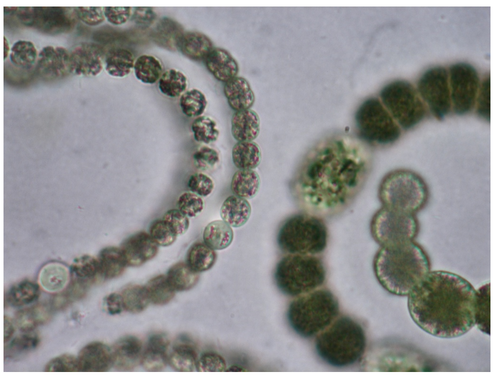
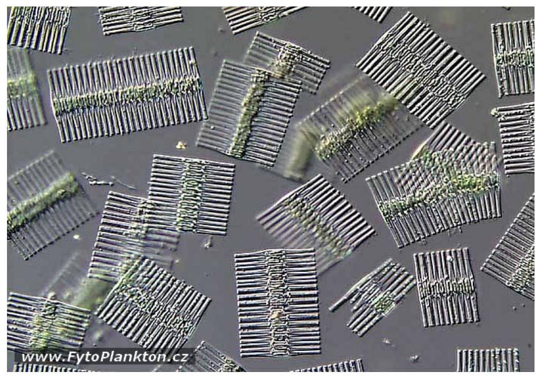
Conesus Lake Monitoring 2022:

Seasonal and Long-term Trends in Phytoplankton Community Structure and Water Column Characteristics





Report Submitted to
The Livingston County Planning Department

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Summary

- The 2022 Conesus Lake monitoring program focused on the state of the phytoplankton community, which consists of the planktonic microalgae and cyanobacteria. This was the first full taxonomic study of the Conesus Lake phytoplankton since 2014.

- Sampling was conducted approximately every 2 weeks starting on May 31 and ending on September 22. More frequent sampling was conducted in July in order to more thoroughly document the bloom of single-celled picocyanobacteria that now occurs every year in July . On each date we collected integrated samples (0-3 m) for phytoplankton analysis. These samples were preserved on site, then stored refrigerated until shipped to the consulting firm, PhycoTech, Inc. for taxonomic analysis. On each sampling date we also obtained vertical profiles of temperature and other water column characteristics, and collected samples from several depths for analysis of Total Phosphorus, Orthophosphate and Nitrate-Nitrite concentrations.

- The phytoplankton community showed strong seasonal shifts in taxonomic composition. Diatoms, particularly *Fragillaria crotonensis,* and other types of microalgae (i.e., not cyanobacteria) dominated during the spring and even into early summer. However, by July these species had been largely replaced by cyanobacteria, with single-celled *Synechococcus* reaching densities of nearly 250 thousand cells per mL in mid-July and the filamentous *Dolichospermum* making up 55% of the biovolume on August 24. Cyanobacteria declined in early September, with cooling waters supporting the resurgence of diatoms, particularly *Fragillaria crotonensis*, which by Sept. 15 made up nearly 60% of the biovolume.

- An initial comparison of the 2022 results to long-term trends based on eight previous studies showed that cyanobacteria have been a significant component of the phytoplankton community in Conesus Lake since as far back as 1985. Nevertheless, the 2014 and 2022 average cell counts were the highest ever recorded. When these values are corrected to total phytoplankton numbers, 2022 is shown to have the highest % representation and the % composition is shown to have increased steadily in the four surveys conducted since 1996. While a shift in the ecosystem favoring cyanobacteria seems to be in place, the alarming cyanobacteria numbers that were reported for 2014 are appropriately seen as exceptional.

- By coupling detailed taxonomic analysis and intensive sampling of water column characteristics, the present study has resulted in a greater understanding of the phytoplankton community and the environmental factors that drive seasonal and long-term changes in Conesus Lake. These interactions are complex and dynamic, and more information is needed if we are to effectively manage the lake ecosystem. Therefore, our top recommendations are that we should take a deeper look at the available phytoplankton and environmental data to better understand long-term trends, and that we prioritize studies of this type to be completed at least every 5 years if not more frequently as part of the watershed monitoring program.

Background

The phytoplankton community of a lake is key to many important ecosystem processes such as nutrient cycling, food web dynamics, light and heat distribution and more. Disturbances such as nutrient runoff, climate warming and invasive species can disrupt the balance of the phytoplankton by changing biomass or species composition. These changes often have undesirable outcomes in terms of ecosystem health, water quality and other ecosystem services. One well-known example of this phenomenon was the rise of potentially harmful cyanobacteria that occurred in temperate North American lakes as zebra mussels spread into the region (Idrisi et al., 2001). Another example that was well documented in Conesus Lake was the increase in phytoplankton biomass and lake turbidity that resulted from loss of the large herbivorous *Daphnia* due to predation by the introduced zooplanktivorous alewife, *Alosa pseudoharengus* (Makarewicz, 2001).

The phytoplankton community of Conesus Lake has been studied extensively by many investigators. The first detailed study was carried out by Ed Mills of Cornell University as part of his dissertation research comparing four Finger Lakes (Mills, 1975). Mills' work , as characterized by Forest et. al. 1977, yielded a richly diverse assemblage of more than 159 phytoplankton species, rich in species of diatoms, green algae and dinoflagellates among other groups. The number of species of cyanobacteria was greater in Conesus Lake than in Hemlock, Owasco or Skaneateles Lake, according to Mills, and included some familiar forms that are present in the lake today, including species of *Microcystis* and *Lyngbya*, *Anabaena* (now *Dolichospermum*) and *Aphanizomenon* that combined showed relatively high biomass over the summer season in 1972. Forest *et al.,* (1977) concluded that because of taxonomic and methodological constraints, there was no way to accurately quantify the precise number of cyanobacteria species in Mills's survey of Conesus Lake.

The next significant work on the Conesus Lake phytoplankton community was carried out by Professor Joe Makarewicz and collaborators starting in 1985 and for multiple years after (1988, 1991, 1993; See Makarewicz et al., 2016 for a full account). Makarewicz and colleagues were especially interested in changes to the phytoplankton that had occurred after the invasive alewife had removed most of the herbivorous *Daphnia* influence in Conesus Lake. The work focused on changes in phytoplankton biomass, size distribution, water clarity, trophic state and other aspects of the lake ecology that were influenced by this dramatic shift in the food web (Makarewicz 2001, Makarewicz *et al*., 2016). Interest in the phytoplankton continued in subsequent years driven in part by questions about the ecosystem effects of zebra mussels, which first colonized Conesus Lake in 1992. Additional taxonomic surveys of the phytoplankton were carried out in 1996, 1999 and 2004 (Makarewicz et al., 2004). However, as no significant influence by zebra mussels on the phytoplankton could be detected (Makarewicz et al. 2016), attention was shifted to other pressing water quality issues in the lake. Consequently, after 2004 there was a 10 year gap in phytoplankton studies until a full taxonomic survey was completed in 2014 (Makarewicz and Lewis, 2014). The paucity of data leading up to this year is regrettable. The 2014 Makarewicz and Lewis study documented cell numbers and biomass of phytoplankton and cyanobacteria that were unprecedented. However, having no recent data for comparison, the researchers could not determine whether conditions in 2014 were part of a trend or simply an ecological outlier. In a 2016 historical review of long-term changes in the Conesus Lake system, Makarewicz and colleagues suggest there were signs that the lake might have entered a new ecological state of elevated phytoplankton and cyanobacteria biomass. Their observation raises important questions about the state of the phytoplankton and the ecosystem of Conesus Lake that should be a focal point of the monitoring plan for the foreseeable future.

The primary goal of our monitoring research in 2022 was to document the state of the phytoplankton community in Conesus Lake. This was the first full taxonomic study of the Conesus Lake phytoplankton since 2014. We were particularly interested in determining whether the unusually high phytoplankton biomass and cyanobacteria representation in the 2014 community was part of a trend in the ecosystem or simply an unusually productive year for the Conesus Lake phytoplankton.

Methods

Sampling for this study was conducted approximately on a bi-weekly basis beginning on May 31 and ending on September 22, 2022. More frequent samples were taken in mid-July (July 11, 13, 20) to document the intensive bloom of single cell picocyanobacteria that now is typical of the summer phytoplankton dynamics in Conesus Lake.

All collections for phytoplankton and all profiles of water column characteristics, nutrient concentrations, turbidity and measurements of Secchi depth were taken in the South Basin of Conesus Lake over 18 m of water at approximately the exact position of the long-term monitoring station first established by the DEC at or near the following coordinates: *42.75473 N and -77.71535 W.*

For consistency with previous studies, the taxonomic study of the phytoplankton community was conducted on samples collected from the upper 3 m of the water column. Duplicate integrated samples were collected with a weighted tube sampler that was lowered from the surface to a depth of 3 m. The two collections were combined and mixed. Subsamples of approximately 50 mL volume were immediately preserved in 1% final concentration Paraformaldehyde or Glutaraldehyde, depending on availability. The first set of samples including collections up to July 20 was stored in dark bottles in a refrigerator for six weeks and then sent out for analysis. The second set of samples to Sept. 15 were refrigerated for 4 months before being sent out for analysis. The environmental consulting firm PhycoTech Inc. provided the taxonomic services (St. Joseph MI). The analytical procedures and quality control measures used by PhycoTech Inc. were provided in the original QAPP and a copy will be submitted with this report.

Copies of the organized data reports submitted by PhycoTech to SUNY Geneseo are submitted with the accompanying materials. PhycoTech Inc.also provided detailed data analysis results as Excel files. These files were transcribed into more structured spreadsheets that followed the data table format in reports from previous taxonomic studies of phytoplankton reported by Makarewicz and colleagues (e.g., Makarewicz and Lewis, 2014 and references therein). The original PhycoTech Excel spreadsheets are submitted as accompanying materials to this report as is a single Excel file with the tables transcribed by the authors.

For analysis of Total Phosphorus (TP), Orthophosphate, and Nitrate + Nitrite (NO_x), duplicate 2.2 L water samples were collected from discrete depths with a Van Dorn sampler. Sample water for Orthophosphate and NO_x analysis was filtered immediately on site with 0.45-µm filters. Total phosphorus samples were acidified to pH <2 with sulfuric acid. Samples were stored in acid-washed plastic bottles and held in coolers on ice for transport. On each collection date, a field blank and a field duplicate of one randomly selected depth was collected and processed for quality control purposes. In general, all procedures followed Standard Methods for the Analysis of Water and Wastewater (USEPA, 1999). All water samples were analyzed by a NYSDOH ELAP certified laboratory (SUNY Brockport, ELAP #12116).

