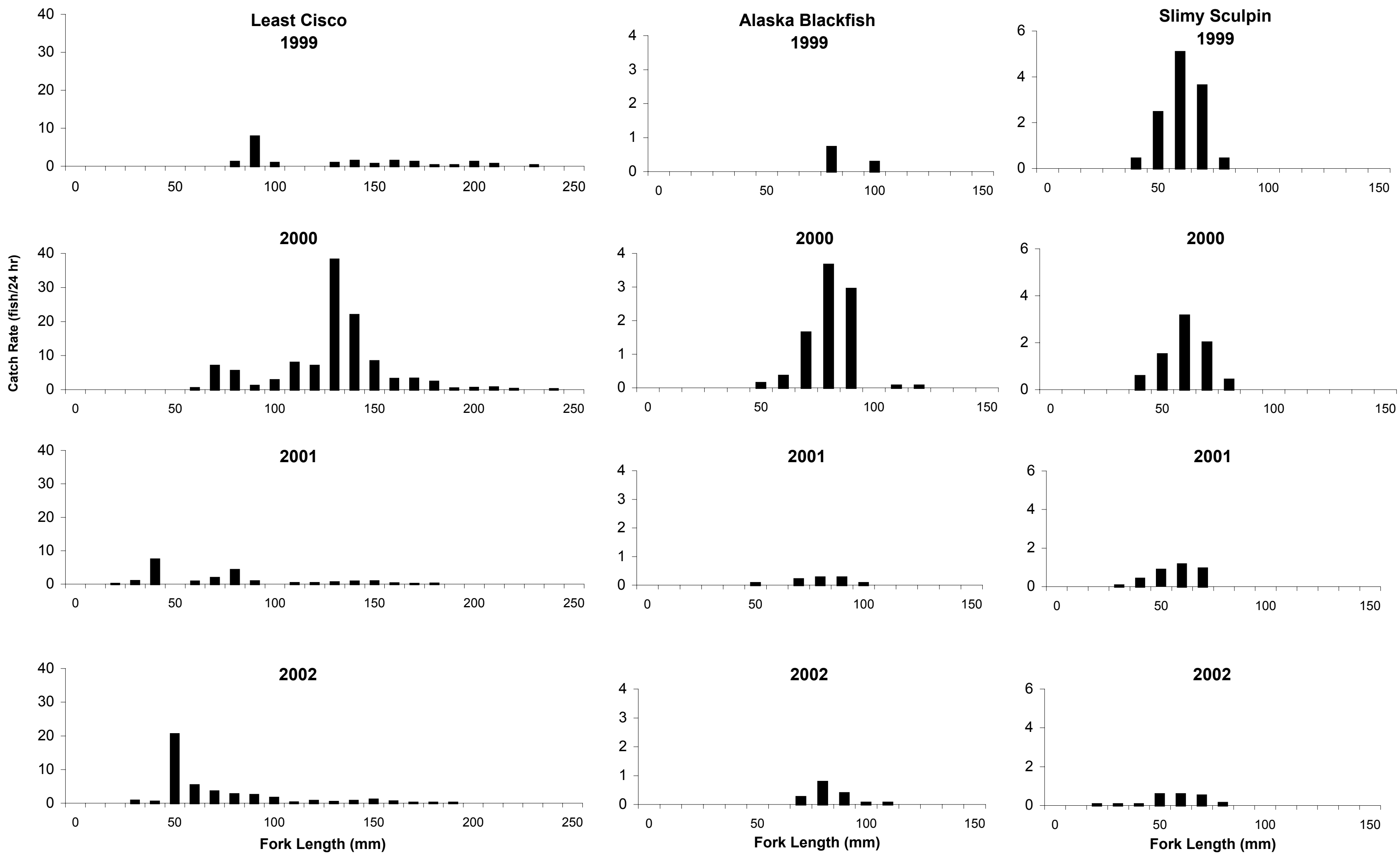


Figure 9. Length frequencies of least cisco, Alaska blackfish and slimy sculpin in lake L9312 during 1999-2002 sampling with fyke nets

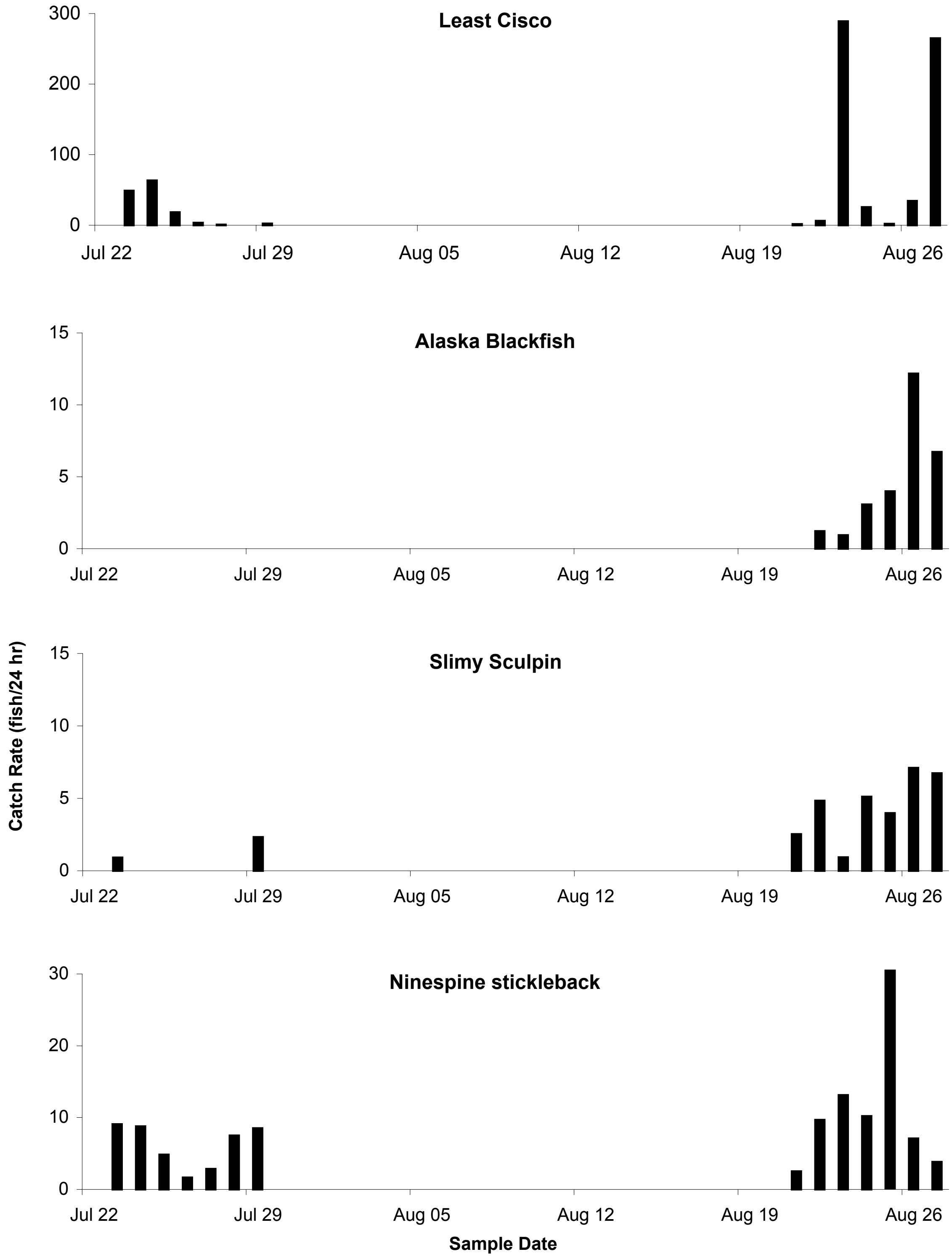


Figure 10. Daily pattern of catch for dominant species in lake L9312 during 2002 fyke net sampling (catches in fish per day).

