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2004 Bone Lake Water Quality
Technical Report

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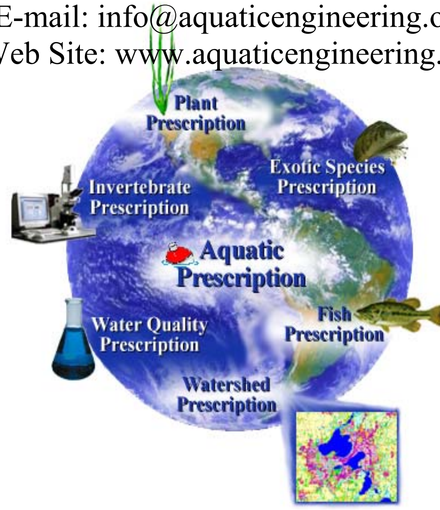

2004 Bone Lake Water Quality Technical Report

February 2005

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In cooperation with the Wisconsin Department of Natural Resources and the Polk County Land and Water Resources Department

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Executive Summary

Bone Lake is a 1,781-acre drainage lake located in Polk County, Wisconsin. Four inflows are located in the sub-watersheds. The outflow is the Fox Creek, which flows into the Apple River. The Bone Lake watershed is part of the Upper Apple River watershed in the Saint Croix River Basin. This basin was designated as a priority for non-point source pollution control by the Saint Croix Water Quality Management Plan *(WI DNR 1994)* and included in the Polk County Land and Water Resource Plan *(Bursik 2001)*.

The water quality of Bone Lake was sampled from June to October of 2004. A single sample station was selected for the North and South basins of Bone Lake. Parameters of reactive phosphorus, total phosphorus, total Kjeldahl nitrogen, and chlorophyll a were analyzed by the Water and Environmental Analysis Laboratory located at the University of Wisconsin - Stevens Point. Temperature, dissolved oxygen, conductivity, specific conductance, and salinity were recorded on site and measured with a YSI probe at one-meter intervals from the surface to the bottom. Secchi depth readings were also taken at each water quality sampling point. Measurements were taken weekly in June and July and once per month in August through October.

The water quality results and Secchi readings show that Bone Lake is a mesotrophic to slightly eutrophic lake with a composite[1] TSI (Trophic Status Index) value of 48.3. The North basin of Bone Lake is slightly more eutrophic than the South basin with TSI values of 49.6 and 46.9, respectively. Bone Lake becomes thermally stratified in the summer and mixes well in the spring and fall. The condition of the lake water quality is similar to that of other lakes in the region.

The TSI values observed in 2004 were improvements from the values reported in the 1997 Barr Engineering report. The improvements may be due to the implementation of

[1] A composite TSI value was calculated by averaging the TSI_{TP}, $TSI_{Chl\ a}$ and TSI_S values from both basins.

recommendations made in that report or could be due to seasonal variation in temperature and precipitation.

Recommendations outlined in the current management plan should continue to be implemented. In addition to current recommendations, it is recommended that Bone Lake manage its curly-leaf pondweed population every spring to minimize the phosphorus loading affects that occur each summer when CLP decays. Self-help monitoring and the creation and enforcement of zoning and land use ordinances will continue to play a major role in improving water quality within Bone Lake.

2004 Bone Lake Water Quality Monitoring Technical Report

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Introduction

Bone Lake *(WDNR Water Body Identification Code #2628100)* is a 1,781-acre drainage lake with a mean depth of 23 feet and a maximum depth of 43 feet, located in Polk County, Wisconsin. Four inflows are located in the sub-watersheds. The outflow is Fox Creek, which flows into the Apple River. The Bone Lake watershed is part of the Upper Apple River watershed in the Saint Croix River Basin, which was designated as a priority for non-point source pollution control by the Saint Croix Water Quality Management Plan *(WI DNR 1994)* and included in the Polk County Land and Water Resource Plan *(Bursik 2001)*.

The Bone Lake Management District was formed in 1975 to address issues of dense algal blooms and extensive weed beds. The District immediately sought help from the Office of Inland Lake Renewal, which conducted a survey of Bone Lake from 1977 to 1978. The results of the survey were presented to the District in 1980 and concluded that Bone Lake is eutrophic and that the algae and macrophyte problems stemmed from elevated phosphorous levels. The recommendations listed in the report included an alum treatment, to reduce the amount of phosphorous internally cycled, and macrophyte harvesting in certain areas.

The Bone Lake Management District has continued to be proactive in managing the lake. From 1988 to 1989 the WI DNR surveyed Bone Lake and designated 11 sensitive areas of the lake that were critical to supporting fish and wildlife. Since 1998, a volunteer from the District has collected water clarity data, as outlined by the WI DNR self-help monitoring program.

In 1997 the District contracted Barr Engineering to conduct a lake survey and write a Management Plan. The plan was completed in three phases, where the third phase was the development of a Management Plan. Management suggestions from this plan reinforced the recommended alum application and suggested creating ordinances for storm water, septic systems, and shoreland development. The District and Polk County have since followed through on creating ordinances for storm water, septic systems, and shoreland development but have chosen not to perform an alum application. The Management Plan also recommended continued self-help Secchi depth monitoring and water quality measurements for total phosphorous and chlorophyll a from the North and South basins every third year.

Studies leading to Barr Engineering's Management Plan *(Barr 1997 and 1999)* addressed Bone Lake's watershed, hydrology, and nutrient cycling processes, but the Plan itself did not contain an adequate aquatic plant management component. Increasing Curly-leaf pondweed populations[1] are a concern for Bone Lake and should be addressed in a Management Plan update.

Curly-leaf pondweed (CLP) is an exotic aquatic plant that impacts water quality by releasing nutrients into the water column in mid-summer and promoting algal blooms *(Crowell 2003)*. It was unintentionally introduced in Wisconsin during common carp stocking activities in the 1800's and is now present in many Wisconsin lakes. All aquatic plants contribute nutrients to lakes as they decay, but native plants die off in the late summer or early fall, and their nutrients are consumed by bacteria before they can fuel algal growth. As much as 5.5 pounds of phosphorus per acre can be released from monotypic CLP beds *(McComas 2000)*. Excess nutrients such as phosphorus cause murky water conditions and algal blooms.

[1] Aquatic Engineering Inc. mapped 57.7 acres of Curly-leaf pondweed in May 2003.

Figure 1. Water quality locations within the North and South basins of Bone Lake, Polk County, WI. 2004.

2.0 Methods

2.1 Water Sample Collection

Water quality monitoring is a specific recommendation of the Polk County Land and Water Resource Plan *(p. 22)*. Therefore, two sample sites were established at opposite ends of the lake; one site was selected in the North basin at the deep hole, and one in the South basin, just south of the island *(Fig. 1)*. Water samples were collected by representatives of Polk County and were sent to the Water and Environmental Analysis Laboratory *(WEAL)* located at UW – Stevens Point, where they were analyzed for total phosphorus, soluble reactive phosphorus, chlorophyll-a, pH, total Kjeldahl nitrogen, nitrate + nitrite, ammonia, alkalinity, total hardness, chloride, and total suspended solids. These samples were collected at elbow depth and kept on ice until they arrived at the laboratory. Samples were collected weekly in June and July and then monthly until fall turnover.

2.2 On-Site Water Quality Measurements

Depth profiles were collected weekly at the two mid-basin sampling sites during the summer sampling period *(June and July)* and once per month until the fall turnover event. Data points were collected at one-meter intervals throughout the water column and measured on-site for dissolved oxygen, pH, conductivity, and temperature with a YSI SONDE probe.

2.3 Phytoplankton and Zooplankton Samples

Phytoplankton and zooplankton samples were collected in August at both lake water quality monitoring stations. A 2-meter integrated surface sampling device was used to collect a composite sample of the epilimnion. The device was lowered to approximately 1 foot below the water surface effectively capturing a 2 meter column of water from approximately 1 to 7 feet below the water surface. Phytoplankton samples were mailed overnight to the Wisconsin State Lab of Hygiene in Madison, WI. The most common organism was identified to species; remaining organisms were identified to division, and biomass estimates were calculated. Zooplankton samples were collected either from the bottom of the epilimnion to the water surface, or from two feet above the lake bottom to the surface, depending on field conditions. A vertical tow net with 66 µm mesh and collection cup was used for sampling. The most common taxa were identified to species; all other taxa were identified to genus, and the biovolume of each taxon was estimated. Zooplankton samples were mailed overnight to Phycotech, where all taxa were identified to species, and the biovolume of each taxon was estimated.

2.4 Trophic Status Calculations

Trophic status was calculated for each sampling location using the following equations *(the units of measurement required for each parameter are included as a subscript in the equation):*

$TSI_{SD} = 60 - 14.41 * \ln (SD_m)$

$TSI_{chl} = 9.81 * \ln (chl_{\mu g}) + 30.6$

$TSI_{TP} = 14.42 * \ln (TP_{\mu g}) + 4.15$

The following scale is used to evaluate trophic status *(Lillie and Mason 1983):*

TSI < 30	oligotrophic
40 < TSI < 50	mesotrophic
TSI > 50	eutrophic

3.0 Results

3.1 Phosphorous

The average total phosphorus *(TP)* for the North basin was 24.4µg/L with a maximum of 35µg/L and a minimum of 13µg/L. The average for the South basin was 21.4µg/L with a maximum of 34µg/L and a minimum of 9µg/L. The TSI_{TP} values for the North and South basins are 50.2 and 48.3, respectively.

