Allied Biological

Mount Kemble Lake

2014 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.

Morristown, NJ

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YEAR END SUMMARY
2014 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

INTRODUCTION

The following report is the 2014 Year-End Summary of the Water Quality Monitoring and Lake Management Program for Mount Kemble Lake located in Morristown, Morris County, New Jersey. This report includes details of lake surveys, the water quality monitoring program, phytoplankton surveys, and observations logged during site visits in 2014. Recommendations for Mount Kemble Lake management efforts for the 2015 season are also included. The Appendix of this report includes graphs and tables of the 2014 field data, reference guides, along with supporting documents for this report.

Scientific Name	Common Name
Potamogeton foliosus	Leafy Pondweed
Potamogeton crispus	Curly-leaf Pondweed
Lemna minor	Small Duckweed
Najas guadalupensis	Southern Naiad
Potamogeton diversifolius	Variable Pondweed

Table 1. 2014 Observed Aquatic Macrophytes.

The 2014 Lake Management Program for Mount Kemble Lake focused on control of nuisance and invasive aquatic plant growth, most specifically curly-leaf pondweed (*Potamogeton crispus)*, leafy pondweed (*Potamogeton foliosus*), and southern naiad (*Najas guadalupensis*). Through the season a total of five (5) different aquatic macrophytes were observed during surveys of the lake (Table 1), with invasive species highlighted in red. One (1) of these species duckweed (*Lemna minor*) is a floating aquatic plant.

WEATHER DISCUSSION

In 2014, the mid-Atlantic region saw below to well below average temperatures (Rutgers Climate Lab Figure 1.) during January through April, following what many recall as being the coldest winter since the 1970's. Numerous snowfall records were also shattered in many areas. The cold temperatures that extended well into April influenced generally slow development of aquatic vegetation growth through the spring season, with aquatic plant growth not developing until May. The remainder of the management season experienced mostly average atmospheric temperatures, with August becoming approximately two degree Fahrenheit below average for the month. Overall, precipitation amounts through the season were relatively average, until dry conditions persisted for much of August and September in northern New Jersey (Rutgers Climate Lab Figure 2.).

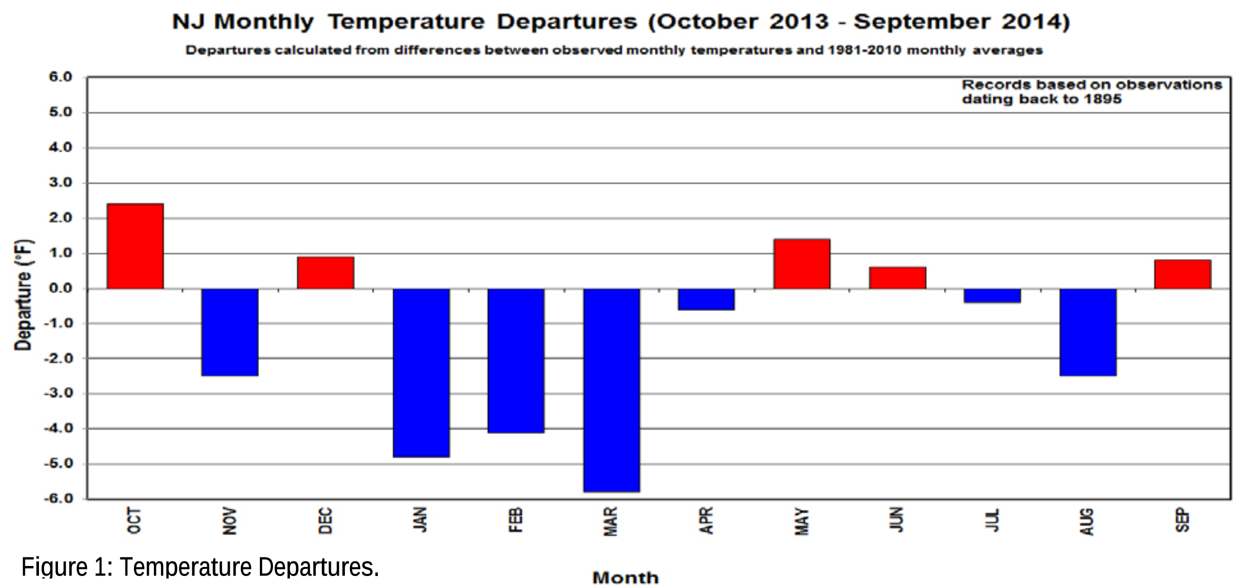


Figure 1: Temperature Departures.

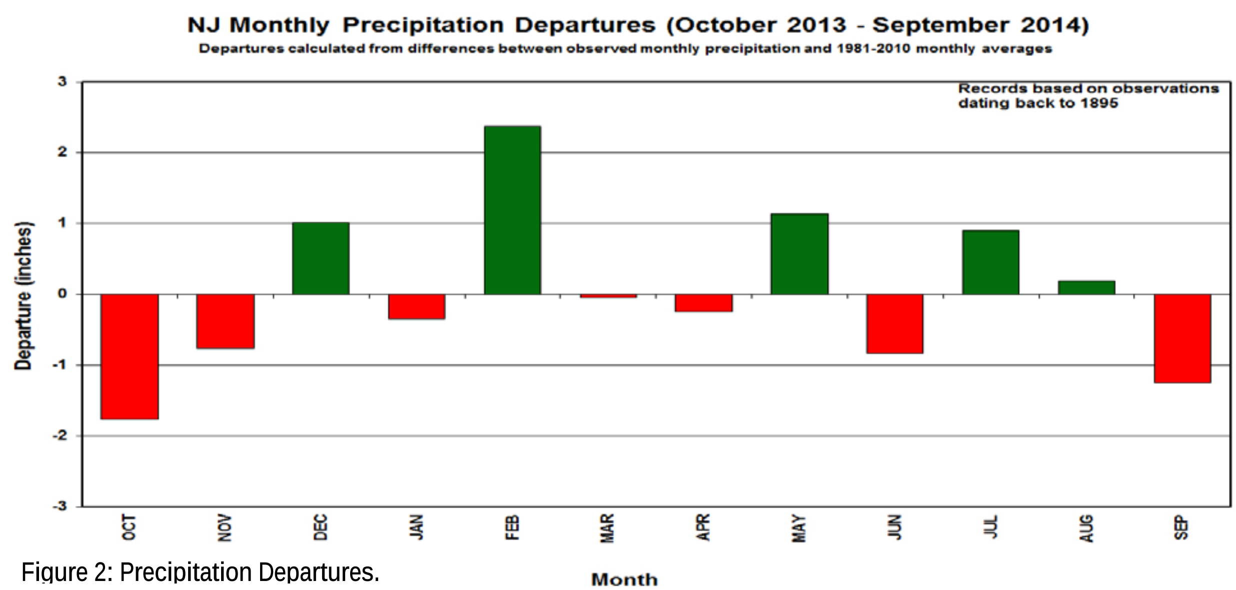


Figure 2: Precipitation Departures.

Lake Management

Aquatic biologists were at Mount Kemble Lake on seven (7) dates from April through August to conduct on-water assessments of aquatic vegetation and algae growth, and to perform *in situ* water quality analysis. On three (3) dates, comprehensive water quality analysis was conducted including, sampling for planktonic algae and zooplankton, lab sample collection and lake profile analysis for temperature and dissolved oxygen. Following each survey, biologists would review lake conditions to determine if management activity was required. In 2014, on two (2) dates

Allied Biological field staff conducted herbicide and algaecide applications for control of nuisance and invasive aquatic vegetation growth. The table below provides a reference to indicate dates of applications, what aquatic pesticides were applied, and the target acreage and aquatic plant species for each date (Table 2). Additionally, on July 23rd an application of Aluminum Sulfate was conducted to neutralize nutrients within the water column.

Date	Service Performed	Acres Treated	Target Species
6/6/2014	Copper Sulfate	5	Filamentous algae
	Reward	5	*P. foliosus / P. crispus*
7/23/2014	Aluminum Sulfate	13.6	Total Phosphorous
8/20/2014	Copper Sulfate	5	Filamentous algae
	Reward	5	*N. guadalupensis*

Table 2: Mount Kemble Lake 2014 Treatment Log

Early season surveys conducted at Mount Kemble Lake during April and May were highlighted by only a single rooted stem of curly-leaf pondweed (*P. crispus*) along the eastern shoreline, and no other submersed aquatic plant growth observed. Filamentous algae densities were also light in April with only scattered trace surface "clumps" along the lake perimeter, while there was no filamentous algae growth observed during the May 23rd lake survey. Through this time shoreline surveys of Clubhouse Pond indicated that generally sparse density filamentous algae growth was scattered along the lake bottom and surface. An application of the contact herbicide Reward (a.i. diquat) was performed on June 6th targeting a five acre community of leafy pondweed (*P. foliosus*) and curly-leaf pondweed that were growing collectively at sparse density along most of the western shoreline, and across the shallow inlet area of Mount Kemble Lake. In addition to the herbicide management, an application of the algaecide Copper Sulfate was also conducted within the same treatment area for usually sparse density surface filamentous algae growth. Water clarity at this time also increased to eight feet, from 4 feet and 3.5 feet observed in April and May, respectively.

A lake survey performed on July 3rd indicated that scattered patches of duckweed (*L. minor*) were located along the shoreline, along with a moderate density area of variable pondweed (*P. diversifolius*) north of the boat launch, and sparse patches along the eastern and western shorelines. Usually light density filamentous algae growth was colonizing on the plants that were decomposing from the previous herbicide treatment. An application of Aluminum Sulfate was performed on July 23rd to target nutrients in the water column by binding the material along with other organic and inorganic matter and settling the "floc" to the bottom of the lake. The Aluminum Sulfate neutralizes nutrients rendering them unavailable, limiting plant and algae development. A light density bloom of unicellular algae was visible in the water column at this time, reducing water clarity to a little more than five feet. Growth of southern naiad was also established at sparse to moderate density along most of the inlet area and western shoreline.

The final lake management activity of the season was conducted on August 20th with an application of Reward and Copper Sulfate performed to control nuisance growth of southern naiad and filamentous algae across the inlet and adjacent shoreline areas. Water clarity improved to eight feet at this time as planktonic algae growth was only observed at trace density in the water column.

Water Quality Monitoring Program

In 2014, the water quality monitoring program included *in-situ* field measured limnological analysis including temperature/dissolved oxygen profiles, pH, transparency, alkalinity, and total hardness. In addition, surface water chemistry samples were collected at the north inlet and lake station, as well as from the lake bottom at the lake station site, and transported to Aqua Pro-Tech Laboratories (Fairfield, New Jersey) for analysis of the following parameters: ammonia, conductivity, nitrate, total phosphorus, and total suspended solids. On April 28th, samples for total phosphorous were also collected at the inlet and outlet in accordance with the New Jersey Total Maximum Daily Load (TMDL) threshold. Collection for phytoplankton and zooplankton identification and enumeration was also performed on three dates. Provided in the Appendix is a short description of each water quality parameter, and laboratory data results. Below is the water quality data tabulated to provide a seasonal reference.

Water Quality Data Tables

Mount Kemble Lake Water Quality Results – Inlet Station			
Parameter	**Units**	**4/28/2014**	**Limits**
Total Phosphorus	mg/L	0.01	0.03

Table 3. 2014 Mount Kemble Lake Water Quality Results

Mount Kemble Lake Water Quality Results- North Station					
Parameter	**Units**	**4/28/2014**	**6/6/2014**	**7/302014**	**Limits**
Temperature	°C	14.7	21.2	26.4	NA
Dissolved Oxygen	mg/L	13.13	8.12	4.9	<4.0
ph	SU	8.0	7.5	7.5	9
Alkalinity	mg/L	44	76	60	NA
Total Hardness	mg/L	120	80	120	NA
Secchi	feet	4’	8’	5’	<4’
Ammonia	mg/l	ND	ND	ND	0.3
Nitrate	mg/L	0.9	0.98	ND	0.3
Total Phosphorus	mg/L	0.03	0.05	0.01	0.03
Total Suspended Solids	mg/L	ND	ND	ND	25
Conductivity	Umhos/cm	320	300	291	1500

Table 4. 2014 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that exceed the acceptable lake management limit.

Mount Kemble Lake Water Quality Results- Lake Station Surface					
Parameter	**Units**	**4/28/2014**	**6/6/2014**	**7/302014**	**Limits**
Temperature	°C	14.8	21.6	24.9	NA
Dissolved Oxygen	mg/L	13.63	9.51	8.55	<4.0
ph	SU	8.0	8.0	7.5	9
Alkalinity	feet	44	84	60	NA
Total Hardness	mg/L	120	100	100	NA
Secchi	mg/L	4'	8.5'	5'	<4'
Ammonia	mg/l	ND	ND	ND	0.3
Nitrate	mg/L	0.9	0.98	ND	0.3
Total Phosphorus	mg/L	0.03	0.03	0.02	0.03
Total Suspended Solids	mg/L	ND	ND	ND	25
Conductivity	Umhos/cm	310	290	291	1500

Table 5. 2014 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that exceed the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Lake Station-Bottom					
Parameter	**Units**	**4/28/2014**	**6/6/2014**	**7/302014**	**Limits**
Dissolved Oxygen	mg/L	3.34	.08	0.38	<4.0
Ammonia	mg/L	ND	0.48	ND	0.3
Nitrate	mg/L	0.95	ND	ND	0.3
Total Phosphorus	mg/L	0.03	0.08	0.02	0.03
Total Suspended Solids	mg/L	ND	6.00	ND	25
Conductivity	umhos/cm	317	325	289	1500

Table 6. 2014 Mount Kemble Lake Water Quality Results
Results highlighted in red identify those that exceed the acceptable lake management limit.

Mount Kemble Lake Water Quality Results – Outlet Station			
Parameter	**Units**	**4/28/2014**	**Limits**
Total Phosphorus	mg/L	0.03	0.03

Table 7. 2014 Mount Kemble Lake Water Quality Results

Water Quality Results Summary

During 2014, the surface water temperature was 14.8° C in April, and increased to 21.6°C, and 24.9°C in June and July, respectively. The water temperature on the July 3rd lake survey date was the highest observed temperature of the season at 28.0° C. The pH values collected from the inlet and lake station sites throughout the year ranged from 7.5 to 8.0, which falls within the typical range for freshwater lake systems, and is within historical readings of the past several years for Mt. Kemble Lake. The hardness levels ranged from 80 mg/L to 120 mg/L at either location throughout the season. The typical range characteristics to freshwater lakes are those falling between 4 and 200mg/L. The chemical composition of Mount Kemble Lake's surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 44 to 84 mg/l, and within a comparable level compared to similar NJ freshwater lakes' chemical composition. Conductivity was consistent throughout the season with values ranging from 289 to 320 µmhos/cm., with the highest observed value obtained in the June lake bottom sample.

Ammonia and nitrates are nutrients based on the chemical composition of nitrogen. These naturally occurring compounds when influenced by human activity can cause excessive plant and algae growth. The only sample that returned a value for ammonia was the lake bottom sample on the June 6th sampling date. The ammonia level at this depth and on this date was a result of the water column being nearly depleted of dissolved oxygen below approximately twelve feet. When dissolved oxygen is exceptionally low, ammonia cannot be oxidized into nitrate, which is why this sample was also the only to return a non detected value for nitrate.

