Mount Kemble Lake

2016 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.
Morristown, NJ

December 7, 2016

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YEAR END SUMMARY
2016 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

Introduction

The following report is the 2016 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 2016. Recommendations for Mount Kemble Lake management efforts for the 2017 season are also included. The Appendix of this report includes graphs and tables of the 2016 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	Water-thread Pondweed

Table 1. 2016 Observed Aquatic Macrophytes.

The 2016 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

The weather in 2016 was much different in comparison to 2015 as almost every month of the year ~~saw~~ experienced above average temperatures, with the summer being the second warmest, and August being the warmest on record since records were kept in 1895 (Rutgers Climate Lab). As for precipitation, most of the year ~~saw~~ received below average rainfall amounts, with July being the exception as it rained two inches above average. The overall pattern of the summer was high temperatures and low rainfall, which at times can make managing lakes more challenging. (Figure 2.)

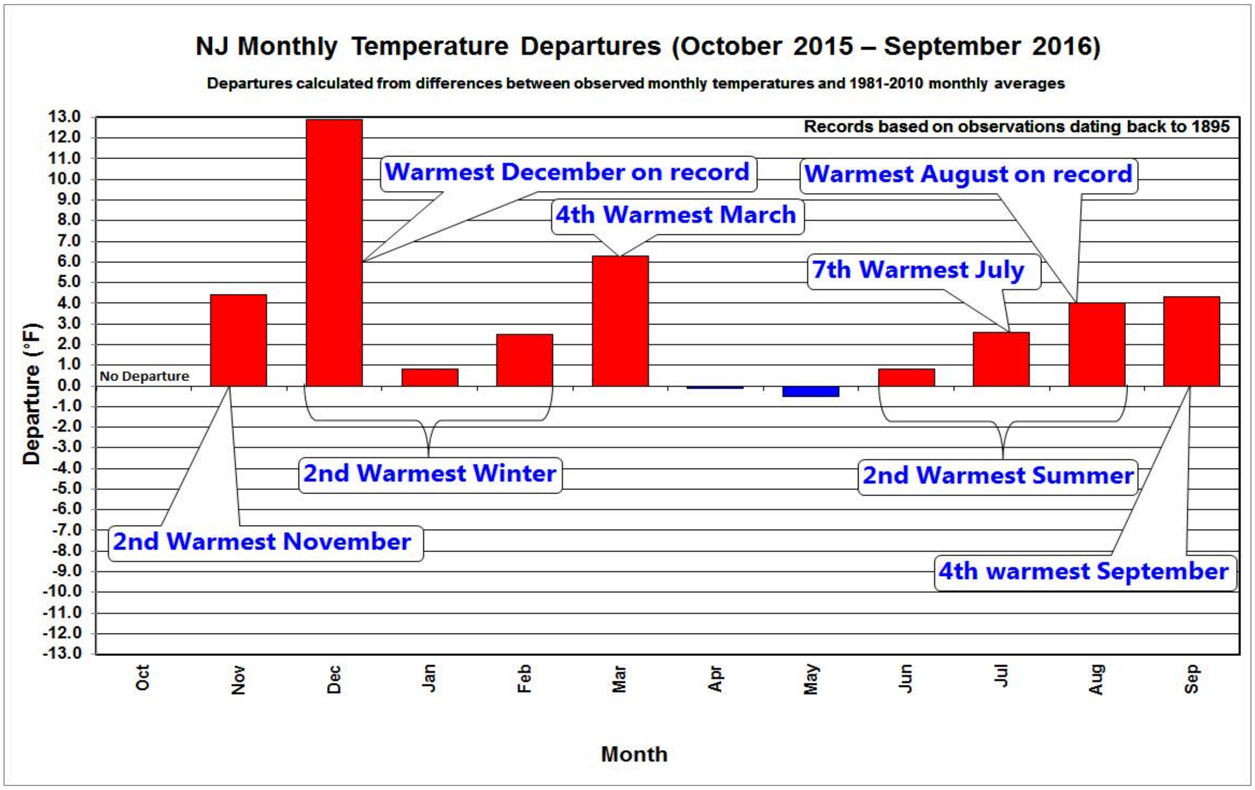


Figure 1: Temperature Departures.

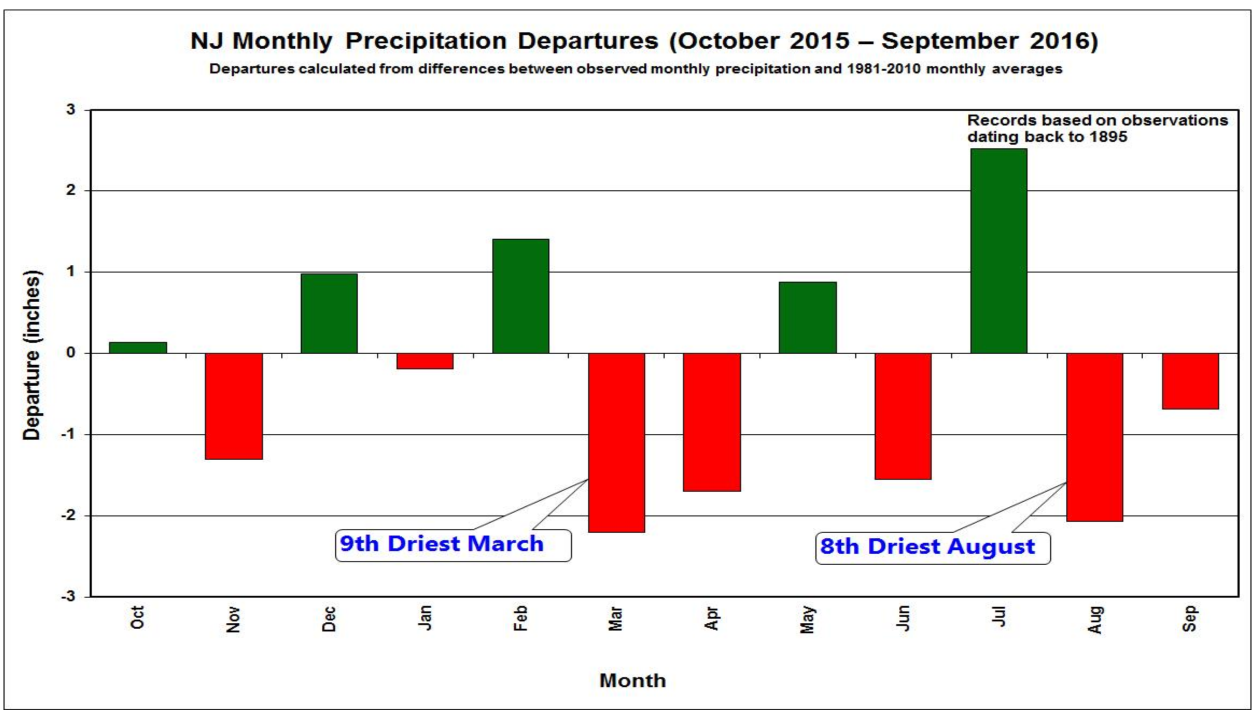


Figure 2: Precipitation Departures.

Lake Management

Aquatic biologists were at Mount Kemble Lake on six (6) 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 2016, on four (4) dates SŌLitude Lake Management field staff conducted herbicide, algaecide, or aluminum sulfate applications for control of nuisance and invasive aquatic vegetation growth as well as nutrient reduction. 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).

Date	Service Performed	Acres Treated	Target Species
5/12/2016	Copper Sulfate	7.5	Filamentous Algae
6/6/2016	Reward	5	*N. guadalupensis*
	Copper Sulfate	5	Filamentous Algae
6/20/2016	Copper Sulfate	6.7	Unicellular Algae
6/27/2016	Aluminum Sulfate	13.4	Total Phosphous
7/14/2016	Reward	0.3	Duckweed

Table 2: Mount Kemble Lake 2016 Treatment Log

The early season survey conducted at Mount Kemble Lake during April showed that the lake supported dense patches of southern naiad (*N. guadalupensis*) along the eastern shoreline and the western shoreline had similar findings. Curly-leaf pondweed (*P. crispus*) was only observed floating in the beach area and no rooted stems were observed at this time. Also, along the western shoreline there were moderate amounts of benthic filamentous algae observed. On May 12th, the second survey of the season was conducted and at this time aquatic plant life was minimal. The northern portion of the lake contained moderate to dense patches of benthic filamentous and floating filamentous algae. Water clarity at this time was good at approximately eight feet meaning there was a low population of unicellular algae at that time. **Copper Sulfate** was employed for treatment of the algae that was present in the northern areas of the lake.

The lake was visited again in early June and the survey indicated that 80% of the shoreline contained dense amounts of curly-leaf pondweed, southern naiad, and water-thread pondweed (*P. diversifolius*). The plants were also supporting moderate amounts of filamentous algae, which was colonizing on the stems and leaves. At this time water clarity was still acceptable although there was some drop off from what was observed in May. The herbicide **Reward (diquat)** was used to suppress the aquatic plant growth, while **Copper Sulfate** was applied to gain control of the benthic and floating filamentous algae that was present on the plants.

On June 20th, the lake survey showed that the previous treatment had been successful as little plant growth was observed. The only plant growth that was observed was trace amounts of leafy pondweed (*Potamogeton foliosus*) and they were yellow and brown in appearance showing that they had been affected by the treatment. At this time water clarity had dropped to five feet and the water started to get a green tint, which would indicate an increased population of unicellular algae growth. **Copper Sulfate** was used to treat the unicellular algae growth in the water column. At the end of the month the lake visit consisted of an aluminum sulfate treatment, which was done to reduce the amount of available nutrients in the water column to reduce the growth of plants and algae.

In mid-July, the lake focus of the visit was the small inlet pond, which had sparse to moderate amounts of duckweed around the shoreline. The duckweed was treated using Reward to clear up the shoreline and to regain a more appealing surface appearance. A shoreline survey was conducted on the main lake and at that time the lake surface was free from any algae growth, limited submersed plant growth and maintained an overall appealing appearance. The lake was visited again in early August and at this time the lake had a favorable appearance. In the shallow area of the lake there were sparse to moderate densities of southern naiad. Most of the aquatic plant growth was observed near the launch with trace densities of leafy pondweed and duckweed in that location. Trace amounts of leafy pondweed were observed along the shoreline, but were not an issue at that time as no treatment was performed.