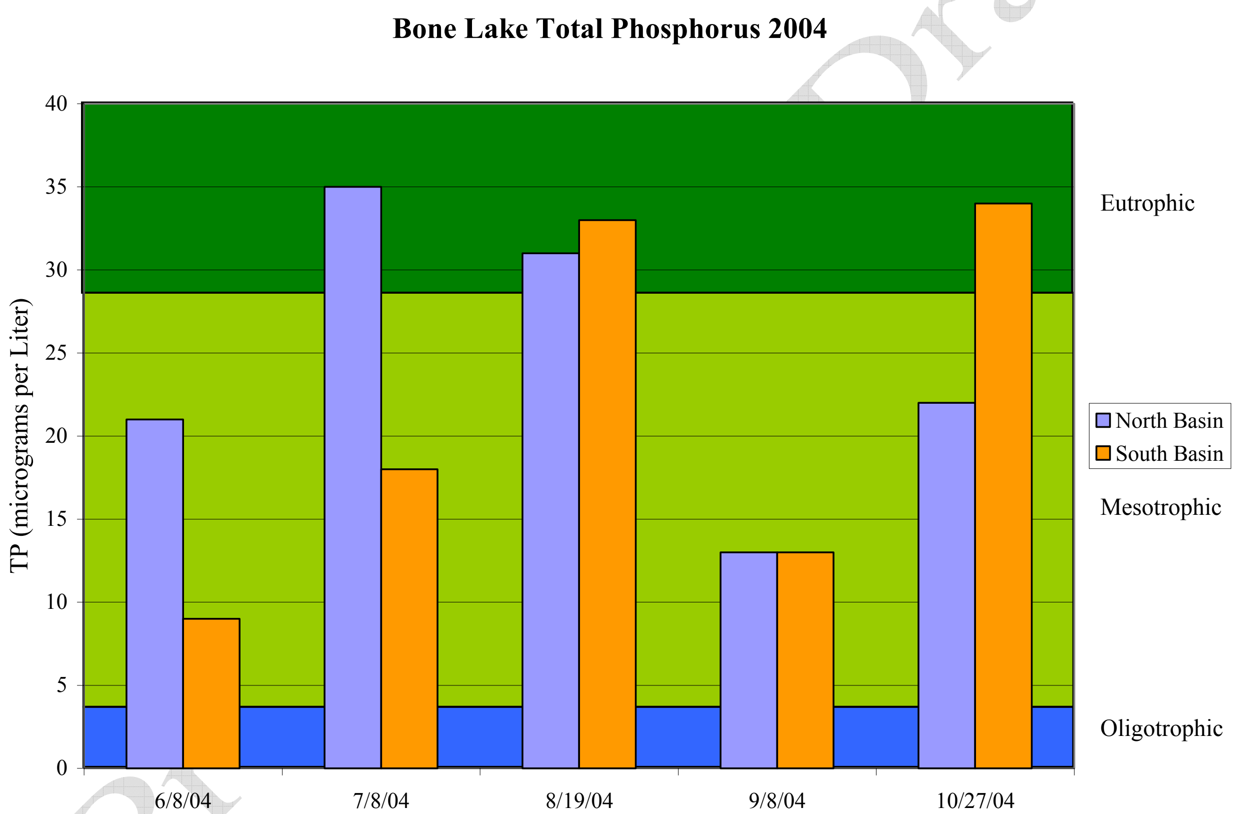


Figure 2. Total phosphorus measurements from North and South basin sample locations in Bone Lake, Polk Co., WI. 2004.

3.2 Chlorophyll a

The average chlorophyll a (Chl a) a for the North basin was 10.12µg/L with a maximum of 17.6µg/L and a minimum of 5.4µg/L. The average Chl a for the South basin was 5.76µg/L with a maximum of 10.0µg/L and a minimum of <1.0µg/L. The TSI_{chl} values for the North and South basins are 53.3 and 47.8, respectively.

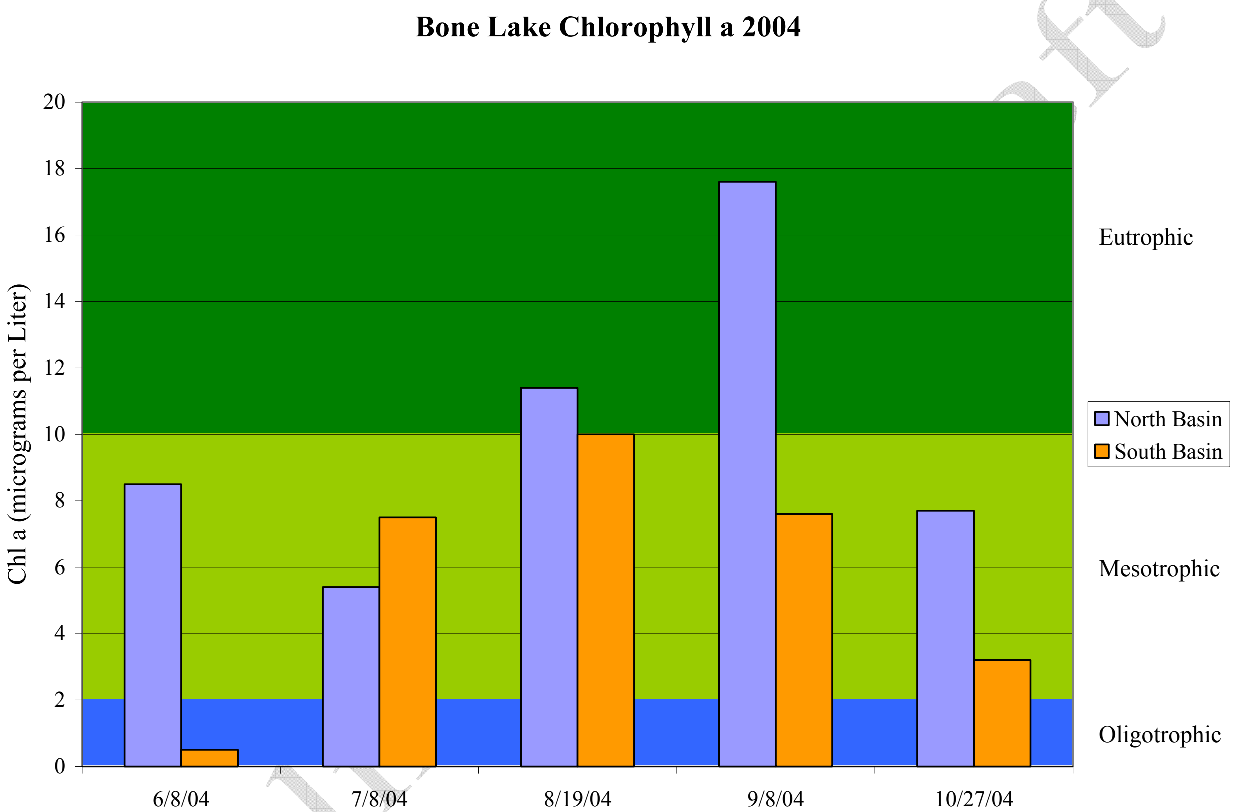


Figure 3. Chlorophyll a measurements from the North and South basin sample locations in Bone Lake, Polk Co., WI. 2004.

3.3 Secchi Depth

The average Secchi reading for the North basin was 9.08 ft with a maximum of 16.5 ft and a minimum of 5.0 ft, recorded on October 27th and August 9th, 2004, respectively. The average reading for the South basin was 9.45 ft with a maximum reading of 17.0 ft and a minimum of 6.5 ft, recorded on October 27th and September 8th, 2004, respectively. The TSI_S for the North and South basins are 45.3 and 44.8, respectively.

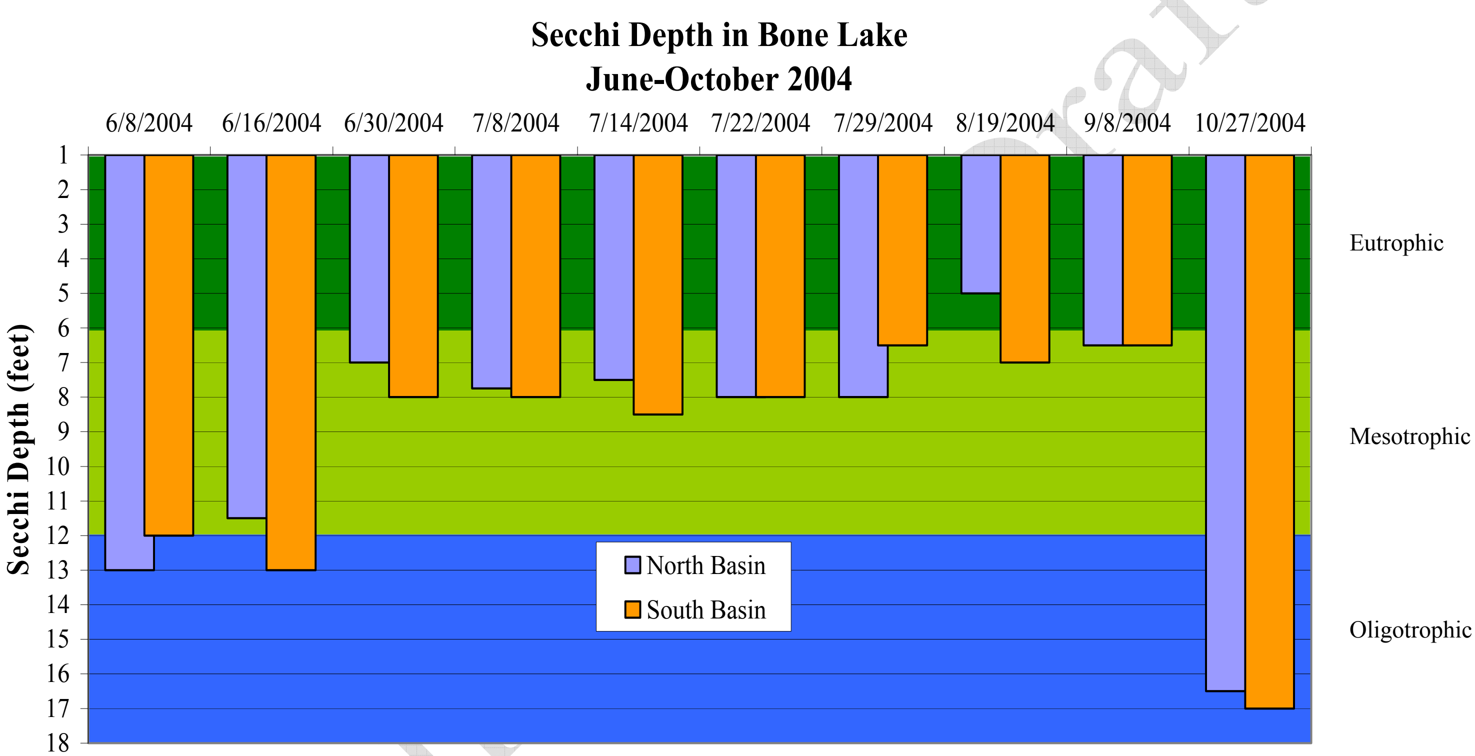


Figure 4. Secchi depth readings from the North and South basin sample locations in Bone Lake, Polk Co., WI. 2004.

3.4 Other Parameters

Other parameters, such as total Kjeldahl nitrogen, soluble reactive phosphorus, temperature, conductivity, specific conductance, and salinity affect water quality in many different ways and are discussed separately in the following sections.

3.4.1 Total Kjeldahl Nitrogen *(TKN)*

The Kjeldahl technique is a laboratory test for measuring the amount of organic nitrogen contained in water. Organic nitrogen concentration is equal to total Kjeldahl nitrogen concentration (TKN) minus ammonia concentration. Organic nitrogen may exist as either dissolved or suspended particulate matter in water. High levels of organic nitrogen in water may indicate excessive biological production or organic pollution in the watershed. Animal and human waste, decaying organic matter, and live organic material like tiny algae cells can cause organic nitrogen enrichment of lake water *(Tippecanoe Environmental Lake and Watershed Foundation 2005)*. Nitrogen, like phosphorus, is an essential macronutrient needed for algal production. Most Midwest lakes, however, are phosphorus-limited, and attempts to reduce lake nitrogen levels may have little effect on algal biomass *(Holdren et al. 2001)*. The average TKN for Bone Lake in 2004 was 487μg/L. The N: P ratio was approximately 21 and supports the conclusion that Bone Lake is phosphorus-limited.