Nitrates were found elevated in the April and June surface samples, but were not detected in the July surface samples. In April, nitrate levels were 0.9 mg/L in both surface sites, and were 0.95 mg/L in the bottom sample. During the June sampling nitrate levels were 0.98 at the lake station and inlet stations. These values are three times the threshold value for excessive aquatic plant productivity. The lack of nitrate in the July samples is a result of the application of Aluminum Sulfate being conducted only seven days prior to sampling depleting the water column of available nutrients.

Total phosphorus is usually present in freshwater lakes at low concentrations. Total phosphorus concentrations in a freshwater lake system should be less than 0.03 mg/L to prevent higher productivity. The only surface sample that returned a value higher than the 0.03mg/L threshold was the June sample at the North Station, which was 0.05 mg/L. In June, the lake station bottom sample was elevated at 0.08 mg/L, while the other two dates were at or below the 0.03 mg/L threshold. In terms of total phosphorous levels, the values observed in 2014 were significantly lower than those observed in 2013, when phosphorous sampling returned values of 0.04 mg/L, 0.09 mg/L and 0.13 mg/L. This translates to an average phosphorous value in 2014 that was half than 2013, declining from 0.086 mg/L to 0.043 mg/L. This appears attributable to the application of Aluminum Sulfate in July that prevented elevated phosphorous levels through the latter half of the summer season.

Oligotrophic <0.012mg/L Very Good	Mesotrophic 0.012 - 0.024mg/L Good	Eutrophic 0.025 - 0.096mg/L Fair	Hypereutrophic >0.096mg/L Impoundments

Table 8: Trophic Status Based on Phosphorus Values

Transparency (water clarity) displayed moderate variability in 2014, with observed secchi readings between 3.5 and 8.5 feet. The highest secchi measurement was recorded on June 6th, while the lowest observed clarity reading was on May 23rd, likely affected by turbidity from recent rainfall. Overall, water clarity was considered fair to good throughout the season, and was not observed to be negatively affected by blooms of planktonic algae.

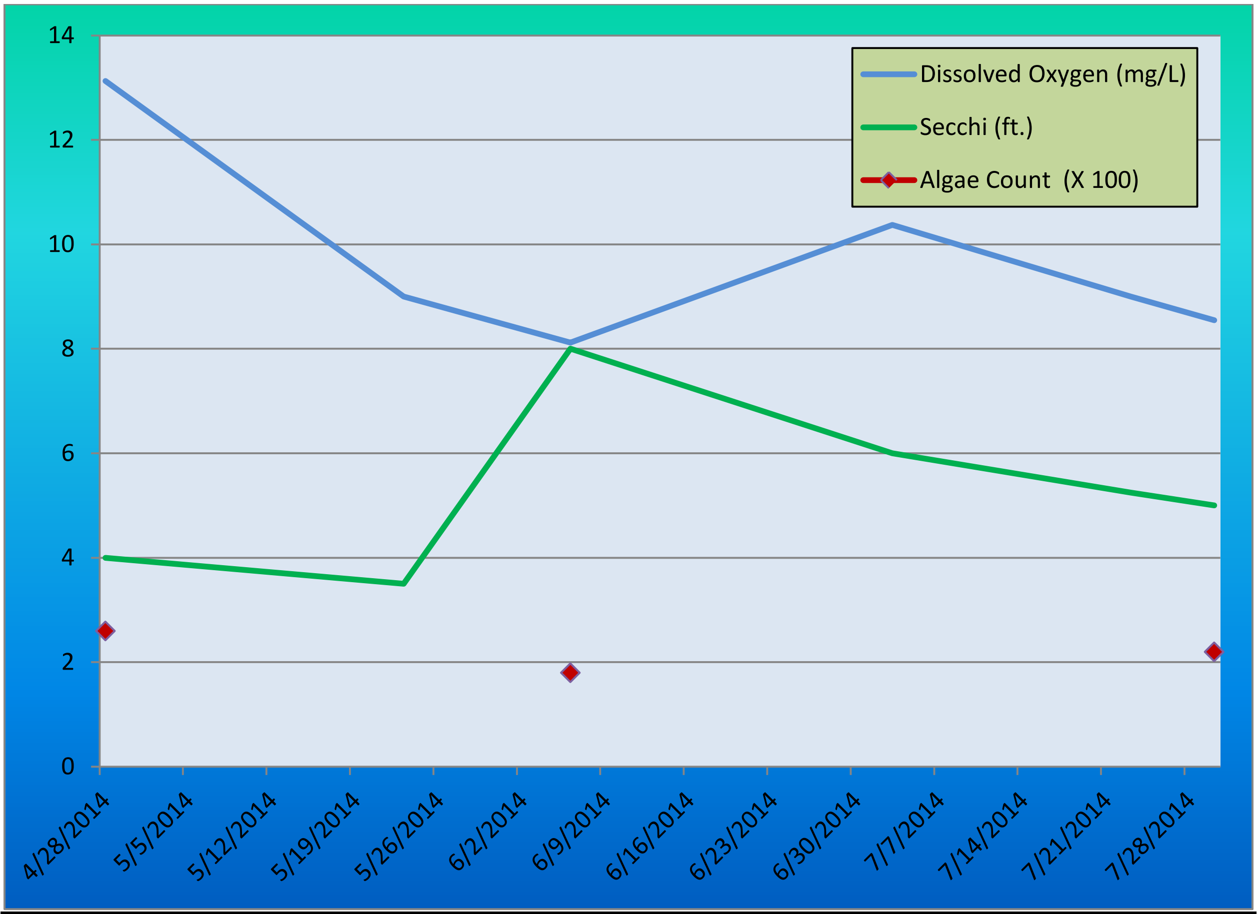


Figure 3. Mount Kemble Lake Seasonal Profile

Lake Profile Description

In 2014, temperature and dissolved oxygen profiles were collected from the lake station sampling site utilizing a temperature / dissolved oxygen meter. The April profile revealed a well mixed water column, with favorable dissolved oxygen to a depth of twenty-four feet. During June, the lake profile revealed what is called a positive heterograde curve, which simply means that the water quality conditions of the lake depleted dissolved oxygen below a depth of approximately twelve feet, and likely supported an algae bloom at about nine feet,

	4/28/2014		6/6/2014		7/30/2014	
Depth (m)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	14.8	13.63	21.6	9.51	24.9	8.55
1	14.4	13.85	21.6	9.35	24.7	8.41
2	14.2	13.56	21.6	9.41	24.6	8.45
3	13.0	14.69	16.9	14.06	24.6	8.38
4	9.3	8.87	12.8	2.90	24.5	8.30
5	7.7	5.31	9.7	0.19	23.8	4.69
6	7.0	5.04	8.1	0.13	21.9	1.65
7	6.5	4.26	7.2	0.11	18.7	0.38
8	6.2	3.34	6.6	0.10		
9			6.6	0.10		

Table 9. Mount Kemble Lake Dissolved Oxygen Profiles.

which corresponds with the observed water clarity of a little less than nine feet. The algae bloom at this depth is indicated by the spike in dissolved oxygen at this depth alone. This type of water quality condition is observed most frequently in lakes where the surface area is small relative to the maximum depth and protected from intense wind action by surrounding topography and vegetation, which is descriptive of Mt. Kemble Lake. The July 30th lake profile displayed a more typical mid-summer stratification, where dissolved oxygen is consistent to a particular depth, in this case approximately twelve feet, and then declines to anoxia at an approximate depth of eighteen feet. Complete profile graphs are provided in the Appendix of this report.

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2014, surface phytoplankton samples were collected at two established water quality monitoring sites in April, June, and July. Samples were collected in dedicated, pre-rinsed one liter plastic bottles and placed in a cooler with ice for transport. The samples were identified and enumerated under a compound microscope immediately upon return to Allied Biological's laboratory. The 2014 microscopic examination data sheets and graphs are provided in the Appendix. In 2014, a single vertical zooplankton tow was conducted at the lake station on each date. The collected sample was preserved in the field, and returned to ABI's lab for analysis.

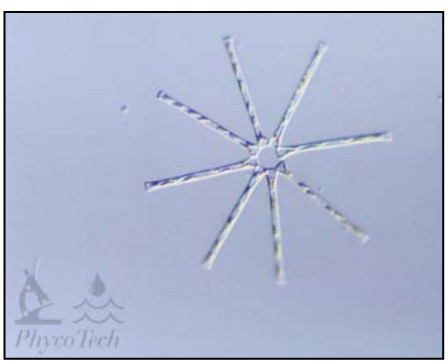
A Phytoplankton Primer

Lakes typically contain three broad categories of phytoplankton (also sometimes referred to as algae). These include filamentous phytoplankton, macroscopic multi-branched phytoplankton (which appear similar to submersed plants), and unicellular phytoplankton. Each category shall be discussed in turn, although the results of the 2014 sampling will focus on the unicellular phytoplankton population.

Filamentous phytoplankton are typically macroscopic (that is, visible with the naked eye), composed of long chains of cells that are attached to a substrate, typically the lake bottom, submersed or emergent vegetation, or rocks. This is called benthic filamentous algae (BFA), and rampant growth can become visible at the surface. As pieces of benthic filamentous algae break apart, it often floats on the surface as dense unsightly mats called floating filamentous algae (FFA). Typically, genera of green algae or blue-green algae develop into nuisance filamentous mats. Abundant nuisance growth of filamentous phytoplankton creates numerous negative impacts to a lake. These can include a decrease in aesthetics, a decrease in recreational uses, increased fishing frustration, and water quality degradation.

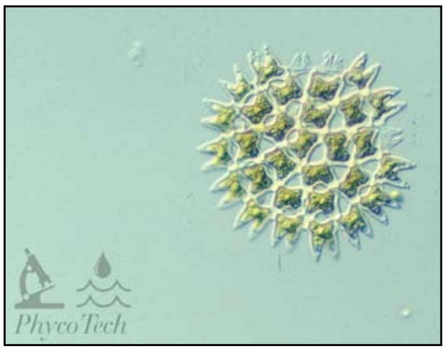
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, under ideal conditions, this type of phytoplankton can reach lengths of several feet, and create a dense carpet on the bottom of a lake. Therefore, it typically does not reach nuisance levels in a lake, save for high use areas such as beaches and other popular swim areas. Since this phytoplankton occupies a similar ecological niche as submersed plants, it's often included in detailed and visual aquatic plant surveys. It provides numerous benefits to a lake system, including sediment stabilization, acting as a nutrient sink, providing invertebrate and fish shelter and habitat, and is one of the first to re-colonize a disturbed area. In the Northeast, muskgrass (*Chara* sp.) and stonewort (*Nitella* sp.) are two of the most common macroscopic multi-branched phytoplankton.

Unicellular phytoplankton are typically microscopic, and consist of individual cells or colonies of cells suspended in the water column. At high enough densities (often called a bloom), they can impart a green or brown (and sometimes, even red) tint to the water column. Unicellular phytoplankton belongs to several taxonomic groups with density and diversity of these groups often varying due to seasonality. When unicellular phytoplankton density becomes elevated it can reduce water clarity (giving the water a "pea soup" appearance), and impart undesirable odors. Usually blue-green algae are responsible for these odors, but other groups or extremely elevated densities can impart them as well. In addition to decreased aesthetics, unicellular phytoplankton blooms can cause degradation of water quality, increase the water temperature (turbid water warms faster than clear water), and can possibly produce a variety of toxins (in the case of blue-green algae), depending on the type of genera present and environmental conditions. Numerous groups of unicellular phytoplankton are common in the Northeast, including diatoms, golden algae, green algae, blue-green algae, euglenoids and dinoflagellates. Each group shall be discussed in turn.

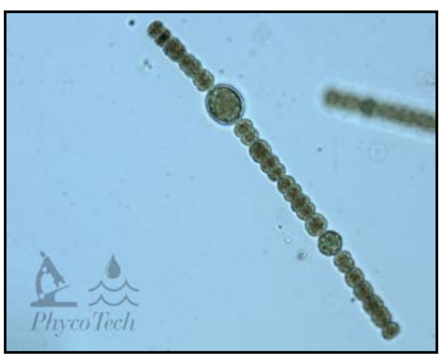


Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population characteristics of diatoms. Some are round and cylindrical (centric) in shape, while others are long and wing-shaped (pennales). They are usually brown in color, and reach maximum abundance in colder or acidic water. Therefore, they tend to dominate in winter and early spring. Common diatoms in the Northeast include *Fragilaria*, *Cyclotella*, *Navicula*, and *Asterionella* (pictured).

Golden Algae are typically yellow or light brown in color. Cell size is usually small oval shaped with a partially empty area, but several genera create colonies of smaller cells. Most have two flagella, and some type of scales or a rigid coating that grants it a fuzzy appearance. However, a few filamentous forms are possible as well. They typically prefer cooler water, so they dominate in the late fall, winter, or early spring. They also tend to bloom at deeper (cooler) depths. They are common in low nutrient water, and numerous forms produce taste and odor compounds. Common golden algae in the Northeast include *Dinobryon* (pictured), *Mallomonas*, and *Synura*.

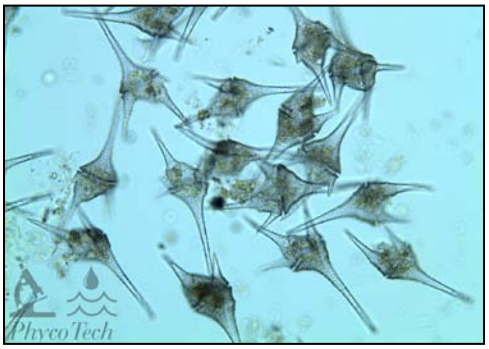


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically with distinct cell shapes light green in color. Some prefer acidic waters, and others highly eutrophic (sewage) conditions. A green algae bloom usually occurs in water with high nitrogen levels. Green algae typically dominate in mid to late summer in the Northeast. Common genera include *Chlorella*, *Scenedesmus*, *Spirogyra* and *Pediastrum* (pictured).



Blue-green algae are actually photosynthetic bacteria. Therefore, they tend to be small, simple in structure and lacking interior cell details. Blue-green algae are typically encased in a mucilaginous outer layer. Some genera are adorned with heterocysts, swollen structures capable of fixing nitrogen, a competitive advantage. These types tend to bloom in nitrogen-poor or eutrophic systems. Yet, blue-green algae are tolerant of a wide variety of water chemistries, and boast many oligotrophic forms as well. Blue-green algae often have gas vesicles which provide increased buoyancy another competitive advantage over other groups of phytoplankton, due to their propensity to shade out others by blooming at the surface. Numerous blue-green algae are documented taste and odor (T&O) producers, and under certain environmental conditions and high enough densities, can produce toxins dangerous to fish, livestock, and possibly humans. Blue-green algae typically dominate a lake system in late summer to early fall. Common blue-green algae that occur in the Northeast include *Anabaena* (pictured), *Aphanizomenon*, *Microcystis* and *Coelosphaerium.*

Euglenoids are typically motile with 0 to 3 (typically 2) flagella, one of which is longer. Euglenoids has plasticity of shape, and usually are grass green in color (although sometime they are clear or even red). Most forms have a distinct red “eyespot. They are often associated with high organic content water, and eutrophic conditions. Common euglenoids that occur in the Northeast include *Euglena* (pictured), *Phacus,* and *Trachelomonas*.



