FISH HABITATS IN THE COLVILLE RIVER UNIT SATELLITE DEVELOPMENT CD-SOUTH: 1999-2001

Final Data Report

May 2002

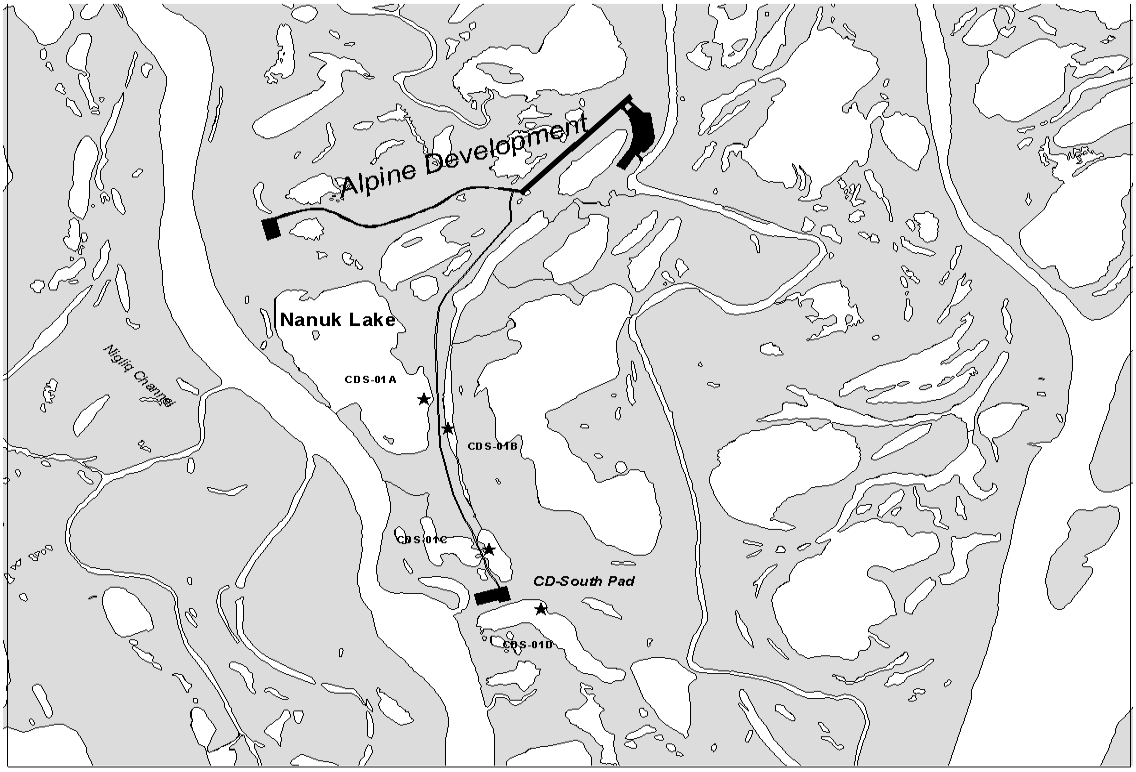

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Table of Contents

List of Tables

List of Figures

FISH HABITATS IN THE COLVILLE RIVER UNIT
SATELLITE DEVELOPMENT
CD-SOUTH: 1999-2001

INTRODUCTION

PHILLIPS Alaska Inc. has been exploring for oil within the CD-South Exploration Area (Figure 1). During exploration, rivers and lakes are crossed by ice roads and water is withdrawn from lakes to support both industrial and domestic needs. Additional potential impacts will arise when the area is developed for oil extraction, thus it is important to obtain biological information to define the pre-development baseline conditions.

Because of the biological sensitivity of this area, the fish and fish habitats in or near this region of the Colville Delta have been studied since 1995 (Moulton 1997). These earlier surveys revealed that lakes within the delta are relatively deep, averaging almost 15 ft deep. This is unlike lakes in the Prudhoe Bay and Kuparuk oil fields, where lakes are rarely in excess of 7 ft deep. The combination of deep water, which allows successful wintering, and proximity to a major river creates abundant habitat for fish and many species are found in lakes throughout the delta (Moulton 1998). As a result, over 85% of the lakes within the delta support fish populations, while fish are rare in the thaw lakes east of the Colville River (Moulton 1998).

Studies of fish habitats in the channels and tapped lakes of the delta were initiated in 1995 prior to development of the Alpine field in order to obtain information needed for permitting the field. Those studies revealed that the minor channels, such as the Sakoonang Channel, are lightly used during summer, mostly by juvenile fishes. Highest densities of fish were found in tapped lakes, with catches again primarily juveniles, dominated by broad whitefish and least cisco (Moulton 1997). During summer, adult fishes for many of the dominant species range widely through Harrison Bay and along the Beaufort Sea coast, only returning in fall to winter within the delta.

In order to submit applications for exploration and development permits, information specific to the activity area is required in order to evaluate the biological sensitivity of lakes and river channels in the region. This study was designed to provide physical and biological information on lakes and channels associated with CD-South exploration and development to understand their use by various fish species. Results of the survey can be used, in concert with previous surveys within the area, to identify sensitive areas when developing spill-response plans, and to assess the need for monitoring during field operation.

The objective of this study is to document fish presence and habitat use in tapped and perched lakes in or near the CD-South Exploration Area. The study area for the CD-South fisheries investigations is generally defined as the lakes and river channels between the Alpine Development and the vicinity of the proposed CD-South pad, and approximately 2500 meters east and west of the

proposed CD-South road (Figure 1). Selected lakes include those that may be used to support exploration. Some of the lakes in the area of interest were sampled in previous years. Two perched lakes were sampled with fyke nets to develop information on the population status of fish inhabiting these lakes prior to field development and possible use of these lakes as water sources.

METHODS

FIELD SAMPLING

Fyke Net Sampling

Fyke nets were first used in 2001 to sample 2 tapped lakes and 2 perched lakes in the CD-South study area (Table 1, Figure 3). Previous investigations of the CD-South area used gill nets to evaluate presence of fish in perched lakes in the surrounding area. The tapped lakes were sampled to provide information of fish habitats on either side of the proposed CD-South road. The fyke net stations (CDS-01A and CDS-01B) were positioned near the narrowest strip of land between the two basins.

Sampling was by fyke net so that fish could be released unharmed. Sampling covered mid to late July (July 11-25) and late August (August 17-25) to evaluate seasonality in use patterns. Fyke nets used during the 2001 sampling had an opening 0.9 m deep by 1.1 m wide, the trap end was 4.9 m long, made of 9.5 mm mesh. The wings (5 m long) and lead (15 m long) were made of 12.7 mm mesh. The nets were emptied daily. Fish were measured and released, with no fish retained for laboratory analysis. Duration of each set was recorded to allow calculation of catch rates. Water chemistry measurements taken in conjunction with the fyke net sampling included water temperature, specific conductance, dissolved oxygen, turbidity and pH.

Fish greater than 250 mm were tagged to reveal the extent to which fish caught in the CD-South study area contribute to the subsistence catch. Floy FD-68B anchor tags (monofilament = 5/8 inch, vinyl = 1 1/8 inch) were applied to whitefish, cisco, Dolly Varden char and burbot caught by fyke net. Recapture was monitored in research sampling within the Colville Delta and eastern NPR-A study areas, in the Nuiqsut subsistence fishery and in the Colville Delta commercial fishery.

Gill Net Sampling

Sampling was conducted in 1996-1999 at 13 lakes in or near the CD-South study area identified by PHILLIPS Alaska (Figure 2). The lake sampling included basic inventory in lakes within the CD-South study area that had not previously been surveyed or re-surveyed lakes that had been sampled in the mid 1980's. Sampling was with gill nets combined with physical measurements. Lakes 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 baseline data from lakes throughout the Colville Delta and nearby areas. Sets were kept to a short duration (typically 2 to 6 hours per net) to minimize both entangling waterfowl and fish mortality, and a person tended each net to ensure waterfowl did not approach the net. Fish captured were measured and released if not severely injured. Duration of each set was recorded to allow calculation of catch rates.

Water chemistry parameters were measured in studied lakes to assess habitat conditions and provide information on the suitability of water for domestic and industrial uses. Water chemistry measurements included water temperature, specific conductance or salinity, dissolved oxygen, and pH. In many lakes, a water sample was taken and sent to Northern Test Labs for more detailed analysis. Laboratory analysis included determining levels of chloride, sodium, calcium, magnesium, hardness and total dissolved solids (TDS).

Bathymetric data were collected 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 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. Readings were converted to distance measurements and resulting points were plotted on the known location of each transect.

Lake volume was estimated by either applying the formula for the volume of a cone to the surface area and maximum depth of each lake, or by plotting a contour map of the lake depths. For the cone volume method, surface area was obtained from a GIS base map using USGS 1:63,360 scale quads. Maximum depth was the maximum observed depth from the bathymetric transects. The amount allowed for winter water withdrawal from fish-bearing lakes was estimated as 15% of the volume of the lake deeper than 7 feet. In this case, the surface area was proportionally reduced to that associated with a 7 foot reduction in depth.

For lakes that are proposed for long-term use, volume was estimated based on contour maps of the lake. Contour mapping was assumed to be the most accurate method for estimating volume. Contour maps were prepared by plotting depth positions obtained by GPS on GIS basemaps and plotting the contours in 1 ft intervals on maps of the surveyed lakes. The surface area of each 1 ft contour was obtained, and 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.

This report uses lake numbering based on the Emergency Response Grid (ERG) used by Alaska Clean Seas, the response organization for the North Slope oilfield region. This numbering system

allows the lakes to be quickly located on area maps. The lake number corresponds to the grid within which the lake occurs, along with a sequence number. In most cases, there is only one lake within a grid. Where two or more lakes occur within the same grid, lakes are numbered sequentially beginning from the west and south sides of the grid.

Five different lake types are defined, based primarily on the potential for access by fish. Definitions for the lake types are as follows:

Perched (Frequent Flooding) = Perched lake near a floodplain, but above the water surface elevation of the active channel, with an obvious high water channel. These lakes are likely subject to annual flooding.

Perched (Infrequent Flooding) = Perched lake near a floodplain, but above the water surface elevation of the active channel, with no obvious high water channel. These lakes are likely subject to flooding on an infrequent basis (every five years or more).

Drainage = Drainage Lake, a lake that is part of a defined drainage system, i.e. there is an active connection to a creek.

Oxbow = Oxbow lake, formed from abandoned river channels.

Tundra = Tundra Lake, a thaw lake not within or connected to the Colville Delta, little potential for fish access on a regular basis.

RESULTS AND DISCUSSION

FYKE NET SAMPLING

Fyke net sampling was conducted in 2001 at four stations on two tapped lakes and two perched lakes during 2001 (Table 1, Figure 3). The 2001 effort of 1,418 net hours in the lakes resulted in a catch of 8,376 fish from 15 species (Table 2). Four species (least cisco, broad whitefish, humpback whitefish and ninespine stickleback) accounted for 93% of the catch. The four sample locations were quite different from one another and will be discussed separately.

Nanuk Lake (Station CDS-01A)

Nanuk Lake is a tapped lake connected to the Nigliq Channel throughout the summer. Water chemistry was typical of a tapped lake, with elevated specific conductance and variable turbidity that fluctuated as silt was re-suspended by winds (Figure 4). The catches of fish reflect this condition, with high diversity (13 species) and a mix of freshwater, brackish water and migratory species (Table 2). The high catch of least cisco is somewhat misleading because an estimated 3,000 young-of-the-year were caught in one day (August 19) – the catch was not uniformly spread through the summer (Figure 5). Similar pulses of high catch are seen for arctic cisco, broad whitefish and humpback whitefish (Figures 6-8). Few round whitefish were caught in Nanuk Lake (Figure 9).

As with other tapped lakes within the delta, catches during summer were dominated by juvenile fishes, with adults of the migratory species essentially absent (Figures 10-14). This pattern is typical of summer catches because the adults have migrated into the Beaufort Sea coastal region for summer feeding (Gallaway and Fechhelm 2000).

Lake M9525 (Station CDS-01B)

Lake M9525 is a long, thin tapped lake lying along the east side of the proposed CD-South road (Figure 2). The lake is separated from the Sakoonang Channel by a large drained lake basin and is connected to the channel primarily during and shortly after break-up. The connection to the river channel is more sporadic than the connection between Nanuk Lake and Nechelik Channel, which is reflected in reduced catches and lower diversity (9 species). The lake has many characteristics of a perched lake, including a steep shoreline and extensive *Arctophila* beds, but the moderate specific conductance indicates frequent flooding (Figure 4). Previous sampling by fyke net in 1995 had caught broad whitefish, least cisco and ninespine stickleback.

Lake L9323 (Station CDS-01C)

Lake L9323 is a perched lake lying north of the proposed CD-South pad. The lake is apparently not flooded on a frequent basis because least cisco residing in the lake are stunted, averaging only 235 mm at age 11 (Moulton 1998), which indicates little interchange with the anadromous population.

In 2001, the fyke net catch was dominated by least cisco and ninespine stickleback, which together represented 90% of the fish caught (Table 2). Only 7 species were taken, with migratory species in low abundance, again indicating the low frequency at which the lake is flooded. Although only 7 species were caught, this adds four species to the list of those know to inhabit the lake. Previous sampling with gill nets caught only broad whitefish, round whitefish and least cisco. The lack of large least cisco (few exceeded 200 mm) is consistent with previous sampling results, which identified a high density of stunted least cisco in the lake.

Lake L9324 (Station CDS-01D)

Lake L9324 is a perched lake lying south of the proposed CD-South pad. During high water, the lake connects to both the Nigliq Channel at its northwest end and the Sakoonang Channel via a drained lake through its southeast end. Catches in 2001 were high, with a high diversity (Table 2). The number of species caught (12) was almost as great as that recorded in Nanuk Lake, and species more associated with the river than with perched lakes were caught, including Dolly Varden, arctic cisco, arctic grayling, humpback whitefish, and longnose sucker. Previous sampling with gill nets had only produced broad whitefish, round whitefish and least cisco, a catch more typical of perched lakes. It appears that the lake was flooded during high water in early summer, 2001, which brought many fish into the lake.

Tag Releases in CD-South during 2001

A total of 49 tagged fish were released in the CD-South study area during 2001, primarily least cisco and broad whitefish (Table 5). One least cisco and one broad whitefish were recovered at the release location three and two days after release, respectively. One Dolly Varden char, about 300 mm fork length, that was tagged in lake L9324 was recaptured three times in three consecutive days. Normally, captures one day after tagging are not counted because the fish may have re-entered the trap immediately after release. In this case, however, the char may have learned that the trap contained a large number of juvenile fishes.

GILL NET SAMPLING

Biological Observations

Between 1996 and 1999, fish sampling with gill nets was been conducted in 13 lakes in of near the CD-South study area (Table 6). As with most other fish surveys in this region, least cisco dominated the catches in samples obtained by gill net; broad whitefish and arctic cisco were also present (Table 7). Additional species, such as ninespine stickleback and Alaska blackfish are present in many of the lakes, as indicated by sampling with fyke nets or minnow traps, but are not sampled efficiently by gill net.

Fish were caught in all of the 13 sampled lakes. Least cisco were caught in 12 of the lakes, and

represented 74% (120 of 163 fish) of the catch by gill net. Broad whitefish were the second most abundant species, and were caught in 10 of the lakes. The only lake that did not produce least cisco (X3.1, a small drainage lake) contained arctic grayling.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 8. The most relevant parameters are specific conductance and total dissolved solids (TDS), which reflect the dissolved ion concentration. During freeze-up, ions are excluded from the ice, leading to a build-up in ion concentration in the remaining water. High levels of dissolved solids in late winter can lead to fish mortality, thus rendering the lake unsuitable for wintering. All the sampled lakes had relatively low dissolved solids compared to lakes farther north in the Colville Delta.

Evaluation of Water Availability in the CD-South Area

Information from fish sampling, depth measurements and water chemistry was used to evaluate each lake regarding its potential to support fish. Obviously, since fish were captured in all sampled lakes, all were classified as fish-bearing. Results of the evaluation are summarized in Table 9. The 13 lakes in or near the proposed CD-South Development Area contain an estimated 37.2 million gallons of water available for winter use under current permitting criteria.