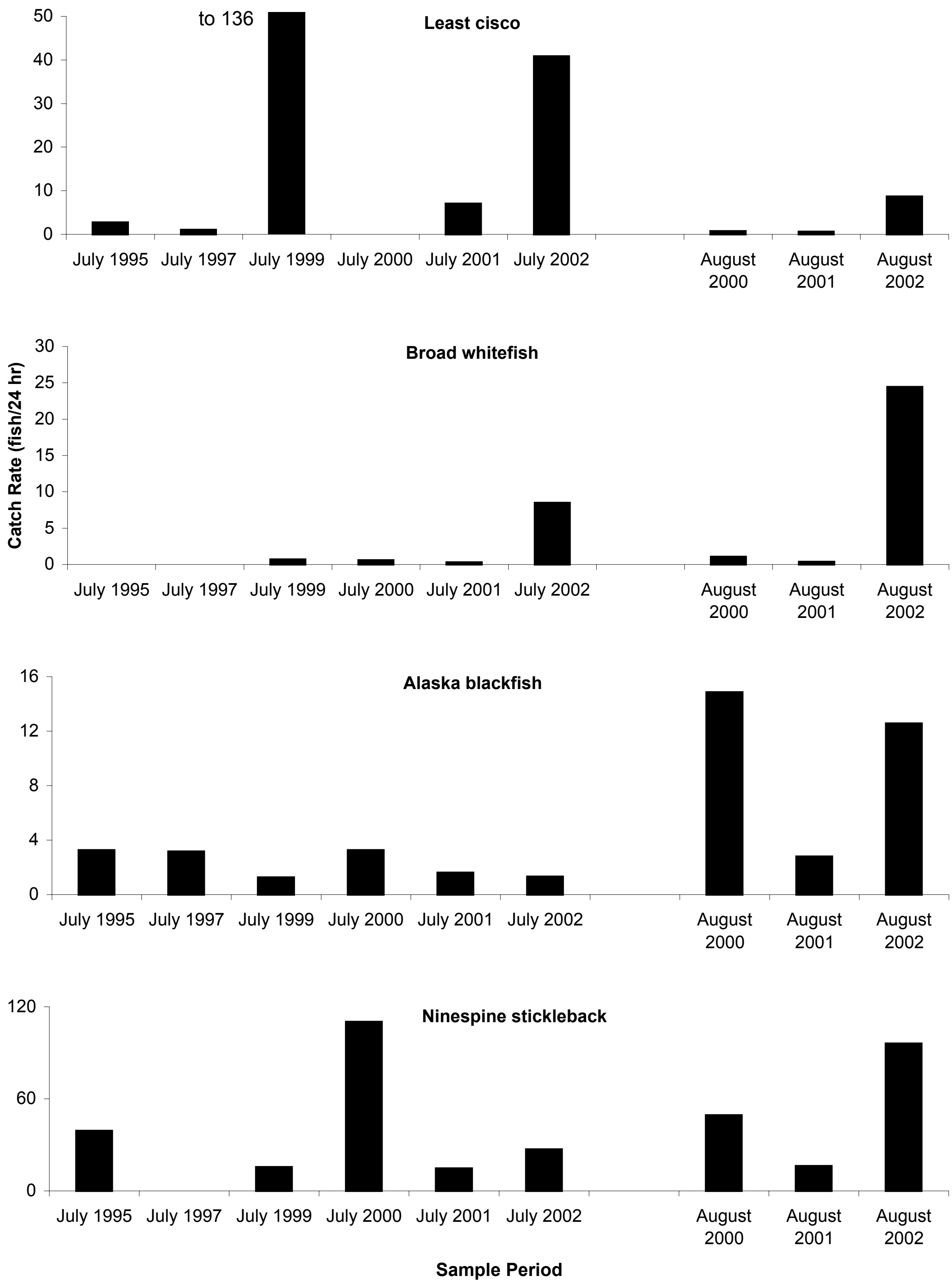


Figure 11. Mean catch rates of selected species in lake L9313, Alpine Development Area, 1995-2002 (* = nets fished in 1995 and 1997 were at different locations).

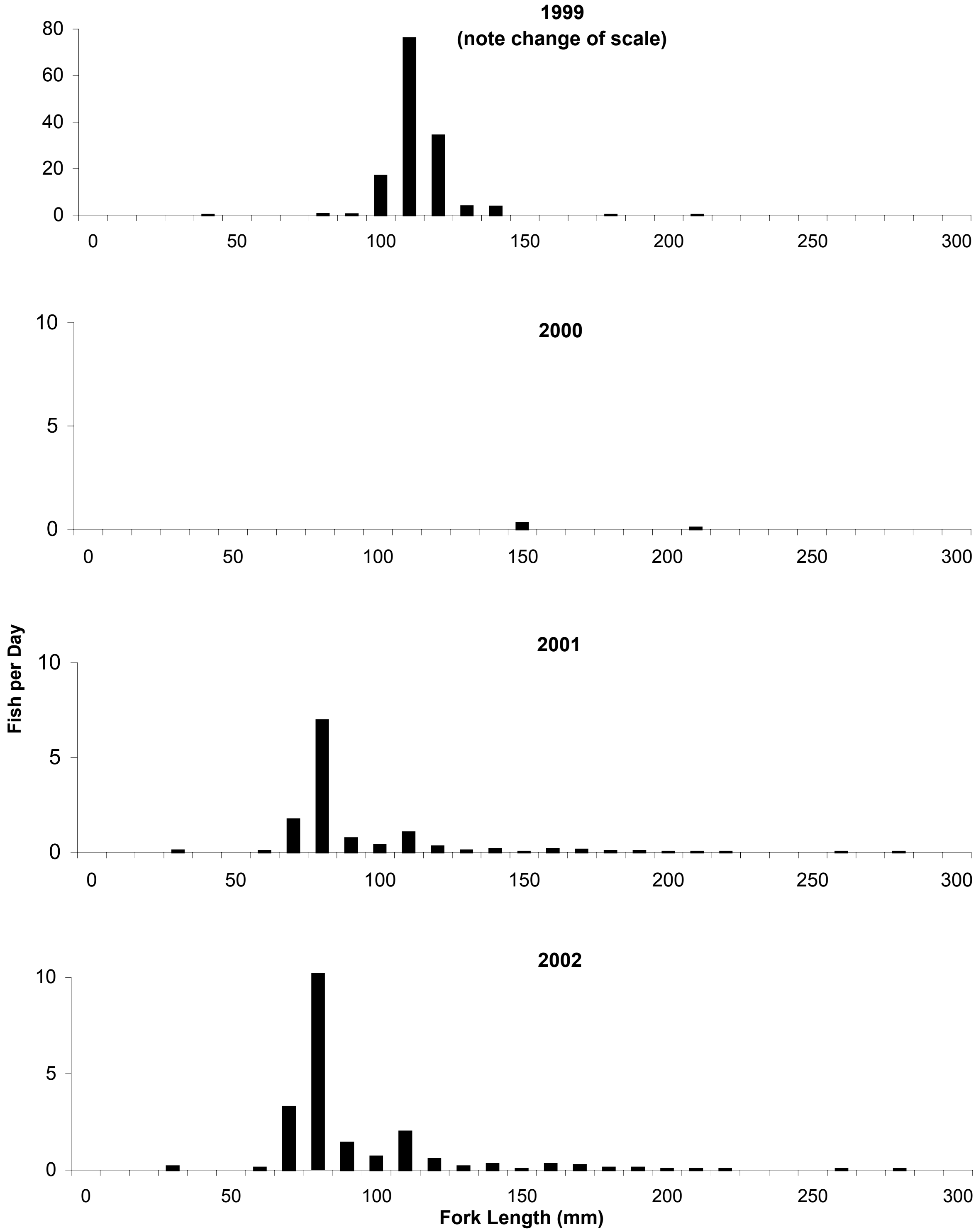


Figure 12. Length frequencies of least cisco in lake L9313 during 1999-2002 sampling with fyke nets.

