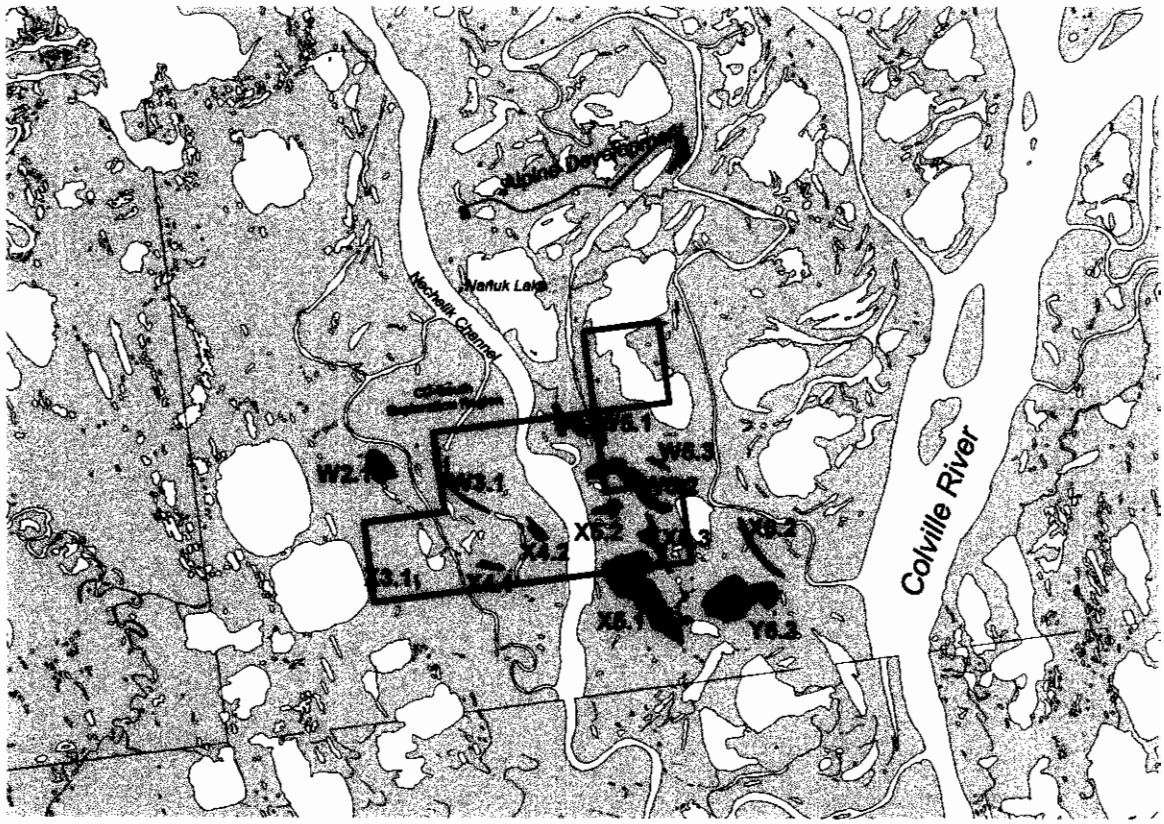
FISH OCCURRENCE IN LAKES OF THE CD-SOUTH EXPLORATION AREA

Final Data Report

December 2000



Prepared by:

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700 G Street
Anchorage, AK

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FISH UTILIZATION OF LAKES IN THE CD-SOUTH EXPLORATION AREA

INTRODUCTION

Phillips Alaska Inc. has proposed to explore for oil within the CD-South exploration area (Figure 1). Exploration will lead to crossing rivers and lakes with ice roads and withdrawal of water from lakes to support both industrial and domestic needs.

During review of exploration, and potentially development, permits, information will be required on the biological sensitivity of lakes in the region. The study was designed to provide physical and biological information on these lakes to understand their use by various fish species. In addition, the results of the survey can be used, in concert with previous surveys within the area, to direct any future investigations that may be needed.

The objectives of the study are to document fish presence and habitat use in lakes in or near the CD-South exploration area. Selected lakes include those that may be used to support exploration. Some lakes in the area of interest were sampled in previous years, with data reported in Moulton (1998), while others were sampled in 1999. Information from other surveys, such as Bendock and Burr (1986) are included in the lake summaries.

METHODS

Sampling was conducted in or near the CD-South exploration area identified by ARCO Alaska (presently Phillips Alaska) from 1996 to 1999 (Figure 1). Location information for each lake is presented in Table 1.

The biological survey consisted of sampling for fish 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 inventory-level data from lakes throughout the Colville Delta and nearby areas. The sets were kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Fish captured were measured and released if not severely injured. Duration of each set was recorded to allow calculation of catch rates.

Water chemistry parameters were measured in the studied lakes to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses. Water chemistry measurements included water temperature, specific conductance or salinity, dissolved oxygen, and pH. In many of the lakes, a water sample was taken and sent to Northern Test Labs for more detailed analysis. The 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 the transects on base maps of the lakes. Individual depth measurements were located with a hand-held GPS receiver while traversing the lake with either a boat or float tube. The readings were converted to distance measurements and the resulting points were plotted on the known location of the transect.

The lake volume is estimated by applying the formula for the volume of a cone to the surface area and maximum depth of each lake. The surface area is obtained from a GIS base map using the USGS 1:63,360 scale quads. The amount allowed for winter water withdrawal is estimated as 15% of the volume of the lake deeper than 7 feet. The volume estimation is a rough estimate, but is currently accepted for a first estimate for a one-time use. For lakes that are proposed for long-term use, volume is estimated based on contour maps of the lake.

The lakes are grouped to correspond to the exploration areas identified by Phillips Alaska for 1999 (Figures 2 and 3). The lakes are not necessarily within the boundaries of each region, but are nearby or near potential ice road routes. Since sampling was conducted prior to final exploration planning, some lakes may not appear close to the final exploration configuration.

Water chemistry parameters were measured in the studied lakes to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses.

LAKE SUMMARIES

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, the lakes are numbered sequentially beginning from the west and south sides of the grid.

Information contained for each surveyed lake (if measured) includes:

1. A diagram of the lake,
2. Other names utilized for the same lake,
3. Lake location, in latitude/longitude,
4. The USGS quadrangle sheet and the township and range in which the lake is situated
5. Habitat classification,
6. Surface area in acres, obtained from USGS digital maps,
7. Maximum depth in feet,
8. Presence or absence of an outlet,
9. pH,

10. Calculated lake volume and volume of water permitted for winter withdrawal,
11. Water chemistry measurements,
12. Catch record, including gear used, date sampled, species caught and size range,
13. Where appropriate data exist, the length frequency of dominant species is plotted,
14. The depth distribution based on bathymetric transects that were recorded.

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 with an obvious high water channel, likely subject to annual flooding.

Perch (Infrequent Flooding) = Perched lake with no obvious high water channel, 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

Fish were present in all 13 lakes sampled in the CD-South area (Table 2). As with most other fish surveys in this region, broad whitefish and least cisco dominated the catches, with round whitefish and arctic grayling also caught. Least cisco was the most abundant species, occurring in 12 of the 13 lakes (Figure 2). The only lake in which they were not found was a small drainage lake (X3.1/L9808) that contained arctic grayling. Distributions of broad whitefish and round whitefish are illustrated in Figures 3 and 4.

Water chemistry parameters measured in the studied lakes are presented Table 4. During the 1999 survey (Jul 9 to Aug 4, 1999), water temperature averaged 12.6 °C (range: 7.4 to 15.3°C), with dissolved oxygen averaging 95.8% saturation (range: 82.4-107.8%). Ion concentrations were low, with total dissolved solids less than 100 mg/l except in one lake (X4.2/L9901).

Under existing state regulatory policies, the 13 lakes in the CD-South exploration area provide 102.8 million gallons of water to support winter exploration. Almost 60% of the volume comes from 3 lakes – W5.2/L9324, X5.1/B8531, and Y6.3/L9327.

LITERATURE CITED

Bendock, T.N. and J.M. Burr. 1986. Arctic Area Trout Studies. Federal Aid in Fish Restoration and Anadromous Fish Studies, 1985-1986, Volume 27, Study T-7-1, Alaska Department of Fish and Game, Sport Fish Division, Juneau, AK. 75p.

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

Table 1. Locations of lakes sampled in or near the CD-South exploration 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 2. Catches of fish from sampling with gill nets in or near the CD-South exploration 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, 1999	3.8	2	1				3
X5.2	L9325	Jul 24 99	2.6	3	1	5			9
X5.3	None	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 3. Water chemistry parameters measured at lakes in or near the CD-South exploration area.

ERG Name	Lake Name	Date	Water Temp (deg C)	Dissolved Oxygen (mg/l)	Specific Conductance (µS/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	14	9	4	38	70
W3.1	L9341b	Jul 22 99	9.0	11.3	167	7.9	15	7	8	3	30	67
W5.1	L9323	Jul 27 99	8.7	11.9	86	7.9	4	3	2	4	17	53
W5.2	L9324	Jul 25 99	9.5	12.0	85	8.2	2	2	2	5	19	95
W5.3	M9929	Jul 26 99	8.7	10.4	108	8.2	10	5	9	5	42	52
X4.1	L9902	Jul 23 99	10.1	11.2	171	8.0	21	12	12	7	58	88
X4.2	L9901	Jul 23 99	9.2	11.0	312	8.2	49	23	20	13	101	154
X5.1	B8531	Aug 01 99	10.5	11.3	89	7.9	4	3	2	6	23	50
X5.2	L9325	Jul 24 99	10.6	10.7	102	7.7	5	3	2	6	24	62
X5.3	None	Aug 03 99	12.2	11.7	106	8.1	6	4	11	4	44	48
X6.2	L9328	1993					3	2	2	6	25	46
Y6.3	L9327	1993					2	2	2	5	19	78

Table 4. Summary of fish presence and available water in lakes in or near the CD-South exploration area.

ERG Name	Lake Name	GIS Est Acreage	Maximum Depth (ft)	Calculated Volume (mil gals)	15% Vol. >7 ft (mil gals)	Fish Caught[1]	Fish Concern	Volume Available (mil gals)
W2.1	L9306	64.0	10.2	70.2	3.3	BDWF,LSCS	Yes	3.3
W3.1	L9341b	4.1	19.3	62.3	6.0	BDWF,LSCS	Yes	6.0
W5.1	L9323	84.1	11.0	99.4	5.4	BDWF,LSCS,RDWF	Yes	5.4
W5.2	L9324	126.1	13.0	176.3	12.2	BDWF,LSCS,RDWF	Yes	12.2
W5.3	M9929	11.5	13.8	17.1	1.3	LSCS	Yes	1.3
X3.1	L9808	5.0	14.2	7.7	0.6	GRAY	Yes	0.6
X4.1	L9902	15.7	16.6	28.1	2.4	BDWF,LSCS	Yes	2.4
X4.2	L9901	16.3	25.0	43.7	4.7	BDWF,LSCS	Yes	4.7
X5.1	B8531	295.6	13.2	419.5	29.6	BDWF,LSCS,BKFH	Yes	29.6
X5.2	L9325	32.5	17.3	60.5	5.4	BDWF,LSCS	Yes	5.4
X5.3	None	61.2	15.3	100.7	8.2	LSCS	Yes	8.2
X6.2	L9328	41.6	13.2	59.1	4.2	BDWF,LSCS	Yes	4.2
Y6.3	L9327	202.3	13.0	282.8	19.6	BDWF,LSCS	Yes	19.6

[1] 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. Evaluated lakes in or near the CD-South exploration area.

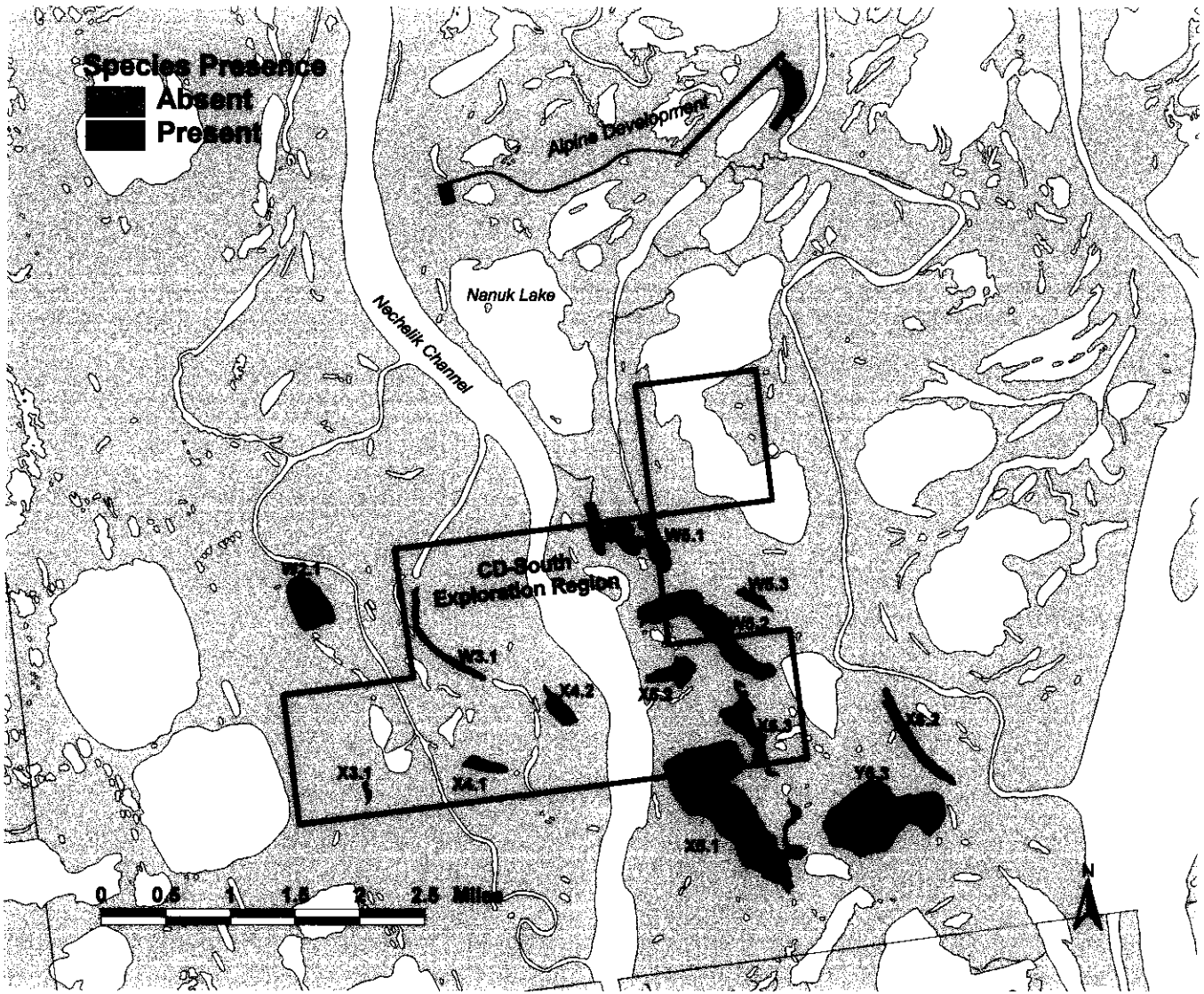


Figure 2. Distribution of least cisco in lakes in or near the CD-South exploration area.

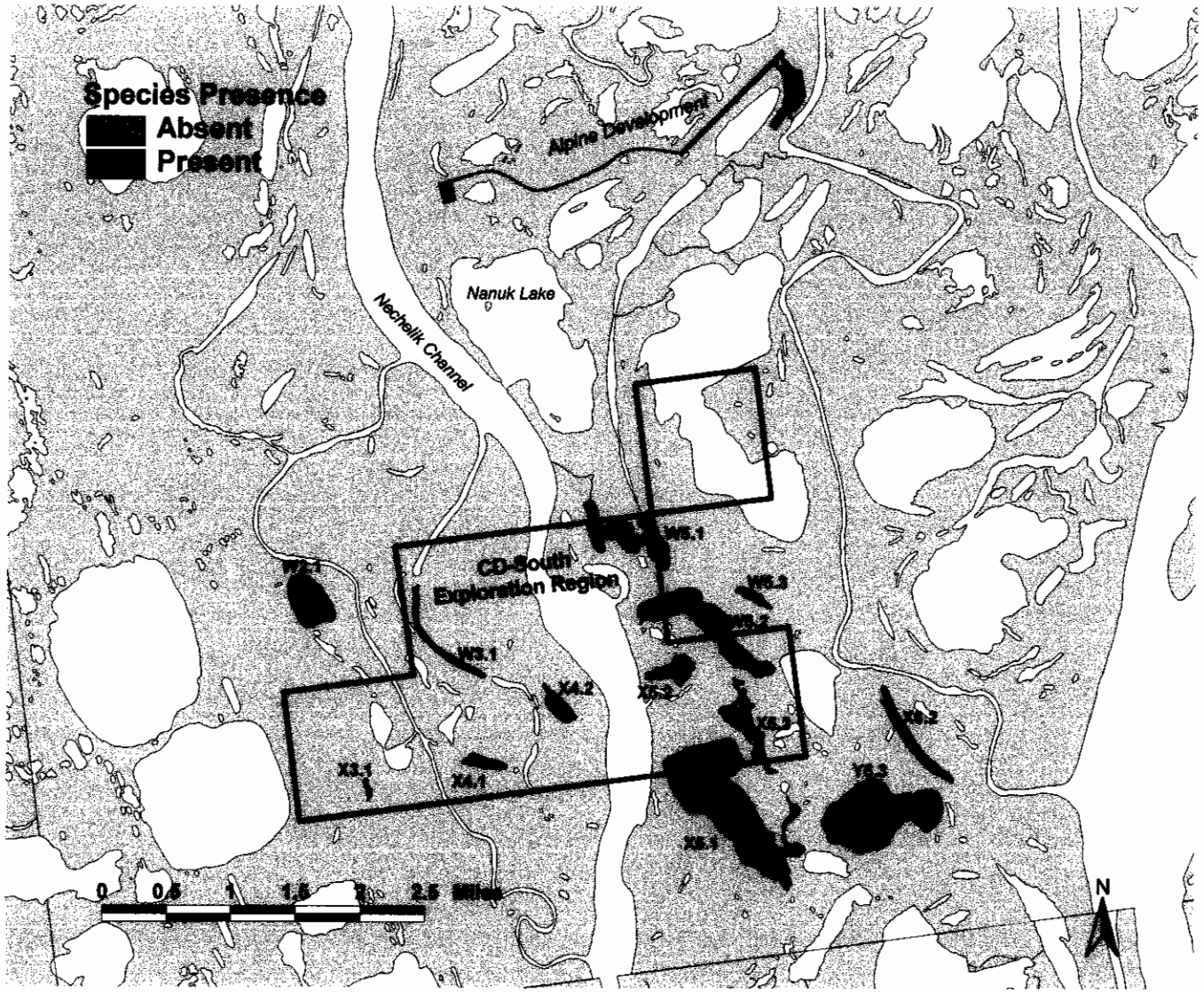


Figure 3. Distribution of broad whitefish in lakes in or near the CD-South exploration area.

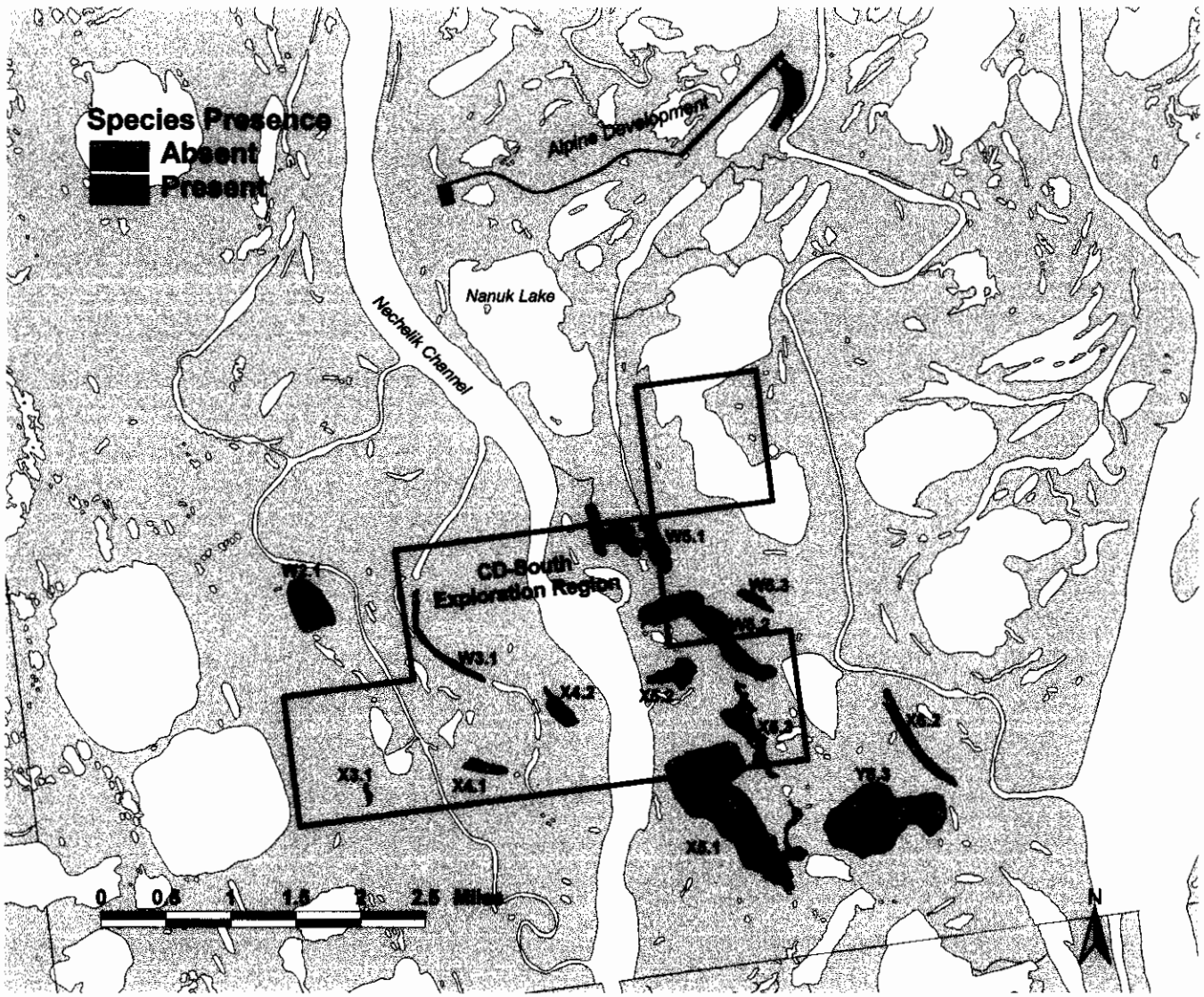


Figure 4. Distribution of round whitefish in lakes in or near the CD-South exploration area.