Contour mapping of lakes L9323 and L9324 modified the amount of water estimated to be available from theses two lakes (Figures 16 and 17). Based on bathymetry data obtained through 2001, the two lakes near the proposed CD-South pad, W5.1 (L9323) and W5.2 (L9324) could provide an estimated 14.1 million gallons for water use. These estimates may change as additional depth data are obtained.

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Table 1. Fyke net stations occupied in the CD-South study area during 2001.
(latitude and longitude based on NAD27 datum)

Station	Latitude	Longitude	Location	Dates Fished
CDS-01A	70.31569	150.99888	Nanuk Lake (tapped lake)	July 11-25, August 17-25
CDS-01B	70.31813	150.99663	M9525 (tapped lake)	July 12-25, August 17-25
CDS-01C	70.29825	150.98835	L9323 (perched lake)	July 11-25, August 17-25
CDS-01D	70.29103	150.97321	L9324 (perched lake)	July 18-25, August 17-25

Table 2. Catches of fish by station from fyke net sampling in lakes in the CD-South study area, 2001.

	Station				
Species	**Nanuk Lake tapped lake (CDS-01A)**	**M9525 tapped lake (CDS-01B)**	**L9323 perched lake (CDS-01C)**	**L9324 perched lake (CDS-01D)**	**Total**
Broad whitefish	316	93	7	103	519
Humpback whitefish	359	154	25	341	879
Arctic cisco	64	4	0	16	84
Least cisco	3,103	157	486	1,301	5,047
Round whitefish	9	2	22	237	270
Dolly Varden char	1	0	0	3	4
Arctic grayling	3	0	0	7	10
Burbot	1	7	0	0	8
Alaska blackfish	0	5	43	6	54
Rainbow smelt	4	0	0	0	4
Longnose sucker	2	0	0	5	7
Arctic lamprey	0	0	0	1	1
Fourhorn sculpin	90	0	0	0	90
Slimy sculpin	33	1	25	1	60
Ninespine stickleback	101	620	565	53	1,339
Total Catch	4,086	1,043	1,173	2,074	8,376
Number of Species	13	9	7	12	15
Total Effort (hrs)	326	473	305	313	1,418

Table 3. Observed handling mortality for fyke nets in the CD-South study area, 2001.

Species	Number of Mortalities	Total Caught	Percent Mortality
Broad whitefish	28	519	5.4
Humpback whitefish	3	879	0.3
Arctic cisco	0	84	0.0
Least cisco	65	5,047	1.3
Round whitefish	0	270	0.0
Dolly Varden char	0	3	0.0
Arctic grayling	0	10	0.0
Burbot	0	8	0.0
Alaska blackfish	1	54	1.9
Rainbow smelt	1	4	25.0
Longnose sucker	0	7	0.0
Arctic lamprey	0	1	0.0
Fourhorn sculpin	0	90	0.0
Slimy sculpin	0	60	0.0
Ninespine stickleback	0	1,339	0.0

Table 4. Catch rates and total catch by species at fyke net stations in the CD-South study area, based on fyke net sampling during July-August 2001.

Catch Rate (fish per day)

	Nanuk Lake (CDS-01A)		M9525 (tapped) (CDS-01B)		L9323 (perched) (CDS-01C)		L9324 (perched) (CDS-01D)	
Species	**July**	**August**	**July**	**August**	**July**	**August**	**July**	**August**
Broad whitefish	5.7	46.4	3.4	12.2	0.2	0.7	10.6	4.9
Humpback whitefish	2.3	58.2	0.6	26.4	0.6	2.8	8.7	45.7
Arctic cisco	8.3	0.0	0.6	0.0	0.0	0.0	1.9	0.5
Least cisco	4.8	523.2	15.4	8.6	14.6	47.2	145.7	48.0
Round whitefish	0.5	0.9	0.0	0.4	0.7	2.0	19.4	16.8
Dolly Varden char	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.0
Arctic grayling	0.0	0.5	0.0	0.0	0.0	0.0	1.0	0.0
Burbot	0.0	0.2	0.1	1.1	0.0	0.0	0.0	0.0
Alaska blackfish	0.0	0.0	0.0	0.9	2.6	1.2	0.4	0.5
Rainbow smelt	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Longnose sucker	0.1	0.2	0.0	0.0	0.0	0.0	0.4	0.3
Arctic lamprey	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Fourhorn sculpin	6.3	7.0	0.0	0.0	0.0	0.0	0.0	0.0
Slimy sculpin	0.0	5.6	0.0	0.2	1.2	1.5	0.0	0.2
Ninespine stickleback	7.9	6.8	33.6	67.6	38.9	5.8	4.9	3.1

Number of Fish

	Nanuk Lake (CDS-01A)		M9525 (tapped) (CDS-01B)		L9323 (perched) (CDS-01C)		L9324 (perched) (CDS-01D)	
Species	**July**	**August**	**July**	**August**	**July**	**August**	**July**	**August**
Broad whitefish	44	272	24	69	3	4	73	30
Humpback whitefish	18	341	4	150	8	17	60	281
Arctic cisco	64	0	4	0	0	0	13	3
Least cisco	37	3,066	108	49	199	287	1,006	295
Round whitefish	4	5	0	2	10	12	134	103
Dolly Varden char	0	1	0	0	0	0	3	0
Arctic grayling	0	3	0	0	0	0	7	0
Burbot	0	1	1	6	0	0	0	0
Alaska blackfish	0	0	0	5	36	7	3	3
Rainbow smelt	4	0	0	0	0	0	0	0
Longnose sucker	1	1	0	0	0	0	3	2
Arctic lamprey	0	0	0	0	0	0	1	0
Fourhorn sculpin	49	41	0	0	0	0	0	0
Slimy sculpin	0	33	0	1	16	9	0	1
Ninespine stickleback	61	40	236	384	530	35	34	19
Total Effort (hrs)	185.8	140.6	168.5	136.3	327.3	145.9	165.8	147.5

Table 5. Tag releases and recaptures in the CD-South study area, by station and species, 2001.

Station	Broad Whitefish	Humpback Whitefish	Least Cisco	Arctic Cisco	Dolly Varden	Burbot
Released						
CDS-01A	4	0	3	1	0	1
CDS-01B	4	1	8	0	0	0
CDS-01C	0	0	4	0	0	0
CDS-01D	11	0	10	0	2	0
Release Total:	19	1	25	1	2	1
Recaptured						
CDS-01A	1	0	0	0	0	0
CDS-01B	0	0	1	0	0	0
CDS-01C	0	0	0	0	0	0
CDS-01D	0	0	0	0	0	0
Recapture Total:	1	0	1	0	0	0

Table 6. Locations of lakes sampled in the CD-South study area.

ERG	Lake	Latitiude		Longitude		USGS		
Name	Name	deg.	min.	deg.	min.	Topo Sheet	Township/Range	Habitat
W2.1	L9306	70	17.76	151	6.06	Harrison Bay B-2	T11N R4E Sect. 22	Perched Lake (Frequent Flooding)
W3.1	L9341b	70	17.35	151	4.05	Harrison Bay B-2	T11N R4E Sect. 23	Perched Lake (Frequent Flooding)
W5.1	L9323	70	17.88	150	59.61	Harrison Bay B-2	T11N R4E Sect. 24	Perched Lake (Infrequent Flooding)
W5.2	L9324	70	17.24	150	58.16	Harrison Bay B-2	T11N R5E Sect. 19, 30	Perched Lake (Frequent Flooding)
W5.3	M9929	70	17.36	150	57.50	Harrison Bay B-2	T11N R5E Sect. 19	Perched Lake (Infrequent Flooding)
X3.1	L9808	70	16.44	151	5.38	Harrison Bay B-2	T11N R4E Sect. 27	Drainage Lake
X4.1	L9902	70	16.49	151	3.22	Harrison Bay B-2	T11N R4E Sect. 26	Perched Lake (Frequent Flooding)
X4.2	L9901	70	16.84	151	1.72	Harrison Bay B-2	T11N R4E Sect. 25	Perched Lake (Frequent Flooding)
X5.1	B8531	70	16.22	150	58.77	Harrison Bay B-2	T11N R5E Sect. 31	Drainage Lake
X5.2	L9325	70	16.98	150	58.98	Harrison Bay B-2	T11N R4E Sect. 25/R5E Sect. 30	Perched Lake (Frequent Flooding)
X5.3	None	70	16.45	150	57.90	Harrison Bay B-2	T11N R5E Sect. 30	Drainage Lake
X6.2	L9328	70	16.32	150	54.54	Harrison Bay B-2	T11N R5E Sect. 29, 32	Perched Lake (Infrequent Flooding)
Y6.3	L9327	70	15.84	150	55.50	Harrison Bay B-2	T11N R5E Sect. 32	Perched Lake (Infrequent Flooding)

Table 7. Catches of fish from sampling with gill nets in or near the CD-South study area.

ERG Name	Lake Name	Date	Duration (hours)	Broad Whitefish	Least Cisco	Round Whitefish	Arctic Grayling	Alaska Blackfish	Total Catch
W2.1	L9306	Aug 3 99	6.7	2	3				5
W3.1	L9341b	Jul 22 99	1.4	1	1				2
W5.1	L9323	Jul 21 96	5.6	3	50	1			54
		Jul 27 99	6.1	1	3	1			5
W5.2	L9324	Jul 21 96	11.5	3		6			9
		Jul 25 99	4.7						0
		Jul 26 99	7.7	4	4				8
W5.3	M9929	Jul 26 99	2.1		19				19
X3.1	L9808	Aug 4 99	1.8				1		1
X4.1	L9902	Jul 23 99	0.6	1	4				5
X4.2	L9901	Jul 23 99	1.6	2	7				9
X5.1	B8531	Jul 1985	~24	+	+			+	
		Aug 1 99	3.8	2	1				3
X5.2	L9325	Jul 24 99	2.6	3	1	5			9
X5.3	M9934	Aug 3 99	4.0		6				6
X6.2	L9328	Jul 20 96	9.9	5	6				11
Y6.3	L9327	Jul 20 96	11.2	2	15				17
Number of Lakes:				10	12	3	1	1	13
Total Catch:				29	120	13	1		163
Total Effort (hrs):			81.3						
Fish/24 Hr:				8.6	35.4	3.8	0.3	0.0	

Table 8. Water chemistry parameters measured at lakes in or near the CD-South study area.

ERG Name	Lake Name	Date	Water Temp (deg C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Hardness (mg/l)	TDS (mg/l)
W2.1	L9306	Aug 03 99	12.6	11.3	145	8.0	22.1	13.7	8.6	4.0	38	70
W3.1	L9341b	Jul 22 99	9.0	11.3	167	7.9	15.0	6.8	7.5	2.8	30	67
W5.1	L9323	Jul 27 99	8.7	11.9	86	7.9	4.0	2.8	1.5	4.3	17	53
W5.2	L9324	Jul 25 99	9.5	12.0	85	8.2	2.0	1.7	1.5	5.3	19	95
W5.3	M9929	Jul 26 99	8.7	10.4	108	8.2	9.9	4.9	8.9	4.9	42	52
X4.1	L9902	Jul 23 99	10.1	11.2	171	8.0	20.7	11.7	12.4	6.5	58	88
X4.2	L9901	Jul 23 99	9.2	11.0	312	8.2	49.1	22.5	19.8	12.6	101	154
X5.1	B8531	Aug 01 99	10.5	11.3	89	7.9	4.0	3.2	1.8	6.3	23	50
X5.2	L9325	Jul 24 99	10.6	10.7	102	7.7	5.0	3.4	1.9	6.3	24	62
X5.3	M9934	Aug 03 99	12.2	11.7	106	8.1	5.8	4.4	10.6	4.1	44	48
X6.2	L9328	Jul 20 96	12.0		80							
		1993					3.0	2.3	2.3	6.4	25	46
Y6.3	L9327	Jul 20 96	13.2		97							
		1993					2.0	1.5	1.7	4.9	19	78

Table 9. Summary of fish presence and available water in lakes in the CD-South study area, updated using proportional cone calculation method.

ERG Name	Lake Name	GIS Est Acreage	Maximum Depth (ft)	Calculated Volume (mil gals)	Calculation Method[1]	15% Vol. >7 ft (mil gals)	Fish Caught2	Fish Concern	Volume Available (mil gals)
W2.1	L9306	64.0	10.2	70.9	Prop. Cone	0.3	BDWF,LSCS	Yes	0.3
W3.1	L9341b	4.1	19.3	62.9	Prop. Cone	2.4	BDWF,LSCS	Yes	2.4
W5.1	L9323	84.1	23.2	397.9	Contours	10.9	BDWF,LSCS,RDWF	Yes	10.9
W5.2	L9324	126.1	13.0	463.2	Contours	2.4	BDWF,LSCS,RDWF	Yes	2.4
W5.3	M9929	11.5	13.8	17.3	Prop. Cone	0.3	LSCS	Yes	0.3
X3.1	L9808	5.0	14.2	7.7	Prop. Cone	0.6	GRAY	Yes	0.6
X4.1	L9902	15.7	16.6	28.3	Prop. Cone	0.8	BDWF,LSCS	Yes	0.8
X4.2	L9901	16.3	25.0	44.2	Prop. Cone	2.5	BDWF,LSCS	Yes	2.5
X5.1	B8531	295.6	13.2	423.8	Prop. Cone	6.6	BDWF,LSCS,BKFH	Yes	6.6
X5.2	L9325	32.5	17.3	61.1	Prop. Cone	1.9	BDWF,LSCS	Yes	1.9
X5.3	None	61.2	15.3	101.7	Prop. Cone	2.4	LSCS	Yes	2.4
X6.2	L9328	41.6	13.2	59.7	Prop. Cone	0.9	BDWF,LSCS	Yes	0.9
Y6.3	L9327	202.3	13.0	285.7	Prop. Cone	4.2	BDWF,LSCS	Yes	4.2

[1] Prop. Cone = volume of cone using proportional surface area for 7 foot level, Contours = volume estimated from contour map.

[2] BDWF = broad whitefish, LSCS = least cisco, ARCS = arctic cisco, RDWF = round whitefish
HBWF = humpback whitefish, GRAY = arctic grayling, BKFH = Alaska blackfish
NSSB = ninespine stickleback

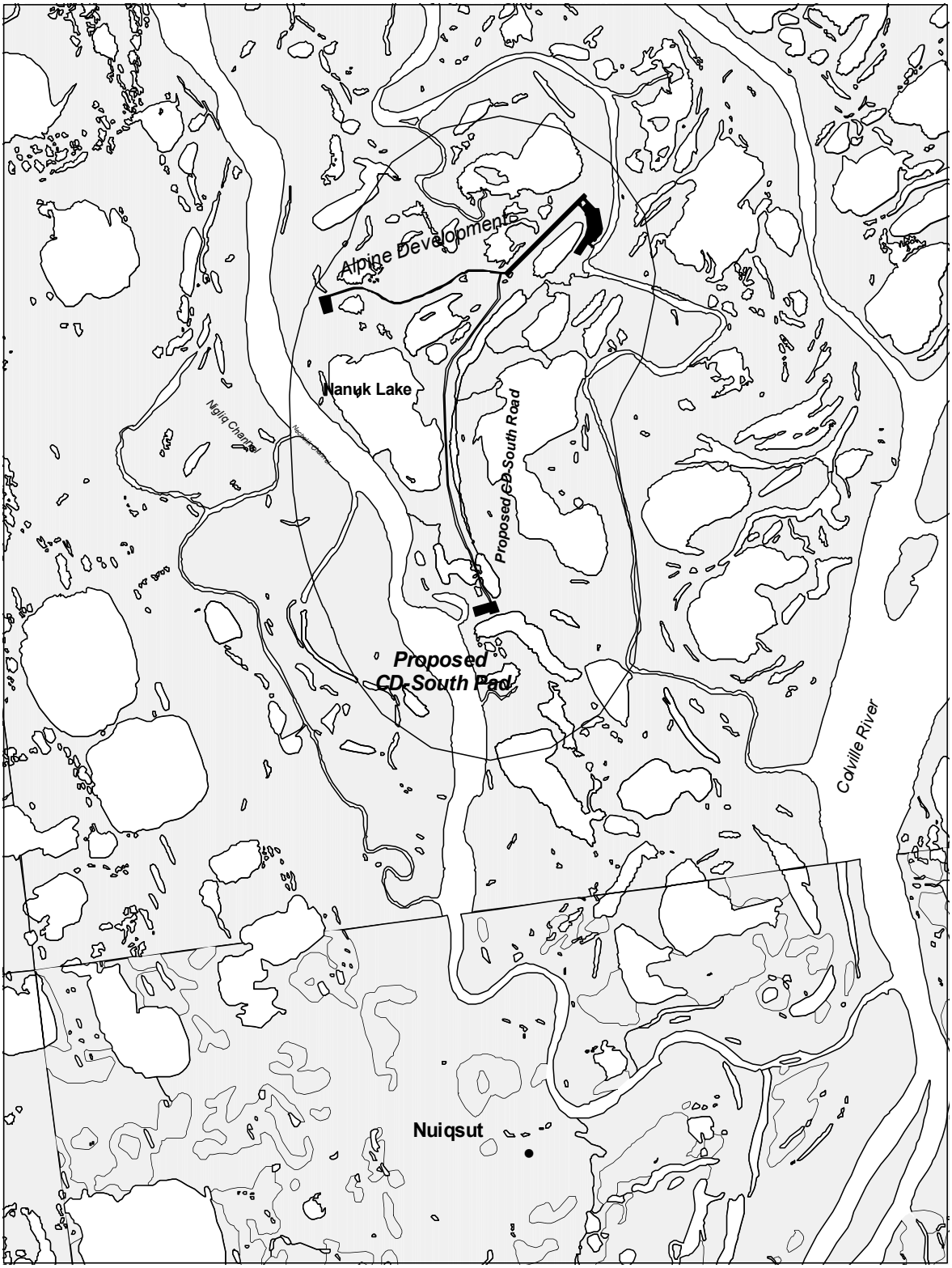

Figure 1. CD-South study area showing proposed CD-South road and facilities pad in relation to Nuiqsut and Alpine facilities (approximate boundary of study area indicated by enclosure).