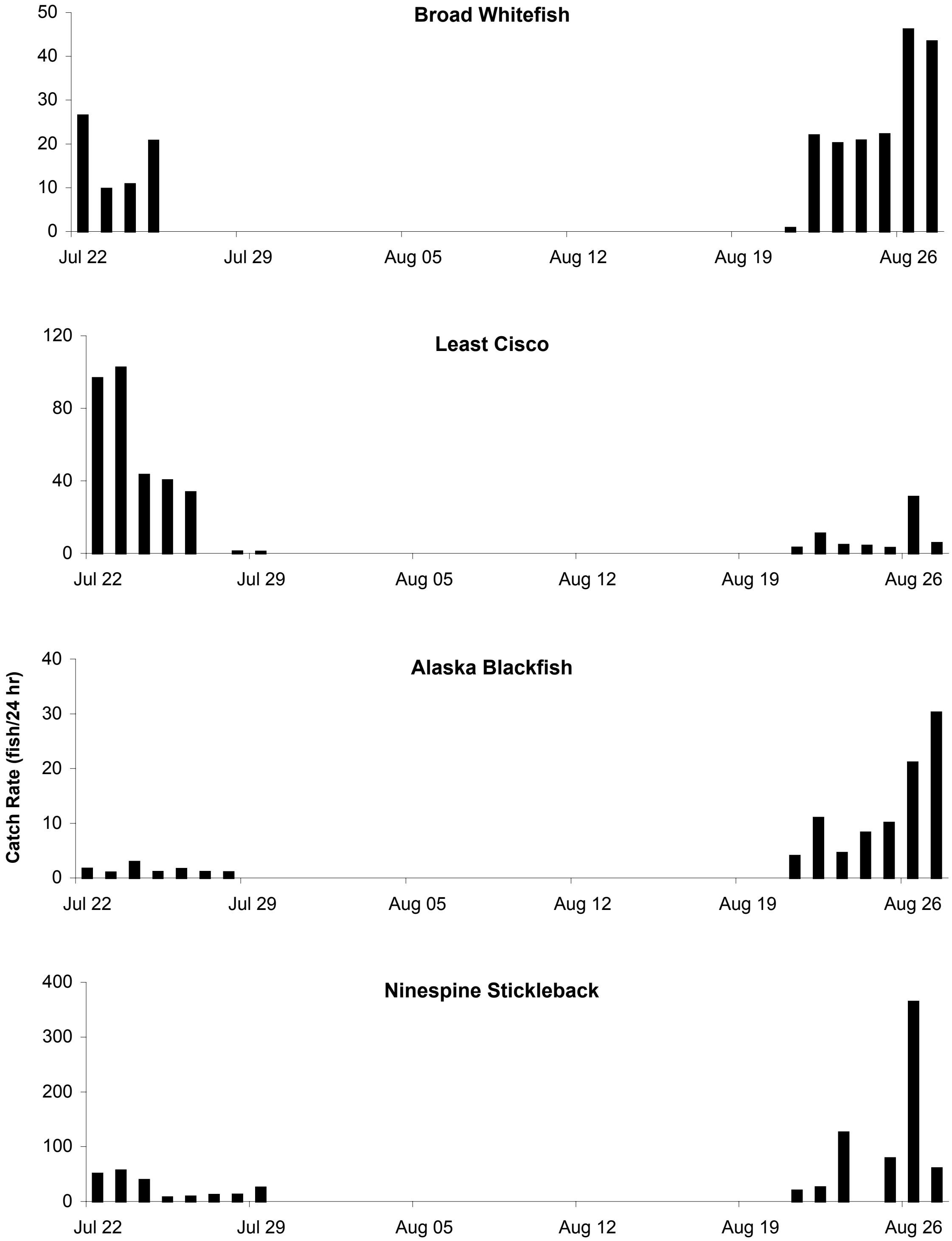


Figure 13. Daily pattern of catch for dominant species in lake L9313 during 2002 fyke net sampling (catches in fish per day).

APPENDIX A
Water Chemistry from Alpine Area Lakes
1995 to 2002

Appendix Table A-1. Water chemistry measurements for lake L9310, 1995 - 2002.

Date	Sample Depth (ft)	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface	13.0		186					MJM Research
11/2/1995	surface	0.0		176			12.0	1.1	MJM Research
	1.6	0.1		176			12.0	1.1	MJM Research
	3.3	0.2		176			12.0	1.1	MJM Research
	4.9	0.5		178			12.0	1.1	MJM Research
	6.6	0.5		182			12.0	1.1	MJM Research
	8.2	0.8		182			12.0	1.1	MJM Research
	9.8	1.2		182			12.0	1.1	MJM Research
	11.5	1.9		201			12.0	1.1	MJM Research
7/9/1997	surface	8.7	11.9	126	7.9				MJM Research
7/11/1997	surface	7.4	11.6	127					MJM Research
7/13/1997	surface	8.1	9.7	128					MJM Research
7/14/1997	surface	8.0	11.3	127					MJM Research
7/15/1997	surface	10.0	11.8	128					MJM Research
8/3/1997	surface	14.2	10.5	129	8.1				MJM Research
2/8/2001	6.0	1.3	9.7	347	8.1	0	23.1	4.8	URS
	12.0	1.6	8.2	347	8.2	0	23.1	4.8	URS
	18.0	1.8	6.7	339	7.9	0	23.1	4.8	URS
2/21/2001	12.0	1.8	6.3	325	7.3	0	25.0*	5.1	URS
	16.0	1.9	6.0	299	7.3	1	25.0*	5.1	URS
	22.0	1.4	4.7	251	6.9	3	25.0*	5.1	URS
3/7/2001	6.5	1.9	7.9	353	7.2	0	24.3	5.3	URS
	12.0	2.3	6.1	346	7.0	0	24.3	5.3	URS
	18.0	2.3	5.8	350	6.7	0	24.3	5.3	URS
3/20/2001	7.0	2.6	7.4	367	7.2	0	24.9	5.7	URS
	15.5	2.7	7.8	364	7.0	0	24.9	5.7	URS
	23.5	3.2	7.5	362	6.8	0	24.9	5.7	URS
4/3/2001	12.0	2.9	9.0	377	7.2	0	22.7	6.0	URS
	18.0	3.0	8.2	376	7.1	0	22.7	6.0	URS
	22.0	3.1	8.7	375	6.7	0	22.7	6.0	URS
4/19/2001	16.0	4.4	10.3	359	7.0	0	25.2	6.2	URS
	18.0	5.2	9.3	349	6.8	0	25.2	6.2	URS
	22.0	5.7	10.4	341	6.5	0	25.2	6.2	URS
4/28/2001	10.0	4.2	10.1	373	7.7	0	23.6	6.1	URS
	14.0	4.2	8.7	375	7.7	0	23.6	6.1	URS
	18.0	4.1	8.9	378	7.8	0	23.6	6.1	URS
7/31/2001	surface	10.8	9.9	157	7.9	0.83			MJM Research
	3.3	10.8	9.7	145	7.8	1.2			MJM Research
	6.6	10.9	9.5	142	7.9	0.64			MJM Research
	10.8	10.9	9.4	142	7.9	1.1			MJM Research

Appendix Table A-1. Water chemistry measurements for lake L9310, 1995 - 2002.

Date	Sample Depth (ft)	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
1/16/2002	5.0	11.3	0.4	210	7.7	0.5	20.9	4.00	MBJ 2002
	8.0	10.7	0.8	210	7.6	0.5	20.9	4.00	MBJ 2002
	11.0	9.5	1.6	222	7.6	0.5	20.9	4.0	MBJ 2002
	14.0	8.1	1.8	229	7.5	0.6	20.9	4.0	MBJ 2002
	17.0	6.1	2.0	242	7.5	0.9	20.9	4.0	MBJ 2002
	19.0	4.8	2.1	254	7.4	1.1	20.9	4.0	MBJ 2002
2/9/2002	6.0	0.5	10.2	451	7.6	0.7	21.4	5.0	MBJ 2002
	9.0	1.2	9.1	334	7.5	0.7	21.4	5.0	MBJ 2002
	12.0	1.6	8.5	320	7.4	0.8	21.4	5.0	MBJ 2002
	15.0	1.9	7.5	313	7.3	1.4	21.4	5.0	MBJ 2002
	18.0	2.0	5.4	310	7.2	1.8	21.4	5.0	MBJ 2002
	20.0	2.1	1.0	311	7.1	1.9	21.4	5.0	MBJ 2002
3/11/2002	6.5	2.5	9.1	352	7.2	0.8	18.5	5.6	MBJ 2002
	9.5	2.6	8.1	348	7.2	0.8	18.5	5.6	MBJ 2002
	12.5	2.4	7.1	345	7.1	0.8	18.5	5.6	MBJ 2002
	15.5	2.5	6.5	351	7.2	1.38	18.5	5.6	MBJ 2002
4/6/2002	7.5	1.3	7.9	660	7.8	0.7	21.1	6.3	MBJ 2002
	10.5	1.6	7.3	653	7.7	0.8	21.1	6.3	MBJ 2002
	13.5	1.9	6.4	637	7.6	0.9	21.1	6.3	MBJ 2002
	16.5	2.3	5.8	625	7.6	0.7	21.1	6.3	MBJ 2002
	19.5	2.3	5.3	639	7.6	0.8	21.1	6.3	MBJ 2002
8/14/2002	5.0	9.6	10.7	159	8.4	0.4	20.2		MBJ 2002
	8.0	9.4	11.1	160	8.6	0.5	20.2		MBJ 2002
	11.0	9.4	11.0	161	8.7	0.6	20.2		MBJ 2002
	14.0	9.4	10.9	161	8.7	0.5	20.2		MBJ 2002
	17.0	9.3	10.9	160	8.6	1.4	20.2		MBJ 2002
	19.0	9.3	10.8	160	8.7	0.5	20.2		MBJ 2002

* denotes soft lake bottom observed during field measurement

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2002.