Water column profiles were obtained with two separate profiling units and both sets of data are submitted with the report. SUNY Geneseo's Hydrolab 5a sonde is equipped with sensors for depth (m) temperature (°C), conductivity ($\mu Siemens \cdot cm^{-2}$), dissolved oxygen ($mg \cdot L^{-1}$ and % saturation), pH and redox potential (mV). All sensors were calibrated before and after sampling, in adherence to the procedures and recommendations of the manufacturer (OTT Hydromet) and guidelines in our quality assurance plan (QAPP). A YSI ProDSS multiparameter deployed by the SUNY Brockport collaborators was used to determine *in vivo* chlorophyll a and phycocyanin in units of relative fluorescence (RFUs). These sensors were calibrated immediately prior to each sampling event. The YSI also carried probes for temperature, oxygen and other basic water quality parameters and that data along with the *in vivo* chlorophyll and phycocyanin are submitted as a separate set of Excel and .pdf files.

Two independent measures of water transparency were recorded. Water turbidity as nephelometer turbidity units (NTU) was measured with a calibrated Hach 2100P turbidity meter in the laboratory within two hours of collection. The Secchi depth was measured with a black and white 20-cm disk following standard operating procedures.

Results and Discussion

Seasonal Pattern of Phytoplankton Composition

In **Table 1 A-J** we summarize the results of the taxonomic analysis completed by PhycoTech**,** Inc. These tables show the species composition, abundance in terms of cells/mL, Biovolume in μm^3/mL and the % of the total cell number and biovolume made up by each species. The data are also organized by taxonomic Division- for example the Cyanophyta is the taxonomic Division of the cyanobacteria, and the Bacilliarophyta are the diatoms. A summary of the key statistics and how they changed over the 2022 sampling season is shown in **Table 2**. While a detailed analysis of the seasonal changes in species and higher taxa composition is beyond the scope of this report, below we provide a summary of the major trends, with an emphasis in the cyanobacteria community.

A seasonal pattern of phytoplankton succession was evident in 2022. As the lake slowly warmed in June, diatoms (Division Bacilliarophyta) remained the dominant group, comprising 78 and 96% of the total phytoplankton biovolume in some very rich samples in late June (**Table 1A-C, Figures 1, 2**). The dominant species throughout this period was the diatom by *Fragillaria crotonensi,* which accounted for most of the phytoplankton biovolume (**Tables 1A-C**). By July 11, as the lake warmed, the diatom community had declined significantly and cyanobacteria had begun to dominate, representing 47% % of the biovolume (**Table 1C-D**). The most prominent species at this time were representatives of the cyanobacterial genus *Dolichospermum*, which as a group are well known for their ability to use molecular nitrogen (N_2) as a primary source of N (they are "nitrogen fixers"). Another major change in late June/early July was an increase in the abundance of picocyanobacteria cells. Chroococcacea sp. and *Aphanocaspa* sp. flourished in late June and *Synechococcus* became especially abundant in July (**Table 1C-F, Figure 3**) reaching an abundance of more than 224 thousand cells/mL at the surface in the July 13 samples. The lake was very turbid for a week or more during this period, with Secchi depths declining from 3 m to 1 m and turbidity increasing from 1-3 NTU to 7 NTU (**Figure 4**). As in previous years, in 2022 the picocyanobacteria numbers declined precipitously approximately 2 weeks after the start of the bloom. In the late July and August time period several species of *Dolichospermum* had once again become abundant (**Table 1G-I**; see **Figure 2** peak in late August). For example, in the August 24 sample, cyanobactertia were 75% of the total phytoplankton biovolume and five species of *Dolichospermum* were 60% of the total phytoplankton biovolume. By the September 15 sample (**Table 1-J**) the diatoms were once again dominant making up nearly 61% of the biovolume whereas the cyanobacteria were only 19% and there was no record of *Dolichospermum*.

Possible Drivers of Phytoplankton Seasonality

Integration of detailed taxonomic analysis and intensive sampling of water column characteristics has yielded some insights into the possible environmental factors that drive the seasonal progression of the phytoplankton community in Conesus Lake. One important observation was the possible role of stratification in producing the switch to cyanobacteria dominance in July, and as a driver of the Synechococcus blooms. The temperature profiles shown in **Figure 5** reveal a very typical seasonal pattern for Conesus Lake. Warming of surface waters had begun to establish a thermocline by mid-June, physically separating the epilimnion and hypolimnion by late June. The onset of stratification and cessation of full water column mixing seems to bring about two major important changes to the surface waters. First, warming proceeds faster without the upward mixing of deep waters. By mid-July, surface temperatures were 24-25 °C, which was close to the maximum for the whole summer season **(Figure 5).** Second**,** the cessation of mixing reduces the availability of dissolved nutrients for use by phytoplankton in surface waters. This observation is supported by the dissolved Nitrate+Nitrite profile distribution (**Figure 6)**, which shows how the higher concentrations in the upper 6 m on May 31 have declined to undetectable levels by July. Similarly in **Figure 7**, orthophosphate concentrations in early July decline to very low levels as this dissolved form of P is used by phytoplankton and also begins to accumulate in the hypolimnion (**Figure 8**). A closer look at the seasonal trends in the very surface waters (0-3 m) where we sampled for phytoplankton shows that both orthophosphate and Nitrate-Nitrite are at their lowest levels of the season by early July into mid-August (**Figure 9**). In other words, in mid-summer the waters of Conesus Lake were not only warm but also N and P nutrient limited. These are conditions widely known to favor the growth of some cyanobacteria. A strong case can be made that the *Synechococcus* bloom in July (**Figure 3**) was connected to the nutrient/temperature dynamics. Species of *Synechococcus* are known to be very competitive in taking up nutrients when concentrations are low in the water, as they were in July. Moreover, the Conesus Lake species seem to grow best at 24-25 °C, which corresponds to surface water temperatures in mid-July. The high biovolumes of *Dolichospermum* in August may also be tied to nutrient dynamics as this group is capable of fixing its own nitrogen at a time when dissolved nitrate-nitrite are at seasonal lows.

Observations of Long-Term Trends in the Phytoplankton Community

We are fortunate to have an extensive record of research into the water quality and phytoplankton community structure of Conesus Lake. Over 4 decades of work, Professor J.C. Makarewicz and colleagues at SUNY Brockport have amassed a long-term detailed database on the phytoplankton community of Conesus Lake. Makarewicz and colleagues (2016) published a very important study in which they analyzed 9 years of biological (including phytoplankton) and chemical data and showed that Conesus Lake had undergone major shifts in ecosystem and phytoplankton composition due sequentially to the invasion of the alewife and loss of large herbivores and less importantly, the zebra mussel. The conclusions of their analysis were influenced significantly by the results of a 2014 survey of the phytoplankton in Conesus Lake, which showed dramatic levels of phytoplankton and cyanobacteria in terms of cell numbers and biovolume. The authors suggested that Conesus Lake had possibly entered a cyanobacteria dominated regime, in which increasing nutrient levels have produced higher phytoplankton biomass, and differential grazing on smaller single-celled algae by the remaining small herbivorous zooplankton, which would reduce nutrient competition and favor the buildup of larger filamentous and colonial cyanobacteria (Makarewicz et al., 2016).

Professor Makarewicz has been very kind in providing for our use a set of very organized tables containing data from 9 seasonal surveys of the phytoplankton community in Conesus Lake that were compiled for the 2016 study. These include taxonomic analyses in '96, '99 and '14 that were carried out by PhycoTech, Inc. Below we present a brief comparison that puts the present study in the context of the long-term historical record amassed by Dr. Makarewicz. We were particularly interested in how the 2022 cyanobacteria community compares to that of previous years in terms of cell numbers. Our analysis excludes picoplankton since the techniques to count picoplankton were not resolved until 1996. Only data collected from July 1- September 22 were considered. All of the studies have 5-6 sampling dates during that time interval.

The trends are presented as box plots that show the mean, median, the 25 and 50th interquartile range of the data and the maximum and minimum values. As seen in **Figure 10,** based on cyanobacteria cell number alone, 2014 and 2022 were the highest in the long-term record. These are the only two complete studies in the last 18 years, so we have to be very careful in drawing any final conclusions from this "trend". **Figure 11** shows long-term trends in cyanobacteria composition- in other words, it shows what percent of all the phytoplankton each year were cyanobacteria. This comparison gives a very different perspective because it takes into accounts differences in the total phytoplankton cell number between years. First, the % composition data shows that cyanobacteria have been a significant component of the Conesus Lake phytoplankton community for some time (even if the number of phytoplankton and cyanobacteria were lower; see 1991, for example). We also see that the % cyanobacteria composition was high in 2014, but not much higher than many other years. This is because 2014 was a prolific year for all phytoplankton, not just for cyanobacteria as cell numbers along would seem to indicate in **Figure 10**. Finally, and somewhat troubling, the 4 studies after 1996 give the impression that cyanobacteria representation in Conesus Lake has increased progressively over the last two decades.

There is a potential bias in the analysis of long term trends based solely on cell numbers. The cells of cyanobacteria show a great deal of variation in size, shape and morphology. Consequently, cell number alone is not necessarily an accurate indicator of biomass trends. Biovolume is considered a more reliable indicator of changes in phytoplankton community biomass and food web dynamics. However, even minor methodological differences between studies could adversely affect the results of a trend analysis based on biovolume. We are being more cautious in how we interpret the available historical data on biovolume trends and that's the rationale for not including a long-term biovolume analysis in this report. .

As mentioned earlier, we did not include picocyanoplankton in the long term analysis of cell numbers because there were no counts available prior to 1999. Interestingly, the limited data available indicates that the picocyanoplankton communities in 2014 and 2022 were very similar, showing very high cell counts if *Synechococcus* in mid-July (**Figures 12, 13**). We are in the process of having the 1999 samples reanalyzed, but the original results showed an earlier, less pronounced peak with fewer *Synechococcus*.

Conclusions

This study of the phytoplankton community and related water column characteristics in 2022 revealed a seasonal pattern of species composition, with a succession of dominance that begins with diatoms in late spring, followed by blooms of filamentous and single-celled cyanobacteria in July and August. In September with cooling water temperatures, the lake transitions to another diatom-dominated state.

Cyanobacteria in 2022 were on average 96.0% of the total phytoplankton cell numbers. However, many of the cells were of picoplankton (< 2 µm) and nanoplankton size (2-10 µm) and the biovolume of cyanobacteria was 25.7% of the total phytoplankton biovolume.

We tentatively identified environmental factors that may be drivers of phytoplankton seasonality and cyanobacteria abundance. Complete stratification of the water column in late

June is an important factor in causing rapid warming and nutrient-limited conditions that favor the onset of cyanobacterial dominance.

The 2022 phytoplankton data were compared to long-term trends based on eight previous phytoplankton taxonomic studies by Professor Joe Makarewicz and Colleagues. Results show that the 2022 cyanobacteria cell counts were among the highest ever recorded, averaging 16,145 cells/mL not including picoplankton, but far behind the 2014 average of 64,690 cells/mL. When these values are corrected to total phytoplankton numbers, 2022 is shown to have the highest % and cyanobacteria relative abundance increased steadily in the four surveys conducted since 1996. This trend should be explored using biovolume data, and we are working with PhycoTech to harmonize biovolume data from different studies.