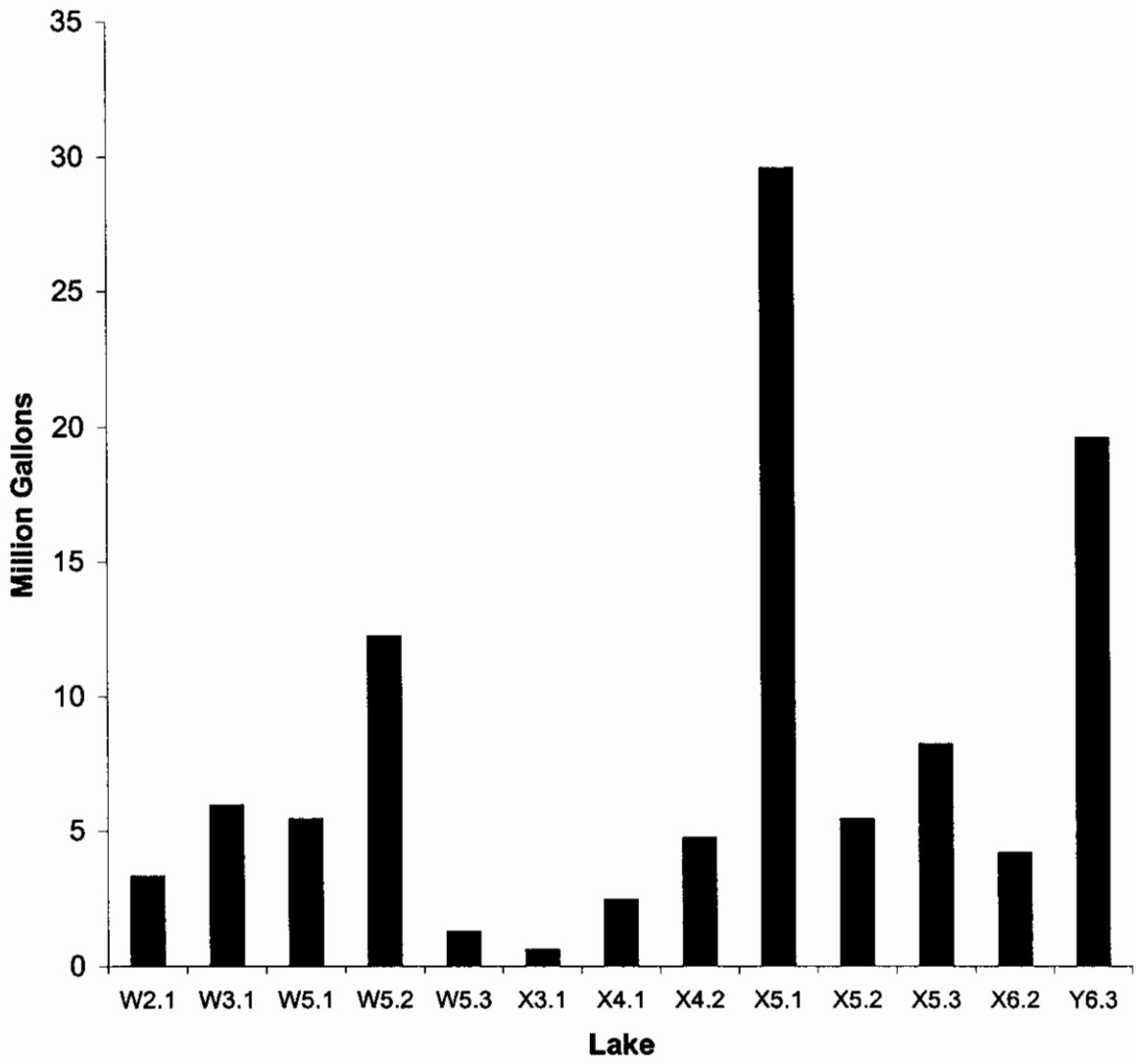
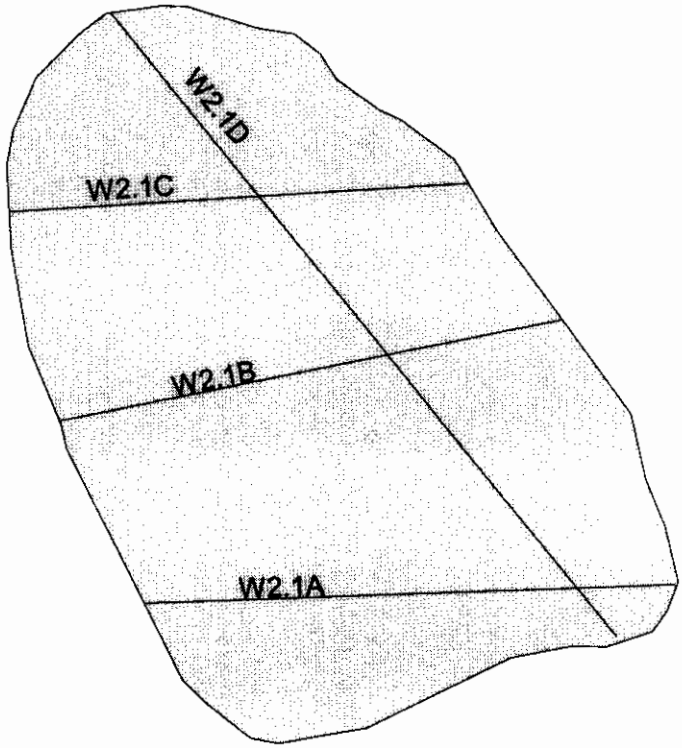
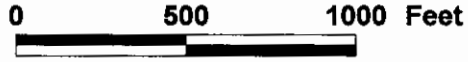


Figure 5. Estimated maximum volumes of water likely to be permitted for winter withdrawal from lakes in or near the CD-South exploration area

LAKE SUMMARIES

W2.1
(L9306





Lake W2.1

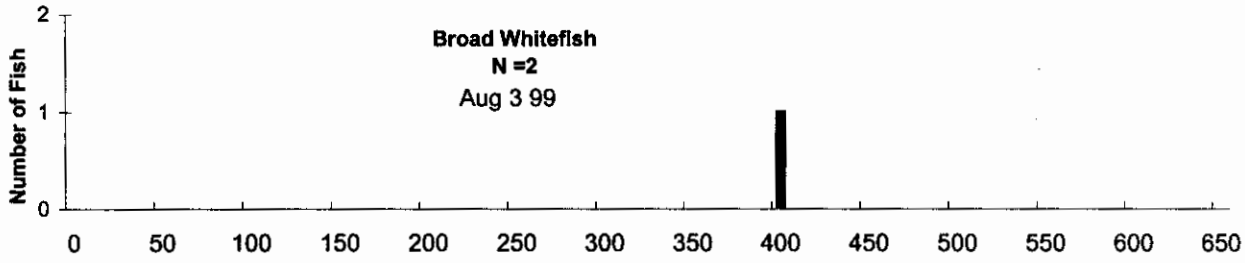
Other Names:	L9306
Location:	70°17.73'N 151°06.28'W
USGS Quad Sheet:	Harrison Bay B-2: T11N R4E Sect. 22
Habitat:	Perched Lake (Frequent Flooding)
Area:	64 acres
Maximum Depth:	10.2 feet
Active Outlet:	
Spec. Conductance:	145 µS/cm
pH:	8.0
Calculated Volume:	70.2 million gallons
Permittable Volume:	3.3 million gallons

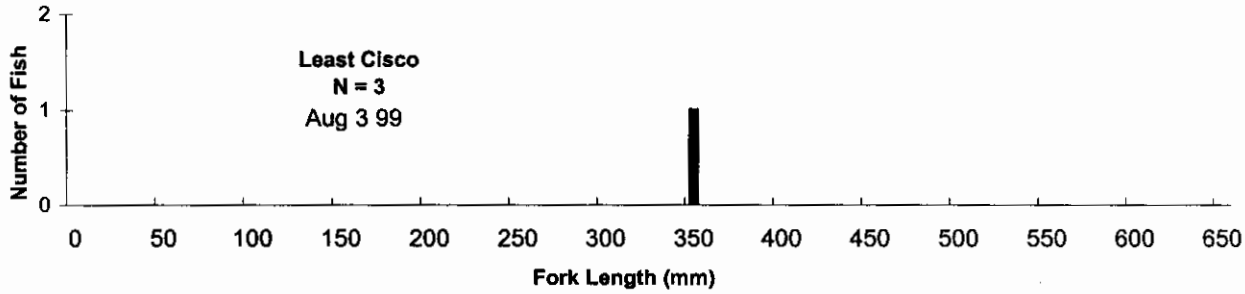
Water Quality:

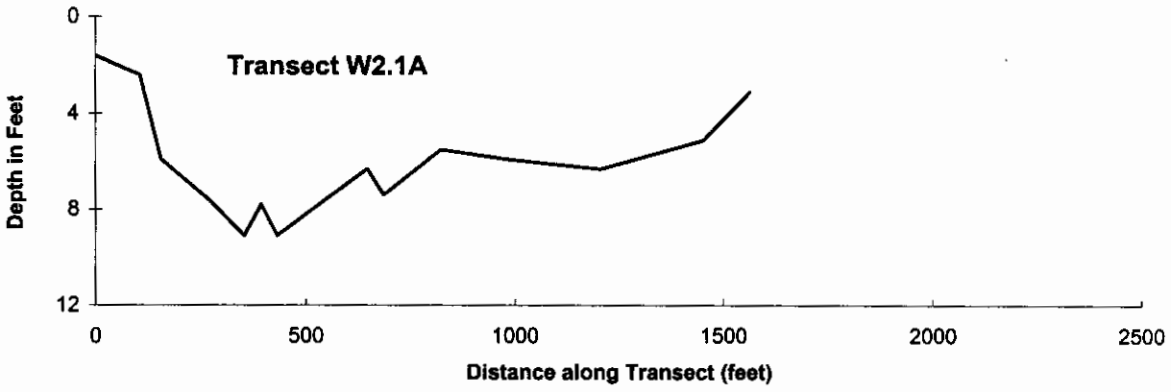
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	25.0	13.0	6	2.3	24	110	J. Lobdell
1998	21.1	9.5	7.3	3.1	31.1	68	J. Lobdell
1999	22.1	13.7	8.6	4	38	70	J. Lobdell

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 3 99	6.7	Broad whitefish	2	131, 433
			Least cisco	3	337-360



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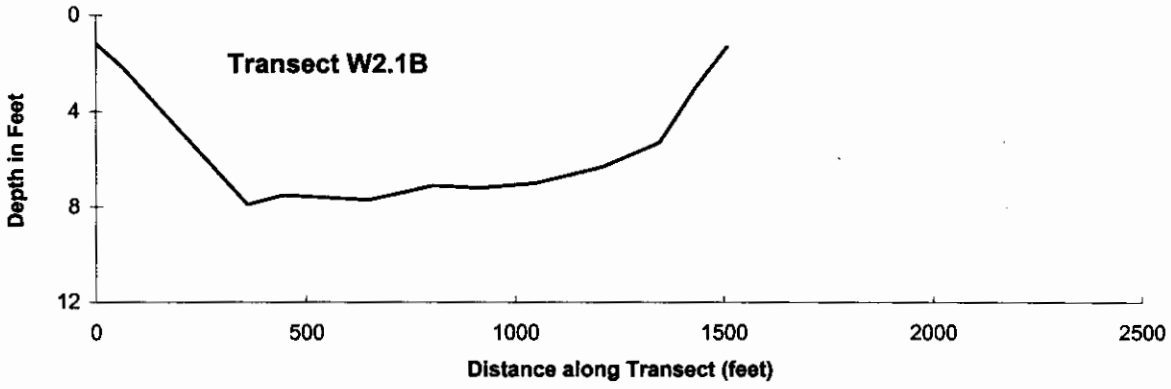
Distance along Transect (feet)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2500
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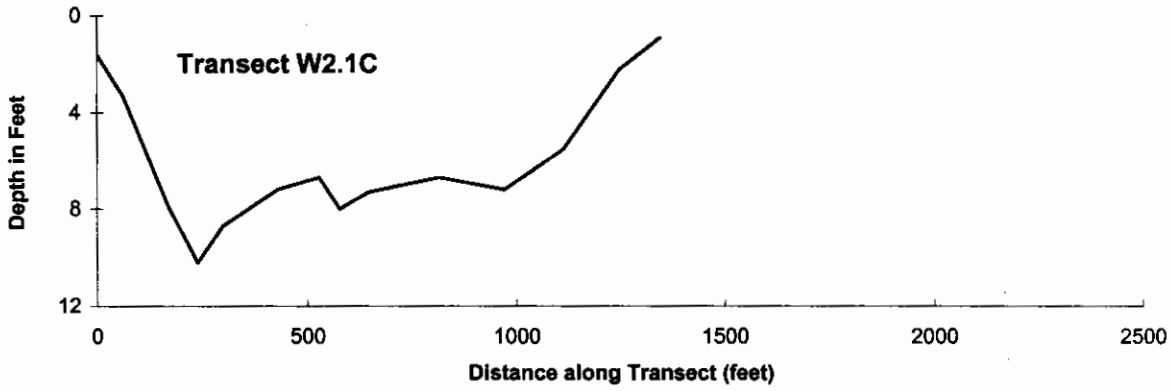
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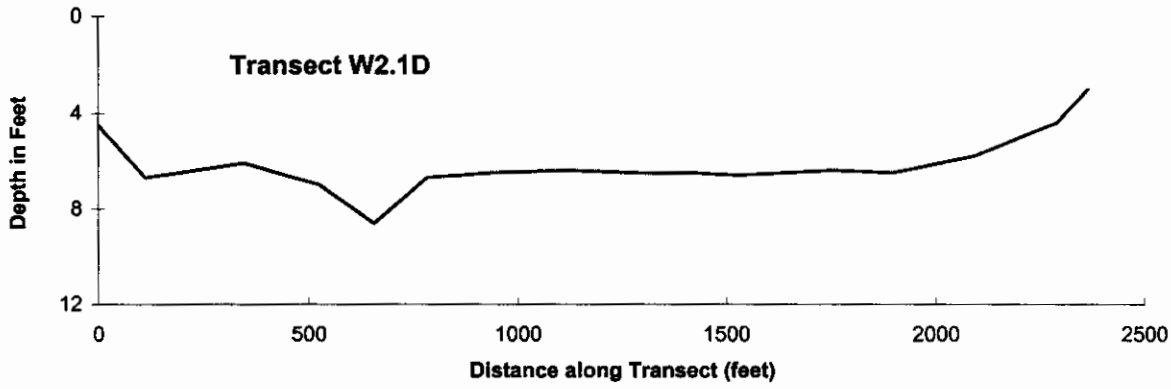
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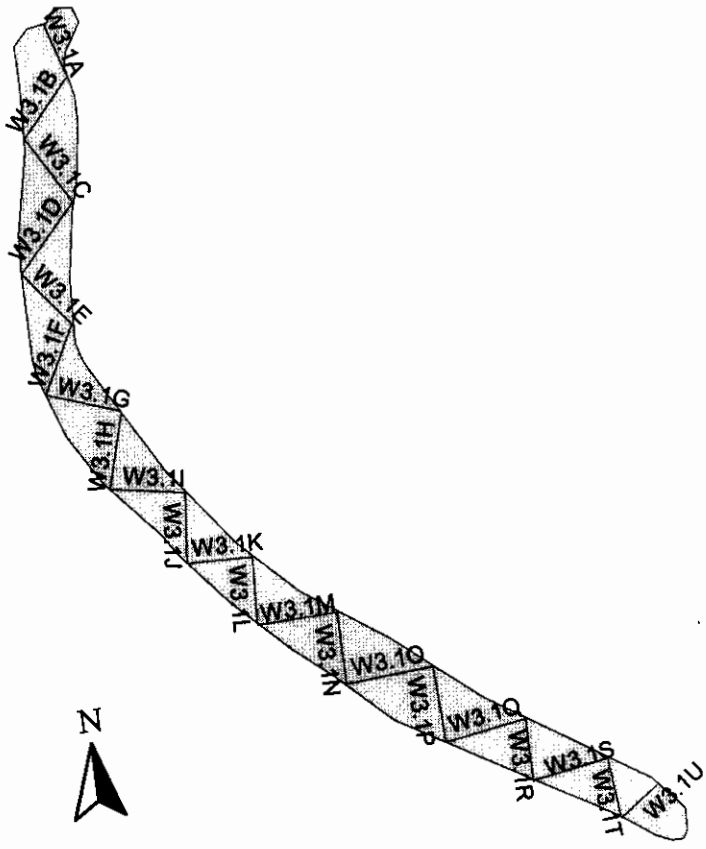
W3.1
(L9341b)



0 500 1000 1500 2000 Feet

Lake W3.1

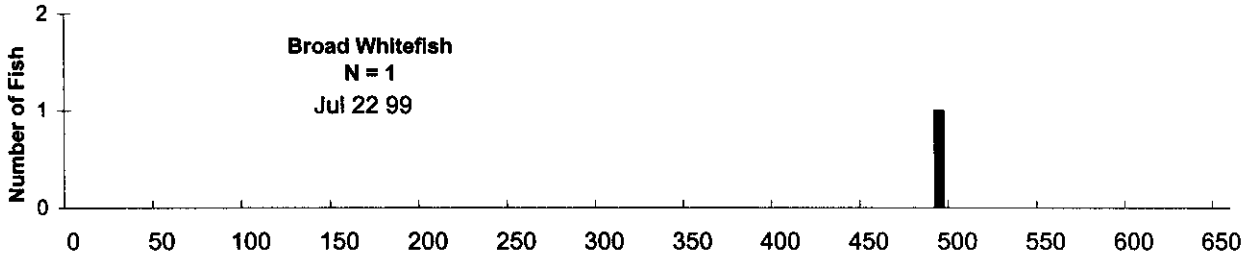
Other Names: L9341b
Location: 70°17.35'N 151°04.05'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4E Sect. 23
Habitat: Perched lake (frequent flooding)
Area: 30 acres
Maximum Depth: 19.3 feet
Active Outlet:
Spec. Conductance: 167 µS/cm
pH: 7.9
Calculated Volume: 62.3 million gallons
Permittable Volume: 6.0 million gallons

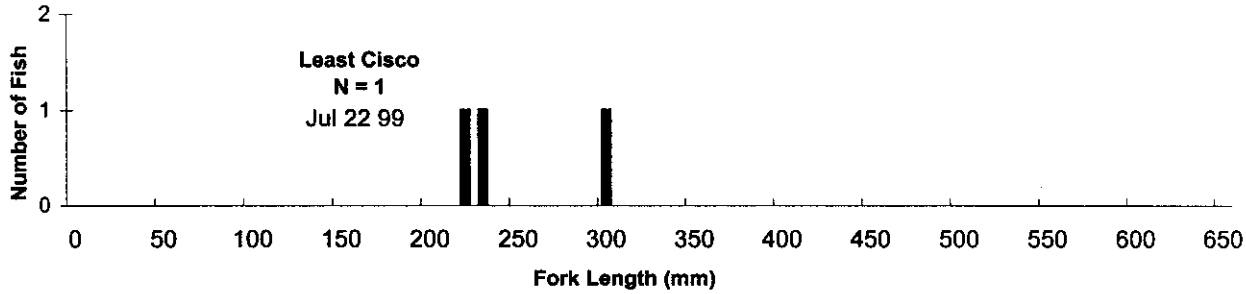
Water Quality:

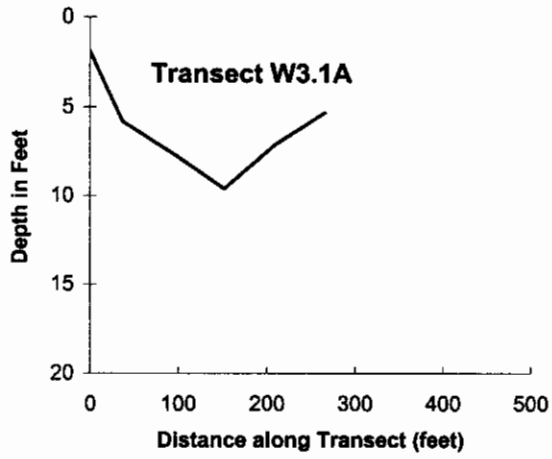
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	15	6.8	7.5	2.8	30	67	J. Lobdell

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 22 99	1.4	Broad whitefish	1	408
			Least cisco	1	355



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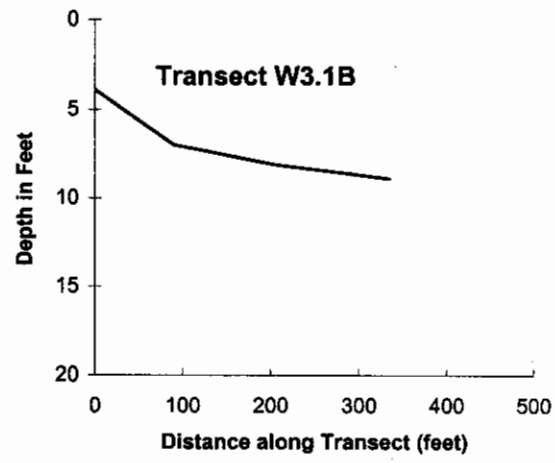
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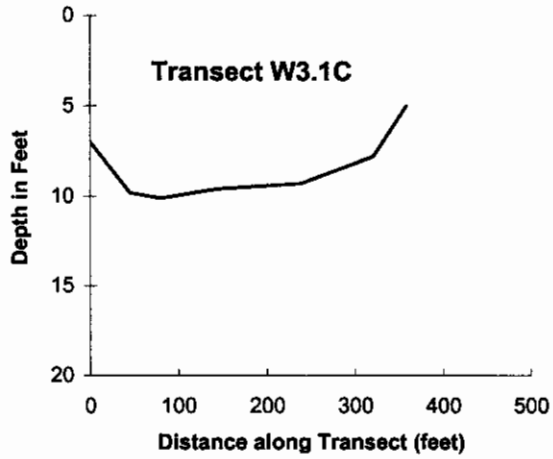
500
Distance along Transect (feet)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100
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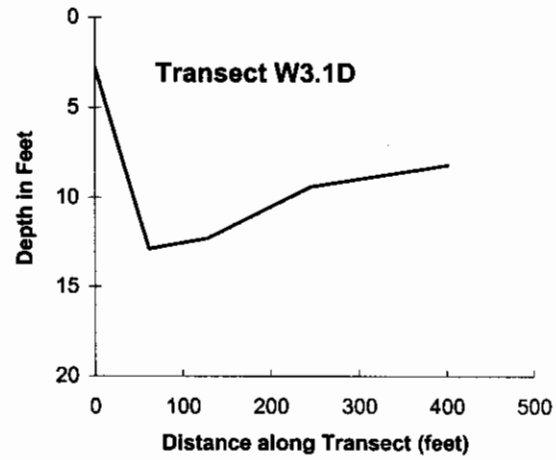
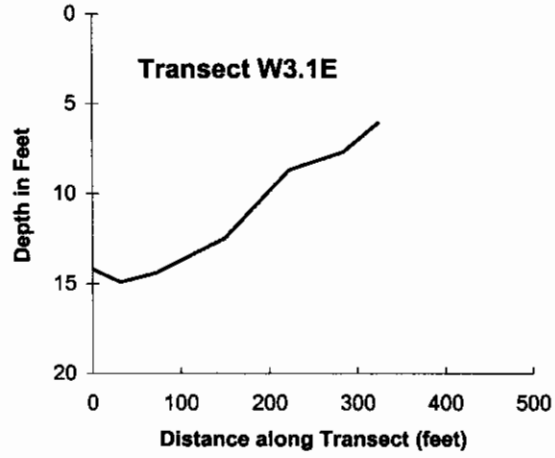
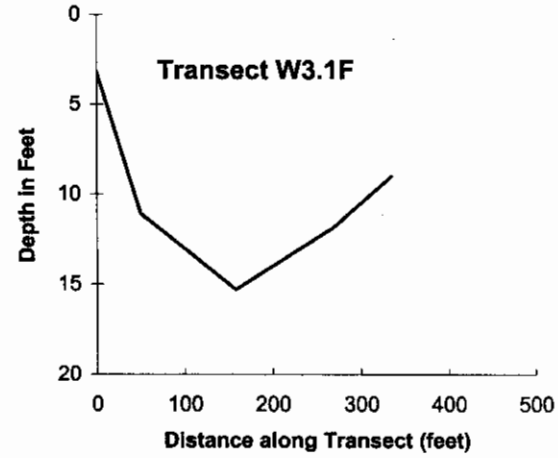
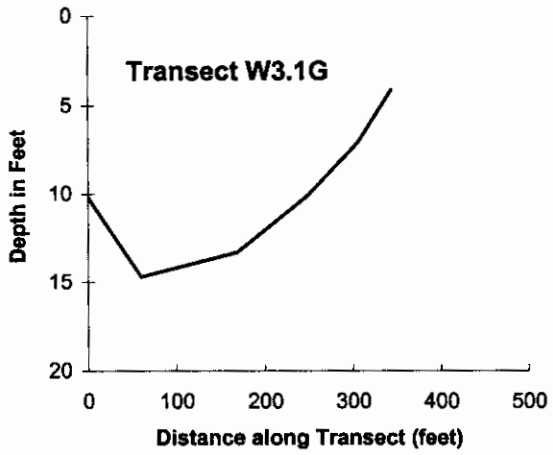
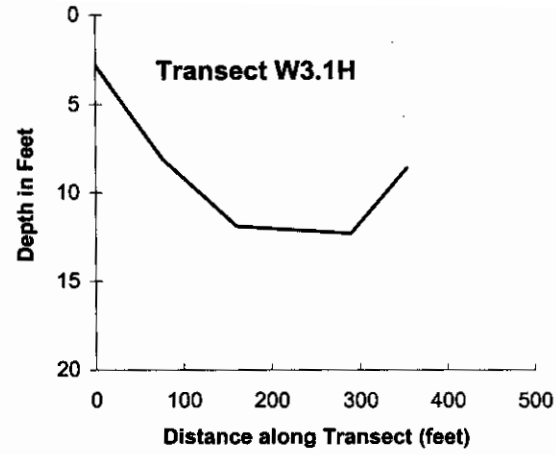
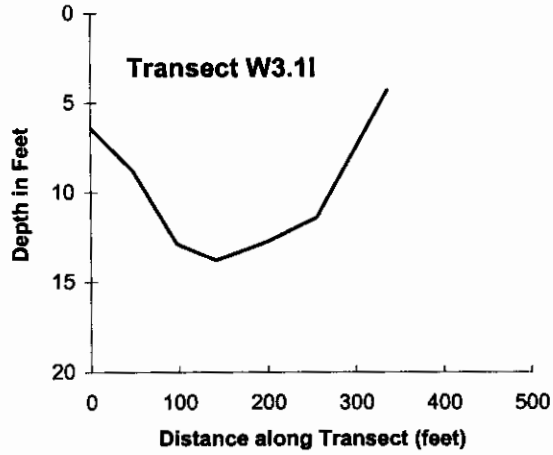