Dinoflagellates are very common in marine environments, in which they often cause toxic blooms. However, toxin production in freshwater genera is very rare. Dinoflagellates are typically single ovoid to spherical cells, but large compared to phytoplankton from other groups. They usually possess two flagella (one wrapped around the middle of the cell) which grant them rotation while they move through the water column. Cellulose plates (armored dinoflagellates) are more common, but genera without cellulose plates (naked dinoflagellates) also occur. They generally prefer organic-rich or acidic waters, and can impart a coffee-like brown tint to the water at high enough densities. Common dinoflagellates in the Northeast include *Ceratium* (pictured) and *Peridinium*.

Phytoplankton Results

In April, the phytoplankton density was considered low, with a favorable community of mostly diatoms, green algae and euglenoids, with traces of golden algae and dinoflagellates at the inlet station only. Diversity was high at the inlet station with eleven genera, and moderate at the lake station with eight total genera.

Algal Group	Inlet Station		
% Abundance	4/28/2014	6/6/2014	7/30/2014
Diatoms	**33.3%**	7.7%	7.7%
Golden Algae	3.3%	**69.2%**	
Protozoa		15.4%	
Green Algae	26.8%	7.7%	**69.2%**
Blue-green Algae			
Dinoflagellates	3.3%		23.1%
Euglenoids	**33.3%**		
Total Orgs / mL	**300**	**130**	**130**

Table 10. Inlet Station

By June, the phytoplankton density and diversity decreased at both sites, with assemblages comprised of five genera at the inlet station, and only three genera at the lake station. Each of the phytoplankton assemblages consisted of trace amounts of diatoms, golden algae, and protozoa, while the inlet station also contained a trace of green algae. Water clarity at this time was improved to 8.5 feet.

Algal Group			
% Abundance	4/28/2014	6/6/2014	7/30/2014
Diatoms	**50.0%**	16.6%	
Golden Algae		**77.8%**	13.6%
Protozoa		5.6%	
Green Algae	30.8%		13.6%
Blue-green Algae			9.1%
Dinoflagellates			**63.6%**
Euglenoids	19.2%		
Total Orgs. / mL	**260**	**180**	**220**

Table 11. Lake Station

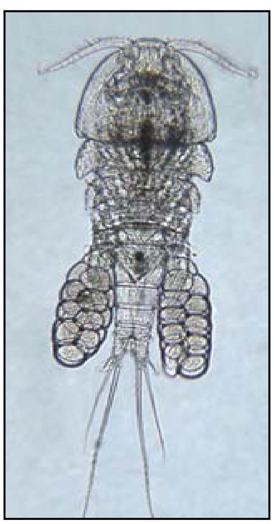
On the final sampling date on July 30th, the algal community at each sampling site remained at light density, with 130 organisms per liter at the inlet, and 220 organisms per liter at the lake station. The assemblage at the inlet site was dominated by five genera of green algae accounting for 69.2 percent of population. A light density bloom of *Peridinium* (140 orgs./mL), a dinoflagellate, was responsible for 63.6 percent of the assemblage at the lake station, with additionally, traces of golden, green and blue-green algae.

A Zooplankton Primer

Zooplankton provides an important link in a typical lake's food web between phytoplankton and developing/juvenile stages of fish. In general, zooplankton feed on phytoplankton, while fish in turn feed on zooplankton. The rate of phytoplankton feeding efficiency is primarily based on body size, but zooplankton group, and to some effect specific genera, also plays an important role. There are three main groups of zooplankton found in freshwater systems: rotifers, cladocera, and copepods.

Rotifers are a diverse group of zooplankton, very common in lakes and marine environments alike. Rotifers are generally the smallest zooplankton of the three groups, and thus typically the least efficient phytoplankton grazers. Feeding preferences are determined primarily by mouth structures, and include generalist feeders (omnivores), which eat any small organic detritus encountered, and predators, which eat other smaller rotifers and small phytoplankton. Generalist feeders include *Filinia, Keratella, Lecane, Euchlanis*, and *Brachionus*. Predator genera include *Polyarthra* (larger species), *Asplanchna*, *Synchaeta*, and *Trichocerca*.

Cladocera are less diverse, but also very common in freshwater lakes. They are sometimes called "water fleas". They spend most of their lifecycle reproducing via parthenogenesis (asexual reproduction with an all female population) only switching to less efficient sexual reproduction when environmental conditions decline. Some genera (such as *Daphnia*) can be quite large (up to 5.0 mm long, visible without magnification), and thus can be classified as highly efficient phytoplankton grazers. Most cladocera are phytoplankton grazers, although their diet includes most organic matter ingested, including bacteria and protozoa. Body size (and thus mouth size) determines feeding efficiency, but ironically the larger-bodied genera are easier to see by predaceous fish, and thus typically have reduced numbers in populations of zooplanktivorous fish. *Daphnia* are the most efficient phytoplankton feeders, while *Ceriodaphnia, Bosmina* and *Eubosmina* are less efficient. There are a few predator genera as well, including *Polyphemus* and *Leptodora*.



Copepods are almost excusive to freshwater lake systems (not streams or rivers) and estuarine and marine systems. Of the six suborders native to the United States, three are parasitic, and three are free living. One of the free living, *Harpacticoida* are exclusively benthic and thus often not collected in traditional plankton tows (unless the bottom sediments are disturbed). The remaining two suborders, the Calanoida and the Cyclopoida are of primary concern during lake studies. All copepods have several naupilar stages, followed by several immature stages, before reaching an adult stage. Both suborder adults are considered large bodied zooplankton, but have distinct feeding preferences. Calanoids are almost exclusively phytoplankton feeders and have even demonstrated selective feeding strategies. Cyclopoids have mouth parts suitable for biting and seizing prey. Their diet is primarily other crustacean zooplankton (including cannibalism on younger life stages), as well as phytoplankton and organic detritus ingestion, but less efficiently.

Zooplankton samples were collected with an 80 um Nitex plankton net. At the Lake Station, a single vertical tow was performed to a depth of 18 feet. Using as little site water as possible, the sides of the net were rinsed of any trapped zooplankton, concentrating the organisms into the net bottom. This concentrate was then emptied into a clean 1000 mL HDPE sample bottle. Immediately after collection, the sample was preserved with an equal amount of 10% sucrose formalin, to achieve a 5% solution. Sucrose was added to the preservative to help maintain carapace integrity. The samples were then placed in a cooler stocked with blue ice. On arrival at ABI's laboratory, the samples were stored in a dark refrigerator until the samples were identified and enumerated.

In the laboratory, each sample was manually mixed for about one minute, before a one mL subsample was removed using a calibrated syringe. The subsample was placed on a Sedgewick-Rafter counting cell, and examined under a compound microscope at 100X magnification. By using calibrated guides on the microscope stage, the entire one mL sample was examined, and any zooplankton were identified and enumerated to the lowest practical taxa using regionally appropriate taxonomic keys. This procedure was repeated two more times to generate three replicate counts. The counts were then averaged, and back-calculated to achieve an organism per liter density. The zooplankton count data sheets in the Appendix describe the step by step procedures for all three replicates, and the final averaged densities. Also included in the Appendix are pie charts depicting the sample date zooplankton group distribution.

2014 Zooplankton Results

Zooplankton Group	**4/28/2014**	**6/30/2014**	**7/30/2014**
Rotifers	**94.3%**	**86.1%**	**86.05%**
Cladocera	1.2%	12.5%	9.05%
Copepoda	4.5%	1.4%	4.9%
Total Zooplankton (Orgs. / mL)	1285	7079	1391

Table 12. Mount Kemble Lake 2014 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 1,285 organisms per liter, which is considered high. Sample diversity was moderate with seven different genera observed. At this time Rotifers accounted for 94.3 percent of the total zooplankton community with *Keratella*, accounting individually for 82.6 percent. Additionally, a single genus of Cladoceran (*Daphnia*) and Copepod (*Cyclopoid nauplii*) were also represented in the zooplankton community, with *Daphnia* individually only accounting for 1.2 percent of the community.

The June sampling revealed a higher diversity rotifers, with nine genera accounting for 6,095 organisms per liter, which is approximately six times greater than any observed rotifer density over the past two seasons. *Keratella* accounted for 49.4 percent of the rotifer population, and 42.5 percent of the total zooplankton community. The second most abundant genera of rotifer, *Polyarthra*, represented 28.9 percent of the rotifers, and 24.8 percent of the total community. *Daphnia* density also increased significantly from the previous sampling, with the individual population increasing from 15 organisms per liter in April to 882 organisms per liter at this time. Additionally, a single genus of Copepod (*Cyclopoid nauplii*) was also observed, although representing only 1.5 percent of the zooplankton community.

On the final sampling date of July 30th, the zooplankton composition although still diverse, was more representative of the April sampling, with a total population density of 1,391 organisms per liter, colonized by nine genera of rotifers. Also at this time there were no observed genera of *Daphnia* within the collected sample. Overall similar to the previous two seasons, rotifers, more specifically *Keratella* and *Polyarthra* were the most dominant genera of zooplankton during the season. The low density of *Daphnia* is likely a result of the low densities of observed phytoplankton growth, as the population dynamics of *Daphnia* are generally directed by the intensity of phytoplankton growth. It is more concerning from a fisheries management perspective, as *Daphnia* provide the base of the fish population food chain.

Discussion

The 2015 management program of Mount Kemble Lake will continue to focus on the control of nuisance densities of plant and algae growth. The target aquatic macrophyte species observed at Mount Kemble Lake in 2014 were southern naiad, curly-leaf and leafy pondweed. It is recommended that localized applications of the contact aquatic herbicide Reward continue to be utilized through the season for its ability to selectively control nuisance submerged vegetation by rapid absorption into the target plant. In addition, it is beneficial to allow certain amounts of plants to persist in the lake to provide dissolved oxygen, habitat and compete for nutrients required for nuisance plant and algae development. The growth of leafy pondweed (*Potamogeton foliosus*) and southern naiad (*Najas guadalupensis)* should be encouraged in areas of the lake, such as the northern inlet, where they are not interrupting recreational activities or reducing the aesthetic appeal of the lake.

Copper sulfate will continue to provide the most effective and cost efficient management method for controlling nuisance density filamentous and planktonic algae growth. It should be reminded that Copper Sulfate has acknowledged negative impacts on zooplankton populations, with localized targeted applications recommended for only nuisance growth of filamentous algae, and limited use on planktonic algae blooms only at times when water clarity is significantly impaired. Numerous other copper and non-copper based algaecides are available and at the request of the Association, ABI would be happy to discuss these alternatives.

The success of the application of Aluminum Sulfate on July 23rd was evident during the July 30th water quality sampling, as water clarity increased approximately three feet, and concentrations of nitrate and total phosphorous were significantly reduced. Based on the observed results of this application, it is recommended that an application of Aluminum Sulfate be performed during the month of May in 2015 to reduce nutrient levels in the water column prior to the height of the summer aquatic plant and algae growth period, and compare results with those observed from the 2014 application.

The current Mount Kemble Lake Water Quality Monitoring Program is well-designed, and provides suitable water quality data allowing for proactive management of the lakes' environment and reduces the opportunity for the development of problematic situations. It is important to continue water quality monitoring on a regular yearly basis over the long-term to build a baseline data record which will assist biologists in developing more quantitative analysis for greatest possible management procedures.

The entire staff at Allied Biological appreciates the opportunity to be of service to the Mount Kemble Lake Association and looks forward to assisting the Association on the stewardship of Kemble Lake for many years to come.

Sincerely,

Robert Schindler
Bob Schindler
Aquatic Biologist

APPENDIX

APPENDIX A: WATER QUALITY PARAMETER DESCRIPTION
APPENDIX B: AQUATIC MACROPHYTE GUIDE
APPENDIX C: WATER QUALITY SAMPLING MAP
APPENDIX D: PHYTOPLANKTON ENUMERATION CHARTS
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS
APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES
APPENDIX G: LAB DATA REPORTS

Appendix A: Water Quality Parameter Descriptions

Temperature

Temperature is measured in degrees Celsius, and is very important to aquatic biota. Several factors affect temperature in a lake system, including air temperature, season, wind, water flow through the system, and shade trees. Turbidity can also increase water temperature as suspended particles absorb sun rays more efficiently. Water depth also affects temperature. In general, deeper water remains cooler during the summer months.

Temperature preferences vary among aquatic biota. Since water temperature typically varies between 5 ºC and 30 ºC during the season, most aquatic biota can flourish under this wide range of temperatures. Of more concern is thermal shock, which occurs when temperature rapidly changes in a short amount of time. Some aquatic biota can become stressed when temperature changes as little as 1-2 ºC in a 24 hour period.

Dissolved Oxygen

Dissolved Oxygen is the measurement of the amount of oxygen freely available to aquatic biota in water. Several factors play a role in affecting the amount of dissolved oxygen in the water. These factors include temperature (warmer water holds less dissolved oxygen), low atmospheric pressure (such as higher altitude) decreases the solubility of oxygen, mineral content of the water can reduce the water's dissolved oxygen capacity, and water mixing (via wind, flow over rocks, or thermal upwelling) increases dissolved oxygen in the water. In addition, an over abundance of organic matter, such as dead algae or plants causes rapid aerobic bacteria growth. During this growth, bacteria consume oxygen during respiration, which can cause the water's dissolved oxygen to decrease.

Dissolved oxygen has a wide range, from 0 mg/L to 20 mg/L. To support diverse aquatic biota, 5-6 mg/L is minimally required, but 9-10 mg/L is an indicator of better overall water quality. Dissolved oxygen reading of below 4 mg/L is stressful to most aquatic organisms, especially fish.

Water Clarity

Transparency (or visibility) is measured with a Secchi disc, and can provide an experienced biologist with a quick determination of a lake's water quality. In short, higher visibility indicates a cleaner (and healthier) aquatic system. Cloudy conditions could indicate nutrient rich sediments entering the lake or excessive algal blooms due to nutrient availability, leading to a degradation of water quality.
Clear conditions allow greater light penetration and the establishment of a deeper photic zone. The photic zone is the depth of active photosynthesis carried out by plants and algae. A byproduct of photosynthesis is dissolved oxygen, required for use by higher aquatic organisms, such as zooplankton and fish.

Total Hardness

Hardness is a measure of dissolved salts in the water, usually calcium, but also magnesium and iron. Hardness is usually influenced by the rock and soil types of the watershed, and the amount of runoff over these surfaces. Hardness can be measured for only calcium content (Hardness (Ca)), or for all three salts, called Total Hardness. Water with Hardness (Ca) less than 10 mg/L can only support sparse aquatic biota. Freshwater typically has a Hardness (Ca) level from 4 to 100 mg/L. In general, the degree of total hardness can be classified according to the table to the right.

