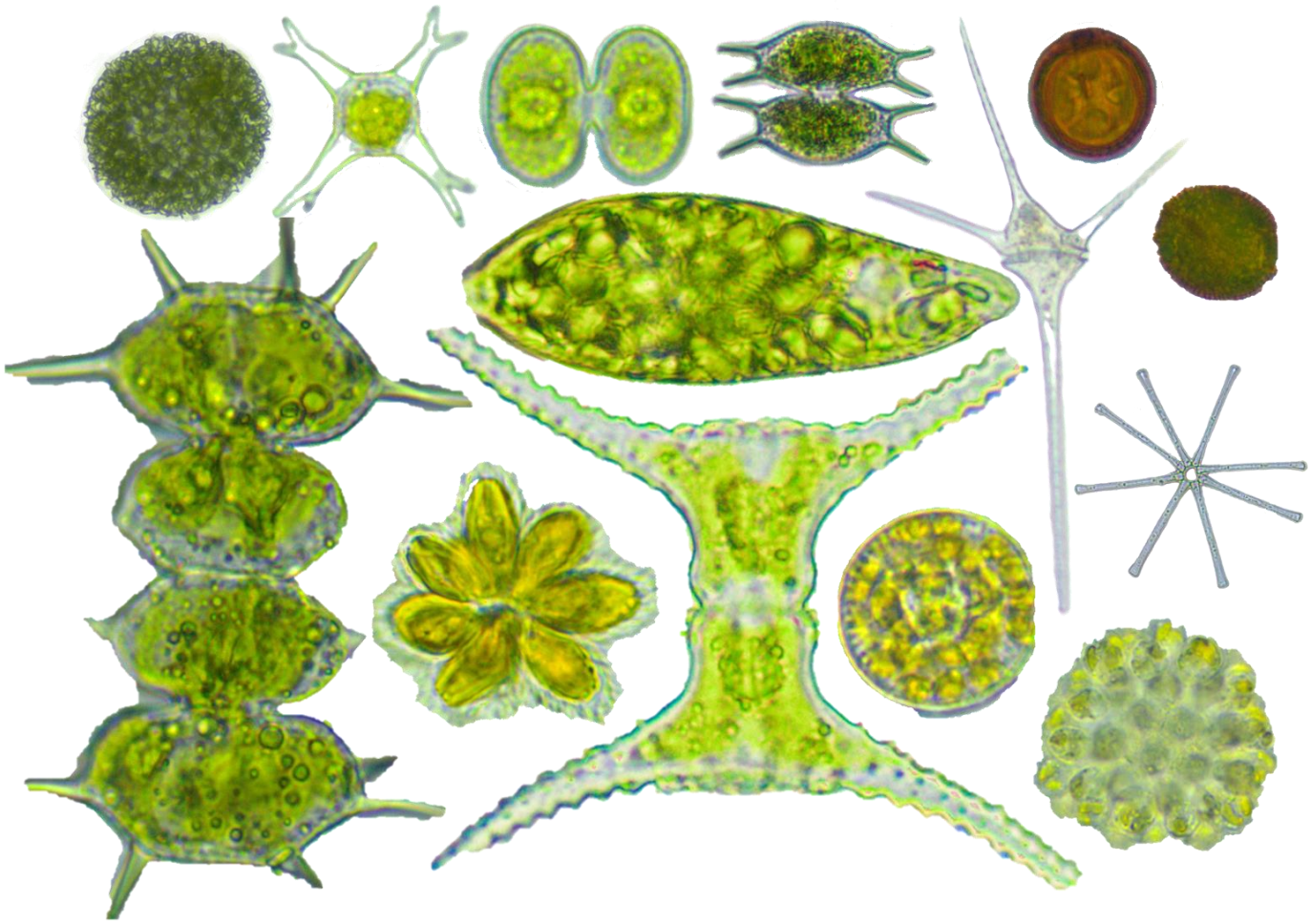
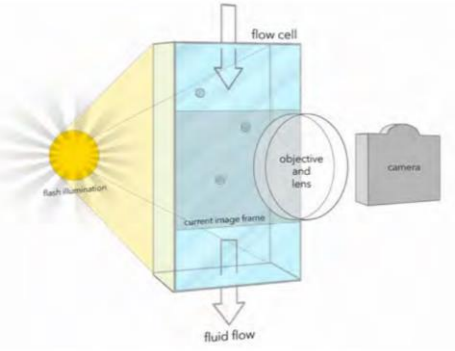