Overall, the % composition data show that cyanobacteria have been proportionately abundant in the phytoplankton community of Conesus Lake since at least 1985. Interestingly, the dominant cyanobacteria historically have been species of the nitrogen-fixing *Dolichospermum*. *Microcystis* species typically have been rare in Conesus Lake, with the exception of 2014, which in many ways was an exceptional year for phytoplankton in the Lake.

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Tables and Figures

Table 1. Taxonomic composition, abundance and biovolume of phytoplankton in Conesus Lake based on samples taken from the upper 0-3 m of the water column in bi-weekly collections from May 31 – Sep 15, 2022.

Table 1-A. Phytoplankton abundance and biovolume at 0-3 m on May 31, 2022.

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm^3/mL)	% Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	4.2	0.091	359.2	0.194
	Asterionella formosa	5.9	0.127	667.9	0.360
	Fragillaria crotonensis	65.6	1.413	56,938.8	30.689
	Fragilaria filiformis	8.5	0.182	2,710.0	1.461
	Tabellaria flocculosa	3.3	0.072	3,777.3	2.036
	Stephanodiscus alpinus	0.3	0.006	17,629.3	9.502
	Cyclotella ocellata	4.2	0.091	1,662.9	0.896
	Totals	92.0	1.981	83,745.4	45.138
Chlorophyta	Chlorococcaceae 2-9.9 µm spher.	8.5	0.182	283.8	0.153
	Scenedesmus serratus	8.5	0.182	119.7	0.065
	Totals	17.0	0.365	403.5	0.218
Chryptophyta	*Cryptomonas erosa*	16.9	0.365	19,387.6	10.450
	Plagioselmis minuta	4.2	0.091	141.9	0.077
	Totals	21.1	0.456	19,529.5	10.526
Chrysophyta	*Kephyrion gracile*	4.2	0.091	79.8	0.043
	Uroglenopsis	635.2	13.677	48,446.9	26.112
	Chrysophyceae	508.2	10.942	27,494.0	14.878
	Dinobryon sociale	4.2	0.091	665.2	0.359
	Totals	1,151.8	24.801	76,685.9	41.391
Cyanophyta	*Psudanabaena limnetica*	211.7	4.559	1,496.6	0.807
	Chroococcaceae $\leq$ 1 µm spherical	1,836.9	39.554	492.5	0.265
	Synechococcus sp. 1 $\leq$ 1 µm ovoid	1,224.6	26.369	492.4	0.265
	Totals	3,273.2	70.5	2,481.5	1.338
Haptophyta	*Chrysochromulina parva*	88.9	1.915	2,689.4	1.390
	Totals	88.9	1.915	2,689.4	1.390
	Community Totals	4,644.0	100.0	185,535.2	100.0
	Cyanophyta Totals	3,273.2	70.5	2,481.5	1.338

Table 1-B. Phytoplankton abundance and biovolume at 0-3 m on June 14, 2022.

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm³/mL)	% Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	8.5	0.008	415.7	0.090
	Fragillaria crotonensis	359.9	0.334	358,767.4	77.626
	Cyclotella ocellata	4.2	0.004	359.2	0.078
	Totals	372.7	0.346	359,542.3	77.794
Chlorophyta	*Monoraphidium griffithii*	4.2	0.004	95.8	0.0002
	Chlamydomonas	4.2	0.004	1,079.2	0.233
	Oocystis parva	55.1	0.051	10,140.3	2.194
	Scenedesmus bijuga	12.7	0.020	638.57	0.14
	Tetraedron minimum	4.2	0.003	542.0	0.117
	Sphaerocystis schroeteri	182.9	0.170	10,507.0	2.273
	Chlorococcaceae 2-9.9 μm	84.7	0.079	12,970.9	2.807
	Desmodesmus communis	16.9	0.015	1,108.6	0.239
	Scenedesmus serratus	8.5	0.007	44.4	0.009
	Totals	365.0	0.352	37,126.7	8.011
Chrysophyta	*Kephyrion gracile*	76.2	0.071	2088.1	0.452
	Mallomas globosa	4.2	0.006	332.6	0.172
	Mallomonas sp.	4.2	0.004	6,386.0	1.482
	Chrysococcus minutus	4.2	0.004	128.1	0.128
	Stychogloea olivacea	8.5	0.008	895.1	0.194
	Chrysophyceae 1	186.3	0.180	7,262.0	1.501
	Chrysophyceae 2	4.2	0.004	274.9	0.089
	Chrysocapsaceae ≥ 1 μm spherical	4.2	0.004	277.2	0.001
	Dinobryon sociale	8.5	0.008	44.3	0.009
	Totals	300.6	0.288	17,688.2	4.027
Cyanophyta	*Dolichospermum sp.*	5.6	0.005	848.1	0.184
	Cyanogranis ferruginea	1,530.8	1.423	402.2	0.087
	Aphanocaspa sp ≤ 1 μm spherical	44,775.6	51.158	28,825.6	6.237
	Psudanabaena limnetica	225.8	0.210	2,394.6	0.518
	Chroococcaceae ≤1 um spherical	44,775.6	41.608	12,004.3	2.597
	Synechococcus sp. 1 ≤1 um ovoid	4,975.1	4.623	2,000.5	0.433
	Totals	96,288.5	99.027	46,475.3	10.055
Euglenophyta	*Trachelomonas*	0.3	0.0002	494.8	0.107
	Totals	0.3	0.0002	494.8	0.107
	Community Totals	97,327.0	100.0	461,327.30	100.0
	Cyanophyta Totals	96,288.5	99.0	46,475.29	10.06

Table 1-C. Phytoplankton abundance and biovolume at 0-3m on June 28, 2022.

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (µm³/mL)	% Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	16.9	0.013	982.8	0.022
	Fragillaria crotonensis	5,108.3	4.038	4,404,604.6	96.330
	Fragillaria filiformis	0.3	0.0003	29.7	0.001
	Cyclotella ocellata	4.2	0.003	359.2	0.008
	Totals	5,129.7	4.055	4,405,976.3	96.360
Chlorophyta	*Monoraphidium griffithii*	8.5	0.007	319.3	0.007
	Monoraphidium arcuatum	8.5	0.007	3,574.3	0.078
	Chlamydomonas	4.2	0.003	2,129.4	0.047
	Muscidosphaerium pulchellum	16.9	0.011	512.3	0.011
	Elakatothrix gelatinosa	25.4	0.020	399.1	0.009
	Oocystis parva	69.9	0.055	14,126.5	0.309
	Scenedesmus bijuga	21.2	0.017	379.100	0.01
	Tetraedron minimum	16.9	0.013	935.9	0.021
	Sphaerocystis schroeteri	135.5	0.107	2572.00	0.056
	Chlorophyta 1	118.6	0.094	8648.10	0.182
	Chlorophyta 2	510.3	0.403	1615.80	0.036
	Desmodesmus communis	16.9	0.013	1,108.6	0.024
	Totals	952.8	0.8	36320.4	0.8
Chrysophyta	*Kephyrion gracile*	4.2	0.003	79.8	0.002
	Dinobryon	8.5	0.007	971.2	0.021
	Dinobryon divergens	4.2	0.003348	957.80	0.02
	Stychogloea olivacea	12.7	0.010	1,342.6	0.029
	Chrysophyceae 1	55.1	0.044	2,301.3	0.050
	Dinobryon sociale	8.5	0.007	1,720.6	0.037
	Totals	93.2	0.073	7,373.3	0.161
Chryptophyta	*Cryptomonas erosa*	0.3	0.0002	231.30	0.005
	Totals	0.3	0.0002	231.30	0.01
Cyanophyta	*Merismopedia ferrophila*	33.9	0.02671	4.4	0.0001
	Aphanocaspa sp. <1 um spherical	88,445.0	69.917	46,309.5	1.013
	Aphanothece nidulans	4,082.1	3.226	4,274.8	0.094
	Chroococcus limneticus	177.9	0.1	9,609.5	0.210
	Chroococaceae ≤1 µm spherical	25,768.3	20.370	6,908.5	0.151
	Synechococcus sp. 1 ≤ 1 µm ovoid	1,785.9	1.4	718.1	0.016
	Totals	120,293.1	95.1	67,824.8	1.483
Euglenophyta	*Trachelomonas*	4.2	0.003	3.704.7	0.081
	Totals	4.2	0.003	3.704.7	0.081
Haptophyta	*Chrysochromulina parva*	8.5	0.001	256.1	0.006
	Totals	8.5	0.001	256.1	0.006
Pyrrophyta	*Gymnodinium* sp. 1	4.2	0.003	10,642.8	0.233
	Peridinium	4.2	0.003	2,554.3	0.056
	Peridinium umbonatum	8.5	0.007	37,515.7	0.821
	Totals	16.9	0.013	50,712.8	1.109
	Community Totals	126,498.7	100.0	4,568,695	100.0
	Cyanophyta Totals	120,293.1	95.1	67,824.8	1.483

Table 1-D. Phytoplankton abundance and biovolume at 0-3m on July 11, 2022

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm^3/mL)	Percent Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	4.2	0.0003	212.9	0.062
	Fragillaria crotonensis	12.8	0.001	11,307.4	3.291
	Cyclotella ocellata	67.8	0.049	4,052.2	1.179
	Totals	84.8	0.050	15,572.5	4.532
Chlorophyta	*Desmodesmus grahneisii*	8.5	0.006	354.8	0.103
	Kirchneriella irregularis	16.9	0.012	207.9	0.061
	Chlorogonium	4.2	0.003	95.8	0.028
	Closterium moniliferum	46.6	0.034	10,662.0	3.092
	Oocystis parva	214.3	0.154	55.8	14.831
	Scenedesmus bijuga	33.9	0.024	487.8	0.142
	Tetraedron minimum	16.9	0.012	2,804.3	0.816
	Sphaerocystis schroeteri	878.3	0.633	16,931.7	4.92
	Chlorococcaceae 2-9.9 um	135.5	0.098	6,704.9	1.952
	Chlorococcaceae $\leq$ 2 um	1,148.1	0.827	3,163.3	0.922
	Phacotus lendneri	63.5	0.046	15,772.6	4.591
	Desmodesmus communis	16.9	0.012	319.3	0.093
	Totals	2,583.6	1.9	57,560.2	31.549
Chrysophyta	*Dinobryon*	4.2	0.003	332.6	0.097
	Dinobryon divergens	29.6	0.021	2,108.6	0.614
	Stichogloea olivacea	38.1	0.027	4,027.8	1.172
	Totals	71.9	0.052	6,469.0	1.883
Chryptophyta	*Cryptomonas erosa*	16.9	0.012	10,039.0	2.922
	Plagioselmis minuta	8.5	0.006	283.8	0.082
	Totals	25.4	0.018	10,322.8	3.004
Cyanophyta	*Snowella litoralis*	875.2	0.630	1,505.6	0.438
	Dolichospermum	59.3	0.043	6,208.3	1.807
	Aphanocascpa elachista	364.2	0.262	643.6	0.187
	Aphanocascpa delicatissima	1,530.8	1.103	801.5	0.233
	Aphanocaspa sp. $\leq$1 µm	2,449.3	1.764	1,282.4	0.373
	Aphanothece nidulans	612.3	0.441	78.9	0.023
	Chroococcus limneticus	74.1	0.053	5,293.7	1.541
	Chroococcus minutis	16.9	0.012	159.6	0.047
	Chroococcaceae $\leq$1 µm	48,985.0	35.288	13,132.9	3.822
	Synechocystis $\geq$1 um spherical	8.5	0.006	15.0	0.004
	Synechococcus sp.1 $\leq$ 1µm	80,749.1	58.171	32,469.2	9.450
	Dolichospermum spiroides	296.4	0.214	75,542.3	21.987
	Totals	136,021.0	98.0	137,132.9	39.9
Euglenophyta	*Trachelomonas*	8.5	0.006	7,409.5	2.157
	Totals	8.5	0.006	7,409.5	2.157
Pyrrophyta	*Glenodinium quadridens*	4.2	0.003	31,289.7	9.107
	Peridinium umbonatum	12.7	0.009	26,961.7	7.847
	Totals	16.9	0.012	58,251.4	16.954
	Community Totals	138,812.1	100.0	292,718.3	100.0
	Cyanophyta Totals	136,021.0	98.0	137,132.9	39.9

Table 1-E. Phytoplankton abundance and biovolume on July 13, 2022.