3.4.2 Soluble Reactive Phosphorus *(SRP)*

Soluble reactive phosphorus (SRP) is a dissolved form of phosphorus. Because dissolved phosphorus is readily available for uptake by plants, the amount of SRP found in a lake provides a good estimation of how much phosphorus is available for algae and plant growth. Because aquatic plant growth is typically limited by phosphorus, added phosphorus (especially in dissolved, bio-available form) can fuel plant growth and cause algae blooms. Sources of SRP can include failing septic systems, animal waste, fertilizers, decaying plants and animals, and sediment resuspension from the lake bottom. Because phosphorus is cycled so rapidly through biota, SRP concentrations as low as 5 μg/L are enough to maintain eutrophic or highly productive conditions in lake systems

(Tippecanoe Environmental Lake and Watershed Foundation 2005). The average SRP for Bone Lake in 2004 was 16.3µg/L.

3.4.3 Temperature

Temperature plays a major role in water quality, especially in lakes that become thermally stratified. Thermal stratification occurs when water in the top layer of a lake becomes heated by the sun, and insufficient mixing action allows this warm water layer *(epilimnion)* to "float" on top of a cooler, more dense layer of water near the bottom *(hypolimnion)*. As the summer progresses, the difference in density between the two layers increases, and when the difference becomes too great for wind energy to mix, the lake becomes stratified *(Holdren et al. 2001)*. The region between the epilimnion and hypolimnion is called the *metalimnion*. The depth within the metalimnion where the rate of change in temperature is greatest is called the *thermocline (Holdren et al. 2001)*. In 2004 Bone Lake formed a thermocline in both basins of the lake. The thermocline in the South basin, however, was more distinct than that in the North basin, but neither thermocline was particularly strong in 2004. The fetch of Bone Lake (the area of the lake affected by wind motion) allows for plenty of mixing action caused by wind and waves, and a steady flow of recreationalists also aids in mixing the water.

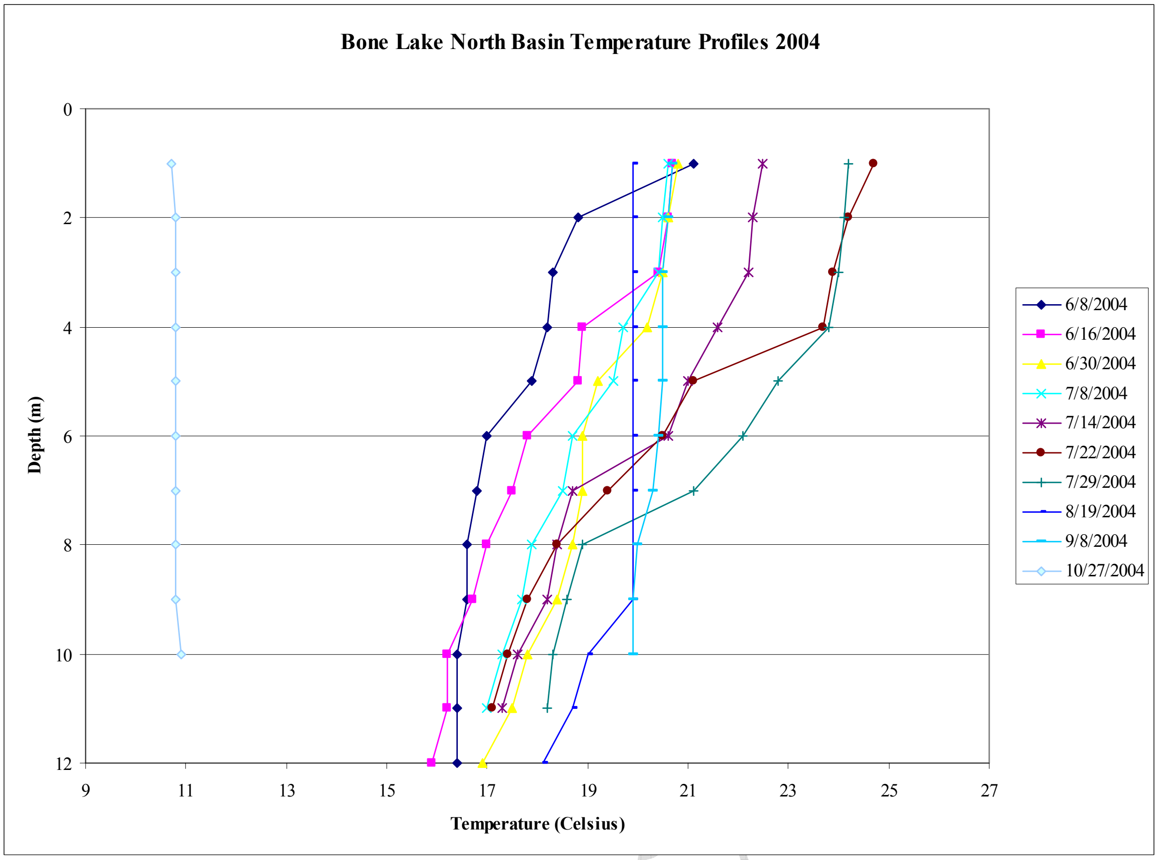


Figure 5. Bone Lake North basin temperature profiles for 2004.

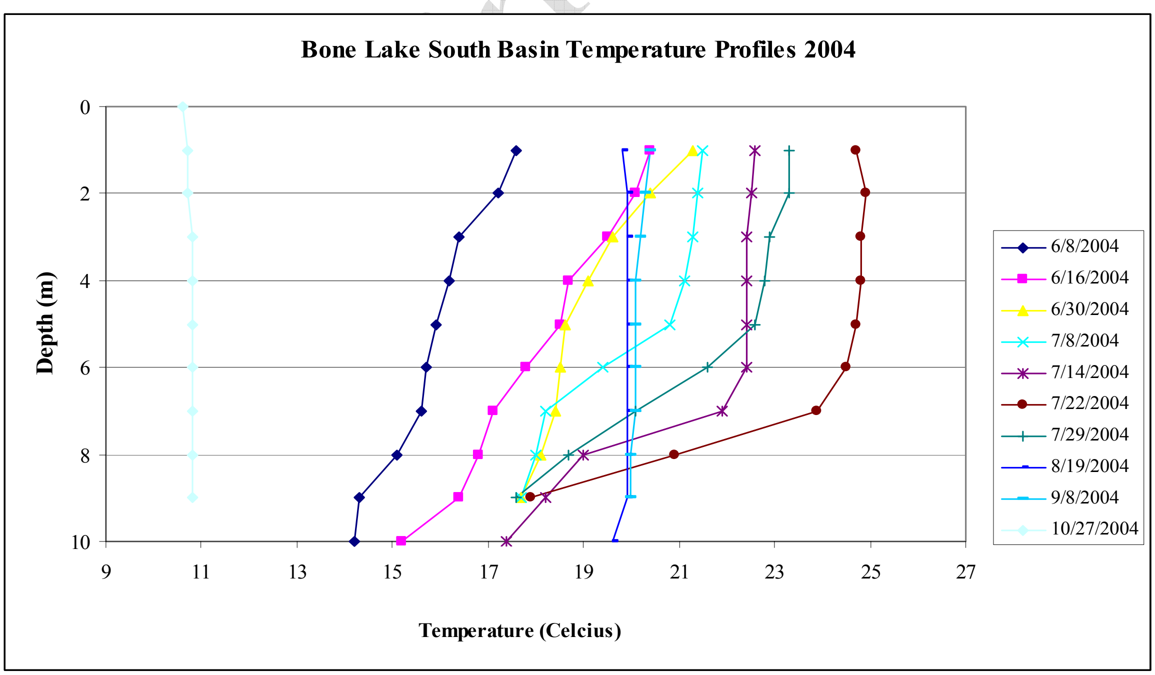


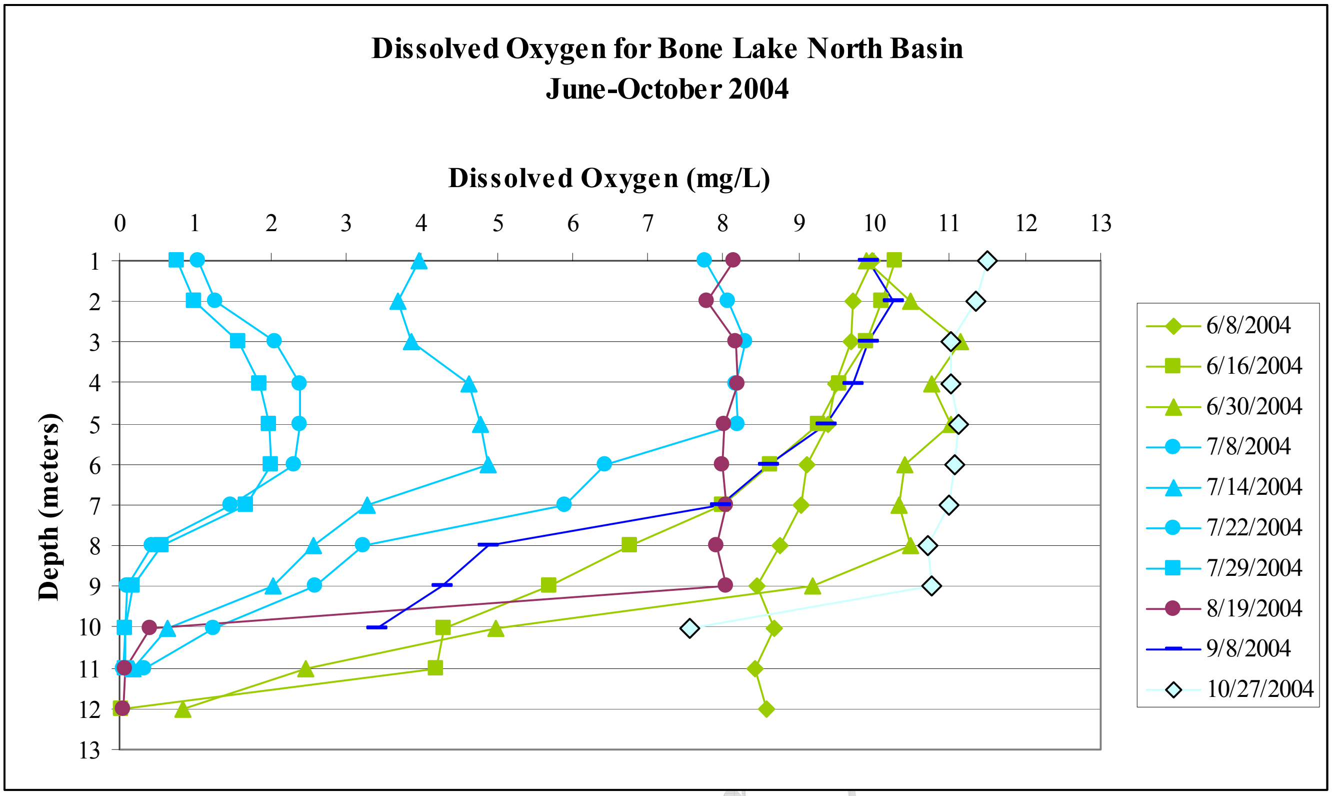
Figure 6. Bone Lake South basin temperature profiles for 2004.

