Bathymetric Mapping and Baseline Limnological Study of Brewster Lake, Barry County, Michigan

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Introduction

Brewster Lake is a small, inland lake of glacial origin located in Baltimore Township of Barry County, Michigan. It has been isolated from any industrial use, agricultural activity or public access since at least 1952. The lake has been classified as a meso-oligotrophic lake and has been the subject of limited research (Pierce, pers. comm.; Cimo and Wolfson, 2001). One earlier study indicated that the lake system may be more highly enriched than previously thought (Cimo and Wolfson, 2001). Our study mapped the bathymetry of the lake and collected additional water quality data for use in the classification of the trophic status of this lake ecosystem.

The lake is located entirely within the Pierce Cedar Creek Institute property and is part of a dedicated nature preserve. The general location of the lake is depicted in Figure 1. Pierce Cedar Creek Institute is located on 661 acres of land in Barry County, Michigan. The makeup of the property is 40% forest cover, 45% wetlands, 13% upland forest and fields, and 2% lake surface. The previous owner of the majority of the property, naturalist Dr. H. Lewis Batts, actively protected the land from development or degradation, and most of it has remained untouched for the past 50+ years. The Batts family had a small cottage near the shore of the lake but used it infrequently so that even recreational pressures were minimal. Pierce Cedar Creek Institute maintains the property as a preserve under an easement granted by Southwest Michigan Land Conservancy (PCCI, 2005). This makes this lake ideal for limnological study and could serve as a basis for a long-term ecological research (LTER) site for a small, southern Michigan lake and wetland ecosystem.

Bathymetric Mapping

One of principal needs in development of any ecological research site is an adequate map of the area being studied. Topographical maps published by the United States Geological Survey for the area exist and document land forms, elevations, and surface features of the Brewster Lake watershed. The Natural Resource Conservation Service of the United States Department of Agriculture has conducted two soil surveys of the area, one in 1924 and one in 1990. These studies produced published soil maps for the entire county (Guthrie, 2005). There was, however, no bathymetric map of Brewster Lake available for researchers. The first component of our study was the construction of a bathymetric map of the bottom surface of the lake. This work was conducted using standard depth sounding procedures (Birge and Juday, 1914; Hutchinson, 1938; Hutchinson, 1957; Wetzel, 1975) linked to surface global positioning data.

Materials and Methods:

Bathymetry

Depth measurements and GPS coordinates were recorded at over 250 points around the lake perimeter and along transects across the lake. A Thales Mobile Mapper® global positioning unit was used to record the surface location (latitude and longitude) of all depth soundings. Lake edge delineation was conducted by Alma College researchers with a Trimble GPS unit and used to define the boundaries of the lake surface (depth = zero). Precise delineation of the lake edge was difficult and somewhat subjective as the lake perimeter has abundant wetlands with emergent macrophytes and standing water so it is difficult to determine a precise lake edge boundary. Decimal GPS coordinates for latitude and longitude made up the X and Y coordinates of the data set and lake water depth (depth from the surface water elevation to bottom) comprised the Z coordinate.

Lake water depth was measured using a calibrated polypropylene rope attached to a 2.5 pound steel weight. Measurements of lake water depth started on a roughly south-southwest to north-northeast transect along the length of the lake. Additional depth soundings were made along five east-west transects set at right angles to the north-south transect. Accumulated dated were first hand-plotted to establish a rough bathymetric map in the field. Data were then typed into data tables and fed into the Surfer® version 8 software to generate a wire-frame contour map of the lake from edge to bottom. Data were compiled to generate a colored bathymetric map of the lake using Surfer® version 8 computer software (Golden Software, 2004).

Limnological Profiles and Sampling

Measurements of temperature, pH, dissolved oxygen saturation and oxidation-reduction potential were made using a YSI 556 multi-probe analyzer with a 10-meter cable and attached, weighted sonde unit. The YSI unit uses a solid-state polarographic probe for measurement of dissolved oxygen saturation in ambient samples. Temperature is measured via a precision thermistor having a range of - 5 C to 45 C with an accuracy of +/- 0.1 degrees C. pH is measured via a glass combination electrode with a range of 0 to 14 pH units with accuracy of +/- 0.2 units. Oxidation/reduction potential is determined using a platinum button electrode with a range of – 999 mV to 999 mV. The meter was calibrated for dissolved oxygen and pH before each field use.

Algal samples were collected by a variety of techniques throughout the summer. These included collection of whole water samples, collection of floating mats of algae, and scraping of plant leaves, stones and other substrates. Algae samples were taken to the Biology Department at Central Michigan University for identification. Algal genera were identified using light microscopy and Prescott (1978). Macrophytes were identified in the field using Wandell and Wolfson (2000).

During our final sampling period we collected representative lake water samples for ion and nutrient analyses according to standard methods (APHA, 2001). These samples were analyzed in the laboratory of Dr. Monaliza Sirbescu at Central Michigan University using automated ion chromatography systems. Samples were analyzed by ion exchange chromatography using a Dionex DX-320 Ion Chromatograph with a suppressed conductivity detector system. Samples were run through an IonPac CS12A 4 mm column for cations and an IonPac AS9-HC 4mm column for anions. Duplicate runs were made on all samples and the results averaged. To assure diurnal consistency throughout the study, all samples were collected and measurements taken between 10:00 and 11:45 hours.

Secchi disk readings were taken at three surface sites to determine water transparency (Beeton, 1958; 1961) during the May sampling. Transparency readings (2.5 meters to 2.65 meters) were similar to those obtained by Cimo and Wolfson (2001) throughout the study period and were not repeated after the May sampling as they were expected to vary little during the study. We did note some decrease in water transparency during mid-Summer as algal populations increased. By late July, water transparency as measured by Secchi disk visibility had returned to 2.6 meters.

Results and Discussion

Bathymetry and Lake Origin

The bathymetric map generated for Brewster Lake is depicted in Figure 2. A general review of the bathymetry indicates a typical "pot hole" lake of glacial origin that has been modified in the post-glacial period by biological productivity and surficial hydrology. It is postulated that the lake was originally formed by deposition of one irregular or two individual blocks of calved glacial ice, based on the two discrete basins observed in the bathymetry. This ice was likely imbedded in the glacial outwash till and subsequently melted to form Brewster Lake. The steep side slopes of much of the existing lake indicate that the ice form was likely in a solid rectangular shape that originally formed near vertical walls which have subsequently eroded to form the current lake basin. Primary productivity and accumulation of organic matter over the circa 11,000 year post-glacial period has resulted in the deposition of organic matter in the lake sediments. The complete data set used to generate the bathymetric map is contained in Table 1.

Algae and Macrophytes

Brewster Lake has very productive and diverse populations of both algae and macrophytes (see Photographs 1 and 2). Data from two representative algae samplings and a list of macrophytes observed throughout the study period are contained in Table 2. Samples collected in late Spring and early summer showed a preponderance of green algae and diatoms. Later samples exhibited increasing populations of blue-green algae and subsequent diminishment of diatoms and green algae species. Algal genera identified were typical of mesotrophic lake systems. As early as mid-June of 2005 we observed floating mats of algae on the surface of the lake (Photograph 2).