Date	Sample Depth (ft)	Water Temp (^oC)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface	13.4		60					MJM Research
11/2/1995	surface	0.0		136			12.0	1.0	MJM Research
	1.6	0.0		138			12.0	1.0	MJM Research
	3.3	0.5		132			12.0	1.0	MJM Research
	4.9	0.5		132			12.0	1.0	MJM Research
	6.6	0.8		132			12.0	1.0	MJM Research
	8.2	1.1		131			12.0	1.0	MJM Research
	9.8	1.7		132			12.0	1.0	MJM Research
	11.5	1.8		135			12.0	1.0	MJM Research
7/9/1997	surface	8.1	11.9	83	7.9				MJM Research
7/10/1997	surface	7.7	11.6	84	7.7				MJM Research
7/13/1997	surface	8.2	10.5	84					MJM Research
7/14/1997	surface	7.8	11.2	83					MJM Research
7/15/1997	surface	9.5	12.4	84					MJM Research
8/3/1997	surface	13.4	10.6	85	8.2				MJM Research
7/28/1999	surface	8.9	11.4	76					MJM Research
7/29/1999	surface	8.6	11.5	80					MJM Research
7/30/1999	surface	8.8		76					MJM Research
7/31/1999	surface	9.5		76					MJM Research
8/1/1999	surface	11.4		76					MJM Research
8/2/1999	surface	13.5		79					MJM Research
8/3/1999	surface	12.0		76					MJM Research
7/23/2000	surface				7.9				MJM Research
7/24/2000	surface	12.1		55					MJM Research
7/25/2000	surface	10.5	10.9	55					MJM Research
7/26/2000	surface	10.2	10.9	55					MJM Research
7/27/2000	surface	10.0	10.8	55					MJM Research
7/28/2000	surface	10.0		55					MJM Research
7/29/2000	surface	11.2	10.9	55					MJM Research
8/16/2000	surface	8.5		56					MJM Research
8/17/2000	surface	7.4		56					MJM Research
8/18/2000	surface	7.6		55					MJM Research
8/19/2000	surface	7.9		56					MJM Research
8/20/2000	surface	7.5		56					MJM Research
8/21/2000	surface	6.6		56					MJM Research
7/21/2000	surface	10.4	11.1	53		10.5			MJM Research
	4.9	10.0	11.2	53		7.6			MJM Research
	8.2	9.8	11.1	53		7.5			MJM Research
	11.5	9.6	11.1	53		8.6			MJM Research

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
8/15/2000	surface	6.2	11.6	55		4.0			MJM Research
	4.9	6.0	11.7	55		4.1			MJM Research
	8.2	5.9	11.9	55		3.9			MJM Research
	11.5	5.9	11.7	55		5.7			MJM Research
2/8/2001	6.0	0.9	10.9	180	8.5	0	14.9	4.8	URS
	12.0	2.4	1.5	269	8.0	0	14.9	4.8	URS
2/21/2001	6.0	1.2	12.5	161	7.3	0	14.2*	5.1	URS
	8.0	2.2	10.8	149	7.3	0	14.2*	5.1	URS
	12.0	2.9	3.0	118	6.5	0	14.2*	5.1	URS
3/7/2001	6.5	1.4	11.2	178	7.4	0	14.1	5.4	URS
	9.5	2.4	7.8	181	7.8	0	14.1	5.4	URS
	13.0	3.0	4.4	162	6.9	0	14.1	5.4	URS
3/20/2001	7.0	2.3	11.0	169	7.3	0	14.8	5.7	URS
	10.0	3.0	7.5	193	7.6	0	14.8	5.7	URS
	13.5	3.2	2.5	152	6.3	0	14.8	5.7	URS
4/3/2001	8.0	3.0	10.2	186	7.0	0	14.4	6.1	URS
	10.0	3.5	7.0	185	6.8	0	14.4	6.1	URS
	12.0	3.7	6.8	184	6.7	0	14.4	6.1	URS
4/18/2001	12.0	4.3	5.7	208	7.1	0	14.6	6.4	URS
	13.0	4.2	3.3	252	6.8	0	14.6	6.4	URS
	14.0	4.2	1.6	236	7.0	0	14.6	6.4	URS
4/28/2001	8.0	4.3	10.6	195	7.8	0	15.4	6.2	URS
	10.0	4.5	11.2	197	7.8	0	15.4	6.2	URS
	12.0	4.5	11.1	197	7.8	0	15.4	6.2	URS
7/28/2001	surface	13.3	8.6	59	7.8	1.1			MJM Research
	3.3	13.4	8.7	59	7.8	1.1			MJM Research
	6.6	13.4	8.5	59	7.7	1.2			MJM Research
	10.8	13.4	8.5	59	7.6	1.7			MJM Research
8/25/2001	surface	4.7	13.2	58	7.9	0.5			MJM Research
	3.3	4.7	13.2	58	7.9	0.7			MJM Research
	6.6	4.7	13.1	58	7.9	1			MJM Research
	10.8	4.7	13.0	58	7.9	0.5			MJM Research
1/16/2002	4	0.4	16.0	151	7.6	0.3	11.40	3.10	MBJ 2002
	7	1.5	14.2	134	7.6	0.5	11.40	3.10	MBJ 2002
	10	2.5	9.8	126	7.5	0.4	11.40	3.10	MBJ 2002

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/9/2002	5	0.6	15.9	152	7.5	1.2	11.40	3.9	MBJ 2002
	8	1.6	15.5	150	7.5	1.5	11.40	3.9	MBJ 2002
	10	2.3	13.7	145	7.2	2.1	11.40	3.9	MBJ 2002
#######	5	1.3	15.4	185	7.3	2.0	11.5	4.7	MBJ 2002
	8	2.1	14.3	171	7.3	1.6	11.5	4.7	MBJ 2002
	10	2.6	10.0	164	7.2	1.8	11.5	4.7	MBJ 2002
4/6/2002	6.5	2.0	9.7	159	6.9	0.6	11.7	5.4	MBJ 2002
	9.5	2.9	9.3	152	7.1	0.6	11.7	5.4	MBJ 2002
8/7/2002	surface	9.7	10.9	63	8.1	1.1			MJM Research
	3.3	9.7	10.8	63	8.1	1.3			MJM Research
	6.6	9.7	10.8	63	8.1	1.2			MJM Research
	9.8	9.7	10.7	63	8.1	1.2			MJM Research
#######	4	9.4	11.3	68	8.2	1.1	11.9		MBJ 2002
	7	9.3	11.3	70	8.0	1.3	11.9		MBJ 2002
	10	9.3	11.2	71	7.8	1.2	11.9		MBJ 2002

* denotes soft lake bottom observed during field measurement

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface	13.1		107					MJM Research
10/31/1995	surface	0.0		189			8.5	1.0	MJM Research
	1.6	0.1		189			8.5	1.0	MJM Research
	3.3	0.2		188			8.5	1.0	MJM Research
	4.9	0.4		187			8.5	1.0	MJM Research
	6.6	0.9		182			8.5	1.0	MJM Research
	8.2	1.0		170			8.5	1.0	MJM Research
7/9/1997	surface	7.9	11.2	123	7.7				MJM Research
7/10/1997	surface	7.7	11.6	127	7.7				MJM Research
7/11/1997	surface	8.6	11.6	125					MJM Research
7/13/1997	surface	8.1	11.1	128					MJM Research
7/14/1997	surface	7.7	11.0	127					MJM Research
7/15/1997	surface	9.4	12.2	127					MJM Research
7/28/1999	surface	8.8	12.3	172	7.8				MJM Research
7/29/1999	surface	8.3	11.6	178					MJM Research
7/30/1999	surface	8.6		170					MJM Research
7/31/1999	surface	9.4		171					MJM Research
8/1/1999	surface	11.4		171					MJM Research
8/2/1999	surface	12.5		177					MJM Research
8/3/1999	surface	12.7		171					MJM Research
7/28/1999	surface	8.9	11.4	76					MJM Research
7/23/2000	surface				8.0				MJM Research
7/25/2000	surface	11.2	10.9	167					MJM Research
7/26/2000	surface	10.6	11.2	167					MJM Research
7/27/2000	surface	10.3		169					MJM Research
7/28/2000	surface	10.3	11.1	167					MJM Research
7/29/2000	surface	10.6		169					MJM Research
8/16/2000	surface	8.5		172					MJM Research
8/17/2000	surface	7.5		170					MJM Research
8/18/2000	surface	7.6		175					MJM Research
8/19/2000	surface	8.0		175					MJM Research
8/20/2000	surface	7.5		177					MJM Research
8/21/2000	surface	6.9		175					MJM Research
7/18/2000	surface	11.2	10.6	162		3.6			MJM Research
	4.9	11.1	10.5	162		3.3			MJM Research
	8.2	10.8	10.8	163		3.3			MJM Research
	11.5	10.8	10.9	163		3.5			MJM Research
8/15/2000	surface	6.6	12.3	170		5.5			MJM Research
	4.9	5.9	12.4	171		5.7			MJM Research
	8.2	5.7	12.6	171		15.0			MJM Research
	11.5	5.7	12.5	171		7.5			MJM Research