3.4.4 Conductivity and Specific Conductance

Conductivity in lake water comes from a variety of sources. Agricultural and industrial runoffs contribute large amounts of dissolved salts, which raise conductivity. Sewage from septic tanks and treatment facilities also add to conductive properties in water. Another source comes from the hypolimnion of thermally-stratified lakes, where a "rain" of dead algal cells constantly falls on the sediments of the lake as planktonic algae die throughout the summer. Bacteria in and near the sediment aid in decomposition of algal cells by breaking high energy bonds stored in the algal cell wall. When this occurs, CO_2 is released into the water, where it rapidly dissolves into carbonic acid, bicarbonate, and carbonate ions. These ions contribute to the conductive properties of the lake water. The conductivity of Bone Lake in 2004 was 181µS/cm. This value is typical of lakes in the region.

3.4.5 Dissolved Oxygen

Dissolved oxygen plays an important role in both the lake biology and chemical properties. Anoxic conditions make certain compounds more soluble in water. The chemical and biological properties are most affected during summer stratification, when the hypolimnion does not mix with the oxygen-rich epilimnion. The dissolved oxygen profiles for Bone Lake in 2004 reveal that there is a rapid depletion of oxygen that begins approximately at 6 meters deep. Oxygen depletion was apparent at both basins and occurred from mid June through September *(Figure 7)*.



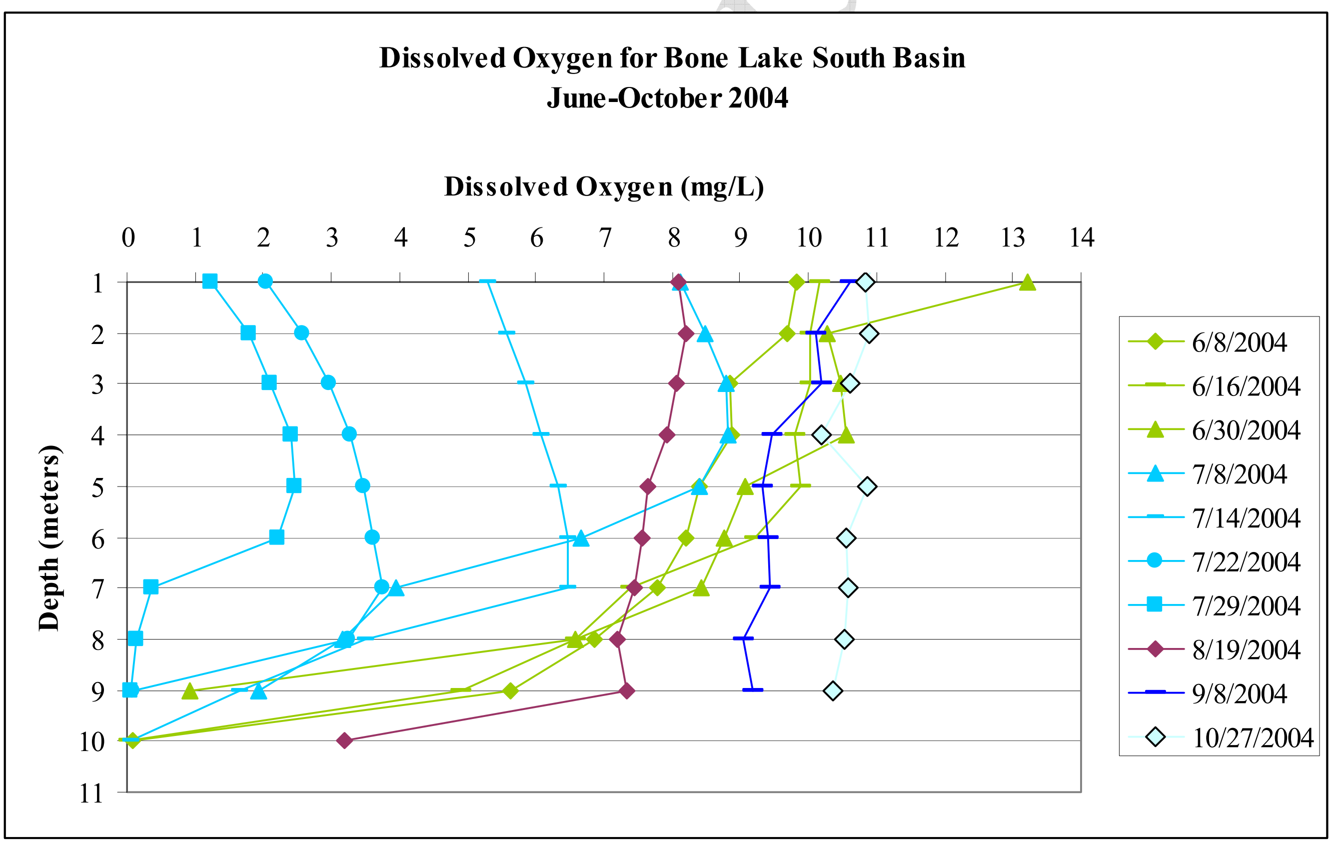


Figure 7. Dissolved oxygen profiles for the North and South basins of Bone Lake in 2004.

3.4.6 Salinity

Salinity values reported are 0.1 ppt, which is at the lower limit for considering water "fresh" as opposed to "saline." The lower limit of the test capabilities was reached with the water sampled from Bone Lake in both the North and South basins.

3.5 Phytoplankton and Zooplankton

Phytoplankton

Composite surface samples analysis show that on August 19, 2004, the three dominant species found in the North basin were *Fragilaria crotonensis*, *Aphanizomenon* sp., and *Tabellaria* sp. with relative percent concentrations of 61, 15, and 13, respectively, with Fragilaria comprising 60.8% of the relative frequency *(Table 1)*. The three dominant species found in the South basin were also *Fragilaria crotonensis*, *Aphanizomenon* sp., and *Tabellaria* sp., with relative percent concentrations of 57, 12, and 12, respectively, with *Fragilaria* comprising 56.8% of the relative frequency *(Table 2)*. A total of 16 species were collected from the North and South basins during this collection event. *Aphamizomenon* sp. made up 14.5% and 11.5% of the samples from the North and South basins, respectively. Some organisms belonging to this genus produce toxic substances that may be fatal to livestock that drink the water.

During the two sampling events at each basin, organisms belonging to the Bacillariophyceae class were the most common. This type of phytoplankton belongs to a larger group of organisms commonly known as diatoms. Diatoms are an important base for many aquatic food chains.

Table 1. Phytoplankton analysis of the 6-foot composite sample collected from the North basin sample site of Bone Lake, Polk Co., WI. 2004.

Taxa	Division	Concentration (Units/ml)[2]	Relative % Concentration
Asterionella formosa	Bacillariophyta	8	0.7%
Aulacoseira granulate	Bacillariophyta	12	1.1%
Cyclotella sp.	Bacillariophyta	4	0.4%
Fragilaria crotonensis	Bacillariophyta	719	60.8%
Tabellaria sp.	Bacillariophyta	151	12.8%
Dinobryon sertularia	Chrysophyta	48	4.0%
Ochromonas sp.	Chrysophyta	2	0.2%
Cryptomonas sp.	Chrysophyta	2	0.2%
Anabaena sp.	Cyanophyta	14	1.2%
Anabaena sp.	Cyanophyta	2	0.2%
Aphanizomenon sp.	Cyanophyta	172	14.5%
Aphanocapsa sp.	Cyanophyta	2	0.2%
Ceratium hirundinella	Pyrrhophyta	43	3.7%
Glenodinium sp.	Pyrrhophyta	2	0.2%

Table 2. Phytoplankton analysis of the 6-foot composite sample collected from the South basin sample site of Bone Lake, Polk Co., WI. 2004.

Taxa	Division	Concentration (Units/ml)[3]	Relative % Concentration
Asterionella formosa	Bacillariophyta	6	0.7%
Aulacoseira granulate	Bacillariophyta	43	4.6%
Cyclotella sp.	Bacillariophyta	4	0.4%
Fragilaria crotonensis	Bacillariophyta	534	56.8%
Tabellaria sp.	Bacillariophyta	110	11.7%
Staurastrum sp.	Chlorophyta	4	0.4%
Dinobryon sertularia	Chrysophyta	68	7.3%
Ochromonas sp.	Chrysophyta	4	0.4%
Aphanizomenon sp.	Cyanophyta	108	11.5%
Aphanocapsa sp.	Cyanophyta	4	0.4%
Microcystis sp.	Cyanophyta	2	0.2%
Ceratium hirundinella	Pyrrhophyta	50	5.3%
Glenodinium sp.	Pyrrhophyta	2	0.2%

[2] Natural Unit Count = unicell, colony or filament equals 1 unit

Zooplankton

The most common organisms in the North basin of Bone Lake on August 19, 2004, were Rotifers *(Rotifera)* followed by Copepods *(Copepoda, Figure 6)*. In the South basin, these two assemblages were also the most common, with the Copepods comprising the majority of the community *(Figure 7)*. In this first sampling, members of the class Branchiopoda (which contains *Daphnia*; also know as water flea) were also present but were only found during this survey.

Approximately three weeks later, on September 8, 2004, a second collection found only members of the Copepoda and Rotifera. In both the North and South basins, the Copepods held the majority of the community with 54% and 62% of the organisms identified *(Figures 8 and 9)*.