Macrophytes, both submerged and emergent, were abundant in the lake throughout the entire study period. Large areas of the littoral zone were totally covered with emergent macrophytes. Submerged macrophytes were observed throughout the lake at depths from 0-10 feet. These large populations of primary producers indicated the likelihood of significant nutrient enrichment in the lake ecosystem. No quantitative assessment of primary productivity was undertaken as part of this study but should be considered for further research.

Lake basin soil types and a soil map were obtained from the Natural Resources Conservation Service of the United States Department of Agriculture in East Lansing, Michigan (Guthrie 2005). Review of these maps showed a preponderance of Houghton Muck soil in the immediate lake basin. This soil type is a heavy soil rich in organic components that may serve as a reservoir for phosphorous and nitrate/nitrite input to the lake. Photographs of the lake showing the dense aquatic macrophyte growth and a floating mat of algae are included in the attachments as Photograph 1 and 2 respectively.

Water Quality Data

Climo and Wolfson (2001) conducted some elementary limnological studies on Brewster Lake in 2000 in an attempt to provide a baseline set of data. Data generated in that study seemed to support more of a mesotrophic or meso-eutrophic classification for Brewster Lake than the meso-oligotrohic classification previously ascribed to this body of water. This is particularly evident when evaluating the data collected at certain periods of the year where dissolved oxygen in the hypolimnion dropped to zero and an abundance of blue-green algae were noted in the water column. Our survey verified anoxic conditions in portions of the hypolimnion during the study period.

Water quality profiles for Temperature, pH, Dissolve Oxygen Saturation, and Oxidation/Reduction potential are shown in Table 3 (a. through j.). Brewster Lake exhibited characteristics of a typical, dimyctic inland lake of North America. The lake underwent stratification early in the field season and remained thermally stratified throughout the study period. The period of study was warmer than recent years and was slightly deficient in rainfall based on long-term averages (NOAA 2005). These conditions likely accelerated the seasonal stratification and resulted in very high surface temperatures (>26 C) earlier in the season than would be expected for lakes at this latitude. Water surface temperatures varied from 24 to 26.5 degrees C while bottom temperatures ranged from 6.8 to 7.6 C throughout the study period.

Dissolved oxygen saturation ranged from a high of 84.5% early in the study period at the mid-depths of the lake to near zero in the hypolimnion . We determined an anoxic zone (< 1% oxygen saturation) in the deep holes of the lake that was approximately 6 feet thick. Bottom sediments in these areas consisted of a fine, organic muck interspersed with marl. It is postulated that respiration in these bottom sediments resulted in oxygen depletion during the time that the lake remained stratified. One area suggested for additional research is a more detailed examination of the composition and biological activity of the deep bottom sediments of Brewster Lake.

The pH of Brewster Lake water varied from 6.7 to 10.1. pH generally was highest in surface water samples and decreased with depth. Organic acids in lake sediments may be responsible for this observation. There also appears to be a relationship between lake water pH and the relative contribution of surface and groundwater sources to the lake water. Early in this study, during an extremely dry period when groundwater sources would be expected to dominate, the pH was higher, running from 7.5 to 9.5 at surface to mid-depths. During one sampling period, approximately 24 hours after a major rain event, the pH dropped to 7.5 to 7.8 throughout the water column. We expect this is the result of the inflow of acidic precipitation to the lake basin after the rain event that was caught before buffering by carbonates and bicarbonates was complete.

The results of analysis of anions and cations in Brewster Lake water samples are presented in Table 4. It does not appear that either phosphorus or nitrates are excessively high in this ecosystem, thus not supporting classification as a full-blown Eutrophic lake. High sulfate concentrations were observed and were confirmed by sulfurous odors detected when bottom sediments were collected. Overall, the chemical data collected and the biota observed would seem to support a trophic classification for Brewster Lake as either a Mesotrophic or Meso-Eutrophic system.

More detailed studies of the water quality of Brewster Lake and the drainage basin are recommended as areas for further research. Additional profiles of dissolved oxygen, pH, temperature, conductivity, and nutrient flux taken earlier in the Spring and Summer should help to determine the ultimate proper classification for Brewster Lake. If possible, profiles should also be collected through the ice in late Winter to determine if anoxic conditions are produced by ice cover. No record was found of any reports of winter kill of fish on the lake, but this is likely given the anoxic conditions reported in this and earlier studies. Additional nutrient analyses of lake water, influent runoff, precipitation and groundwater should be performed to quantify the sources and relative contributions of nutrient inputs to the lake.

Presentation and Dissemination of Results

The student and faculty mentor have prepared this final report on the project for submission to the Pierce Cedar Creek Institute. Results of this study are also being presented in poster form by the student researcher at the September 24, 2005 meeting of the PCCI University Research Consortium Board and PCCI board members at the institute.

Results of this study will also be prepared in poster format for presentation at Central Michigan University's "Posters at the Capitol" symposium in April of 2006. This is an annual event in Lansing that showcases undergraduate research projects from CMU. Research projects presented at this poster session are also promoted by CMU's office of information services which sends out press releases and abstracts of research work presented at this session. This event helps to publicize undergraduate research work at CMU and will bring the Pierce Cedar Creek Institute work to the attention of lawmakers and influential agency staff in the state capitol.

Relationship to Goals of the Institute

The primary purpose of this research project was to provide an experiential learning experience for the undergraduate student conducting the study while generating a useful bathymetric map of Brewster Lake and some baseline limnological data. This project provided hands-on experience in a number of the techniques and methods of applied limnology and generated a complete bathymetric map of Brewster Lake. The study served as a student research project which generated new limnological data and contributed to the body of scientific knowledge relating to southern Michigan inland lakes.

The student researcher had the opportunity to work closely with the faculty mentor and receive one-on-one training in limnological study techniques and scientific investigation. This project supported the stated educational principles and goals of the Pierce Cedar Creek Institute and provided a map and data for use by the institute. Evaluations of the experience by the student researcher and the faculty mentor will be used to help improve the undergraduate research program of the institute.

Acknowledgements

We are grateful for and express our thanks to the Pierce Cedar Creek Institute, their Board of Directors and their excellent staff for their support of this project. Dr. Monaliza Sirbescu of the Department of Geology at Central Michigan University performed chemical analysis of water samples for us without charge and we thank her for her assistance. Central Michigan University in Mount Pleasant provided laboratory space, computer support and other in-kind support to this project throughout the summer.

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Attachments:

Tables and figures follow as attachments.