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	6.0	0.8	7.8	491	7.9	0	9.5	4.6	URS
2/21/2001	6.0	2.5	5.7	561	6.4	0	9.4*	5.0	URS
	7.5	2.0	5.5	580	6.5	1	9.4*	5.0	URS
	8.0	2.2	5.3	579	6.6	3	9.4*	5.0	URS
3/7/2001	6.5	1.0	4.0	519	6.9	0	9.6	5.2	URS
	8.5	0.8	4.1	517	6.9	0	9.6	5.2	URS
3/20/2001	6.5	1.1	4.0	408	9.0	0	9.6	5.5	URS
	8.5	2.1	3.8	549	8.7	0	9.6	5.5	URS
4/3/2001	6.0	1.3	3.3	634	7.0	56	9.5	5.8	URS
	8.0	2.6	3.9	526	6.7	128	9.5	5.8	URS
4/18/2201	7.5	2.5	2.5	842	7.1	0	9.6	6.1	URS
	8.0	3.6	2.1	785	7.0	0	9.6	6.1	URS
	9.5	4.1	2.0	769	6.8	0	9.6	6.1	URS
4/28/2001	7.0	2.4	3.8	623	7.2	0	9.6	6.1	URS
	8.0	2.7	3.4	671	7.3	0	9.6	6.1	URS
7/25/2001	surface	13.2	9.2	249	8.0	1.7			MJM Research
	3.3	13.6	9.5	247	8.0	1.4			MJM Research
	6.6	13.6	9.5	247	8.0	1.3			MJM Research
	10.8	13.7	10.0	247	7.9	4.6			MJM Research
8/25/2001	surface	4.4	12.6	249	8.0	0.7			MJM Research
	3.3	4.4	12.6	249	8.0	0.7			MJM Research
	6.6	4.5	12.5	248	8.0	1			MJM Research
	10.8	4.5	12.4	248	8.0	2			MJM Research
1/16/2002	4.7	0.6	10.8	573	8.2	0.56	9.4	3.7	MBJ 2002
	7.7	1.9	9.5	623	7.5	0.55	9.4	3.7	MBJ 2002
2/9/2002	5.3	1.1	7.1	764	7.1	1.08	9.5	4.4	MBJ 2002
	8.3	2.1	6.0	723	7.1	1.11	9.5	4.4	MBJ 2002
3/12/2002	6	1.7	3.8	805	6.3	1.08	9.5	5.4	MBJ 2002
	9	2.2	2.8	836	6.3	1.22	9.5	5.4	MBJ 2002
4/7/2002	6.8	1.4	0.1	910	6.9	0.9	9.4	5.8	MBJ 2002
	8.0	2.1	0.0	1066	6.9	0.9	9.4	5.8	MBJ 2002
5/11/2002	7.0	3.1	4.0	894	7.3	13.9	9.5	5.9	MBJ 2002

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^oC)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
8/3/2002	surface	15.3	9.95	176	8.21	0.92			MJM Research
	3.3	15.2	9.92	176	8.14	0.9			MJM Research
	6.6	15.1	9.86	176	8.12	0.85			MJM Research
	9.8	15.1	9.65	176	8.13	0.74			MJM Research
8/14/2002	4.7	9.5	11.40	241		1	9.5		MBJ 2002
	7.7	9.4	11.40	244		1.6	9.5		MBJ 2002

* denotes soft lake bottom observed during field measurement

Appendix Table A-4. Water chemistry measurements for lake B8534/L9282, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^oC)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface	15.3		276					MJM Research
7/17/1998	surface	13.3	10.5	280					MJM Research
7/17/1998	surface	13.6	10.2	279					MJM Research
7/18/1998	surface	13.1	10.2	282					MJM Research
7/18/1998	surface	13.1	10.1	282					MJM Research
7/18/1998	surface	12.3	9.1	284					MJM Research
7/19/1998	surface	13.6	10.3	281					MJM Research
7/19/1998	surface	13.6	10.1	282					MJM Research
7/19/1998	surface	13.7	10.3	282					MJM Research
7/20/1998	surface	14.1	10.3	281					MJM Research
7/20/1998	surface	14.4	10.3	282					MJM Research
7/20/1998	surface	14.4	10.7	285					MJM Research
7/21/1998	surface	14.2	10.3	282					MJM Research
7/21/1998	surface	14.5	10.4	282					MJM Research
7/21/1998	surface	14.3	9.9	282					MJM Research
7/22/1998	surface	14.6	10.2	282					MJM Research
7/22/1998	surface	14.5	10.3	282					MJM Research
7/22/1998	surface	14.1	10.2	273					MJM Research
7/24/1998	surface	12.6	10.4	282					MJM Research
7/24/1998	surface	13.1	9.9	283					MJM Research
2/8/2001	6.0	1.0	11.4	777	8.4	0	23.6	4.9	URS
	12.0	1.7	10.2	726	8.3	0	23.6	4.9	URS
	18.0	2.2	9.9	696	8.2	0	23.6	4.9	URS
3/7/2001	6.5	1.4	8.2	754	7.5	0	24.6	5.4	URS
	12.0	2.1	8.3	722	7.4	0	24.6	5.4	URS
	18.0	2.6	7.1	706	7.1	10*	24.6	5.4	URS
4/3/2001	12.0	2.5	8.7	786	7.5	0	23.8	5.9	URS
	18.0	2.5	8.7	814	7.3	0	23.8	5.9	URS
	22.0	2.6	8.7	813	6.9	0	23.8	5.9	URS
4/28/2001	12.0	4.3	9.7	759	8.2	0	23.7	6.2	URS
	18.0	4.0	9.9	808	8.0	0	23.7	6.2	URS
	22.0	3.9	9.7	811	7.6	0	23.7	6.2	URS
8/5/2001	surface	7.8	10.7	286	8.2	2.8			MJM Research
1/16/2002	4.8	0.5	9.1	464	7.9	1.4	21.0	3.8	MBJ 2002
	7.8	1.0	8.2	447	7.8	0.7	21.0	3.8	MBJ 2002
	10.8	1.2	10.0	462	7.8	0.5	21.0	3.8	MBJ 2002
	13.8	1.8	10.4	546	7.7	0.4	21.0	3.8	MBJ 2002
	16.8	2.0	9.0	572	7.6	0.6	21.0	3.8	MBJ 2002
	19.8	2.3	7.3	570	7.8	0.6	21.0	3.8	MBJ 2002

Appendix Table A-4. Water chemistry measurements for lake B8534/L9282, 1995-2002.

Date	Sample Depth (ft)	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2002	5.0	1.0	11.8	646	7.7	0.5	21.0	4.9	MBJ 2002
	8.0	1.0	10.8	665	7.6	0.5	21.0	4.9	MBJ 2002
	11.0	2.0	10.6	642	7.6	0.5	21.0	4.9	MBJ 2002
	14.0	2.0	10.7	642	7.6	0.7	21.0	4.9	MBJ 2002
	17.0	2.0	10.8	642	7.6	0.9	21.0	4.9	MBJ 2002
	20.0	2.0	10.1	642	7.7	0.8	21.0	4.9	MBJ 2002
3/11/2002	6.0	1.0	9.4	763	7.4	1.4	21.1	5.4	MBJ 2002
	9.0	1.1	9.1	756	7.3	1.9	21.1	5.4	MBJ 2002
	12.0	1.5	8.8	740	7.3	0.9	21.1	5.4	MBJ 2002
	15.0	1.7	8.3	733	7.3	1.0	21.1	5.4	MBJ 2002
	18.0	1.9	8.2	719	7.2	1.0	21.1	5.4	MBJ 2002
4/6/2002	7.0	1.3	7.9	660	7.8	0.7	21.0	5.8	MBJ 2002
	10.0	1.6	7.3	653	7.7	0.8	21.0	5.8	MBJ 2002
	13.0	1.9	6.4	637	7.6	0.9	21.0	5.8	MBJ 2002
	16.0	2.3	5.8	625	7.6	0.7	21.0	5.8	MBJ 2002
	19.0	2.3	5.3	639	7.6	0.8	21.0	5.8	MBJ 2002
5/11/2002	7.0	2.0	10.4	553	6.9	3.5	20.8	6.0	MBJ 2002
	10.0	2.6	9.1	699	7.1	1.2	20.8	6.0	MBJ 2002
	13.0	2.8	7.4	712	7.1	0.7	20.8	6.0	MBJ 2002
	16.0	2.9	6.6	709	7.1	0.6	20.8	6.0	MBJ 2002
	19.0	2.7	5.7	732	7.2	1.1	20.8	6.0	MBJ 2002
8/14/2002	5.0	8.9	10.7	331	8.7	0.6			MBJ 2002
	8.0	8.9	10.6	331	8.8	0.8			MBJ 2002
	11.0	8.8	10.6	332	8.8	0.7			MBJ 2002
	14.0	8.8	10.6	332	8.8	0.6			MBJ 2002
	17.0	8.8	10.6	332	8.9	0.9			MBJ 2002
	20.0	8.8	10.5	332	8.9	0.6			MBJ 2002

Appendix Table A-5. Water chemistry measurements for lake L9283, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface	16.8		234					MJM Research
2/8/2001	6.0	0.5	7.8	1,043	7.8	0	8.5	4.8	URS
3/7/2001	6.5	1.1	3.9	999	6.9	0	8.6	5.4	URS
3/7/2001	7.0	1.4	3.9	950	6.5	0	8.6	5.4	URS
4/3/2001	7.5	1.9	2.7	1,238	7.0	0	9.0	6.1	URS
4/28/2001	7.0	1.1	4.4	1,078	7.1	0	8.9	6.4	URS
4/28/2001	8.0	1.8	4.0	1,033	8.1	0	8.9	6.4	URS
8/5/2001	surface	7.1	11.1	333	8.1	1.7			MJM Research
1/16/2002	5.0	0.5	12.9	838	6.9	1.2	9.0	4.0	MBJ 2002
	8.0	0.9	12.1	850	7.2	0.8	9.0	4.0	MBJ 2002
2/8/2002	6.0	1.0	7.9	831	7.5	0.8	8.7	5.1	MBJ 2002
	7.0	1.0	8.7	812	7.5	1.0	8.7	5.1	MBJ 2002
3/11/2002	7.0	1.0	9.8	1,008	7.7	3.4	9.0	6.1	MBJ 2002
	8.0	2.0	10.2	945	7.5	6.0	9.0	6.1	MBJ 2002
4/6/2002	7.3	0.6	2.2	1,199	7.4	1.4	9.0	6.3	MBJ 2002
5/11/2002	7.7	2.3	1.7	1,253	7.2	2.1	9.1	6.7	MBJ 2002
8/14/2002	5.0	8.1	11.1	310	8.5	0.8	8.9		MBJ 2002
	8.0	8.0	11.0	312	8.5	0.9	8.9		MBJ 2002

Appendix Table A-6. Water chemistry measurements for lake L9275, 2001-2002.