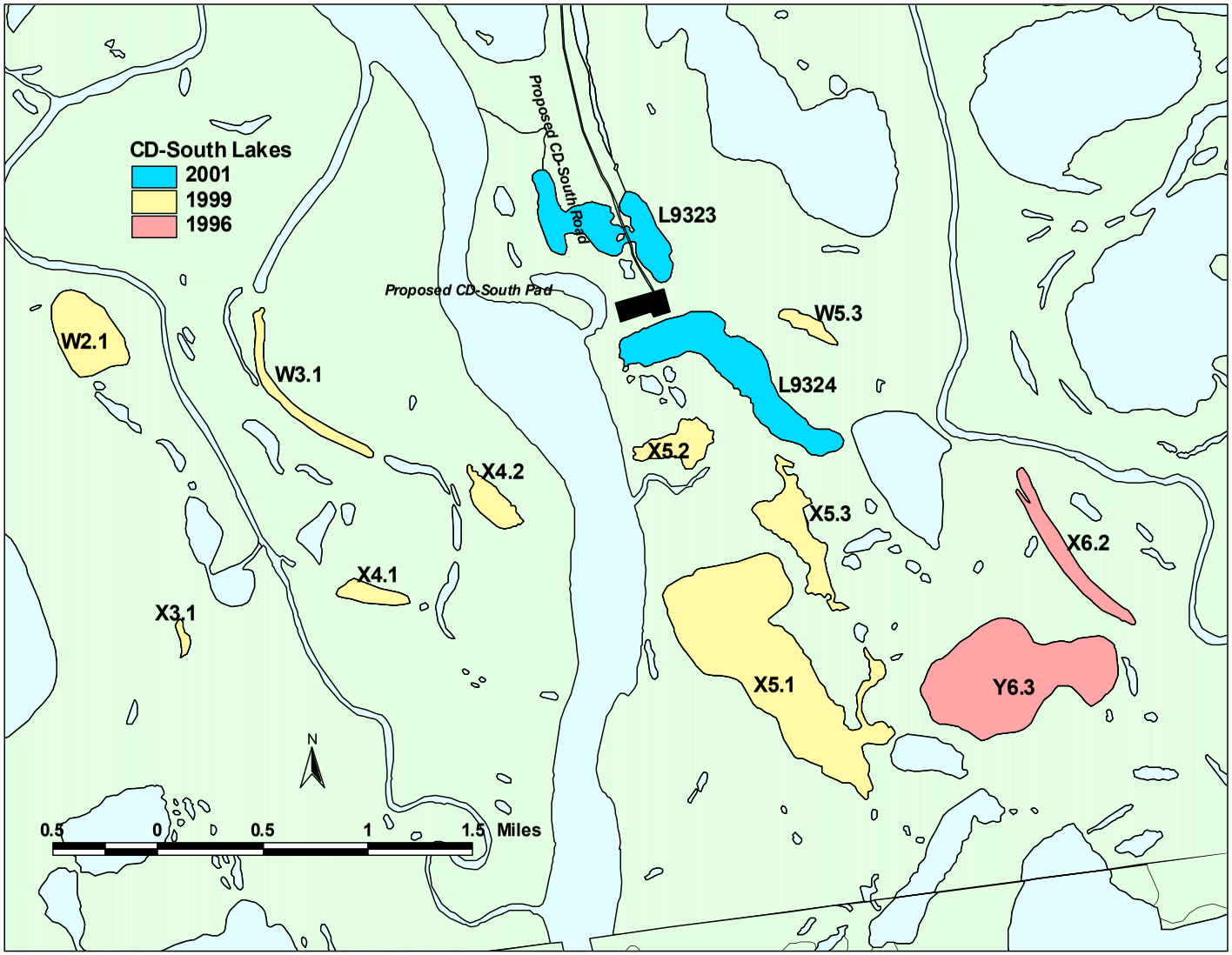

Figure 2. Lakes in or near the CD-South study area, with most recent year of fish sampling indicated.

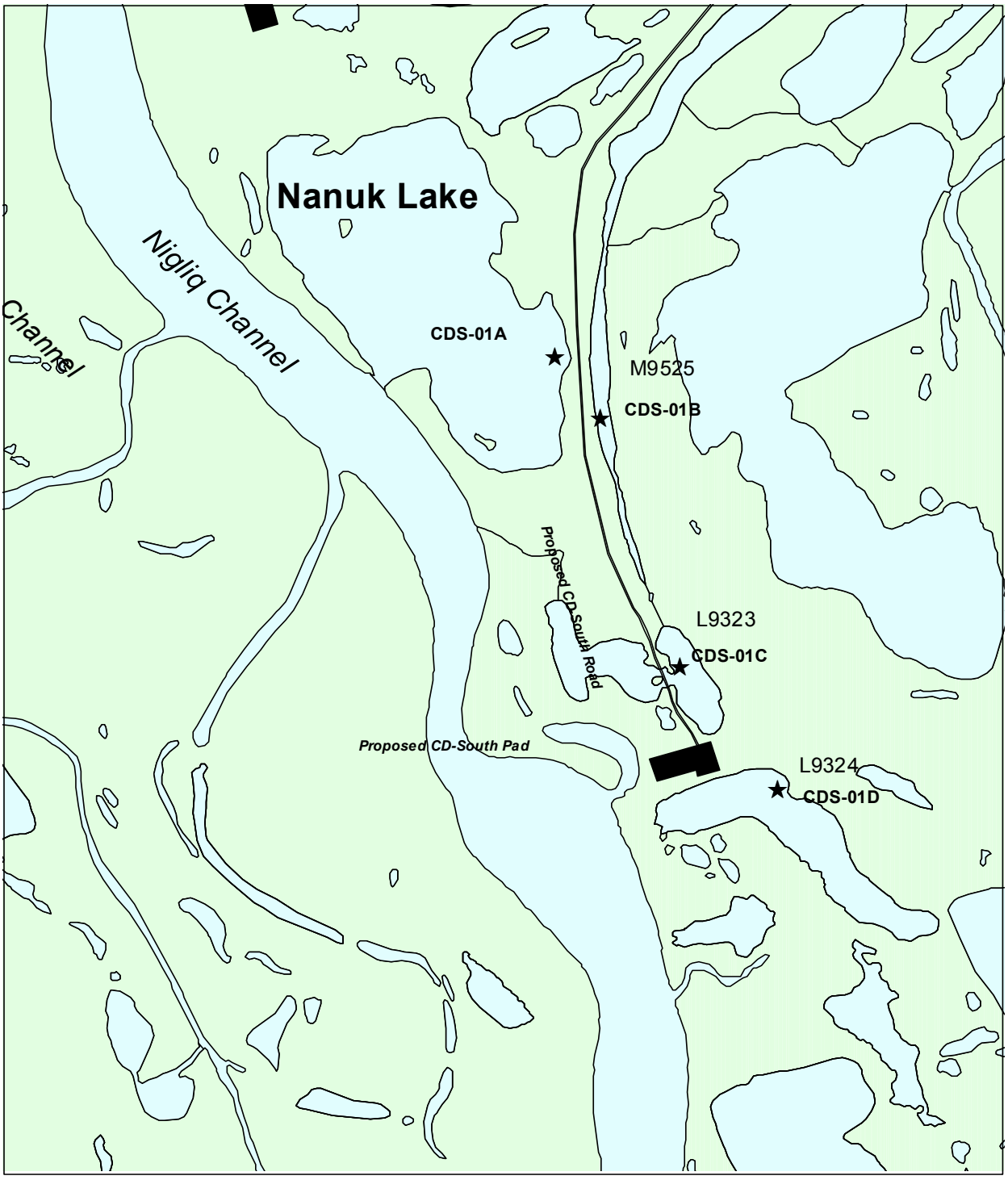

Figure 3. Fyke net stations sampled in 2001 relative to the proposed CD-South road and pad.

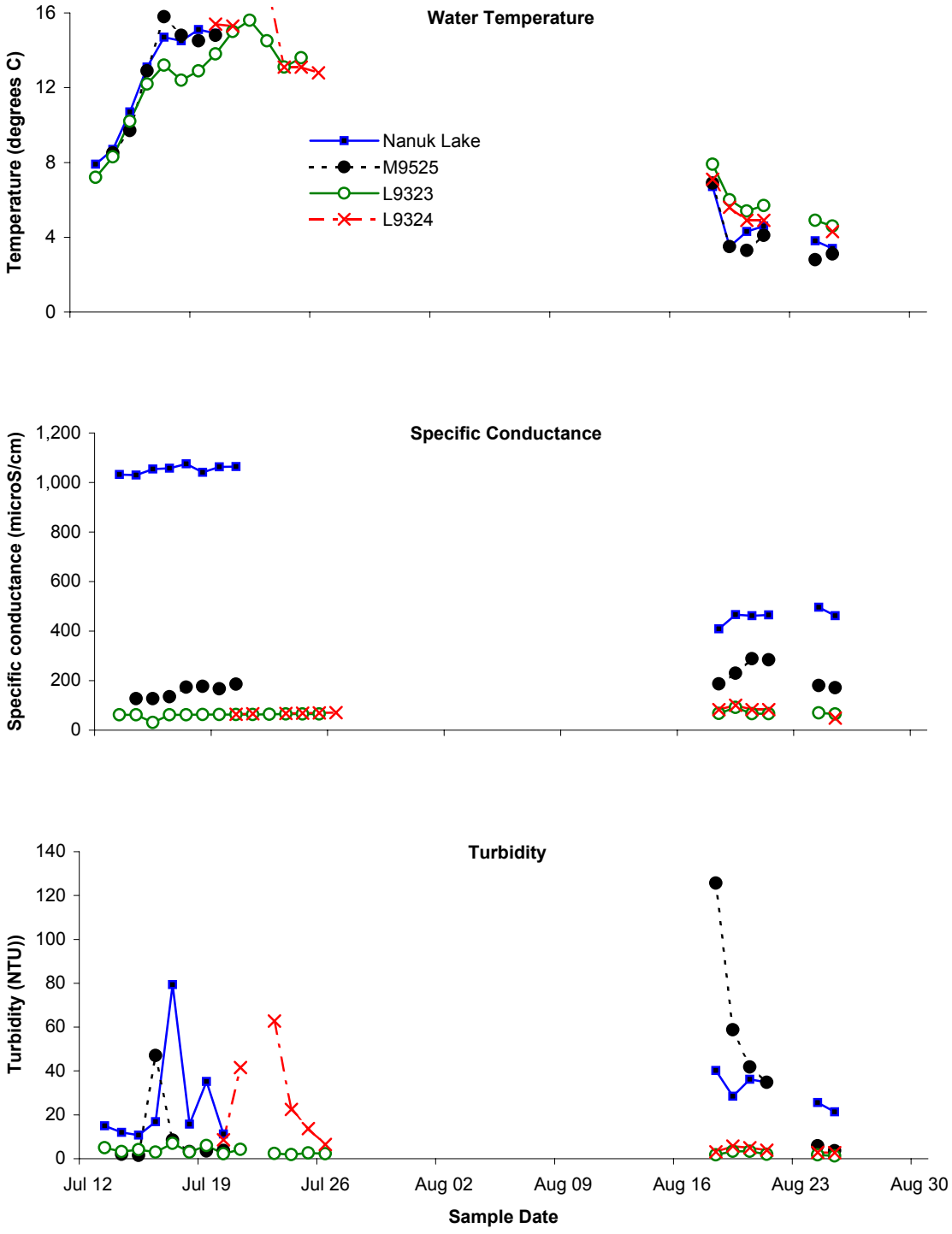

Figure 4. Water temperature, specific conductance and turbidity at fyke net stations sampled in the CD-South study area, 2001.

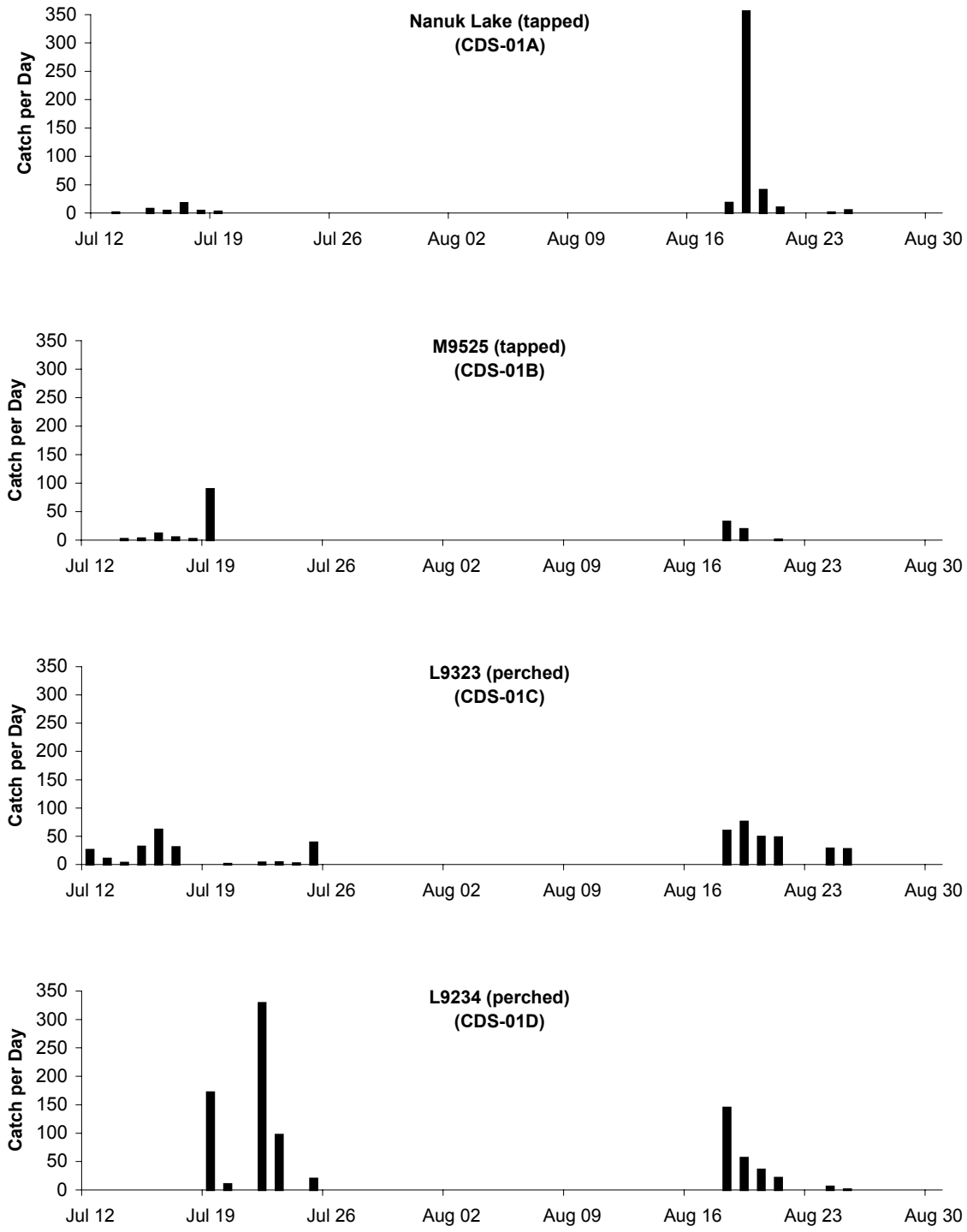

Figure 5. Daily catch rate of least cisco at CD-South study area fyke net stations, 2001.