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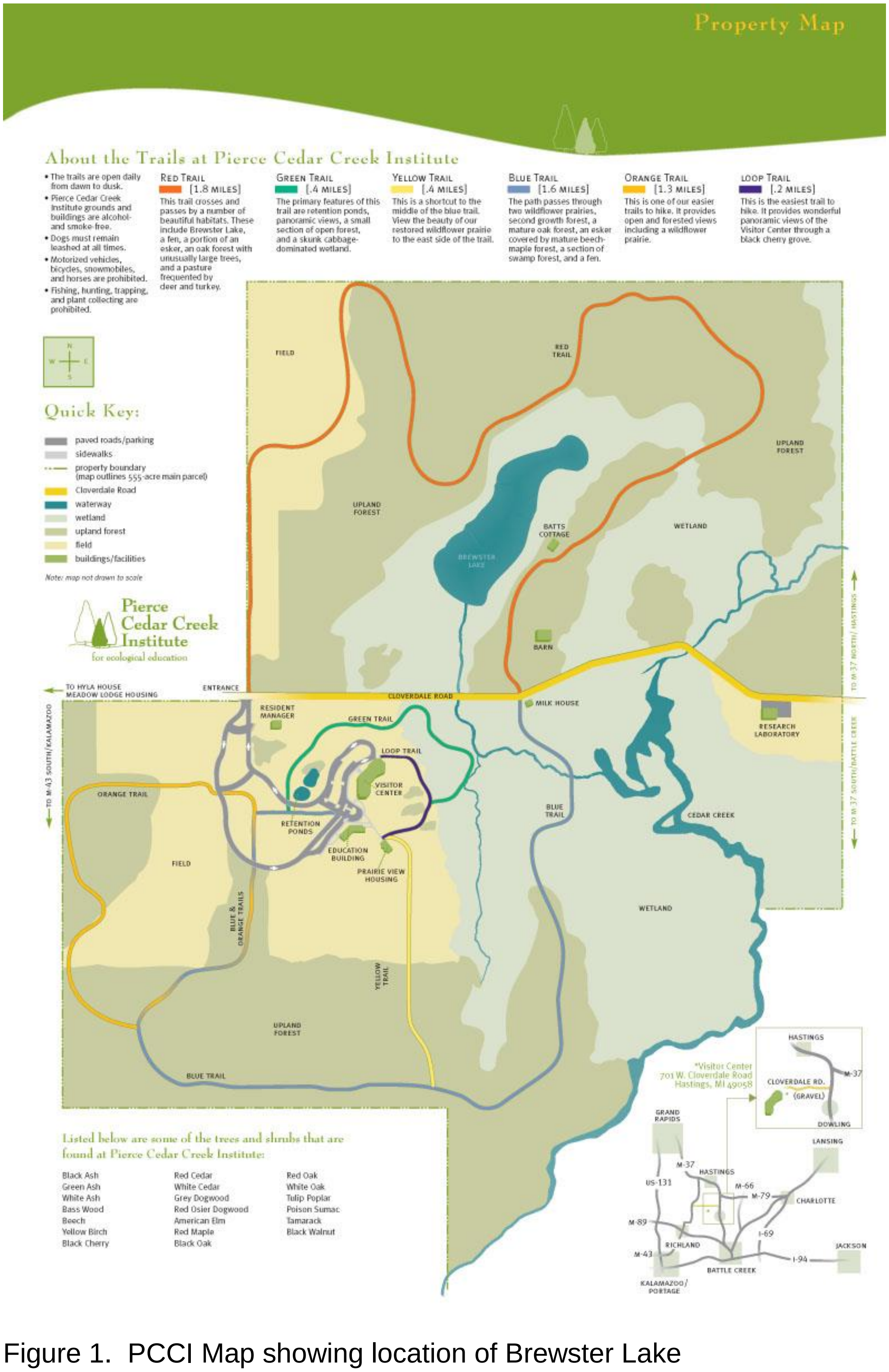

Figure 1. PCCI Map showing location of Brewster Lake

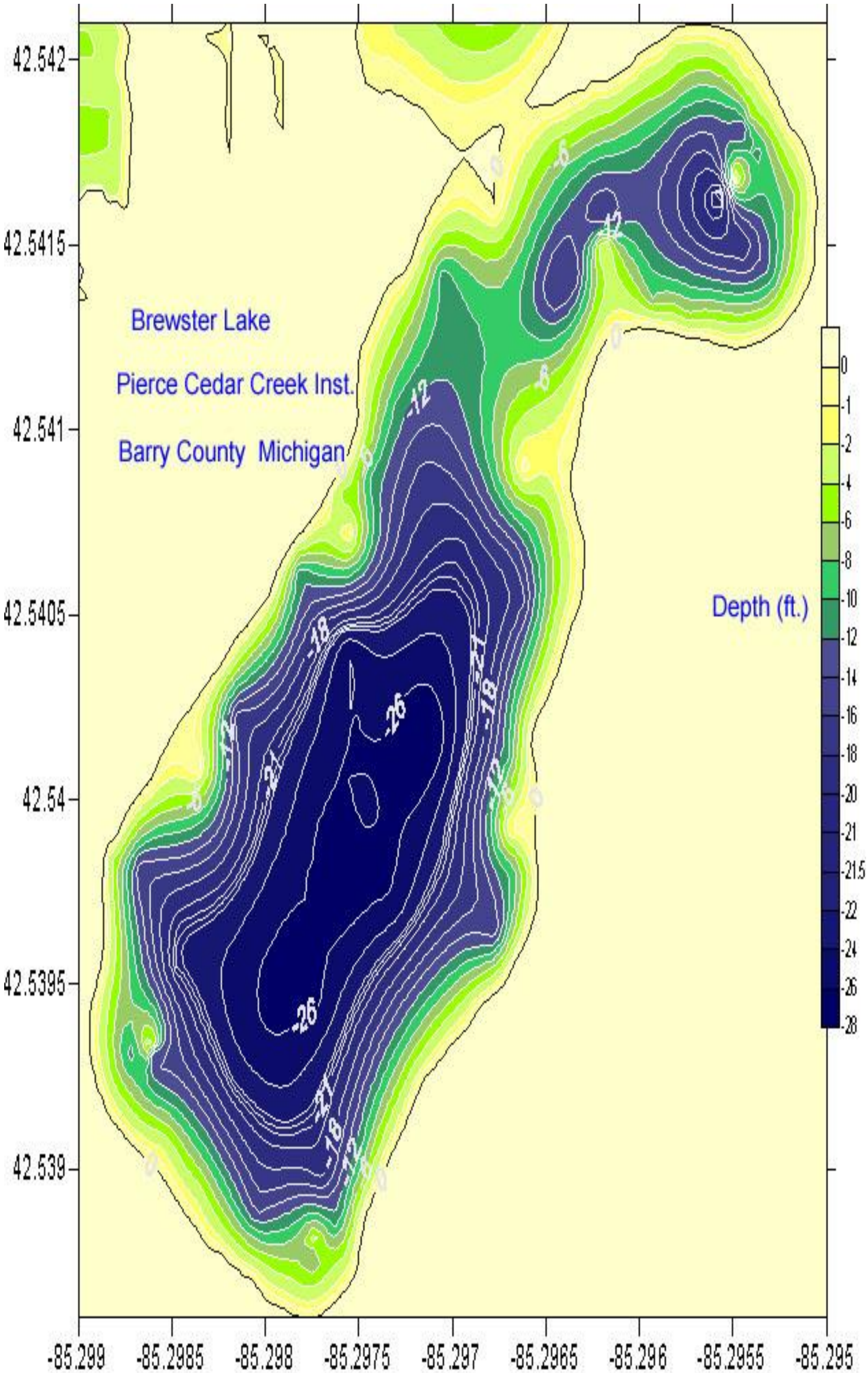
Brewster Lake
Pierce Cedar Creek Inst.
Barry County Michigan
Depth (ft.)
0
-1
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-21
-21.5
-22
-24
-26
-28
42.542
42.5415
42.541
42.5405
42.54
42.5395
42.539
-85.299
-85.2985
-85.298
-85.2975
-85.297
-85.2965
-85.296
-85.2955
-85.295

Figure 2. Bathymetric Map of Brewster Lake. Latitude and Longitude are shown on the Y and X axis. Depth contours are shown at 2 foot intervals.