Transect W3.1D
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

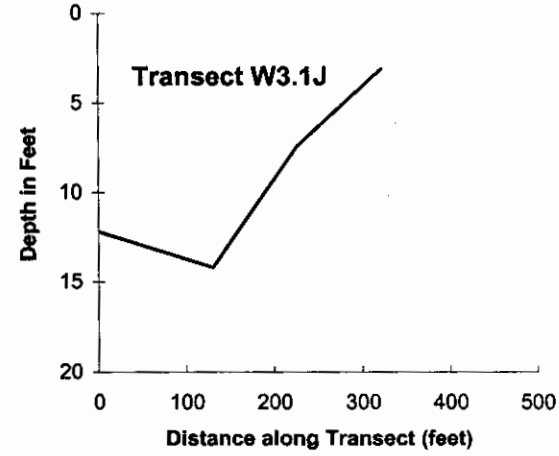

Transect W3.1E
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

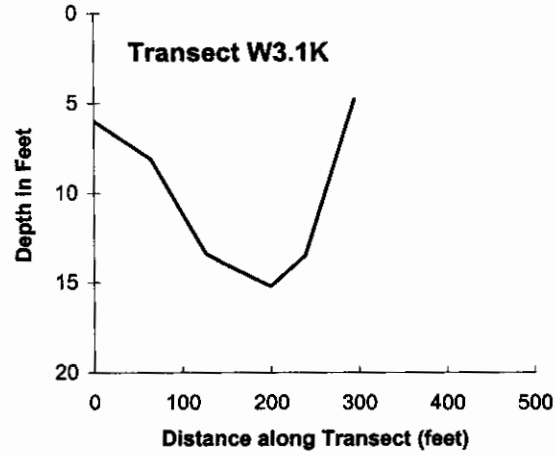

Transect W3.1F
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

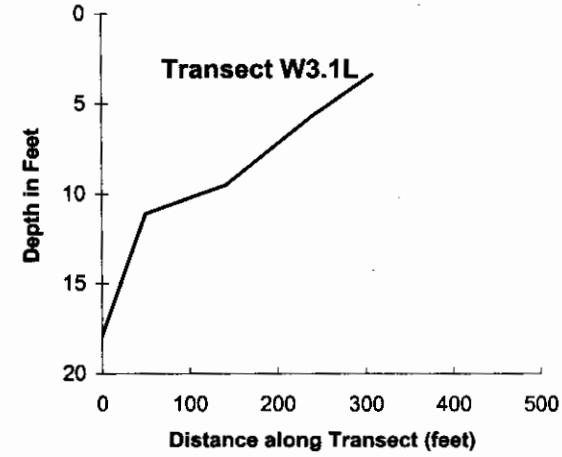

Transect W3.1G
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

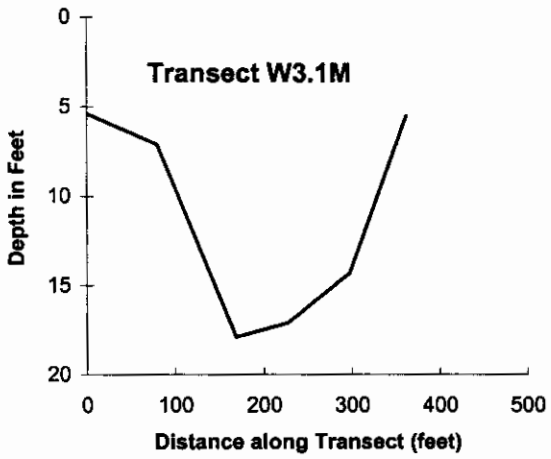

Transect W3.1H
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

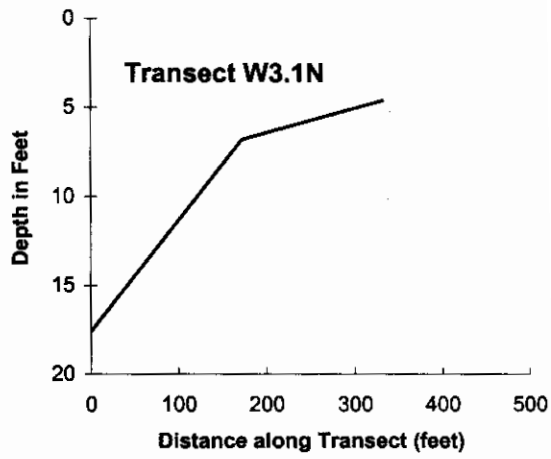

Transect W3.1I
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

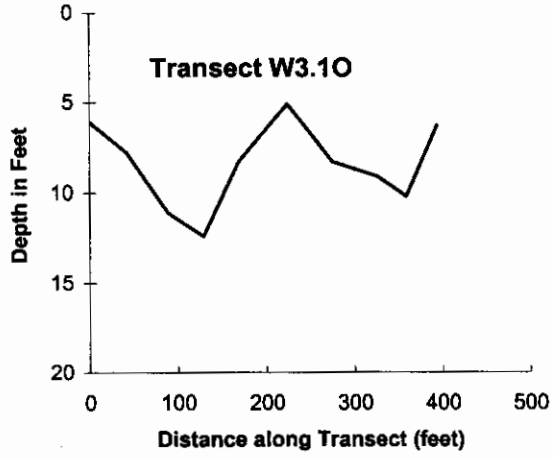

Transect W3.1J
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

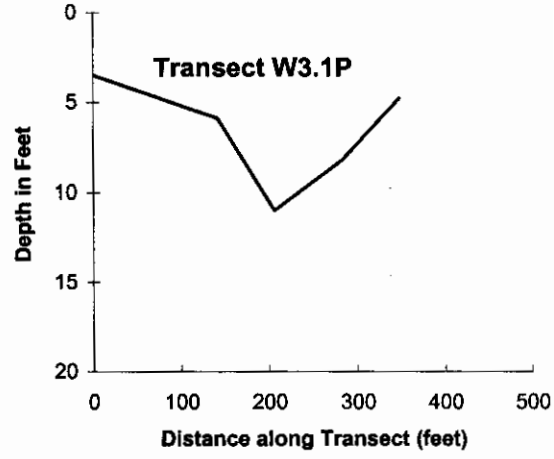

Transect W3.1K
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

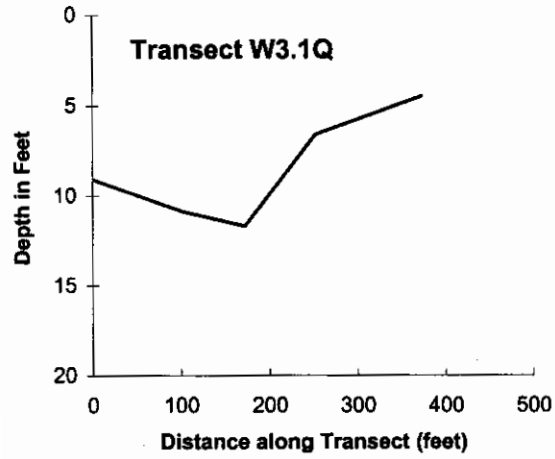

Transect W3.1L
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

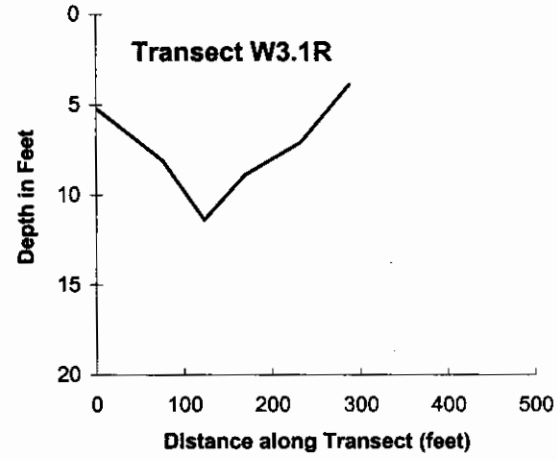

Transect W3.1M
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

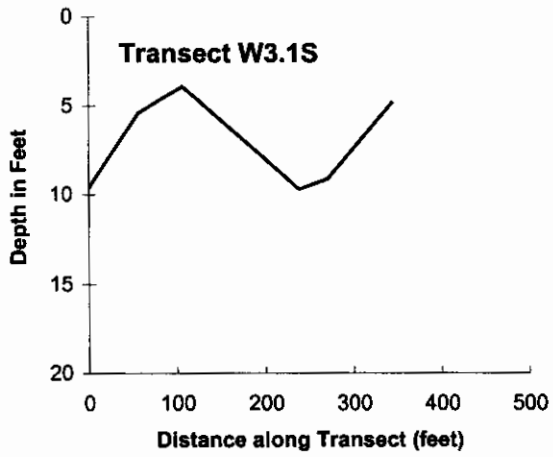

Transect W3.1N
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

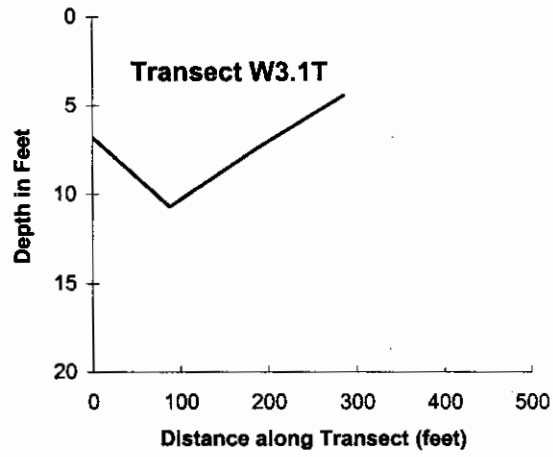

Transect W3.1O
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

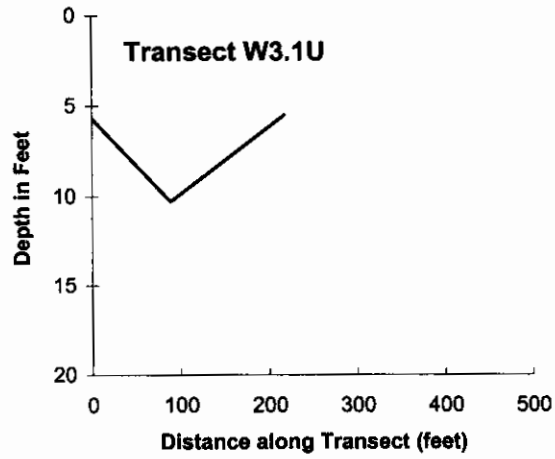

Transect W3.1P
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)


Transect W3.1Q
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

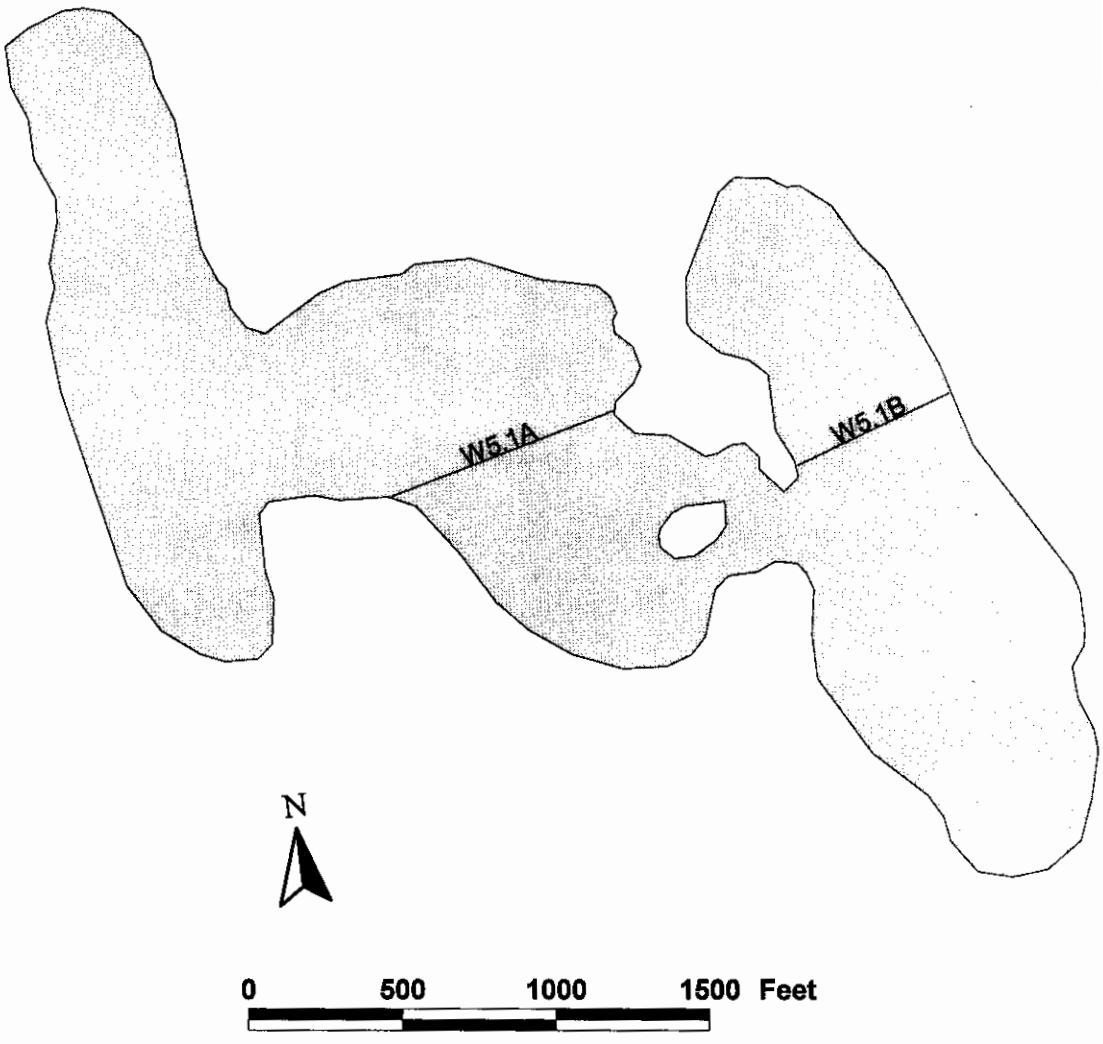

Transect W3.1R
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)


Transect W3.1S
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)


Transect W3.1T
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)


Transect W3.1U
Depth in Feet
0
5
10
15
20
0
100
200
300
400
500
Distance along Transect (feet)

W5.1
(L9323)



Lake W5.1

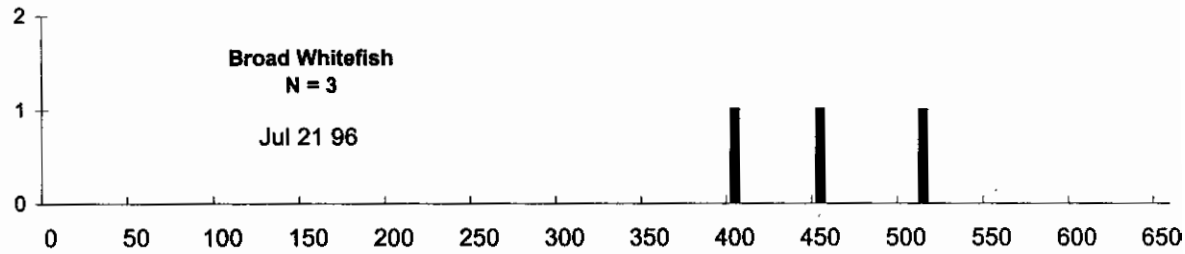
Other Names: L9323
Location: 70°17.93'N 150°59.80'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4E, Sect 24
Habitat: Perched Lake (Infrequent Flooding)
Area: 84 acres
Maximum Depth: 11.0 feet
Active Outlet: No
Spec. Conductance: 74 µS/cm
Calculated Volume: 99.4 million gallons
Permittable Volume: 5.4 million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

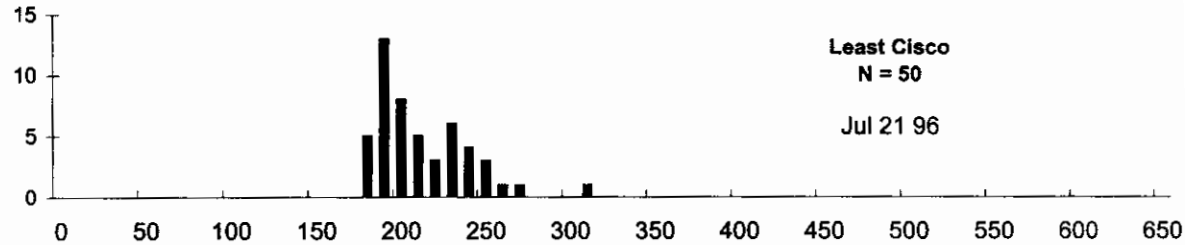
Water Quality:

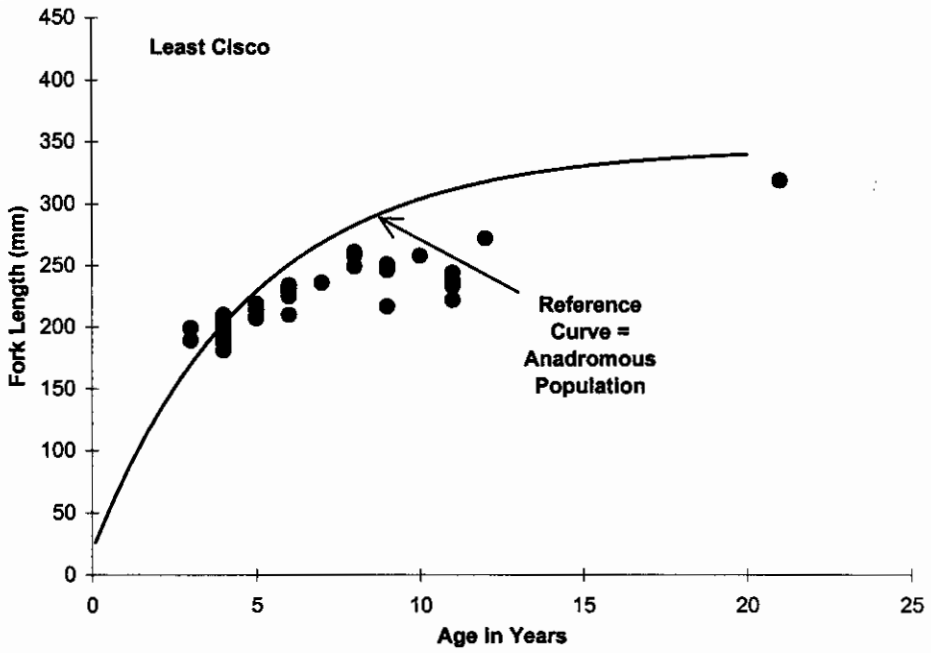
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	4	2.8	1.5	4.3	17	53	J. Lobdell

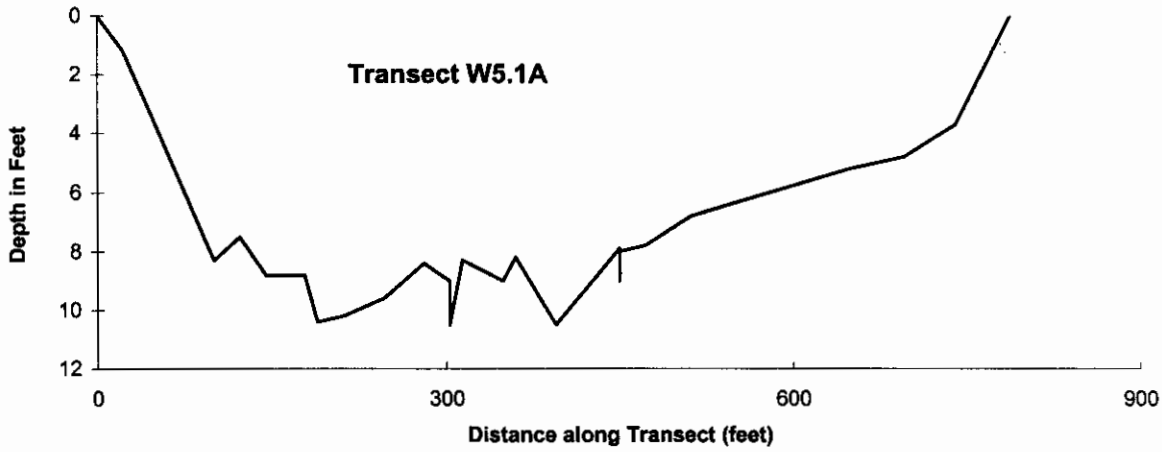
Catch Record:

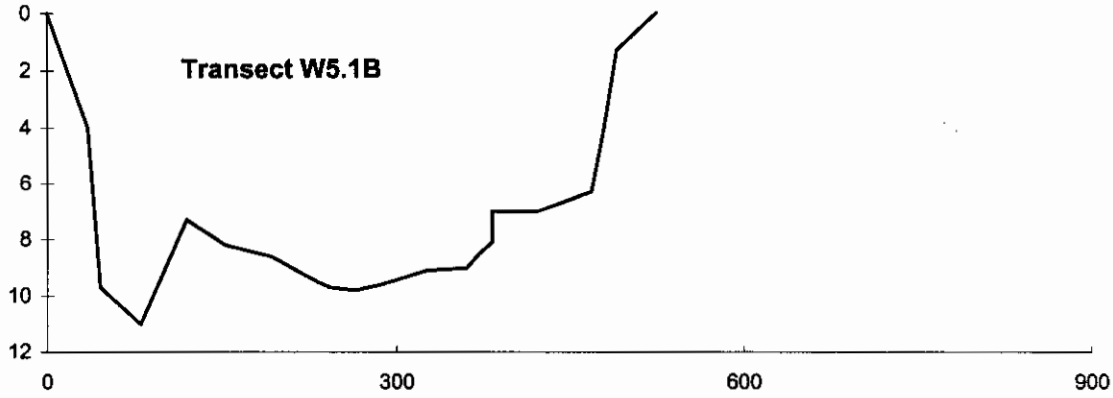
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 96	5.6	Broad whitefish	3	400-512
			Least cisco	50	181-319
			Round whitefish	1	217
Gill Net	Jul 27 99	6.1	Broad whitefish	1	495
			Least cisco	3	227-305
			Round whitefish	1	153



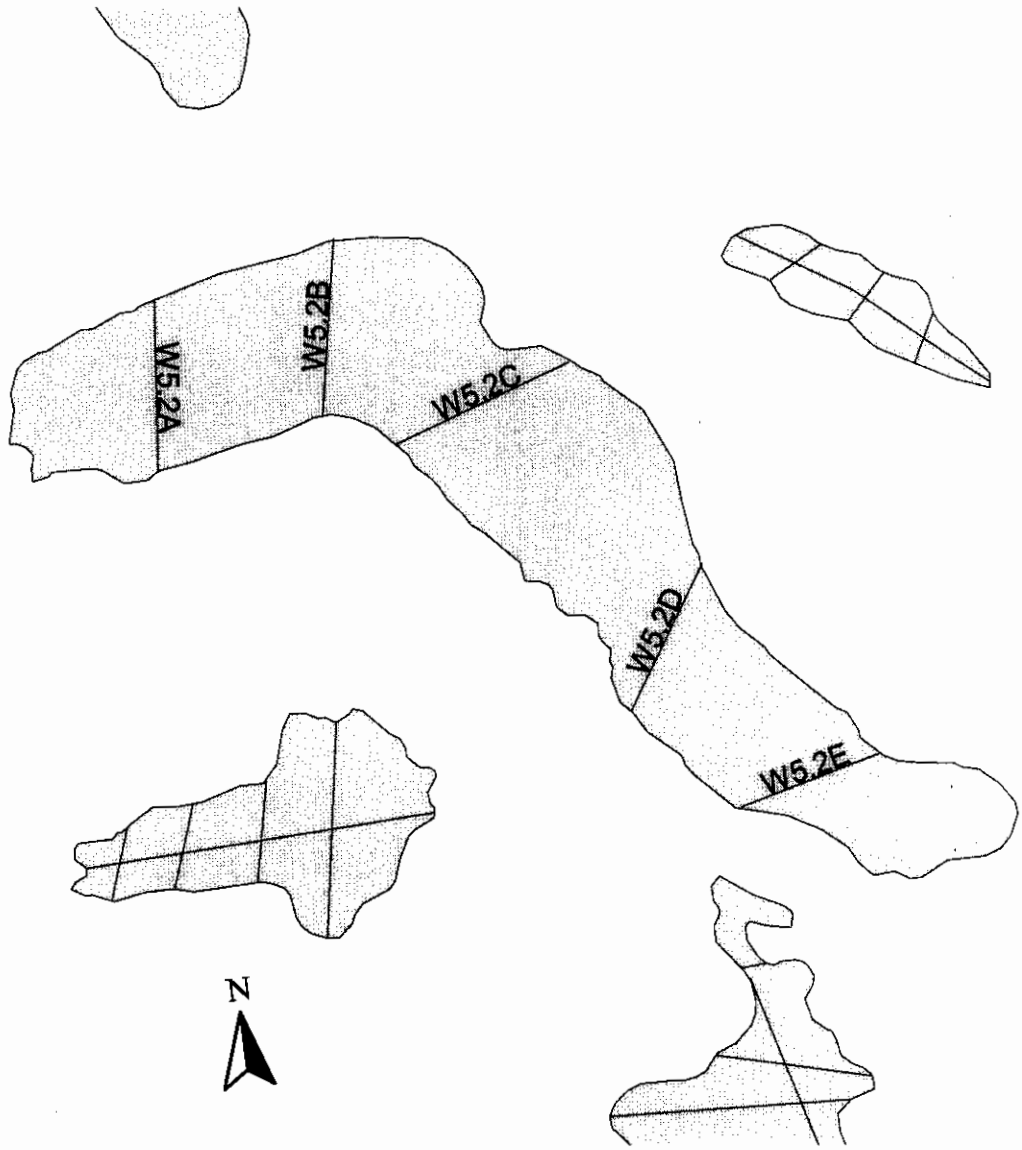



Least Cisco
Fork Length (mm)
Age in Years
Reference Curve = Anadromous Population
0
50
100
150
200
250
300
350
400
450
0
5
10
15
20
25


Transect W5.1A
Depth in Feet
Distance along Transect (feet)
0
2
4
6
8
10
12
0
300
600
900


Transect W5.1B
0
2
4
6
8
10
12
0
300
600
900

W5.2
(L9324)



Lake W5.2

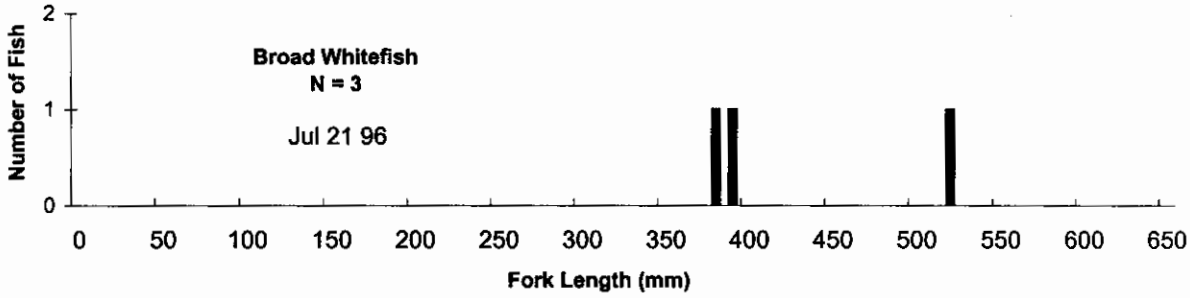
Other Names: L9324
Location: 70°17.24'N 150°58.16'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E, Sect 19-30
Habitat: Perched Lake (Frequent Flooding)
Area: 126 acres
Maximum Depth: 13.0 feet
Active Outlet: Yes
Spec. Conductance: 55 µS/cm (1996)
85 µS/cm (1999)
pH: 8.2
Calculated Volume: 176.3 million gallons
Permittable Volume: 12.2 million gallons