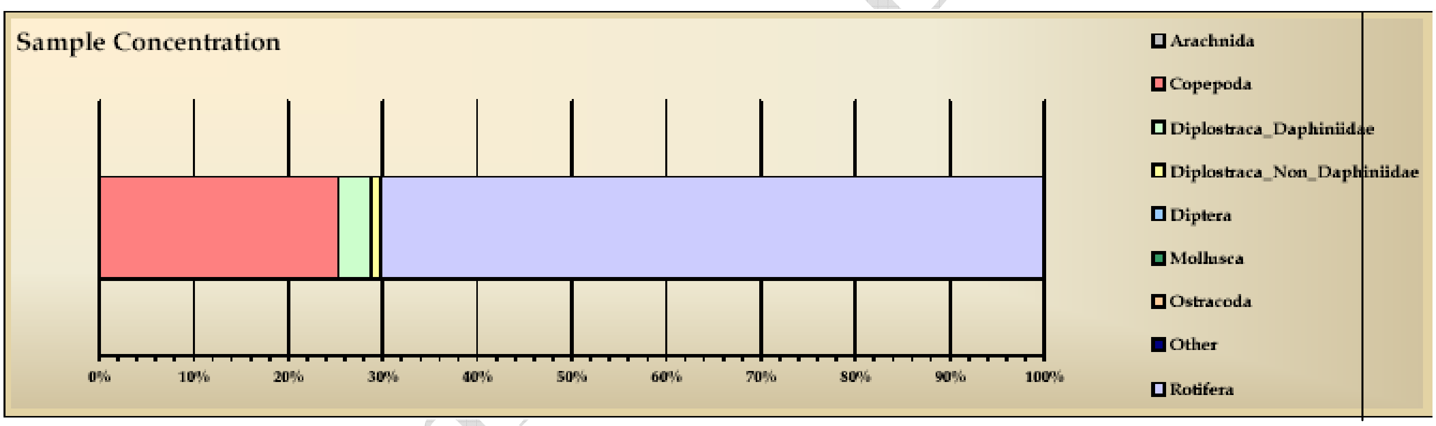


Figure 8. Zooplankton community composition of Bone Lake North basin on August 19, 2004.

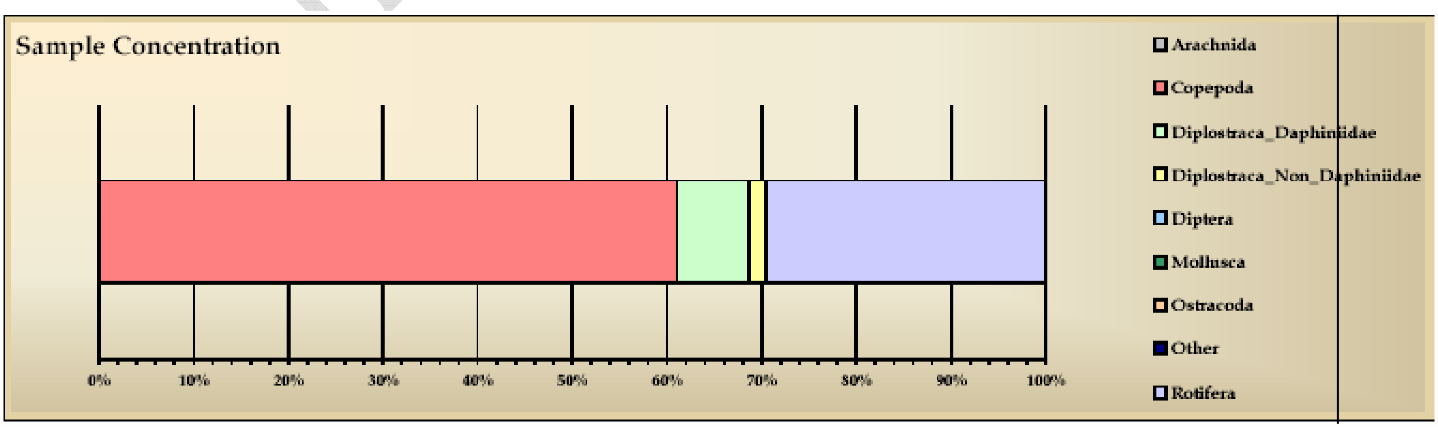


Figure 9. Zooplankton community composition of Bone Lake South basin on August 19, 2004.

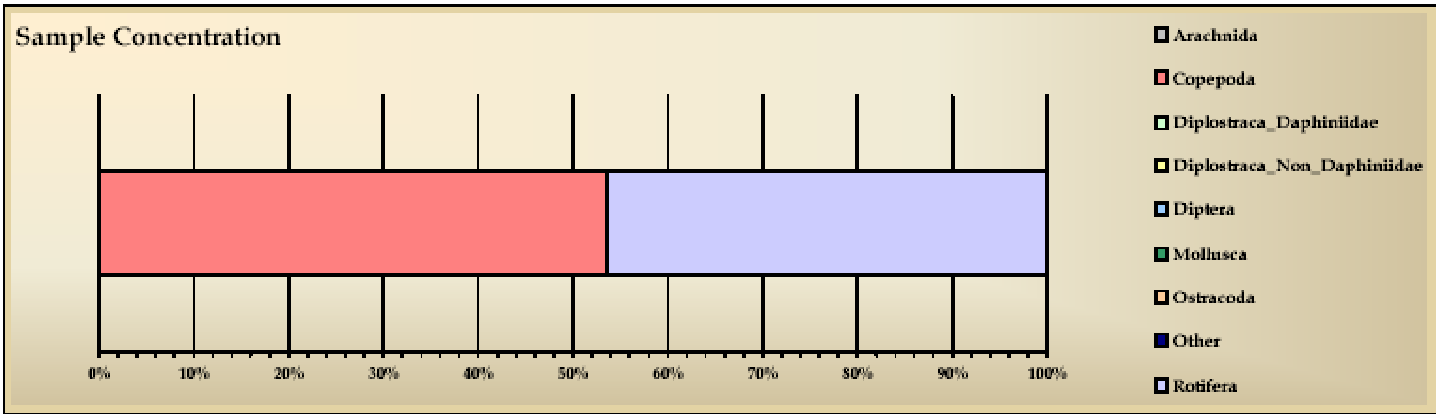


Figure 10. Zooplankton community composition of Bone Lake North basin on September 8, 2004.

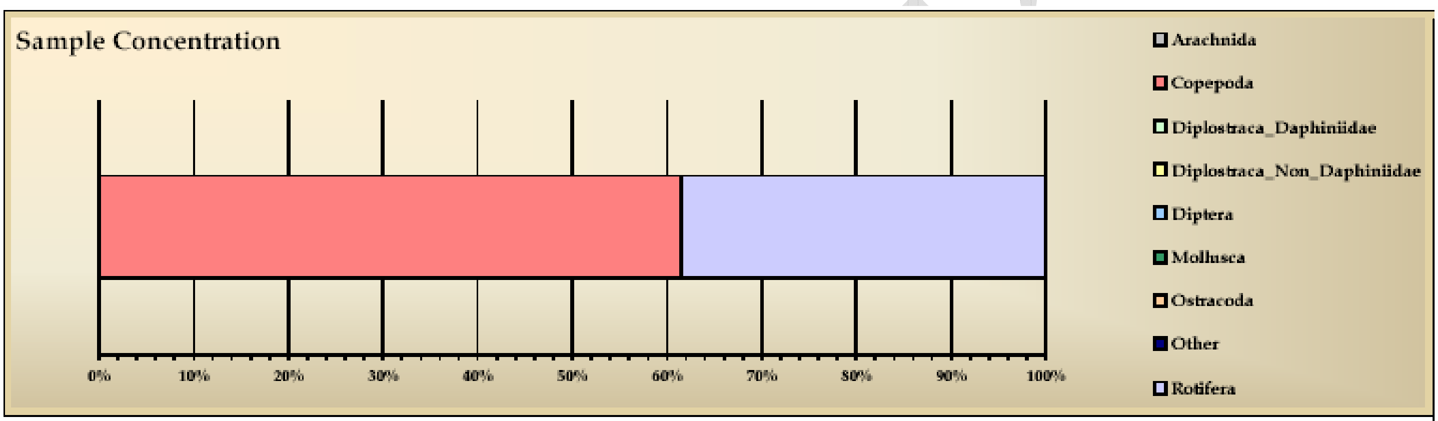


Figure 11. Zooplankton community composition of Bone Lake South basin on September 8, 2004.

4.0 Discussion

4.1 Trophic Status Index

The TSI values for Bone Lake in 2004 show that it is a slightly eutrophic to mesotrophic lake. Water clarity data support the mesotrophic status, while chlorophyll and total phosphorus support a slightly eutrophic status. Bone Lake has qualities expected of each status that occur seasonally. In the spring and fall, phosphorus and chlorophyll levels are down and Secchi depth is high as expected for a mesotrophic lake. As the season progresses and algae bloom, the lake displays characteristics one would expect to find in a eutrophic body of water. As part of a future monitoring strategy, TSI values can be calculated and compared from year to year and should indicate whether the eutrophication process is increasing, decreasing, or remaining constant. Sudden changes would likely be due to major changes in the phosphorus load and should be investigated if observed.

4.2 Water Quality

Bone Lake is a phosphorus-limited lake that slightly stratifies thermally in the summer and mixes in the spring and fall. It has water quality similar to other lakes in its region. All of the parameters measured in 2004 fell within acceptable ranges for Wisconsin lakes.

4.3 Phytoplankton and Zooplankton

Phytoplankton

Aphanizomenon is a native genus of algae in Wisconsin capable of producing algal toxins. Though this can be a serious issue, the volume of water in Bone Lake, coupled with the relatively low density of this particular strain, makes a toxic algal bloom unlikely. *Aphanizomenon* are "blue-green" algae capable of fixing atmospheric nitrogen for cellular growth and are therefore more dominant in lakes where nitrogen is the limiting nutrient.

Zooplankton

There is not enough data available regarding zooplankton in Wisconsin lakes to make any judgments on water quality based on the assemblage present in Bone Lake. Some bio-assessment criteria are available through the USEPA. These criteria require that the members of the population be broken down into their respective functional groups.

5.0 Recommendations

The Bone Lake Management Plan, written by Barr Engineering in 1999, set a goal for water quality based on annual average total phosphorus measurements. The goal set was not to exceed an annual average of 18µg/L of total phosphorus *(mesotrophic midpoint)* in the North and South basins *(Barr 1999)*. In 2004, the North and South basins had 24.4 µg/L and 21.4 µg/L, respectively. This is an improvement from the 1996 and 1998 values of 26.5 and 27 for the North and South basins, respectively *(Barr1999)*.

Four major recommendations made by Barr Engineering were 1) alum treatment, 2) use of BMP's, 3) ordinance adoptions for stormwater, shoreland development, and septic system and 4) additional watershed BMP's *(Barr 1999)*. The additional BMP recommendations targeted three areas of the watershed that were contributing to disturbance or had the potential to create disturbance in the lake. Monitoring water quality every third year was recommended in addition to annual citizen self-help monitoring.

Since the adoption of the plan, an alum treatment has not occurred. The alum treatment was not completed because the benefits did not justify the cost of the treatment. Implementation of some of the recommended watershed BMP's may have contributed to the improvement in TP levels found in 2004.

We are recommending the following practices for improving the water quality of Bone Lake:

- Public education and implementation of buffer strips and shoreline restoration
- Manage internal loading in the summer by reducing CLP biomass in the spring
- Reevaluate the need for an alum treatment in 2010
- Watershed BMP's as outlined in the current plan
- Work with the county and local townships as they create their land use and zoning regulations to help minimize effects of future development

- Annual participation in self-help monitoring with Secchi disk readings and 2-meter surface integrated laboratory analysis for TP, Chl a, TKN and SRP one year out of every three. Sampling should occur monthly from May to October during that year.