Date	Sample Depth (ft)	Water Temp (°C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	8.0	2.2	13.4	519	7.1	0	16.1	4.8	URS
	12.0	2.1	10.1	525	7.2	0	16.1	4.8	URS
3/7/2001	6.5	1.8	9.2	449	7.6	0	16.2	5.4	URS
	10.0	2.2	9.3	381	7.4	0	16.2	5.4	URS
	15.0	3.1	5.4	309	6.9	0	16.2	5.4	URS
4/3/2001	8.0	2.8	11.3	547	7.7	0	16.2	6.0	URS
	12.0	3.3	11.2	547	7.5	0	16.2	6.0	URS
	16.0	3.5	10.9	562	6.5	0	16.2	6.0	URS
4/28/2001	8.0	4.4	10.9	529	8.3	0	16.1	6.2	URS
	10.0	4.7	11.1	523	8.3	0	16.1	6.2	URS
	14.0	4.9	12.5	497	8.3	0	16.1	6.2	URS
8/5/2001	surface	7.1	11.4	210	8.1	2.4			MJM Research
1/15/2002	4.8	1.0	14.4	419	8.4	0.8	12.5	3.8	MBJ 2002
	7.8	1.4	14.4	402	8.7	0.6	12.5	3.8	MBJ 2002
	10.8	1.9	13.6	395	8.8	0.4	12.5	3.8	MBJ 2002
2/8/2002	5.2	1.0	12.6	499	7.6	0.6	12.5	4.2	MBJ 2002
	8.2	2.0	12.4	464	7.4	0.6	12.5	4.2	MBJ 2002
	11.2	2.0	12.0	464	7.5	0.6	12.5	4.2	MBJ 2002
3/11/2002	5.0	0.6	11.6	569	7.2	1.3	12.8	5.0	MBJ 2002
	8.0	1.3	11.6	541	7.6	0.9	12.8	5.0	MBJ 2002
	11.0	1.9	11.4	501	7.8	0.9	12.8	5.0	MBJ 2002
4/6/2002	6.5	1.3	9.5	493	6.9	0.7	12.7	5.4	MBJ 2002
	9.5	1.9	8.4	474	7.0	0.6	12.7	5.4	MBJ 2002
	11.0	2.2	8.5	464	7.2	0.6	12.7	5.4	MBJ 2002
8/13/2002	5.0	8.9	11.3	241	9.0	0.6	12.5		MBJ 2002
	8.5	8.9	11.4	241	9.0	0.5	12.5		MBJ 2002
	11.0	8.9	11.4	241	8.9	0.5	12.5		MBJ 2002

Appendix Table A-7. Water chemistry measurements for lake L9342, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^oC)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface	12.7		84					MJM Research
11/2/1995	surface	0.2		186		0.0	8.9	1.1	MJM Research
11/2/1995	surface	0.3		185		0.5	8.9	1.1	MJM Research
11/2/1995	3.3	0.5		184		1.0	8.9	1.1	MJM Research
11/2/1995	4.9	0.7		183		1.5	8.9	1.1	MJM Research
11/2/1995	6.6	1.0		183		2.0	8.9	1.1	MJM Research
11/2/1995	8.2	1.1		184		2.5	8.9	1.1	MJM Research
									MJM Research
4/17/2000	8.2	2.1	5.5	315			11.5	6.5	MJM Research
4/18/2000	8.2	1.8	4.8	339			9.0	6.5	MJM Research
4/18/2000	6.6	0.8	5.3	342			6.8	6.5	MJM Research
4/18/2000	6.0	0.8	5.5	325			6.2	6.0	MJM Research
4/18/2000	6.6	0.8	5.8	338			6.7	6.5	MJM Research
4/19/2000	8.2	2.4	4.7	340			9.1	6.5	MJM Research
4/19/2000	8.2	2.8	4.8	335			11.3	6.5	MJM Research
4/19/2000	8.2	2.2	5.2	337			10.0	6.5	MJM Research
4/19/2000	6.6	0.4	5.0	357			7.5	6.5	MJM Research
4/19/2000	5.7	0.1	5.6	297			6.0	5.8	MJM Research
2/8/2001	5.0	1.5	8.3	348	8.3	0.0	12.8	4.8	URS
2/8/2001	11.0	3.0	5.2	355	8.0	1.0	12.8	4.8	URS
3/7/2001	6.5	1.8	7.9	359	7.0	0.0	12.7	5.3	URS
3/7/2001	11.0	2.8	8.0	335	7.0	0.0	12.7	5.3	URS
4/3/2001	8.0	2.4	8.9	292	7.1	0.0	13.3	6.0	URS
4/3/2001	12.0	3.5	9.3	227	6.9	0.0	13.3	6.0	URS
4/28/2001	8.0	3.0	6.5	448	7.4	0.0	13.2	6.2	URS
4/28/2001	12.0	4.3	6.0	417	7.5	0.0	13.2	6.2	URS
7/31/2001	surface	10.7	9.9	123	7.7	1.1			MJM Research
7/31/2001	3.3	10.6	10.1	117	7.7	1.8			MJM Research
7/31/2001	6.6	10.6	10.2	115	7.7	0.8			MJM Research
7/31/2001	10.8	10.6	9.7	114	7.7	0.8			MJM Research
1/16/2002	5.0	0.6	10.0	275	7.7	0.4	11.3	4.0	MBJ 2002
	8.0	1.4	9.6	262	7.5	0.3	11.3	4.0	MBJ 2002
	10.0	1.9	8.1	270	7.2	0.4	11.3	4.0	MBJ 2002
2/9/2002	5.7	1.3	10.0	322	6.5	0.7	11.3	4.7	MBJ 2002
	8.7	1.9	9.3	306	6.7	0.6	11.3	4.7	MBJ 2002
	10.0	2.4	7.2	299	6.8	0.9	11.3	4.7	MBJ 2002
3/11/2002	6.5	1.1	8.5	383	6.2	1.4	10.8	5.5	MBJ 2002
	9.5	2.1	8.1	361	6.4	1.6	10.8	5.5	MBJ 2002

Appendix Table A-7. Water chemistry measurements for lake L9342, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
4/6/2002	7.0	1.8	5.7	345	7.6	0.5	11.2	6.0	MBJ 2002
	10.0	2.4	4.5	348	7.4	0.4	11.2	6.0	MBJ 2002
5/11/2002	7.2	2.4	6.8	317	6.3	5.0	11.2	6.2	MBJ 2002
	10.2	3.2	6.3	411	6.3	1.6	11.2	6.2	MBJ 2002
8/14/2002	5.0	8.9	11.0	130	8.3	0.8	11.8		MBJ 2002
	8.0	8.8	10.9	132	8.3	0.5	11.8		MBJ 2002
	10.0	8.8	10.8	132	8.4	0.4	11.8		MBJ 2002

Appendix Table A-8. Historical measurements of ion concentrations at lakes in the Alpine region.

Lake	Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
L9310	1993	10	4.8	3.7	11	43	130	J. Lobdell
L9312	1993	8	4.5	2.1	7.2	27	150	J. Lobdell
L9313	1993	19	9.3	3.1	8	33	54	J. Lobdell
B8534	1985					103		Bendock & Burr 1986
(L9282)	1992	43	1.5	10.6	19	91	240	J. Lobdell
L9283	1992	2.8	1.8	3.2	29	86	110	J. Lobdell
L9275	1985					103		Bendock & Burr 1986
	1992	13	6.2	9.8	22	95	140	J. Lobdell
L9342	1993	14	5.3	3.2	7.4	32	87	J. Lobdell

APPENDIX B
Catch Data from lakes L9312 and L9313
For 1995 to 2002

Appendix Table B-1. Results of fish sampling in lakes L9312 and L9313 prior to 1999.