Water Quality Monitoring Program

In 2016, 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 20th, 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**	**4/20/2016**	**Limits**
Total Phosphorus	mg/L	0.2	0.03

Table 3. 2016 Mount Kemble Lake Water Quality Results

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

Mount Kemble Lake Water Quality Results- North Station					
Parameter	**Units**	**4/20/2016**	**6/2/2016**	**8/8/2016**	**Limits**
Temperature	°C	15.2	27.2	25.4	NA
Dissolved Oxygen	mg/L	12.96	7.14	7.26	<4.0
ph	SU	8.50	8.00	8.00	9
Alkalinity	mg/L	68.0	80.0	80.0	NA
Total Hardness	mg/L	100.0	120.0	140.0	NA
Secchi	feet	5.5’ est	10’ +	5.5	<4’
Ammonia	mg/l	ND	ND	ND	0.3
Nitrate	mg/L	0.7	0.7	ND	0.3
Total Phosphorus	mg/L	0.04	0.04	0.09	0.03
Total Suspended Solids	mg/L	4.0	ND	5.0	25
Conductivity	Umhos/cm	337	350	317	1500

Table 4. 2016 Mount Kemble Lake Water Quality Results

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

Mount Kemble Lake Water Quality Results- Lake Station Surface					
Parameter	**Units**	**4/20/2016**	**6/2/2016**	**8/8/2016**	**Limits**
Temperature	°C	15.5	24.2	26.3	NA
Dissolved Oxygen	mg/L	11.09	8.16	9.22	<4.0
ph	SU	8.00	8.00	8.50	9
Alkalinity	feet	72.0	60.0	60.0	NA
Total Hardness	mg/L	120.0	120.0	120.0	NA
Secchi	mg/L	4' est	10.5'	5.0’ est	<4’
Ammonia	mg/l	ND	ND	ND	0.3
Nitrate	mg/L	0.6	ND	ND	0.3
Total Phosphorus	mg/L	0.03	0.02	0.2	0.03
Total Suspended Solids	mg/L	7.0	4.0	8.0	25
Conductivity	Umhos/cm	322	343	322	1500

Table 5. 2016 Mount Kemble Lake Water Quality Results

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

Mt. Kemble Lake Water Quality Results–Lake Station-Bottom					
Parameter	**Units**	**4/20/2016**	**6/2/2016**	**8/8/2016**	**Limits**
Dissolved Oxygen	mg/L	6.76	NA	NA	<4.0
Ammonia	mg/L	ND	ND	ND	0.3
Nitrate	mg/L	0.6	ND	ND	0.3
Total Phosphorus	mg/L	0.04	0.06	0.03	0.03
Total Suspended Solids	mg/L	7.0	16.0	5.0	25
Conductivity	umhos/cm	336	347	324	1500

Table 6. 2016 Mount Kemble Lake Water Quality Results

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

Mount Kemble Lake Water Quality Results – Outlet Station			
Parameter	**Units**	**4/20/2016**	**Limits**
Total Phosphorus	mg/L	0.03	0.03

Table 7. 2016 Mount Kemble Lake Water Quality Results

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

Water Quality Results Summary

During 2016, the surface water temperature was 15.5° C in April, and increased a great deal to 24.2°C, and 27.0°C in June and August, respectively. The pH values collected from the inlet and lake station sites throughout the year were consistent with a small range of 8.0 to 8.5, 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 were stable, ranging from 100 mg/L to 140 mg/L at the north station and remaining constant at 120 mg/L at the lake station 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 60 to 80 mg/L, and within a comparable level compared to similar NJ freshwater lakes' chemical composition and more consistent than the values observed in 2015. Conductivity was consistent throughout the season with values ranging from 317 to 350 µmhos/cm., with the highest observed value obtained in the June north lake station location. These conductivity reading were also more consistent then the observed values in 2015.

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. All of the lake surface samples showed results that were within the acceptable range for ammonia. The samples that were taken this year all came back not detected, which means that levels were too low to be detected by the lab instruments.

Nitrates were found to be elevated in the April surface samples, but decreased to values that were within acceptable limits for freshwater lake systems or not detected. In April, nitrate levels were 0.6 mg/L, and 0.7 mg/L respectively at the surface sites. They were 0.6 mg/L in the bottom sample. The rest of the season saw that levels of nitrates fell back into what would be considered a acceptable range.

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. In the 2016 season the April and June phosphorus levels were just above the acceptable threshold at the north station, with the exception of the August sampling in which phosphorus levels were three times the threshold. The April sampling was slightly above the threshold at the bottom station and nearly double the threshold in the June sampling. At the lake station location the phosphorus levels fell within the acceptable range throughout the season. When levels were elevated they were marginally above the typical values expected in a eutrophic lake system with the exception of the north station August reading. Based on the results of the total phosphorous sampling, in water phosphorous inputs appear to be a result of introduction from the inlet pond.

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 2016, with observed secchi readings between 4 and 10 feet. The highest secchi measurement was recorded on both surveys in June, while the lowest observed clarity readings were observed early in the season. Overall, water clarity was considered fair to good throughout the season, and was not observed to be negatively affected by blooms of planktonic algae as planktonic algae counts were very low throughout the course of the summer.

Lake Profile Description

	4/20/2016		6/2/2016		8/8/2016	
Depth (m)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	15.5	11.09	24.2	8.16	26.3	9.22
1	15.4	12.03	24.0	8.04	26.1	9.30
2	15.1	12.11	18.7	13.80	26.1	9.05
3	10.8	13.57	15.9	11.96	26.1	8.94
4	9.5	12.61	13.2	6.59	26.1	8.75
5	9.0	11.89	11.0	2.06	26.0	8.78
6	8.3	7.13	9.2	0.34	26.0	8.67
7	9.0	6.81	8.0	0.13	26.0	8.30
8	9.1	10.20	7.6	0.12	25.5	6.34
9	8.8	7.59	7.3	0.10	25.0	6.15

Table 9. Mount Kemble Lake Dissolved Oxygen Profiles.

In 2016, 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-seven 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 the lake likely supported an algae bloom, however, water clarity at this time was the highest it was all season, which makes this an interesting result to have obtained. 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 August 8th lake profile displayed what would typically be observed during the spring turnover as the temperature and dissolved oxygen profiles remain relatively constant as depth increases. Complete profile graphs are provided in the Appendix of this report.

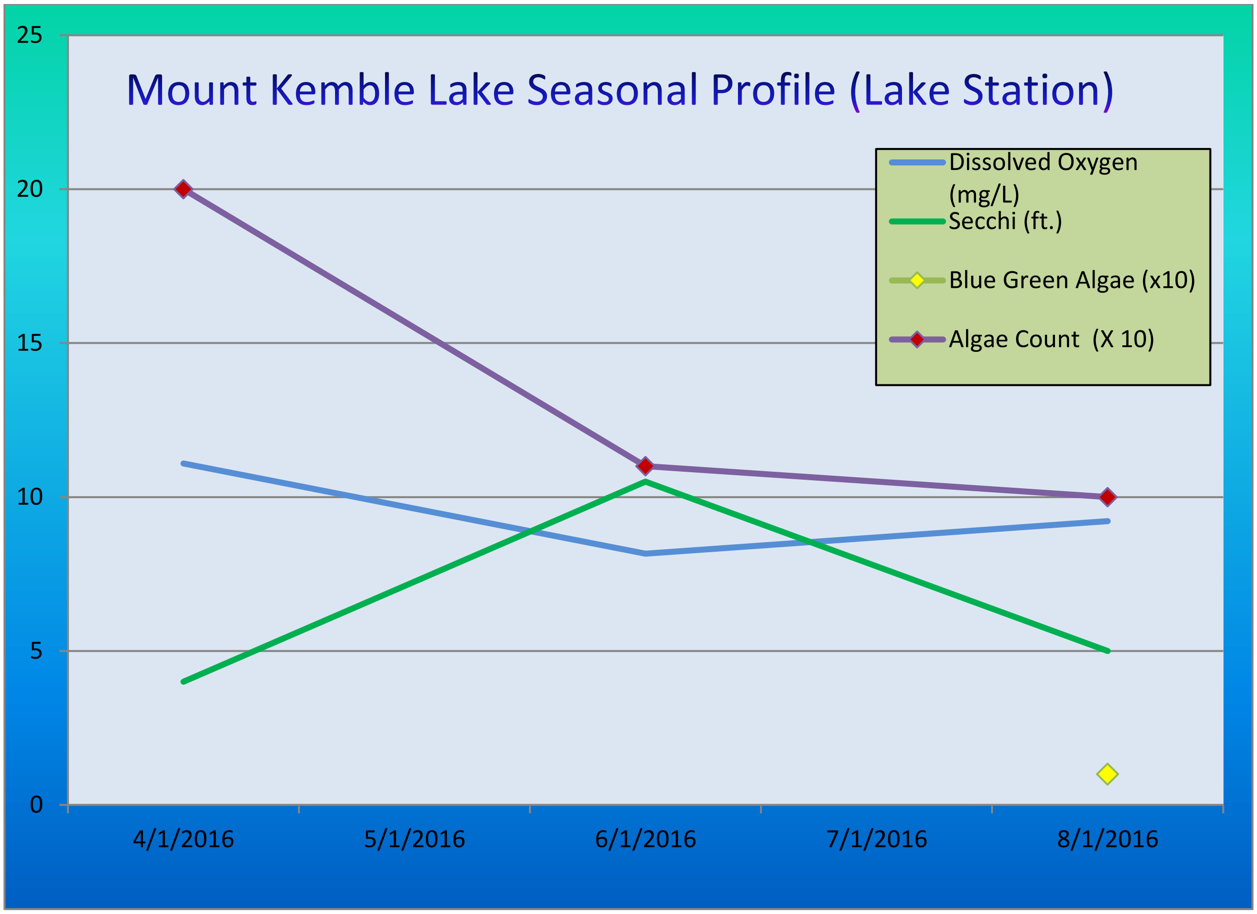


Figure 3. Mount Kemble Lake Seasonal Profile

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2016, surface phytoplankton samples were collected at two established water quality monitoring sites in April, June, and August. 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 SŌLitude Lake Managements's laboratory. The 2016 microscopic examination data sheets and graphs are provided in the Appendix. In 2016, 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 SŌLitude's lab for analysis.

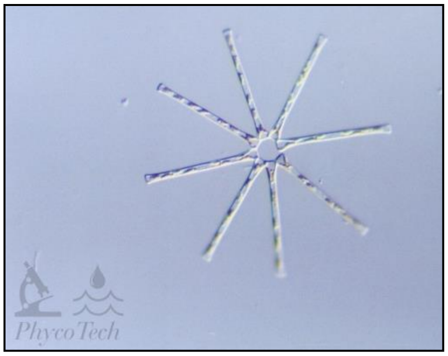
A Phytoplankton Primer

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 2015 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.

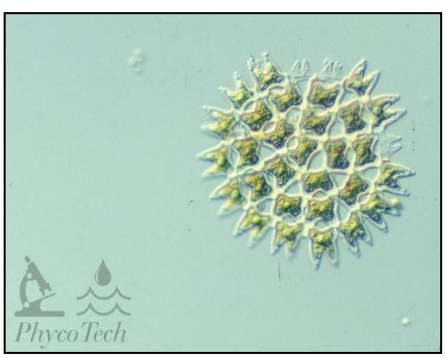
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, 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.

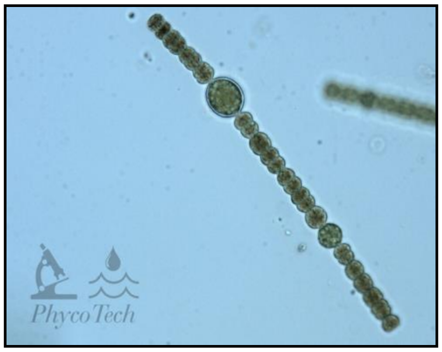


Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population 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*.