6.0 References

Barr Engineering Co. 1997. Bone Lake Management Plan (Phase 1 and Phase 2).

Barr Engineering Co. 1999. Bone Lake Management Plan (Phase 3).

Bursik, B. 2001. Polk County Land and Water Resources Plan. Polk County Land Conservation Committee.

Crowell W. 2003. Curlyleaf pondweed: new management ideas for an old problem. Minnesota Department of Natural Resources Exotic Species Program.

Holdren, C., W. Jones, and J. Taggart. 2001. Managing Lakes and Reservoirs. N. Am. Lake Mange. Soc. And Terrene Inst. In coop. with Off. Water Assess. Watershed Prot. Div. U.S. Environ. Prot. Agency, Madison, WI.

Lillie, R. A. and J. W. Mason. 1983. Limnological Characteristics of Wisconsin Lakes. Wisconsin Department of Natural Resources Technical Bulletin 138, Madison, WI.

McComas, S. 2000. Curlyleaf pondweed: another exotic aquatic plant in Minnesota. Minnesota Lake Association.

Tippecanoe Environmental Lake and Watershed Foundation. website accessed on February 2, 2005 http://www.telwf.org/watertesting/watertesting.htm

Wisconsin Department of Natural Resources (WI DNR). 1994. St. Croix River Basin Water Quality Management Plan.

Appendix A:
Water Quality Profile Raw Data

North Basin

Date	Meters	Secchi Feet	Temperature (°C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25°C)	Salinity (ppt)
6/8/2004	1	13	21.1	114.9	9.96	182.3	197.4	0.1
	2		18.8	106.1	9.73	174.5	198.1	0.1
	3		18.3	102.1	9.69	173	198.3	0.1
	4		18.2	100.7	9.48	172.6	198.5	0.1
	5		17.9	100.7	9.39	171.6	198.6	0.1
	6		17	96.6	9.1	169.1	199.3	0.1
	7		16.8	91.7	9.02	168.3	199.7	0.1
	8		16.6	88.5	8.74	167.8	199.6	0.1
	9		16.6	87.6	8.45	167.1	200	0.1
	10		16.4	86.9	8.68	167.3	199.8	0.1
	11		16.4	86.5	8.42	166.8	200	0.1
	12		16.4	91.2	8.57	167.3	199.8	0.1
6/16/2004	1	11.5	20.7	116.4	10.27	181.4	197.6	0.1
	2		20.6	112.8	10.1	181.2	197.6	0.1
	3		20.4	110.6	9.89	180.3	197.8	0.1
	4		18.9	102.1	9.54	175.5	198.7	0.1
	5		18.8	101.3	9.26	175.1	198.6	0.1
	6		17.8	91.4	8.62	171.6	196.9	0.1
	7		17.5	83.6	7.99	171	199.6	0.1
	8		17	70.2	6.76	170.2	201.1	0.1
	9		16.7	59.2	5.7	170.2	202.3	0.1
	10		16.2	44.1	4.3	170.3	204.5	0.1
	11		16.2	41.5	4.21	170.3	204.8	0.1
	12		15.9	0.4	0.03	187.8	227	0.1
6/30/2004	1	7	20.8	103.5	9.89	181.9	197.9	0.1
	2		20.6	116.3	10.49	181.8	198.4	0.1
	3		20.5	122.6	11.14	181.7	198.8	0.1
	4		20.2	117.5	10.77	180.9	198.8	0.1
	5		19.2	116.4	11.02	176.7	198.8	0.1
	6		18.9	115.5	10.41	176.2	199.4	0.1
	7		18.9	110.4	10.34	176.1	199.7	0.1
	8		18.7	108.8	10.47	175.7	199.5	0.1
	9		18.4	85.5	9.19	175.1	199.6	0.1
	10		17.8	49.6	4.98	174.7	202.8	0.1
	11		17.5	23.1	2.46	176.8	206.3	0.1
	12		16.9	10.2	0.85	179	211.7	0.1

Date	Meters	Secchi Feet	Temperature (°C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25°C)	Salinity (ppt)
7/8/2004	1	7.75	20.6	77.5	7.75	182.8	199.5	0.1
	2		20.5	89.6	8.06	182.3	199.5	0.1
	3		20.4	91.7	8.3	181.5	199.2	0.1
	4		19.7	94.5	8.17	179.9	200.1	0.1
	5		19.5	93.1	8.2	179.3	200.3	0.1
	6		18.7	67.7	6.43	178.2	202.1	0.1
	7		18.5	62.3	5.9	176.9	202.1	0.1
	8		17.9	33.6	3.24	177.7	205.5	0.1
	9		17.7	26.9	2.59	178.1	207.1	0.1
	10		17.3	12.8	1.24	179.6	210.4	0.1
	11		17	2.9	0.32	219.8	259.7	0.1
7/14/2004	1	7.5	22.5	34.7	3.97	186.3	195.7	0.1
	2		22.3	32.1	3.69	186.4	196.7	0.1
	3		22.2	39.7	3.87	188.7	199.7	0.1
	4		21.6	51.6	4.62	187.6	200.9	0.1
	5		21	53.6	4.79	186.2	201.7	0.1
	6		20.6	54.5	4.89	185	202.1	0.1
	7		18.7	35.5	3.29	181.3	205.9	0.1
	8		18.4	27.7	2.58	181	207.1	0.1
	9		18.2	20.7	2.03	181	207.9	0.1
	10		17.6	6.7	0.64	181.9	212.2	0.1
	11		17.3	1.9	0.18	183.4	214.9	0.1
7/22/2004	1	8	24.7	13	1.05	198.5	199.9	0.1
	2		24.2	14.3	1.28	197.8	200.9	0.1
	3		23.9	23.6	2.06	197.2	201.3	0.1
	4		23.7	27.9	2.4	197	202	0.1
	5		21.1	26.8	2.39	190.8	204.7	0.1
	6		20.5	25.7	2.31	188.2	205.8	0.1
	7		19.4	16.3	1.48	185.8	208.3	0.1
	8		18.4	4.9	0.43	185.4	212.1	0.1
	9		17.8	1.2	0.1	187.9	217.8	0.1
	10		17.4	0.7	0.07	189.4	221	0.1
	11		17.1	0.5	0.04	230.8	253	0.1

Date	Meters	Secchi Feet	Temperature (^oC)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25^oC)	Salinity (ppt)
7/29/2004	1	8	24.2	11.1	0.77	196.4	199.2	0.1
	2		24.1	11.3	0.98	196.4	199.9	0.1
	3		24	17.9	1.57	196.6	200.5	0.1
	4		23.8	21.7	1.86	196.7	201.4	0.1
	5		22.8	23	1.99	194.6	203.1	0.1
	6		22.1	23.1	2.00	194.2	205.5	0.1
	7		21.1	18.6	1.69	192.7	207.5	0.1
	8		18.9	8.1	0.56	191.4	216.7	0.1
	9		18.6	2.2	0.18	191.2	217.9	0.1
	10		18.3	0.8	0.07	254.4	292.1	0.1
	11		18.2	0.8	0.07	254.3	291.5	0.1
8/19/2004	1	5	19.9	88.5	8.13	185.0	204.3	0.1
	2		19.9	88.0	7.79	185.4	205.3	0.1
	3		19.9	91.2	8.17	185.3	205.3	0.1
	4		19.9	90.4	8.19	185.4	205.4	0.1
	5		19.9	90.0	8.02	185.3	205.4	0.1
	6		19.9	88.0	8.00	185.3	205.4	0.1
	7		19.9	87.4	8.03	185.3	205.4	0.1
	8		19.9	88.3	7.91	185.2	205.3	0.1
	9		19.9	89.0	8.03	185.2	205.4	0.1
	10		19.0	9.9	0.40	194.7	220.0	0.1
	11		18.7	0.6	0.07	200.5	227.9	0.1
	12		18.1	0.5	0.04	286.1	331.6	0.2
9/8/2004	1	6.5	20.7	115.0	9.92	182	198.5	0.1
	2		20.6	115.3	10.25	183.4	200.1	0.1
	3		20.5	106.6	9.91	183.4	200.7	0.1
	4		20.5	109.8	9.72	183.9	201.2	0.1
	5		20.5	108.3	9.36	184.1	201.6	0.1
	6		20.4	101.2	8.61	184.3	201.9	0.1
	7		20.3	94.0	7.97	184.9	203.2	0.1
	8		20	60.0	4.89	186.3	206	0.1
	9		19.9	49.3	4.27	186.2	206.3	0.1
	10		19.9	40.4	3.41	187.3	207.4	0.1

Date	Meters	Secchi Feet	Temperature (^{o}C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25^{o}C)	Salinity (ppt)
10/27/2004	Surface	16.5	10.7	351.8	over	149	205.1	0.1
	1		10.7	104.3	11.5	149	205	0.1
	2		10.8	103.1	11.34	149.2	204.9	0.1
	3		10.8	99.6	11.01	149.2	204.9	0.1
	4		10.8	98.8	11.01	149.2	204.8	0.1
	5		10.8	101.4	11.11	149.2	204.8	0.1
	6		10.8	100.3	11.07	149.3	204.8	0.1
	7		10.8	99.6	10.99	149.3	204.7	0.1
	8		10.8	98.8	10.7	149.3	204.7	0.1
	9		10.8	98.8	10.75	149.3	204.7	0.1
	10		10.9	96.3	7.55	150.5	205.9	0.1

South Basin

Date	Meters	Secchi Feet	Temperature (°C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25°C)	Salinity (ppt)
6/8/2004	1	12	17.6	106.9	9.82	171	198.8	0.1
	2		17.2	98.1	9.68	169.7	199.4	0.1
	3		16.4	91.5	8.86	167	200.1	0.1
	4		16.2	91.6	8.87	166.6	200.3	0.1
	5		15.9	84.5	8.39	165.4	200.3	0.1
	6		15.7	82.1	8.21	164.9	200.4	0.1
	7		15.6	81.1	7.79	164.4	200.6	0.1
	8		15.1	67.6	6.86	162.9	201.1	0.1
	9		14.3	55.3	5.62	161.2	202.2	0.1
	10		14.2	0.7	0.08	173.7	219	0.1
6/16/2004	1	13	20.4	115.5	10.15	180.6	197.7	0.1
	2		20.1	111	10.03	179.4	197.7	0.1
	3		19.5	109.2	10.01	177.2	198.2	0.1
	4		18.7	107.1	9.8	174.6	198.6	0.1
	5		18.5	104.7	9.88	173.8	198.6	0.1
	6		17.8	97.7	9.2	171.5	198.9	0.1
	7		17.1	78.6	7.4	170.1	200.3	0.1
	8		16.8	68.8	6.57	169.7	201.1	0.1
	9		16.4	52.4	4.9	168.8	203.3	0.1
	10		15.2	0.2	0.04	184.5	227.1	0.1
6/30/2004	1	8	21.3	120.9	13.22	182	195.8	0.1
	2		20.4	113.4	10.27	178.5	195.7	0.1
	3		19.6	144.4	10.48	175.9	196.3	0.1
	4		19.1	114	10.56	175.8	198.2	0.1
	5		18.6	99.5	9.06	175	199.3	0.1
	6		18.5	94.8	8.75	174.5	199.2	0.1
	7		18.4	91.5	8.44	174.8	200	0.1
	8		18.1	66.3	6.59	175.4	202	0.1
	9		17.7	11.9	0.92	183.7	215.4	0.1