Lake	Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
L9312	Fyke Net	Jul 14, 1995	23.9	Alaska blackfish	1	
				Slimy sculpin	1	
				Ninespine stickleback	10	
		Jul 26, 1995	20.0	Broad whitefish	1	428
				Ninespine stickleback	2	
		Jul 11-15 1997	116.6	Least cisco	1	56
				Alaska blackfish	5	70
				Slimy sculpin	8	38-84
				Ninespine stickleback	57	
	Gill Net	Nov 2, 1995	21.7	Least cisco	62	116-303
				Broad whitefish	5	334-470
	Minnow Trap	Jul 14, 1995	48.6	Slimy sculpin	2	
				Ninespine stickleback	1	
	Set Line	Jul 14, 1995	23.5	None	0	
L9313	Fyke Net	Jul 14, 1995	23.3	Least cisco	5	229-283
				Alaska blackfish	6	42-90
				Ninespine stickleback	63	
		Jul 26, 1995	20.7	Ninespine stickleback	9	
		Jul 11-15 1997	91.2	Least cisco	4	167-276
				Alaska blackfish	12	79
				Slimy sculpin	1	
	Gill Net	Nov 1, 1995	20.6	None	0	
		Aug 8, 1996	9.1	None	0	
	Minnow Trap	Jul 15, 1995	43.2	Ninespine stickleback	9	
	Set Line	Jul 15, 1995	21.6	None	0	
		Jul 16, 1995	24.3	None	0	

Appendix Table B-2. Catches of fish from Alpine Area Lakes fyke net sampling, 1999.

Species	Net A Jul 29	Net A Jul 30	Net A Jul 31	Net B Aug 1	Net B Aug 2	Net B Aug 3	Net B Aug 4	Net A Total	Net B Total
L9312									
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):	20.3	24.2	24.0	25.3	26.1	19.3	26.3	68.4	97.0
L9313									
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):	26.8	24.2	24.1	25.3	26.0	19.3	26.7	51.1	121.3

Appendix Table B-3. Catches of fish from Alpine Area Lakes fyke net sampling, 2000.

Species	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	July Total	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug Total
L9312																
Broad whitefish	3	0	0	0	2	0	0	5	1	1	0	1	1	0	0	4
Humpback whitefish	3	6	6	3	4	3	2	27	8	4	1	1	1	0	0	15
Arctic cisco	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	5
Least cisco	196	680	380	32	17	14	30	1,349	25	47	45	17	35	12	15	196
Round whitefish	0	3	1	1	1	0	1	7	3	5	6	0	0	0	3	17
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Longnose sucker	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Alaska blackfish	4	3	5	4	3	2	1	22	17	12	15	4	17	18	19	102
Slimy sculpin	1	0	0	5	3	2	2	13	9	30	10	6	7	21	10	93
Ninespine stickleback	292	115	67	53	65	50	87	729	43	146	75	31	20	24	29	368
Net Hours:	18.0	27.4	24.3	25.4	23.7	22.8	26.7	168.3	27.4	18.1	24.2	27.0	27.0	21.2	20.8	165.7
L9313																
Broad whitefish	4	0	0	0	0	0	0	4	1	1	1	2	0	0	2	7
Humpback whitefish	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	5
Least cisco	0	0	0	0	0	0	0	0	2	0	1	1	0	0	1	5
Round whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Alaska blackfish	2	10	5	1	0	2	3	23	10	15	20	13	10	13	19	100
Ninespine stickleback	256	200	116	44	53	45	65	779	49	133	41	32	27	26	24	332
Net Hours:	17.7	31.0	24.3	23.3	24.0	23.9	25.4	169.7	23.5	17.9	29.7	23.2	27.0	21.2	19.1	161.6

Appendix Table B-4. Catches of fish from Alpine Area Lakes fyke net sampling, 2001.

	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	July Total	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	August Total
L9312																	
Broad whitefish	0	5	1	0	1	0	0	7	0		0	0	0	0	0	0	0
Humpback whitefish	0	0	1	0	0	0	0	1	0		1	0	0	0	0	0	1
Arctic cisco	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Least cisco	8	28	16	1	0	1	2	56	24		64	8	2	65	53	12	228
Round whitefish	1	1	0	1	1	0	1	5	1		1	2	0	0	0	0	4
Burbot	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Longnose sucker	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Alaska blackfish	0	4	0	0	0	0	1	5	0		1	2	1	2	2	0	8
Fourhorn sculpin	0	0	0	0	0	0	0	0	0		0	0	0	0	0	1	1
Slimy sculpin	0	1	1	1	0	0	1	4	6		14	4	2	11	10	2	49
Ninespine stickleback	16	28	15	3	6	12	9	89	20		18	8	6	8	4	11	75
Effort (hrs)	24.8	24.5	20.5	24.4	27.3	24.0	21.0	166.4	22.9		46.6	21.1	24.1	23.0	23.4	26.8	187.8
L9313																	
Broad whitefish	0	1	0	0	0	0	1	2	0		0	1	0	0	0	2	3
Humpback whitefish	0	0	0	0	0	1	0	1	0		1	1	0	0	2	0	4
Least cisco	28	2	2	0	0	8	8	48	0		2	2	0	1	0	0	5
Round whitefish	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Alaska blackfish	4	2	0	3	0	2	0	11	4		4	3	3	5	1	2	22
Ninespine stickleback	22	7	12	27	17	12	3	100	15		41	37	6	4	15	10	128
Effort (hrs)	25.9	26.4	20.4	24.1	21.9	22.2	23.3	164.2	18.3		53.0	21.2	23.9	23.4	22.9	26.3	189.1

Appendix Table B-5. Catches of fish from Alpine Area Lakes fyke net sampling, 2002.

	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	July Total	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	Aug 26	Aug 27	August Total
L9312																	
Broad whitefish	0	0	0	0	0	1	0	0	1	2	4	1	9	2	19	2	39
Humpback whitefish	0	0	0	0	0	0	0	0	0	2	1	1	4	8	16	32	64
Arctic cisco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least cisco	0	54	65	15	4	1	0	3	142	2	5	308	25	2	34	276	652
Round whitefish	2	1	0	2	0	10	0	0	15	27	54	106	1	1	1	1	191
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
Longnose sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	0	0	0	0	0	0	0	0	0	0	1	1	3	4	12	7	28
Fourhorn sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slimy sculpin	0	1	0	0	0	0	0	3	4	3	4	1	5	4	7	7	31
Ninespine stickleback	0	10	9	4	2	3	5	11	44	3	8	14	10	95	7	4	141
Effort (hrs)	27.1	26.5	24.6	19.8	29.3	25.4	16.0	31.0	199.7	28.6	19.8	25.6	23.5	24.1	23.7	25.0	170.3
L9313																	
Broad whitefish	31	10	11	19					71	1	18	22	20	22	46	46	175
Humpback whitefish	1			1					2	28		1		2			31
Least cisco	113	105	44	37	41		1	1	342	4	9	5	4	3	31	6	62
Round whitefish		1		1					2								0
Burbot									0								0
Alaska blackfish	2	1	3	1	2	1	1		11	5	9	5	8	10	21	32	90
Ninespine stickleback	59	58	40	7	11	11	12	29	227	25	21	137		78	363	64	688
Effort (hrs)	28.1	24.6	24.4	22.0	29.3	22.4	22.9	27.4	201.1	30.0	19.7	26.2	23.1	23.8	23.9	25.4	172.0

Appendix Table B-6. Tagged fish released in Alpine lakes L9312 and L9313 during 2001.

Lake	Species	Release Date	Release Length	Tag Code
L9312				
	Broad whitefisl	7/23/2001	400	MJM010250
		7/23/2001	362	MJM010426
		7/23/2001	320	MJM010427
		7/24/2001	486	MJM010432
L9313				
	Least cisco	7/23/2001	295	MJM010428
		7/24/2001	262	MJM010433
		8/22/2001	306	MJM011332
	Broad whitefisl	8/20/2001	270	MJM011338

Appendix Table B-7. Tagged fish released in Alpine lakes L9312 and L9313 during 2002.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9312						
	Broad whitefish	8/23/2002	285	MJM020503		
		8/24/2002	326	MJM020509		
	Humpback whitefish	8/22/2002	349	MJM020527		
		8/23/2002	350	MJM020502		
	Least cisco	7/22/2002	196	MJM020469		
		8/24/2002	352	MJM020507		
	Round whitefish	7/22/2002	264	MJM020470		
		7/25/2002	247	MJM020480		
		7/25/2002	281	MJM020482		
		8/25/2002	311	MJM020510		
		8/26/2002	282	MJM020561		
L9313						
	Broad whitefish	7/22/2002	240	MJM020473		
		7/22/2002	200	MJM020474		
		7/22/2002	181	MJM020476		
		7/22/2002	197	MJM020477		
		8/22/2002	386	MJM020528		
		8/22/2002	330	MJM020530		
		8/22/2002	375	MJM020531		
		8/22/2002	366	MJM020533		
		8/22/2002	340	MJM020534		
		8/23/2002	235	MJM020505	8/26/2002	3
		8/23/2002	331	MJM020506		
		8/25/2002	418	MJM020560		
		8/26/2002	200	MJM020537		
		8/26/2002	186	MJM020538		
		8/26/2002	515	MJM020562		
		8/26/2002	365	MJM020564		
		8/26/2002	189	MJM020565		
		8/27/2002	468	MJM020540		
	Least cisco	7/22/2001	281	MJM010243	7/22/2002	365
		7/22/2002	186	MJM020471		
		7/22/2002	215	MJM020472		
		7/22/2002	188	MJM020475	8/26/2002	35
		8/23/2002	250	MJM020504		
		8/26/2002	181	MJM020536		
		8/27/2002	369	MJM020539		