Table 1. Raw Data of Brewster Lake Perimeter and Depth Soundings.

Longitude (DMS)	Latitude (DMS)	Water Depth (ft) from Surface
-85.296775	42.542272	-12.0
-85.290397	42.540550	-3.5
-85.297814	42.540625	-12.0
-85.297806	42.540631	-9.5
-85.297739	42.540567	-12.5
-85.297558	42.540408	-26.0
-85.297111	42.540161	-28.0
-85.296853	42.540161	-19.0
-85.296642	42.540331	-10.0
-85.297678	42.539808	-28.0
-85.297958	42.539356	-26.0
-85.298347	42.538933	-3.0
-85.298539	42.539083	-3.0
-85.298631	42.539206	-9.0
-85.298794	42.539453	-6.0
-85.298575	42.539794	-16.0
-85.298158	42.540228	-17.0
-85.296219	42.541553	-15.0
-85.29545	42.541964	-2.0
-85.295358	42.541747	-11.0
-85.295933	42.541356	-8.0
-85.296525	42.540786	-6.0
-85.297203	42.539303	-5.0
-85.297831	42.538703	-4.5
-85.298006	42.538856	-12.0
-85.297828	42.539328	-25.0
-85.297883	42.539925	-24.0
-85.297281	42.541069	-11.0
-85.297053	42.541419	-11.0
-85.296453	42.541361	-16.0
-85.296947	42.540708	-20.0
-85.297456	42.539967	-25.5
-85.296767	42.539642	-15.5
-85.297311	42.539711	-25.5
-85.298719	42.539886	-6.0
-85.298472	42.539656	-21.0
-85.298758	42.539197	-4.5
-85.298594	42.539306	-15.0
-85.297881	42.539778	-25.5

-85.297461	42.541067	-3.0
-85.297172	42.540908	-16.0
-85.296442	42.540475	-3.0
-85.296681	42.540675	-15.5
-85.297739	42.539842	-26.0
-85.297769	42.539733	-26.0
-85.297653	42.5396	-26.0
-85.297708	42.539439	-26.0
-85.298144	42.539417	-25.0
-85.298167	42.539233	-22.0
-85.297881	42.539167	-23.0
-85.2978	42.539108	-21.0
-85.29805	42.538886	-14.5
-85.297742	42.538775	-9.0
-85.297492	42.539047	-10.0
-85.297461	42.539039	-7.5
-85.297608	42.540828	-5.0
-85.297439	42.540864	-10.5
85.297144	42.540744	-20.0
-85.296628	42.540542	-17.0
-85.296694	42.540119	-10.0
-85.296464	42.5418	-3.5
-85.296133	42.541753	-9.5
-85.295697	42.542	-4.5
-85.295789	42.541811	-12.5
-85.2954	42.541844	-5.5
-85.29545	42.541811	-15.0
-85.295156	42.541639	-5.5
-85.292114	42.541508	-4.0
85.295278	42.541594	-13.0
-85.29555	42.541644	-22.5
-85.295314	42.541306	-4.0
-85.295306	42.541422	-12.0
-85.295619	42.541714	-17.5
-85.295431	42.541494	-17.5
-85.295739	42.541314	-6.0
-85.295719	42.541481	-14.5
-85.296158	42.541556	-14.5
-85.296178	42.541311	-2.5
-85.296347	42.541414	-16.0
-85.29658	42.53981	-2.5
-85.29667	42.53981	-9
85.29883	42.53927	-5.5
-85.29872	42.53932	-11.5
-85.29849	42.53955	-21.5
85.29821	42.53984	-24
-85.29882	42.53985	-4.5
-85.29868	42.53982	-15
85.29797	42.53971	-27
-85.29756	42.53877	-3.5

-85.29762	42.53886	-11.5
-85.2977	42.53899	-19
-85.29625	42.54191	-1.5
-85.29605	42.54187	-5.5
-85.29598	42.54199	-1.5
-85.29583	42.54192	-6
-85.29581	42.54204	-2.5
-85.29567	42.542	-5
-85.29562	42.54183	-13
-85.29787	42.53938	-26
-85.29738	42.54025	-25
-85.29655	42.53973	0
-85.29658	42.53965	0
-85.29664	42.53959	0
-85.29669	42.53954	0
-85.29674	42.53949	0
-85.29679	42.53947	0
-85.29686	42.53944	0
-85.29692	42.53938	0
-85.29701	42.53934	0
-85.29707	42.53929	0
-85.29715	42.53925	0
-85.29719	42.53920	0
-85.29723	42.53915	0
-85.29727	42.53910	0
-85.29732	42.53905	0
-85.29736	42.53900	0
-85.2974	42.53895	0
-85.29745	42.53890	0
-85.29748	42.53885	0
-85.2975	42.53878	0
-85.29752	42.53871	0
-85.29758	42.53867	0
-85.29765	42.53863	0
-85.29773	42.53860	0
-85.29782	42.53860	0
-85.29792	42.53863	0
-85.29799	42.53864	0
-85.29806	42.53870	0
-85.29815	42.53873	0
-85.29823	42.53877	0
-85.29831	42.53879	0
-85.29837	42.53884	0
-85.29843	42.53888	0
-85.29849	42.53893	0
-85.29855	42.53898	0
-85.29862	42.53902	0
-85.2987	42.53906	0
-85.29878	42.53911	0
-85.29883	42.53914	0

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-85.29892	42.53927	0
-85.29894	42.53932	0
-85.29894	42.53938	0
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-85.2989	42.53950	0
-85.29888	42.53955	0
-85.29886	42.53962	0
-85.29886	42.53969	0
-85.29887	42.53975	0
-85.29886	42.53982	0
-85.29881	42.53988	0
-85.29877	42.53993	0
-85.29869	42.54000	0
-85.29861	42.54005	0
-85.29857	42.54011	0
-85.29851	42.54017	0
-85.29846	42.54022	0
-85.2984	42.54025	0
-85.29834	42.54029	0
-85.29827	42.54034	0
-85.29821	42.54038	0
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-85.29811	42.54046	0
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-85.29752	42.54099	0
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-85.29698	42.54171	0