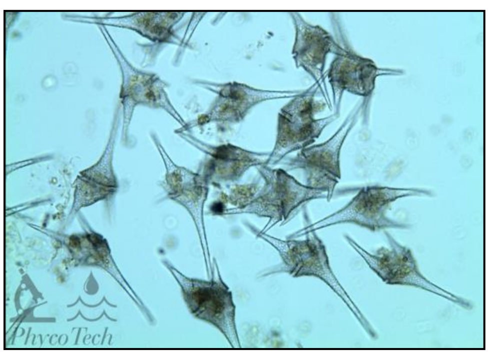


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically 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 of 2016, the phytoplankton density was considered low, with a near even split between diatoms and golden algae accounting for the entire sample. Diversity was low at the inlet station with four (4) genera, and moderate at the lake station with six (6) total genera. The most commonly observed genera was *Synedra* as it accounted for more than half of the sample. Despite the low algal composition the water clarity would have been expected to be higher.

Algal Group	Inlet Station		
% Abundance	**4/20/2016**	**6/2/2016**	**8/8/2016**
Diatoms	**60.0%**	**87.5%**	
Golden Algae	40.0%	12.5%	**53.8%**
Protozoa			
Green Algae			7.7%
Blue-green Algae			7.7%
Dinoflagellates			30.8%
Euglenoids			
Total Orgs / mL	**200**	**80**	**130**

Table 10. Inlet Station

Algal Group			
% Abundance	**4/20/2016**	**6/2/2016**	**8/8/2016**
Diatoms	40.0%	**54.5%**	
Golden Algae	**55.0%**		40.0%
Protozoa			
Green Algae			**50.0%**
Blue-green Algae			
Dinoflagellates		45.5%	10.0%
Euglenoids	5.0%		
Total Orgs. / mL	**200**	**110**	**100**

Table 11. Lake Station

By June, the phytoplankton density decreased by nearly 50% at both sites as did diversity as only three (3) genera were found at each lake station respectively. At each station the abundance of diatoms remained the most commonly found as *Synedra* was the dominant genera at both sites. Another genera that became present was the dinoflagellate, *Peridinium*, which accounted for the same density as *Synedra*.

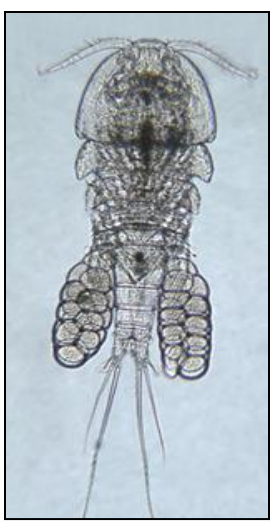
The final sampling date occurred on August 8th, and the algal community at each sampling site stayed nearly the same at a low density as only 130 (Orgs/mL) were observed. At this time the diversity had remained similar to the last sampling with a slight increase at both lake stations, and would be considered low to moderate. At the inlet station and outlet station Golden algae was most commonly found with *Dinobryon* as the dominate genera. Overall, the entire lake management season consisted of low density and diversity during all phytoplankton sampling events, with blue-green only at trace density during the August sampling at the inlet station.

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 SŌLitude'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.

2016 Zooplankton Results

Zooplankton Group	4/20/2016	6/2/2016	8/8/2016
Rotifers	**96.9%**	**91.1%**	25.5%
Cladocera	1.0%	1.5%	**65.2%**
Copepoda	2.1%	7.4%	9.3%
Total Zooplankton (Orgs. / mL)	277	193	1405

Table 12. Mount Kemble Lake 2016 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 277 organisms per mililiter, which is considered low, but sample diversity was moderate with seven (7) different genera observed. At this time Rotifers accounted for nearly all off the total sample at 96.9 percent of the total zooplankton community with *Keratella* being the most abundant genera. Additionally, a single genus of Cladoceran (*Bosmina*) and Copepod (*Cyclopoid nauplii*) were also represented in the zooplankton community, however these two genera only represented 3.1 percent of the total sample.

The June sampling revealed an even lower density of zooplankton as there were 176 organisms per mililiter. Once again Rotifers were the most commonly found as they accounted for 91.1 percent of the total with the genera *Polyarthra* being the most commonly found within the group. At this time zooplankton diversity is considered relatively low as only a total of five (5) different genera were found in the sample. *Bosmina* was the only Cladoceran and it only accounted for a small portion of the total sample at 1.5%. Only one genera of *Copepoda* (*Cyclopoid nauplii*) was found and it accounted for a total of 7.4 percent of the zooplankton observed.

On the final sampling date of August 8th, the zooplankton composition was considered moderate as six (6) different genera were found at that time, however, the density had increased to be relatively high only 1405 organisms per milliliter were found. Rotifers made of 25.5 percent of the zooplankton composition with *Keratella* being the most abundant in the sample. *Cyclopoid nauplii* made up 9.3 percent of the sample and the Cladoceran, *Bosmina* made up the majority of the sample totaling 65.2 percent of the sample.

Discussion

The 2017 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 2016, southern naiad (*N. guadalupensis*) and water-thread pondweed (*P. diversifolius*) were the target aquatic macrophyte species observed. 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. Throughout the 2016 lake management season, the appearance of curly-leaf pondweed was minimal, as only throughout the seasons surveys trace amounts were observed in very few locations. In addition, it is beneficial to allow certain amounts of plants to persist in the lake to provide dissolved oxygen, fish habitat, and compete for nutrients required for nuisance plant and algae development. The growth of leafy pondweed and southern naiad 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 cost 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, SŌLitude Lake Management would be happy to discuss these alternatives.

The management program for 2017 is anticipated to be revised to a more aggressive monitoring program including at least once per month lake surveys, including lake-wide assessment of the submersed aquatic plant community. Increased monitoring will lead to better timed herbicide and algaecide applications to mitigate the nuisance infestations of submersed plant growth that was observed during the latter part of the 2016 season.

A more intensive management effort for the inlet pond will also be evaluated for 2017, including a possible nutrient mitigation application to reduce phosphorous introduction into Mt. Kemble Lake.

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.

SŌLitude Lake Management appreciates the opportunity to be of service to the Mount Kemble Lake Association and looks forward to assisting the Association on the stewardship of Mount Kemble Lake in the 2017 lake management season.

Sincerely,
Carl Cummins

Carl Cummins
Environmental Scientist

SŌLITUDE
LAKE MANAGEMENT

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.

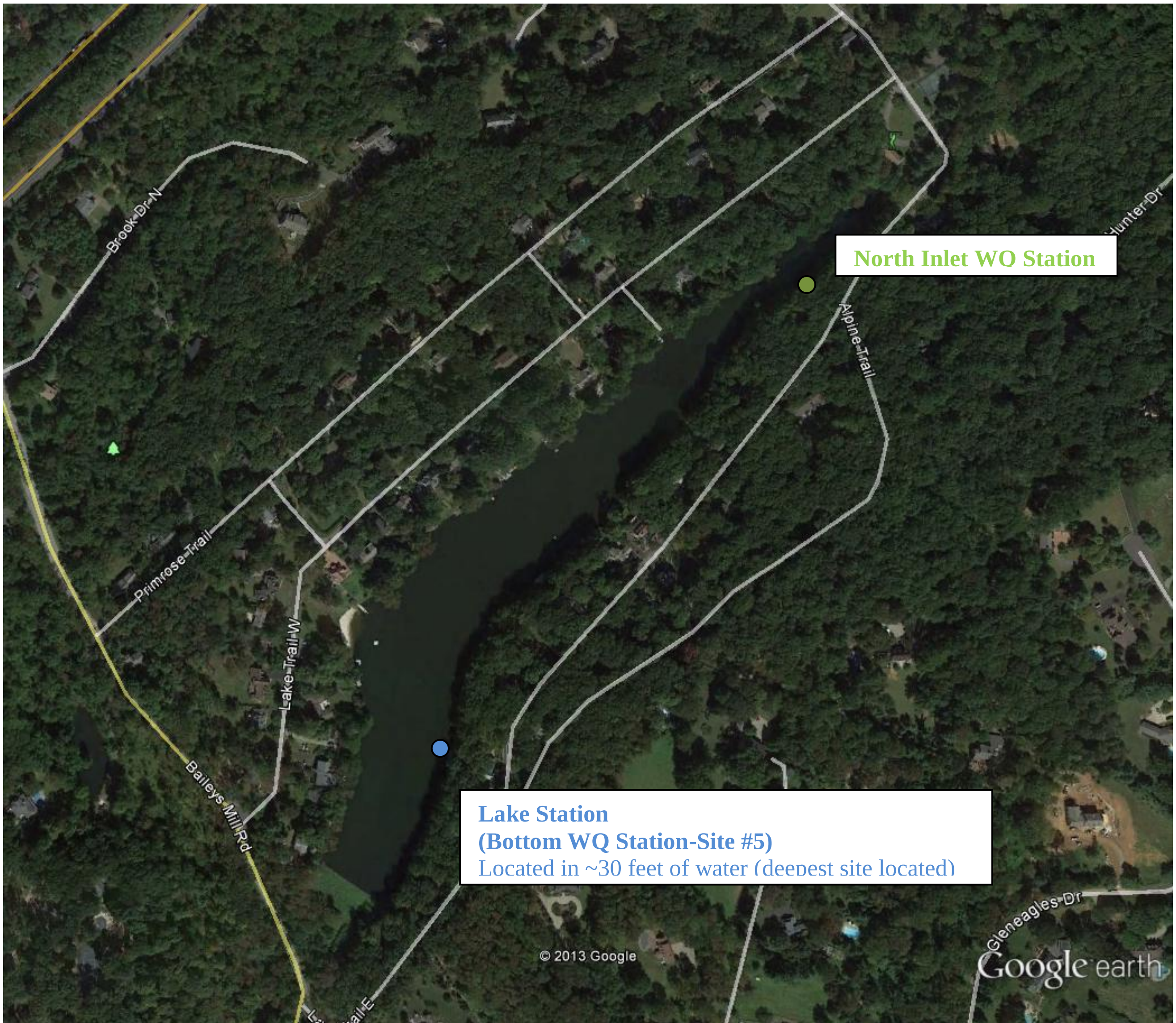
Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native**.): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly more narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. 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.

Water-thread 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.