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (µm³/mL)	% Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	135.5	0.046	6,651.7	1.184
	Fragillaria crotonensis	56.2	0.019	45,229.8	8.051
	Cyclotella ocellata	33.9	0.032	1,662.9	0.296
	Totals	225.6	0.097	53,544.4	9.531
Chlorophyta	*Chlamydomonas*	16.9	0.006	8517.8	1.516
	Closterium moniliferum	16.9	0.006	4,384.9	0.781
	Oocystis parva	338.8	0.115	117,117.6	20.847
	Scenedesmus bijuga	67.8	0.023	1,277.1	0.227
	Tetraedron minimum	153.1	0.052	63,944.1	11.38
	Sphaerocystis schroeteri	1,002.8	0.339	42,258.8	7.522
	Chlorophyta 1-9.9 um, spherical	2,755.4	0.933	24,496.5	4.361
	Chlorophyta 2 ≤ 2 um spherical	306.2	0.103	656.6	0.117
	Phacotus lendneri	101.6	0.034	25,236.1	4.492
	Stichococcus bacillaris	1,071.6	0.363	1,292.7	0.230
	Totals	5831.1	1.974	289,182.2	51.476
Chrysophyta	Chrysophyceae	765.4	0.259	6,380.7	1.136
	Polygonoiochloris circularis	16.9	0.006	5,283.1	0.940
	Totals	782.3	0.265	11,663.8	2.1
Chryptophyta	*Cryptomonas erosa*	16.9	0.006	15,325.0	2.728
	Totals	16.9	0.006	15,325.0	2.728
Cyanophyta	*Snowella litoralis*	409.008	0.138	6651.72	0.102
	Aphanocascpa elachista	767.9	0.260	1,357.0	0.242
	Aphanocaspa sp. ≤1 um	3,673.9	1.244	30,056.9	5.350
	Chroococcus limneticus	2.0	0.001	94.2	0.017
	Chroococcaceae ≤1 µm spheres	58,170.0	19.692	15,595.4	2.776
	Synechocystis ≥1 µm spherical	1,071.6	0.363	1,878.4	0.334
	Synechococcus sp.1 ≤ 1µm ovoid	224,260.5	75.919	90,175.1	16.052
	Dolichospermum spiroides	166.2	0.056	231.7	0.041
	Totals	288,521.1	97.7	146,040.4	24.9
Euglenophyta	*Trachelomonas*	1.0	0.0002	1979.1	0.352
	Trachelomonas volvocina	0.5	0.0002	462.6	0.082
	Totals	1.5	0.0003	2,441.7	0.435
Pyrrophyta	*Glenodinium quadridens*	16.9	0.006	49,666.2	8.841
	Totals	16.9	0.006	49,666.2	8.841
	Community Totals	295,395.4	100.0	567,863.7	100.0
	Cyanophyta Totals	288,521.1	97.7	146,040.4	24.91

Table 1-F Phytoplankton abundance and biovolume at 0-3 m on July 20, 2022.

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (µm³/mL)	% Biovolume
Bacillariophyta	*Cyclotella hakanssoniae*	33.9	0.032	1,682.9	0.425
	Fragillaria crotonensis	16.6	0.016	16,190.2	4.086
	Cyclotella ocellata	25.4	0.024	1,852.5	0.468
	Totals	75.9	0.072	19,725.6	4.978
Chlorophyta	*Desmodemus grahneisii*	204.1	0.193	1709.9	0.432
	Chlamydomonas	42.3	0.040	13165.5	3.322
	Closterium moniliferum	16.9	0.016	989.1	0.250
	Oocystis parva	442.2	0.419	7,934.0	2.002
	Pediastrum duplex	135.5	0.128	20,496.9	5.173
	Scenedesmus bijuga	204.1	0.193	1,025.9	0.259
	Tetraedron minimum	51.0	0.048	11,098.9	2.81
	Sphaerocystis schroeteri	1,033.2	0.978	24,123.6	6.088
	Chlorococcaceae 2-9.9 um	816.4	0.773	42,854.4	10.815
	Chlorococcaceae ≤2 um spher.	1,020.5	0.966	7,338.9	1.852
	Lobomonas	8.5	0.008	463.0	0.117
	Stichococcus bacillaris	51.0	0.048	239.2	0.060
	Totals	4025.7	3.811	131,439.3	33.179
Chrysophyta	*Dinobryon*	51.0	0.048	5,129.7	1.294
	Dynobrion divergens	391.1	0.370	56,978.8	14.379
	Mallomonas	102.1	0.097	25,812.8	6.514
	Stichogloea olivacea	102.1	0.097	11,511.1	2.905
	Chrysophyceae	1683.9	1.594	8,780.9	2.216
	Polyygoniochloris circularis	8.5	0.008	2,641.5	0.667
	Dinobryohn sociale	203.3	0.192	15,964.1	4.029
	Totals	2,542.0	2.406	126,818.9	32.004
Cryptophyta	*Plagioselmis minuta*	51.0	0.048	1,709.9	0.432
	Totals	51.0	0.048	1,709.9	0.432
Cyanophyta	*Cyanodictyon planctonicum*	816.4	0.773	105.2	0.027
	Snowella litoralis	2,032.6	1.924	3,496.8	0.883
	Dolichospermum crassum	144.0	0.136	36,692.0	9.260
	Cyanogranis ferruginea	816.4	0.773	328.3	0.083
	Dolichospermum circinale	592.8	0.561	17,929.5	4.525
	Aphanocaspa elachista	1,803.9	1.707	3,187.8	0.805
	Aphanocaspa ≤ 1 um spherical	4,330.0	4.099	2,267.2	0.572
	Chroococcus limneticus	67.8	0.064	780.5	0.197
	Merismopedia warmingiana	135.5	0.128	17.7	0.005
	Microcystis aeruginosa	76.7	0.073	2,569.9	0.649
	Chroococccaceae ≤1 um	24,492.6	23.189	6,566.5	1.657
	Synechococcus sp.1 ≤1 um ovoid	63,527.7	60.145	25,544.5	6.447
	Dolichospermum spiroides	92.0	0.087	10,132.3	2.557
	Totals	98,928.4	93.659	109,618.2	27.664
Pyrrophyta	*Peridinium*	0.5	0.0005	6,938.7	1.751
	Totals	0.5	0.0005	6,938.7	1.751
	Community Totals	105,623.5	100.0	396,250.6	100.0
	Cyanophyta Totals	98,928.4	93.659	109,618.2	27.664

Table 1-G. **Phytoplankton abundance and biovolume at 0-3m on July 26, 2022.**

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (µm³/mL)	Percent Biovolume
Bacillariophyta	*Cyclotella ocellata*	85.0	0.138	2,915.4	0.453
	Fragillaria crotonensis	141.5	0.229	210,637.9	32.733
	Totals	226.5	0.4	213,553.3	33.2
Chlorophyta	*Monoraphdium griffithii*	14.1	0.023	465.6	0.072
	Monomastix minuta	42.5	0.069	142.5	0.022
	Chlamydomonas	42.5	0.069	37,961.5	5.899
	Crucigenia quadrata	170.1	0.277	408.2	0.063
	Oocystis parva	95.3	0.155	26,167.9	4.067
	Scenedesmus bijuga	42.4	0.069	2,128.6	0.331
	Selenastrum minutum	42.5	0.069	1,612.3	0.251
	Sphaerocystis schroeteri	680.4	1.105	17,235.9	2.679
	Chlorophyta 2-9.9 um spherical	680.4	1.105	10,487.4	1.630
	Pyramichlamys dissecta	14.1	0.023	14,947.2	2.323
	Scenedesmus serratus	170.1	0.276	1,424.9	0.221
	Totals	1994.3	3.239	112,981.9	17.557
Chrysophyta	Chrysophyta >1 um spherical	85.0	0.138	9,746.5	1.515
	Stichogloea olivacea	14.1	0.023	1,491.8	0.232
	Uroglenopsis	42.5	0.069	2,279.9	0.354
	Chrysophyta	3827.0	6.216	9,773.7	1.519
	Polygoniochloris circularis	42.5	0.069	6,929.7	1.077
	Totals	4,011.2	6.515	30,221.5	4.696
Cyanophyta	*Snowella litoralis*	1,530.8	2.486	2,962.9	0.460
	Dolichospermum spp.	127.0	0.206	42,571.0	6.616
	Cyanogranis ferruginea	7,030.3	11.418	1,678.5	0.261
	Aphanocaspa elachista	1,411.5	2.293	2,494.4	0.388
	Aphanocaspa delicatissima	2,104.8	3.419	1,102.1	0.171
	Aphanothece nidulans	13,607.0	22.100	1,752.8	0.272
	Chroococcus limneticus	28.2	0.046	1,300.8	0.202
	Merismopedia warmingiana	340.2	0.553	43.8	0.007
	Chroococccaceae ≤ 1 um	16,583.0	26.935	44,460.0	0.691
	Synechococcus sp. 1 ≤ 1 um	12,331.4	20.003	4,958.4	0.771
	Dolichospermum macrosporum	15.9	0.026	1,751.3	0.272
	Dolichospermum spiroides	42.6	0.069	2,141.6	0.333
	Totals	55,152.8	89.553	107,217.6	10.4
Euglenophyta	*Euglena*	7.1	0.011	7,243.0	1.1
	Total	7.1	0.011	7,243.0	1.1
Haptophyta	*Chrysochromulina parva*	170.1	0.276	5,474.0	0.851
	Totals	170.1	0.276	5,474.0	0.851
Pyrrophyta	*Peridinium*	7.1	0.0115	203,247.1	31.585
	Peridinium umbonatum	0.4	0.0007	3,563.6	0.554
	Totals	7.1	0.0115	203,247.1	32.139
	Community Totals	61,561.9	100.0	672,695.4	100.0
	Cyanophyta Totals	55,152.8	89.553	107,217.6	10.444