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-85.29648	42.54187	0
-85.29643	42.54188	0
-85.2964	42.54190	0
-85.29634	42.54191	0
-85.29628	42.54192	0
-85.29622	42.54194	0
-85.29616	42.54194	0
-85.29611	42.54196	0
-85.29605	42.54198	0
-85.29598	42.54202	0
-85.29589	42.54205	0
-85.29583	42.54207	0
-85.29575	42.54209	0
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-85.29554	42.54208	0
-85.29547	42.54207	0
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-85.29536	42.54199	0
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-85.29526	42.54189	0
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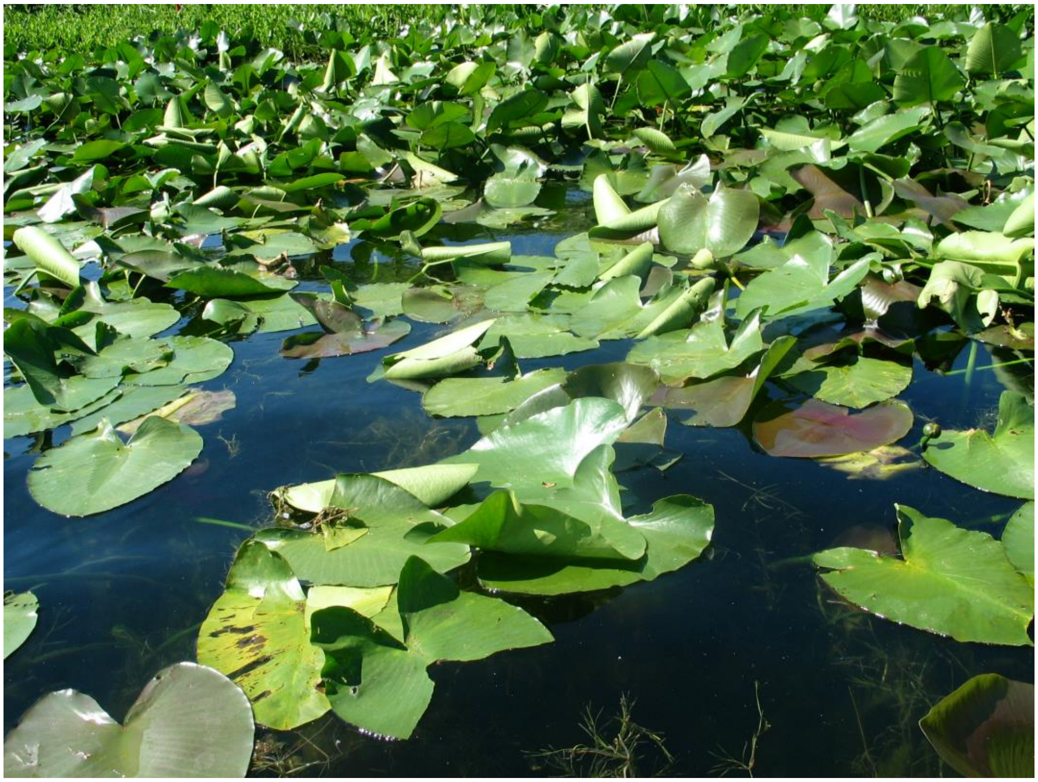
-85.2952	42.54182	0
-85.29516	42.54180	0
-85.29511	42.54176	0
-85.29509	42.54172	0
-85.29506	42.54166	0
-85.29505	42.54162	0
-85.29506	42.54157	0
-85.29507	42.54153	0
-85.29506	42.54148	0
-85.29507	42.54143	0
-85.2951	42.54139	0
-85.29513	42.54136	0
-85.29516	42.54133	0
-85.29521	42.54130	0
-85.29526	42.54127	0
-85.29531	42.54125	0
-85.29536	42.54124	0
-85.29541	42.54123	0
-85.29548	42.54122	0
-85.29555	42.54123	0

-85.29562	42.54124	0
-85.29567	42.54125	0
-85.29574	42.54125	0
-85.2958	42.54126	0
-85.29586	42.54127	0
-85.29594	42.54128	0
-85.296	42.54128	0
-85.29608	42.54126	0
-85.29615	42.54126	0
-85.2962	42.54123	0
-85.29623	42.54119	0
-85.29627	42.54114	0
-85.29629	42.54110	0
-85.29631	42.54104	0
-85.29632	42.54099	0
-85.29634	42.54093	0
-85.29637	42.54088	0
-85.29637	42.54083	0
-85.29634	42.54078	0
-85.29632	42.54074	0
-85.29629	42.54069	0
-85.2963	42.54062	0
-85.2963	42.54057	0
-85.29632	42.54052	0
-85.29636	42.54048	0
-85.29639	42.54043	0
-85.29642	42.54038	0
-85.29645	42.54033	0
-85.29648	42.54029	0
-85.29652	42.54025	0
-85.29656	42.54021	0
-85.29658	42.54016	0
-85.29657	42.54011	0
-85.29655	42.54006	0
-85.29655	42.54002	0
-85.29655	42.53998	0
-85.29655	42.53993	0
-85.29656	42.53989	0
-85.29656	42.53988	0
-85.29656	42.53984	0
-85.29655	42.53980	0
-85.29669	42.53992	0
-85.29774	42.53879	0
-85.29861	42.53933	0
-85.29835	42.54008	0
-85.29755	42.54071	0
-85.29677	42.54159	0
-85.29549	42.54168	0
-85.29619	42.54151	0
-85.29663	42.54089	0

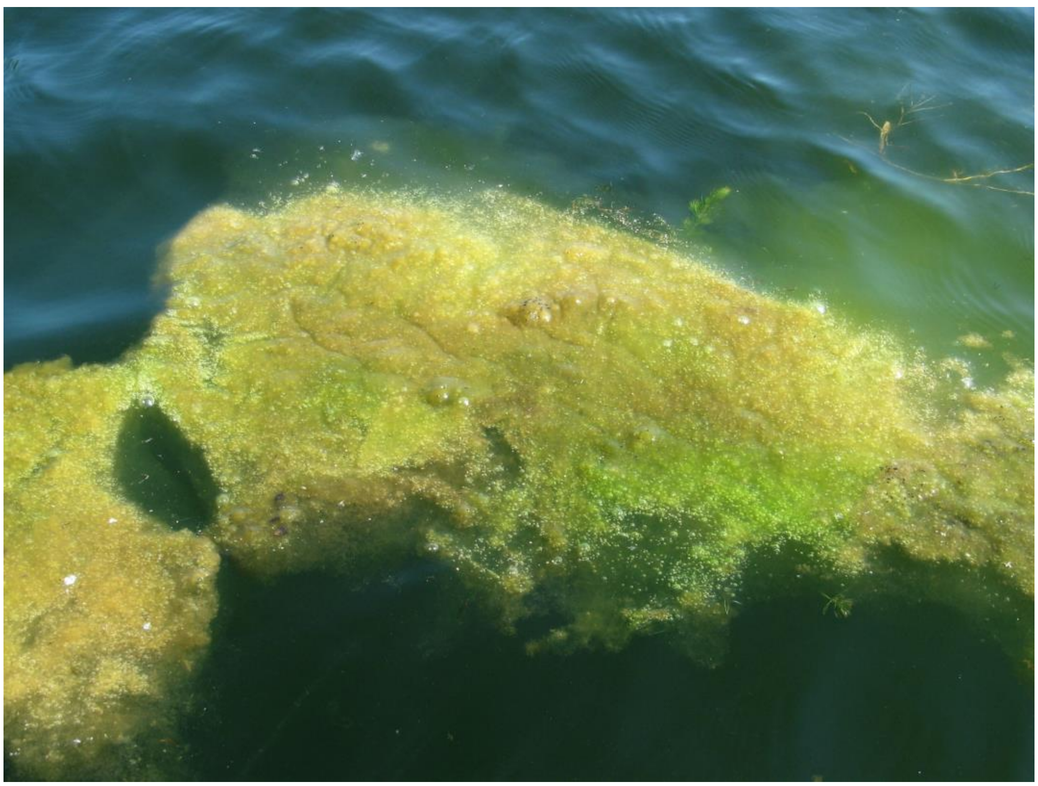
-85.29628	42.53997	0

Table 2. Algae Genera and Macrophytes Identified in Brewster Lake.