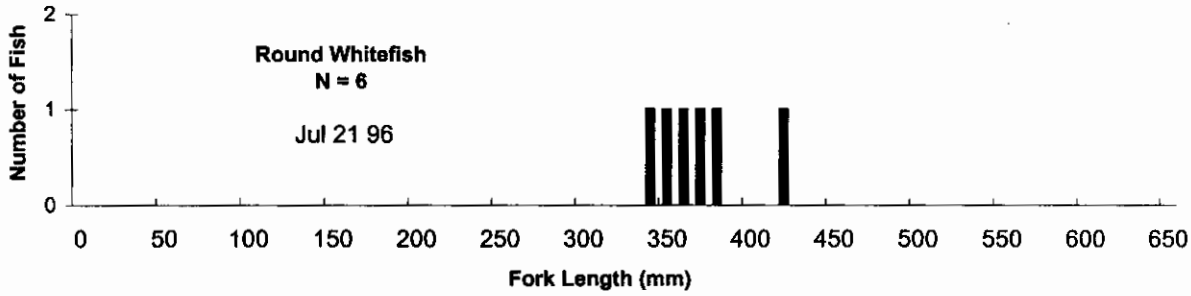
Water Quality:

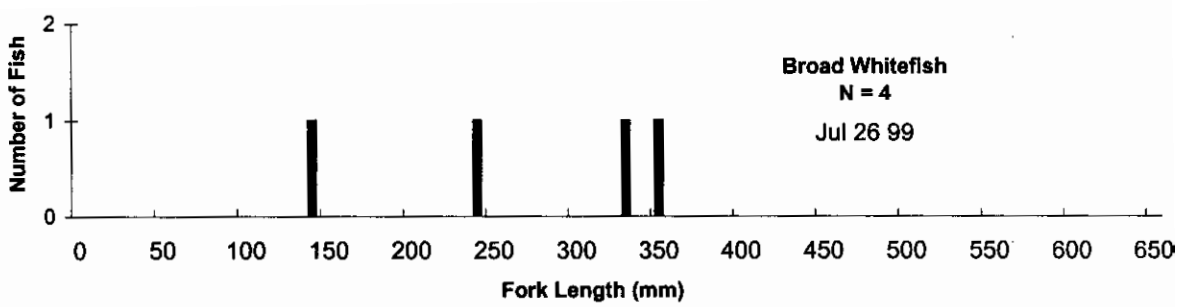
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	2	1.7	1.5	5.3	19	95	J. Lobdell

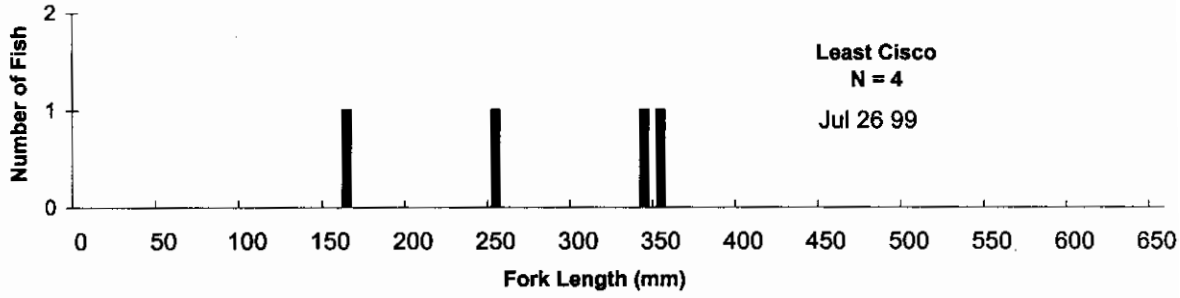
Catch Record:

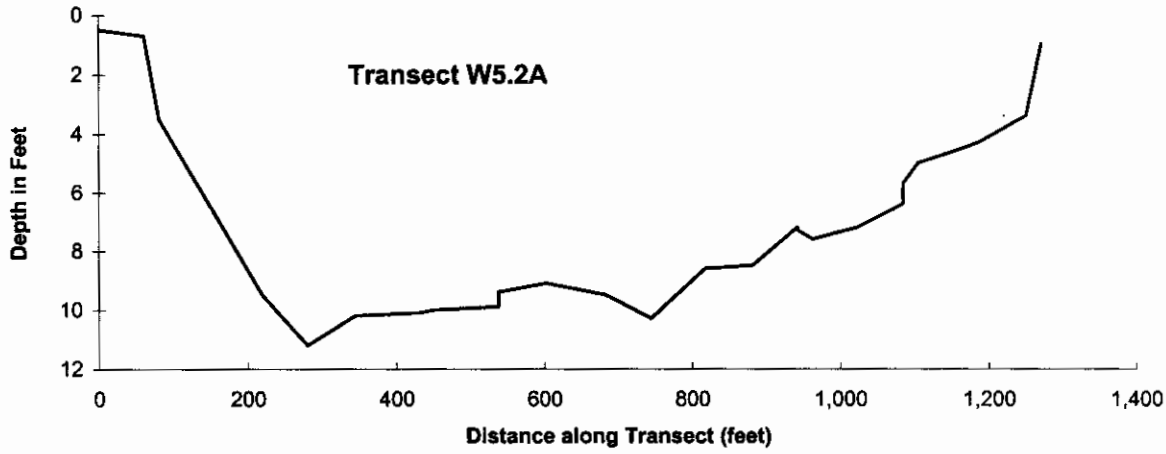
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 96	11.5	Broad whitefish	3	382-528
			Round whitefish	6	340-429
Gill Net	Jul 25 99	4.7	None	0	
Gill Net	Jul 26 99	7.7	Broad whitefish	4	145-357
			Least cisco	4	166-357

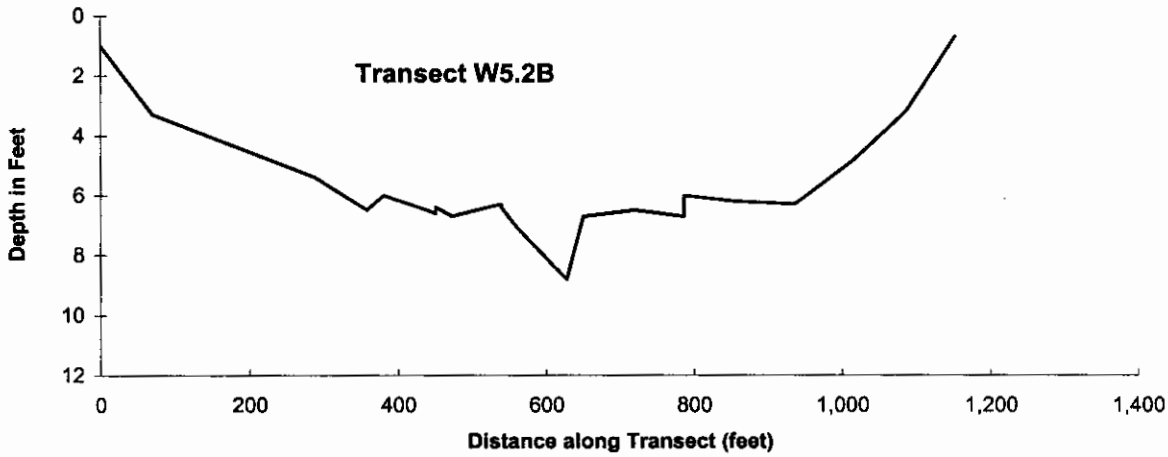


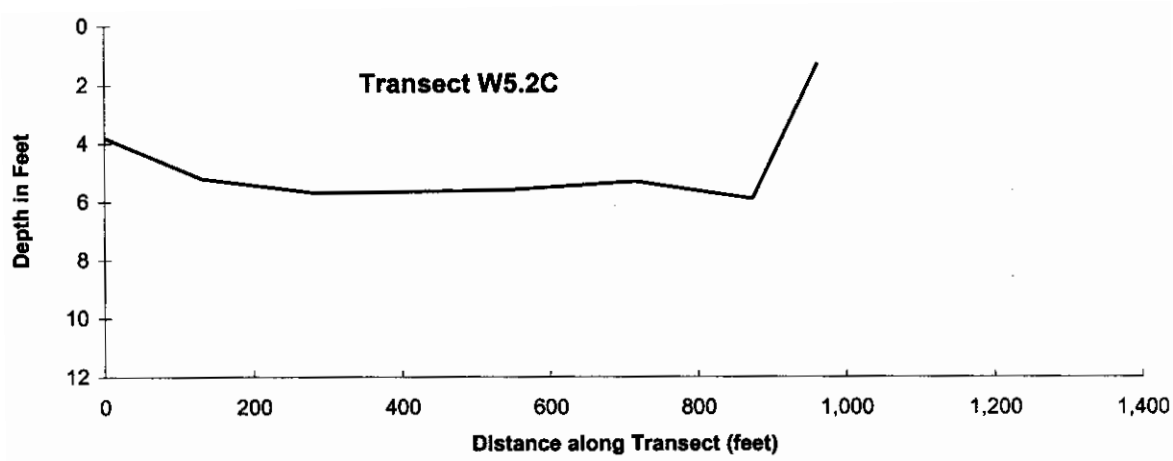


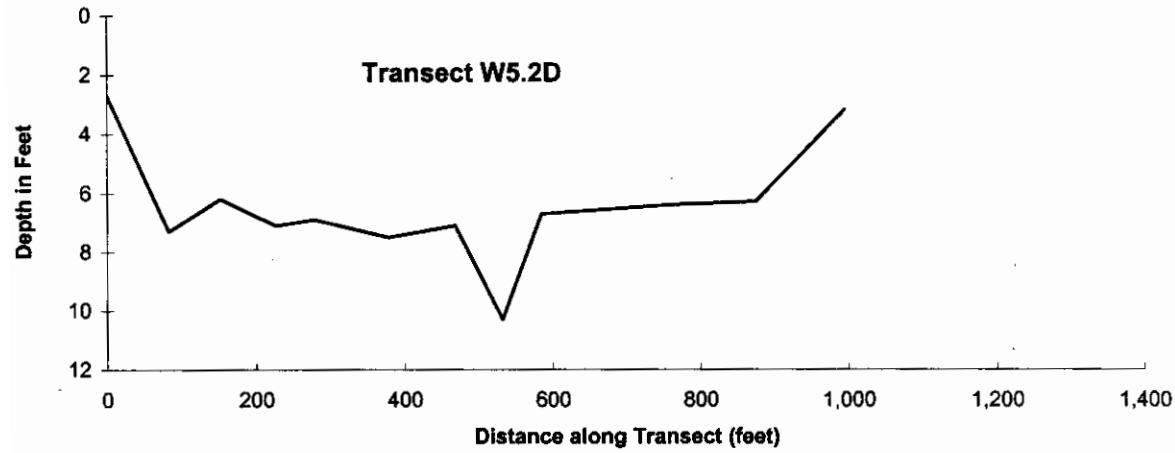

Number of Fish
Broad Whitefish
N = 4
Jul 26 99
Fork Length (mm)

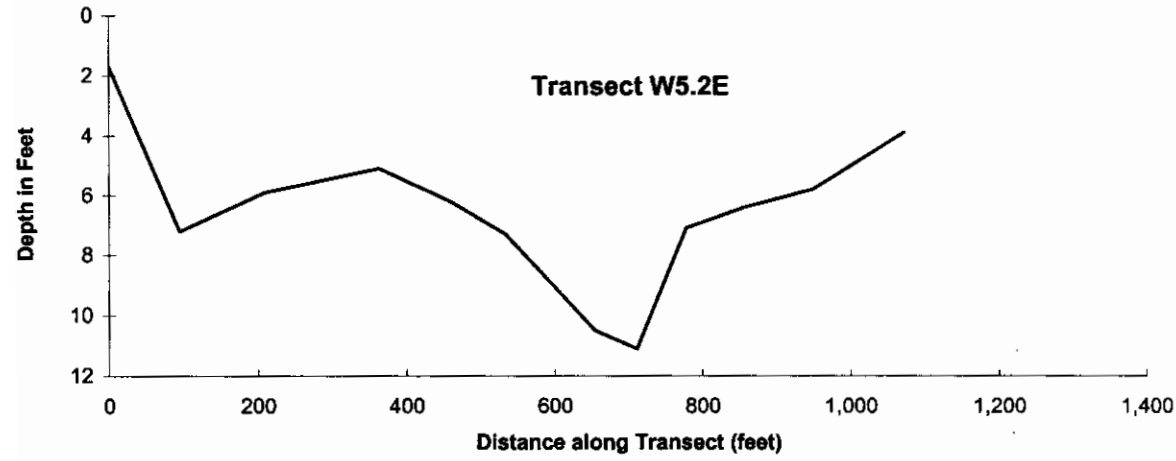

Number of Fish
Least Cisco
N = 4
Jul 26 99
Fork Length (mm)

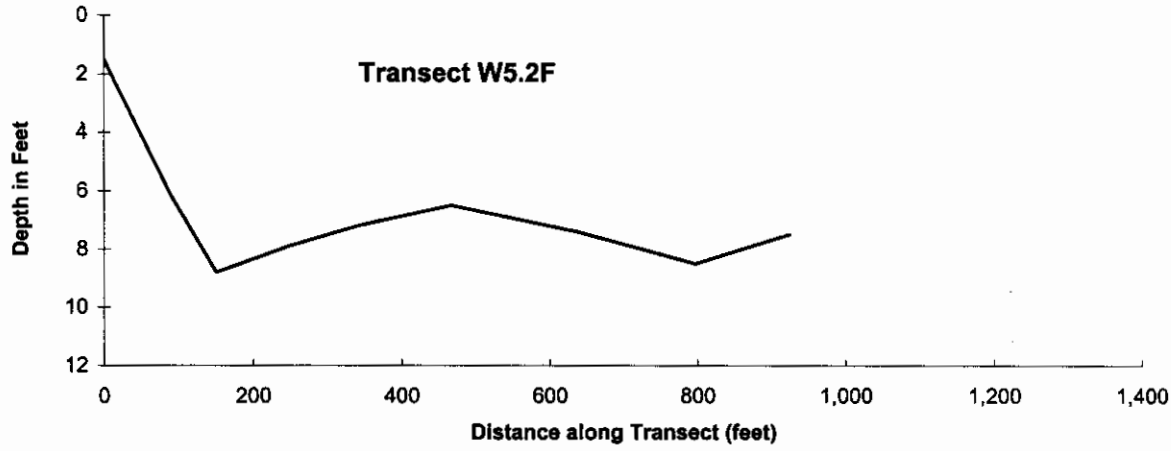

Transect W5.2A
Depth in Feet
Distance along Transect (feet)

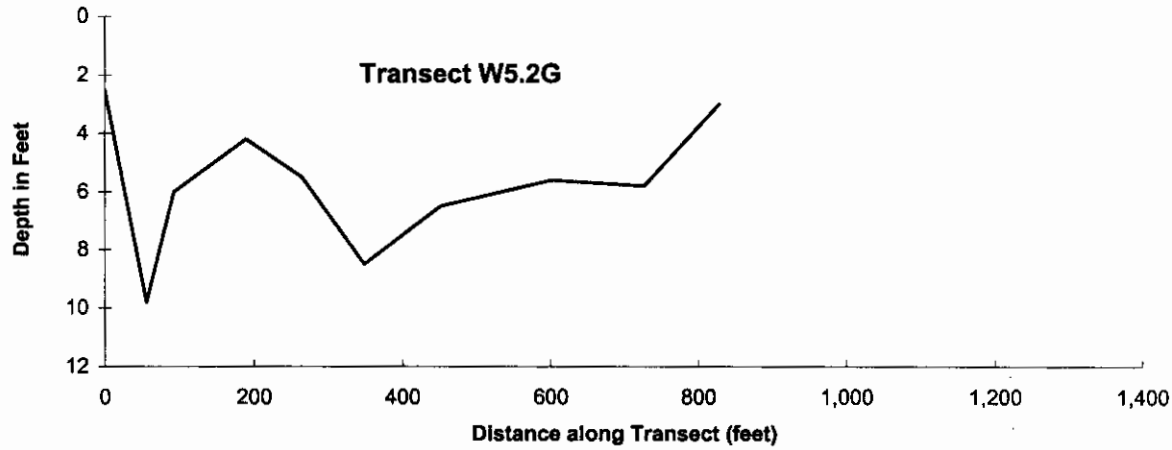

Transect W5.2B
Depth in Feet
Distance along Transect (feet)


Transect W5.2C
Depth in Feet
0
2
4
6
8
10
12
0
200
400
600
800
1,000
1,200
1,400
Distance along Transect (feet)

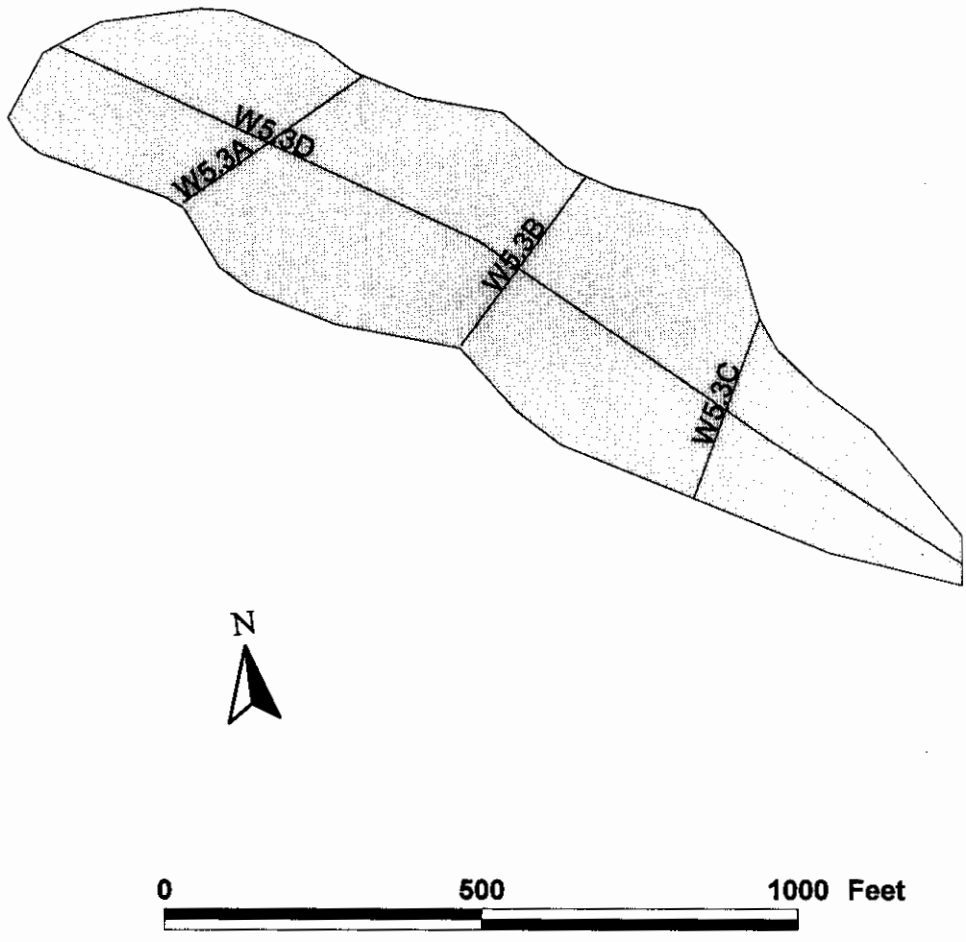

Transect W5.2D
Depth in Feet
0
2
4
6
8
10
12
0
200
400
600
800
1,000
1,200
1,400
Distance along Transect (feet)


Transect W5.2E
Depth in Feet
0
2
4
6
8
10
12
0
200
400
600
800
1,000
1,200
1,400
Distance along Transect (feet)


Transect W5.2F
Depth in Feet
0
2
4
6
8
10
12
0
200
400
600
800
1,000
1,200
1,400
Distance along Transect (feet)


Transect W5.2G
Depth in Feet
0
2
4
6
8
10
12
0
200
400
600
800
1,000
1,200
1,400
Distance along Transect (feet)

W5.3



Lake W5.3

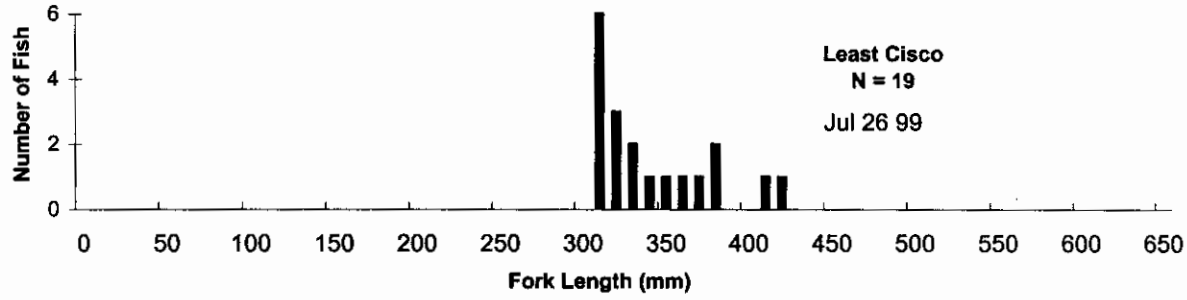
Other Names:	M9929
Location:	70°17.36'N 151°57.50'W
USGS Quad Sheet:	Harrison Bay B-2: T11N R5E Sect. 19
Habitat:	Perched Lake (Infrequent Flooding)
Area:	12 acres
Maximum Depth:	13.8 feet
Active Outlet:	
Spec. Conductance:	108.4 µS/cm
pH:	8.2
Calculated Volume:	17.1 million gallons
Permittable Volume:	1.3 million gallons

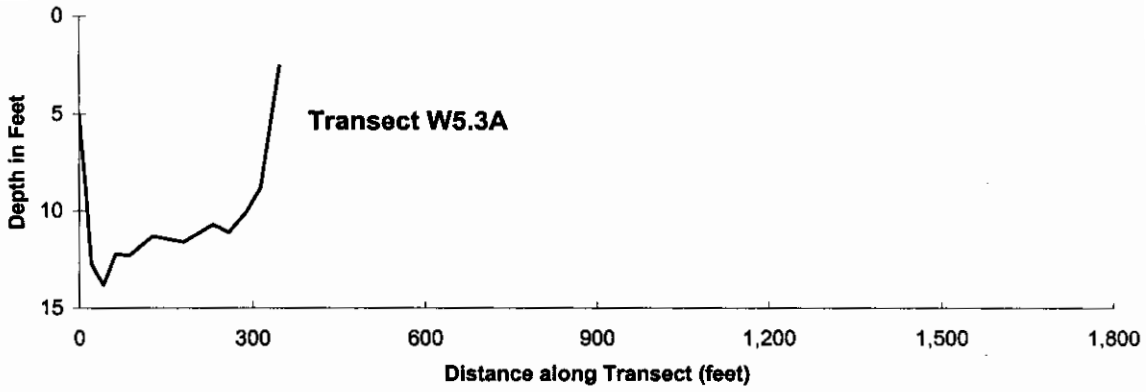
Water Quality:

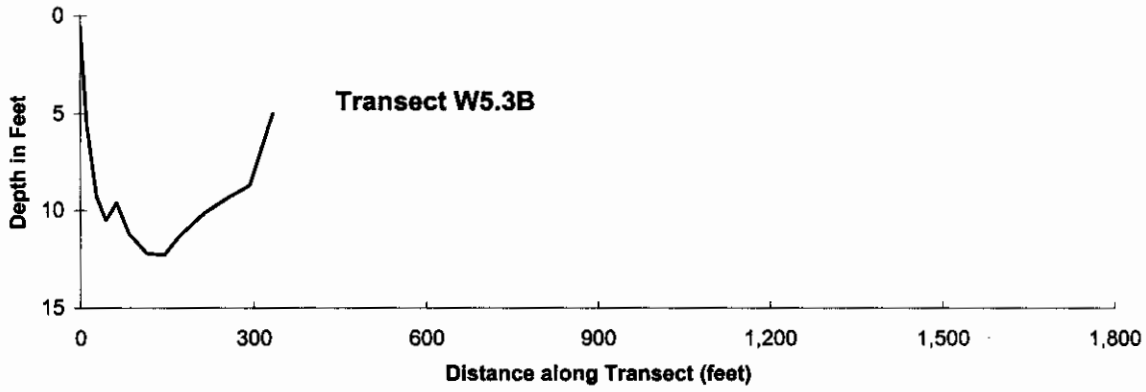
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1999	9.92	4.9	8.92	4.9	42.4	52	this study

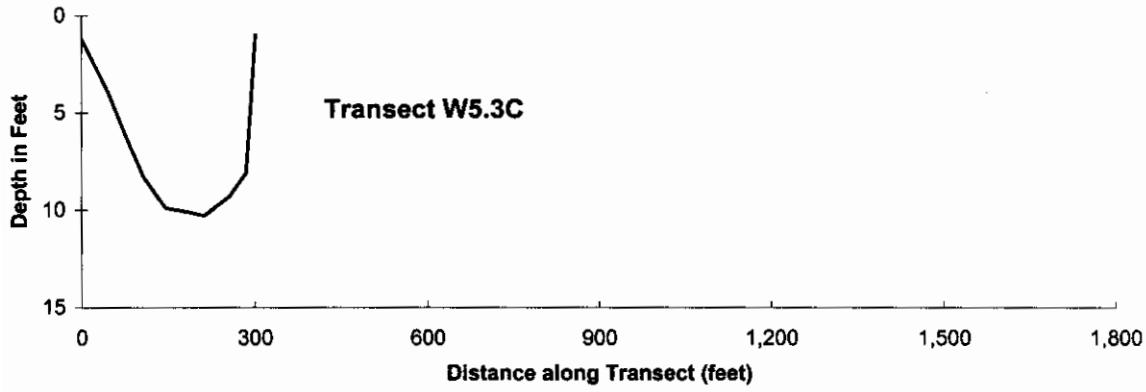
Catch Record:

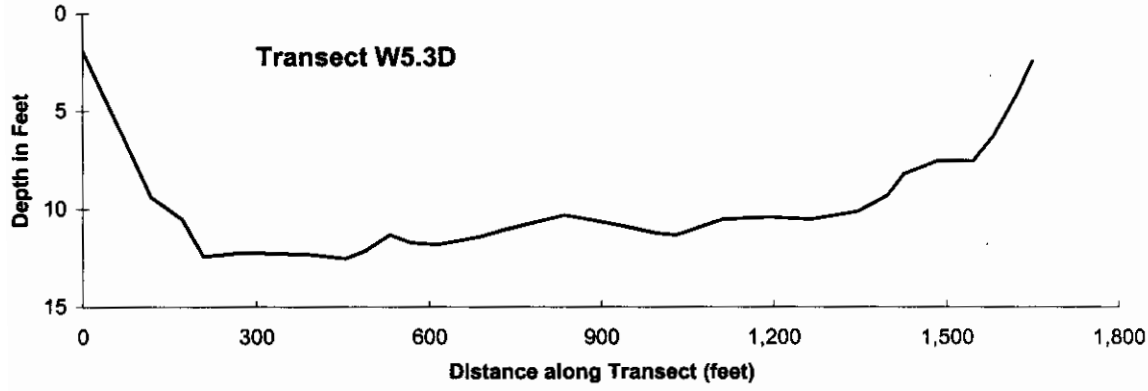
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gillnet	Jul 26 99	2.1	Least cisco	19	310-423



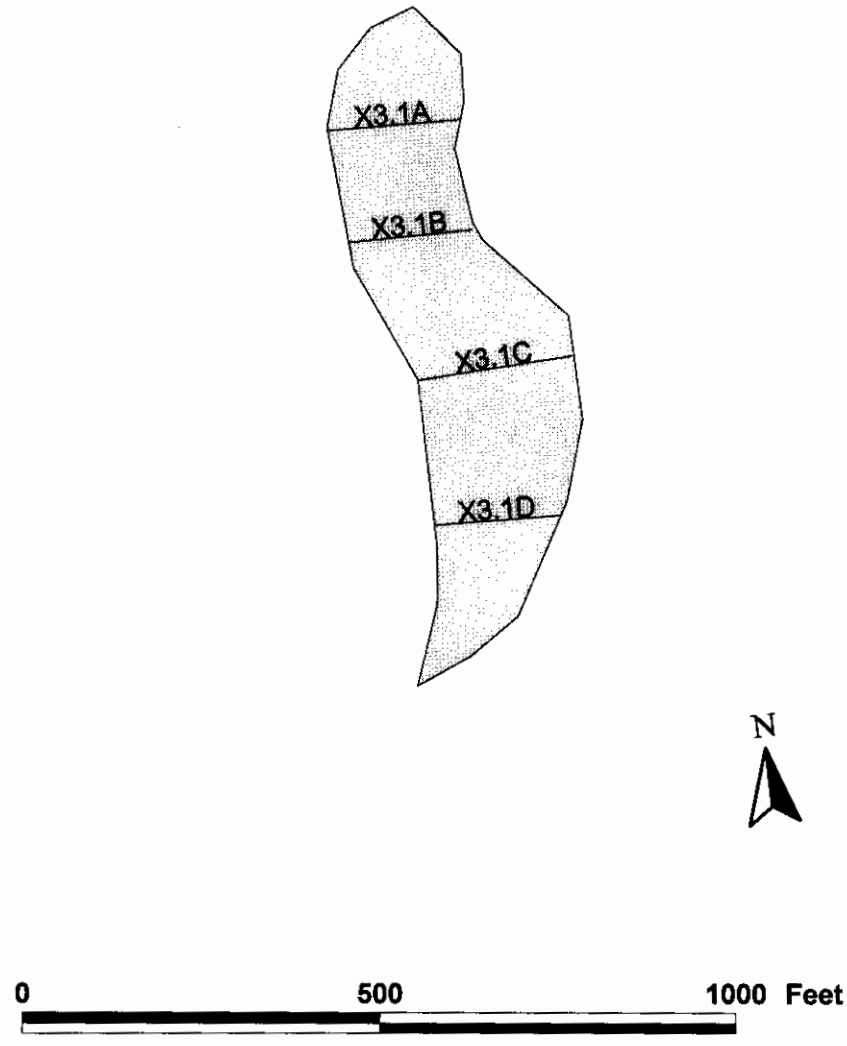

Transect W5.3A
Depth in Feet
0
5
10
15
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)


Transect W5.3B
Depth in Feet
0
5
10
15
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)


Transect W5.3C
Depth in Feet
0
5
10
15
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)


Transect W5.3D
Depth in Feet
0
5
10
15
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)

X3.1
(L9808)



Lake X3.1

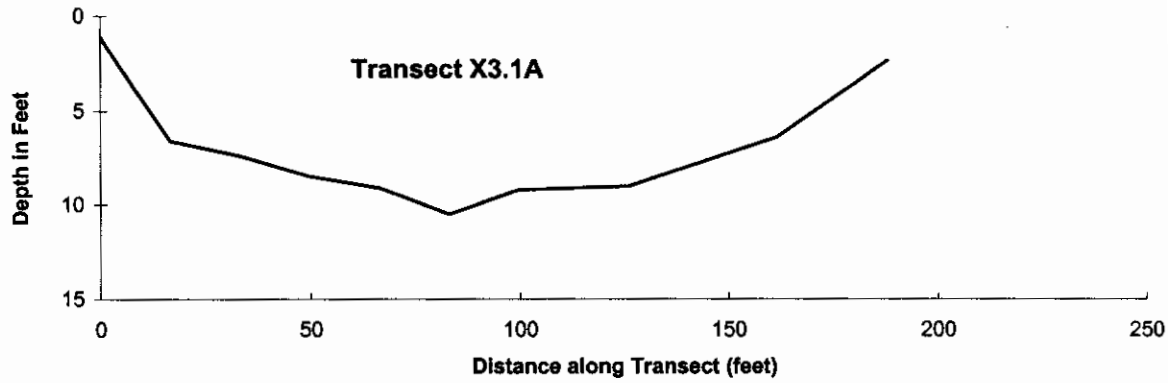
Other Names:	L9808
Location:	70°16.43'N 151°05.57'W
USGS Quad Sheet:	Harrison Bay B-2: T11N R4E Sect. 27
Habitat:	Drainage Lake
Area:	5.0 acres
Maximum Depth:	14.2 feet
Active Outlet:	Yes
Spec. Conductance:	153 µS/cm
pH:	8.2
Calculated Volume:	7.7 million gallons
Permittable Volume:	0.6 million gallons

Water Quality:

Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 4 99	1.8	Arctic grayling	1	142


Transect X3.1A
Depth in Feet
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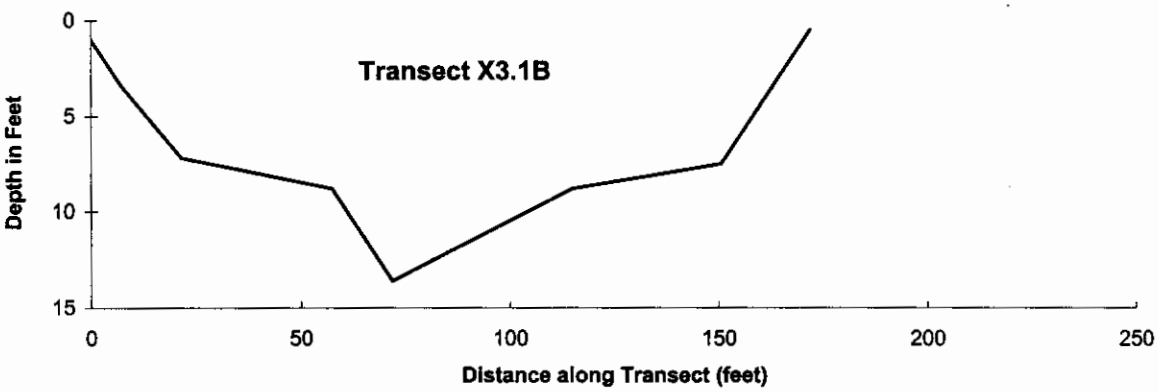
5
10
15
0
50
100
150
200
250
Distance along Transect (feet)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Depth in Feet
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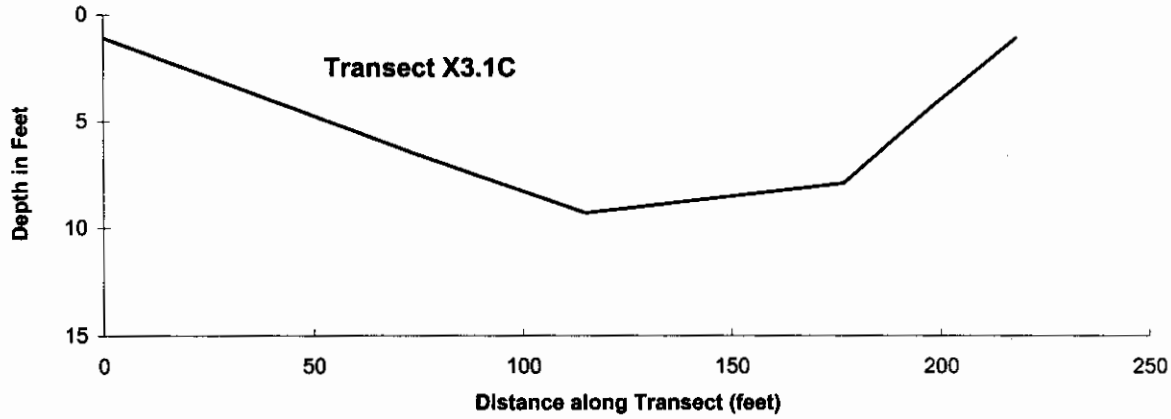
5
10
15
0
50
100
150
200
250
Distance along Transect (feet)


Transect X3.1C
Depth in Feet
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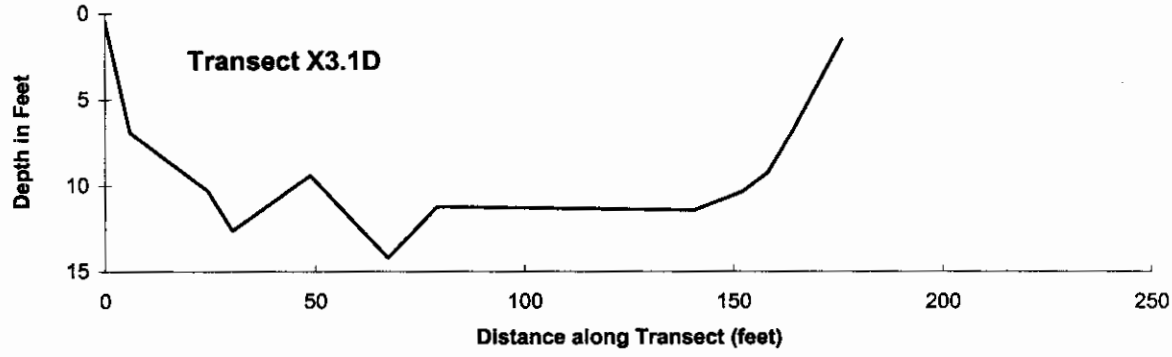
5
10
15
0
50
100
150
200
250
Distance along Transect (feet)


Transect X3.1D
Depth in Feet
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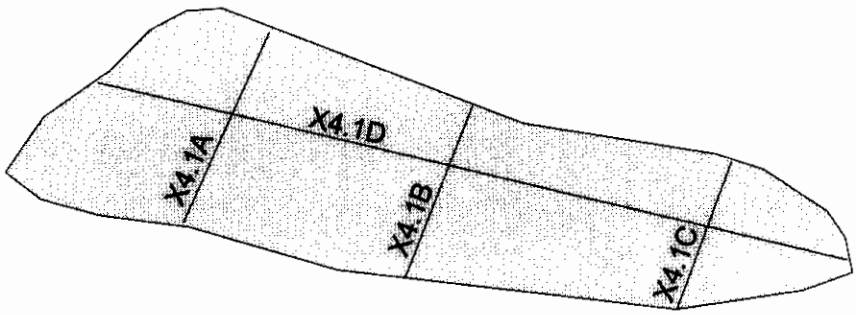
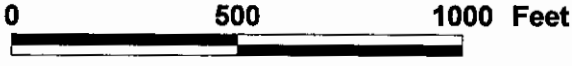
5
10
15
0
50
100
150
200
250
Distance along Transect (feet)

X4.1
(L9902)





Lake X4.1

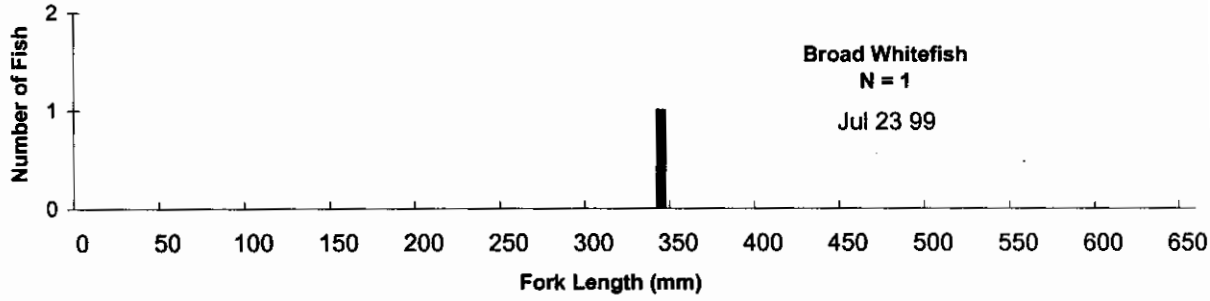
Other Names:	L9902
Location:	70°16.49'N 151°03.22'W
USGS Quad Sheet:	Harrison Bay B-2: T11N R4E Sect. 26
Habitat:	Perched lake (frequent flooding)
Area:	16 acres
Maximum Depth:	16.6 feet
Active Outlet:	No
Spec. Conductance:	171 µS/cm
pH:	8.0
Calculated Volume:	28.1 million gallons
Permittable Volume:	2.4 million gallons

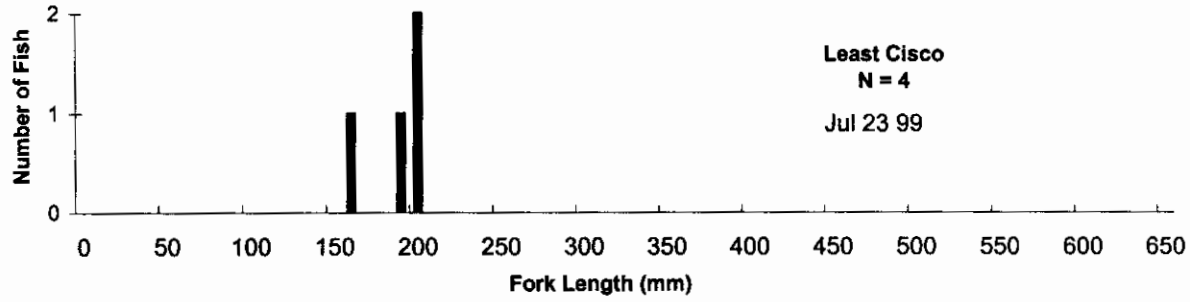
Water Quality:

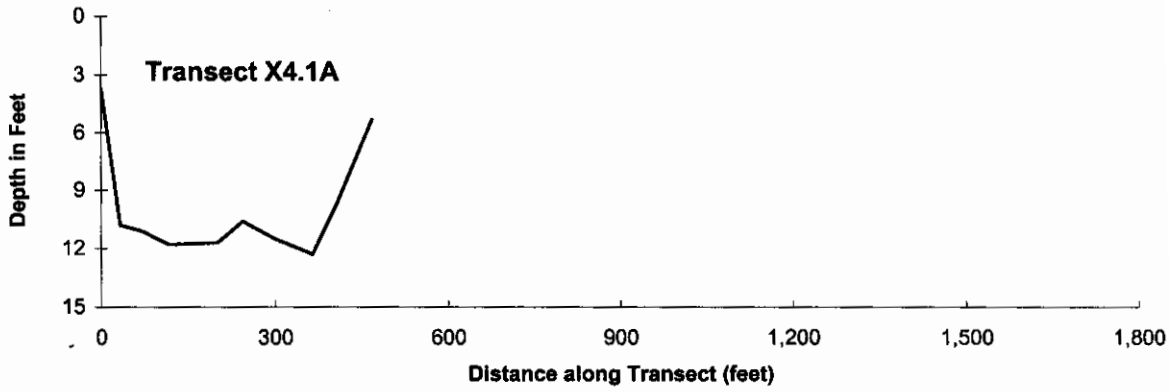
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1999	20.7	11.7	12.4	6.5	57.6	88.0	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 99	0.6	Broad whitefish	1	340
			Least cisco	4	167-205






Transect X4.1A
Depth in Feet
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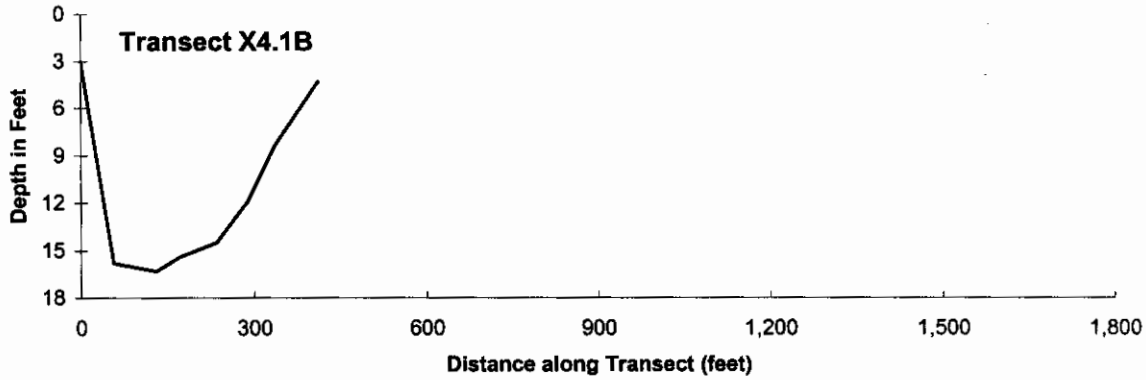
6
9
12
15
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)


Transect X4.1B
Depth in Feet
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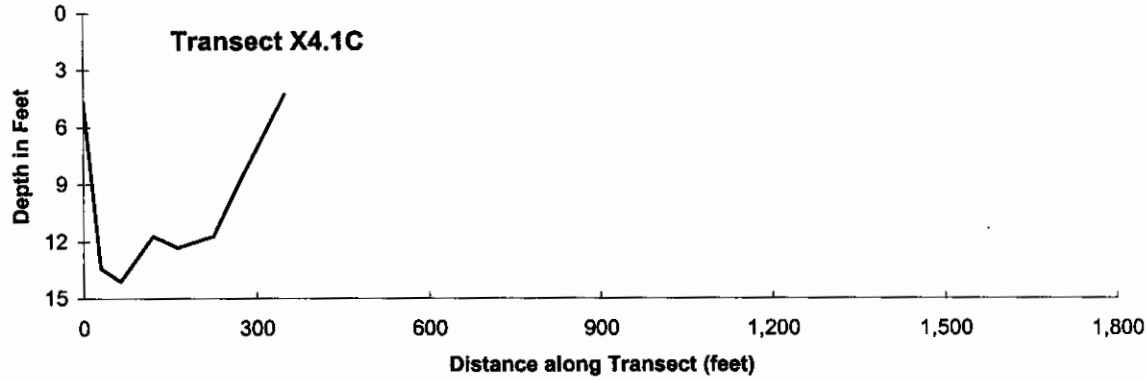
9
12
15
18
0
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)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Depth in Feet
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15
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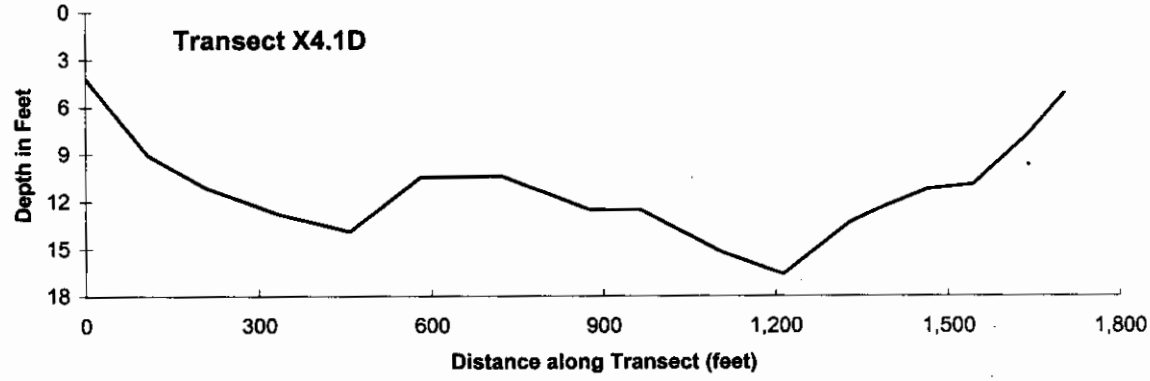
900
1,200
1,500
1,800
Distance along Transect (feet)


Transect X4.1D
Depth in Feet
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3
6
9
12
15
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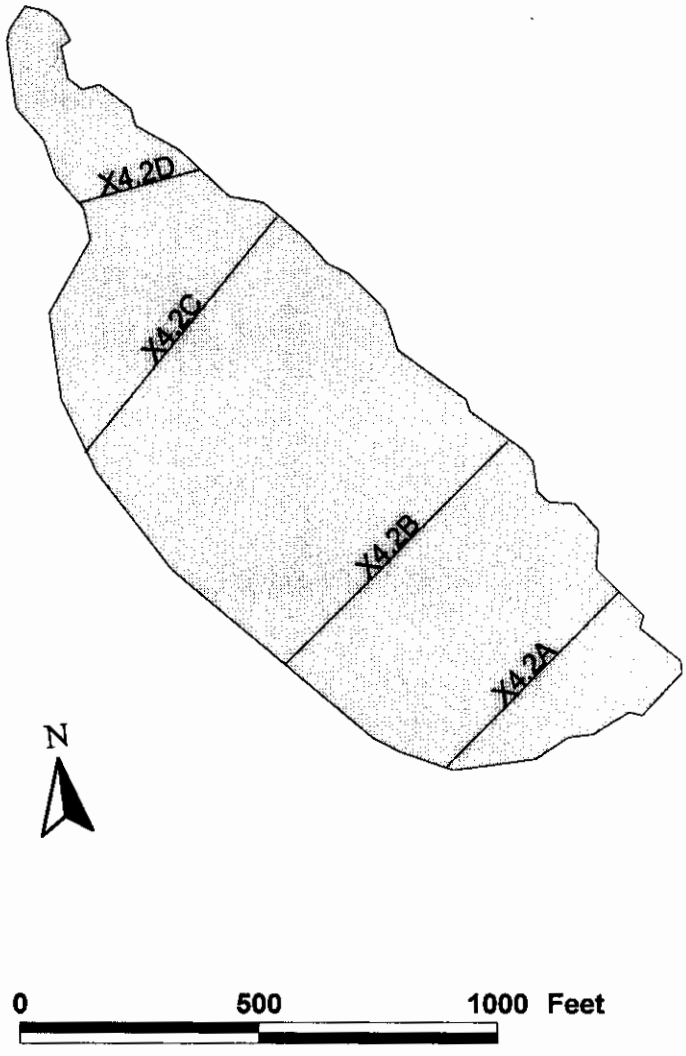
300
600
900
1,200
1,500
1,800
Distance along Transect (feet)

X4.2
(L9901)



Lake X4.2

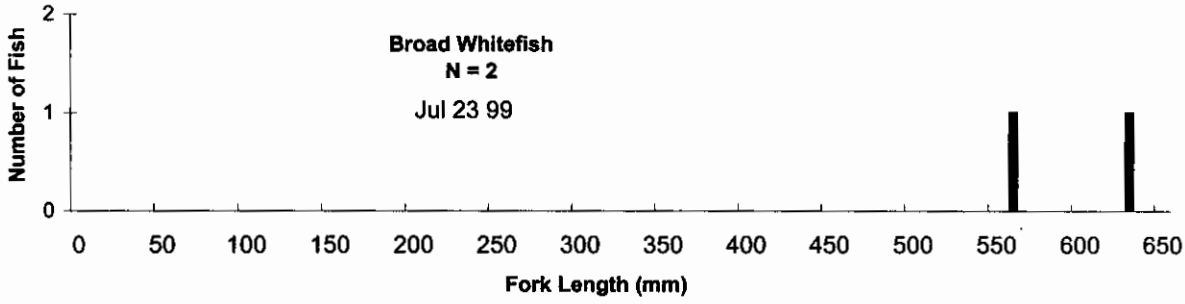
Other Names: L9901
Location: 70°16.84'N 151°01.72'W
USGS Quad Sheet: Harrison Bay B-2: T11N R4E Sect. 25
Habitat: Perched lake (frequent flooding)
Area: 16 acres
Maximum Depth: 25.0 feet
Active Outlet: No
Spec. Conductance: 312 µS/cm
pH: 8.2
Calculated Volume: 43.7 million gallons
Permittable Volume: 4.7 million gallons