APPENDIX C: WATER QUALITY SAMPLING MAP

Mount Kemble Lake 2016 Water Quality Monitoring Sites



Mount Kemble Lake
Morris County, New Jersey

2016 Water Quality Sampling Sites Map

- **= North Inlet WQ Site** (green dot)
- **= Lake Station WQ Site** (blue dot)

SOLITUDE LAKE MANAGEMENT

580 Rockport Road
Hackettstown, NJ 07840
(908) 850-0303
FAX 850-4994

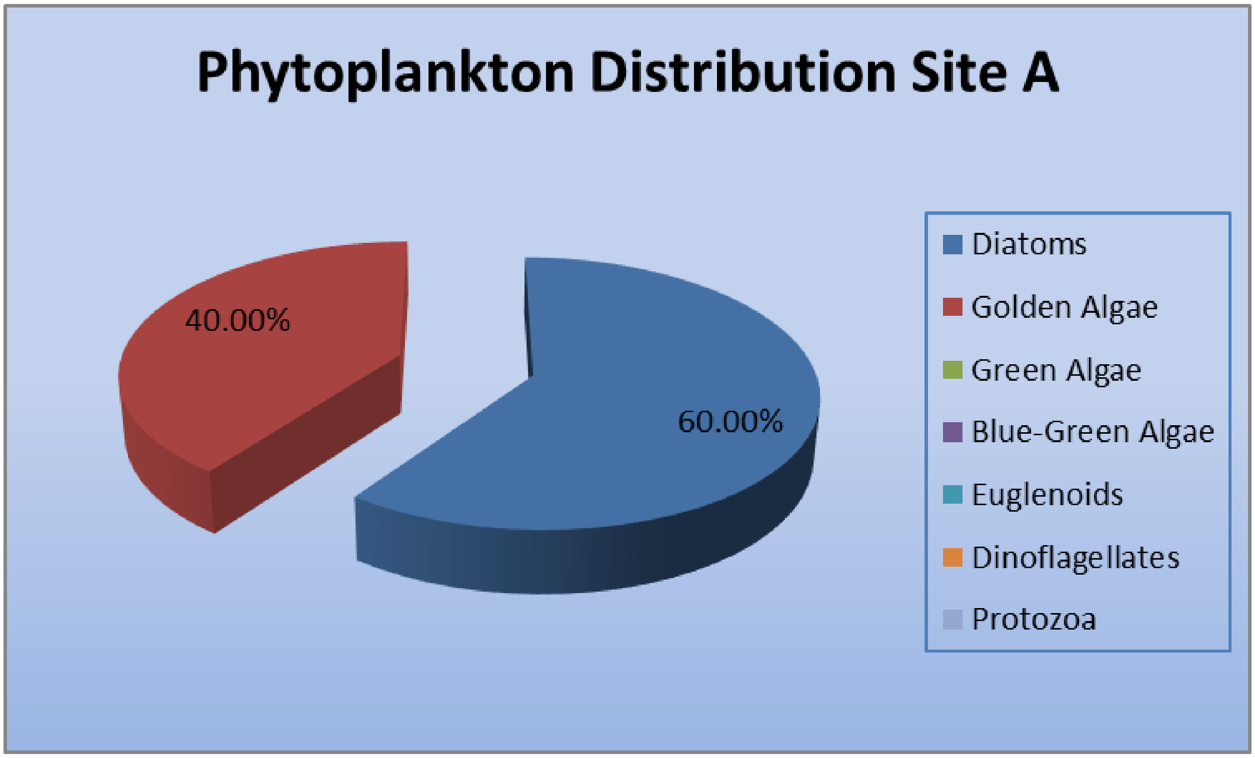
APPENDIX D: PHYTOPLANKTON ENUMERATION CHARTS

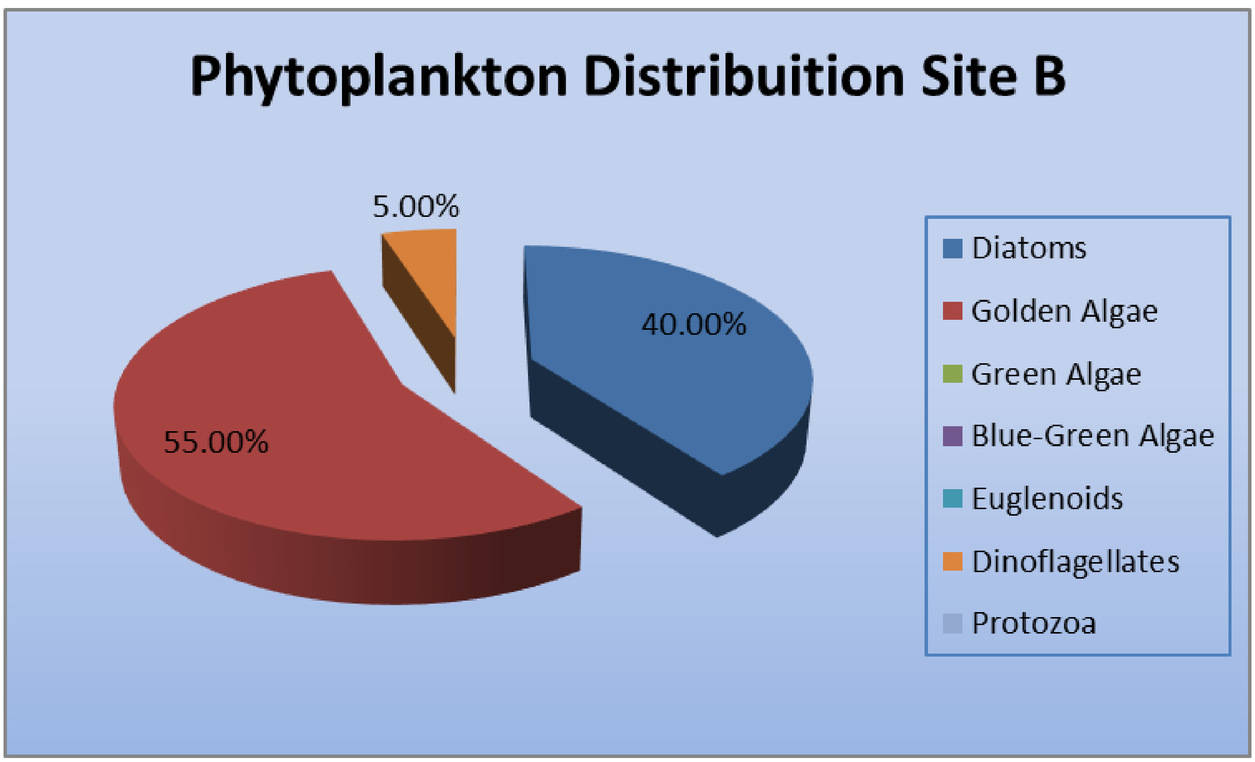
MICROSCOPIC EXAMINATION OF WATER		
Sample from: Mt. Kemble Lake		
Collection Date: 4/20/16	Examination Date: 4/21/16	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella		20		*Ankistrodesmus*				*Anabaena*			
Cyclotella				*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*			
Diatoma				*Chlorococcum*				*Coelosphaerium*			
Fragilaria				*Closterium*				*Gomphosphseria*			
Melosira				*Coelastrum*				*Lyngbya*			
Navicula				*Eudorina*				*Microcystis*			
Nitzschia				*Mougeotia*				*Oscillatoria*			
Pinnularia				*Oedogonium*				*Pseudoanabaena*			
Urosolenia				*Oocystis*				*Synechocystis*			
Stephanodiscus				*Pandorina*				*Agmenellum*			
Stauroneis				*Pediastrum*							
Synedra	120	60		*Phytoconis*				**PROTOZOA**			
Tabellaria				*Rhizoclonium*				*Actinophyrs*			
Cocconeis				*Scenedesmus*							
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Spirogyra*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Staurastrum							
Dinobryon	60	80		*Sphaerocystis*				*Euglena*		10	
Mallomonas	10	20		*Ulothrix*				*Phacus*			
Synura	10	10		*Volvox*				*Trachelomonas*			
Tribonema				*Zygnema*							
Uroglenopsis				*Aulacoseira*							
				Microtinium				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Cosmerium							
								Ceratium			
								Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	4	6	
TRANSPARENCY:	5.5'est	4'est	
ORGANISMS PER MILLILITER:	**200**	**200**	

NOTES: This is the first sampling event of 2016. Phytoplankton density is light and favorable. Phytoplankton diversity is considered to be low at site A, while site B is moderate. The assemblage is dominated by a mixture of diatoms and golden algae, which is typical for early spring. Traces of euglenoids were observed at site B only. No green algae or nuisance blue-green algae were observed. Water clarity is considered


Phytoplankton Distribution Site A
40.00%
60.00%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa


Phytoplankton Distribuition Site B
5.00%
40.00%
55.00%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 06/02/16	Examination Date: 06/03/16	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Navicula			
Nitzschia			
Pinnularia	30	10	
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra	40	50	
Tabellaria			
Cocconeis			

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

CHLOROPHYTA (Green Algae)	**A**	**B**	**C**
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum			
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus			
Spirogyra			
Staurastrum			
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium			
Cosmerium			

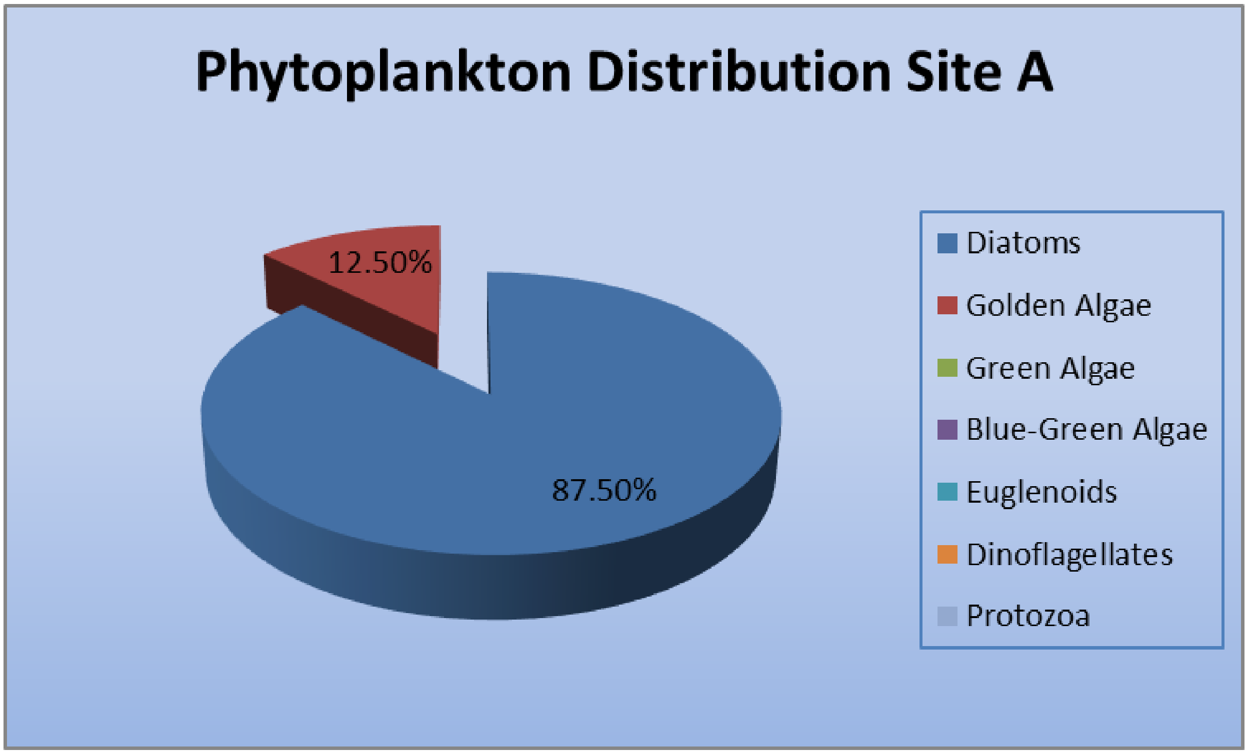
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Anabaena			
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			