Keoka Lake Algae Monitoring Summary

Lakes Environmental Association

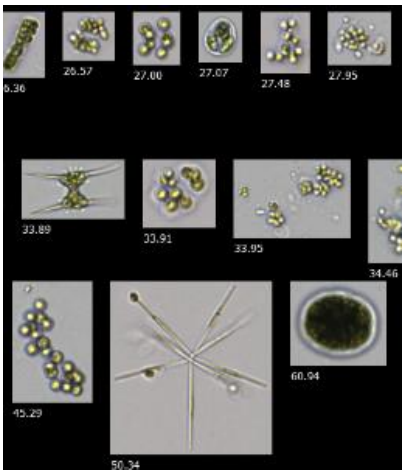
2023

Introduction to LEA's Algae Monitoring Via FlowCam Program



Above: FlowCam schematic.

LEA uses a FlowCam Cyano flow imaging microscope (FlowCam) to quantify algal community composition of water samples collected from lakes within our service area. The FlowCam system draws water samples through an optical flow cell and uses a microscope objective and high speed camera to detect, photograph, count, and measure fluorescing particles (mostly algae) ranging in diameter from 10 µm—100 µm. Occasionally, the FlowCam produces images which are not identifiable because there is not enough information in the image for accurate classification. Those images are grouped into an 'unclassified' category. Images that can be identified are sorted into groups based on taxonomic division. When possible, algal particles are identified to the genus level, which is the taxonomic level below family and above species. This tells us which kinds of algae make up the community in a sample. Particles that can be identified to genus level are further sorted into functional groupings based on potential water quality changes associated with high densities of that genus. Both community composition and functional groupings are explained in the tables on page 5 and are reported in natural units/mL.



Left: LEA's Rachel Harper collecting an algae sample with a core tube.

Center: Flow cell, objective, and syringe inside the FlowCam. Water samples enter through a small funnel at the top, travel through the flow cell where they are photographed, and exit out the bottom.

Right: Images of algae produced by the FlowCam

Guide to algal community composition	
Algal Class	What does it indicate?
Diatom	Diatoms are algae with hard, often ornate, outer shells. While some diatoms can produce taste and odor changes to waterbodies, this is uncommon at low densities.
Cyanobacteria	While not technically algae, Cyanobacteria are often monitored along with algae because some taxa occasionally produce toxins that can cause public health concerns. Those that do produce toxins may not do so all the time, and cyanotoxin production is uncommon at low densities
Cryptomonad, Euglenoid, and Dinoflagellate	In high densities these algae may cause taste and odor changes to waterbodies but this is not common at low densities. Some forms of these algae may indicate high organic content in waterbodies.
Golden and Synura	Golden and Synura algae may produce taste and odor changes to waterbodies but not always. These algae are often found in systems with good water quality.
Green	Green algae can occasionally produce taste and order issues in waterbodies when they occur in large quantities, however, this is uncommon at low densities.

Guide to algal functional groups	
Functional Group	What does it indicate?
Cyanotoxin	Algae in this category are known to produce cyanotoxins. However, the presence of these algae doesn't necessarily mean the presence of cyanotoxins.
Taste & odor	Algae in this category are known to produce taste and odor issues at high densities.
Pollution tolerant	Algae in this category are known to be tolerant to pollution.
Neutral	Algae in this category are not typically associated with water quality issues

Algal Community Composition in Keoka Lake

Integrated surface water samples were collected monthly from Keoka Lake by LEA staff and interns from May through September 2023. One sample was collected each month at the deep spot during regular water testing visits. Sample water was brought to LEA on the day it was collected, stored overnight in a refrigerator, and analyzed with the FlowCam the following day. Each sample run stopped after 500 particles were captured or 7.5 mL of sample were processed, and a minimum of two runs were done for each sample to ensure the best representation of the algal community composition in the sample. Particles less than 10 µm in diameter were excluded from analysis because they were too small to identify. Particles larger than 100 µm in diameter were excluded since we filtered samples with 100 µm Nitex mesh to prevent flow cell clogging. Also excluded from analysis were non-algal particles, images with more than one type of algal particle, and particles that were too blurry to identify.