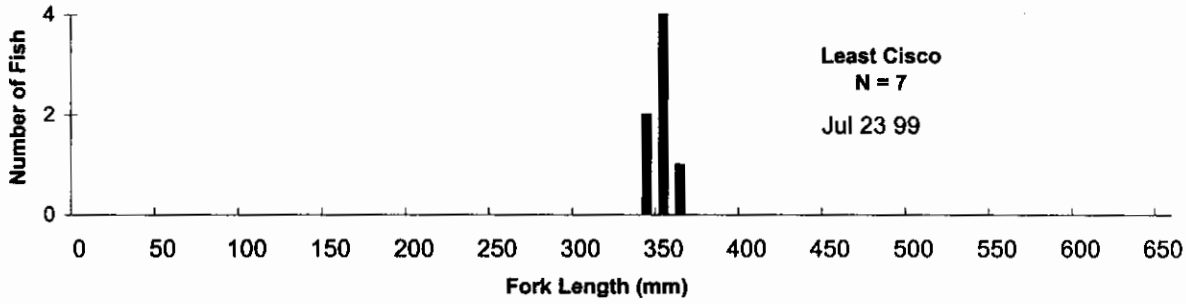
Water Quality:

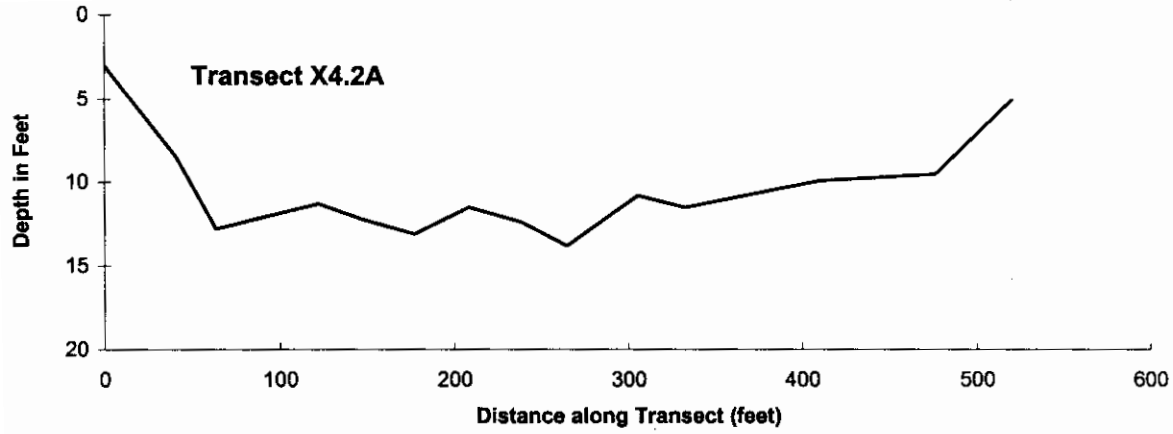
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1999	49.1	22.5	19.8	12.6	101.0	154.0	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gillnet	Jul 23 99	1.6	Broad whitefish	2	560, 630
			Least cisco	7	346-364






Transect X4.2A
Depth in Feet
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10
15
20
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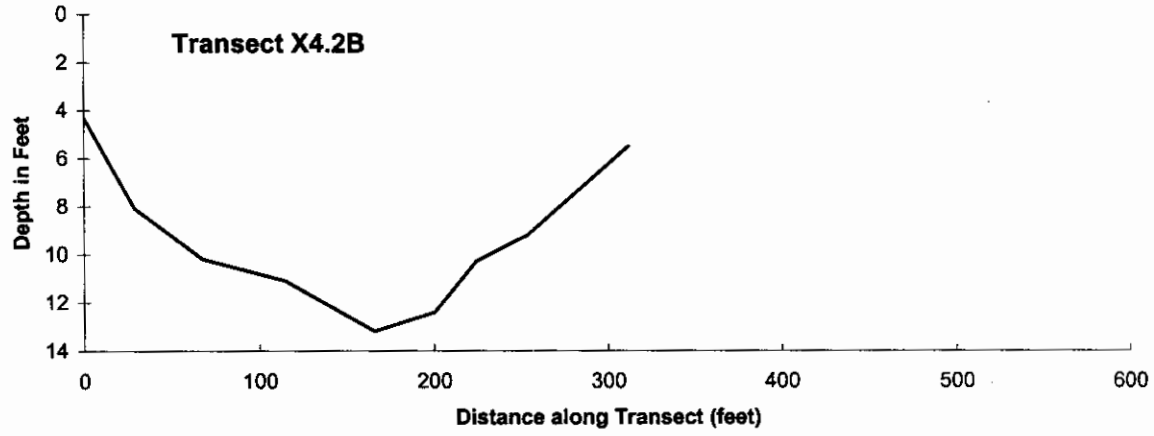
100
200
300
400
500
600
Distance along Transect (feet)


Transect X4.2B
Depth in Feet
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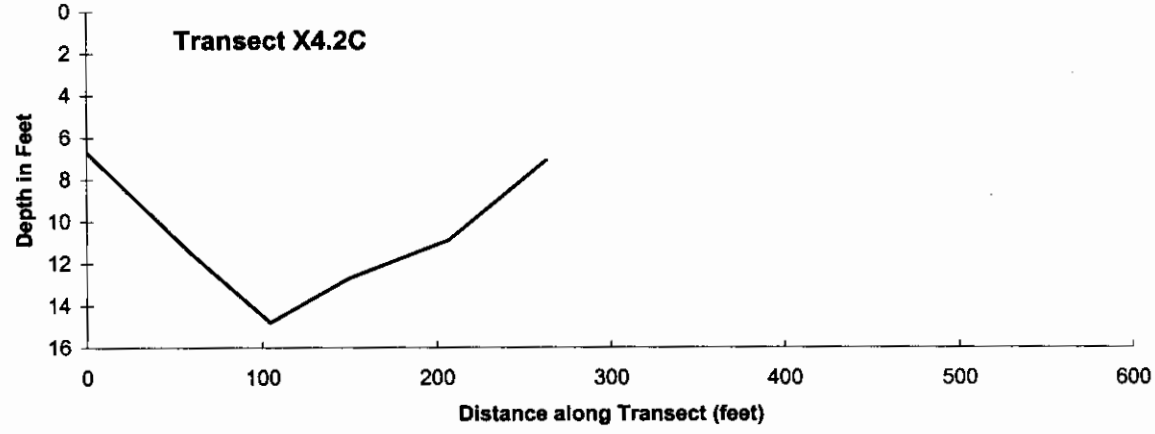
6
8
10
12
14
0
100
200
300
400
500
600
Distance along Transect (feet)


Transect X4.2C
Depth in Feet
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2
4
6
8
10
12
14
16
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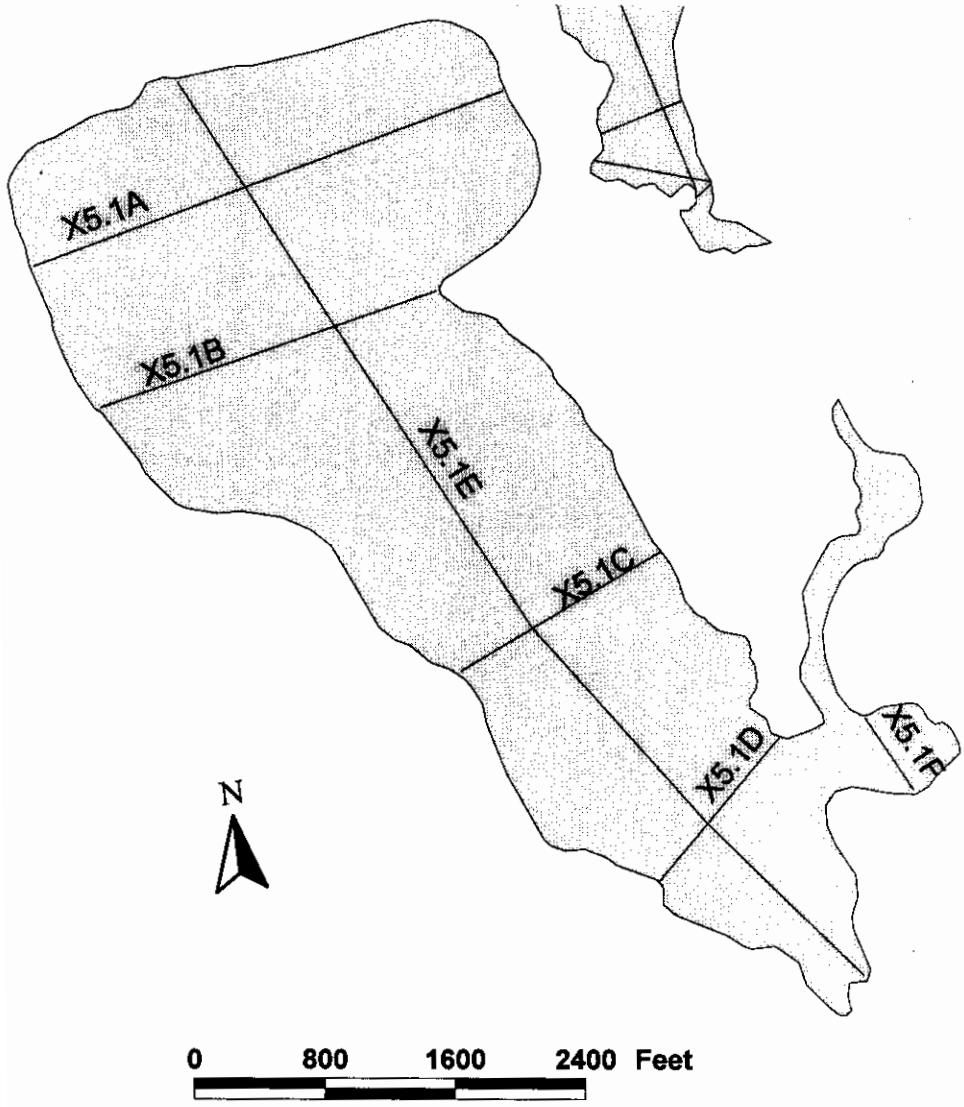
100
200
300
400
500
600
Distance along Transect (feet)

X5.1
(B8531)



Lake X5.1

Other Names: B8531; L9326
Location: 70°16.22'N 150°58.77'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E, Sect 31
Habitat: Drainage Lake
Area: 296 acres
Maximum Depth: 13.2 feet
Active Outlet: Yes
Spec. Conductance: 100 µS/cm (1985)
89 µS/cm (1999)
pH: 8.0 (1985)
7.9 (1999)
Calculated Volume: 419.5 million gallons
Permittable Volume: 29.6 million gallons

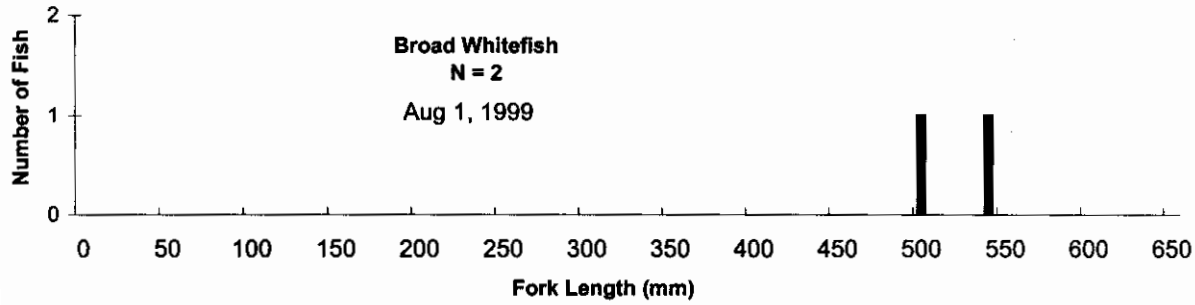
Water Quality:

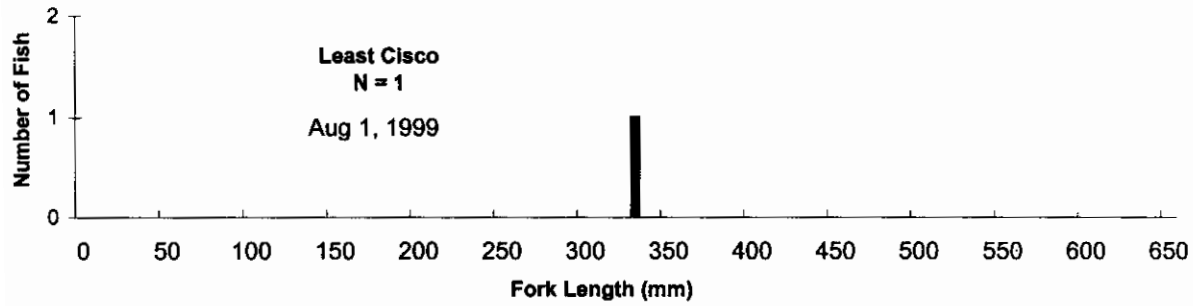
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1985					51		Bendock & Burr 1986
1993	4	3.2	1.8	6.3	23	50	J. Lobdell

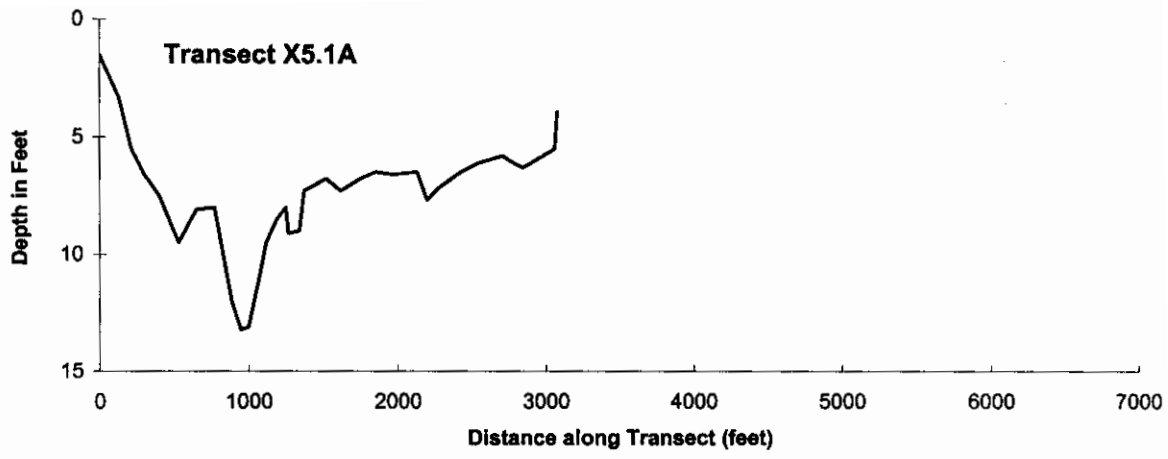
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 16-19, 1985	~24	Broad whitefish	?	
			Least cisco	?	
			Alaska blackfish	?	
Gill Net	Aug 1, 1999	3.83	Broad whitefish	2	507, 547
			Least cisco	1	337
Water Pump	Mar 2000		Alaska blackfish	1	91

Source of 1985 data: Bendock & Burr 1986






Transect X5.1A
Depth in Feet
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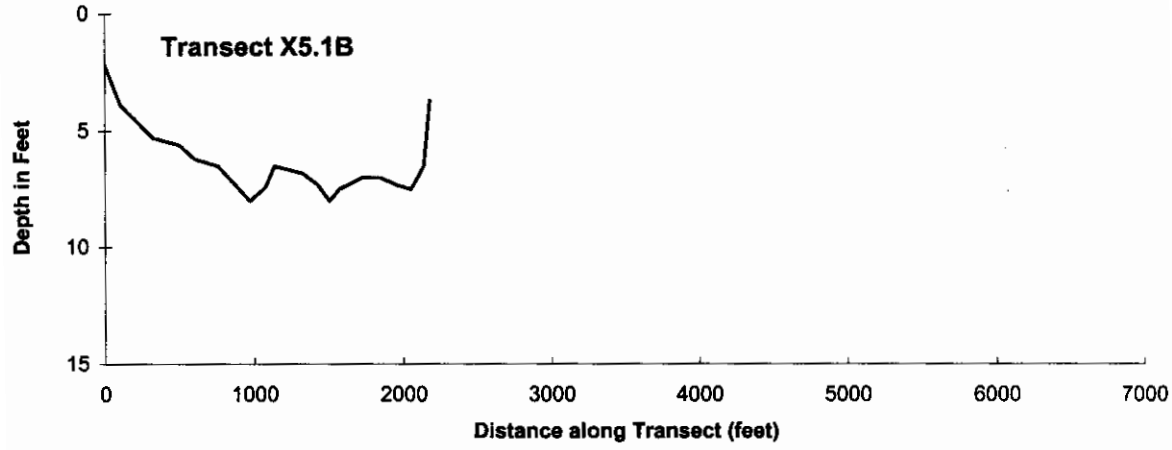
5
10
15
0
1000
2000
3000
4000
5000
6000
7000
Distance along Transect (feet)


Transect X5.1B
Depth in Feet
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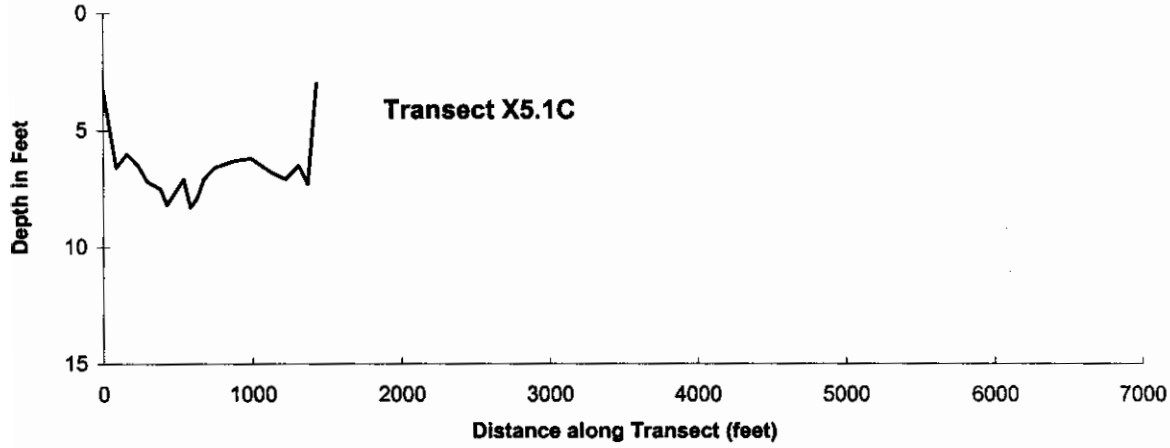
10
15
0
1000
2000
3000
4000
5000
6000
7000
Distance along Transect (feet)


Transect X5.1C
Depth in Feet
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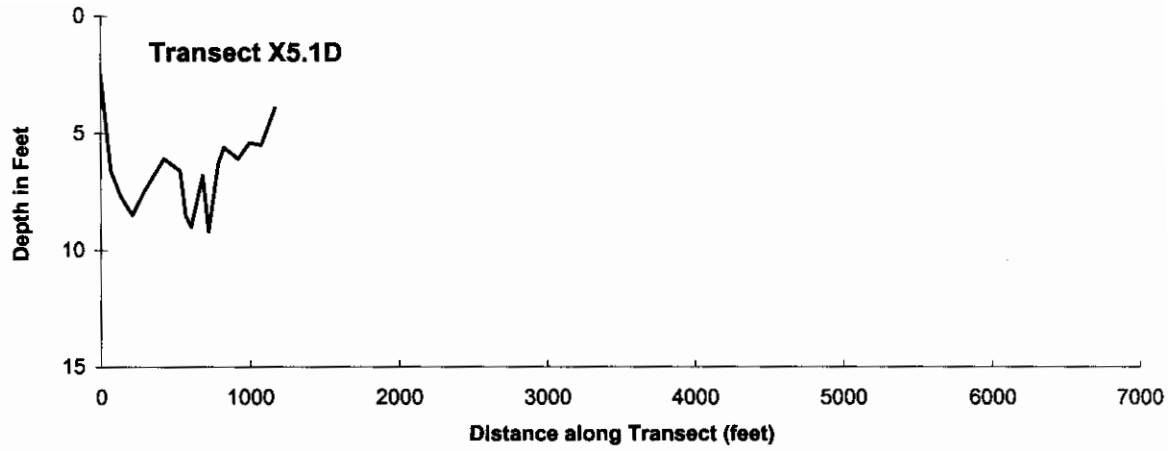
5
10
15
0
1000
2000
3000
4000
5000
6000
7000
Distance along Transect (feet)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Depth in Feet
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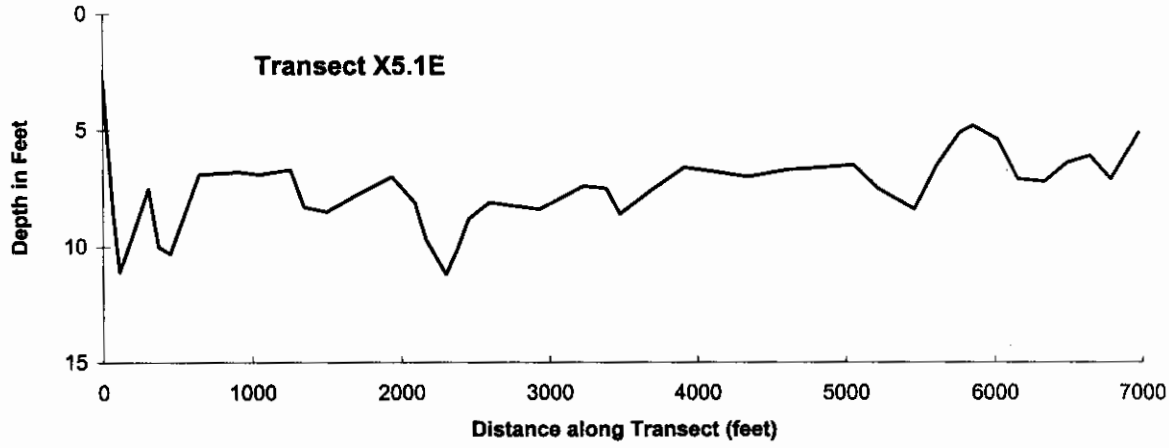
10
15
0
1000
2000
3000
4000
5000
6000
7000
Distance along Transect (feet)


Transect X5.1E
Depth in Feet
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5
10
15
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1000
2000
3000
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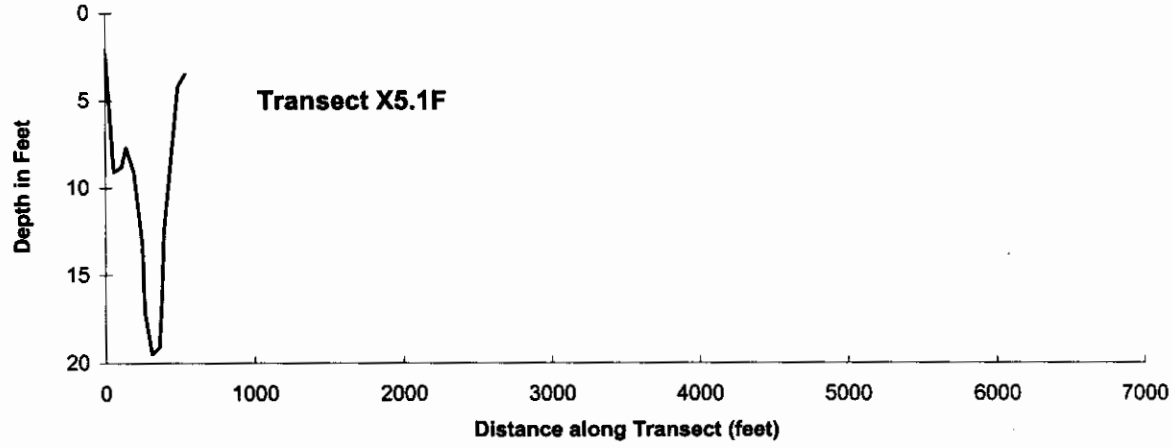
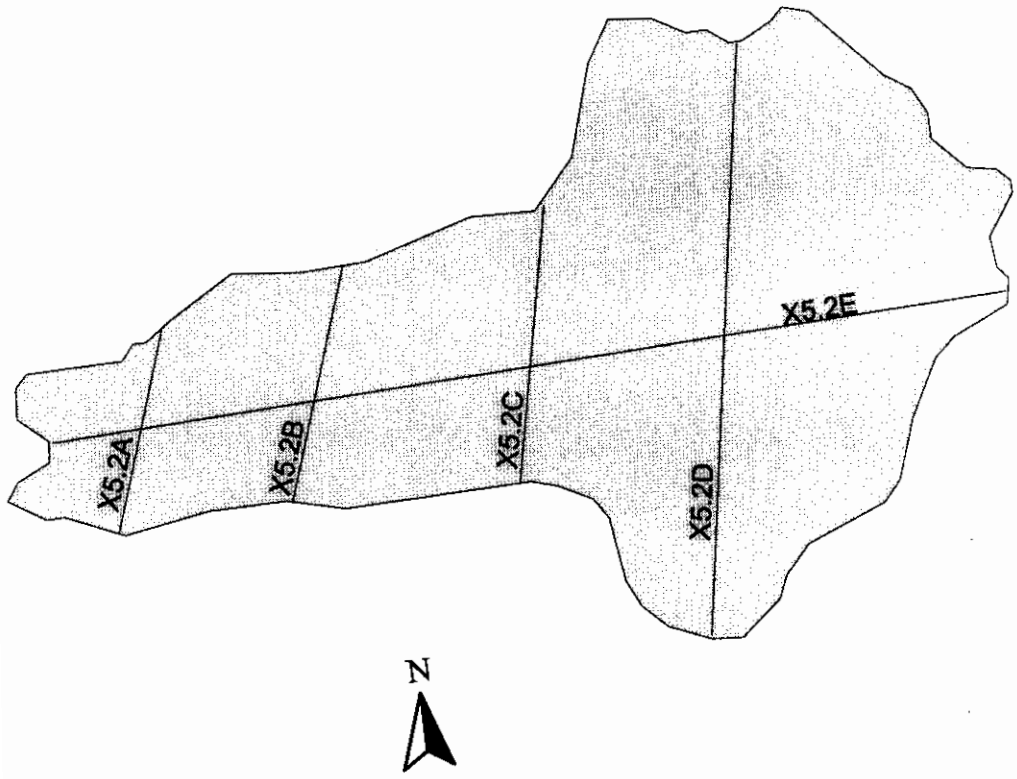
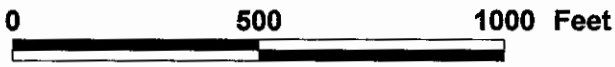
6000
7000
Distance along Transect (feet)