Algae 6/28/05 collection	***Algae 7/12/05 collection***	***Aquatic Macrophytes***
Fragilaria	*Achnanthes*	*Nuphar sp. (Yellow water lily)*
Coelastrium	*Mougeotia*	*Nymphaea sp. (White water lily)*
Mougeotia	*Synedra*	*Potamogeton americanus (American Pondweed)*
Gomphospaeria	*Spirogyra*	*Utricularia sp. (Bladderwort)*
Cymbella	*Cymbella*	*Ceratophyllum demersum (Coontail)*
Synedra	*Flagilaria*	*Potamogeton amplifolius (Large-leafed pondweed)*
Spirogyra	*Oocystis*	*Elodea sp. (Water weed)*
Navicula	*Volvox*	*Chara sp. (Stonewort)*
Pinnularia	*Trachelmonas*	*Najas sp. (Bushy pondweed)*
Cyclotella	*Sphaerocystis*	*Typha latifolia (Cattail)*
Navicula	*Microcystis*	*Lythrum salicaria (Purple loosestrife)*



Photograph 1. Emergent and submerged macrophytes along the shore of Brewster Lake.



Photograph 2. Mat of floating algae on Brewster Lake

Figure 3 – Water Temperature, pH, Dissolved Oxygen % Saturation and Oxidation/Reduction Potential (ORP) Profiles of Brewster Lake – 2005.

Figure 3.a.

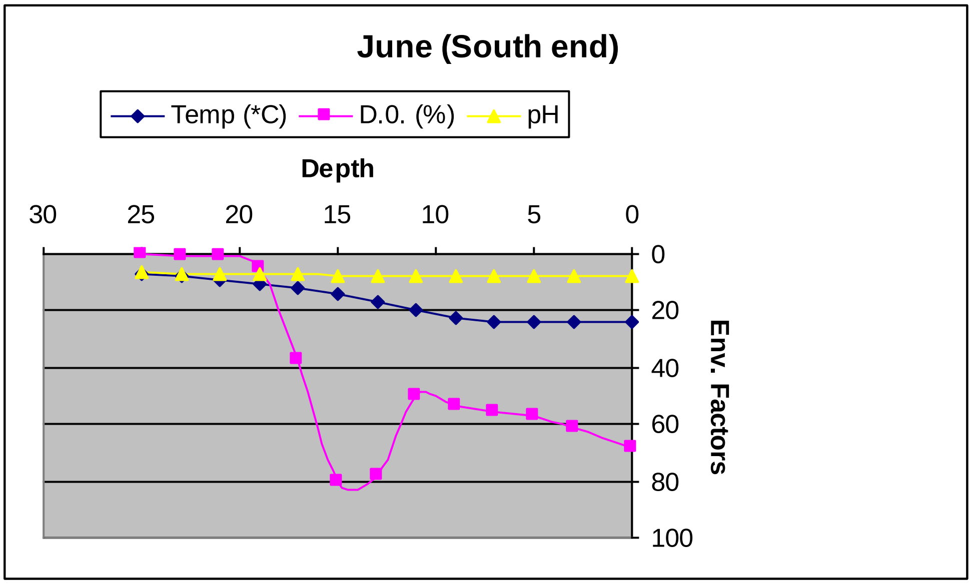


Figure 3.b.

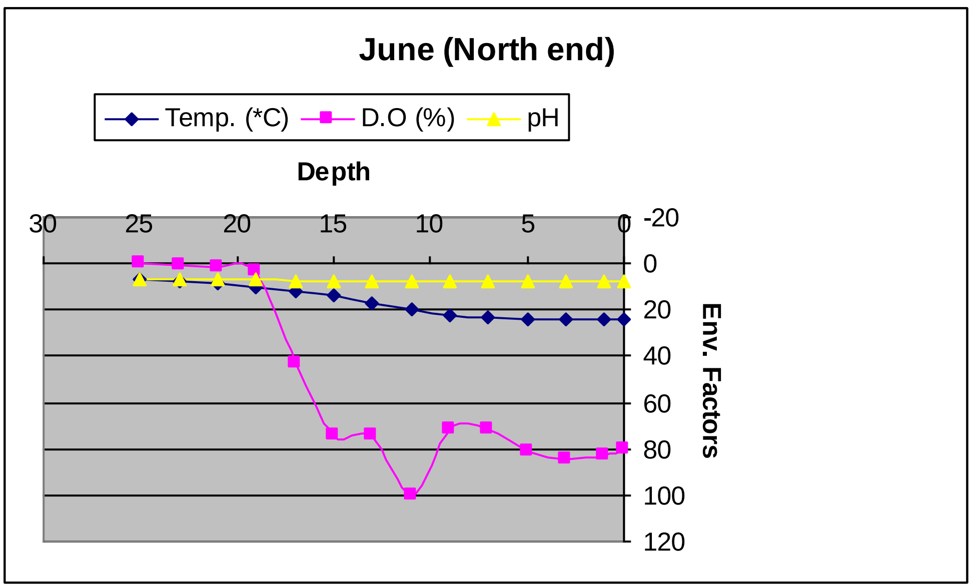


Figure 3.c.

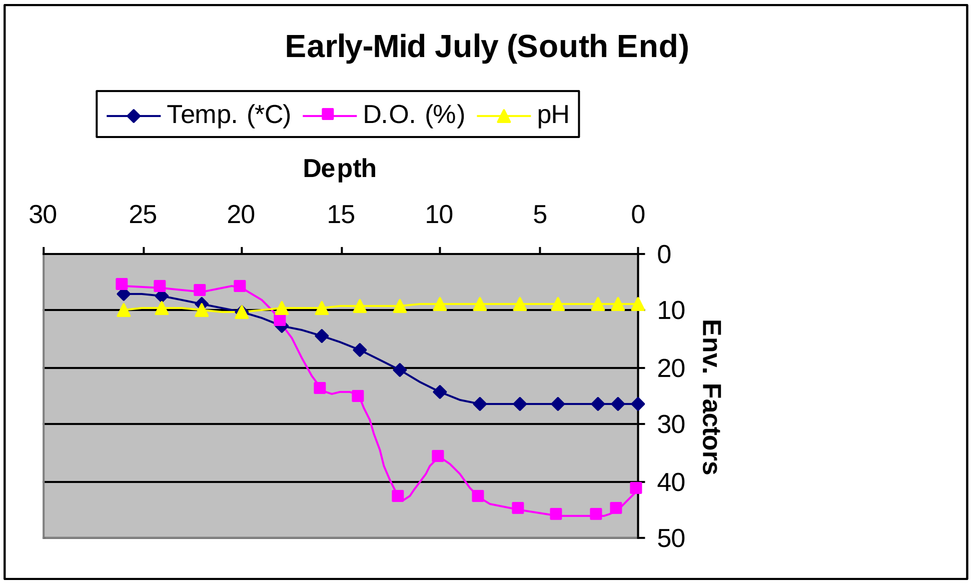


Figure 3.d.