APPENDIX C
Length Frequency Data from lakes L9312 and L9313
2002

Appendix Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	**L9312** Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 29	Jul Total	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	Aug 26	Aug 27	Aug Total
0								0								0
10								0								0
20								0								0
30			11					11				1				1
40								0							7	7
50	1							1			42	34	1	23	215	315
60	2	2	1	1		1	1	8			9	5	1	5	54	74
70	14	11	12	9	1	2	2	51				1			2	3
80	2	5	14	3	2	7		33		1		4			3	8
90								0	1	3	22	4		4	4	38
100		1	3	1		1		6	1		12	5		1		19
110			1					1			3					3
120		2				1		3			7					7
130		3		1				4			1				1	2
140		8			1			9		1				1		2
150		16	1					17								0
160		7						7				1				1
170	1	1						2								0
180								0			1	1				2
190	1							1			1					1
200								0								0
210								0								0
220								0								0
230								0								0
240								0								0
250								0								0
260								0								0
270								0								0
280								0								0
290								0								0
300								0								0
310								0								0
320								0				1				1
330								0								0
340								0								0
350								0				1				1
360								0								0
370								0								0
380								0								0
390								0								0
400								0								0
Total:	21	56	43	15	4	12	3	154	2	5	98	58	2	34	286	485

Appendix Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	**L9313** Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul Total	Aug 21	Aug 22	Aug 23	Aug 25	Aug 26	Aug 27	Aug Total
0						0							0
10						0							0
20						0							0
30		1	2			3							0
40						0							0
50						0							0
60						0			1		1		2
70	18	15	8	5		46			1		2	2	5
80	72	79	27	26	1	205							0
90	3	7	4	6	1	21	1						1
100				1		1	2	1			6	1	10
110						0	2	6	2	2	17	2	31
120	2	2	1		1	6				1	2		3
130	3					3							0
140	3		2			5							0
150	1					1							0
160	4					4		1					1
170	3					3					1		1
180	2					2							0
190		1				1					1		1
200						0					1		1
210	1					1							0
220						0		1					1
230						0							0
240						0							0
250						0							0
260						0			1				1
270						0							0
280	1					1							0
290						0							0
300						0							0
310						0							0
320						0							0
330						0							0
340						0							0
350						0							0
360						0							0
370						0						1	1
380						0							0
390						0							0
400						0							0
Total:	113	105	44	38	3	303	5	9	5	3	31	6	59

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	L9312 Jul 27	Aug 21	Aug 23	Aug 24	Aug 25	Aug 27	Aug Total	L9313 Jul 22	Jul 23	Jul 24	Jul 25	Jul Total
30							0				1	1
40							0					0
50		2		13	2	2	19					0
60				5			5					0
70				1			1				1	1
80	1			2			2	4	2	1	4	11
90				2			2	7	4	4	8	23
100				5			5		2	5	5	12
110							0	1				1
120							0	1				1
130							0					0
140							0	4		1		5
150							0	3				3
160							0	6	2			8
170							0	1				1
180							0	1				1
190							0	1				1
200							0	1				1
210							0					0
220							0					0
230							0					0
240							0	1				1
250							0					0
260							0					0
270							0					0
280			1				1					0
290							0					0
300							0					0
310							0					0
320				1			1					0
330							0					0
340							0					0
350							0					0
360							0					0
370							0					0
380							0					0
390							0					0
400							0					0
410							0					0
420							0					0
430							0					0
440							0					0
450							0					0
460							0					0
470							0					0
480							0					0
490							0					0
500							0					0
510							0					0
520							0					0
530							0					0
540							0					0
550							0					0
Total:	1	2	1	29	2	2	36	31	10	11	19	71

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	L9313 Aug 21	Aug 22	Aug 23	Aug 25	Aug 26	Aug 27	Aug Total
30							0
40							0
50		9	13	10	14	23	69
60		2	3	11	11	20	47
70							0
80							0
90					1		1
100	1				2		3
110			3		5		8
120					3	1	4
130					1		1
140							0
150			1				1
160					2		2
170					1	1	2
180		1			2		3
190							0
200		1			1		2
210							0
220							0
230			1		1		2
240							0
250							0
260							0
270							0
280							0
290							0
300							0
310							0
320							0
330		1	1				2
340		1					1
350							0
360		1			1		2
370		1					1
380		1					1
390							0
400							0
410				1			1
420							0
430							0
440							0
450							0
460						1	1
470							0
480							0
490							0
500							0
510					1		1
520							0
530							0
540							0
550							0
Total:	1	18	22	22	46	46	155

Appedix Table C-3. Length frequencies of humpback whitefish caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	L9312 Aug 21	Aug 22	Aug 23	Aug 24	Total	L9313 Jul 22	Jul 24	Jul Total	Aug 21	Aug 23	Aug 25	Aug Total
0					0			0				0
10					0			0				0
20					0			0	12			12
30				1	1			0	13			13
40					0			0				0
50	2			29	31			0				0
60				3	3			0				0
70				2	2			0				0
80				5	5			0		1	1	2
90				4	4			0				0
100				2	2			0	1		1	2
110					0	1	1	2				4
120					0			0	1			1
130					0			0	1			1
140					0			0				0
150					0			0				0
160				1	1			0				0
170					0			0				0
180				1	1			0				0
190					0			0				0
200					0			0				0
210					0			0				0
220					0			0				0
230					0			0				0
240					0			0				0
250					0			0				0
260					0			0				0
270					0			0				0
280					0			0				0
290					0			0				0
300					0			0				0
310					0			0				0
320					0			0				0
330					0			0				0
340		1			1			0				0
350			1		1			0				0
360					0			0				0
370					0			0				0
380					0			0				0
390					0			0				0
400					0			0				0
Total:	2	1	1	48	52	1	1	2	28	1	2	35

Appendix Table C-4. Length frequencies of round whitefish caught by fyke net in the Alpine study area, 2002.

Fork	L9312										L9313		
Length (mm)	Jul 22	Jul 23	Jul 25	Jul 27	Jul Total	Aug 24	Aug 25	Aug 26	Aug 27	Aug Total	Jul 23	Jul 25	Jul Total
0					0					0			0
10					0					0			0
20					0					0			0
30					0					0			0
40					0					0			0
50					0					0			0
60					0					0			0
70	1				1					0			0
80					0					0			0
90					0	1				1			0
100					0					0			0
110					0					0			0
120		1		1	2					0			0
130					0				1	1			0
140					0					0			0
150					0					0			0
160					0					0			0
170					0					0			0
180					0					0			0
190					0					0			0
200					0					0	1	1	2
210					0					0			0
220					0					0			0
230					0					0			0
240			1		1					0			0
250			1		1					0			0
260	1				1					0			0
270					0					0			0
280					0			1		1			0
290					0					0			0
300					0					0			0
310					0		1			1			0
320					0					0			0
330					0					0			0
340					0					0			0
350					0					0			0
360					0					0			0
370					0					0			0
380					0					0			0
390					0					0			0
400					0					0			0
Total:	2	1	2	1	6	1	1	1	1	4	1	1	2

Appendix Table C-5. Length frequencies of Alaska blackfish caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	**L9312** Aug 22	Aug 25	Aug 26	Aug 27	Aug Total	**L9313** Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul Total	Aug 21	Aug 22	Aug 23	Aug 25	Aug 26	Aug 27	Aug Total
0					0								0							0
10					0								0							0
20					0								0							0
30					0								0							0
40					0								0							0
50					0								0						1	1
60					0			2		1			3		1		1	2		4
70			3	1	4	1				1	1	1	4	1	3	1	1	5	11	22
80	1	2	5	4	12	1		1					2	1	3	2	4	7	14	31
90		2	2	2	6		1		1				2	1	1	2	2	5	1	12
100			1		1								0	2	1		1	2	4	10
110			1		1								0							0
120					0								0						1	1
130					0								0							0
140					0								0							0
150					0								0							0
160					0								0				1			1
170					0								0							0
180					0								0							0
190					0								0							0
200					0								0							0
Total:	1	4	12	7	24	2	1	3	1	2	1	1	11	5	9	5	10	21	32	82

Appendix Table C-6. Length frequencies of slimy sculpin caught by fyke net in the Alpine study area, 2002.

Fork Length (mm)	L9312 Jul 22	Jul 23	Jul 29	Jul Total	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	Aug 26	Aug 27	Aug Total
0				0								0
10				0								0
20				0				1				1
30				0						1		1
40	1		2	3		1						1
50			1	1				2	2	2	3	9
60	1	1		2	1	2	1	1	1	2	1	9
70	1			1	1	1			1	2	3	8
80				0	1			1				2
90				0								0
100				0								0
110				0								0
120				0								0
130				0								0
140				0								0
150				0								0
160				0								0
170				0								0
180				0								0
190				0								0
200				0								0
Total:	3	1	3	7	3	4	1	5	4	7	7	31