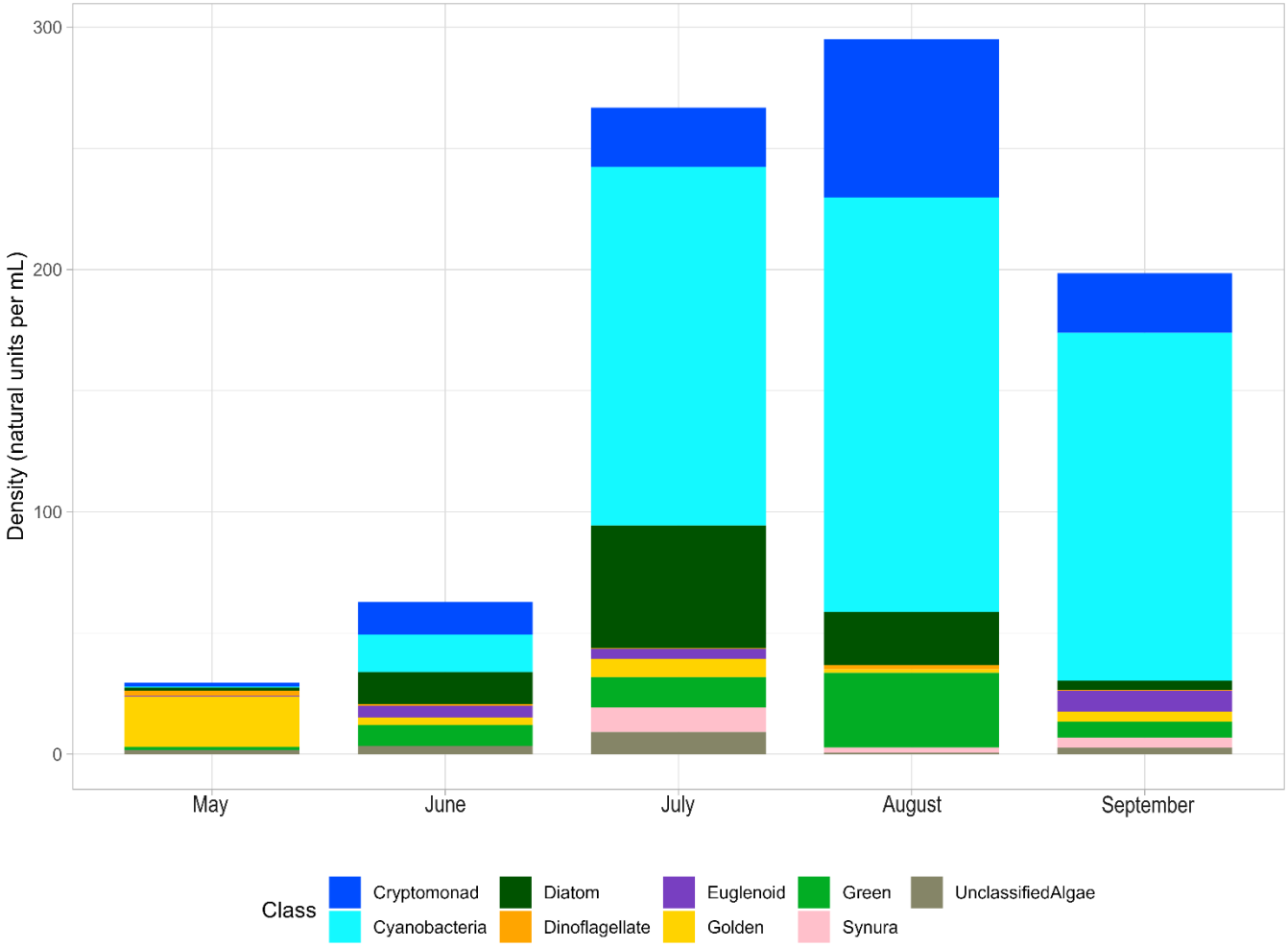


Figure 1. Keoka Lake's algal community composition. The x axis is the sampling month and the y axis is algal density (natural units/mL). Stacked bars represent the density of different algal divisions identified in each month's sample. Each division category is represented by a different color.