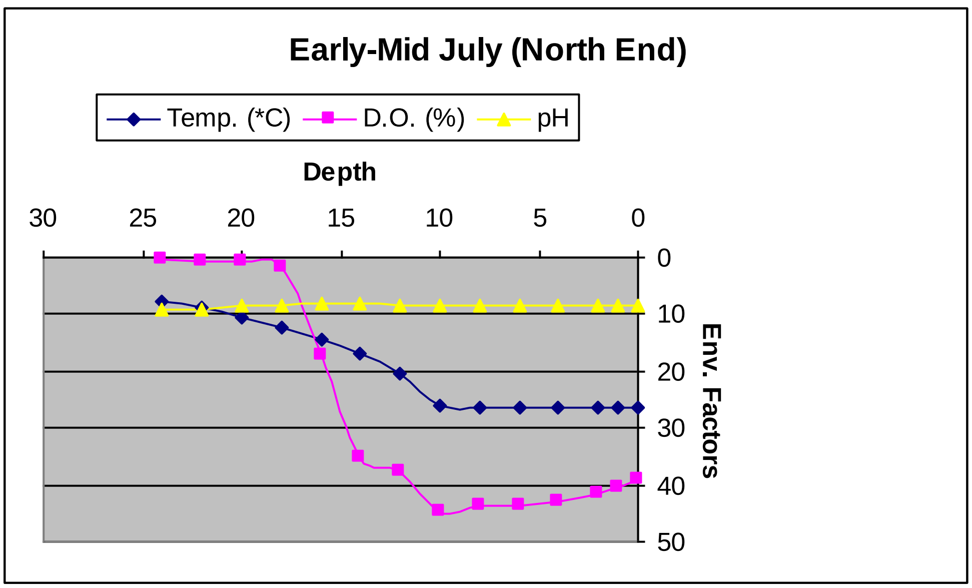


Figure 3.e.

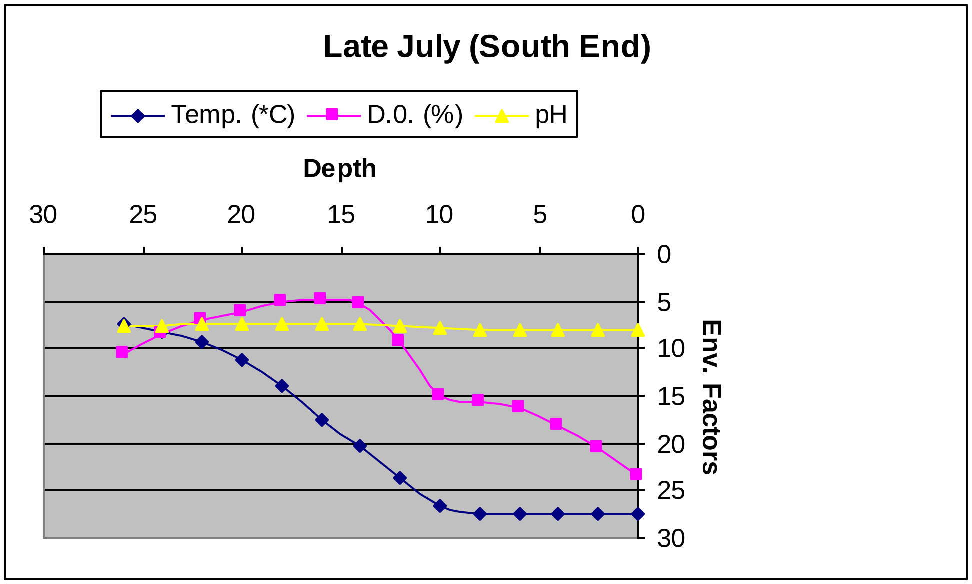


Figure 3.f.

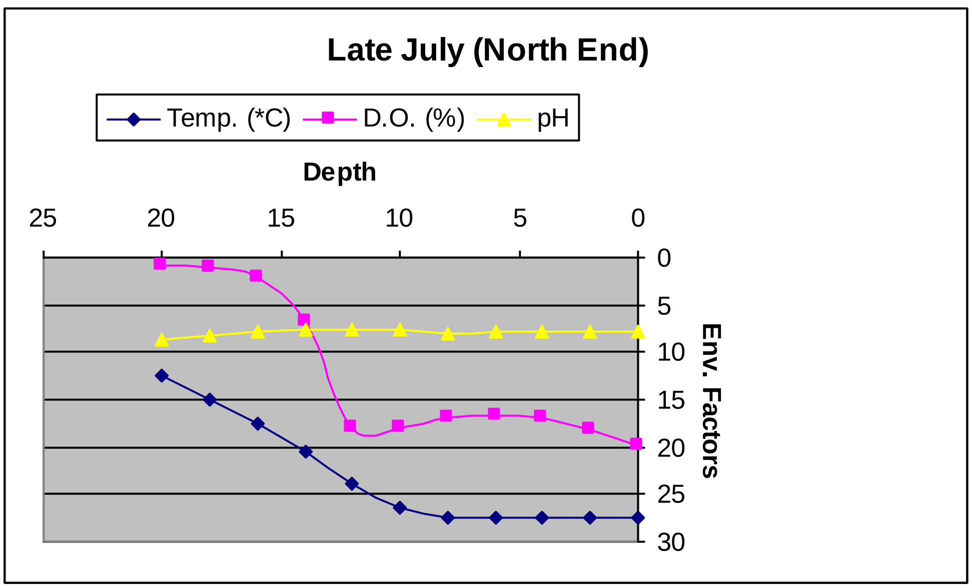


Figure 3.g.

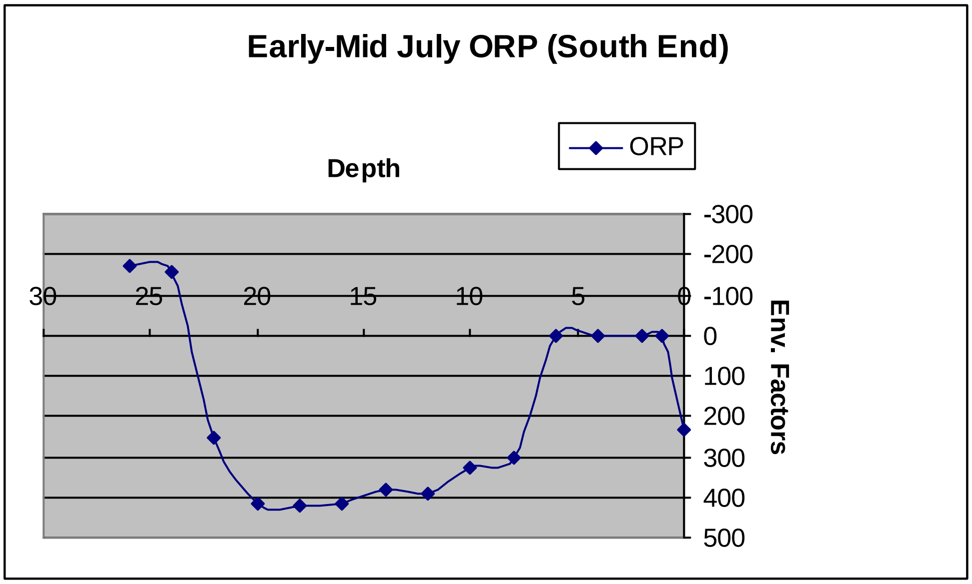


Figure 3.h.