Alkalinity

Alkalinity is the measure of the water's capacity to neutralize acids. A higher alkalinity can buffer the water against rapid pH changes, which in turn prevents undue stress on aquatic biota due to fluctuating pH levels. The alkalinity of a lake is primarily a function of the watersheds soil and rock composition. Limestone, dolomite and calcite are all a source of alkalinity. High levels of precipitation in a short amount of time can decrease the waters alkalinity. A typical freshwater lake has an alkalinity of 20-200 mg/L. A lake with a low alkalinity typically also has a low pH, which can limit the diversity of aquatic biota.

pH

The measurement of acidity or alkalinity of the water is called pH (the "potential for hydrogen"). Several factors can impact the pH of a lake, including precipitation in a short amount of time, rock and soil composition of the watershed, algal blooms (increase the pH), and aquatic plant decomposition (decreases the pH). A pH level of 6.5 to 7.5 is considered excellent, but most lake systems fall in the range of 6.0 to 8.5. Aquatic biota can become stressed if the pH drops below 6.0, or increases above 8.5 for an extended amount of time.

Most aquatic biota are adapted to specific pH ranges. When the pH fluctuates rapidly, it can cause changes in aquatic biota diversity. Immature stages of aquatic insects and juvenile fish are more sensitive to low pH values than their adult counterparts. Therefore, a low pH can actually inhibit the hatch rate and early development of these organisms.

Conductivity

Conductivity is the measure of water's ability to conduct an electrical current, and is measured in umhos/cm, the higher the number of charged particles(ions) in the water, the easier for electricity to pass through it. Conductivity is useful in lake management by estimating the dissolved ionic matter in the water, the lower the conductivity, the higher the quality of water (oligotrophic). A higher conductivity usually indicates an abundance of plant nutrients (total phosphorous and nitrate), or eutrophic conditions. Industrial discharge, road salt runoff, and septic tank leaching can increase conductivity. Distilled water has a conductivity of 0.5 to 2.0 umhos/cm, while drinking water conductivity typically ranges from 50to 1,500 umhos/cm. Conductivity below 500 umhos/cm is considered ideal in a lake system.

Nitrate

Nitrates are chemical compounds derived from nitrogen and oxygen. Nitrogen is needed by all plants and animals to make proteins needed for growth and reproduction. Nitrates are generated during plant and animal decomposition, from man-made sources, and from livestock and waterfowl sources. Man-made sources of nitrates include septic system leaching, fertilizer runoff, and improperly treated wastewater. Freshwater lake systems can potentially receive large nitrate inputs from waterfowl, specifically large flocks of Canada geese. An increase in nitrate levels can in turn cause an increase in total phosphorous levels. A nitrate level greater than 0.3 mg/L can promote excessive growth of aquatic plants and algae.

Total Phosphorous

Total phosphorous is a chemical compound derived from phosphorous and oxygen. Total phosphorous is usually present in freshwater in low concentrations, and is often the limiting nutrient to aquatic plant growth. However, man-made sources of phosphorous include septic system leaching, fertilizer runoff, and improperly treated wastewater. These phosphorous inputs usually enter a freshwater lake system during rain events, and bank erosion.

A total phosphorous level greater than 0.03 mg/L can promote excessive aquatic plant growth and decomposition, either in the form of algal blooms, or nuisance quantities of aquatic plants. This process is called eutrophication, and when induced or sped up by man-made nutrient inputs, it is called cultural eutrophication. As a result of this excessive growth, recreational activities, such as swimming, boating, and fishing in the lake can be negatively impacted. In addition, aerobic bacteria will thrive under these conditions, causing a decrease in dissolved oxygen levels which can negatively impact aquatic biota such as fish.

Total Suspended Solids

Total suspended solids refer to all of the particulate matter suspended in the water column. When these solids settle to the bottom of a water body (a process called siltation), they become sediments. There are two components that make up total suspended solids: inorganic and organic. The inorganic portion is usually considerably higher than the organic portion and includes silts, clays, and soils. Organic solids include algae, zooplankton, bacteria and organic debris. All these solids create turbid (or "muddy") conditions. The geology and vegetation of a watershed affect the amount of suspended solids that enter a lake system. Most suspended solids originate from accelerated soil erosion from agricultural operations, logging activities, and construction activities. Another source is the disturbance of bottom sediments from dredging activities, grazing of bottom feeding fish, and recreational activities such as boating.

Ammonia

Ammonia is a type of nitrogen compound used by plants and algae to support growth. Ammonia content in a body of water is influenced by decaying plants and animals, animal waste, industrial waste effluent, agricultural runoff, and atmospheric nitrogen gas transfer. A concentration exceeding 0.30 mg/L can promote excessive plant and algae growth. Elevated ammonia levels can increase nitrification, which in turn depletes the oxygen content of water. Extremely high ammonia levels can be toxic to aquatic biota (such as fish).

Appendix B: Aquatic Macrophyte Guide

Small Duckweed (*Lemna minor*. Common Names: Small duckweed, water lentil, lesser duckweed. **Native.**). Small duckweed is a free floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces via budding at at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It over winters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It's also consumed by muskrat, beaver and fish, and dense mats of duckweed can actually inhibit mosquito breeding.

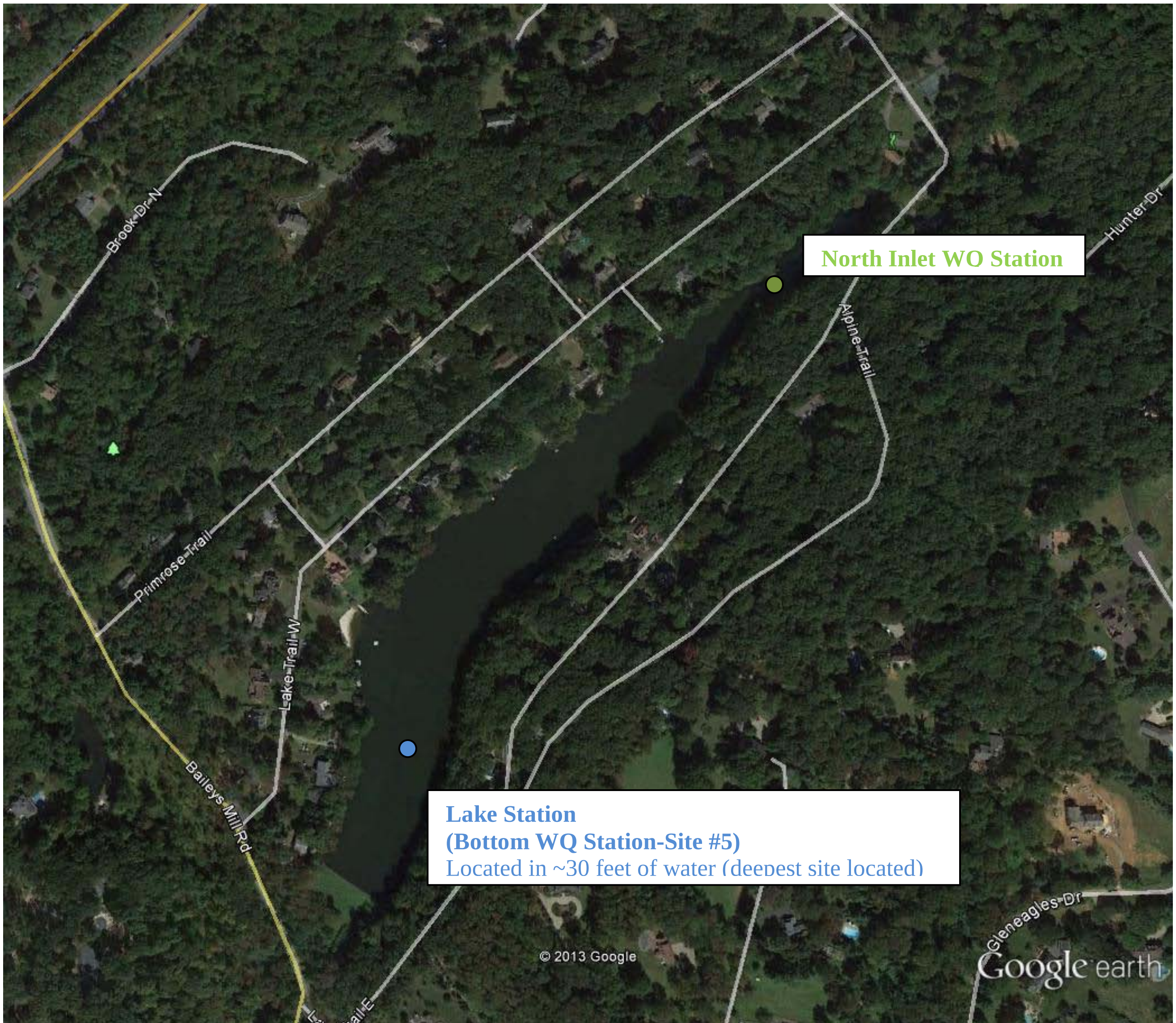
Curly-leaf Pondweed (*Potamogeton crispus*. Common Name: curly-leaf pondweed. **Invasive.**): Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong, and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, Curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.

Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native**.): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly more narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.

Southern Naiad (*Najas guadalupensis*. Common Names: Southern water nymph, bushy pondweed. **Native**.): Southern naiad is an annual aquatic plant that can form dense stands of rooted vegetation. Its ribbon-like leaves are dark-green to greenish-purple, and are wider and less pointed than slender naiad. Flowers occur at the base of the leaves, but are so small, they usually require magnification to detect. Southern naiad is widely distributed, but is less common than slender naiad in northern zones. Southern naiad reproduces by seeds and fragmentation.

Variable-leaf Pondweed (*Potamogeton diversifolius*. Common Names: Water-thread pondweed, variable-leaf pondweed, snailseed pondweed. **Native**.): Variable-leaf pondweed have freely-branched stems emerging from slender rhizomes. The submersed leaves are narrow and linear with one obvious midvein bordered by a row of hollow cells. The floating leaves are shaped like an ellipse, but are usually less than 4 cm long, Variable-leaf pondweed fruit spikes are produced in two distinct forms. It occurs in lakes, ponds, rivers and streams and prefers soft sediment and water less than 2 meters deep. Waterfowl graze on the fruit, and local fauna often graze on the stems and leaves.

Mount Kemble Lake 2014 Water Quality Monitoring Sites



Mount Kemble Lake **Morris County, New Jersey**	**2014 Water Quality Sampling Sites Map** ● = North Inlet WQ Site ● = Lake Station WQ Site
Allied Biological	580 Rockport Road Hackettstown, NJ 07840 (908) 850-0303 FAX 850-4994

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mount Kemble Lake

Collection Date: 4/28/2014	**Examination Date: 4/30/2014**	**Amount Examined:** 200 ml.
Site A : North Station (Inlet)	**Site B: Lake Station**	**Site C:**

BACILLARIOPHYTA (Diatoms)	A	B	C
Asterionella	40	40	
Cocconeis			
Cyclotella	20	50	
Cymbella			
Diatoma			
Fragilaria		20	
Melosira			
Meridion			
Navicula	20		
Pinnularia			
Rhizosolenia			
Stephanodiscus			
Synedra		20	
Tabellaria	20		
Stauroneis			
Nitzschia			
Denticula			
Total Diatoms	**100**	**130**	**0**

CHRYSOPHYTA (Golden Algae)	A	B	C
Dinobryon	10		
Mallomonas			
Synura			
Tribonema			
Uroglenopsis			
Vaucheria			
Total Golden Algae	**10**	**0**	**0**

PROTOZOA	A	B	C
Actinophrys			
Vorticella			
Total Protozoa	**0**	**0**	**0**

CHLOROPHYTA (Green Algae)	A	B	C
Actinastrum			
Ankistrodesmus			
Chlamydomonas			
Chlorella	10	60	
Chlorococcum			
Closterium			
Coelastrum			
Cosmarium			
Desmodium			
Eudorina			
Gloeocystis			
Micrasterias			
Micratinium			
Microspora			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus	10	20	
Sphaerocystis	60		
Spirogyra			
Staurastrum			
Tetraedron			
Ulothrix			
Volvox			
Palmella			
Euastrum			
Zygnema			
Dictyosphaerium			
Quadrigula			
Bottryococcus			
Trackdomuccs			
Eaestrum			
Total Green Algae	**80**	**80**	**0**

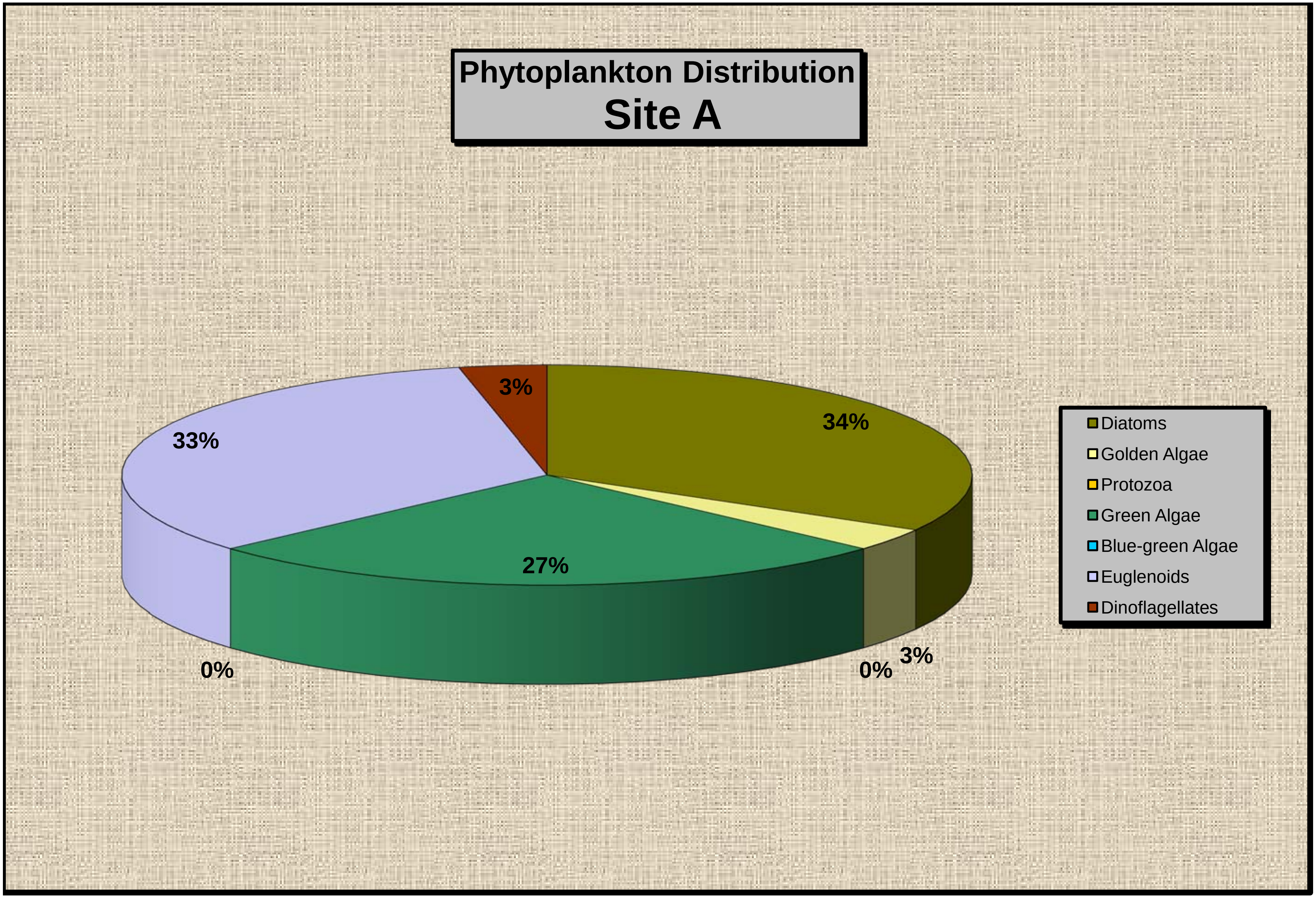
CYANOPHYTA (Blue-green Algae)	A	B	C
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Cylindrospermum			
Gomphosphseria			
Lyngbya			
Microcystis			
Nostoc			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Total Blue-green Algae	**0**	**0**	**0**