Measured algal and cyanobacterial densities in Keoka Lake were low and variable ranging from less than 30 per mL in May to 295 per mL in August (Figure 1). Within Keoka Lake's algal community, 8 different divisions and 38 different genera of algae were identified throughout the sampling season. In May, golden algae were the most abundant class with *Uroglena* being the most abundant genus. In June, cyanobacteria, was the most abundant class, with *Aphanothece* being the most abundant genus however, diatoms and cryptomonads were only slightly less abundant than cyanobacteria. In July, algae populations in all classes increased but cyanobacteria were most abundant, with

Aphanothece being the most abundant genus. Cyanobacteria was the most abundant class in both August and September, with *Merismopedia*, closely followed by *Cryptomonas*, being the most abundant genus in August and *Chroococcus* being the most abundant genus in September.

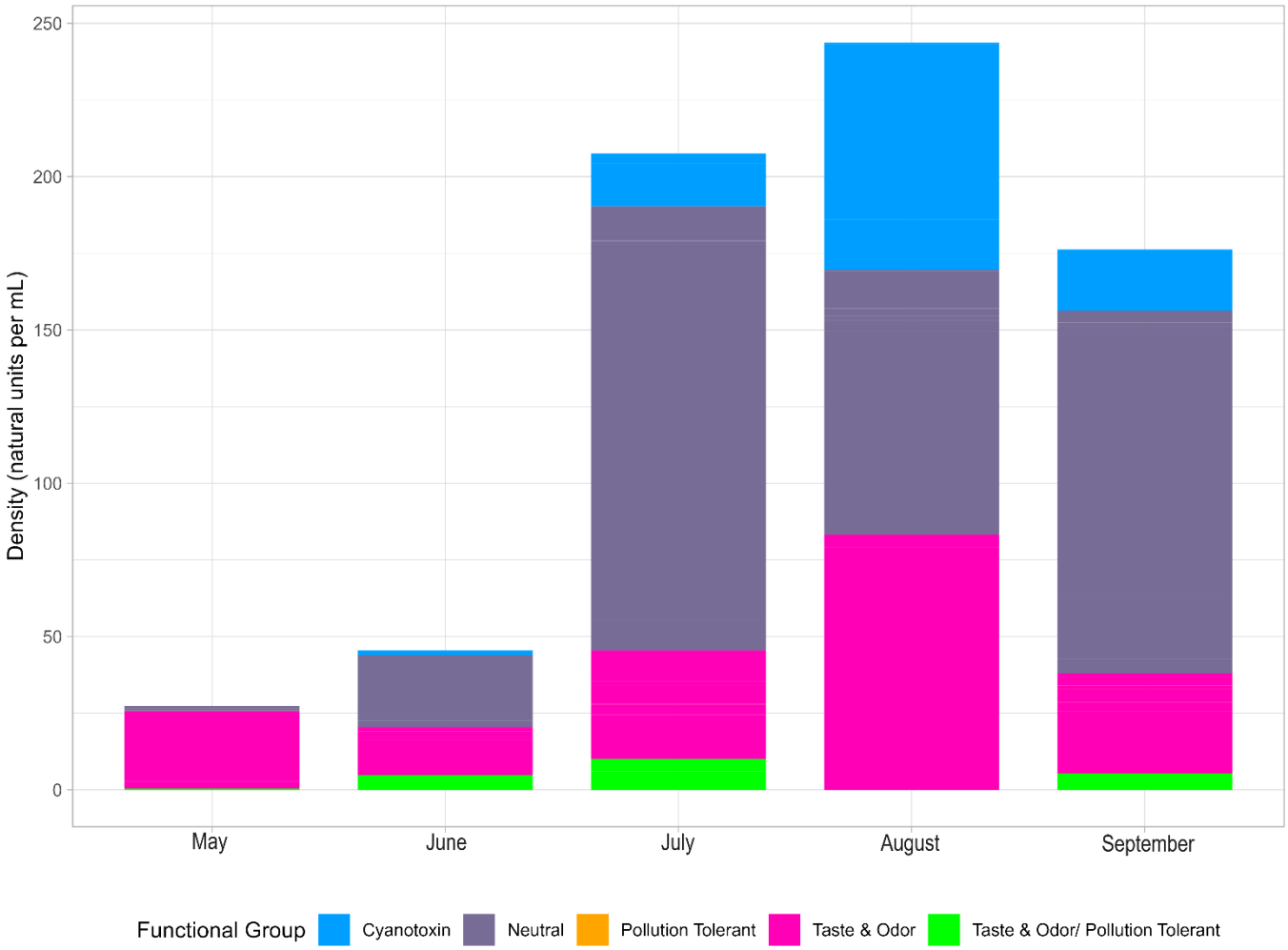
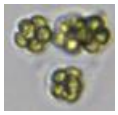
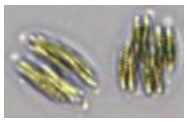
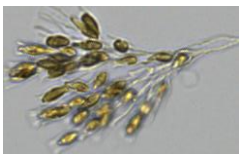
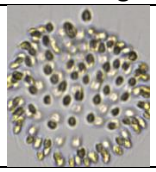