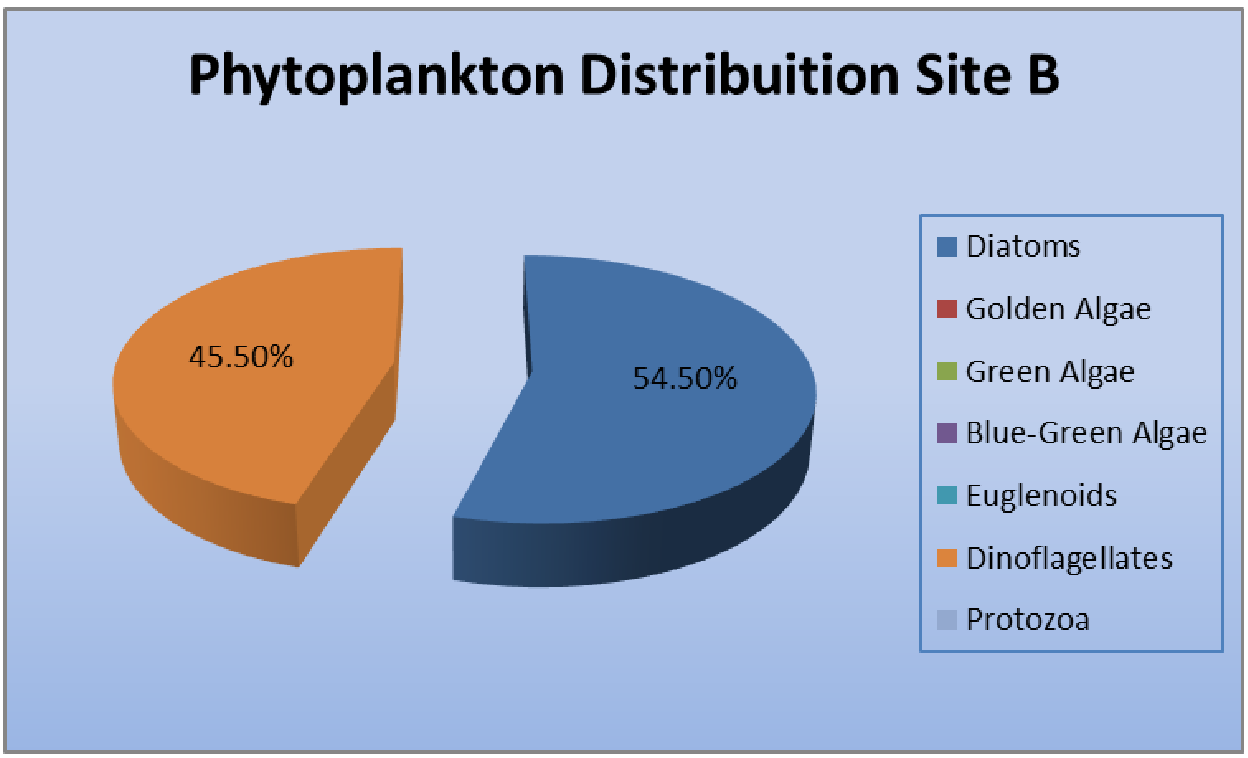
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium			
Peridinium		50	

SITE	**A**	**B**	**C**
TOTAL GENERA:	3	3	
TRANSPARENCY:	1.5’	10.5’	
ORGANISMS PER MILLILITER:	**80**	**110**	

NOTES: Algal density decreased at both sites and continues to be low. Algal diversity decreased and is now considered to be low at each site. Diatoms dominate the assemblage this week. Golden algae and dinoflagellates were observed at site A only. Water clarity decreased at site A while site B increased. Clarity is now considered to be poor at site A whereas site B is excellent.


Phytoplankton Distribution Site A
12.50%
87.50%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa


Phytoplankton Distribuition Site B
45.50%
54.50%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 08/08/16	Examination Date: 08/09/16	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

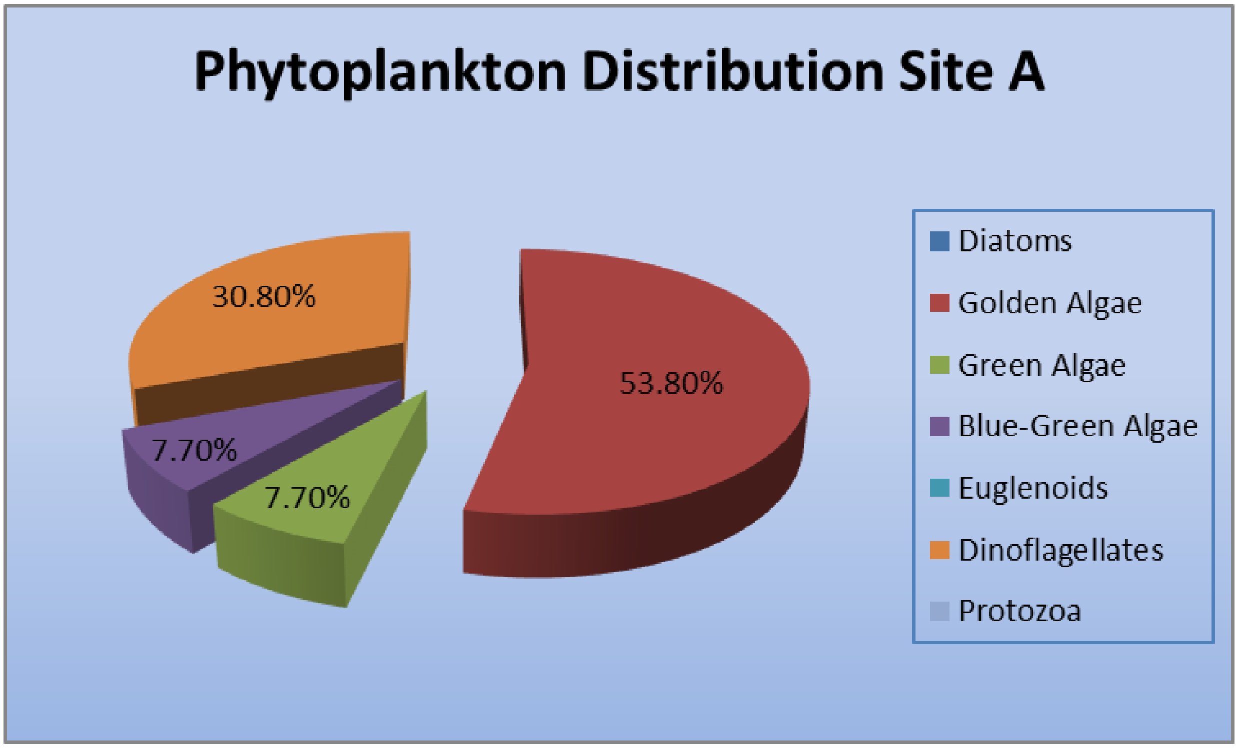
BACILLARIOPHYTA (Diatoms)	A	B	C
Asterionella			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Navicula			
Nitzschia			
Pinnularia			
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra			
Tabellaria			
Cocconeis			
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**
Dinobryon	70	40	
Mallomonas			
Synura			
Tribonema			
Uroglenopsis			

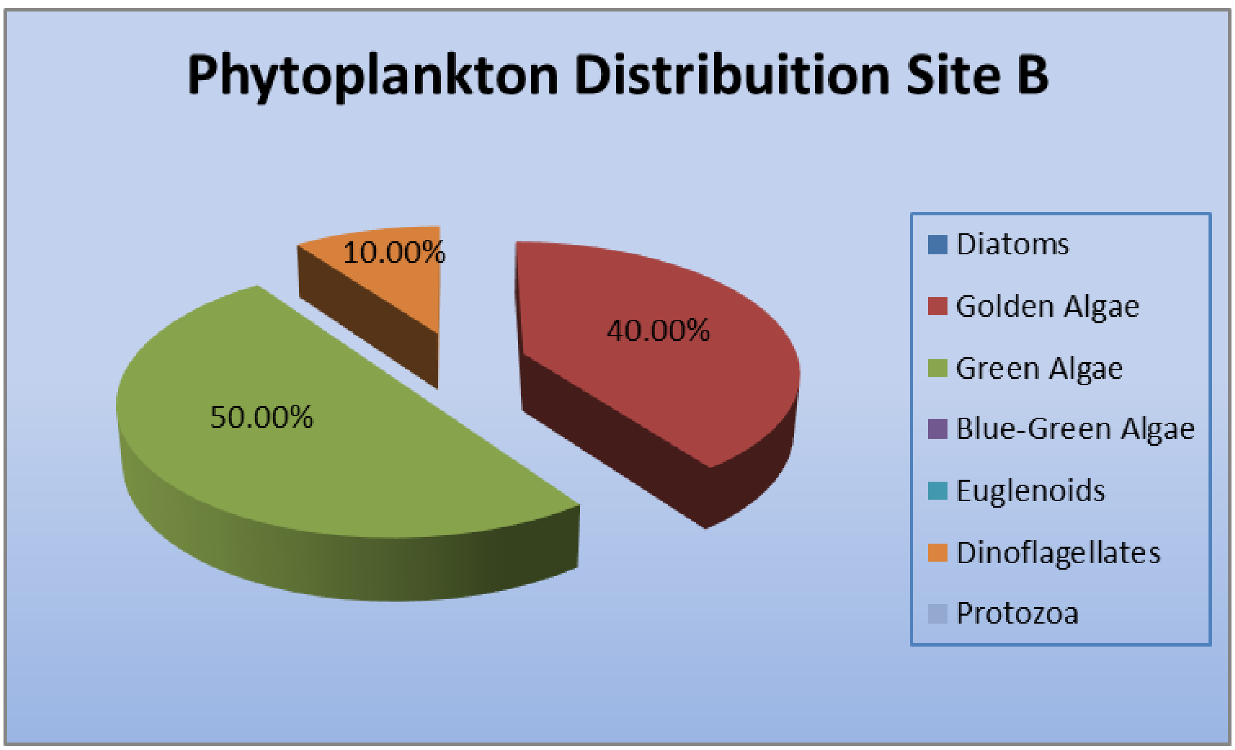
CHLOROPHYTA (Green Algae)	A	B	C
Ankistrodesmus			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum			
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum	10		
Phytoconis			
Rhizoclonium			
Scenedesmus		10	
Spirogyra			
Staurastrum		30	
Sphaerocystis		10	
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium			
Cosmerium			

CYANOPHYTA (Blue-green Algae)	A	B	C
Anabaena	10		
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			
PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium	40	10	
Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	4	5	
TRANSPARENCY:	5.5’	5’est	
ORGANISMS PER MILLILITER:	**130**	**100**	

NOTES: Algal diversity increased at both sites and continues to be low. Algal density increased at site A and decreased at site B. The density continues to be low at each site. Site A is dominated by the golden algae *Dinobryon*. While site B is dominated by green algae. Dinoflagellates were observed at both sites. Traces of blue green algae were observed at site A only. Water clarity increased at site A while site B decreased. Clarity is now considered to be fair at both sites


Phytoplankton Distribution Site A
30.80%
53.80%
7.70%
7.70%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa


Phytoplankton Distribuition Site B
10.00%
40.00%
50.00%
Diatoms
Golden Algae
Green Algae
Blue-Green Algae
Euglenoids
Dinoflagellates
Protozoa