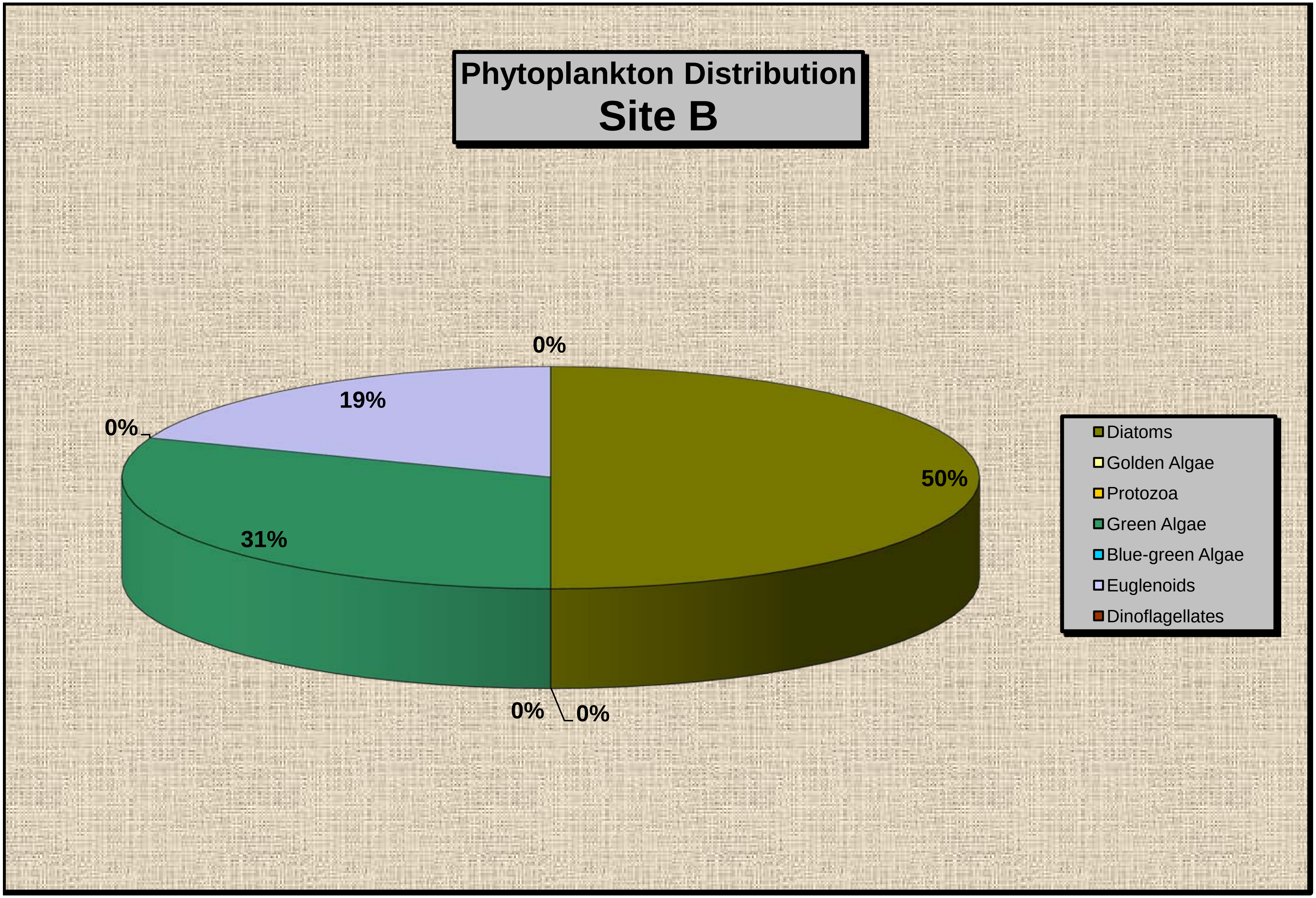
EUGLENOPHYTA (Euglenoids)	A	B	C
Euglena	70	30	
Lepocinclis			
Phacus			
Trachelomonas	30	20	
Total Euglenoids	**100**	**50**	**0**

PYRRHOPHYTA (Dinoflagellates)	A	B	C
Ceratium	10		
Peridinium			
Gymnodinium			
Total Dinoflagellates	**10**	**0**	**0**

SITE	A	B	C
TOTAL GENERA:	11	8	
TRANSPARENCY:	4.0'	4.0'	
ORGANISMS PER MILLILITER:	**300**	**260**	

NOTES: This is the first sampling event of 2014. The algal density at both sites is light and favorable with moderate to moderate-high sample diversity. The assemblage at both Stations was a mixture of diatoms, green algae and euglenoids. Trace golden algae and dinoflagellates were observed at the North Station only. Water clarity was considered fair on this date.


Phytoplankton Distribution
Site A
3%
34%
33%
27%
0%
0%
3%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates



Phytoplankton Distribution
Site B
0%
19%
0%
50%
31%
0%
0%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mount Kemble Lake

Collection Date: 6/6/2014	**Examination Date: 6/6/2014**	**Amount Examined:** 200 ml.
Site A : North Station (Inlet)	**Site B: Lake Station**	**Site C:**

BACILLARIOPHYTA (Diatoms)	A	B	C
Asterionella	10	30	
Cocconeis			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Meridion			
Navicula			
Pinnularia			
Rhizosolenia			
Stephanodiscus			
Synedra			
Tabellaria			
Stauroneis			
Nitzschia			
Denticula			
Total Diatoms	**10**	**30**	**0**

CHRYSOPHYTA (Golden Algae)	A	B	C
Dinobryon	20	140	
Mallomonas	70		
Synura			
Tribonema			
Uroglenopsis			
Vaucheria			
Total Golden Algae	**90**	**140**	**0**

PROTOZOA	A	B	C
Actinophrys	20	10	
Vorticella			
Total Protozoa	**20**	**10**	**0**

SITE	A	B	C
TOTAL GENERA:	5	3	
TRANSPARENCY:	8' est.	8.5'	
ORGANISMS PER MILLILITER:	**130**	**180**	

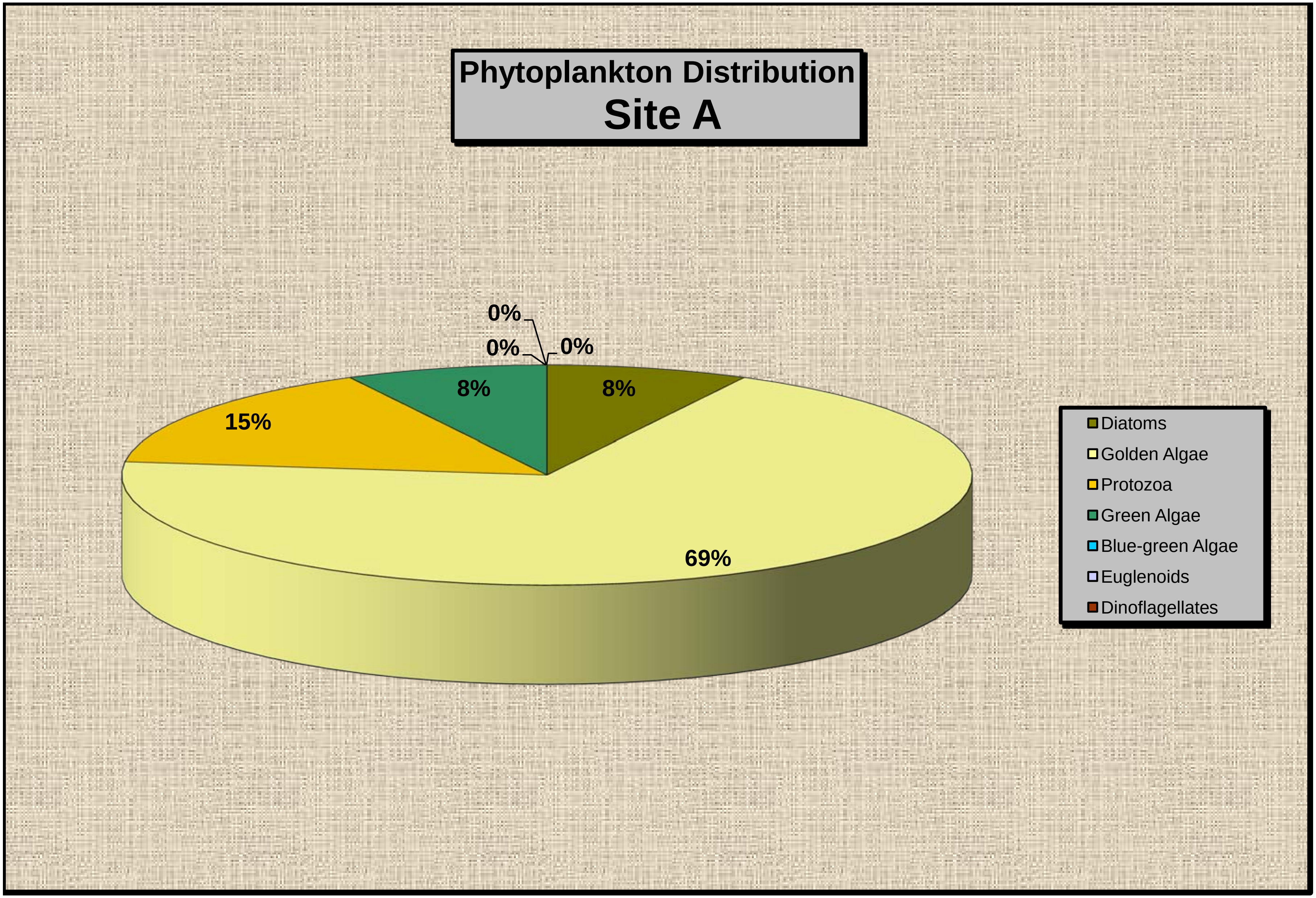
CHLOROPHYTA (Green Algae)	A	B	C
Actinastrum			
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium	10		
Coelastrum			
Cosmarium			
Desmodium			
Eudorina			
Gloeocystis			
Micrasterias			
Micratinium			
Microspora			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus			
Sphaerocystis			
Spirogyra			
Staurastrum			
Tetraedron			
Ulothrix			
Volvox			
Palmella			
Euastrum			
Zygnema			
Dictyosphaerium			
Quadrigula			
Bottryococcus			
Trackdomuccs			
Eaestrum			
Total Green Algae	**10**	**0**	**0**

CYANOPHYTA (Blue-green Algae)	A	B	C
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Cylindrospermum			
Gomphosphseria			
Lyngbya			
Microcystis			
Nostoc			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Total Blue-green Algae	**0**	**0**	**0**

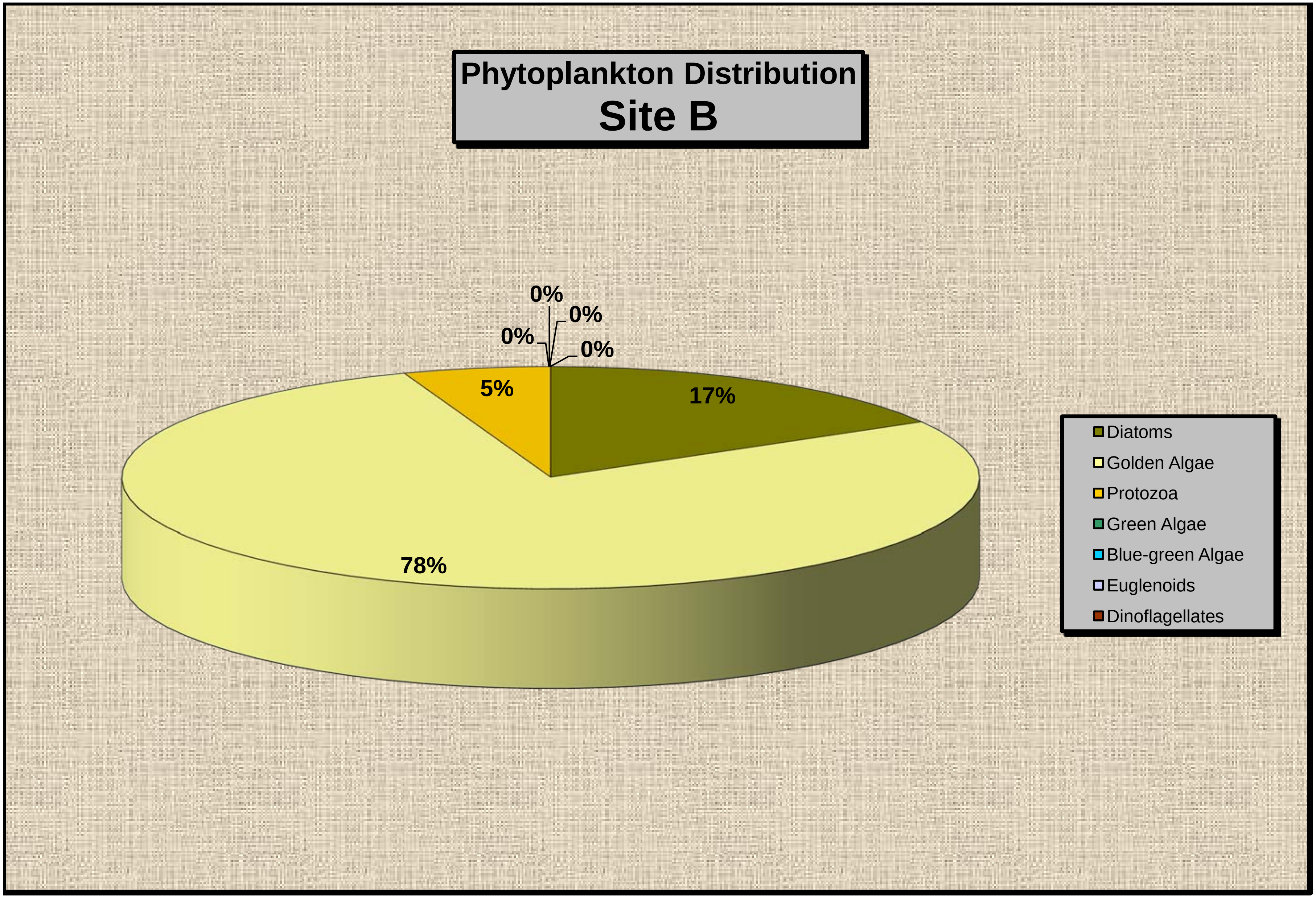
EUGLENOPHYTA (Euglenoids)	A	B	C
Euglena			
Lepocinclis			
Phacus			
Trachelomonas			
Total Euglenoids	**0**	**0**	**0**

PYRRHOPHYTA (Dinoflagellates)	A	B	C
Ceratium			
Peridinium			
Gymnodinium			
Total Dinoflagellates	**0**	**0**	**0**

NOTES: Algal density decreased and is now considered light and favorable at sites A and B. Algal diversity is considered low at all sites. Currently, both sites are dominated by golden algae. Trace amounts of green algae (site A) and protozoa (both sites) were also observed. Water clarity increased and is now considered good to very good at both sites.