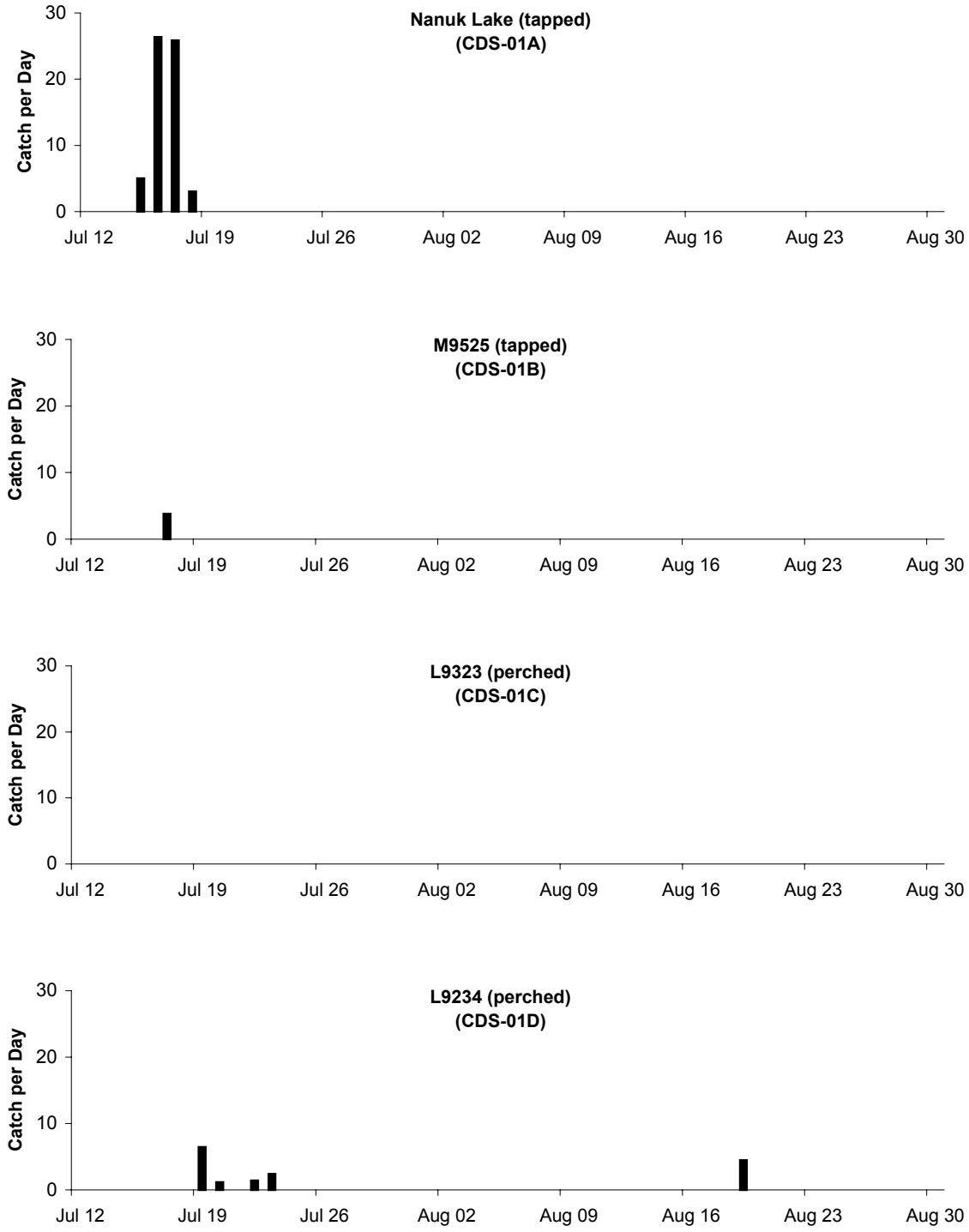

Figure 6 Daily catch rate of arctic cisco at CD-South study area fyke net stations, 2001.

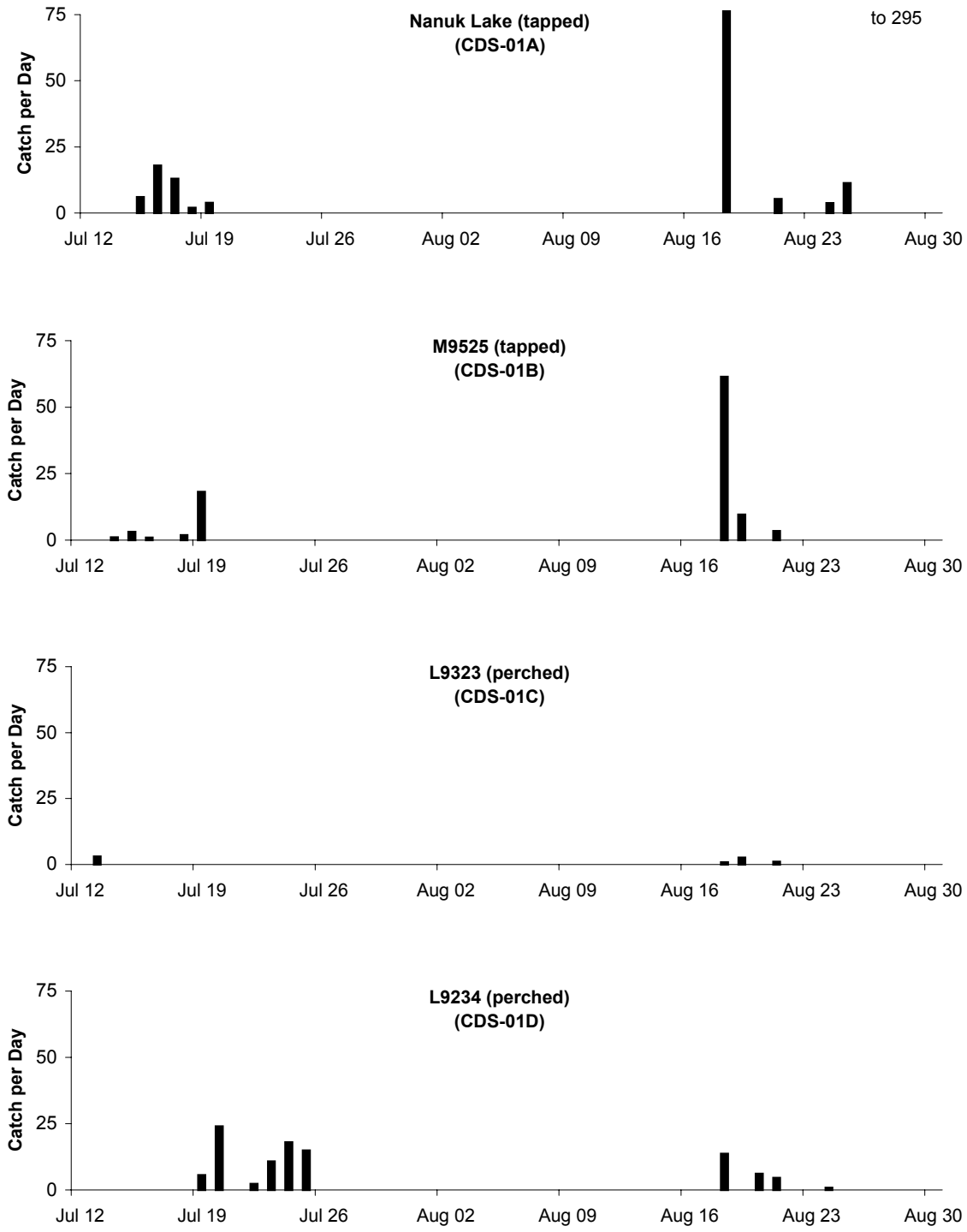

Figure 7. Daily catch rate of broad whitefish at CD-South study area fyke net stations, 2001.

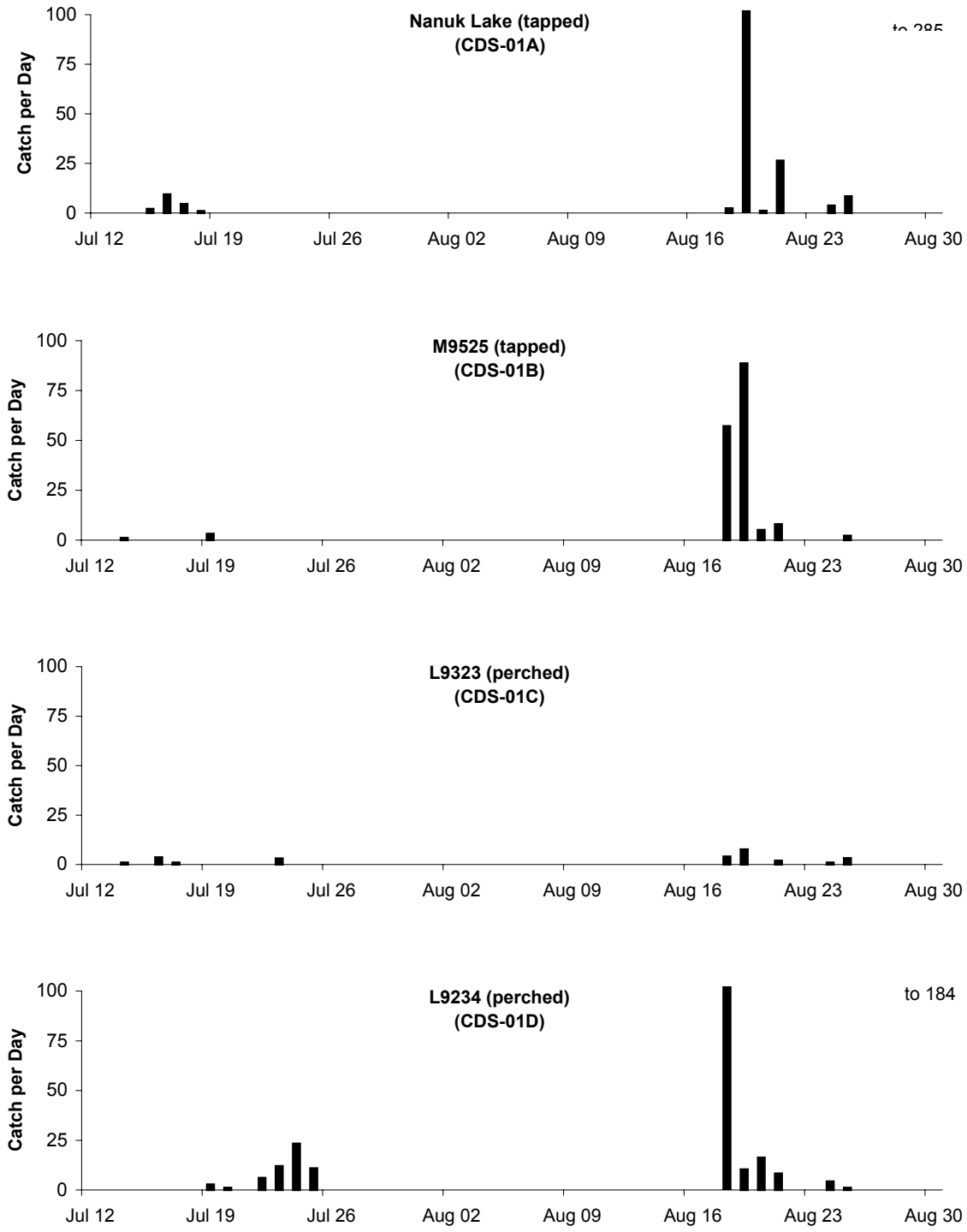

Figure 8. Daily catch rate of humpback whitefish at CD-South study area fyke net stations, 2001.

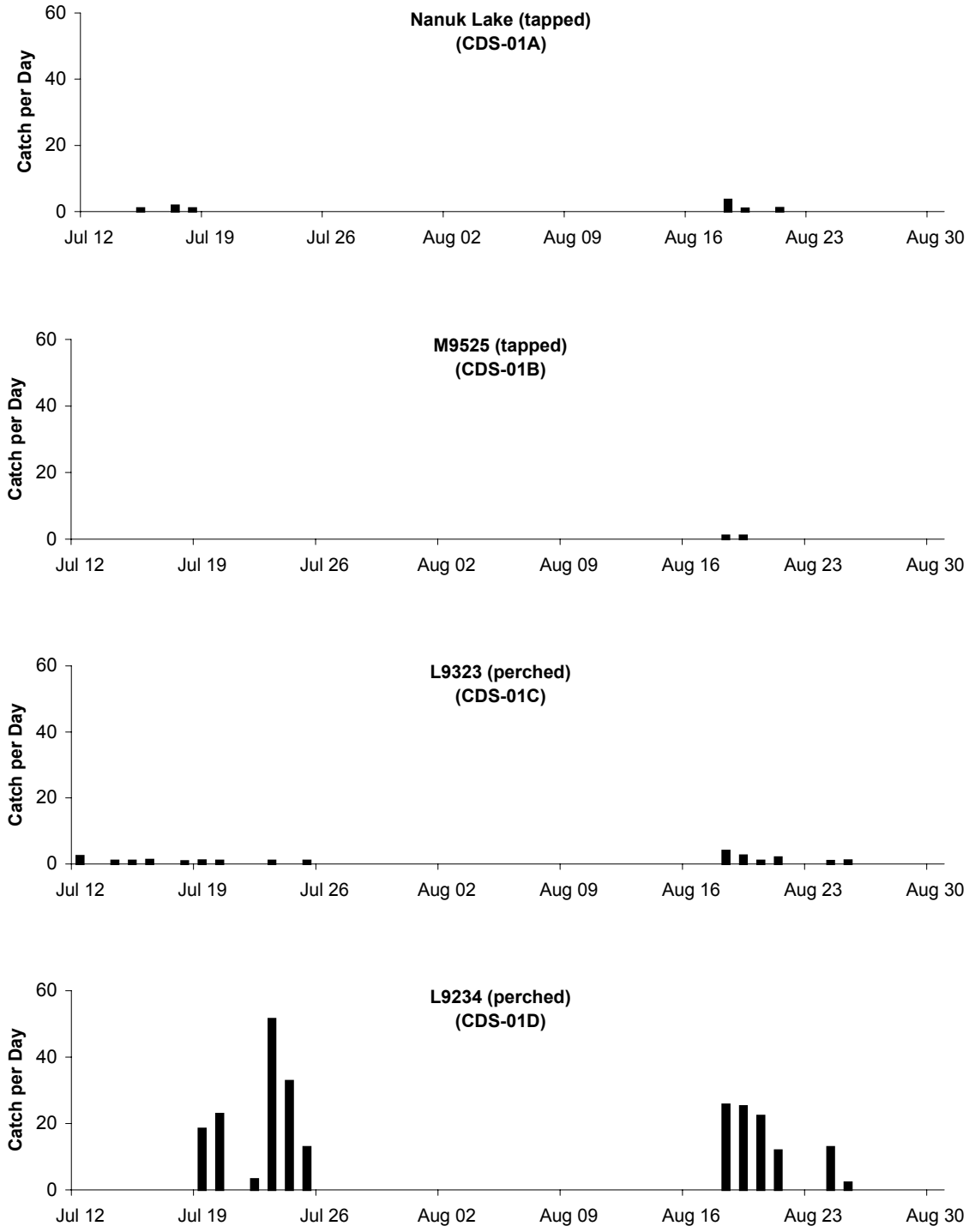

Figure 9. Daily catch rate of round whitefish at CD-South study area fyke net stations, 2001.