Date	Meters	Secchi Feet	Temperature (^oC)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25^oC)	Salinity (ppt)
7/8/2004	1	8	21.5	90.3	8.12	185.5	199	0.1
	2		21.4	95.5	8.47	185.5	199	0.1
	3		21.3	99.1	8.78	184.7	198.8	0.1
	4		21.1	99.5	8.82	184	198.9	0.1
	5		20.8	94.9	8.39	183.7	199.9	0.1
	6		19.4	72.7	6.65	180.7	202.1	0.1
	7		18.2	42	3.96	178.2	204.7	0.1
	8		18	33.7	3.17	178.4	206	0.1
	9		17.7	20.6	1.94	179.6	208.6	0.1
7/14/2004	1	8.5	22.6	60.9	5.29	191.3	200.4	0.1
	2		22.5	63.9	5.57	191	200.4	0.1
	3		22.4	67.2	5.85	190.2	200.2	0.1
	4		22.4	70	6.08	190.3	200.3	0.1
	5		22.4	72.9	6.34	190.3	200.4	0.1
	6		22.4	74.4	6.47	190.4	200.5	0.1
	7		21.9	74.8	6.46	189.8	201.6	0.1
	8		19	38.5	3.5	182.3	205.9	0.1
	9		18.2	18	1.66	182.3	209.4	0.1
	10		17.4	0.8	0.05	241.5	284.8	0.1
7/22/2004	1	8	24.7	22.7	2.03	199.8	200.6	0.1
	2		24.9	30.9	2.58	199.9	200.6	0.1
	3		24.8	35.7	2.98	199.9	200.5	0.1
	4		24.8	39.3	3.27	199.7	200.5	0.1
	5		24.7	41.7	3.48	199.4	200.6	0.1
	6		24.5	43	3.61	198.9	200.9	0.1
	7		23.9	44.4	3.76	197.1	201.4	0.1
	8		20.9	36.4	3.24	189.2	205	0.1
	9		17.9	1.1	0.09	190.2	220.6	0.1

Date	Meters	Secchi Feet	Temperature (°C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25°C)	Salinity (ppt)
7/29/2004	1	6.5	23.3	14.4	1.23	194	200.6	0.1
	2		23.3	20.7	1.78	194.1	200.6	0.1
	3		22.9	24.1	2.09	193.2	201.2	0.1
	4		22.8	27.9	2.42	192.7	201.2	0.1
	5		22.6	28.7	2.47	193.7	202.9	0.1
	6		21.6	25.1	2.22	192.6	206	0.1
	7		20.1	4.6	0.36	188.6	208.3	0.1
	8		18.7	1.5	0.13	189.4	215.2	0.1
	9		17.6	0.6	0.05	287	334.4	0.1
8/19/2004	1	7	19.8	91.2	8.10	184.4	205.2	0.1
	2		19.9	90.2	8.19	184.5	204.6	0.1
	3		19.9	89.2	8.05	184.5	204.5	0.1
	4		19.9	87.9	7.91	184.6	204.5	0.1
	5		19.9	86.5	7.64	184.6	204.5	0.1
	6		19.9	85.5	7.56	184.5	204.5	0.1
	7		19.9	84.0	7.46	184.7	204.6	0.1
	8		19.9	82.8	7.20	184.6	204.6	0.1
	9		19.9	82.6	7.34	184.7	204.8	0.1
	10		19.6	63.3	3.19	191.6	214.3	0.1
9/8/2004	1	6.5	20.4	117.7	10.61	183.5	201.3	0.1
	2		20.3	112.6	10.11	183.4	201.4	0.1
	3		20.2	117.2	10.2	182.9	202.1	0.1
	4		20.1	105.1	9.45	183	202	0.1
	5		20.1	104.2	9.31	183.1	202	0.1
	6		20.1	106.6	9.42	183.1	202	0.1
	7		20.1	105.2	9.44	183.1	202.1	0.1
	8		20	102.7	9.04	182.9	202.2	0.1
	9		20	101.4	9.18	182.8	202.2	0.1

Date	Meters	Secchi Feet	Temperature (°C)	% Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Conductivity (ms)	Specific Conductance (ms at 25°C)	Salinity (ppt)
10/27/2004	Surface	17	10.6	105.9	11.21	149	205.4	0.1
	1		10.7	97.3	10.83	149.2	205.4	0.1
	2		10.7	99.7	10.88	149.1	205	0.1
	3		10.8	97.3	10.61	149.2	204.9	0.1
	4		10.8	93	10.19	149.2	204.9	0.1
	5		10.8	97.8	10.85	149.3	204.9	0.1
	6		10.8	95.5	10.56	149.2	204.9	0.1
	7		10.8	94.4	10.59	149.2	204.7	0.1
	8		10.8	93.3	10.54	149.2	204.8	0.1
	9		10.8	90.1	10.37	149.2	204.8	0.1

Appendix B:
WSLOH Water Quality Lab Reports

DATA REPORT FORM

REPORT IDENTIFICATION: BLAKE LAKES
Sample Location:
Sample Date: 10/26 & 27/04
Sample Time:
Date Received in Lab: 10/29/04
Purchase Order #:
ETF Receipt #: #572661

Sampled By: JW & ALD
Preserved: H2SO4
Sample Type: SW
Field Filtered: NO
Unusual circumstances that may affect results: RECD ON ICE
RESEARCH ACCOUNT CHARGED?

Water & Environmental Analyses La
DNR Cert. No.: 750040280
College of Natural Resources
UW-Stevens Point
Stevens Point, WI 54481
(715) 346-3209

ALL DATA mg/l UNLESS NOTED

Lab #	Site	Reactive Phosphorus	Total Phosphorus	Total Kjeldahl Nitrogen	Chlorophyll-a
Date Analyzed		4-Nov	12-Nov	12-Nov	3-Nov
414-04-1	Big Blake - Mid	0.008	<.012	0.29	2.7
2	Big Blake - Outlet	<.003	0.021	0.33	
3	Big Blake - Inlet	0.009	0.021	0.44	
4	Little Blake	0.009	0.038	0.64	11.9
5	Bone North	0.020	0.022	0.31	7.7
6	Bone South	0.016	0.034	0.39	3.2

DATA REPORT FORM

REPORT IDENTIFICATION: POLK COUNTY LWRD
Sample Location:
Sample Date: 9/8/04
Sample Time:
Date Received in Lab: 9/9/04
Purchase Order #:
ETF Receipt #: #572566

Sampled By:
Preserved:
Sample Type:
Field Filtered:
Unusual circumstances that may affect results:
RESEARCH ACCOUNT CHARGED?

Water & Environmental Anal
DNR Cert. No.: 750040280
College of Natural Resources
UW-Stevens Point
Stevens Point, WI 54481
(715) 346-3209

ALL DATA mg/l UNLESS NOTED

Lab #	Site	Total Phosphorus	Reactive Phosphorus	Total Kjeldahl Nitrogen	Chlorophyll-a
Date Analyzed		24-Sep	14-Aug	24-Sep	14-Sep
348-04-1	Big Blake Inlet	0.046	0.017	0.76	
2	Big Blake Mid	0.072	0.024	0.87	31.6
3	Big Blake Outlet	0.168	0.022	3.10	
4	Little Blake	0.052	0.012	0.69	13.9
5	Bone North	0.035	0.013	0.51	17.6
6	Bone South	0.029	0.013	0.49	7.6

DATA REPORT FORM

REPORT IDENTIFICATION: POLK COUNTY LWRD
Sample Location: BONE LAKE
Sample Date: 8/19/04
Sample Time: AM
Date Received in Lab: 8/24/04
Purchase Order #:
ETF Receipt #: #572051

Sampled By: AD, KH, AE
Preserved: H2SO4,
Sample Type: SW
Field Filtered: NO
Unusual circumstances that may affect results: PH <2 RECD ON ICE
RESEARCH ACCOUNT CHARGED?

Water & Environmental Analyses Lab
DNR Cert. No.: 750040280
College of Natural Resources
UW-Stevens Point
Stevens Point, WI 54481
(715) 346-3209

ALL DATA mg/l UNLESS NOTED

Lab #	Site	Total Kjeldahl Nitrogen	Total Phosphorus	Reactive Phosphorus	Chlorophyll-a
Date Analyzed		1-Oct	1-Oct	27-Aug	25-Aug
319-04-1	Bone Mid-North	0.51	0.031	0.017	11.4
2	Bone Mid-South	0.45	0.033	0.025	10.0

DATA REPORT FORM

REPORT IDENTIFICATION: BONE & BLAKE LAKES
Sample Location:
Sample Date: 7/8/04
Sample Time: 9:20-12 NOON
Date Received in Lab: 7/9/04
Purchase Order #:
ETF Receipt #: #515798

Sampled By: WILLIAMSON
Preserved: H2SO4
Sample Type: SW
Field Filtered: YES
Unusual circumstances that may affect results: RECD ON ICE PH <2
RESEARCH ACCOUNT CHARGED?

Water & Environmental Anal
DNR Cert. No.: 750040280
College of Natural Resources
UW-Stevens Point
Stevens Point, WI 54481
(715) 346-3209

ALL DATA mg/l UNLESS NOTED

Lab #	Site	Chlorophyll-a	Total Phosphorus	Reactive Phosphorus	Total Kjeldahl Nitrogen
Date Analyzed		15-Jul	28-Jul	23-Jul	28-Jul
250-04-1	BON 1	5.4	0.035	0.027	0.430
2	BON 2	7.5	0.018	<.003	0.374
3	LBL 1	20.3	0.029	0.009	0.379
4	BLB 1	4.0	0.029	0.013	0.485

DATA REPORT FORM

REPORT IDENTIFICATION: POLK COUNTY LCD
Sample Location: BONE LAKE
Sample Date: 6/8/04
Sample Time: 11:15-12:30 PM
Date Received in Lab: 6/10/04
Purchase Order #:
ETF Receipt #: #505832

Sampled By: WILLIAMSON & HOLMS
Preserved: H2SO4
Sample Type: SW
Field Filtered: YES
Unusual circumstances that may affect results:
RECD ON ICE PH <2
RESEARCH ACCOUNT CHARGED?