Phytoplankton Distribution
Site A
0%
0%
0%
8%
8%
15%
69%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates


Phytoplankton Distribution
Site B
0%
0%
0%
0%
5%
17%
78%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mount Kemble Lake

Collection Date: 7/30/2014	**Examination Date: 7/30/2014**	**Amount Examined:** 200 ml.
Site A : North Station (Inlet)	**Site B: Lake Station**	**Site C:**

BACILLARIOPHYTA (Diatoms)	A	B	C
Asterionella			
Cocconeis			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Meridion			
Navicula			
Pinnularia			
Rhizosolenia			
Stephanodiscus			
Synedra			
Tabellaria			
Stauroneis			
Nitzschia			
Denticula			
Total Diatoms	**0**	**0**	**0**

CHRYSOPHYTA (Golden Algae)	A	B	C
Dinobryon	10	10	
Mallomonas		20	
Synura			
Tribonema			
Uroglenopsis			
Vaucheria			
Total Golden Algae	**10**	**30**	**0**

PROTOZOA	A	B	C
Actinophrys			
Vorticella			
Total Protozoa	**0**	**0**	**0**

CHLOROPHYTA (Green Algae)	A	B	C
Actinastrum			
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium	10	10	
Coelastrum	50		
Cosmarium			
Desmodium			
Eudorina			
Gloeocystis		20	
Micrasterias			
Micratinium			
Microspora			
Mougeotia			
Oedogonium	10		
Oocystis			
Pandorina			
Pediastrum	10		
Phytoconis			
Rhizoclonium			
Scenedesmus			
Sphaerocystis			
Spirogyra			
Staurastrum	10		
Tetraedron			
Ulothrix			
Volvox			
Palmella			
Euastrum			
Zygnema			
Dictyosphaerium			
Quadrigula			
Bottryococcus			
Trackdomuccs			
Eaestrum			
Total Green Algae	**90**	**30**	**0**

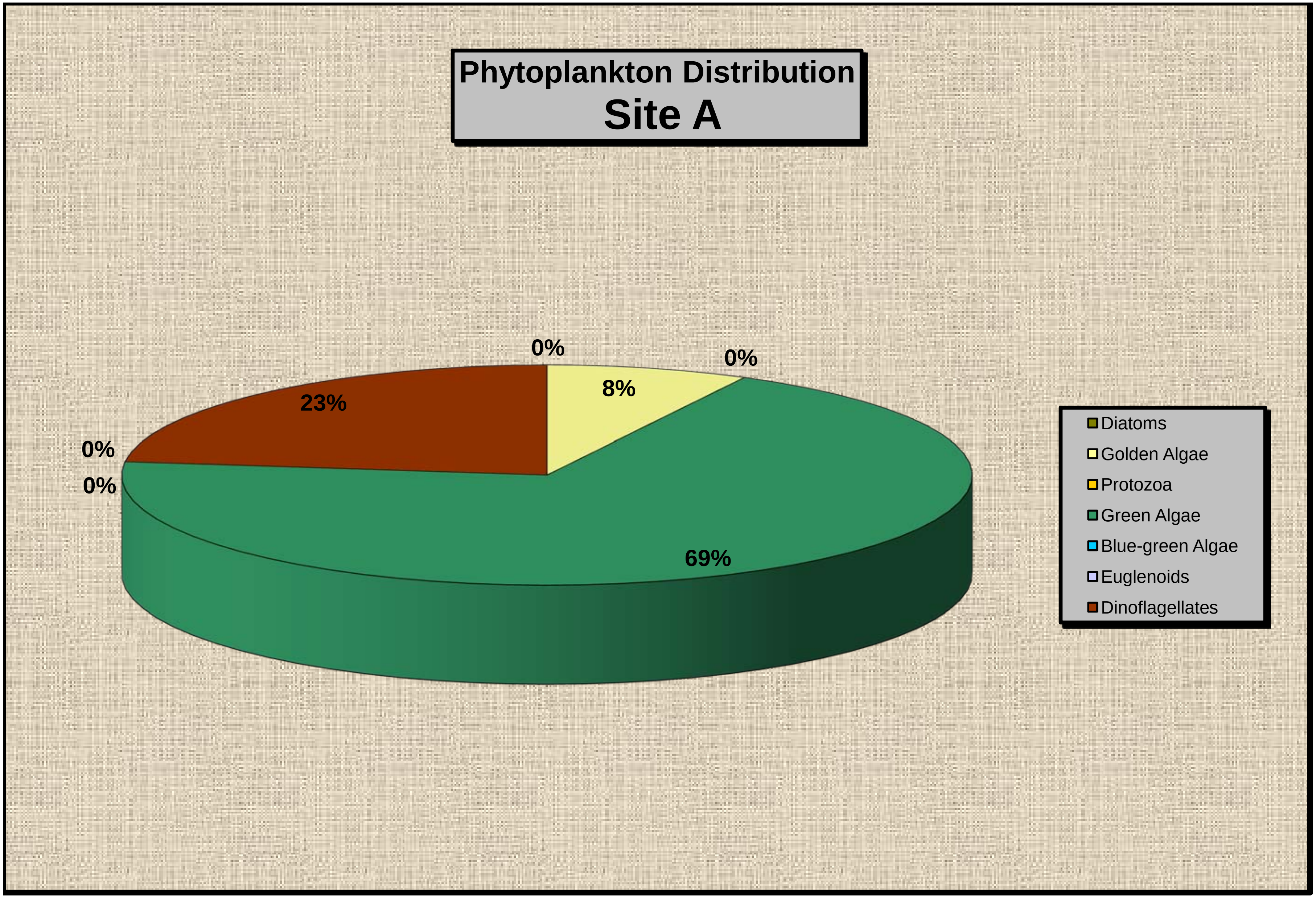
CYANOPHYTA (Blue-green Algae)	A	B	C
Anabaena			
Anacystis			
Aphanizomenon		20	
Coelosphaerium			
Cylindrospermum			
Gomphosphseria			
Lyngbya			
Microcystis			
Nostoc			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Total Blue-green Algae	**0**	**20**	**0**

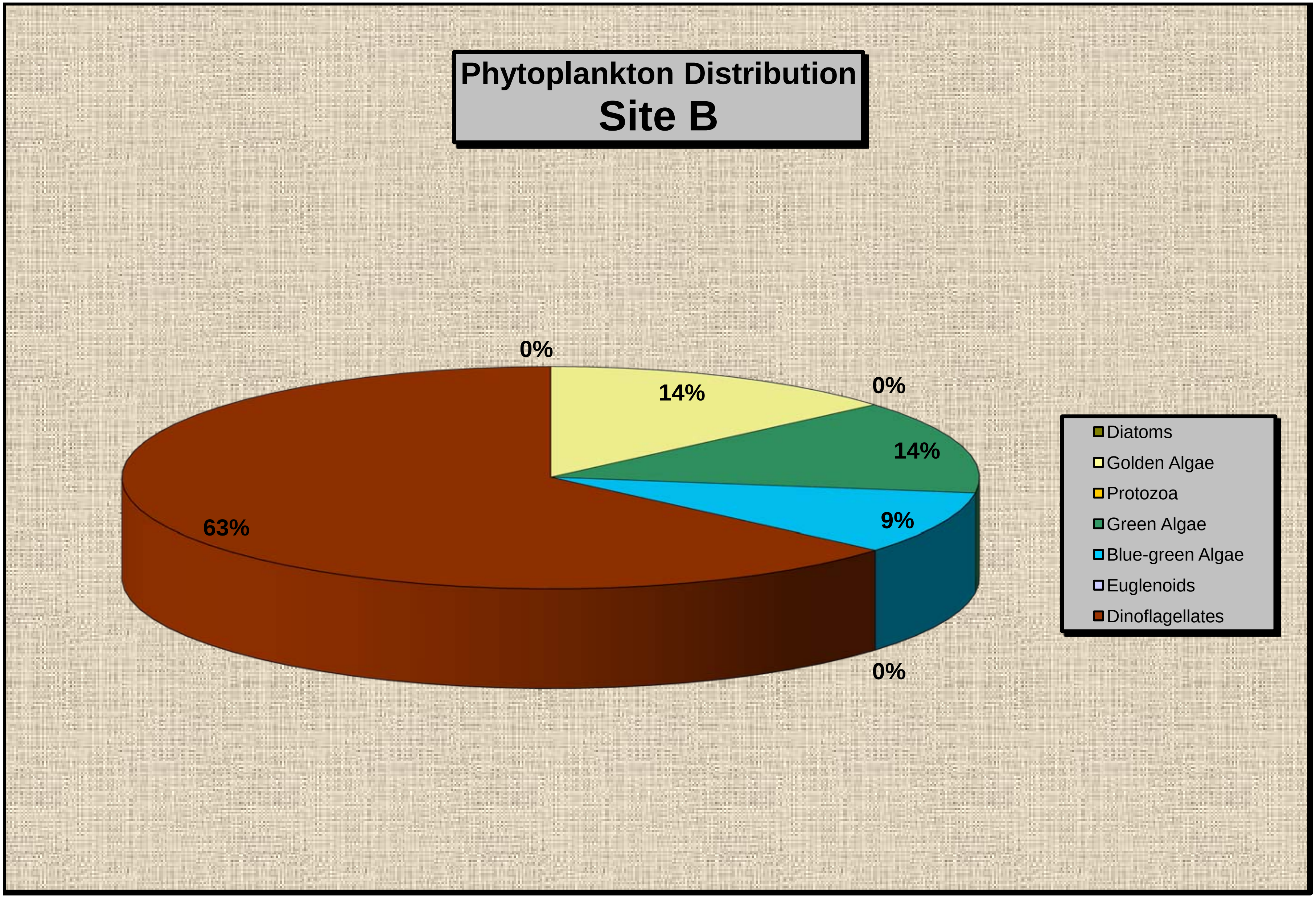
EUGLENOPHYTA (Euglenoids)	A	B	C
Euglena			
Lepocinclis			
Phacus			
Trachelomonas			
Total Euglenoids	**0**	**0**	**0**

PYRRHOPHYTA (Dinoflagellates)	A	B	C
Ceratium	10		
Peridinium	20	140	
Gymnodinium			
Total Dinoflagellates	**30**	**140**	**0**

SITE	A	B	C
TOTAL GENERA:	8	6	
TRANSPARENCY:	5' est.	5.0'	
ORGANISMS PER MILLILITER:	**130**	**220**	

NOTES: Phytoplankton density increased slightly at site B, while site A remained similar to previous results. Phytoplankton density continues to be low at both sites. Algal diversity is considered moderate at both sites. Site A (North) is dominated by the green algae called Coelastrum. Site B (Lake Station) is dominated by the dinoflagellate Peridinium. Other green algae and golden algae were observed this week. Trace amounts of blue green algae were observed at site B only. Water clarity decreased at both sites since the last sampling event. Water clarity is now considered fair at site B, while site A is poor.


Phytoplankton Distribution
Site A
0%
0%
8%
23%
0%
0%
69%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates



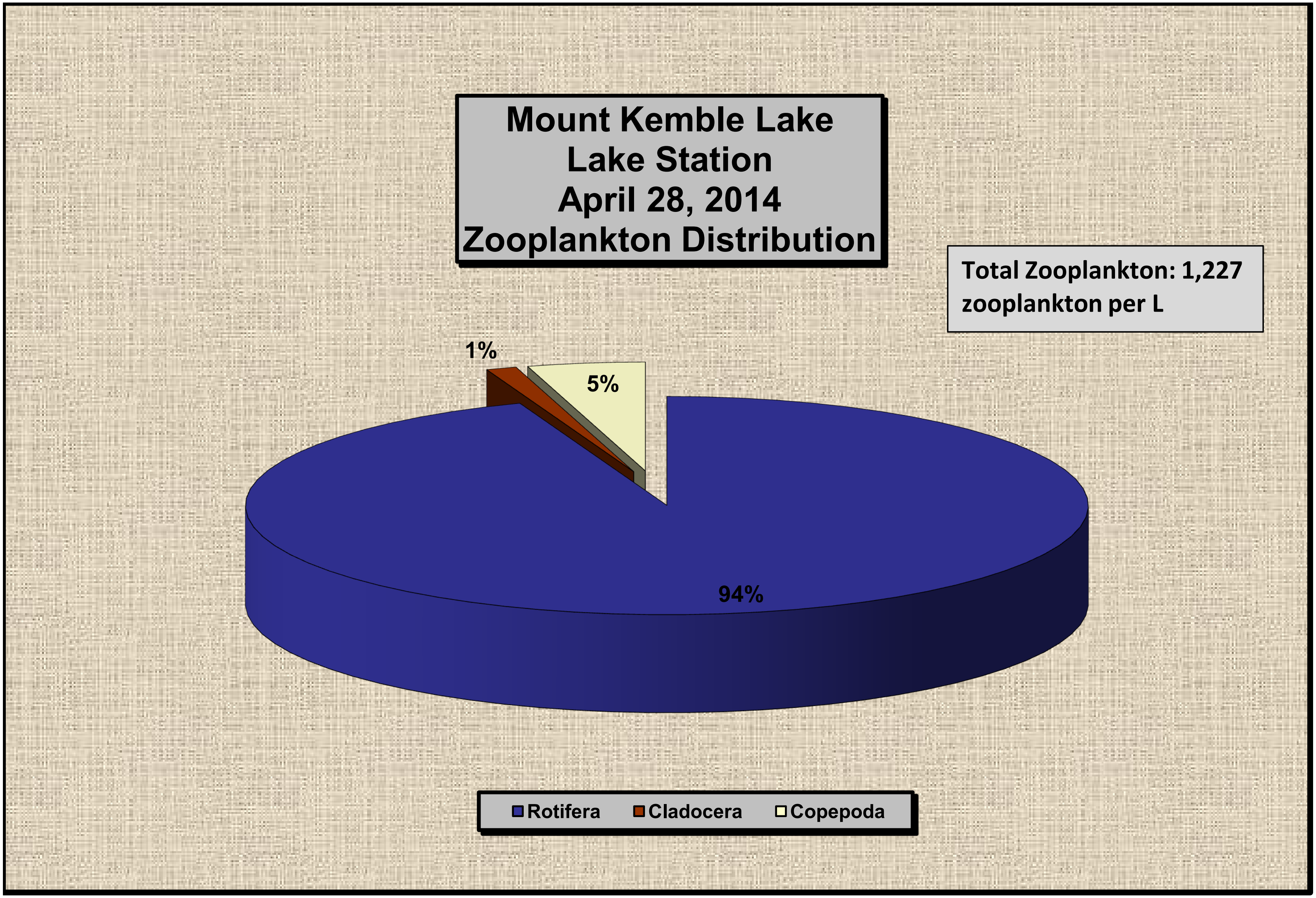
Phytoplankton Distribution
Site B
0%
14%
0%
14%
9%
63%
0%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Euglenoids
Dinoflagellates