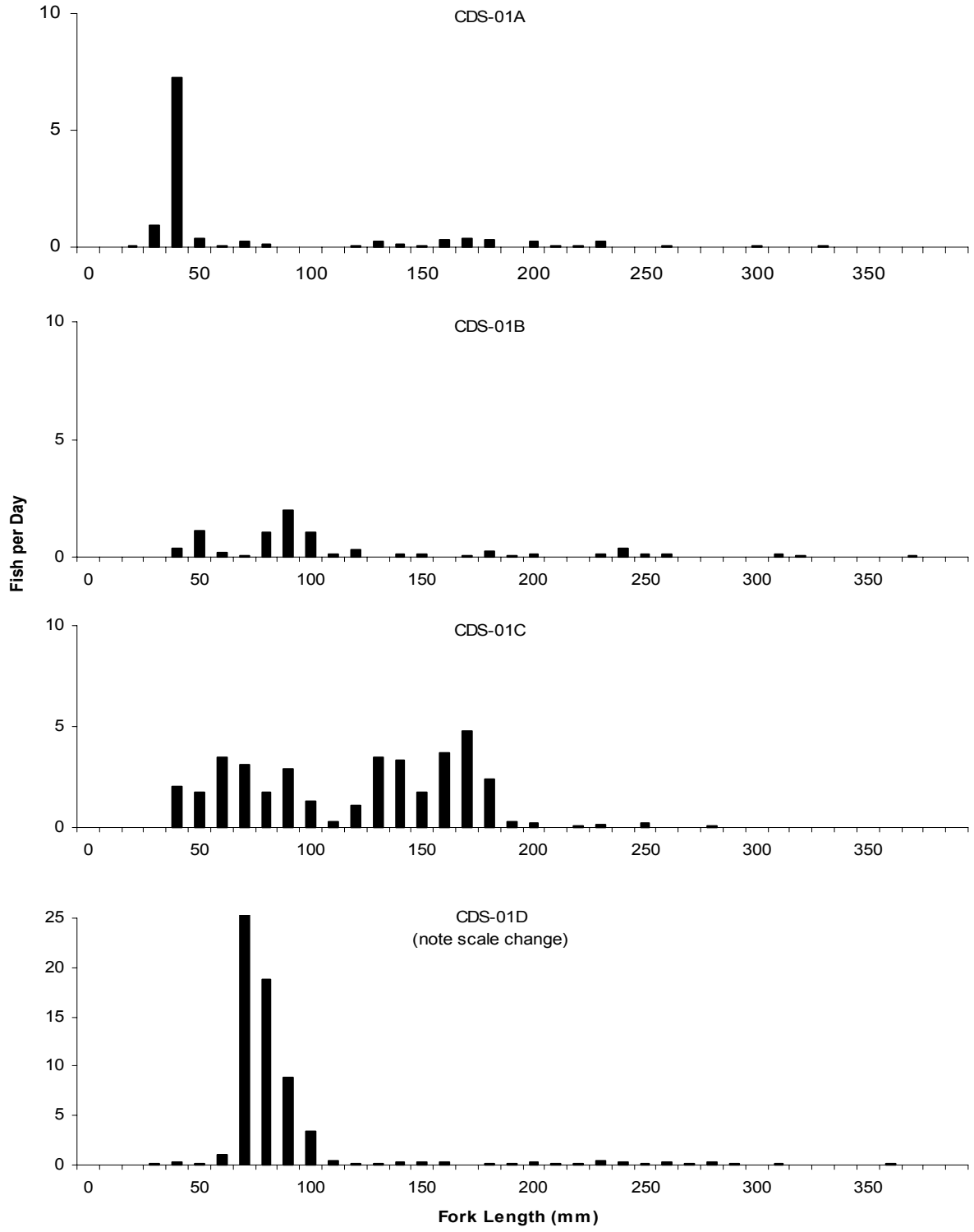

Figure 10. Length frequencies of least cisco caught by fyke net in the CD-South study area, by sample station, 2001 (least cisco mature at about 250 mm)

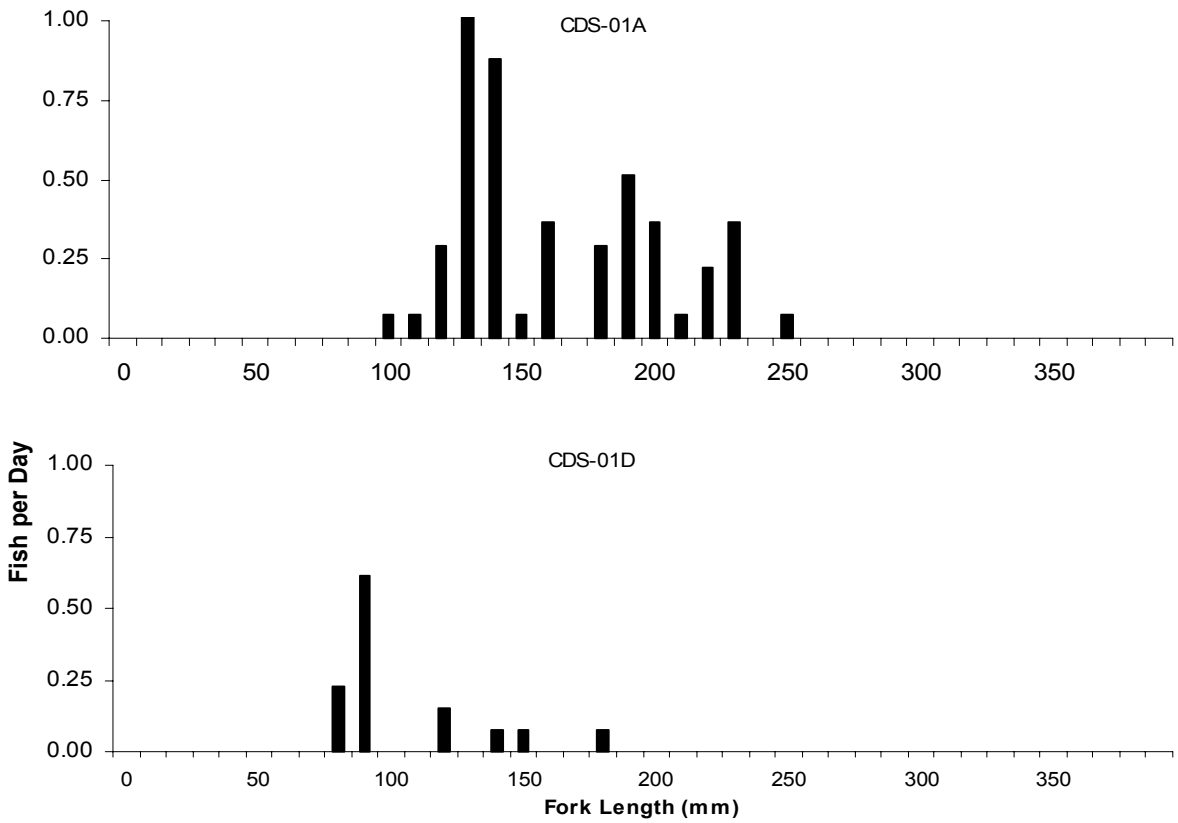

Figure 11. Length frequencies of arctic cisco caught by fyke net in the CD-South study area by station, 2001 (arctic cisco mature at about 350 mm).

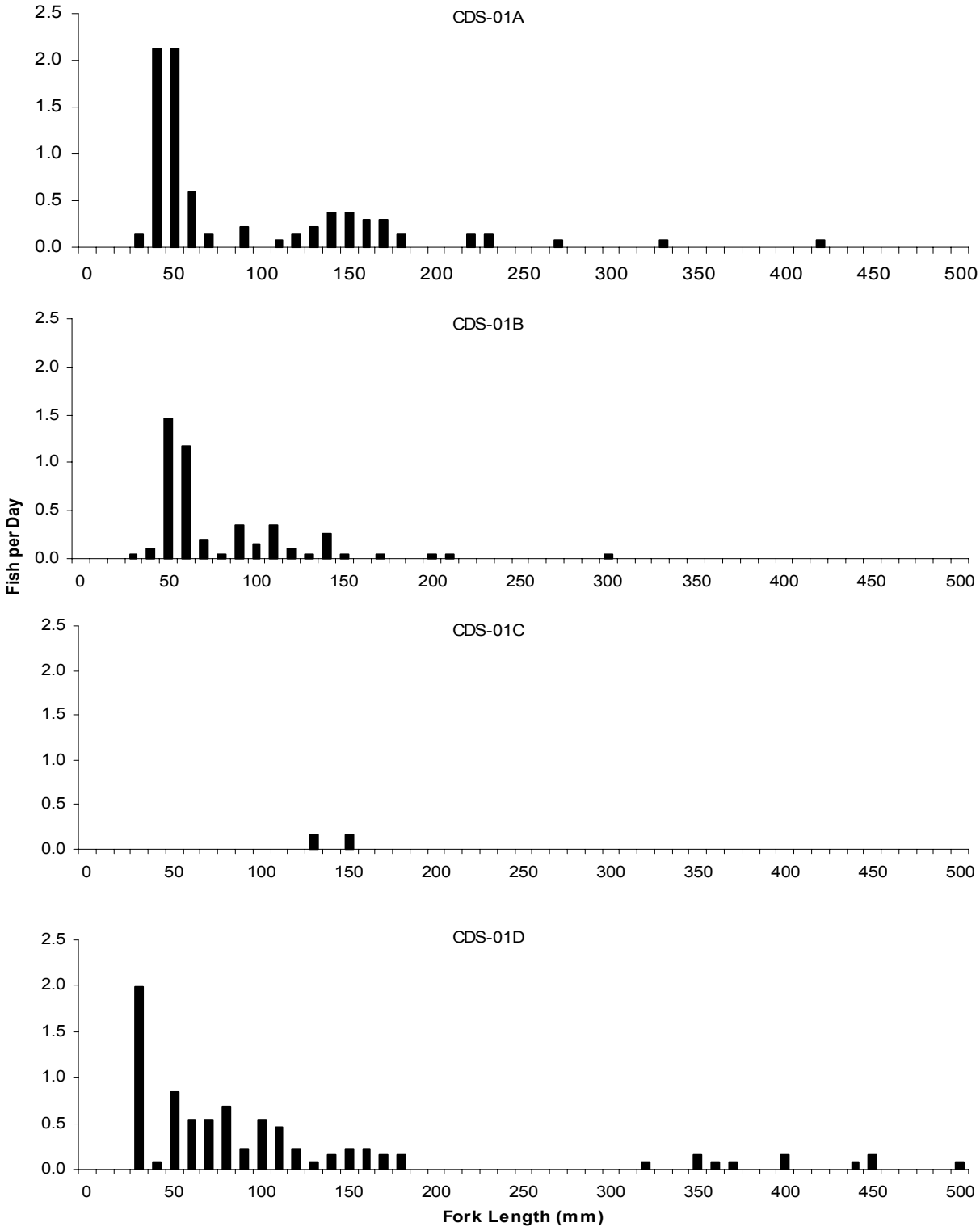

Figure 12. Length frequencies of broad whitefish caught by fyke net in the CD-South study area by station, 2001 (broad whitefish mature at about 480 mm).

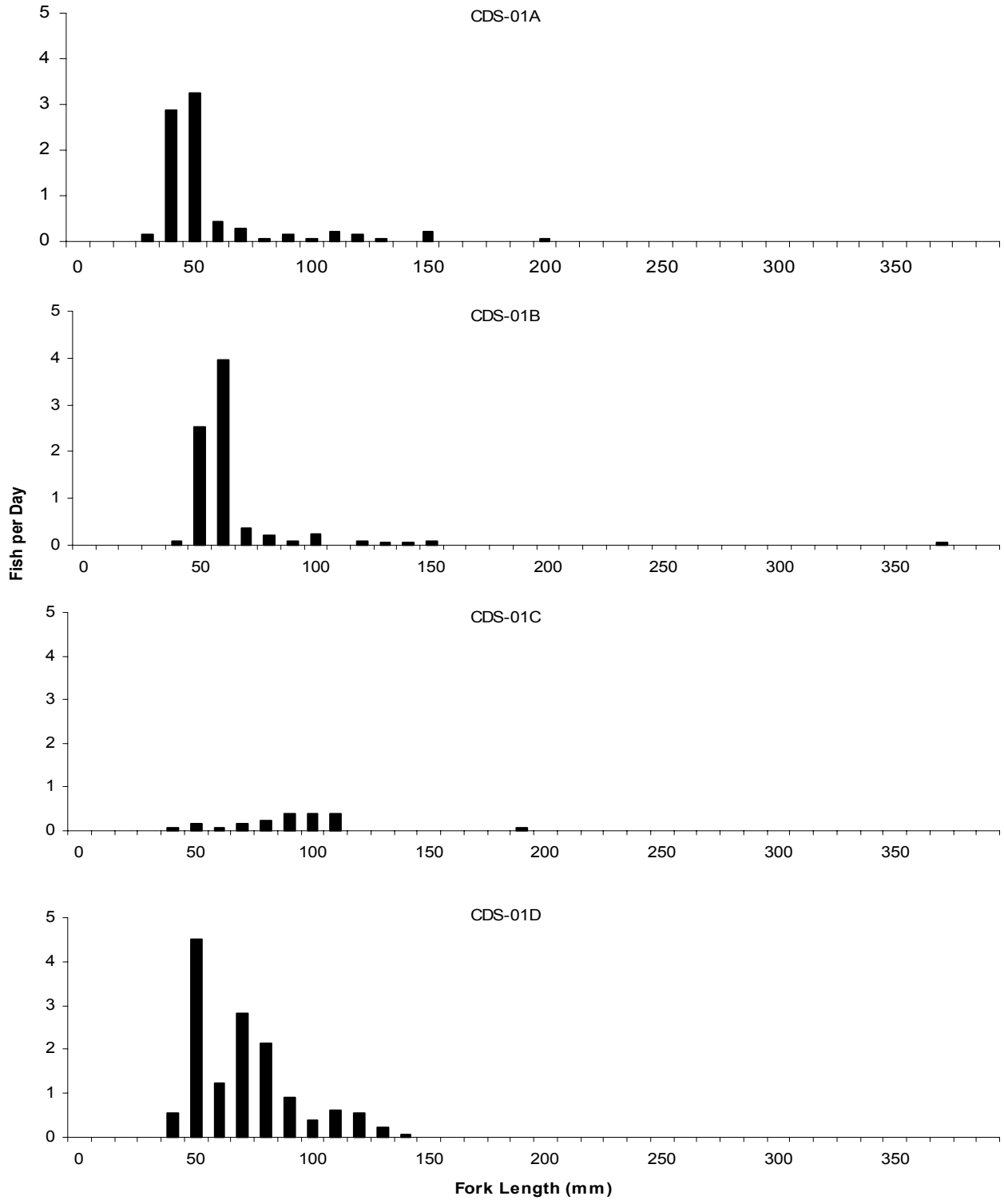

Figure 13. Length frequencies of humpback whitefish caught by fyke net in the CD-South study area, by sample station, 2001 (humpback whitefish mature at about 350 mm).