Table 1-H. Phytoplankton abundance and biovolume at 0-3 m on Aug. 10, 2022

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm^3/mL)	% Biovolume
Bacillariophyta	*Fragillaria crotonensis*	17.9	0.025	12,592.4	1.841
	Cyclotella ocellata	1,052.4	1.485	116,571.0	17.040
	Totals	1,070.3	1.510	129,163.3	18.881
Chlorophyta	*Desmodemus grahneisii*	255.1	0.360	5,289.4	0.773
	Chlamydomonas	31.9	0.045	14,528.4	2.124
	Closterium moniliferum	31.9	0.045	2,159.4	0.316
	Oocystis parva	239.2	0.338	74,611.8	10.907
	Selenstrum minutum	31.9	0.045	1,209.3	0.177
	Tetraedron minimum	5.3	0.007	267.1	0.04
	Sphaerocystis schroeteri	877.0	1.238	7,666.5	1.121
	Chlorophyta 2-9.9 um spherical	2,870.2	4.050	36,033.4	5.267
	Pyramichlamys dissecta	31.9	0.045	13,358.6	1.915
	Totals	4374.4	6.173	155,123.9	22.638
Chrysophyta	*Mallomonas*	31.9	0.045	29,547.2	4.319
	Stichogloea olivacea	31.9	0.045	3,597.2	0.526
	Chrysophyta	1817.8	2.565	4,193.0	0.613
	Totals	1,881.6	2.655	37,337.4	5.458
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Cryptomonas erosa	63.8	0.090	23,613.8	3.452
	Totals	95.7	0.135	34,693.8	5.072
Cyanophyta	*Pseudoanabaena acicularis*	1,270.4	1.793	8,979.8	1.313
	Snowella litoralis	709.3	1.001	1,220.2	0.178
	Dolichospermum	797.3	1.125	61,556.7	8.998
	Dolichospermum crassum	7.7	0.011	2,015.0	0.295
	Cyanogranis ferruginea	6,505.8	9.180	2,322.8	0.340
	Limnoraphis birgei	113.1	0.160	90,973.5	13.298
	Dolichospermum circinale	180.0	0.254	10,577.8	1.546
	Dolichospermum planctonicum	52.9	0.075	13,489.7	1.972
	Aphanocaspa elachista	656.4	0.926	1,159.9	0.170
	Aphanocaspa delicatissma	191.4	0.270	100.2	0.015
	Chroococcus limneticus	103.2	0.146	1,912.4	0.280
	Chroococcus minimus	446.5	0.630	1,870.2	0.273
	Pseudonabaena limnetica	555.8	0.784	3,928.7	0.574
	Chroococcaceae < 1um	17,859.2	25.201	4,788.1	0.700
	Synechocystis > 1 um spherical	63.8	0.090	111.8	0.016
	Synechococcus sp. 1 < 1 um	33,804.9	47.702	13,593.0	1.987
	Totals	63,317.6	89.347	218,599.6	31.954
Haptophyta	*Chrysochromulina parva*	63.8	0.090	2,052.7	0.300
	Totals	63.8	0.090	2,052.7	0.300
Euglenophyta	*Trachelomonas*	31.89	0.045	55,401.0	8.100
		31.9	0.045	55,401.0	8.100
Pyrrophyta	*Peridinium umbonatum*	31.9	0.045	51,724.7	7.561
	Totals	31.9	0.045	51,724.7	7.561
	Community Totals	70,867	100.0	682,044	100.0
	Cyanophyta Totals	63,317.6	89.347	218,599.6	31.95

Table 1-I Phytoplankton abundance and biovolume at 0-3m on August 24, 2022

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm^3/mL)	% Biovolume
Bacillariophyta	*Cocconeis placentula*	7.1	0.005	1,940.1	0.438
	Cyclotella ocellata	85.0	0.058	4,411.6	0.995
	Totals	92.1	0.063	6,351.6	1.433
Chlorophyta	*Monoraphidium griffithii*	7.1	0.005	118.3	0.027
	Chloromonas prona	42.5	0.029	427.5	0.096
	Desmodesmus grahneisii	14.1	0.010	137.5	0.031
	Closterium moniliferum	14.1	0.010	666.8	0.150
	Oocystis parva	272.1	0.186	24,002.5	5.415
	Scenedesmus bijuga	85.0	0.058	718.2	0.162
	Chlorophyta Colonial	56.5	0.039	532.1	0.120
	Sphaerocystis schroeteri	680.4	0.464	14,454.4	3.261
	Chlorophyta 2-9.9 um	978.0	0.667	5,810.7	1.311
	Lagerheimia ciliata	42.5	0.029	7,295.6	1.646
	Stichococcus bacillaris	212.6	0.145	797.2	0.180
	Monoraphidium capricornutum	85.0	0.058	661.0	0.149
	Totals	2490.0	1.699	55,621.8	12.549
Chrysophyta	Chrysophyta >1 um spherical	42.5	0.029	2,462.3	0.556
	Chrysophyta sp.	340.2	0.232	658.4	0.149
	Totals	382.7	0.261	3,120.7	0.704
Chryptophyta	*Cryptomonas erosa*	14.1	0.010	4,744.9	1.071
	Plagioselmis minuta	170.1	0.116	5,699.7	1.286
	Totals	184.2	0.126	10,444.6	2.356
Cyanophyta	*Dolichospermum*	15.34	0.010	7,095.78	0.522
	Dolichospermum crassum	112.9	0.077	30,121.6	6.796
	Cynogranis ferruginea	5,197.1	3.545	1,655.3	0.373
	Limnoraphis birgei	1.0	0.001	4,111.8	0.928
	Dolichospermum circinale	2,338.7	1.595	130,948.1	29.544
	Dolichospermum planctonicum	102.3	0.070	26,080.1	5.884
	Aphanocaspa elachista	19,594.1	13.366	34,349.4	7.750
	Aphanocasma delicatissima	1,530.8	1.044	801.5	0.181
	Aphanotece nidulans	10,630.5	7.252	1,369.3	0.309
	Pseudoanabaena limnetica	397.0	0.271	2,806.2	0.633
	Chroococccaceae ≤1um spherical	30,615.8	20.886	8,208.1	1.852
	Synechococcus sp. 1 ≤1um ovoid	71,436.8	48.733	28,724.7	6.481
	Dolichospermum spiroides	388.2	0.265	58,535.2	13.206
	Chroococcus turgidus	14.1	0.010	3,458.9	0.780
	Totals	142,374.6	97.126	338,265.9	75.2
Haptophyta	*Chrysomulina parva*	1063.1	0.7252	34,212.4	7.719
	Totals	1063.1	0.7252	34,212.4	7.719
	Community Totals	146,586.7	100.0	448,017.0	100.0
	Cyanophyta Totals	142,375	97.1	338,266	75.2

Table 1-J Phytoplankton abundance and biovolume at 0-3m on Sep. 15, 2022

Division	Taxon	Abundance (cells/mL)	% Abundance	Biovolume (μm^3/mL)	% Biovolume
Bacillariophyta	*Cyclotella ocellata*	95.7	0.122	2,404.6	0.550
	Fragillaria crotonensis	206.5	0.264	260,532.5	59.572
	Stephanodiscus alpinus	0.3	0.0004	2,055.9	0.470
	Totals	302.5	0.387	264,993.0	60.592
Chlorophyta	*Monoraphidium griffithi*	382.7	0.489	3,662.1	0.837
	Desmodemus grahneisii	127.6	0.163	641.2	0.147
	Chlamydomonas	5.3	0.007	11,070.2	2.531
	Closterium moniliferum	5.3	0.007	309.1	0.071
	Oocystis parva	191.4	0.245	23,357.3	5.341
	Staurastrum	5.3	0.007	16,221.9	3.709
	Tetraedron minimum	10.6	0.014	929.9	0.213
	Chlorophyta 2-9.9 um spherical	669.7	0.856	12,567.8	2.874
	Stichococcus bacillaris	31.9	0.041	267.2	0.061
	Totals	1429.7	1.827	69,026.8	15.783
Chryptophyta	*Plagioselmis minuta*	31.9	0.041	1,068.7	0.244
	Totals	31.9	0.041	1,068.7	0.244
Cyanophyta	*Pseudoanabaena acicularis*	5697.9	7.281	40,061.8	9.160
	Cyanogranis ferruginea	2,381.2	3.043	578.7	0.132
	Aphanocaspa delicatissima	1,954.5	2.498	1,023.4	0.234
	Chroococcus limneticus	98.8	0.126	3,577.1	0.818
	Merismopedia warmingiana	510.3	0.652	65.7	0.015
	Microcystis aeruginosa	529.3	0.676	17,727.9	4.056
	Chroococccaceae $\leq$ 1um spherical	22,483.5	28.731	6,027.8	1.378
	Synechococcus sp.1 $\leq$ 1 um ovoid	42,575.1	54.406	17,119.4	3.914
	Totals	76,230.6	97.413	86,181.9	19.708
Euglenophyta	*Euglena*	5.3	0.007	7,849.0	1.795
	Totals	5.3	0.007	7,849.0	1.795
Haptophyta	*Chrysochromulina parva*	255.1	0.326	8,211.0	1.877
	Totals	255.1	0.326	8,211.0	1.877
	Community Totals	78,255.0	100.0	428,508.5	100.0
	Cyanophyta Totals	76,230.6	97.413	86,181.9	19.708

Table 2. Summary data of phytoplankton abundance in cells/mL, biovolume and % composition (% of total) for each metric based on analyses of integrated 0-3 m water samples taken between May 31- Sep. 15, 2022. The phytoplankton and picocyanoplankton data include the picocyanobacteria, which explains why the percentages are different from those of **Figure 1**.