Zooplankton Count Results

Site: Mt. Kemble Lake South Station   Date: 4/28/14

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera										
	Ploima	Asplanchnidae	*Asplanchna*	1	1		1	667	68.8	10
		Brachionidae	*Brachionous*	2	4	3	3	3000	68.8	44
			Keratella	66	94	59	73	73000	68.8	1061
			Kellicottia	1		1	1	667	68.8	10
		Synchaetidae	*Polyarthra*	5	6	7	6	6000	68.8	87
									Total:	**1212**
Cladocera	**Cladocera**									
		Daphnidae	*Daphina*		3		1.00	1000	68.8	15
									Total:	**15**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	6	4	2	4.00	4000	68.8	58
									Total:	**58**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1227	1212	98.8%	15	1.2%	58	4.7%

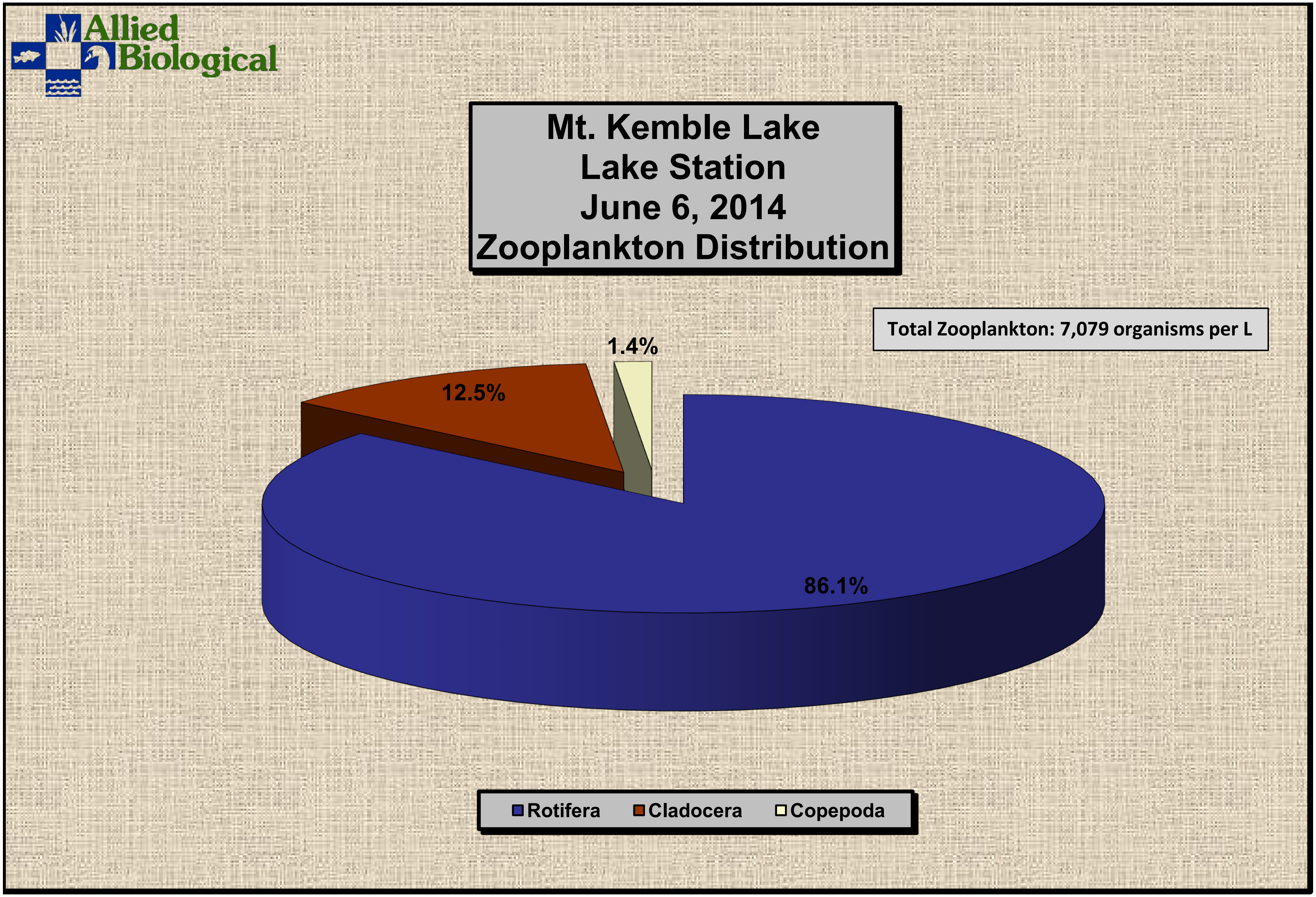

Mount Kemble Lake
Lake Station
April 28, 2014
Zooplankton Distribution
Total Zooplankton: 1,227 zooplankton per L
1%
5%
94%
Rotifera
Cladocera
Copepoda

Zooplankton Count Results

Mt. Kemble Lake **Date: 6/6/14**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna*	3	2	3	2.67	2,667	68.8	39
		Brachionidae	*Brachionus*	9	8	14	10.33	10,333	68.8	150
			Keratella	177	212	232	207.00	207,000	68.8	3009
			Kellicottia	80	67	49	65.33	65,333	68.8	950
		Synchaetidae	*Polyarthra*	48	35	38	121.00	121,000	68.8	1759
			Synchaeta	4	5	10	6.33	6,333	68.8	92
		Trichocercidae	*Trichocerca*			1	0.33	333	68.8	5
	Flosculariacea	Conochilidae	*Conochilus*	2	7	2	3.67	3,667	68.8	53
		Testudinellidae	*Filinia*	4	4		2.67	2,667	68.8	39
									Total:	**6095**
Cladocera	**Cladocera**									
		Daphniidae	*Daphnia*	66	51	65	60.67	60667	68.8	882
									Total:	**882**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	7	8	6	7.00	7000	68.8	102
									Total:	**102**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
7079	6095	86.1%	882	12.5%	102	1.4%

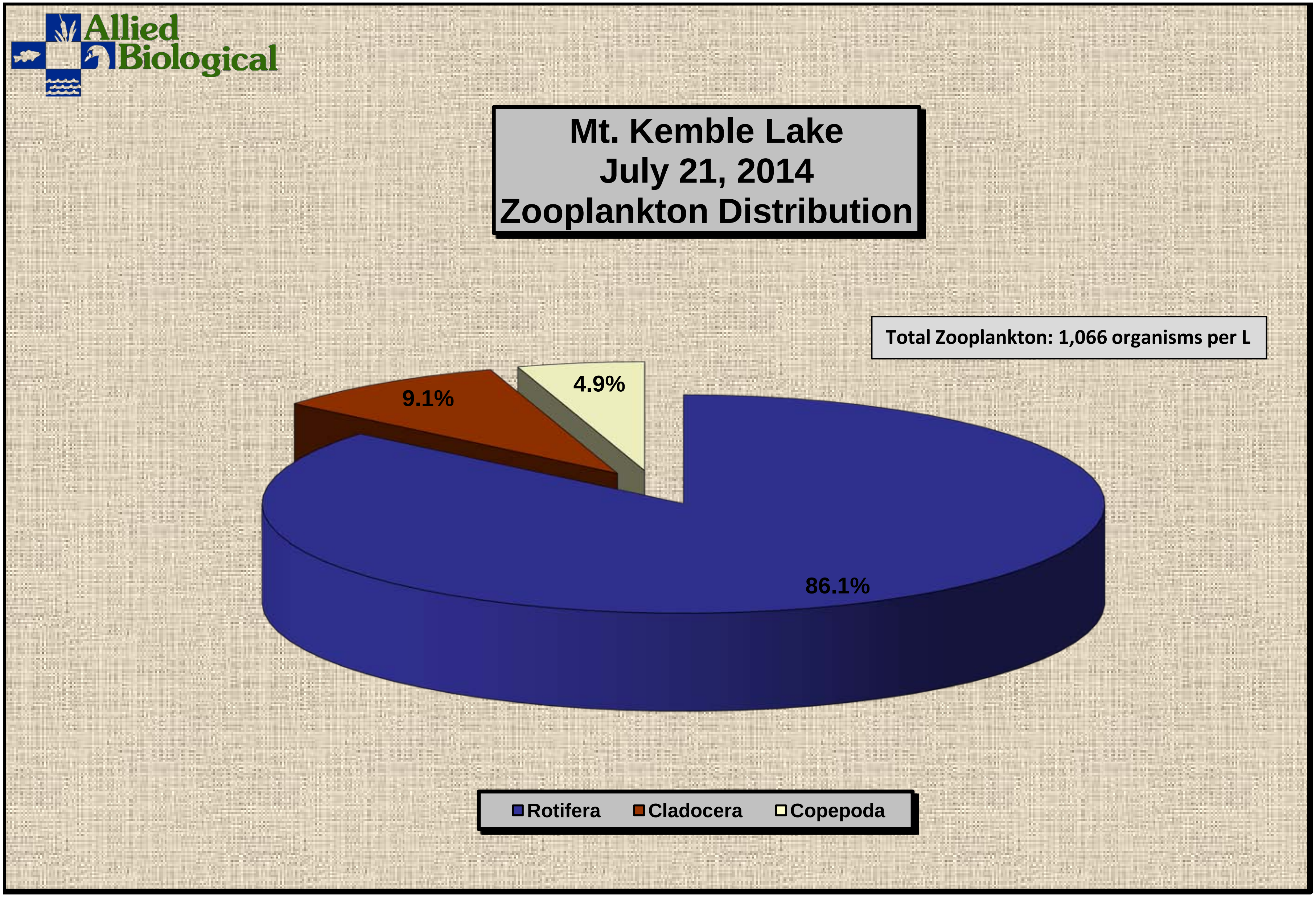

Mt. Kemble Lake
Lake Station
June 6, 2014
Zooplankton Distribution
Total Zooplankton: 7,079 organisms per L
1.4%
12.5%
86.1%
Rotifera
Cladocera
Copepoda

Zooplankton Count Results

Mt. Kemble Lake **Date: 7/30/14**

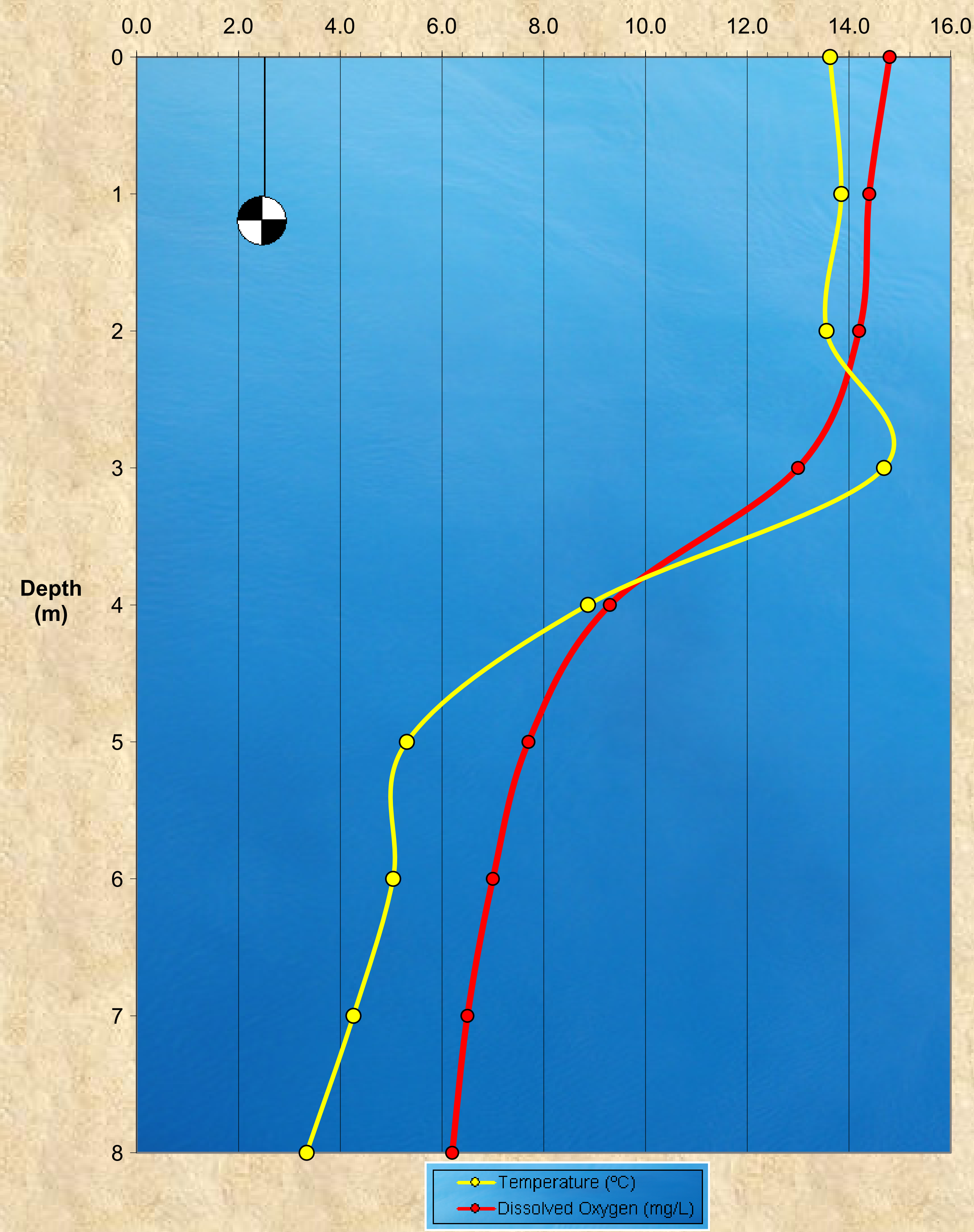
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna*				0.00	0	68.8	0
		Brachionidae	*Brachionus*	3	7	6	5.33	5,333	68.8	78
			Keratella	21	28	25	24.67	24,667	68.8	359
			Kellicottia			1	0.33	333	68.8	5
		Synchaetidae	*Polyarthra*	16	17	14	47.00	47,000	68.8	683
			Synchaeta	5	1	6	4.00	4,000	68.8	58
		Gastropidae	*Ascomorpha*				0.00	0	68.8	0
		Trichocercidae	*Trichocerca*	1	1	1	1.00	1,000	68.8	15
	Flosculariacea	Conochilidae	*Conochilus*				0.00	0	68.8	0
									Total:	**1197**
Cladocera	**Cladocera**									
		Daphniidae	*Ceriodaphnia*				0.00	0	68.8	0
		Bosminidae	*Bosmina*	8	11	7	8.67	8667	68.8	126
									Total:	**126**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	2	6	6	4.67	4667	68.8	68
									Total:	**68**