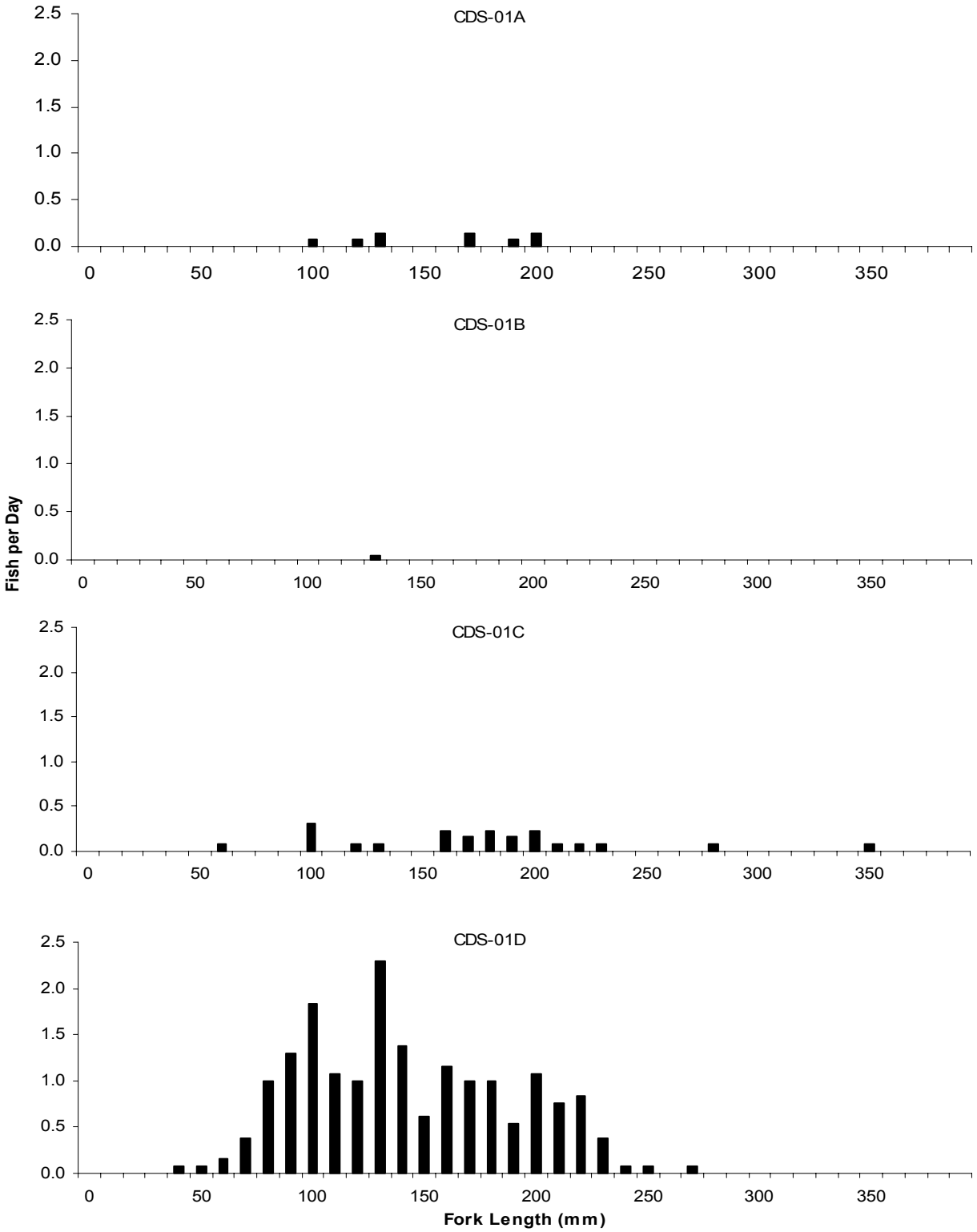

Figure 14. Length frequencies of round whitefish caught by fyke net in the CD-South study area, by sample station, 2001 (round whitefish mature at about 350 mm).

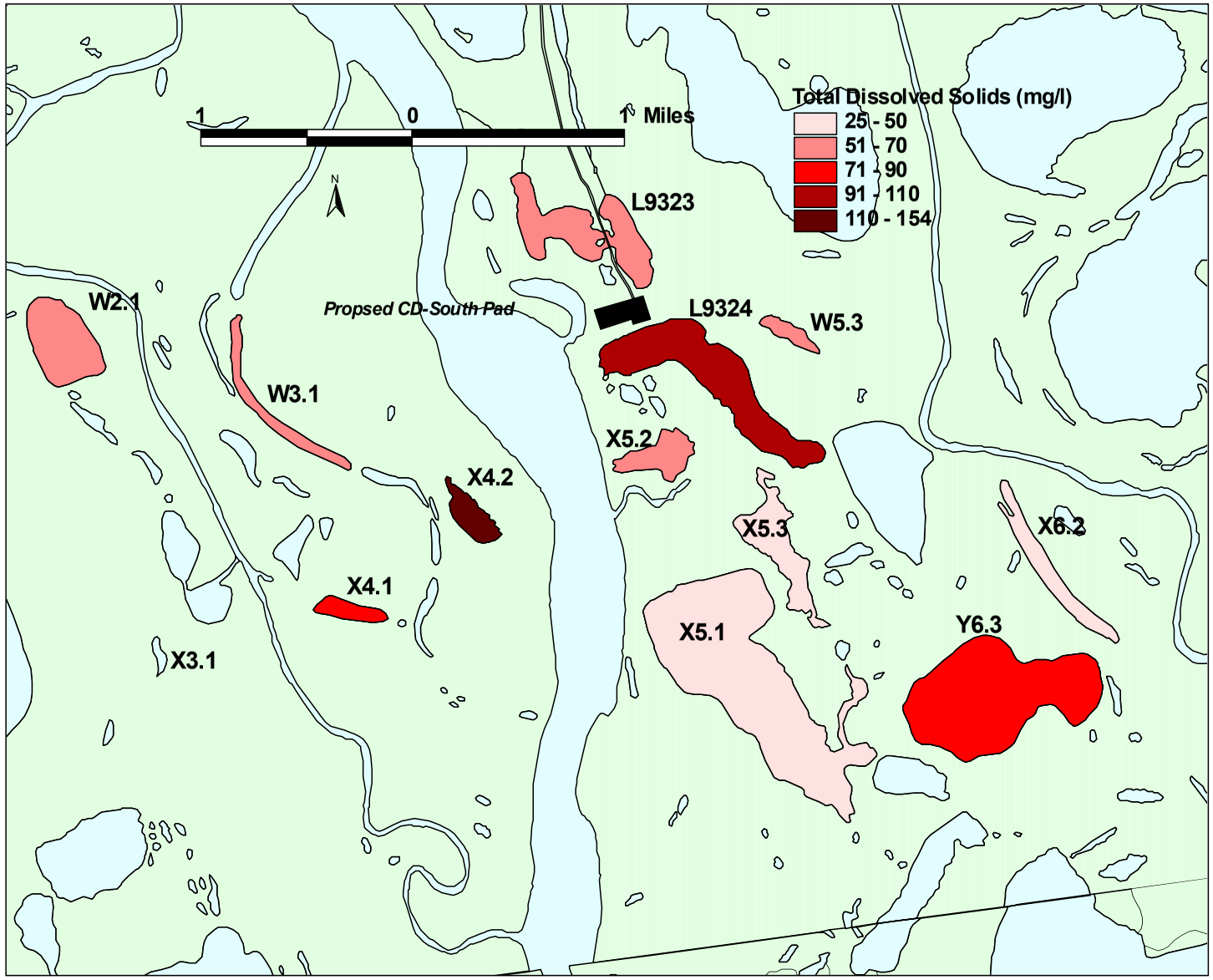

Figure 15. Total dissolved solids in lakes in or near the CD-South study area, based on sampling from 1993 to 1999.

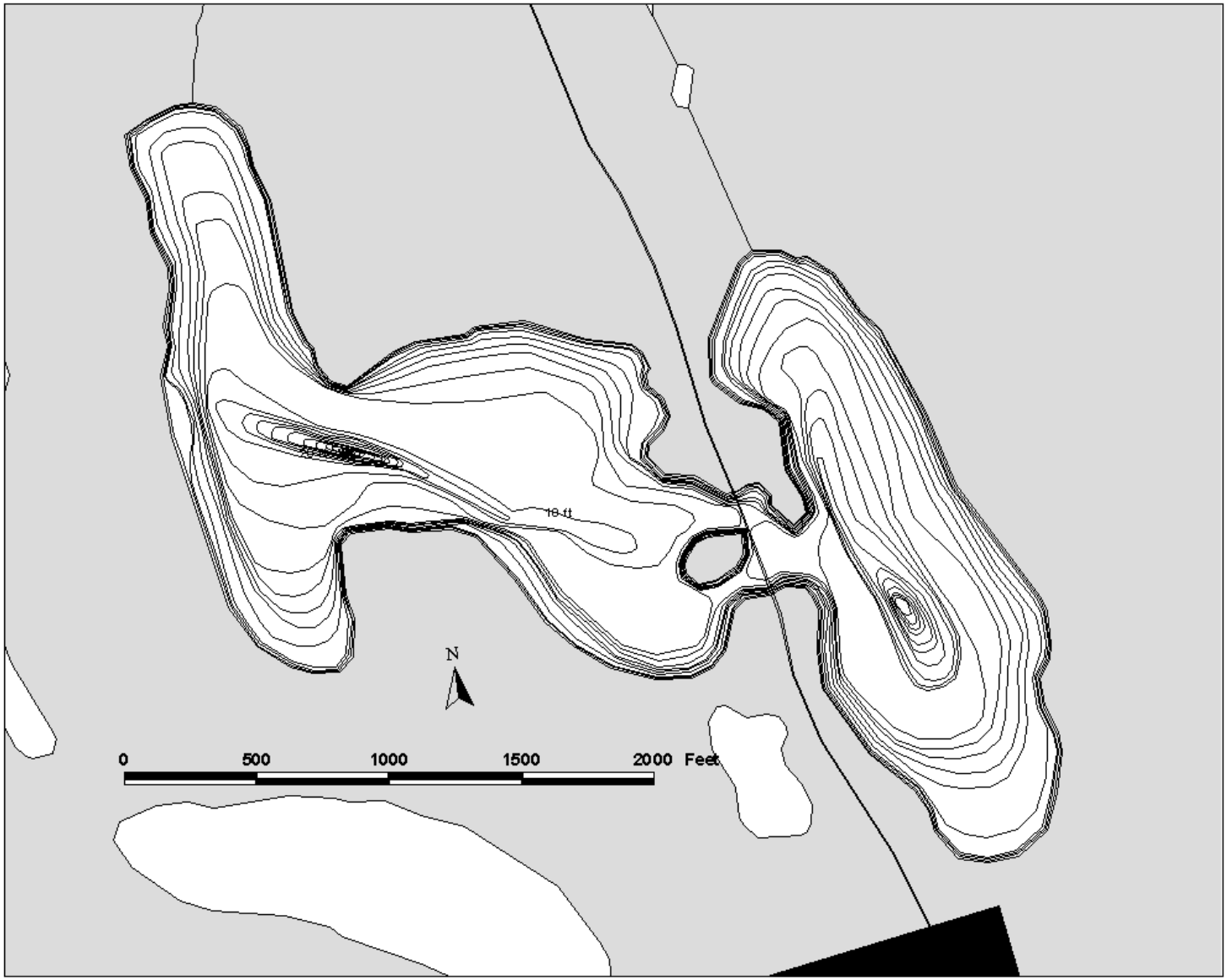

Figure 16. Depth contours of lake W5.1 (L9323) based on 1996 and 2001 depth surveys, in 1 foot intervals.

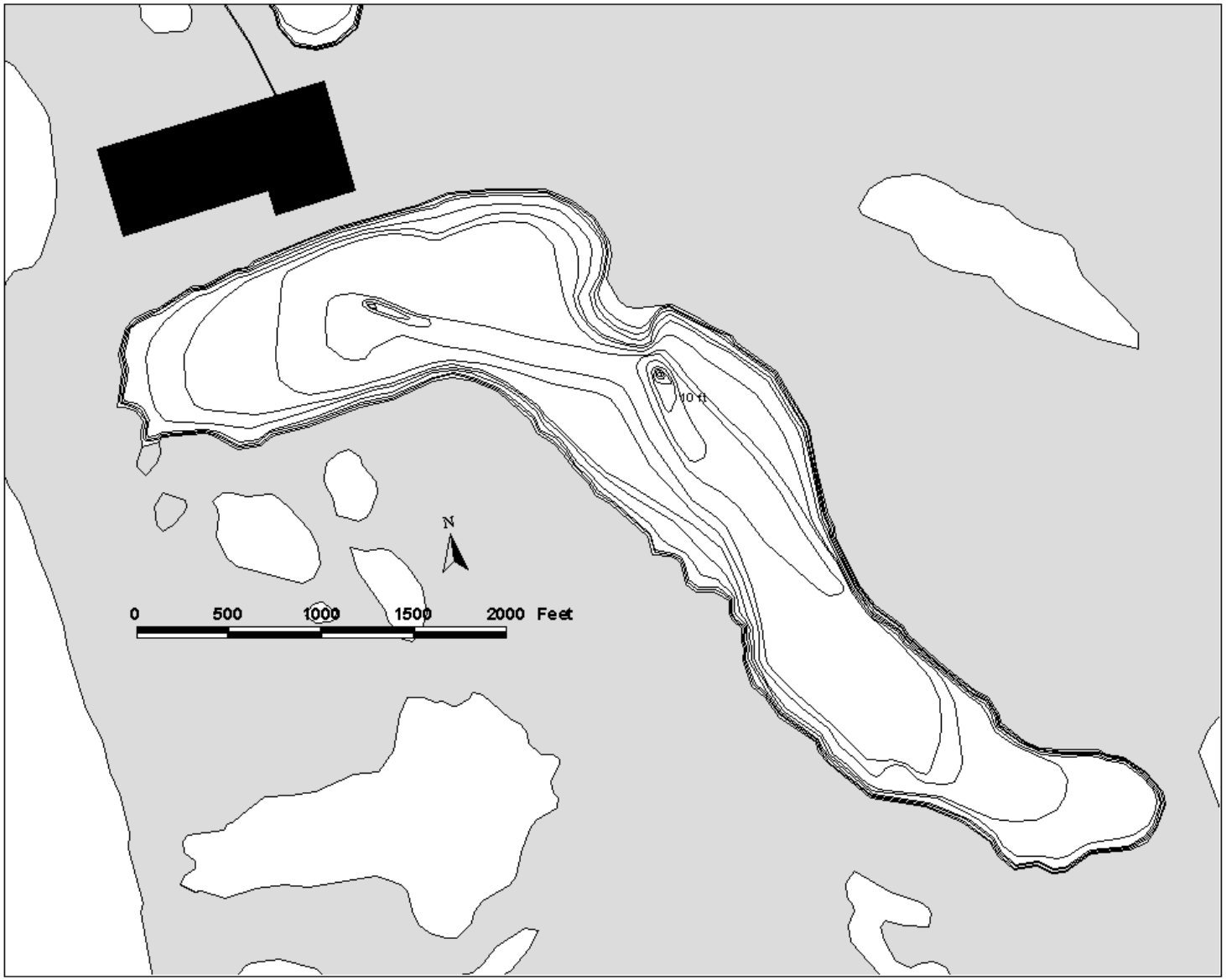

Figure 17. Depth contours of lake W5.2 (L9324) based on 1996 and 1999 depth surveys, in 1 foot intervals.

DATA APPENDIX

Appendix Tables

Appendix Table 1. Water chemistry parameters measured in conjunction with fyke net sampling in the CD-South study area, 2001.