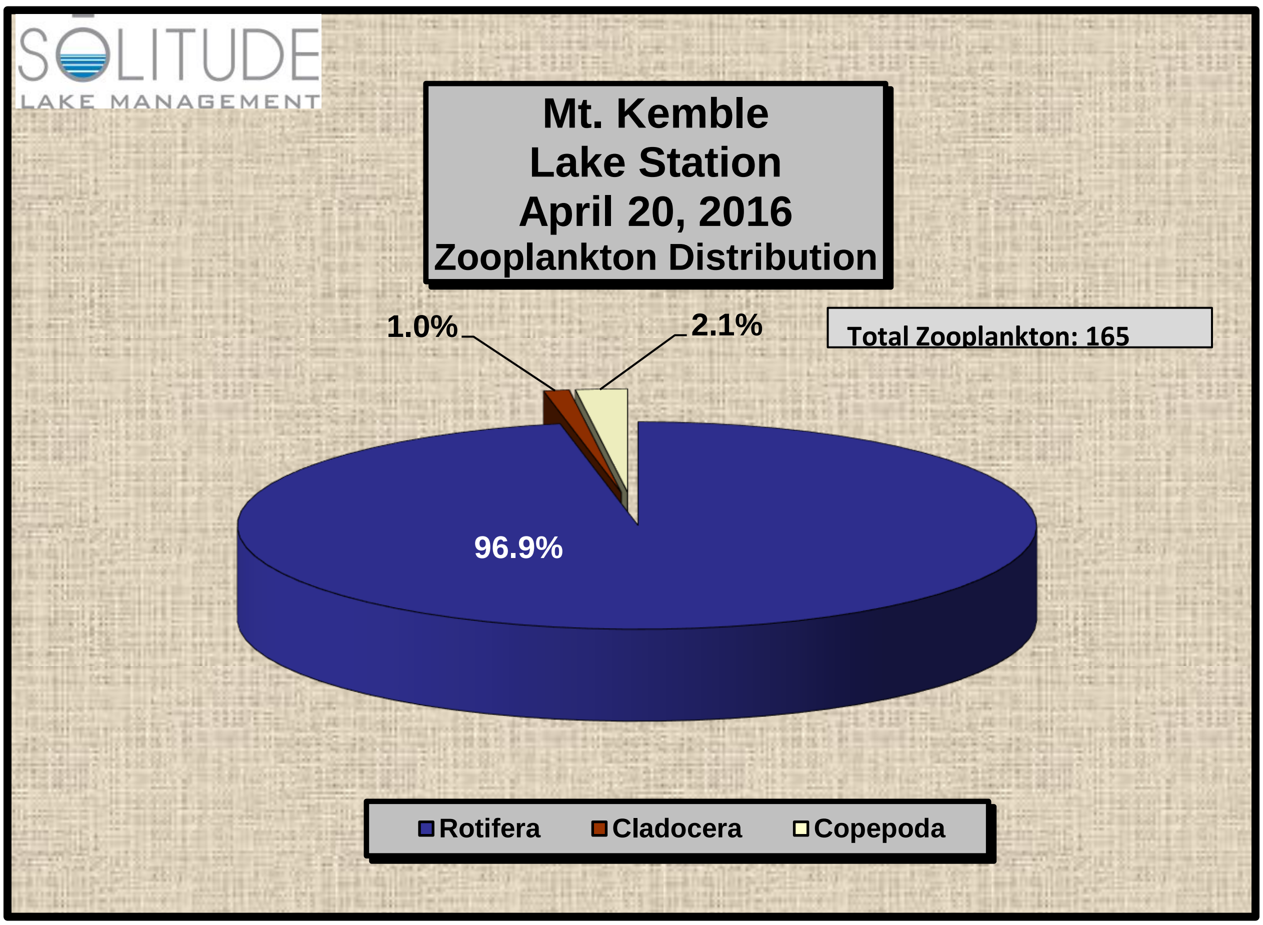
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

Zooplankton Count Results

Site: Mt. Kemble **Date: 4/20/16**

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**	Brachionidae	*Keratella*	17	17	13	15.67	15667	115.7	135
			Brachionus	3	4	22	9.67	9667	115.7	84
		Synchaetidae	*Polyarthra*	3	1	1	1.67	1667	115.7	14
		Asplanchnidae	*Asplanchna*	2	3	2	2.33	2330	115.7	20
		Testudinellidae	Filinia	3	2		1.67	1667	115.7	14
									Total:	**268**
Cladocera	**Cladocera**	Daphniidae	Bosmina			1	0.33	330	115.7	3
									Total:	**3**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii		1	1	0.67	667	115.7	6
									Total:	**6**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
277	268	96.9%	3	1.0%	6	2.1%

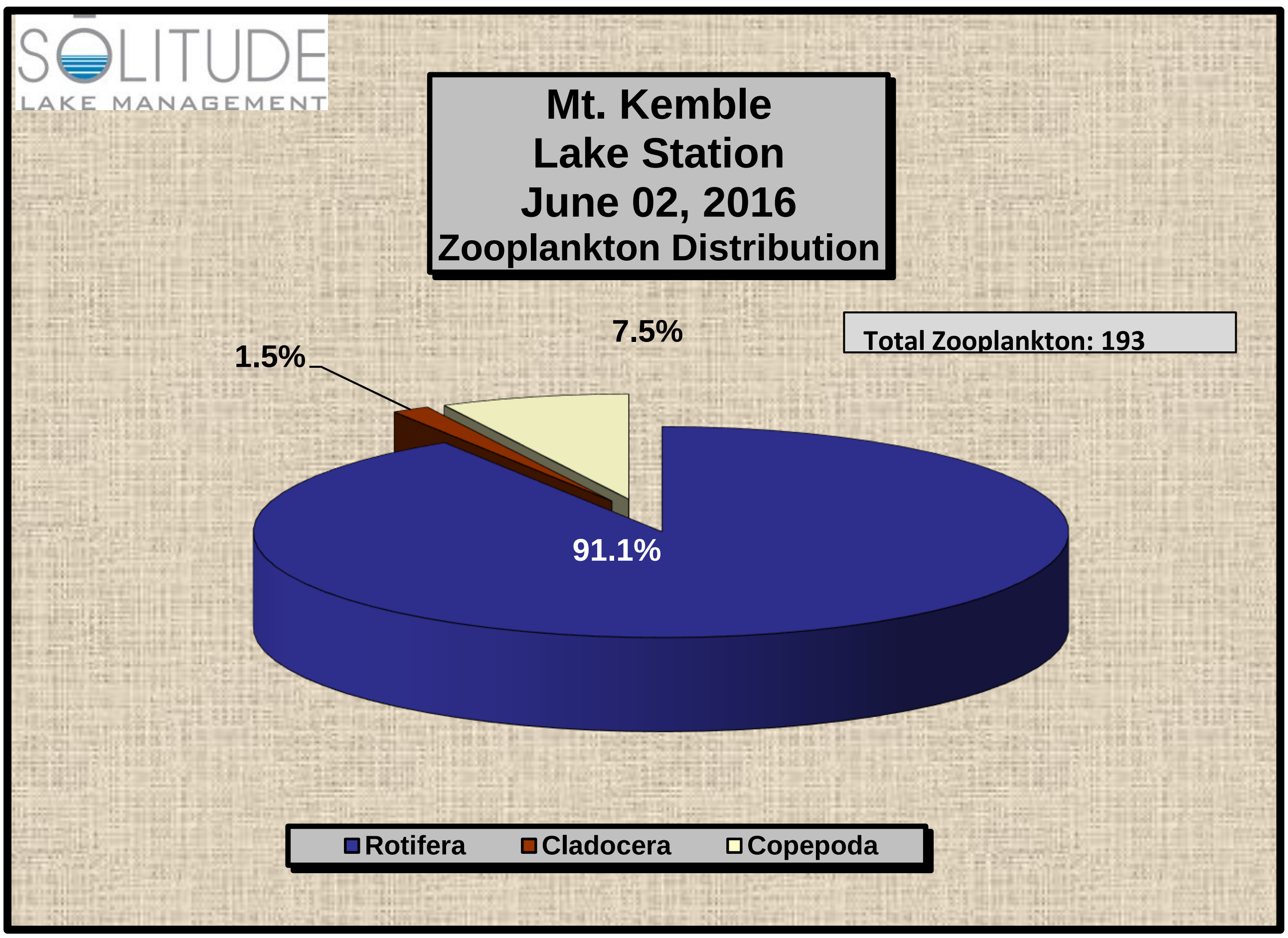


Zooplankton Count Results

Site: Mt. Kemble **Date: 6/2/16**

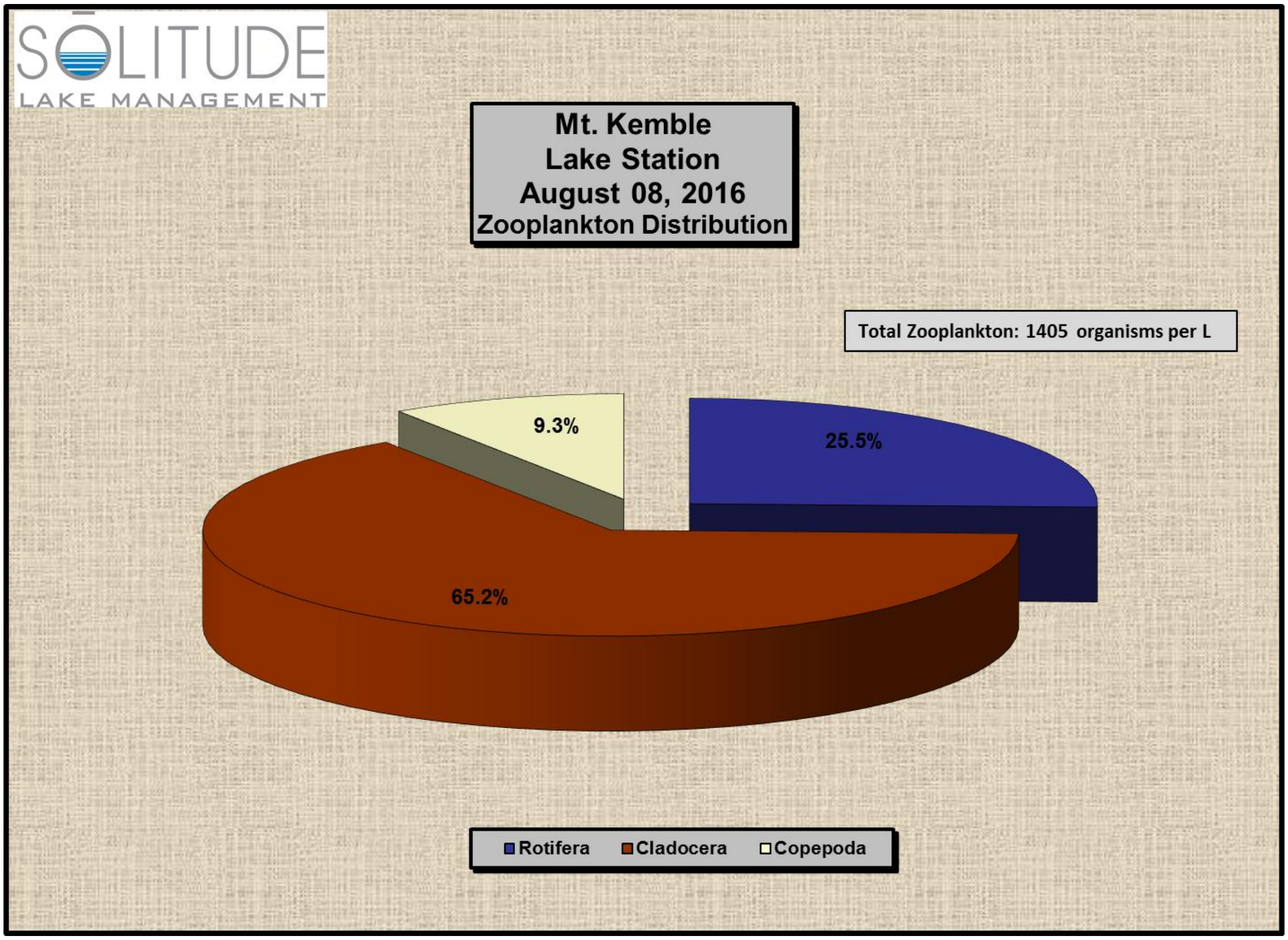
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Keratella*				0.00	0	115.7	0
			Brachionus			1	0.33	333	115.7	3
		Synchaetidae	*Polyarthra*	20	14	19	17.67	17667	115.7	153
							2.33	2330	115.7	20
							0.00	0	115.7	0
									Total:	**176**
Cladocera	**Cladocera**	Daphniidae	Bosmina	1			0.33	330	115.7	3
									Total:	**3**
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	3	2		1.67	1667	115.7	14
									Total:	**14**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
193	176	91.1%	3	1.5%	14	7.5%