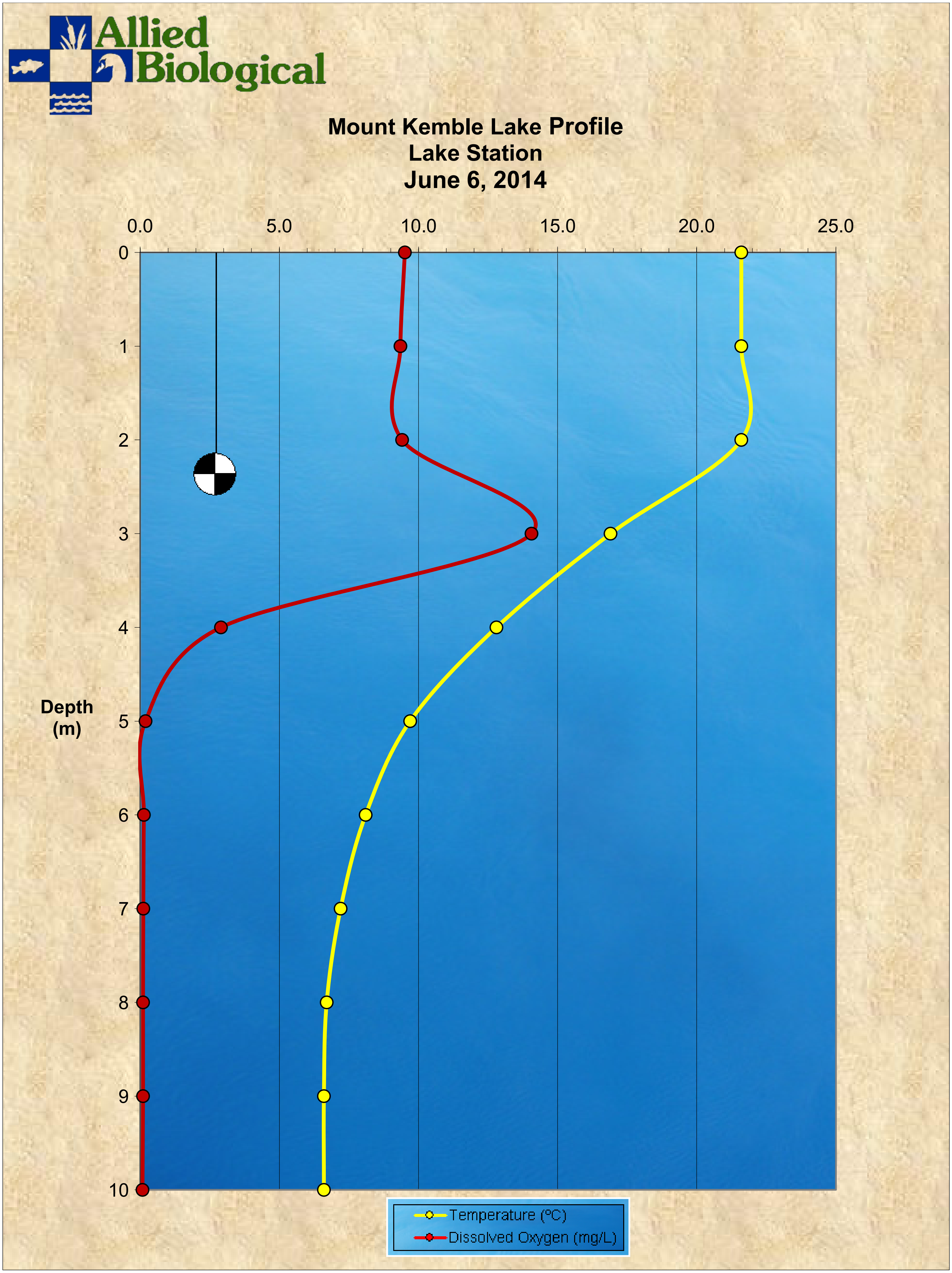
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1391	1197	86.1%	126	9.1%	68	4.9%

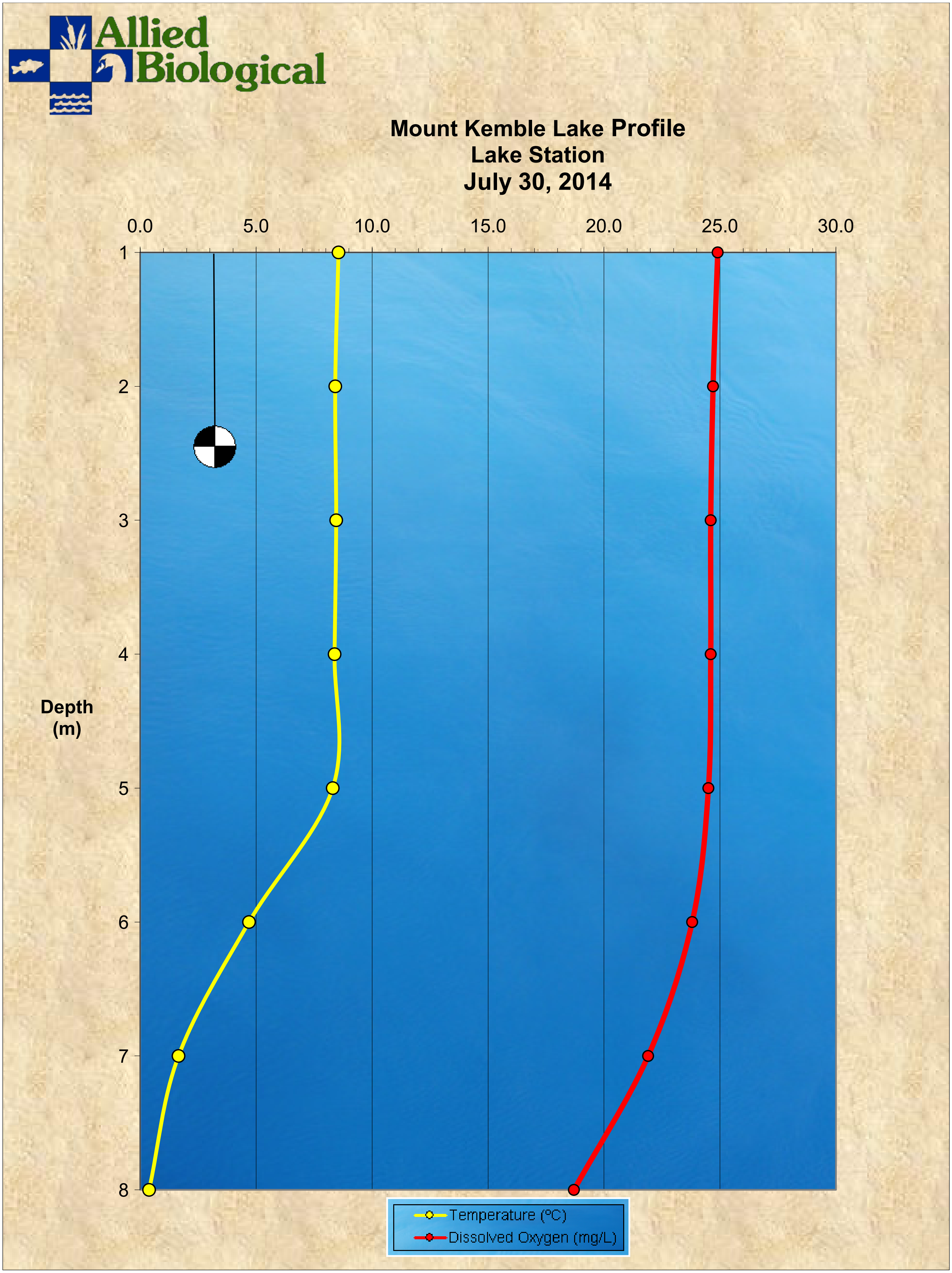


Allied Biological
Mt. Kemble Lake
July 21, 2014
Zooplankton Distribution
Total Zooplankton: 1,066 organisms per L
9.1%
4.9%
86.1%
Rotifera
Cladocera
Copepoda

Mount Kemble Lake Profile
Lake Station
April 28, 2014




Allied Biological
Mount Kemble Lake Profile
Lake Station
June 6, 2014
0.0
5.0
10.0
15.0
20.0
25.0
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
Temperature (ºC)
Dissolved Oxygen (mg/L)


Allied Biological
Mount Kemble Lake Profile
Lake Station
July 30, 2014
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Depth (m)
1
2
3
4
5
6
7
8
Temperature (ºC)
Dissolved Oxygen (mg/L)

APL
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Analytical Results Summary

MT. KEMBLE LAKE

Client:	**Allied Biological**	**Contact:**	**Chris Doyle**
APL Order ID:	**4040816**	**Received:**	**4/28/14 13:40**

Sample ID/Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
4040816-01 (Lake)	NORTH STATION			Collected:	4/28/2014 10:10			
General Chemistry								
Phosphorus	4500PE	5/7/14 11:00	5/7/14 11:00	**0.0300**			**0.0100**	**mg/L**
Nitrate	EPA 300	4/29/14 12:44	4/29/14 12:48	**0.900**			**0.200**	**mg/L**
Specific conductance	SM 2510B	4/30/14 11:00	4/30/14 11:00	**320**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	5/1/14 11:47	5/1/14 11:47	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	5/5/14 15:00	5/5/14 15:00	ND			0.200	mg/L
4040816-02 (Lake)	LAKE STATION SURFACE			Collected:	4/28/2014 10:25			
General Chemistry								
Phosphorus	4500PE	5/7/14 11:00	5/7/14 11:00	**0.0300**			**0.0100**	**mg/L**
Nitrate	EPA 300	4/29/14 12:44	4/29/14 12:48	**0.900**			**0.200**	**mg/L**
Specific conductance	SM 2510B	4/30/14 11:00	4/30/14 11:00	**310**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	5/1/14 11:47	5/1/14 11:47	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	5/5/14 15:00	5/5/14 15:00	ND			0.200	mg/L
4040816-03 (Lake)	LAKE STATION BOTTOM			Collected:	4/28/2014 10:30			
General Chemistry								
Phosphorus	4500PE	5/7/14 11:00	5/7/14 11:00	**0.0300**			**0.0100**	**mg/L**
Nitrate	EPA 300	4/29/14 12:44	4/29/14 12:48	**0.950**			**0.200**	**mg/L**
Specific conductance	SM 2510B	4/30/14 11:00	4/30/14 11:00	**317**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	5/1/14 11:47	5/1/14 11:47	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	5/5/14 15:00	5/5/14 15:00	ND			0.200	mg/L
4040816-04 (Lake)	OUTLET STATION			Collected:	4/28/2014 11:25			
General Chemistry								
Phosphorus	4500PE	5/7/14 11:00	5/7/14 11:00	**0.0300**			**0.0100**	**mg/L**
4040816-05 (Lake)	INLET STATION			Collected:	4/28/2014 11:15			
General Chemistry								
Phosphorus	4500PE	5/7/14 11:00	5/7/14 11:00	**0.0100**			**0.0100**	**mg/L**

APL

AQUA PRO-TECH LABORATORIES

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Analytical Results Summary

Mt. Kenble Lake

Client:	**Allied Biological**	**Contact:**	**Chris Doyle**
APL Order ID:	**4060193**	**Received:**	**6/6/14 12:45**

Sample ID/Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
4060193-01 (Lake)	South Station Surface			Collected:	6/6/2014 9:10			
General Chemistry								
Phosphorus	4500PE	6/10/14 14:00	6/10/14 14:00	**0.0300**			**0.0100**	**mg/L**
Nitrate	EPA 300	6/6/14 17:14	6/6/14 17:17	**0.980**			**0.200**	**mg/L**
Specific conductance	SM 2510B	6/9/14 15:00	6/9/14 15:00	**290**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	6/11/14 11:11	6/11/14 11:11	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	6/12/14 15:00	6/12/14 15:00	ND			0.200	mg/L
4060193-02 (Lake)	North Station			Collected:	6/6/2014 9:20			
General Chemistry								
Phosphorus	4500PE	6/10/14 14:00	6/10/14 14:00	**0.0500**			**0.0100**	**mg/L**
Nitrate	EPA 300	6/6/14 17:14	6/6/14 17:17	**0.980**			**0.200**	**mg/L**
Specific conductance	SM 2510B	6/9/14 15:00	6/9/14 15:00	**300**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	6/11/14 11:11	6/11/14 11:11	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	6/12/14 15:00	6/12/14 15:00	ND			0.200	mg/L
4060193-03 (Lake)	South Station Bottom			Collected:	6/6/2014 9:35			
General Chemistry								
Phosphorus	4500PE	6/10/14 14:00	6/10/14 14:00	**0.0800**			**0.0100**	**mg/L**
Nitrate	EPA 300	6/6/14 17:14	6/6/14 17:17	ND			0.200	mg/L
Specific conductance	SM 2510B	6/9/14 15:00	6/9/14 15:00	**325**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	6/11/14 11:11	6/11/14 11:11	**6.00**			**3.00**	**mg/L**
Ammonia as N	SM 4500 NH3 D	6/12/14 15:00	6/12/14 15:00	**0.480**			**0.200**	**mg/L**

ND - Indicates compound analyzed for but not detected
J - Indicates estimated value
B - Indicates compound found in associated blank
E - Concentration exceeds highest calibration standard

D - Indicates result is based on a dilution
P - Greater than 25% diff. between 2 GC columns.
MDL - Minimum detection limit
RL - Reporting limit

RO-TECH LABORATORIES
d Environmental Testing

Analytical Results Summary
MT KEMBLE

Client:	**Allied Biological**	**Contact:**	**Chris Doyle**
APL Order ID:	**4070942**	**Received:**	**7/30/14 12:50**

Sample ID/Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
4070942-01 (Lake)	NORTH STATION			Collected:	7/30/2014 12:11			
General Chemistry								
Phosphorus	4500PE	8/6/14 10:00	8/6/14 10:00	**0.0100**			**0.0100**	**mg/L**
Nitrate	EPA 300	7/30/14 16:05	7/30/14 16:05	ND			0.200	mg/L
Specific conductance	SM 2510B	8/7/14 11:00	8/7/14 11:00	**291**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	8/4/14 18:16	8/4/14 18:16	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	8/5/14 14:00	8/5/14 14:00	ND			0.200	mg/L
4070942-02 (Lake)	SOUTH STATION SURFACE			Collected:	7/30/2014 11:00			
General Chemistry								
Phosphorus	4500PE	8/6/14 10:00	8/6/14 10:00	**0.0200**			**0.0100**	**mg/L**
Nitrate	EPA 300	7/30/14 16:05	7/30/14 16:05	ND			0.200	mg/L
Specific conductance	SM 2510B	8/7/14 11:00	8/7/14 11:00	**291**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	8/4/14 18:16	8/4/14 18:16	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	8/5/14 14:00	8/5/14 14:00	ND			0.200	mg/L
4070942-03 (Lake)	SOUTH STATION BOTTOM			Collected:	7/30/2014 11:10			
General Chemistry								
Phosphorus	4500PE	8/6/14 10:00	8/6/14 10:00	**0.0200**			**0.0100**	**mg/L**
Nitrate	EPA 300	7/30/14 16:05	7/30/14 16:05	ND			0.200	mg/L
Specific conductance	SM 2510B	8/7/14 11:00	8/7/14 11:00	**289**			**1.00**	**umhos/cm**
Total Suspended Solids	SM 2540D	8/4/14 18:16	8/4/14 18:16	ND			3.00	mg/L
Ammonia as N	SM 4500 NH3 D	8/5/14 14:00	8/5/14 14:00	ND			0.200	mg/L

ND - Indicates compound analyzed for but not detected
J - Indicates estimated value
B - Indicates compound found in associated blank
E - Concentration exceeds highest calibration standard

D - Indicates result is based on a dilution
P - Greater than 25% diff. between 2 GC columns.
MDL - Minimum detection limit
RL - Reporting limit