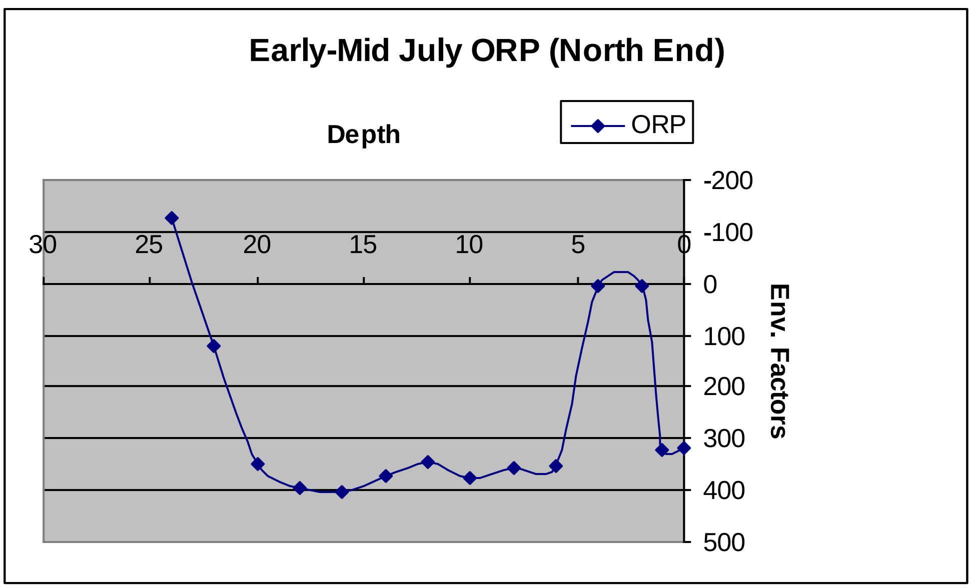


Figure 3.i.

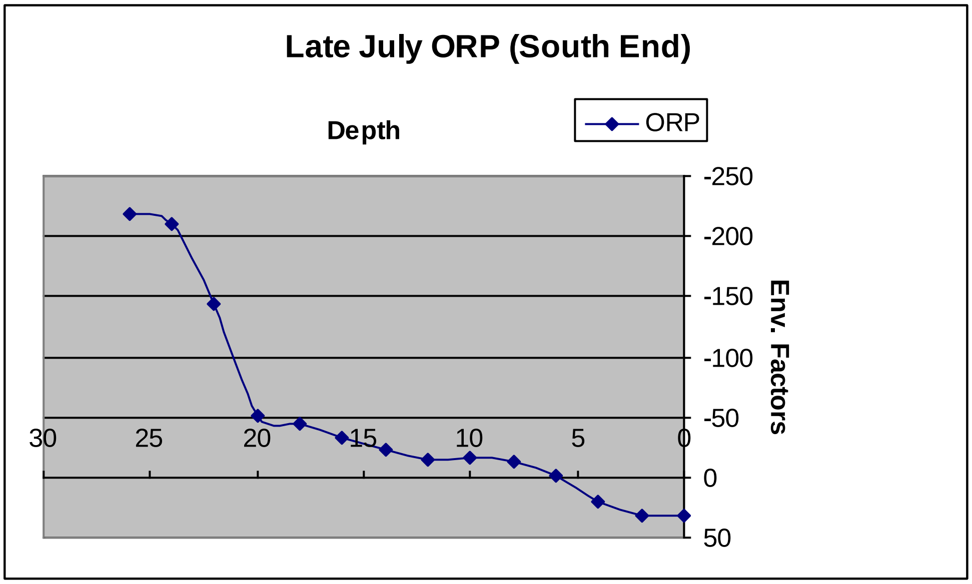


Figure 3.j.

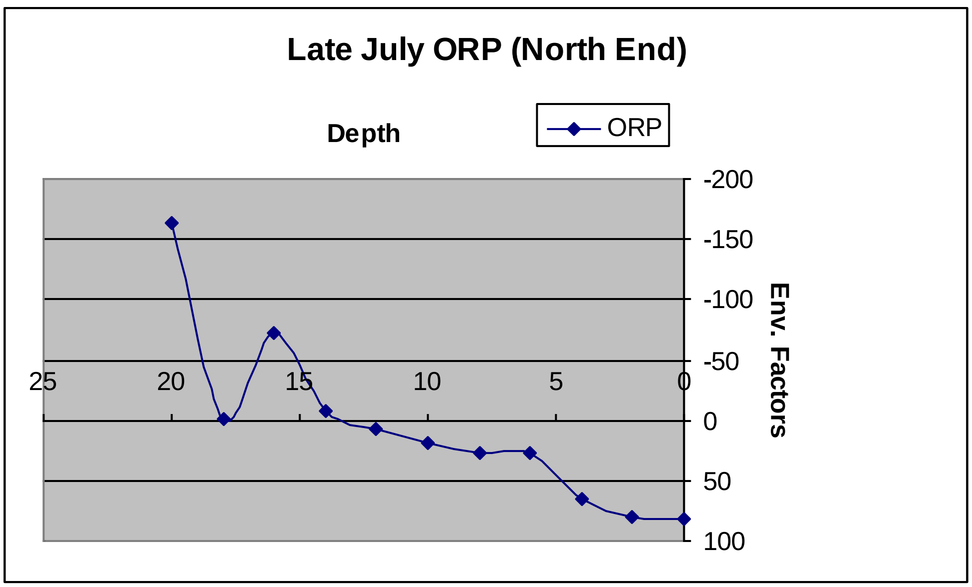


Table 4. Results of Ion-Chromatograph Analyses of Brewster Lake Water.

Ion Chromatograph Analysis of Brewster Lake Water Samples -- Sirbescu

Sample No.	Time	Sample ID ION =	Amount ppb F	Amount ppb Cl	Amount ppb NO2	Amount ppb Br	Amount ppb NO3	Amount ppb PO4	Amount ppb SO4
81	11.08.05 10:17	BL-1	302	1350	n.a.	n.a.	n.a.	n.a.	5986
82	11.08.05 10:48	BL-1	288	1325	n.a.	n.a.	n.a.	n.a.	5963
83	11.08.05 11:18	BL-2	294	1293	n.a.	n.a.	n.a.	n.a.	5722
84	11.08.05 11:49	BL-2	289	1283	n.a.	n.a.	n.a.	n.a.	6025
85	11.08.05 13:20	BL-4	302	1219	n.a.	n.a.	n.a.	n.a.	5864
86	11.08.05 13:51	BL-4	298	1247	n.a.	n.a.	n.a.	n.a.	5934
87	11.08.05 14:21	BL-3	289	1259	n.a.	n.a.	n.a.	n.a.	5902