Date in 2022	Phyto-Plankton cells/mL	Cyano-Phyta cells/ml	Cyano-phyta % cells/ml	Picocyano bacteria (cells/mL)	Phyto-plankton (um^3/mL)	Cyanophyta Biovolume (um^3/mL)	Cyanophyta % Biovolume
31-May	4,644	3,273	70.5	3,062	185,535	2,482	1.3
14-Jun	97,327	96,354	99.0	104,502	461,327	46,475	10.1
28-Jun	126,498	120,300	95.1	115,999	**4,568,665**	67,825	1.5
11-Jul	138,812	136,036	**98.0**	132,192	292,718	137,132	46.8
13-Jul	**294,996**	**288,211**	97.7	**287,174**	567,964	146,040	25.7
20-Jul	105,623	98,925	93.7	92,349	396,250	109,618	27.7
26-Jul	61,562	55,131	89.6	28,915	672,695	107,218	15.9
10-Aug	70,867	63,318	89.3	51,727	682,004	218,600	32.1
24-Aug	146,587	142,336	97.1	102,051	448,017	**338,266**	**75.5**
15-Sep	78,255	76,231	97.4	65,058	428,509	86,181	20.1
Averages	112,517	108,011	96.0	101,997	332,123	125,984	25.7

Figures

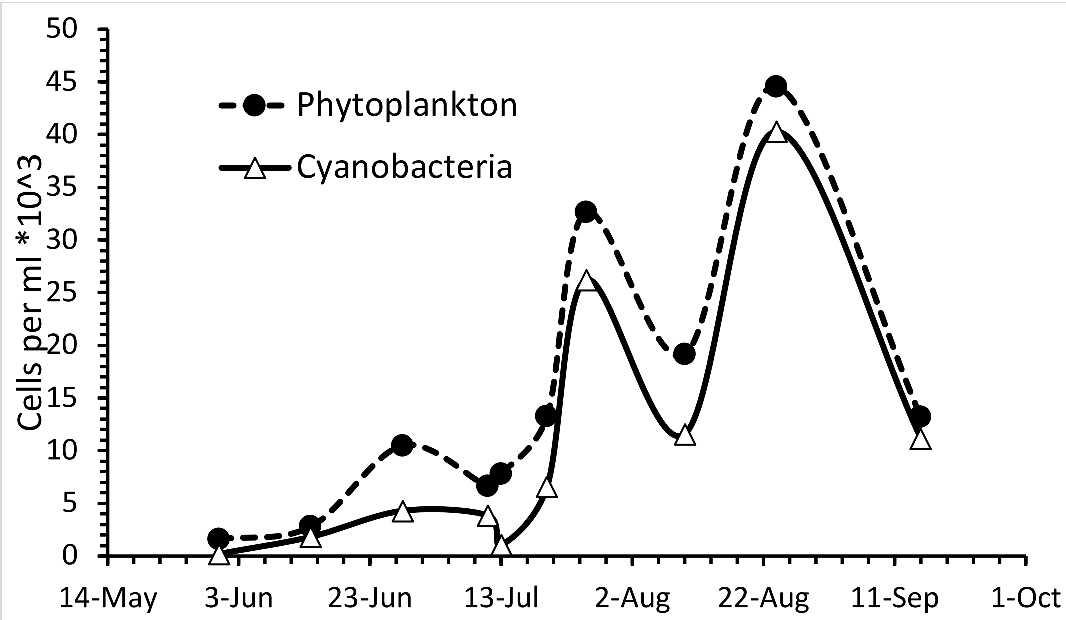

Figure 1. Seasonal abundance per mL for all phytoplankton (including cyanobacteria) and for cyanobacteria only at the surface (0-3 m) between May 31 and Sept. 15, 2022. **Picocyanoplankton cell numbers were not included in this analysis.**

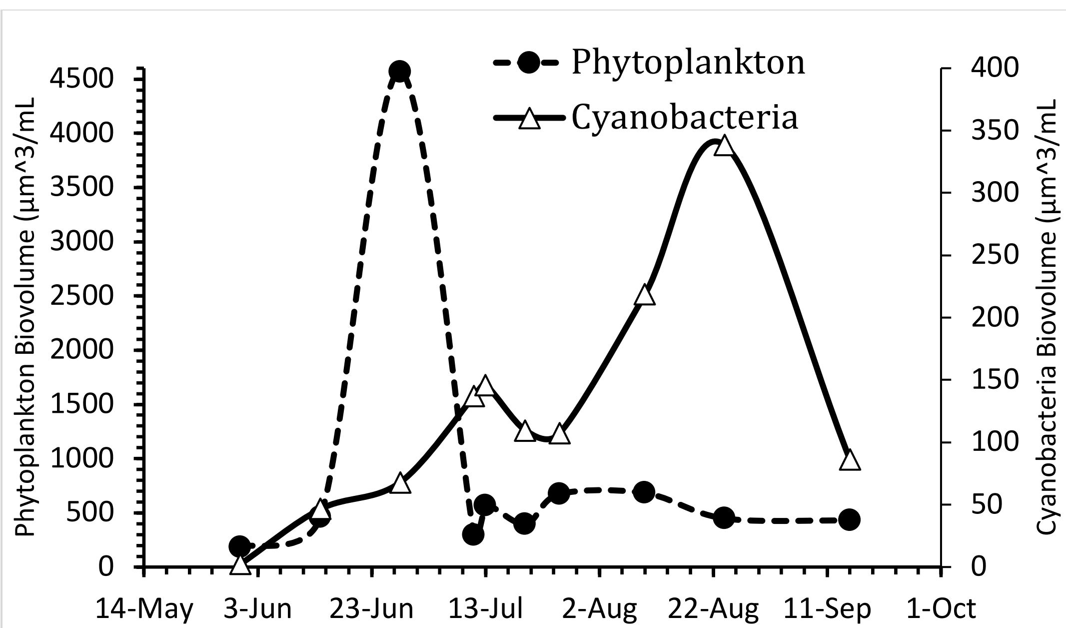

Figure 2. Seasonal pattern of biovolume concentration for all phytoplankton and for cyanobacteria at 0-3 m for 2022. Note dominance of microalgae into late June, when a massive bloom of the diatom *Fragillaria* ensued. Cyanobacteria were more prominent in mid July and into late August, when a large bloom of *Dolichospermum* species prevailed. Note the difference in the axes scales for phytoplankton and cyanobacteria.

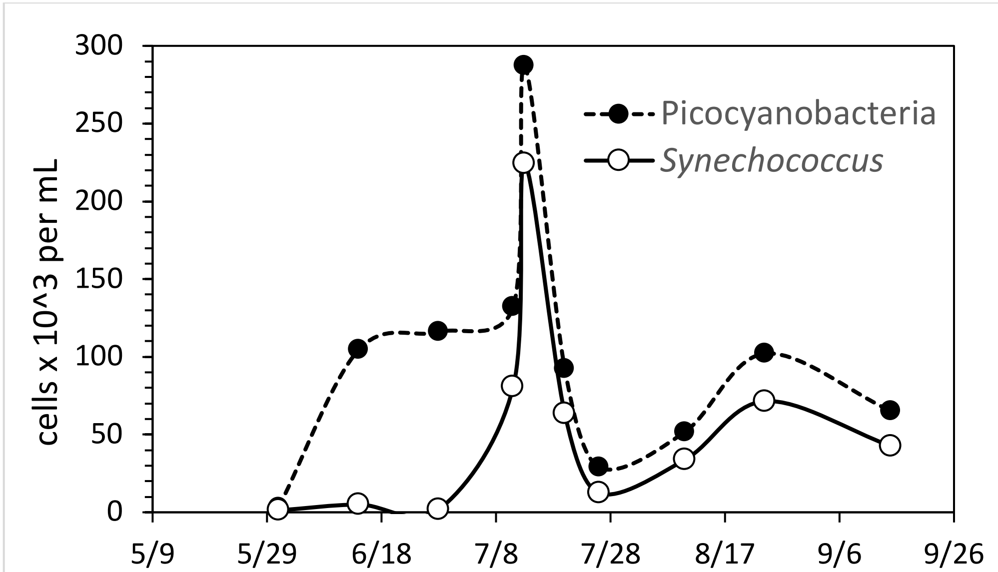

Figure 3. Seasonal patterns of abundance for all picocyanobacteria (i.e. < 2.0 um single cells) and for the genus *Synechococcus*. The trends indicate that *Synechococcus*, identified by its ovoid shape, is primarily responsible for blooms seen in July. The elevated cell numbers seen in June are associated with two other microbes both typically having spherical cells, that were identified to the genus *Aphanocaspa* and the family Chroococcaceae.

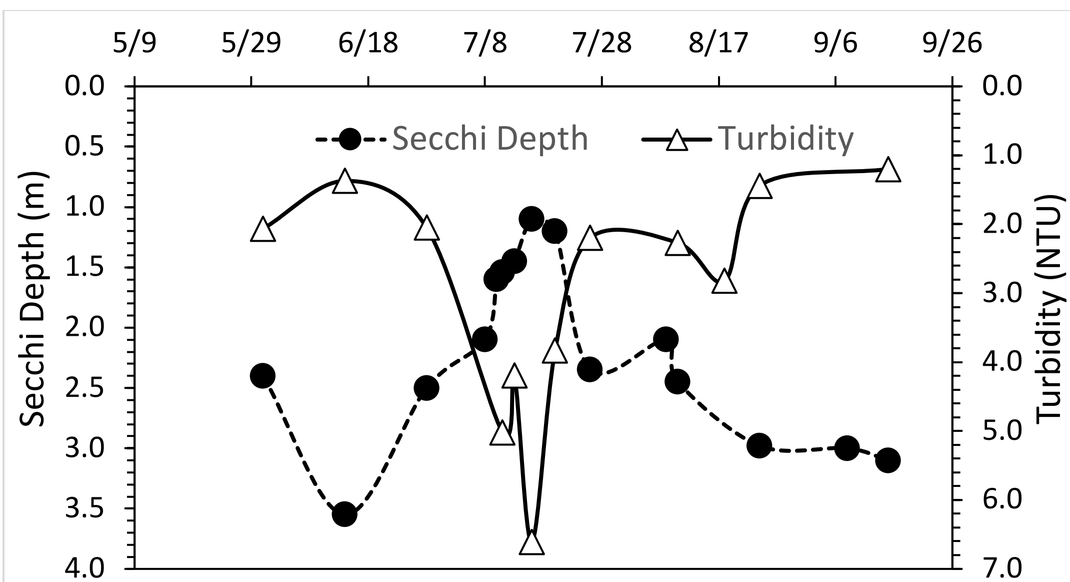

Figure 4. Plot of seasonal changes in turbidity (NTU) and secchi depths (m). Extremely shallow secchi depths and high turbidities coincided with the peak in picocyanobacteria cell numbers shown in Figure 5.