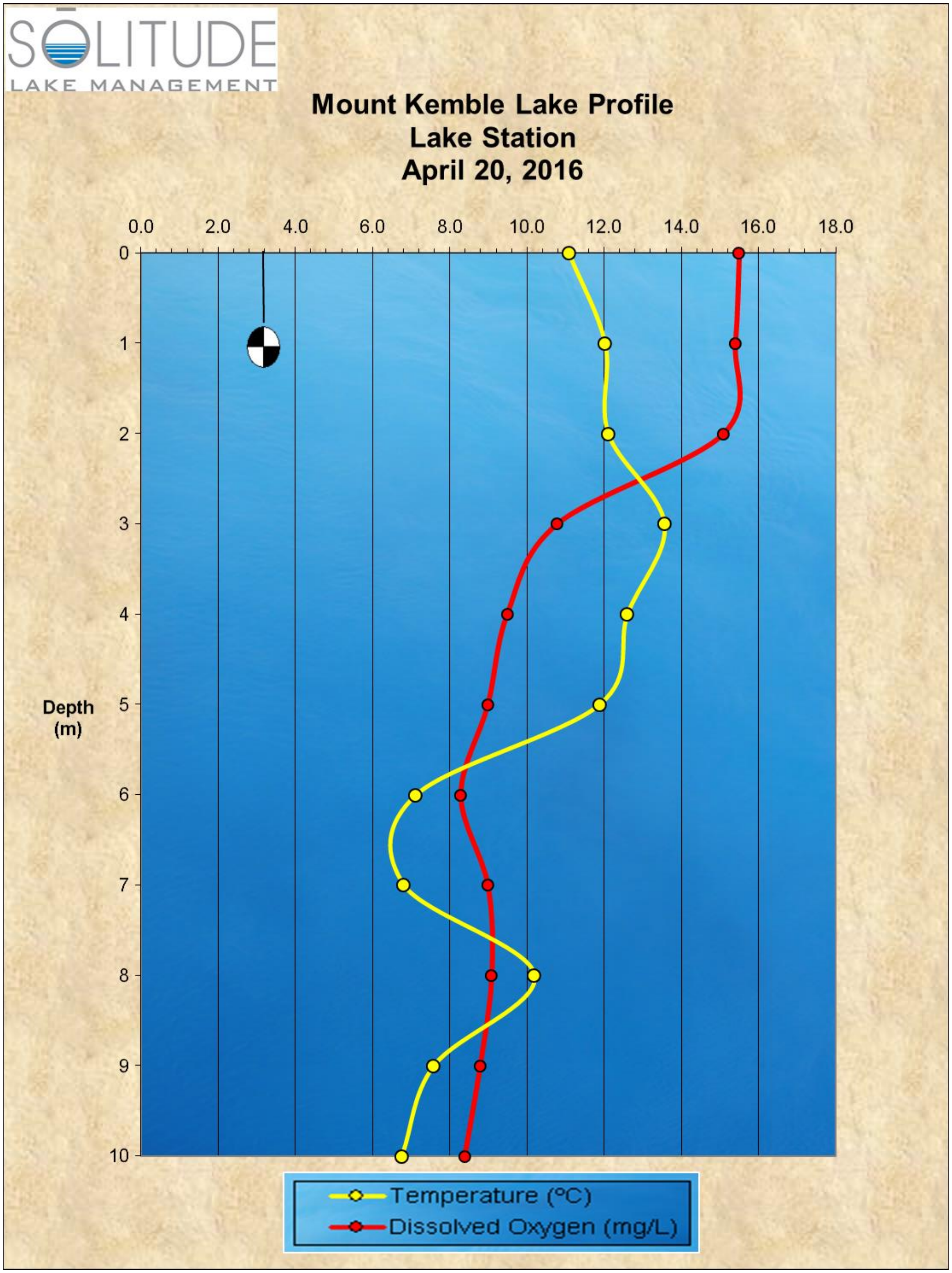


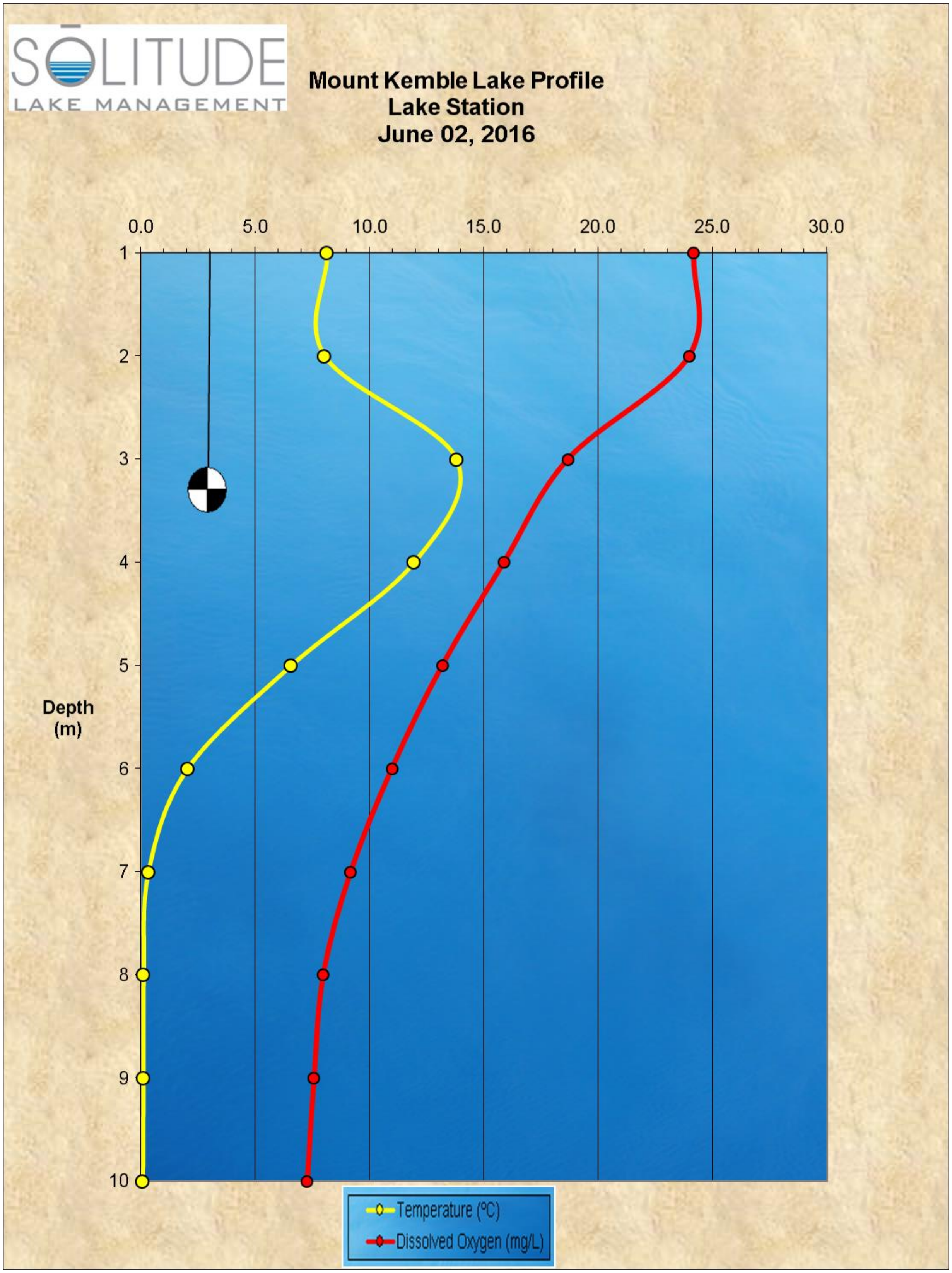
Site: Mt. Kemble			Date: 08/08/16							
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	Ploima	Brachionidae	*Keratella*	4	6	9	6.33	6333	68.8	92
			Brachionus	1	1		0.67	667	68.8	10
		Synchaetidae	*Polyarthra*	7	4	2	4.33	4333	68.8	63
			Synchaeta	4	3	5	12.00	12000	68.8	174
		Trichocercidae	*Trichocerca*		1		1.00	1000	68.8	15
		Asplanchnidae	Asplanchna	1			0.33	333	68.8	5
									Total:	359
Cladocera	Cladocera	Daphniidae	Bosmina	31	23	9	63.00	63000	68.8	916
									Total:	916
Copepoda										
	Cyclopoida	Cyclopoidae	*Cyclopoid* nauplii	6	9	12	9.00	9000	68.8	131
									Total:	131