Transect X5.1F
Depth in Feet
0
5
10
15
20
0
1000
2000
3000
4000
5000
6000
7000
Distance along Transect (feet)

X5.2
(L9325)





Lake X5.2

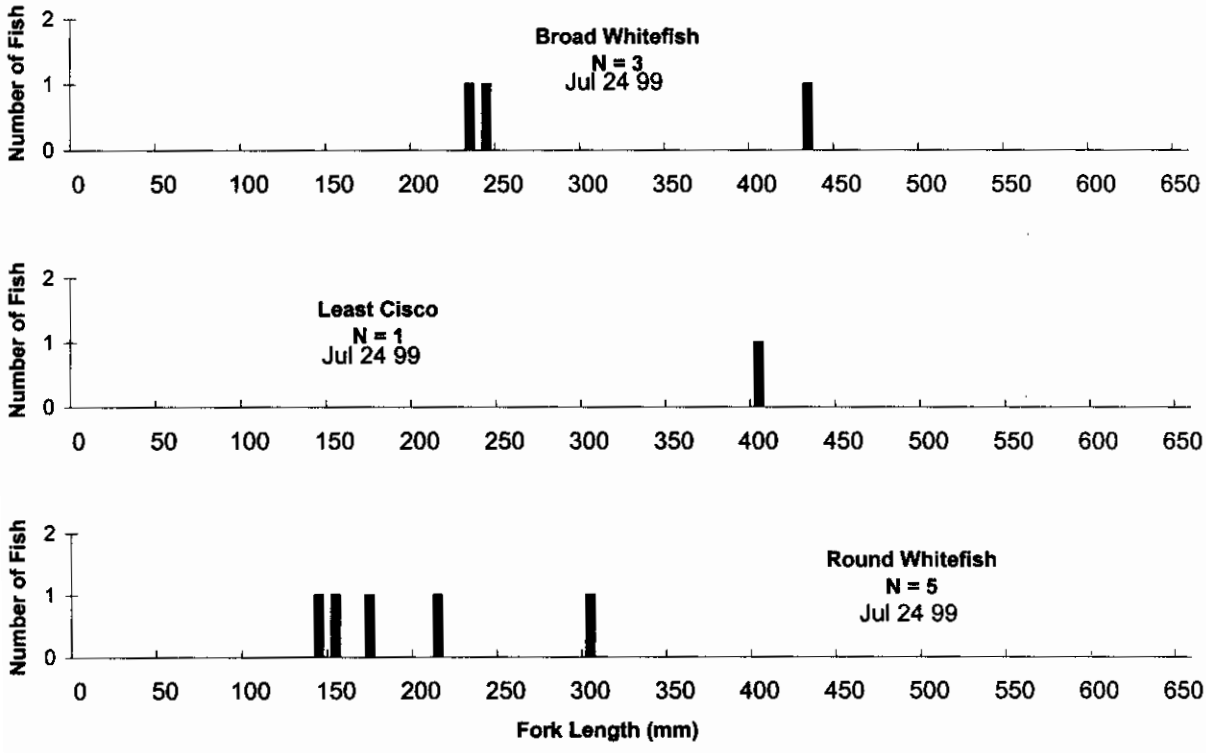
Other Names: L9325
Location: 70°16.98'N 150°58.98'W
USGS Quad Sheet: Harrison Bay B-2: T11N; Boundary of R4E Sect. 25 and R5E Sect. 30
Habitat: Perched Lake (Infrequent flooding)
Area: 33 acres
Maximum Depth: 17.3 feet
Active Outlet: No
Spec. Conductance: 102 µS/cm
pH: 7.7
Calculated Volume: 60.5 million gallons
Permittable Volume: 5.4 million gallons

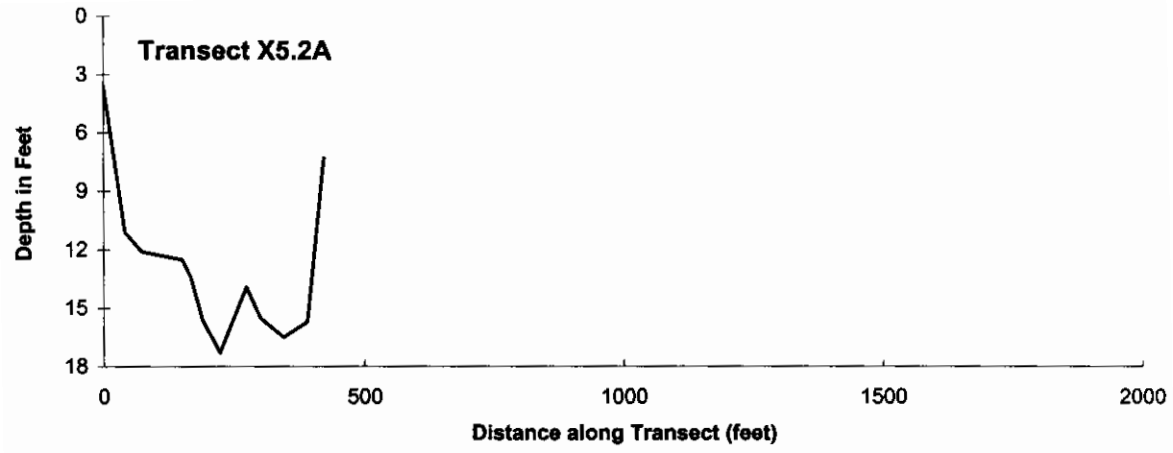
Water Quality:

Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	5	3.4	1.9	6.3	24	62	Lobdell

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 24 99	2.6	Broad whitefish	3	233-437
			Least cisco	1	400
			Round whitefish	5	146-306




Transect X5.2A
Depth in Feet
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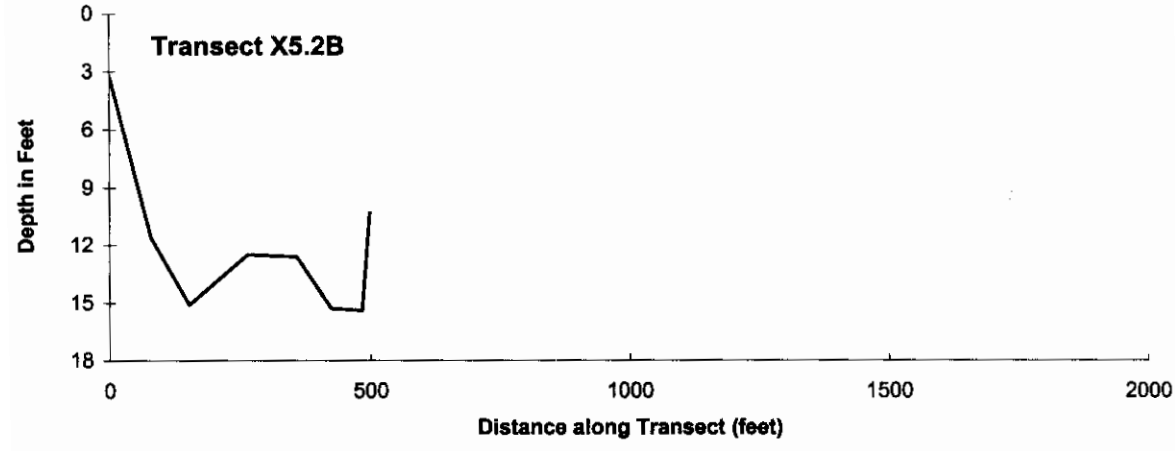
3
6
9
12
15
18
0
500
1000
1500
2000
Distance along Transect (feet)


Transect X5.2B
Depth in Feet
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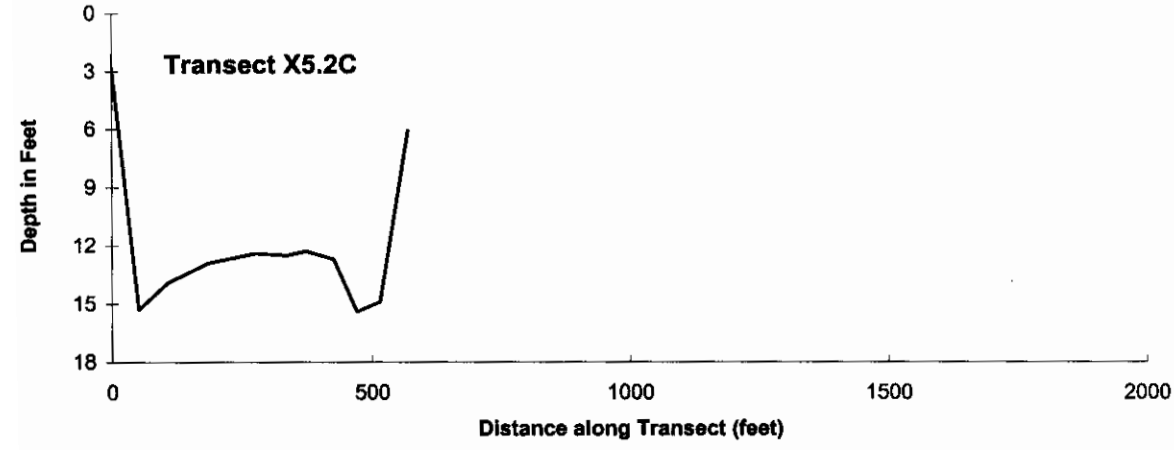
6
9
12
15
18
0
500
1000
1500
2000
Distance along Transect (feet)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Depth in Feet
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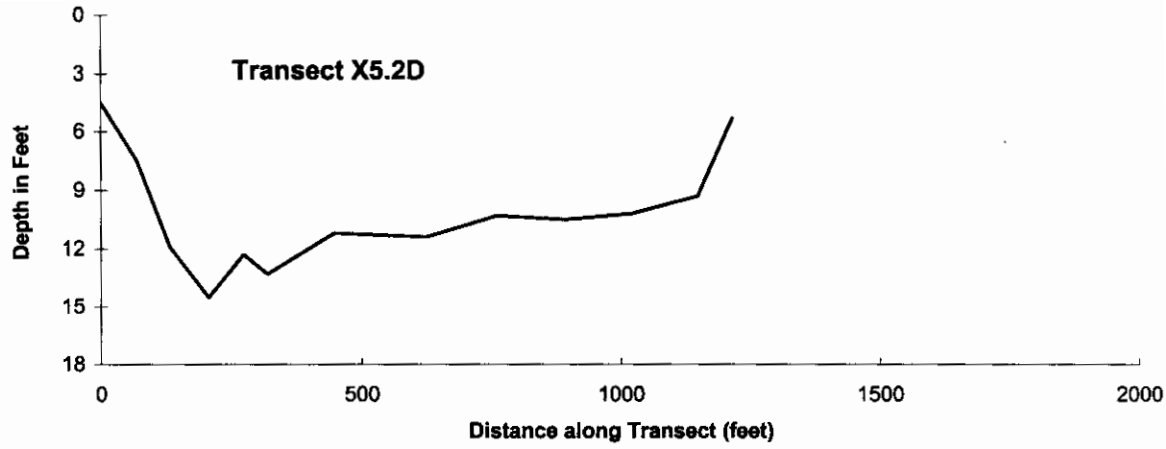
6
9
12
15
18
0
500
1000
1500
2000
Distance along Transect (feet)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Depth in Feet
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6
9
12
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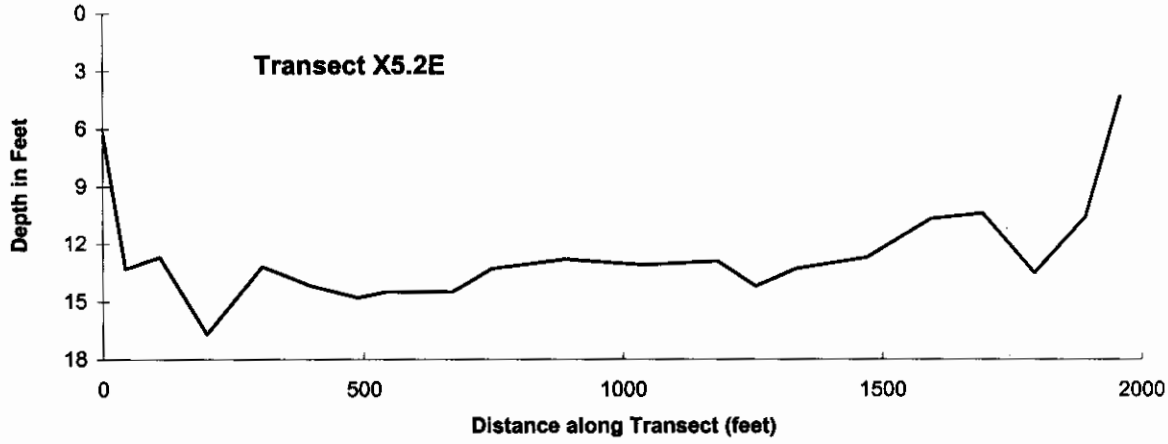
1000
1500
2000
Distance along Transect (feet)


Transect X5.2E
Depth in Feet
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6
9
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18
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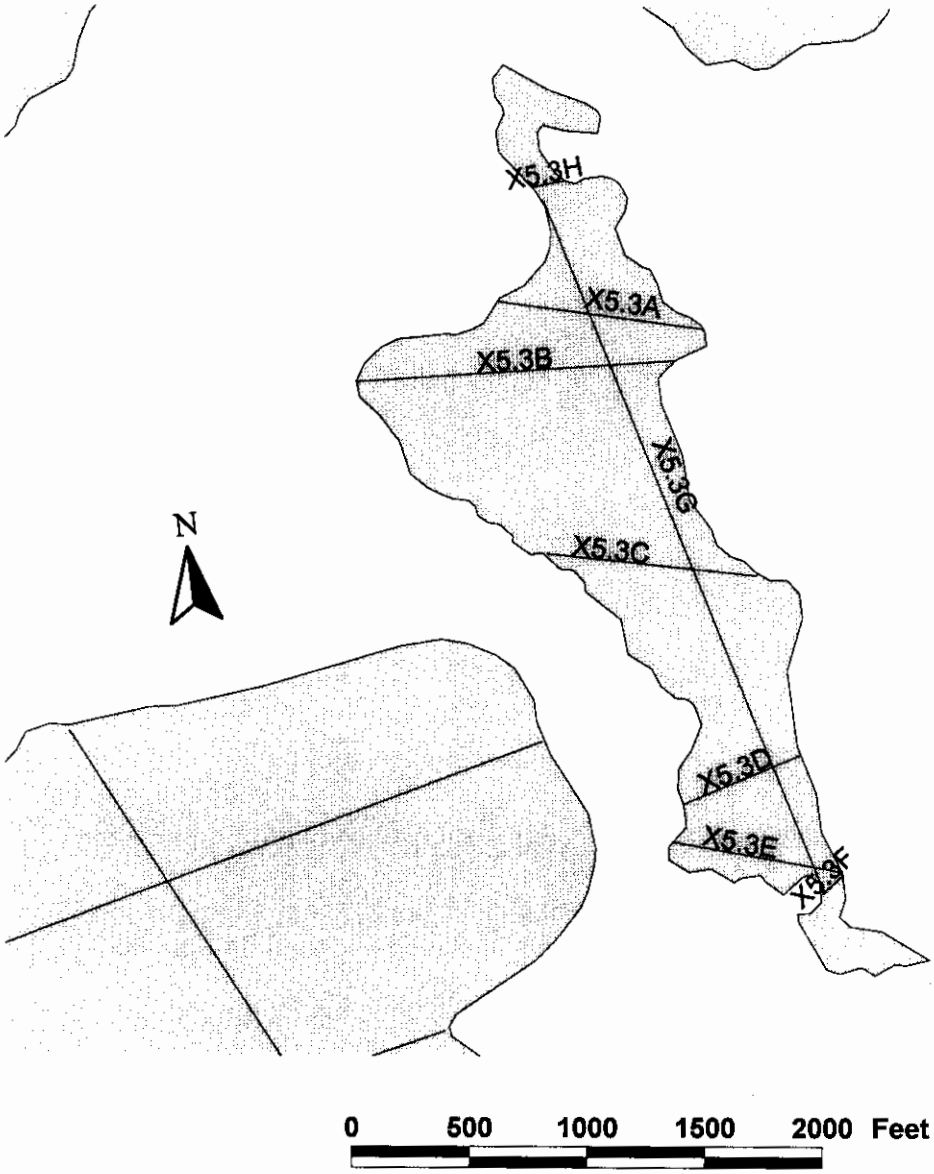
1000
1500
2000
Distance along Transect (feet)

X5.3


X5.3H
X5.3A
X5.3B
X5.3G
X5.3C
X5.3D
X5.3E
X5.3F
N
0
500
1000
1500
2000 Feet

Lake X5.3

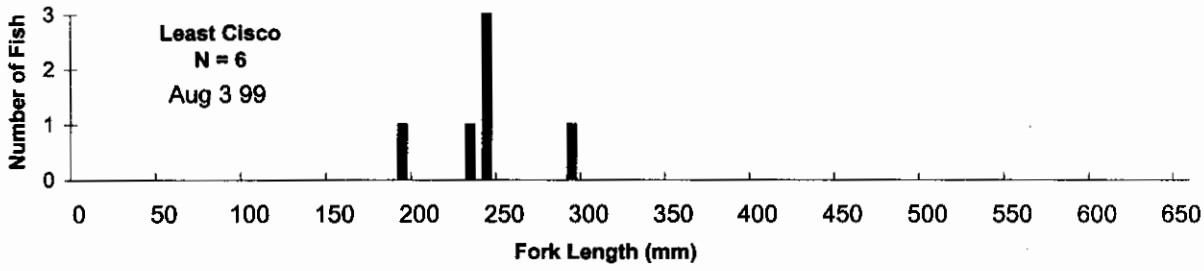
Other Names:
Location: 70°16.45'N 150°57.90'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E Sect. 30
Habitat: Drainage Lake
Area: 61 acres
Maximum Depth: 15.3 feet
Active Outlet: Yes
Spec. Conductance: 106 µS/cm
pH: 8.1
Calculated Volume: 100.7 million gallons
Permittable Volume: 8.2 million gallons

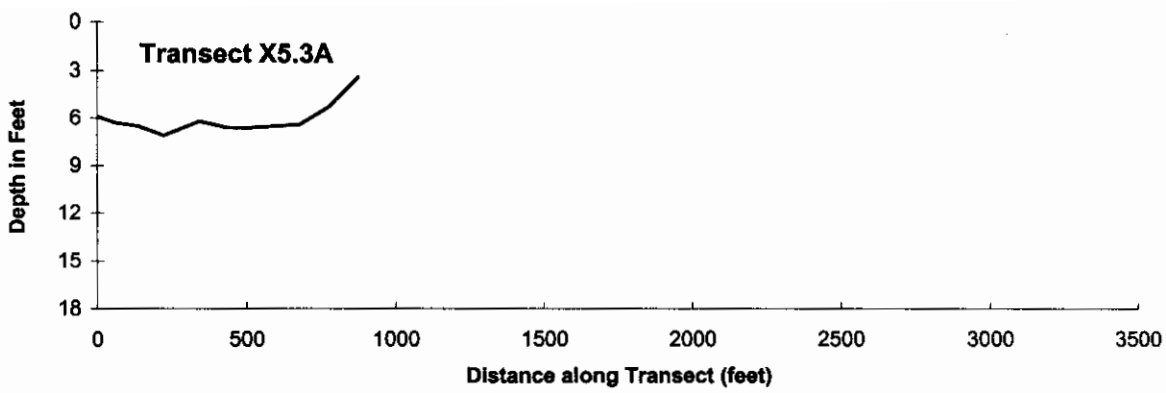
Water Quality:

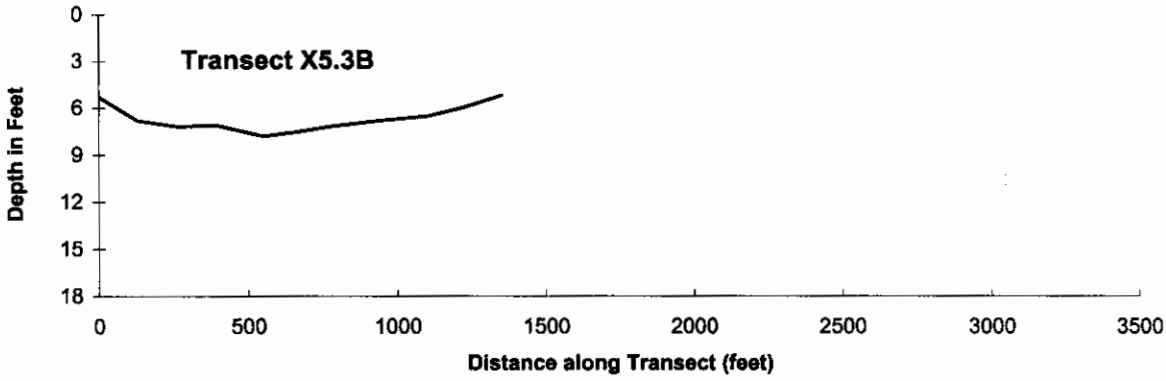
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1999	5.77	4.4	10.6	4.1	43.6	48	this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 3 99	4.0	Least cisco	6	195-291




Transect X5.3A
Depth in Feet
0
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)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Depth in Feet
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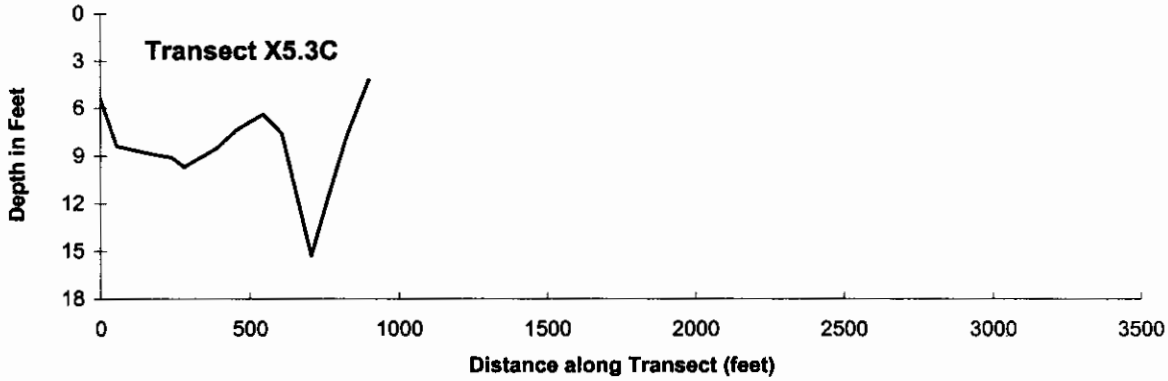
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)


Transect X5.3C
Depth in Feet
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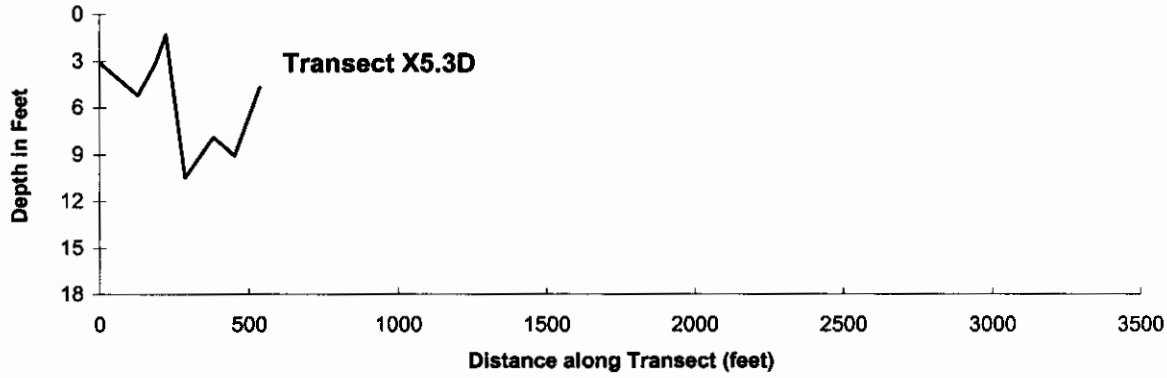
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)