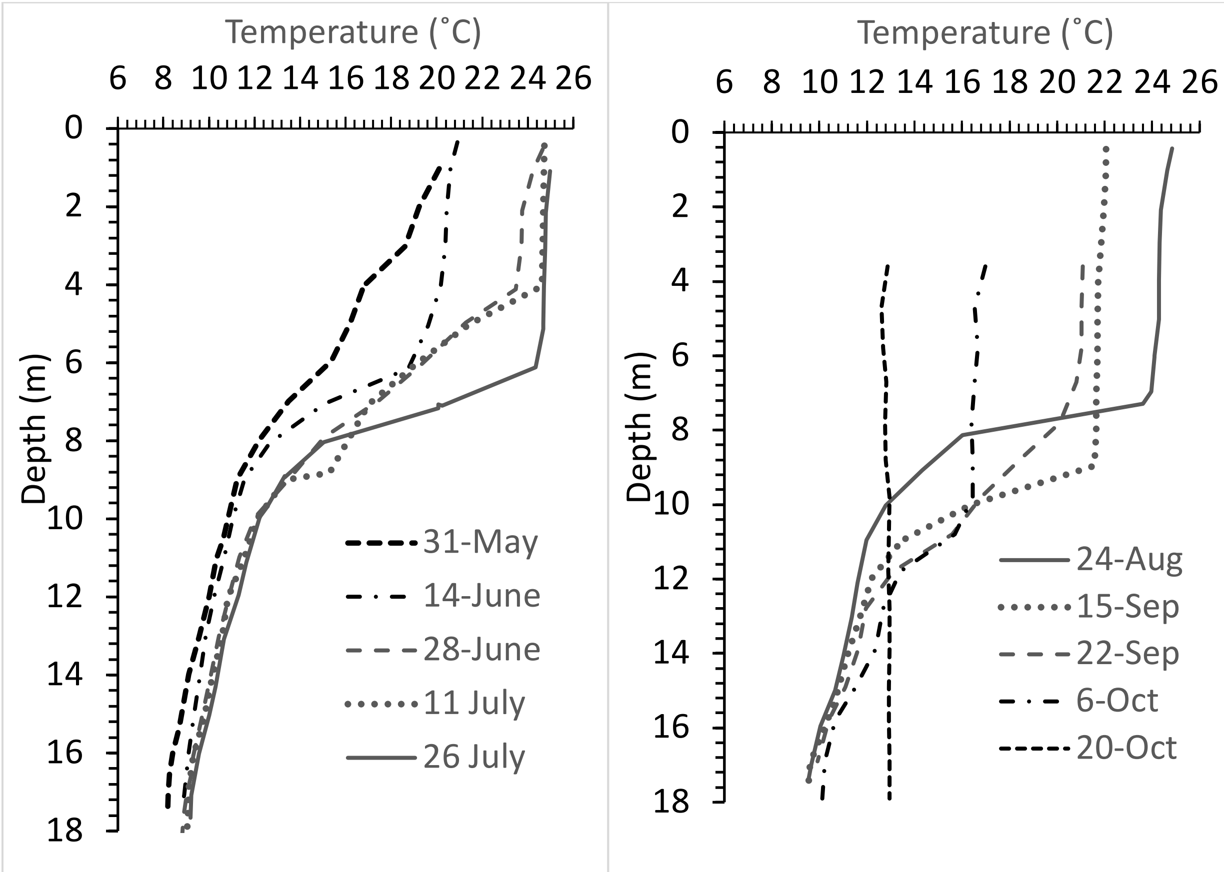

Figure 5. Temperature profiles show how the lake warms and becomes vertically stratified from May into late July (left panel). The panel on the right shows the lake cooling from late August-to October until turnover by the 20th of October. The Sept. 22, Oct. 6 and Oct. 20 data are data from an *in situ* temperature array deployed in the South Basin of Conesus Lake.

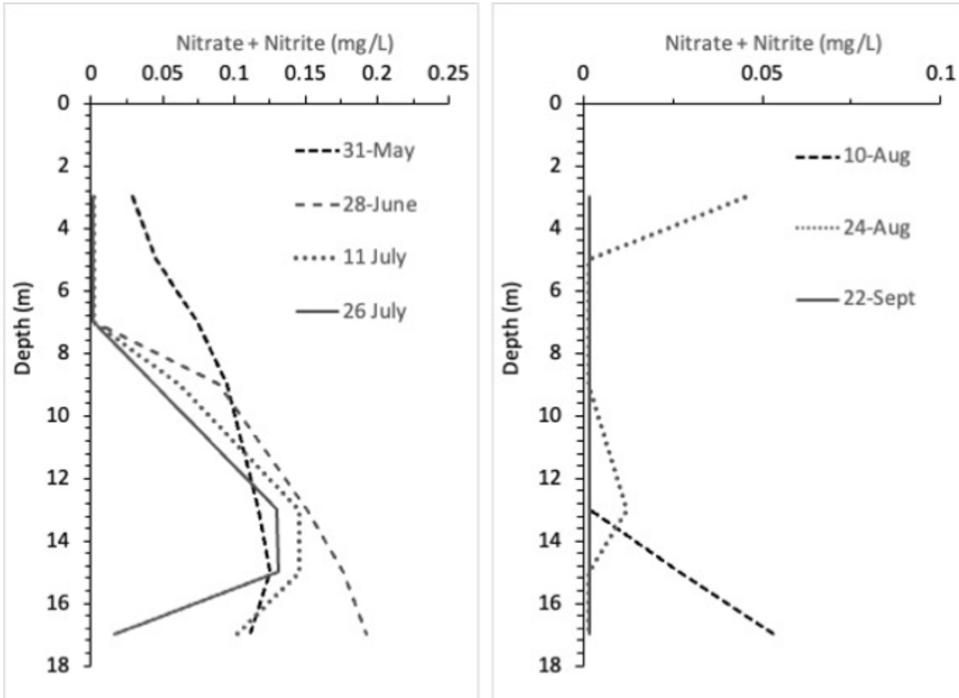

Figure 6. Vertical profiles of nitrate + nitrite from (A) 31 May to 26 July and (B) 10 August to 22 September 2022. Levels in the epilimnion from late June through July were below detection.

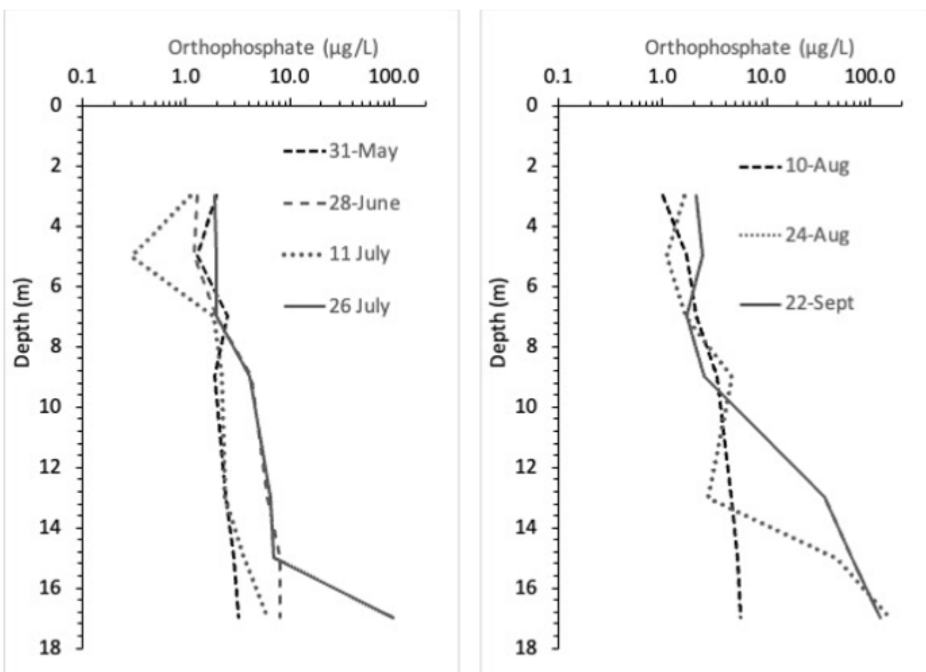

Figure 7. Vertical profiles of orthophosphate (i.e., soluble reactive phosphorus) from (A) 31 May to 26 July and (B) 10 August to 22 September 2022. The lowest epilimnion concentrations were found on June 28 to July 11.

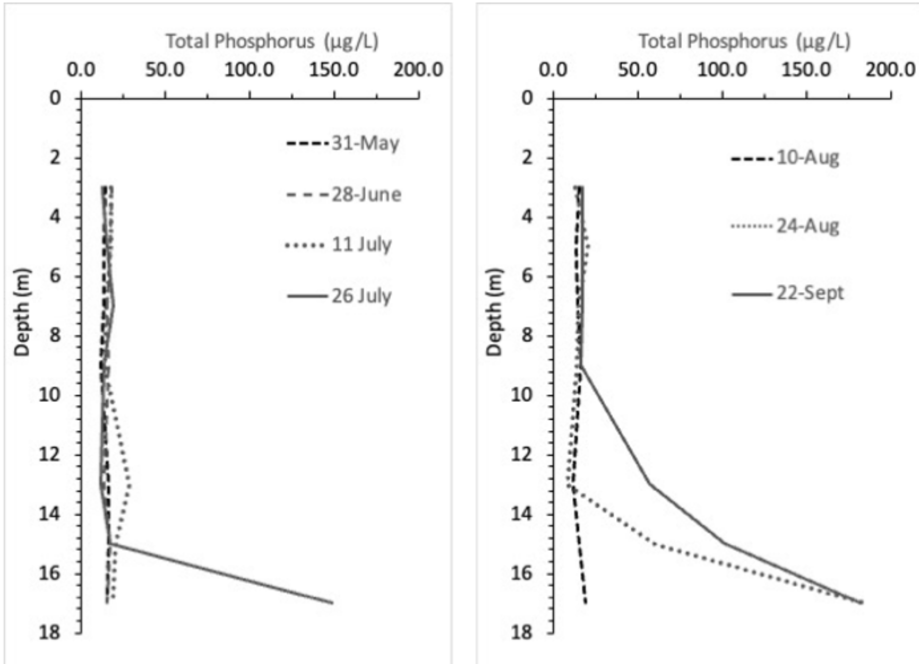

Figure 8. Vertical profiles of total phosphorus from (A) 31 May to 26 July and (B) 10 August to 22 September 2022 showing buildup in the hypolimnion.

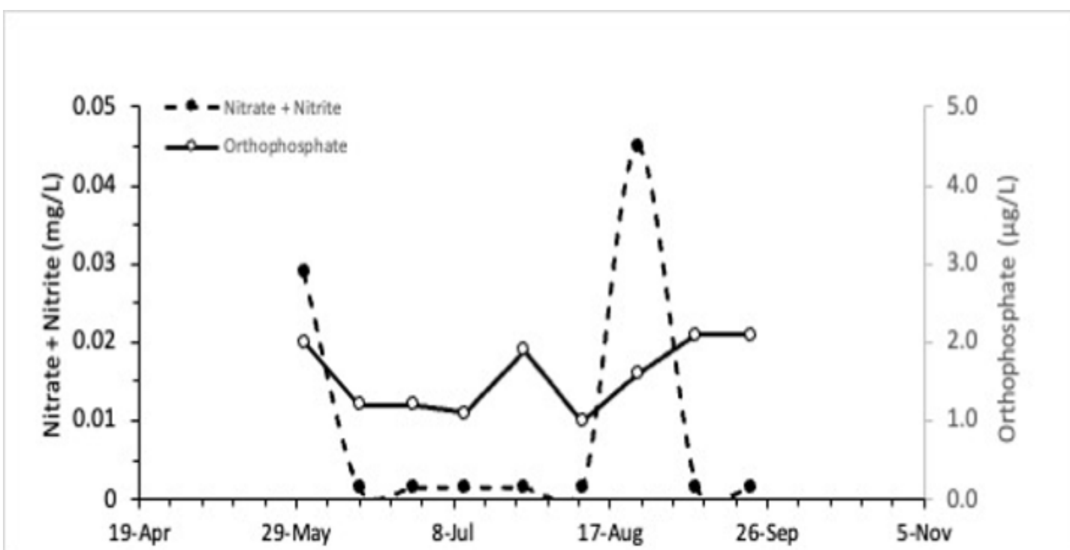

Figure 9. Changes in surface (0-3 m) nitrate + nitrite (NOx) and orthophosphate (soluble reactive phosphorus, SRP) concentrations from late spring to end of summer 2022. The concentrations of dissolved nutrients were lowest in late June into mid-July.