Water & Environmental Anal
DNR Cert. No.: 750040280
College of Natural Resources
UW-Stevens Point
Stevens Point, WI 54481
(715) 346-3209

ALL DATA mg/l UNLESS NOTED		Reactive Phosphorus	Total Phosphorus	Total Kjeldahl Nitrogen	Chlorophyll-a												
Date Analyzed		11-Jun	17-Jun	17-Jun	29-Jun												
Lab #	Site																
191-04-1	BL-1	0.011	0.021	0.760	8.5												
2	BL-2	0.006	0.009	0.556	<1												

Appendix C:
WSLOH Phytoplankton Lab Reports

WISCONSIN STATE LABORATORY OF HYGIENE

Environmental Health Division
2601 Agriculture Dr.
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University of Wisconsin

Algae Identification Report

Site: Bone Lake
Station/Location: South
Depth: 6 foot composite
Laboratory Number: 2004-323

Collection Date: August 19, 2004
Identification Date: September 17, 2004
Identified By: Dawn Karner

Taxa	Division	# Counted	Concentration (Units/mL)[a,b]	Relative % Concentration
Asterionella formosa	Bacillariophyta	3	6	0.7%
Aulacoseira granulata	Bacillariophyta	21	43	4.6%
Cyclotella sp.	Bacillariophyta	2	4	0.4%
Fragilaria crotonensis	Bacillariophyta	258	534	56.8%
Tabellaria sp.	Bacillariophyta	53	110	11.7%
Staurastrum sp.	Chlorophyta	2	4	0.4%
Dinobryon sertularia	Chrysophyta	33	68	7.3%
Ochromonas sp.	Chrysophyta	2	4	0.4%
Aphanizomenon sp.	Cyanophyta	52	108	11.5%
Aphanocapsa sp.	Cyanophyta	2	4	0.4%
Microcystis sp.	Cyanophyta	1	2	0.2%
Ceratium hirundinella	Pyrrhophyta	24	50	5.3%
Glenodinium sp.	Pyrrhophyta	1	2	0.2%
		TOTAL	940	100%

Notes/Comments: Sample was preserved with Lugol's in the field. Analyzed via the Utermohl settling chamber method.

Signature and Date: Dawn Karner 9/17/04

a Natural Unit Count = unicell, colony or filament equals 1 Unit
b Method Reference = American Public Health Association et al. 1998. Standard Methods for the Examination of Water and Wastewater, 20th ed, Method 10200 F2c1

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WSLH WISCONSIN STATE LABORATORY OF HYGIENE

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University of Wisconsin

Algae Identification Report

Site: Bone Lake
Station/Location: North
Depth: 6 foot composite
Laboratory Number: 2004-322

Collection Date: August 19, 2004
Identification Date: September 17, 2004
Identified By: Dawn Karner

Taxa	Division	# Counted	Concentration (Units/mL)[a,b]	Relative % Concentration
Asterionella formosa	Bacillariophyta	4	8	0.7%
Aulacoseira granulata	Bacillariophyta	6	12	1.1%
Cyclotella sp.	Bacillariophyta	2	4	0.4%
Fragilaria crotonensis	Bacillariophyta	347	719	60.8%
Tabellaria sp.	Bacillariophyta	73	151	12.8%
Dinobryon sertularia	Chrysophyta	23	48	4.0%
Ochromonas sp.	Chrysophyta	1	2	0.2%
Cryptomonas sp.	Cryptophyta	1	2	0.2%
Anabaena sp.	Cyanophyta	7	14	1.2%
Anabaena sp.	Cyanophyta	1	2	0.2%
Aphanizomenon sp.	Cyanophyta	83	172	14.5%
Aphanocapsa sp.	Cyanophyta	1	2	0.2%
Ceratium hirundinella	Pyrrhophyta	21	43	3.7%
Glenodinium sp.	Pyrrhophyta	1	2	0.2%
	TOTAL		1183	100%

Notes/Comments: Sample was preserved with Lugol's in the field. Analyzed via the Utermohl settling chamber method.

Signature and Date: Dawn Karner 9/17/04

a Natural Unit Count = unicell, colony or filament equals 1 Unit
b Method Reference = American Public Health Association et al. 1998. Standard Methods for the Examination of Water and Wastewater, 20th ed, Method 10200 F2c1

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Appendix D:
Zooplankton Raw Data

sample_id	system_name	site	sample_date	calculation_typ	level_	depth	taxa_id	organism	phylum	class_	order_	genus	species	relative_concentration_pe	taxa_count	morph	structure_	taxonomic_autl	physiological_s	subspecies
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	104165	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Bosmina	longirostris	0.004948	1	.	Whole Animal	O. F. Mueller, 1	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	128156	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Ceriodaphnia	.	0.004948	1	All	Whole Animal	Mean of C. lacu	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	1000146	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Daphnia	galeata	0.00990193	2	Female	Whole Animal	Birge	Live	mendotae
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	104311	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Daphnia	pulicaria	0.01980386	4	All Stages	Whole Animal	Forbes	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	104403	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Diaphanosoma	leuchtenbergianum	0.004948	1	Female	Whole Animal	Fischer, 1854	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	1000344	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.0841575	17	CI-CIV	Whole Animal	Sars, 1903	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	131852	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.16832095	34	.	nauplius	Esterley 1911	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	131840	Zooplankton	Rotifera	Monogononta	Ploima	Ascomorpha	.	0.0841575	17	.	Whole Animal	Zacharias	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	131841	Zooplankton	Rotifera	Monogononta	Ploima	Asplanchna	.	0.11881129	24	.	Whole Animal	Gosse 1850	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	125572	Zooplankton	Rotifera	Monogononta	Flosculariaceae	Conochilus	unicornis	0.35643982	72	.	Whole Animal	Rousselet 1892	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	125281	Zooplankton	Rotifera	Monogononta	Ploima	Keratella	cochlearis	0.04950372	10	.	Whole Animal	(Gosse 1851)	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	126153	Zooplankton	Rotifera	Monogononta	Ploima	Polyarthra	vulgaris	0.08911144	18	.	Whole Animal	Carlin 1943	Live	.
BL-North	Bone Lake	Mid-Lake N	8/19/2004	Zooplankton - T	Composite	8	131850	Zooplankton	Rotifera	Monogononta	Ploima	Trichocerca	.	0.004948	1	.	Whole Animal	Lamarck, 1901	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	104229	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Chydorus	sphaericus	0.00628861	1	.	Whole Animal	O.F. Mueller, 1	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	104311	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Daphnia	pulicaria	0.07547341	12	All Stages	Whole Animal	Forbes	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	104403	Zooplankton	Arthropoda	Branchiopoda	Diplostraca	Diaphanosoma	leuchtenbergianum	0.01257722	2	Female	Whole Animal	Fischer, 1854	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	131852	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.32075946	51	.	nauplius	Esterley 1911	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	1000344	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.22642022	36	CI-CIV	Whole Animal	Sars, 1903	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	128120	Zooplankton	Arthropoda	Maxillipoda	Calanoida	Diaptomus	.	0.06289618	10	.	Whole Animal	Herrick	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	131840	Zooplankton	Rotifera	Monogononta	Ploima	Ascomorpha	.	0.03144306	5	.	Whole Animal	Zacharias	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	131841	Zooplankton	Rotifera	Monogononta	Ploima	Asplanchna	.	0.1257823	20	.	Whole Animal	Gosse 1850	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	125572	Zooplankton	Rotifera	Monogononta	Flosculariaceae	Conochilus	unicornis	0.08176202	13	.	Whole Animal	Rousselet 1892	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	125278	Zooplankton	Rotifera	Monogononta	Ploima	Kellicottia	longispina	0.01257722	2	.	Whole Animal	Kellicott 1879)	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	125281	Zooplankton	Rotifera	Monogononta	Ploima	Keratella	cochlearis	0.02515445	4	.	Whole Animal	(Gosse 1851)	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	126153	Zooplankton	Rotifera	Monogononta	Ploima	Polyarthra	vulgaris	0.01257722	2	.	Whole Animal	Carlin 1943	Live	.
BL-South	Bone Lake	Mid-Lake S	8/19/2004	Zooplankton - T	Composite	8	131850	Zooplankton	Rotifera	Monogononta	Ploima	Trichocerca	.	0.00628861	1	.	Whole Animal	Lamarck, 1901	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	131852	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.24800282	31	.	nauplius	Esterley 1911	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	1000248	Zooplankton	Arthropoda	Maxillipoda	Cyclopoida	.	.	0.06400252	8	CI-CV	Whole Animal	Burmeister, 18	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	1000344	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.15999703	20	CI-CIV	Whole Animal	Sars, 1903	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	128191	Zooplankton	Arthropoda	Maxillipoda	Cyclopoida	Cyclops	.	0.00800727	1	.	Whole Animal	Muller, 1785	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	128120	Zooplankton	Arthropoda	Maxillipoda	Calanoida	Diaptomus	.	0.05599525	7	.	Whole Animal	Herrick	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	125572	Zooplankton	Rotifera	Monogononta	Flosculariaceae	Conochilus	unicornis	0.04800652	6	.	Whole Animal	Rousselet 1892	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	125281	Zooplankton	Rotifera	Monogononta	Ploima	Keratella	cochlearis	0.09599451	12	.	Whole Animal	(Gosse 1851)	Live	.
BL-North	Bone Lake	Mid-Lake N	9/8/2004	Zooplankton - T	.	8	126153	Zooplankton	Rotifera	Monogononta	Ploima	Polyarthra	vulgaris	0.31999407	40	.	Whole Animal	Carlin 1943	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	131852	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.26315469	30	.	nauplius	Esterley 1911	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	1000248	Zooplankton	Arthropoda	Maxillipoda	Cyclopoida	.	.	0.0789586	9	CI-CV	Whole Animal	Burmeister, 18	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	1000344	Zooplankton	Arthropoda	Maxillipoda	Calanoida	.	.	0.20175599	23	CI-CIV	Whole Animal	Sars, 1903	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	128191	Zooplankton	Arthropoda	Maxillipoda	Cyclopoida	Cyclops	.	0.01752942	2	.	Whole Animal	Muller, 1785	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	128120	Zooplankton	Arthropoda	Maxillipoda	Calanoida	Diaptomus	.	0.05261874	6	.	Whole Animal	Herrick	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	127862	Zooplankton	Rotifera	.	.	.	.	0.07017865	8	.	Whole Animal	Hauer	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	131841	Zooplankton	Rotifera	Monogononta	Ploima	Asplanchna	.	0.00877995	1	.	Whole Animal	Gosse 1850	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	125572	Zooplankton	Rotifera	Monogononta	Flosculariaceae	Conochilus	unicornis	0.01752942	2	.	Whole Animal	Rousselet 1892	Live	.
BL-South	Bone Lake	Mid-Lake S	9/8/2004	Zooplankton - T	.	8	125281	Zooplankton	Rotifera	Monogononta	Ploima	Keratella	cochlearis	0.0789586	9	.	Whole Animal	(Gosse 1851)	Live	.