Station	Date	Time	Water Temp (oC)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)
CDS-01A								
	Jul 13 01	10:18	7.9	11.2	95	1,032	7.9	15.0
	Jul 14 01	11:00	8.7	11.0	95	1,030	8.1	12.0
	Jul 15 01	11:12	10.7	10.5	95	1,054	8.1	10.7
	Jul 16 01	11:15	13.1	11.2	107	1,057	8.0	16.8
	Jul 17 01	12:26	14.7	10.0	98	1,076	8.0	79.4
	Jul 18 01	15:08	14.5	8.9	89	1,041	8.3	15.7
	Jul 19 01	14:41	15.1	9.0	92	1,063	8.2	35.2
	Jul 20 01	9:40	14.9	8.9	92	1,064	8.1	11.2
	Aug 18 01	11:11	6.7	11.2	97	409	8.1	40.2
	Aug 19 01	12:30	3.5	11.7	88	466	7.7	28.5
	Aug 20 01	9:50	4.3	13.5	104	462	7.9	36.2
	Aug 21 01	8:51	4.6	11.9	90	466	7.9	34.8
	Aug 24 01	10:30	3.8	10.0	75	496	7.9	25.6
	Aug 25 01	8:45	3.4	12.8	95	462	7.9	21.3
CDS-01B								
	Jul 14 01	11:25	8.5	9.7	82	128	7.7	2.0
	Jul 15 01	10:30	9.7	9.8	83	127	7.8	1.5
	Jul 16 01	10:24	12.9	8.2	77	135	7.5	47.0
	Jul 17 01	11:12	15.8	8.6	86	174	7.9	8.5
	Jul 18 01	12:30	14.8	7.6	76	177	7.6	3.3
	Jul 19 01	13:55	14.5	7.6	75	167	7.4	3.5
	Jul 20 01	11:25	14.8	7.8	79	186	7.6	3.7
	Aug 18 01	13:45	6.9	10.5	86	187	7.8	125.6
	Aug 19 01	12:00	3.5	11.8	91	229	7.7	58.8
	Aug 20 01	11:00	3.3	9.9	76	288	7.7	41.8
	Aug 21 01	8:10	4.1	9.3	70	284	7.8	34.8
	Aug 24 01	11:00	2.8	9.2	68	180	7.7	5.9
	Aug 25 01	9:00	3.1	10.4	78	171	7.4	3.6
CDS-01C								
	Jul 13 01	11:45	7.2	11.6	96	62	8.1	5.0
	Jul 14 01	13:06	8.3	11.3	95	62	8.0	3.3
	Jul 15 01	13:25	10.2	9.5	85	31	7.9	4.1
	Jul 16 01	13:20	12.2	10.6	101	62	7.9	3.0
	Jul 17 01	9:24	13.2	10.4	99	62	7.8	7.0
	Jul 18 01	8:45	12.4	9.1	86	63	8.0	3.0
	Jul 19 01	12:13	12.9	10.2	98	63	7.9	6.0
	Jul 20 01	12:25	13.8	9.5	92	63	8.0	2.3
	Jul 21 01	11:58	15.0	9.5	94	63	8.4	4.3
	Jul 23 01	12:45	15.6	9.1	92	64	8.0	2.3
	Jul 24 01	12:00	14.5	8.8	85	65	7.9	1.9
	Jul 25 01	10:05	13.1	8.7	79	66	7.9	2.6
	Jul 26 01	10:30	13.6	9.0	86	65	7.9	2.3
	Aug 18 01	15:05	7.9	11.8	99	67	8.0	1.8
	Aug 19 01	9:51	6.0	11.1	91	92	8.0	3.4
	Aug 20 01	9:35	5.4	12.7	100	67	7.9	3.4
	Aug 21 01	9:40	5.7	12.6	95	67	8.0	2.0
	Aug 24 01	11:30	4.9	12.5	97	69	7.8	1.7
	Aug 25 01	9:20	4.6	12.2	95	66	7.7	1.3

Appendix Table 1. Water chemistry parameters measured in conjunction with fyke net sampling in the CD-South study area, 2001.

Station	Date	Time	Water Temp (oC)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)
CDS-01D								
	Jul 20 01	14:34	15.4	9.0	91	65	7.9	8.6
	Jul 21 01	11:00	15.3	9.5	94	66	8.2	41.6
	Jul 23 01	15:25	17.6	8.8	95	68	7.8	62.8
	Jul 24 01	10:43	13.1	9.3	89	68	7.8	22.4
	Jul 25 01	9:12	13.1	8.9	85	70	7.9	13.7
	Jul 26 01	9:17	12.8	9.0	88	71	7.9	6.5
	Aug 18 01	17:25	7.1	12.1	101	83	7.9	3.1
	Aug 19 01	8:53	5.6	11.9	95	101	8.2	5.7
	Aug 20 01	8:40	4.9	12.9	99	83	8.1	5.0
	Aug 21 01	10:43	4.9	12.2	95	83	7.8	3.9
	Aug 24 01						7.8	2.9
	Aug 25 01	9:50	4.3	12.9	100	49	7.8	2.8

Appendix Table 2. Fish catches in CD-South sampling during July, 2001

Station CDS-01A (Nanuk Lk)

	Jul 13	Jul 14	Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	July Total
Broad whitefish				6	19	14	2	3							44
Humpback whitefish				2	10	5	1								18
Arctic cisco				5	28	28	3								64
Least cisco		1		7	4	19	4	2							37
Round whitefish				1		2	1								4
Dolly Varden char															0
Arctic grayling															0
Burbot															0
Alaska blackfish															0
Rainbow smelt					4										4
Longnose sucker					1										1
Arctic lamprey															0
Fourhorn sculpin					10	27	4	8							49
Slimy sculpin															0
Ninespine stickleback	1	2	16	14	13	2	3	10							61
Effort (hrs)	18.8	24.0	24.9	23.9	25.5	26.0	23.9	18.8							185.8

Station CDS-01B (M9525)

	Jul 13	Jul 14	Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	July Total
Broad whitefish			1	3	1		2	17							24
Humpback whitefish			1					3							4
Arctic cisco						4									4
Least cisco			2	3	12	5	2	84							108
Round whitefish															0
Dolly Varden char															0
Arctic grayling															0
Burbot				1											1
Alaska blackfish															0
Rainbow smelt															0
Longnose sucker															0
Arctic lamprey															0
Fourhorn sculpin															0
Slimy sculpin															0
Ninespine stickleback		1	24	30	62	27	41	51							236
Effort (hrs)		23.7	22.7	23.7	25.2	25.3	25.4	22.5							168.5

Appendix Table 2. Fish catches in CD-South sampling during July, 2001

Station CDS-01C (L9323)

	Jul 13	Jul 14	Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	July Total
Broad whitefish		3													3
Humpback whitefish			1		3	1						3			8
Arctic cisco															0
Least cisco	21	10	3	31	51	30			1		7	4	2	39	199
Round whitefish	2		1	1	1		1	1	1			1		1	10
Dolly Varden char															0
Arctic grayling															0
Burbot															0
Alaska blackfish			1	2	4	1	1	3	2		5	11	4	2	36
Rainbow smelt															0
Longnose sucker															0
Arctic lamprey															0
Fourhorn sculpin															0
Slimy sculpin		7	3	1			1	1	1			1		1	16
Ninespine stickleback	1	17			219	36	6	16	5		60	66	40	64	530
Effort (hrs)	19.7	23.9	24.6	23.6	19.8	23.5	27.9	22.4	23.7		48.5	23.3	22.2	24.2	327.3

Station CDS-01D (L9324)

	Jul 13	Jul 14	Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	July Total
Broad whitefish								6	21		5	9	17	15	73
Humpback whitefish								3	1		13	10	22	11	60
Arctic cisco								7	1		3	2			13
Least cisco								186	9		710	81		20	1006
Round whitefish								20	20		7	43	31	13	134
Dolly Varden char								1			2	1	1	1	6
Arctic grayling								1	2			3		1	7
Burbot															0
Alaska blackfish									1		1	1			3
Rainbow smelt															0
Longnose sucker								1			1	1			3
Arctic lamprey											1				1
Fourhorn sculpin															0
Slimy sculpin															0
Ninespine stickleback								6	3		8	12	3	2	34
Effort (hrs)								26.0	21.0		51.8	20.0	22.7	24.2	165.8

Appendix Table 3. Fish catches in CD-South sampling during August, 2001

Station CDS-01A (Nanuk Lk)

	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	August Total
Broad whitefish	251			5			4	12	272
Humpback whitefish	2	300	1	25			4	9	341
Arctic cisco									0
Least cisco	15	3000	36	9			1	5	3066
Round whitefish	3	1		1					5
Dolly Varden char				1					1
Arctic grayling	1	1	1						3
Burbot	1								1
Alaska blackfish									0
Rainbow smelt									0
Longnose sucker	1								1
Arctic lamprey									0
Fourhorn sculpin				1			40		41
Slimy sculpin								33	33
Ninespine stickleback				5			16	19	40
Effort (hrs)	20.2	25.3	21.4	22.8			25.5	25.5	140.6

Station CDS-01B (M9525)

	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	August Total
Broad whitefish	57	9		3					69
Humpback whitefish	53	83	5	7				2	150
Arctic cisco									0
Least cisco	30	18		1					49
Round whitefish	1	1							2
Dolly Varden char									0
Arctic grayling									0
Burbot	4	1					1		6
Alaska blackfish	1			1			1	2	5
Rainbow smelt									0
Longnose sucker									0
Arctic lamprey									0
Fourhorn sculpin									0
Slimy sculpin		1							1
Ninespine stickleback	117	82		71			63	51	384
Effort (hrs)	22.3	22.5	23.6	21.2			25.3	21.5	136.3

Appendix Table 3. Fish catches in CD-South sampling during August, 2001

Station CDS-01C (L9323)

	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	August Total
Broad whitefish	1	2		1					4
Humpback whitefish	5	6		2			1	3	17
Arctic cisco									0
Least cisco	75	59	49	48			31	25	287
Round whitefish	5	2	1	2			1	1	12
Dolly Varden char									0
Arctic grayling									0
Burbot									0
Alaska blackfish	2	1	1	1			2		7
Rainbow smelt									0
Longnose sucker									0
Arctic lamprey									0
Fourhorn sculpin									0
Slimy sculpin		2		1			5	1	9
Ninespine stickleback	13	10	3	4			2	3	35
Effort (hrs)	30.2	18.8	24.1	24.0			26.6	22.2	145.9

Station CDS-01D (L9324)

	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	August Total
Broad whitefish	18		6	5			1		30
Humpback whitefish	243	7	16	9			5	1	281
Arctic cisco		3							3
Least cisco	191	38	35	23			7	1	295
Round whitefish	34	17	22	13			15	2	103
Dolly Varden char									0
Arctic grayling									0
Burbot									0
Alaska blackfish	2	1							3
Rainbow smelt									0
Longnose sucker	1							1	2
Arctic lamprey									0
Fourhorn sculpin									0
Slimy sculpin								1	1
Ninespine stickleback	3	7					6	3	19
Effort (hrs)	31.7	16.2	23.7	26.3			28.0	21.7	147.5

Appendix Table 4. Length frequencies of least cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Jul 14	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	Aug Total
0							0							0
10							0							0
20	1						1							0
30							0	1	6	5	1			13
40							0	13	45	31	7	1	2	99
50							0	1	1		1		2	5
60					1		1							0
70				2	1		3							0
80					1		1						1	1
90							0							0
100							0							0
110							0							0
120		1					1							0
130		1		2			3							0
140		1		1			2							0
150				1			1							0
160			1	2	1		4							0
170		2	1	2			5							0
180		1		3			4							0
190							0							0
200				2		1	3							0
210		1					1							0
220				1			1							0
230				3			3							0
240							0							0
250							0							0
260			1				1							0
270							0							0
280							0							0
290							0							0
300			1				1							0
310							0							0
320							0							0
330						1	1							0
340							0							0
350							0							0
360							0							0
370							0							0
380							0							0
390							0							0
400							0							
Total:	1	7	4	19	4	2	37	15	52	36	9	1	5	118

Appendix Table 4. Length frequencies of least cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01B Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	July Total	Aug 18	Aug 19	Aug 21	Aug Total
0							0				0
10							0				0
20							0				0
30							0				0
40							0	4	3		7
50							0	9	12	1	22
60	1						1	3			3
70						1	1				0
80	1					20	21				0
90		2	1	1		35	39				0
100						16	16	5			5
110							0	2	1		3
120							0	4	2		6
130							0				0
140			1	1		1	3				0
150		1	1			1	3				0
160							0				0
170				1			1				0
180						4	4	1			1
190						1	1				0
200						2	2				0
210							0				0
220							0				0
230				1	1		2				0
240			4	1		2	7				0
250			1		1	1	3				0
260			1				1	1			1
270							0				0
280							0				0
290							0				0
300							0				0
310			1				1	1			1
320			1				1				0
330							0				0
340							0				0
350							0				0
360							0				0
370			1				1				0
380							0				0
390							0				0
400							0				0
Total:	2	3	12	5	2	84	108	30	18	1	49

Appendix Table 4. Length frequencies of least cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01C Jul 13	Jul 14	Jul 15	Jul 16	Jul 17	Jul 18	Jul 20	Jul 21	Jul 23	Jul 24	Jul 25	Jul 26	July Total
0													0
10													0
20													0
30													0
40													0
50	1	1			1			1					4
60	10	7	3		11	2			1	2	1	7	44
70	8	2			5				1			15	31
80					1							9	10
90												1	1
100													0
110	1			1									2
120													0
130													0
140				2	7	1						1	11
150				1	3	5					1	4	14
160				7	6	4						2	19
170				17	11	11			2	1			42
180				1	3	4			2	1			11
190					2	1							3
200				1		1							2
210													0
220	1												1
230				1									1
240													0
250						1			1				2
260													0
270													0
280					1								1
290													0
300													0
310													0
320													0
330													0
340													0
350													0
360													0
370													0
380													0
390													0
400													0
Total:	21	10	3	31	51	30	0	1	7	4	2	39	199

Appendix Table 4. Length frequencies of least cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01C Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	Aug Total
0							0
10							0
20							0
30							0
40	13	7	2	2	2		26
50	11	2	1	1	3		18
60							0
70	3	4	1		1		9
80			8	1	1	2	12
90	3	4	20	4	1	4	36
100			5	4	3	5	17
110			1	1			2
120	4	4	2	2		2	14
130	15	10	4	8	2	5	44
140	7	5	3	9	5	2	31
150	6			1	1		8
160	6	9		5	5	3	28
170	4	4		7	3	1	19
180	3	9	2	2	2	1	19
190					1		1
200		1					1
210							0
220							0
230					1		1
240							0
250				1			1
260							0
270							0
280							0
290							0
300							0
310							0
320							0
330							0
340							0
350							0
360							0
370							0
380							0
390							0
400							0
Total:	75	59	49	48	31	25	287

Appendix Table 4. Length frequencies of least cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01D Jul 20	Jul 21	Jul 23	Jul 24	Jul 26	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	Aug Total
0						0							0
10						0							0
20						0							0
30			1			1							0
40						0	2	1					3
50			1			1							0
60	4		9	1		14							0
70	112	1	186	26	8	333							0
80	60		124	42	6	232	2	5	3	4			14
90	3		8	4	3	18	38	25	20	13	2		98
100			2			2	22	7	5	3	4	1	42
110	2		2			4			1				1
120						0	2						2
130				2		2							0
140						0	2		1				3
150			2		1	3							0
160			1			1			1	1	1		3
170						0							0
180					2	2							0
190						0	1			1			2
200		1		1		2			1	1			2
210				2		2							0
220			1			1							0
230	1	2		1		4			1				1
240	2					2			2				2
250		1				1							0
260		2		1		3							0
270		1				1							0
280	1		1	1		3							0
290		1				1							0
300						0							0
310	1					1							0
320						0							0
330						0							0
340						0							0
350						0							0
360			1			1							0
370						0							0
380						0							0
390						0							0
400						0							0
Total:	186	9	339	81	20	635	69	38	35	23	7	1	173

Appendix Table 5. Length frequencies of arctic cisco caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Jul 16	Jul 17	Jul 18	Jul 19	July Total	CDS-01D Jul 20	Jul 21	Jul 23	Jul 24	July Total	August Aug 19	August 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					0					0		0
80					0	3				3		0
90					0	2		3	1	6	2	2
100			1		1					0		0
110		1			1					0		0
120		2	2		4	1			1	2		0
130		5	8	1	14					0		0
140		6	5	1	12					0	1	1
150			1		1		1			1		0
160		1	4		5					0		0
170					0					0		0
180		3	1		4	1				1		0
190	2	3	2		7					0		0
200	3	2			5					0		0
210		1			1					0		0
220		1	1	1	3					0		0
230		2	3		5					0		0
240					0					0		0
250		1			1					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					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:	5	28	28	3	64	7	1	3	2	13	3	3