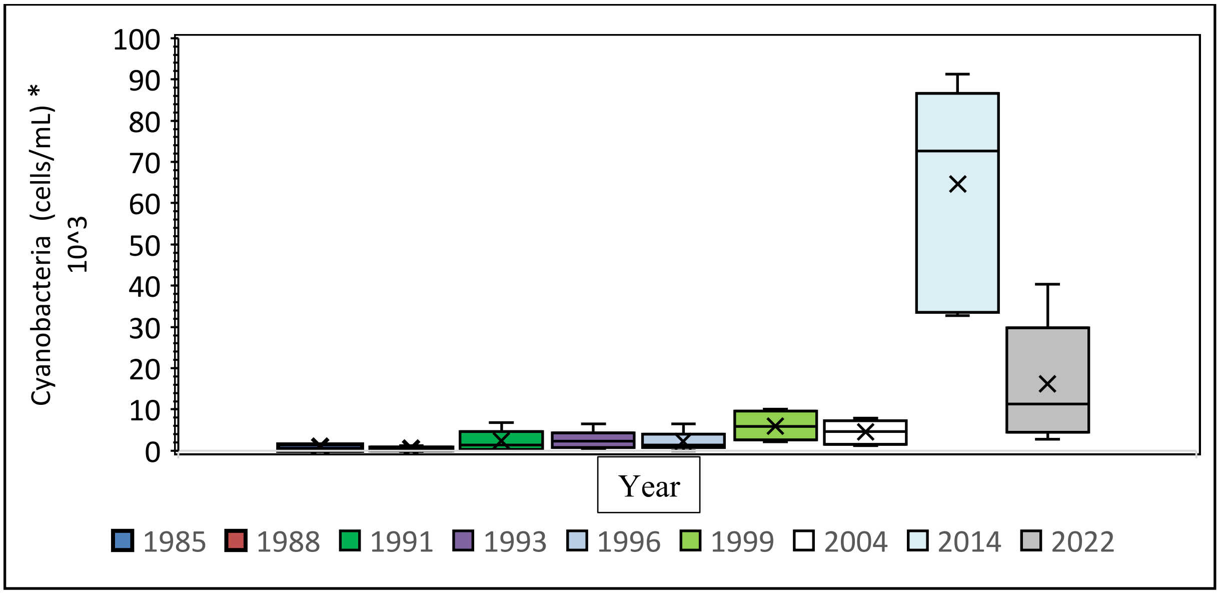

Figure 10. Long-term patterns of cyanobacteria abundance near surface waters (0-3 m) since 1985, shown as a series of box plots. All data were taken from seasonal studies in which samples were analyzed biweekly from May into October, but our analysis was based on samples in July 1-Sept. 21 time frame. The box plots show the mean (x), the median (line) the interquartile range (25% and 50% of the data) and the maximum and minimum of the distribution. Picocyanoplankton (<2.0 µm sized cells) were excluded from this anlaysis.

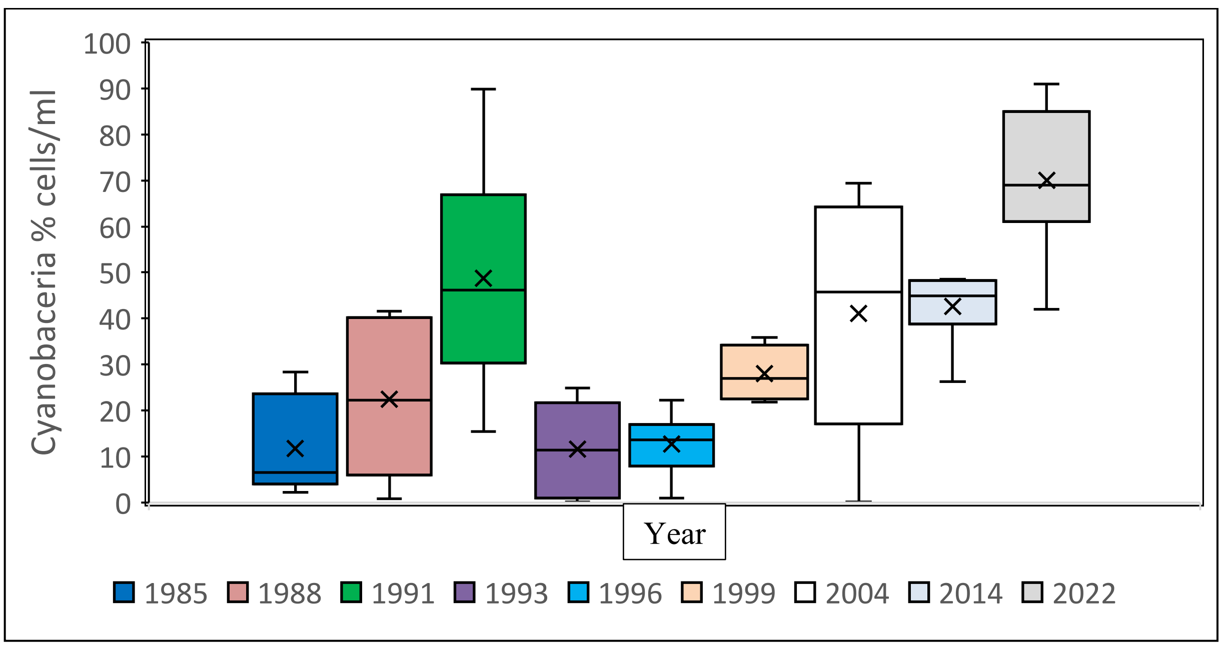

Figure 11. Box plots of the average % composition of the phytoplankton that was cyanobacteria (minus the picocyanoplankton). Cell numbers have increased steadily since 1996, with 2022 having the highest % of cells ever recorded for the July 1-Sep 21 time period.

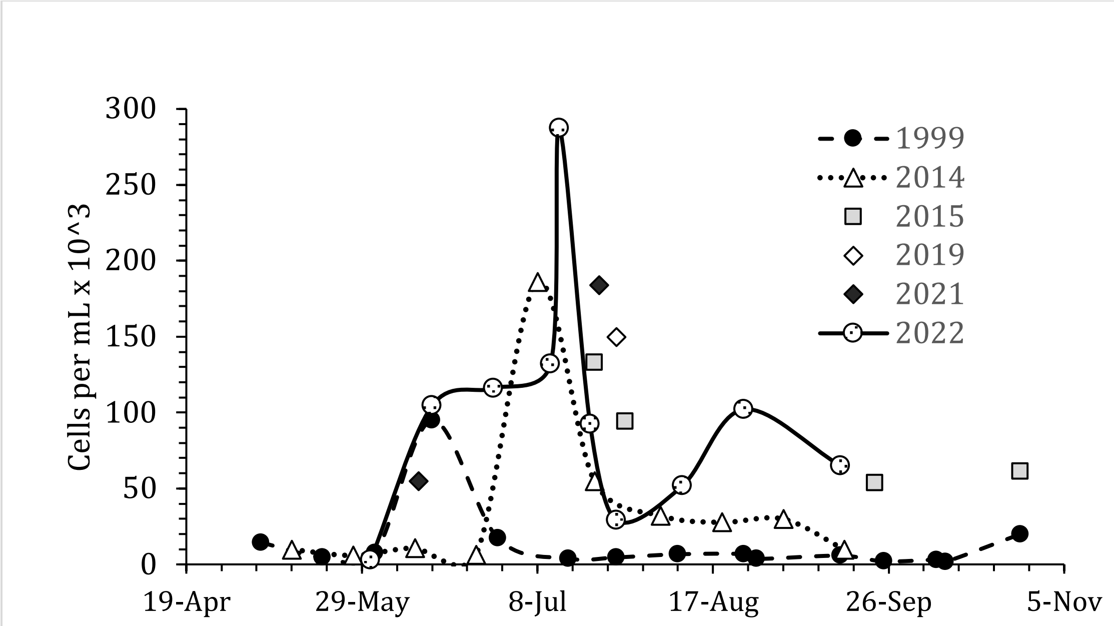

Figure 12. Long term trends in the seasonal abundance of picocyanobacteria for years when analyses were conducted by PhycoTech Inc., including 2022. Note the July peaks in various years but especially in the seasonal data for 2014 and 2022. By contrast, in 1999 the peak in cells occured in June and the cell numbers were less than half of the more recent peaks.

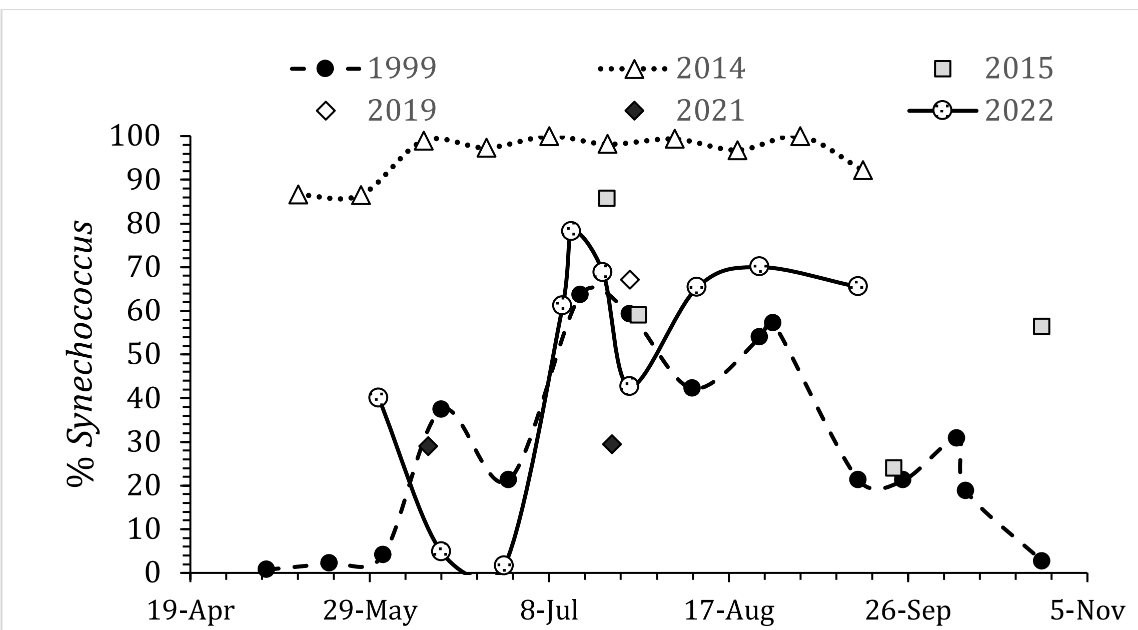

Figure 13. *Synechococcus* representation in the picocyanoplankton community since 1999. *Synechococcus* seems to have been the dominant group in the picocyanoplankton community in all 3 years and particularly during the mid July blooms.