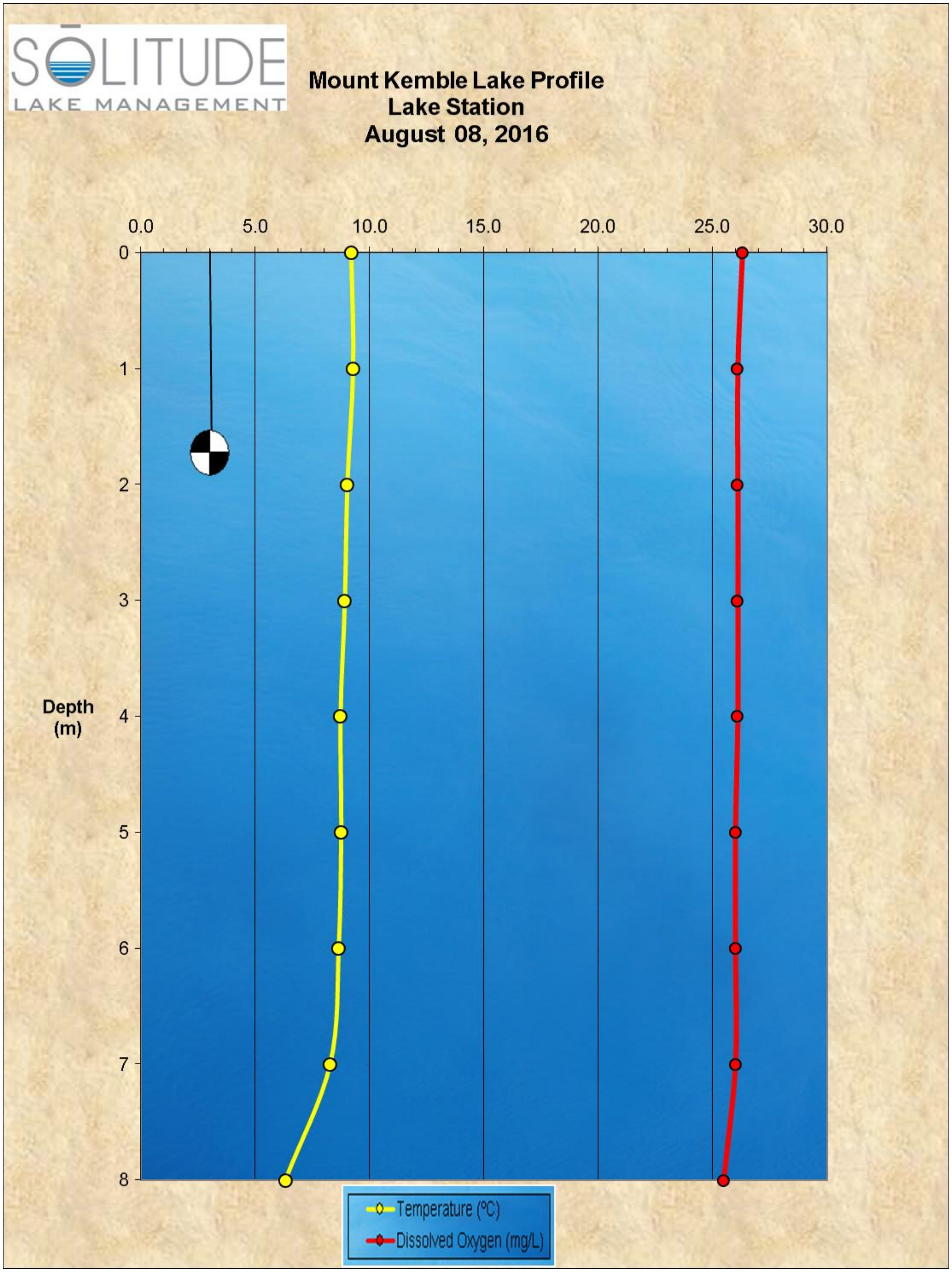
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1405	359	25.5%	916	65.2%	131	9.3%



APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES




SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
June 02, 2016
0.0
5.0
10.0
15.0
20.0
25.0
30.0
1
2
3
4
5
6
7
8
9
10
Depth
(m)
Temperature (ºC)
Dissolved Oxygen (mg/L)


SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
August 08, 2016
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0
1
2
3
4
5
6
7
8
Depth
(m)
Temperature (ºC)
Dissolved Oxygen (mg/L)

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Analytical Results Summary

Mount Kemble

6040675-01 (Lake)

Inlet Stream

Collected	Received	Contact
4/20/2016 13:34	04/20/2016	Chris Doyle

Lab Section/ Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
General Chemistry								
Phosphorus	**4500PE**	4/29/16 11:00	4/29/16 11:00	**0.0200**			**0.0100**	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary

Mount Kemble

6040675-02 (Lake)

Outlet Stream

Collected	Received	Contact
4/20/2016 13:43	04/20/2016	Chris Doyle

Lab Section/ Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
General Chemistry								
Phosphorus	**4500PE**	4/29/16 11:00	4/29/16 11:00	**0.0300**			**0.0100**	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary

Mount Kemble

6040675-03 (Lake)

North Site- Surface

Collected	Received	Contact
4/20/2016 12:59	04/20/2016	Chris Doyle

Lab Section/ Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
General Chemistry								
Ammonia as N	SM 4500 NH3 D	4/26/16 9:30	4/26/16 9:30	ND			0.200	mg/L
Nitrate	**EPA 300.0**	4/20/16 15:40	4/20/16 15:40	**0.700**			**0.200**	mg/L
Phosphorus	**4500PE**	4/29/16 11:00	4/29/16 11:00	**0.0400**			**0.0100**	mg/L
Specific conductance	**SM 2510B**	4/21/16 11:00	4/21/16 11:00	**337**			**1.00**	umhos/cm
Total Suspended Solids	**SM 2540D**	4/26/16 16:47	4/26/16 16:47	**4.00**			**3.00**	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary

Mount Kemble

6040675-04 (Lake)

South Site- Surface

Collected	Received	Contact
4/20/2016 12:04	04/20/2016	Chris Doyle

Lab Section/ Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
General Chemistry								
Ammonia as N	SM 4500 NH3 D	4/26/16 9:30	4/26/16 9:30	ND			0.200	mg/L
Nitrate	**EPA 300.0**	4/20/16 15:40	4/20/16 15:40	**0.600**			**0.200**	mg/L
Phosphorus	**4500PE**	4/29/16 11:00	4/29/16 11:00	**0.0300**			**0.0100**	mg/L
Specific conductance	**SM 2510B**	4/21/16 11:00	4/21/16 11:00	**322**			**1.00**	umhos/cm
Total Suspended Solids	**SM 2540D**	4/26/16 16:47	4/26/16 16:47	**7.00**			**3.00**	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary

Mount Kemble

6040675-05 (Lake)

South Site- Bottom

Collected	Received	Contact
4/20/2016 12:43	04/20/2016	Chris Doyle

Lab Section/ Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
General Chemistry								
Ammonia as N	SM 4500 NH3 D	4/26/16 9:30	4/26/16 9:30	ND			0.200	mg/L
Nitrate	**EPA 300.0**	4/20/16 15:40	4/20/16 15:40	**0.600**			**0.200**	mg/L
Phosphorus	**4500PE**	4/29/16 11:00	4/29/16 11:00	**0.0400**			**0.0100**	mg/L
Specific conductance	**SM 2510B**	4/21/16 11:00	4/21/16 11:00	**336**			**1.00**	umhos/cm
Total Suspended Solids	**SM 2540D**	4/26/16 16:47	4/26/16 16:47	**7.00**			**3.00**	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary
MT KEMBLE

Client: Solitude Lake Management
Contact: Chris Doyle
APL Order ID: 6060046
Received: 6/2/16 13:20

Sample ID/Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
6060046-01 (Lake)	NORTH STATION			Collected: 6/2/2016 10:33				
General Chemistry								
Phosphorus Total	4500PE	6/13/16 9:00	6/15/16 10:31	**0.0400**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	6/2/16 13:28	6/2/16 13:28	**0.700**			**0.200**	**mg/L**
Conductivity	SM 2510B	6/7/16 10:00	6/7/16 10:00	**350**			**1.00**	**umhos/cm**
TSS	SM 2540D	6/7/16 12:08	6/7/16 12:08	ND			3.00	mg/L
Ammonia	SM 4500-NH3 D	6/8/16 15:00	6/8/16 15:00	ND			0.200	mg/L
6060046-02 (Lake)	SOUTH STATION- SURFACE			Collected: 6/2/2016 10:00				
General Chemistry								
Phosphorus Total	4500PE	6/13/16 9:00	6/15/16 10:31	**0.0200**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	6/2/16 13:28	6/2/16 13:28	ND			0.200	mg/L
Conductivity	SM 2510B	6/7/16 10:00	6/7/16 10:00	**343**			**1.00**	**umhos/cm**
TSS	SM 2540D	6/7/16 12:08	6/7/16 12:08	**4.00**			**3.00**	**mg/L**
Ammonia	SM 4500-NH3 D	6/8/16 15:00	6/8/16 15:00	ND			0.200	mg/L
6060046-03 (Lake)	SOUTH STATION BOTTOM			Collected: 6/2/2016 9:50				
General Chemistry								
Phosphorus Total	4500PE	6/13/16 9:00	6/15/16 10:31	**0.0600**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	6/2/16 13:28	6/2/16 13:28	ND			0.200	mg/L
Conductivity	SM 2510B	6/7/16 10:00	6/7/16 10:00	**347**			**1.00**	**umhos/cm**
TSS	SM 2540D	6/7/16 12:08	6/7/16 12:08	**16.0**			**3.00**	**mg/L**
Ammonia	SM 4500-NH3 D	6/8/16 15:00	6/8/16 15:00	ND			0.200	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.

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Analytical Results Summary
MT KEMBLE

Client:	**Solitude Lake Management**	**Contact:**	**Chris Doyle**
APL Order ID:	**6080243**	**Received:**	**8/8/16 13:50**

Sample ID/Analysis	Method	Prepared	Analyzed	Result	Qual	MDL	RL	Units
6080243-01 (Lake)	NORTH STATION			Collected:	8/8/2016 9:30			
General Chemistry								
Phosphorus Total	4500PE	8/12/16 13:00	8/12/16 16:00	**0.0900**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	8/9/16 13:40	8/9/16 13:40	ND			0.200	mg/L
Conductivity	SM 2510B	8/10/16 14:00	8/10/16 14:00	**317**			**1.00**	**umhos/cm**
TSS	SM 2540D	8/11/16 14:37	8/11/16 14:37	**5.00**			**3.00**	**mg/L**
Ammonia	SM 4500-NH3 D	8/11/16 9:30	8/11/16 13:00	ND			0.200	mg/L
6080243-02 (Lake)	SOUTH STATION-SURFACE			Collected:	8/8/2016 10:00			
General Chemistry								
Phosphorus Total	4500PE	8/12/16 13:00	8/12/16 16:00	**0.0200**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	8/9/16 13:40	8/9/16 13:40	ND			0.200	mg/L
Conductivity	SM 2510B	8/10/16 14:00	8/10/16 14:00	**322**			**1.00**	**umhos/cm**
TSS	SM 2540D	8/11/16 14:37	8/11/16 14:37	**8.00**			**3.00**	**mg/L**
Ammonia	SM 4500-NH3 D	8/11/16 9:30	8/11/16 13:00	ND			0.200	mg/L
6080243-03 (Lake)	SOUTH STATION -BOTTOM			Collected:	8/8/2016 10:13			
General Chemistry								
Phosphorus Total	4500PE	8/12/16 13:00	8/12/16 16:00	**0.0300**			**0.0100**	**mg/L**
Nitrate	EPA 300.0	8/9/16 13:40	8/9/16 13:40	ND			0.200	mg/L
Conductivity	SM 2510B	8/10/16 14:00	8/10/16 14:00	**324**			**1.00**	**umhos/cm**
TSS	SM 2540D	8/11/16 14:37	8/11/16 14:37	**5.00**			**3.00**	**mg/L**
Ammonia	SM 4500-NH3 D	8/11/16 9:30	8/11/16 13:00	ND			0.200	mg/L

FootNotes

RL - Reporting limit
MDL - Minimum detection limit
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.