Appendix Table 6. Length frequencies of broad whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	July Total	Aug 18	Aug 21	Aug 24	Aug 25	August Total
0						0					0
10						0					0
20						0					0
30						0	2				2
40						0	26		2	1	29
50						0	23	4	2		29
60	1	1		1	2	5	1	1		1	3
70			1		1	2					0
80						0					0
90	1	1	1			3					0
100						0					0
110			1			1					0
120		1				1	1				1
130	1		2			3					0
140	1	3	1			5					0
150	1	4				5					0
160		2	2			4					0
170		3	1			4					0
180		1	1			2					0
190						0					0
200						0					0
210						0					0
220		1	1			2					0
230	1	1				2					0
240						0					0
250						0					0
260						0					0
270			1			1					0
280						0					0
290						0					0
300						0					0
310						0					0
320						0					0
330						0	1				1
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			1			1					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		1		1		2					0
530						0					0
540						0					0
550						0					0
560						0					0
570						0					0
580						0					0
590			1			1					0
600						0					0
610						0					0
Total:	6	19	14	2	3	44	54	5	4	2	65

Appendix Table 6. Length frequencies of broad whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01B									CDS-01C								
	July						August											
	Jul 15	Jul 16	Jul 17	Jul 19	Jul 20	Total	Aug 18	Aug 19	Aug 21	Total	Aug 18	Aug 19	Aug 21	Total
0						0				0				0
10						0				0				0
20						0				0				0
30				1		1				0				0
40						0	1	1		2				0
50						0	22	4	3	29				0
60						0	20	3		23				0
70					2	2	2			2				0
80		1				1				0				0
90		1			6	7				0				0
100					3	3				0				0
110			1		5	6	1			1				0
120						0	1	1		2				0
130						0	1			1		1	1	2
140						0	5			5				0
150						0	1			1	1	1		2
160						0				0				0
170					1	1				0				0
180						0				0				0
190						0				0				0
200						0	1			1				0
210						0	1			1				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	1			1				0
310						0				0				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
410						0				0				0
420						0				0				0
430						0				0				0
440						0				0				0
450						0				0				0
460						0				0				0
470						0				0				0
480						0				0				0
490						0				0				0
500						0				0				0
510						0				0				0
520						0				0				0
530	1	1		1		3				0				0
540						0				0				0
550						0				0				0
560						0				0				0
570						0				0				0
580						0				0				0
590						0				0				0
600						0				0				0
610						0				0				0
Total:	1	3	1	2	17	24	57	9	3	69	1	2	1	4

Appendix Table 6. Length frequencies of broad whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01D Jul 20	Jul 21	Jul 23	Jul 24	Jul 25	Jul 26	July Total	Aug 18	Aug 20	Aug 21	Aug 24	August Total
0							0					0
10							0					0
20							0					0
30					13	13	26					0
40						1	1					0
50		1					1	8	2			10
60	2	3					5		2			2
70	1	4	1		1		7					0
80	1	3	3	2			9					0
90		1		2			3					0
100				2			2	2		3		5
110							0	4	1		1	6
120							0	3				3
130							0	1				1
140						2	2					0
150				1	2		3					0
160			1		1		2			1		1
170				1			1		1			1
180				1			1			1		1
190							0					0
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		1					1					0
330							0					0
340							0					0
350	1	1					2					0
360		1					1					0
370		1					1					0
380							0					0
390							0					0
400		2					2					0
410							0					0
420							0					0
430							0					0
440		1					1					0
450		2					2					0
460							0					0
470							0					0
480							0					0
490							0					0
500	1						1					0
510							0					0
520							0					0
530							0					0
540							0					0
550							0					0
560							0					0
570							0					0
580							0					0
590							0					0
600							0					0
610							0					0
Total:	6	21	5	9	17	16	74	18	6	5	1	30

Appendix Table 7. Length frequencies of humpback whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Jul 16	Jul 17	Jul 18	Jul 19	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	August Total
0					0							0
10					0							0
20					0							0
30					0				1		1	2
40					0		13	1	18	2	5	39
50					0		36		5	1	2	44
60		1	1		2		1		1	1	1	4
70	1	1	2		4							0
80		1			1							0
90				1	1	1						1
100		1			1							0
110		1	1		2	1						1
120		1	1		2							0
130		1			1							0
140					0							0
150	1	2			3							0
160					0							0
170					0							0
180					0							0
190					0							0
200		1			1							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							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
Total:	2	10	5	1	18	2	50	1	25	4	9	91

Appendix Table 7. Length frequencies of humpback whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01B Jul 15	Jul 16	Jul 17	Jul 20	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 25	August Total
0					0						0
10					0						0
20					0						0
30					0						0
40					0		1		1		2
50					0	17	23	4	4	2	50
60	1				1	26	47	1	2	1	77
70					0	1	6				7
80				3	3	1					1
90					0	2					2
100					0	3	2				5
110					0						0
120					0		2				2
130					0	1					1
140					0	1					1
150					0	1	1				2
160					0						0
170					0						0
180					0						0
190					0						0
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						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:	1	0	0	3	4	53	83	5	7	3	151

Appendix Table 7. Length frequencies of humpback whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01C Jul 15	Jul 16	Jul 17	Jul 18	Jul 24	July Total	Aug 18	Aug 19	Aug 21	Aug 24	Aug 25	August Total
0						0						0
10						0						0
20						0						0
30						0						0
40						0		1				1
50			1		1	2						0
60				1		1						0
70						0	1				1	2
80			2		1	3						0
90	1				1	2	1	2				3
100						0	2	1	1		1	5
110						0	1	2	1		1	5
120						0						0
130						0						0
140						0						0
150						0						0
160						0						0
170						0						0
180						0						0
190						0				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						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
Total:	1	0	3	1	3	8	5	6	2	1	3	17

Appendix Table 7. Length frequencies of humpback whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01D Jul 20	Jul 21	Jul 23	Jul 24	Jul 25	Jul 26	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	August Total
0							0							0
10							0							0
20							0							0
30							0							0
40							0	7						7
50	1						1	49	1	6		2		58
60			4	2	6	2	14	1		1				2
70	2		5	8	15	6	36	1						1
80			1			1	2	14	1	4	4	2	1	26
90							0	8	2	2				12
100			1			1	2	2				1		3
110		1				1	2		2	1	3			6
120							0	3	1	1	2			7
130							0	2		1				3
140					1		1							0
150							0							0
160							0							0
170							0							0
180							0							0
190							0							0
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							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
Total:	3	1	11	10	22	11	58	87	7	16	9	5	1	125

Appendix Table 8. Length frequencies of round whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A									CDS-01B	
	Jul 16	Jul 17	Jul 18	Jul 19	July Total	Aug 18	Aug 19	Aug 21	August Total	Aug 19	August 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					0				0		0
80					0				0		0
90					0				0		0
100					0	1			1		0
110					0				0		0
120			1		1				0		0
130			1		1			1	1	1	1
140					0				0		0
150					0				0		0
160					0				0		0
170				1	1	1			1		0
180					0				0		0
190					0	1			1		0
200	1				1		1		1		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					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:	1	0	2	1	4	3	1	1	5	1	1

Appendix Table 8. Length frequencies of round whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01C Jul 12	Jul 14	Jul 15	Jul 16	Jul 17	Jul 20	Jul 21	Jul 24	Jul 26	July Total	CDS-01C Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	August Total
0										0							0
10										0							0
20										0							0
30										0							0
40										0							0
50										0							0
60		1								1							0
70										0							0
80										0							0
90										0							0
100	1	1								2			1	1			2
110										0							0
120										0				1			1
130										0		1					1
140										0							0
150										0							0
160				1						1	1	1					2
170	1				1					2							0
180							1	1		2	1						1
190										0	2						2
200		1				1				2					1		1
210										0	1						1
220			1							1							0
230									1	1							0
240										0							0
250										0							0
260										0							0
270										0							0
280										0	1						1
290										0							0
300										0							0
310										0							0
320										0							0
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:	2	3	1	1	1	1	1	1	1	12	6	2	1	2	1	1	13

Appendix Table 8. Length frequencies of round whitefish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01D Jul 20	Jul 21	Jul 23	Jul 24	Jul 25	Jul 26	July Total	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	Aug 25	August Total
0							0							0
10							0							0
20							0							0
30							0							0
40							0		1					1
50						1	1							0
60				1	1		2							0
70		1		1	1	1	4		1					1
80		1	1	3	2	3	10	1	1	1				3
90	2			2			4	4	2	1	4	2		13
100	2	3	2	4	4	1	16	2	1	2		3		8
110	2	2	1	3		2	10		1	2	1			4
120	1		1	3	3	1	9	3				1		4
130	1	3		5	3		12	7	2	2	3	2	2	18
140	1			4	1	2	8	4	1	2		3		10
150	1	1		3			5		2		1			3
160	2	2		4	2	1	11	2		1	1			4
170	2	1		2	2	1	8	2		3				5
180		2		5	2		9	2	1	1				4
190	1			1	1		3	1		1		2		4
200	3	3		1	3		10	1		1	1	1		4
210	1	1			3		5	1	2	1	1			5
220	1		1	1			3	3	1	3	1			8
230			1		2		3		1			1		2
240					1		1							0
250							0	1						1
260							0							0
270							0			1				1
280							0							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							0
380							0							0
390							0							0
400							0							0
Total:	20	20	7	43	31	13	134	34	17	22	13	15	2	103

Appendix Table 9. Length frequencies of rainbow smelt caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Jul 17
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	1
100	1
110	1
120	
130	
140	
150	1
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	
Total:	4

Appendix Table 10. Length frequencies of Alaska blackfish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01B Aug 18	Aug 21	Aug 24	Aug 25	August Total	CDS-01C Jul 15	Jul 16	Jul 17	Jul 18	Jul 19	Jul 20	Jul 21	Jul 23	Jul 24	Jul 25	Jul 26	July Total
0					0												0
10					0												0
20					0												0
30					0												0
40					0												0
50					0		1	2					1	3	1		8
60					0		1				3	1	1	2	1	1	10
70					0			1	1	1		1	2	3		1	10
80					0	1							1	2	2		6
90		1			1			1						1			2
100	1		1	2	4												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:	1	1	1	2	5	1	2	4	1	1	3	2	5	11	4	2	36

Appendix Table 10. Length frequencies of Alaska blackfish caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01C						CDS-01D					
	Aug 18	Aug 19	Aug 20	Aug 21	Aug 24	August Total	Jul 21	Jul 23	Jul 24	July Total	Aug 18	Aug 19	August 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				3	1	4				0			0
70	1	1	1			3				0	2		2
80				1	1	2	1			1			0
90	1					1			1	1		1	1
100						0		1		1			0
110						0				0			0
120						0				0			0
130						0				0			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			0
Total:	2	1	1	4	2	10	1	1	1	3	2	1	3

Appendix Table 11. Length frequencies of arctic grayling caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01A Aug 18	Aug 19	Aug 20	August Total	CDS-01D Jul 20	Jul 21	Jul 24	Jul 26	July Total
0				0					0
10				0					0
20				0					0
30				0					0
40				0					0
50				0					0
60				0	1	2	1		4
70				0			2		2
80				0					0
90				0					0
100				0					0
110				0					0
120				0				1	1
130				0					0
140				0					0
150				0					0
160				0					0
170				0					0
180				0					0
190		1	1	2					0
200	1			1					0
210				0					0
220				0					0
230				0					0
240				0					0
250				0					0
Total:	1	1	1	3	1	2	3	1	7

Appendix Table 12. Length frequencies of slimy sculpin caught by fyke net in the CD-South study area, 2001.

Fork Length (mm)	CDS-01B		CDS-01C												
												July			August
	Aug 19	Total	Jul 14	Jul 15	Jul 16	Jul 19	Jul 20	Jul 21	Jul 24	Jul 26	Total	Aug 19	Aug 21	Total
0		0									0			0
10		0									0			0
20		0									0			0
30		0	3		1			1			5			0
40		0	2	2					1		5			0
50	1	1	1	1							2	1		1
60		0	1			1	1				3	1		1
70		0									0		1	1
80		0								1	1			0
90		0									0			0
100		0									0			0
110		0									0			0
120		0									0			0
130		0									0			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			0
Total:	1	1	7	3	1	1	1	1	1	1	16	2	1	3

Appendix Table 13. Tagged fish released in the CD-South study area, 2001.

Release Station	Release Date	Species	Fork Length (mm)	Tag Number	Capture Station	Capture Date	Capture Length
CDS-01A	7/17/2001	ARCS	252	MJM010209			
CDS-01A	7/17/2001	LSCS	310	MJM010210			
CDS-01A	7/17/2001	LSCS	270	MJM010211			
CDS-01A	7/17/2001	BDWF	530	MJM010213	CDS-01A	7/19/2001	524
CDS-01A	7/18/2001	BDWF	278	MJM010217			
CDS-01A	7/20/2001	LSCS	334	MJM010221			
CDS-01A	7/18/2001	BDWF	600	MJM010600			
CDS-01A	8/18/2001	BURB	480	MJM011345			
CDS-01A	8/18/2001	BDWF	340	MJM011348			
CDS-01B	7/15/2001	BDWF	538	MJM010201			
CDS-01B	7/16/2001	BDWF	535	MJM010202			
CDS-01B	7/17/2001	LSCS	314	MJM010204			
CDS-01B	7/17/2001	LSCS	255	MJM010205	CDS-01B	7/20/2001	256
CDS-01B	7/17/2001	LSCS	266	MJM010206			
CDS-01B	7/17/2001	LSCS	326	MJM010207			
CDS-01B	7/17/2001	LSCS	376	MJM010208			
CDS-01B	7/19/2001	LSCS	259	MJM010219			
CDS-01B	7/19/2001	BDWF	540	MJM010220			
CDS-01B	8/19/2001	HBWF	378	MJM011339			
CDS-01B	8/18/2001	BDWF	309	MJM011340			
CDS-01B	8/18/2001	LSCS	319	MJM011342			
CDS-01B	8/18/2001	LSCS	266	MJM011343			
CDS-01C	7/17/2001	LSCS	285	MJM010203			
CDS-01C	7/18/2001	LSCS	255	MJM010215			
CDS-01C	7/23/2001	LSCS	255	MJM010244			
CDS-01C	8/21/2001	LSCS	256	MJM011334			
CDS-01D	7/20/2001	LSCS	285	MJM010222			
CDS-01D	7/20/2001	LSCS	318	MJM010223			
CDS-01D	7/20/2001	BDWF	355	MJM010224			
CDS-01D	7/20/2001	BDWF	505	MJM010225			
CDS-01D	7/21/2001	LSCS	255	MJM010226			
CDS-01D	7/21/2001	BDWF	409	MJM010227			
CDS-01D	7/21/2001	LSCS	266	MJM010228			
CDS-01D	7/21/2001	BDWF	364	MJM010229			
CDS-01D	7/21/2001	BDWF	371	MJM010230			
CDS-01D	7/21/2001	BDWF	455	MJM010231			
CDS-01D	7/21/2001	LSCS	270	MJM010232			
CDS-01D	7/21/2001	LSCS	275	MJM010233			
CDS-01D	7/21/2001	LSCS	295	MJM010235			
CDS-01D	7/21/2001	BDWF	329	MJM010236			
CDS-01D	7/21/2001	BDWF	455	MJM010237			
CDS-01D	7/21/2001	BDWF	352	MJM010238			
CDS-01D	7/21/2001	BDWF	446	MJM010239			
CDS-01D	7/21/2001	BDWF	405	MJM010240			
CDS-01D	7/23/2001	LSCS	282	MJM010245			
CDS-01D	7/23/2001	CHAR	293	MJM010247	CDS-01D	7/24/2001	293
CDS-01D	7/24/2001	CHAR	293	MJM010247	CDS-01D	7/25/2001	298
CDS-01D	7/25/2001	CHAR	298	MJM010247	CDS-01D	7/26/2001	296
CDS-01D	7/23/2001	LSCS	365	MJM010248			
CDS-01D	7/23/2001	CHAR	525	MJM010249			
CDS-01D	7/24/2001	LSCS	266	MJM010429			
CDS-01D	7/24/2001	LSCS	290	MJM010431			

BDWF = broad whitefish
BURB = burbot
HBWF = humpback whitefish
RDWF = round whitefish
LSCS = least cisco
ARCS = arctic cisco
RBSM = rainbow smelt
CHAR = Dolly Varden