Transect X5.3D
Depth in Feet
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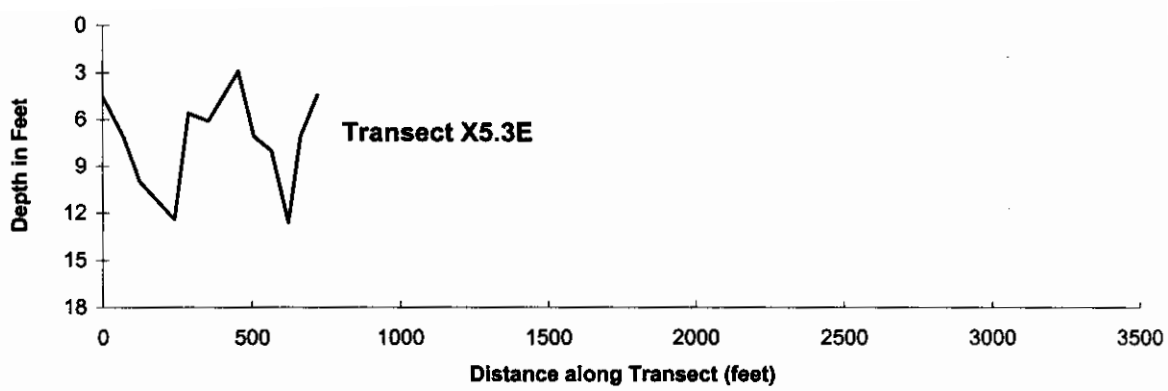
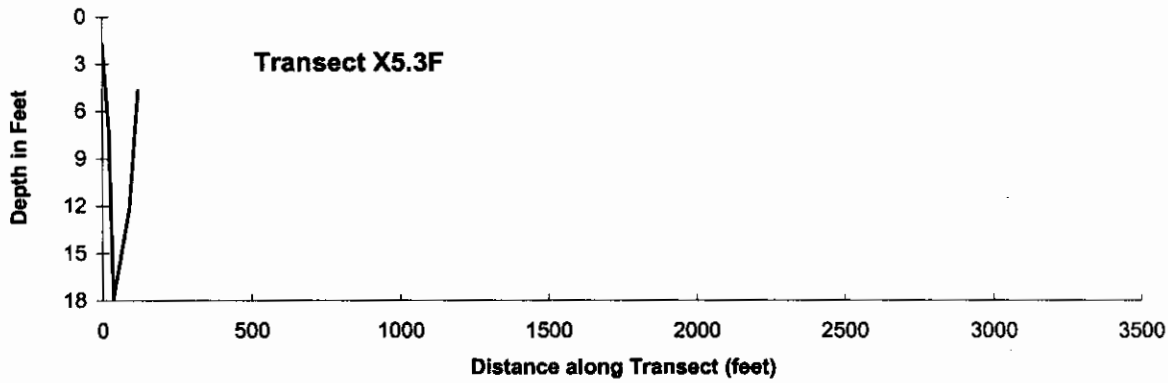
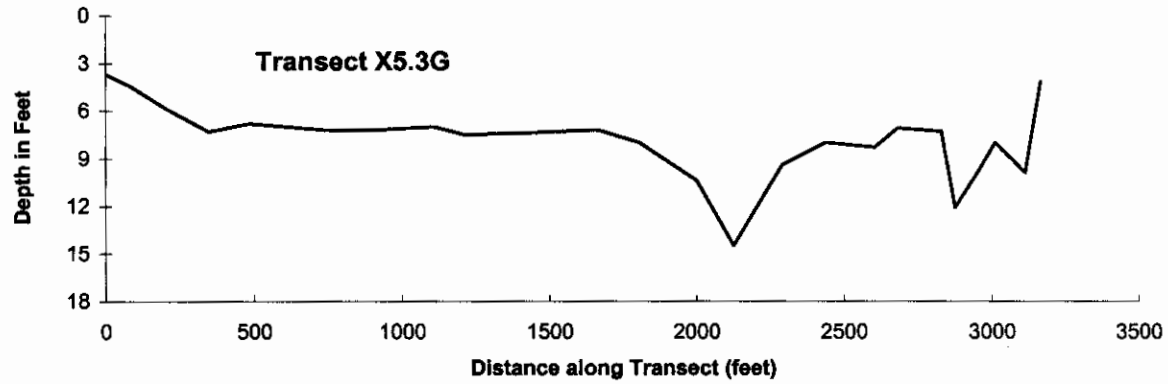
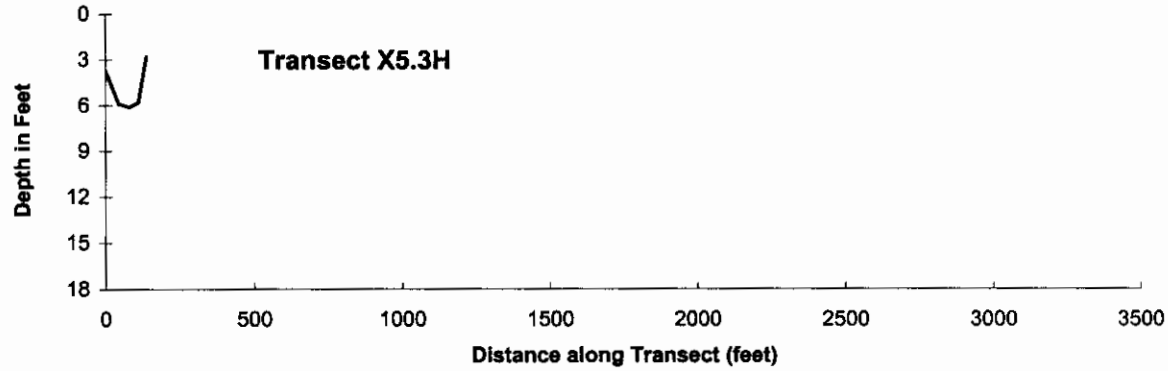
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)

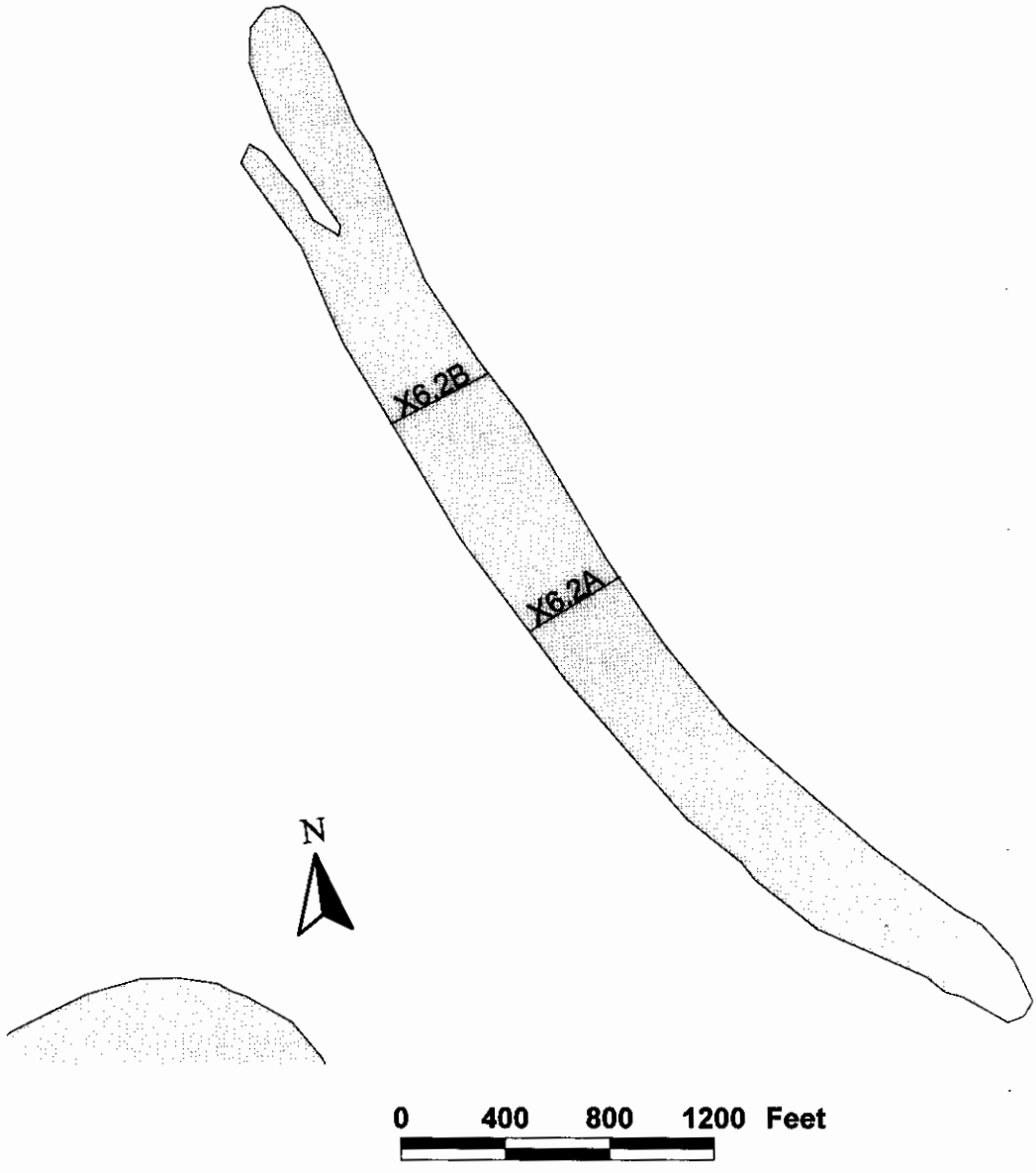

Transect X5.3E
Depth in Feet
0
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)


Transect X5.3F
Depth in Feet
0
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)


Transect X5.3G
Depth in Feet
0
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)


Transect X5.3H
Depth in Feet
0
3
6
9
12
15
18
0
500
1000
1500
2000
2500
3000
3500
Distance along Transect (feet)

X6.2
(L9328)



Lake X6.2

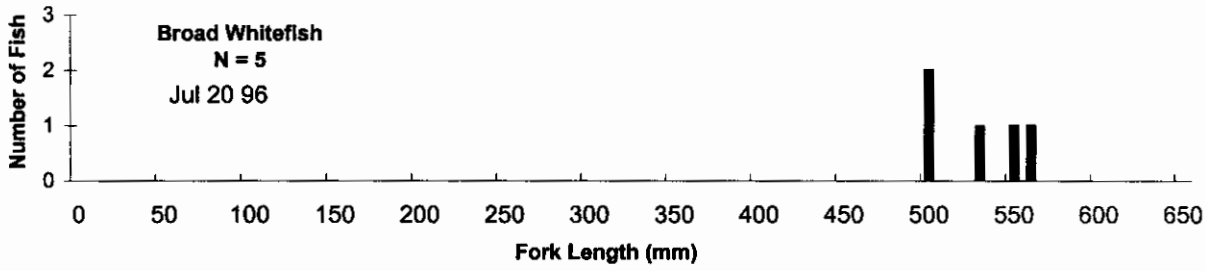
Other Names: L9328
Location: 70°16.19'N 150°54.32'W
USGS Quad Sheet: Harrison Bay B-2: T11N R5E Sect. 29
Habitat: Perched Lake (Infrequent Flooding)
Area: 42 acres
Maximum Depth: 13.2 feet
Active Outlet: No
Spec. Conductance: 97 µS/cm
pH:
Calculated Volume: 59.1 million gallons
Permittable Volume: 4.2 million gallons

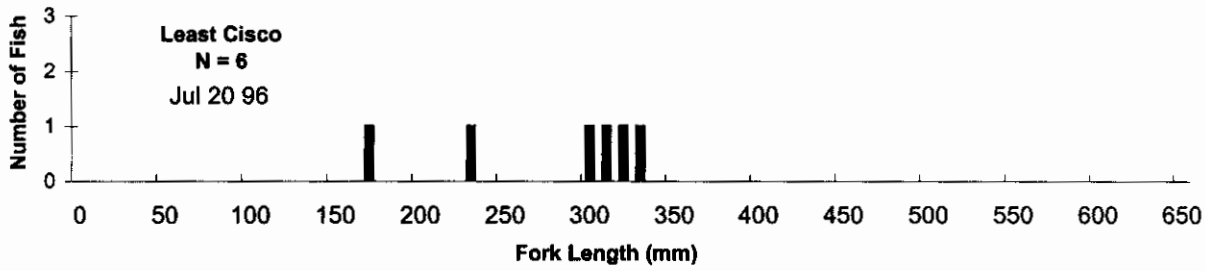
Water Quality:

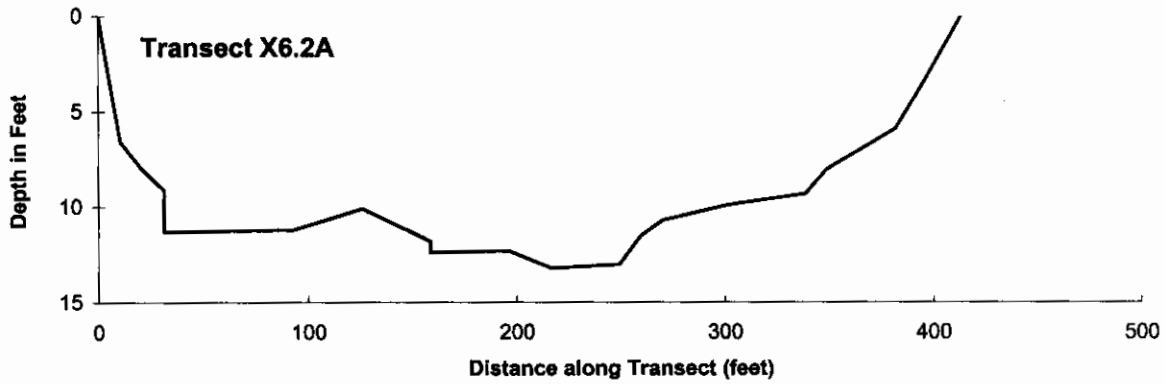
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	3	2.3	2.3	6.4	25	46	J. Lobdell

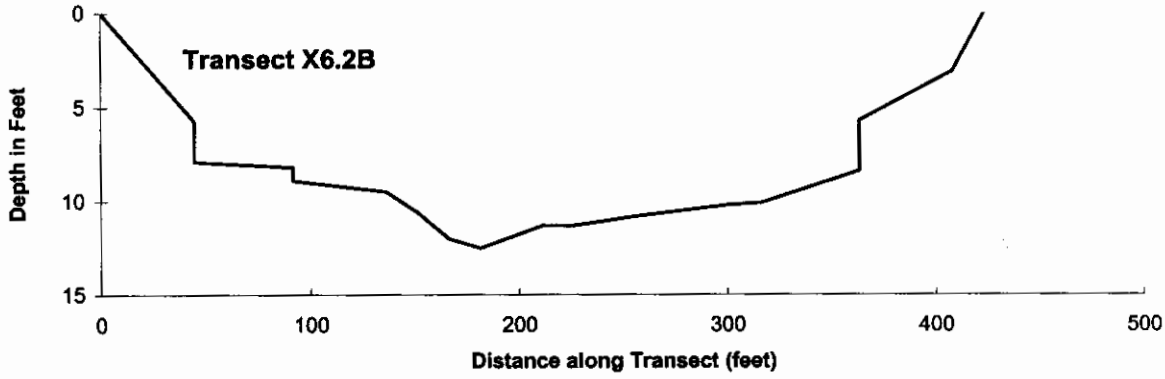
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 20 96	9.9	Broad whitefish	5	500-564
			Least cisco	6	172-330

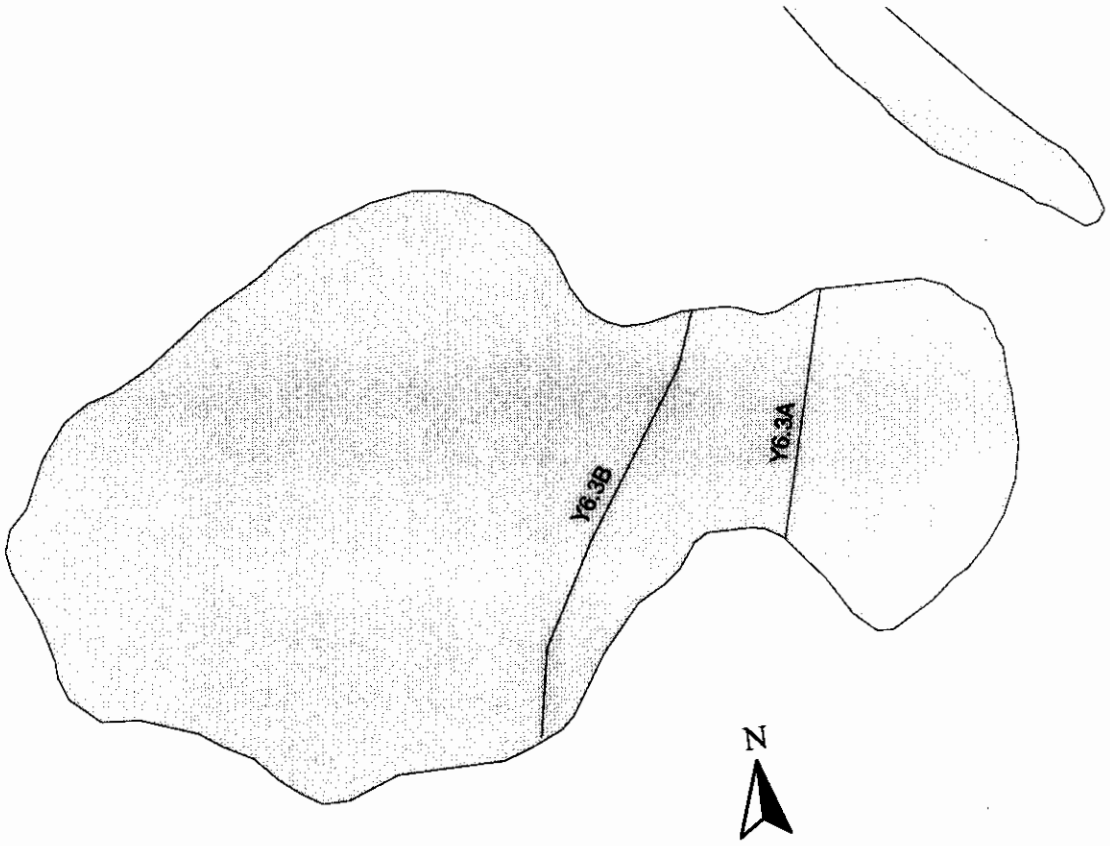





Transect X6.2A
Depth in Feet
0
5
10
15
0
100
200
300
400
500
Distance along Transect (feet)


Transect X6.2B
Depth in Feet
0
5
10
15
0
100
200
300
400
500
Distance along Transect (feet)

Y6.3
(L9327)



0 500 1000 1500 2000 Feet

Lake Y6.3

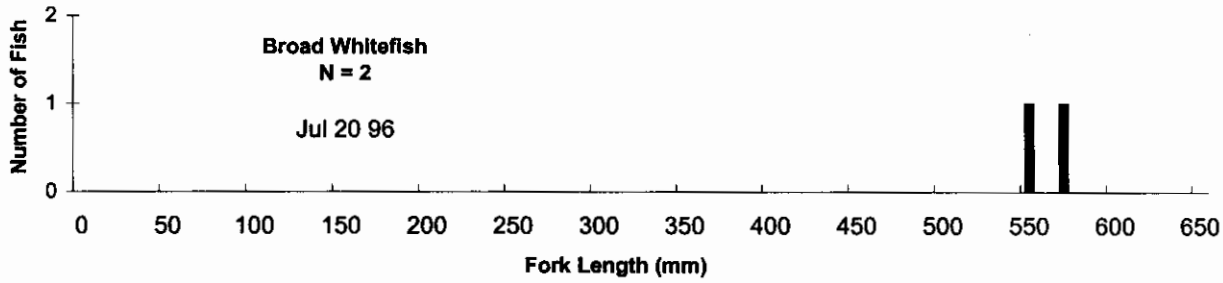
Other Names:	L9327
Location:	70°15.85'N 150°55.51'W
USGS Quad Sheet:	Harrison Bay B-2: T11N R5E, Sect 32
Habitat:	Perched Lake (Infrequent Flooding)
Area:	202 acres
Maximum Depth:	13.0 feet
Active Outlet:	No
Spec. Conductance:	80 µS/cm
pH:	7.5-7.8
Calculated Volume:	282.8 million gallons
Permittable Volume:	19.6 million gallons

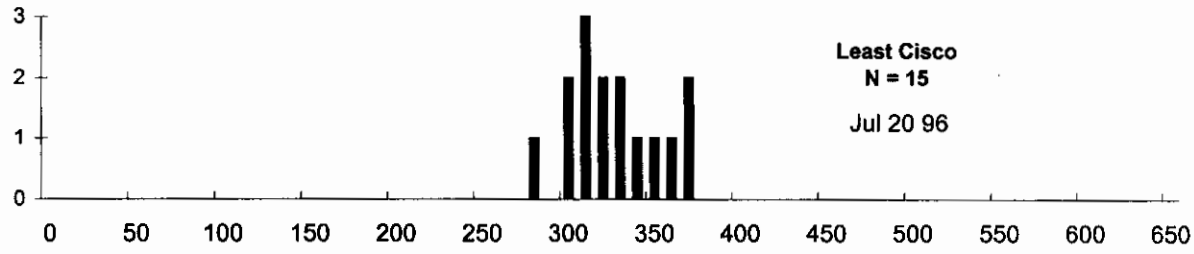
Water Quality:

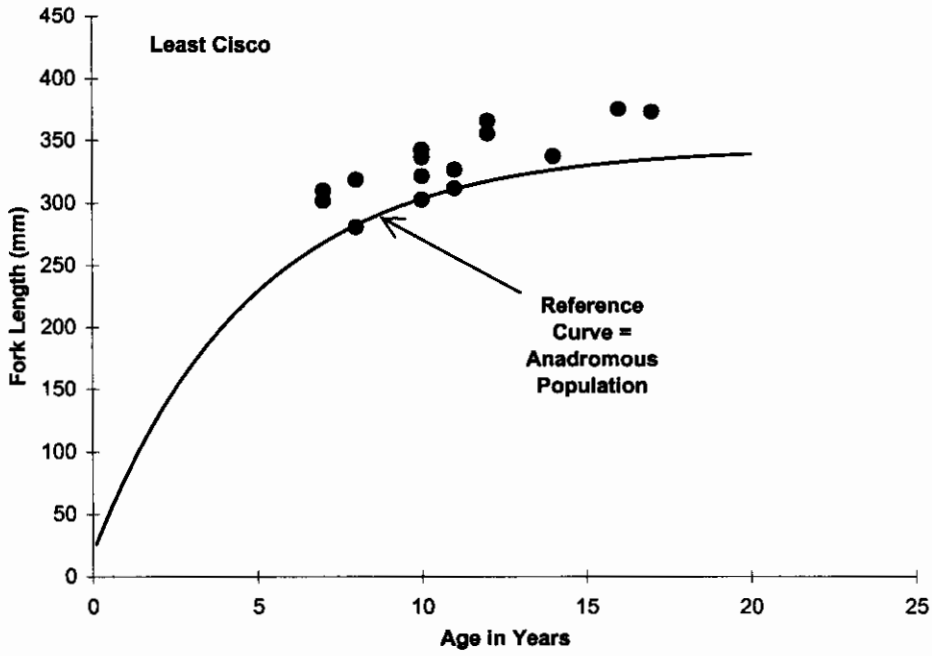
Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
1993	2	1.5	1.7	4.9	19	78	J. Lobdell

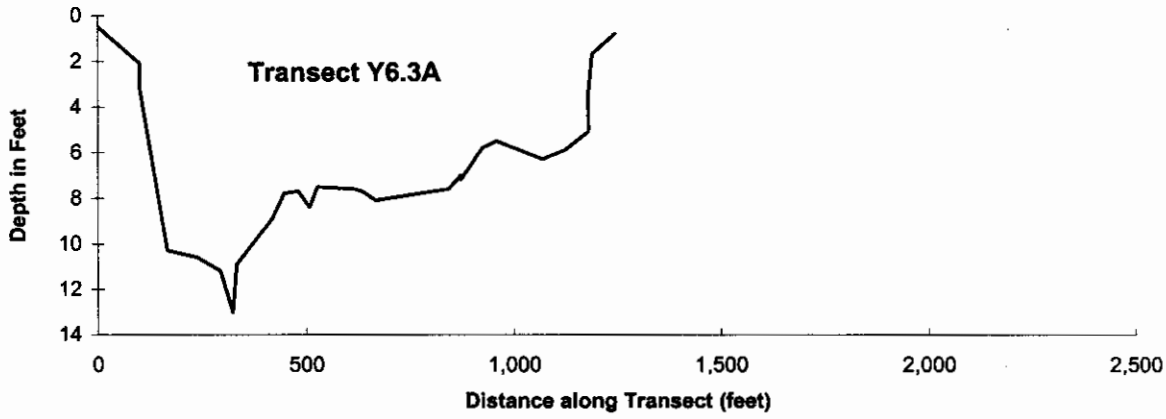
Catch Record:

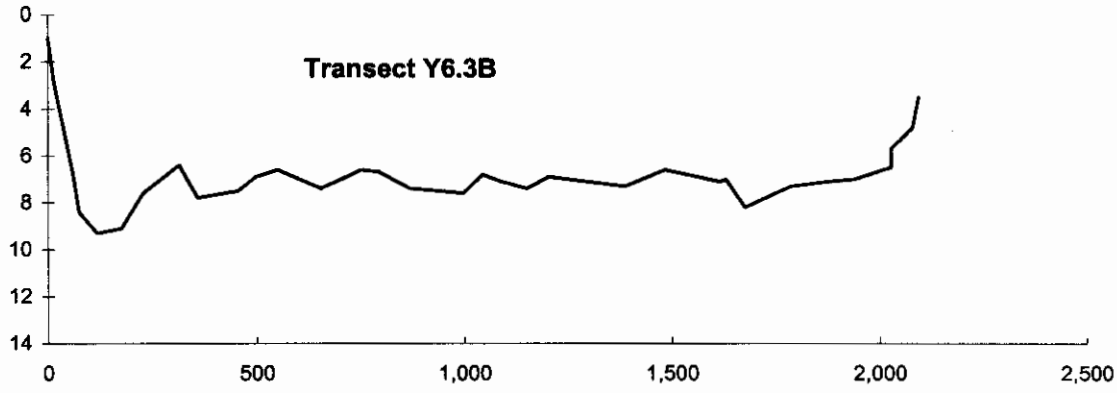
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 20 96	11.2	Broad whitefish	2	552-579
			Least cisco	15	281-376






Least Cisco
Fork Length (mm)
Age in Years
Reference Curve = Anadromous Population
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25


Transect Y6.3A
Depth in Feet
Distance along Transect (feet)
0
2
4
6
8
10
12
14
0
500
1,000
1,500
2,000
2,500


Transect Y6.3B
0
2
4
6
8
10
12
14
0
500
1,000
1,500
2,000
2,500