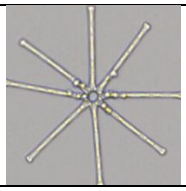
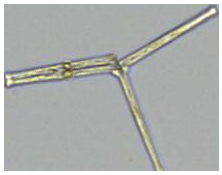
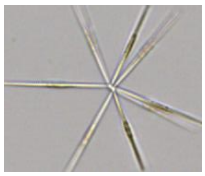
Figure 2. Keoka Lake's algal functional groups. The x axis is the sampling month and the y axis is algal density (natural units/mL). Stacked bars represent the density of different functional groups identified in each month's sample. Each functional group is represented by a different color. Genera that fit into multiple groups are represented by a separate color. Only algae identified to genus level are included in functional groupings.

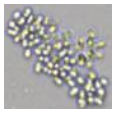
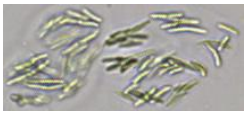
The dominant functional groups in the Keoka Lake samples were the "cyanotoxin", "neutral", and "taste & odor" groups (Figure 2). A few pollution tolerant genus, *Euglena, Cyclotella,* and *Scenedesmus,* were identified. As were multiple taste and odor producers including: *Cryptomonas, Ceratium, and, Mallomonas.* The majority of cyanobacteria identified were of the genus, *Aphanocapsa* and *Aphanothece*. *Aphanothece* do not generally produce cyanotoxins. However *Woronchinia*, *Aphanocapsa, and Merismopedia,* known toxin producers, were found in small quantities Despite finding multiple nuisance genera, none of the taxa in those groups were found at large enough densities to cause concern.

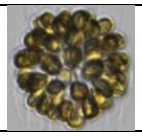
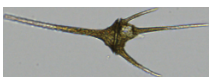
Examples of algae found in Keoka Lake

Green algae			
			
genus *Sphaerocystis*; neutral	genus *Elakatothrix*; neutral	genus *Oocystis*; neutral	genus *Quadrigula*; neutral

Golden Algae			Cryptomonads
			
genus *Dinobryon*; taste and odor producer	genus *Uroglena*; taste and odor producer	genus *Paraphysomonas*; neutral	genus *Cryptomonas*; taste and odor producer

Diatoms			Euglenoids
			
genus *Asterionella*; taste and odor producer	genus *Tabellaria*; taste and odor producer	genus *Fragilaria*; neutral	genus *Euglena*; taste and odor producer, pollution tolerant

Cyanobacteria			
			
genus *Aphanocapsa*; cyanotoxin producer	genus *Aphanothece*; neutral	genus *Chroococcus*; neutral	genus *Rhabdoderma*; neutral

Synura		Dinoflagellate	
			
genus *Mallomonas*; taste and odor producer	genus *Synura*; taste and odor producer	genus *Cystodinium*; neutral	genus *Ceratium*; taste and odor producer

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Thank you for supporting our work