Quiniscoe Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Quiniscoe Lake during 2021 and 2022 (Figure 1; Table 1). Algae were identified to the taxonomic level of species and grouped into broad alga types for analysis.

Table 1: Sample sites and dates sampled in 2021 and 2022

Sample Site (EMS#)	Dates
QUINISCOE LK @ DEEPEST POINT(E316772)	2021-06-28
	2021-09-09
	2022-06-29
	2022-09-12
	Total= 4 samples

Figure 1: Aerial view of Quiniscoe Lake

Samples contained low concentrations of diatoms. Small green algae blooms occurred in both September samples. June samples contained elevated concentrations of flagellates and detritus (Figure 2).

Elevated quantities of suspended debris can affect the health and aesthetics of a water system. Particulates in the water column can cause turbidity and provide adhesive for pollutants including metals and bacteria (Water Science School et al., 2018). Turbidity spikes, from debris, during the spring are common due to elevated wind, rain, erosion, and runoff events (Card et al., 2014). Suspended materials can include clay, silt, organic and inorganic matter, algae, dissolved color compounds, and bacteria (Card et al., 2014).

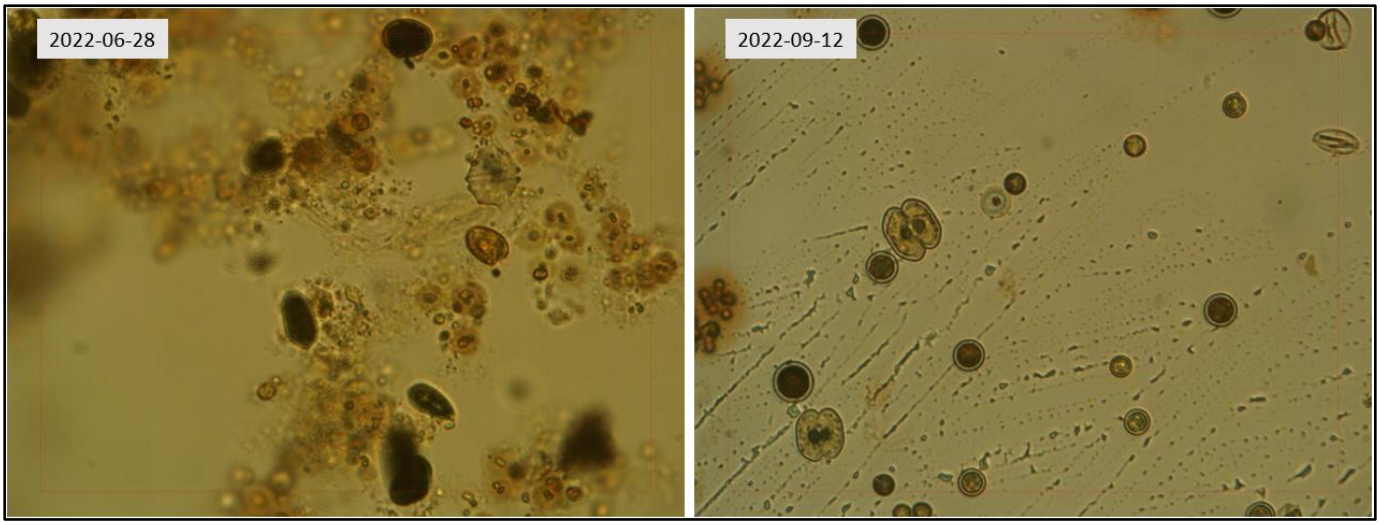

Figure 2: 400x magnification of the Spring 2022 sample with high concentrations of detritus and flagellates (left) vs the summer 2022 sample with a small bloom of green algae (right)

Overview (continued)

Quiniscoe Lake biovolumes were dominated by green algae *Asterococcus limneticus* and *Eremosphaera viridis* (Figure 3). Dinoflagellate *Peridinium cf. bipes* were also frequently enumerated.

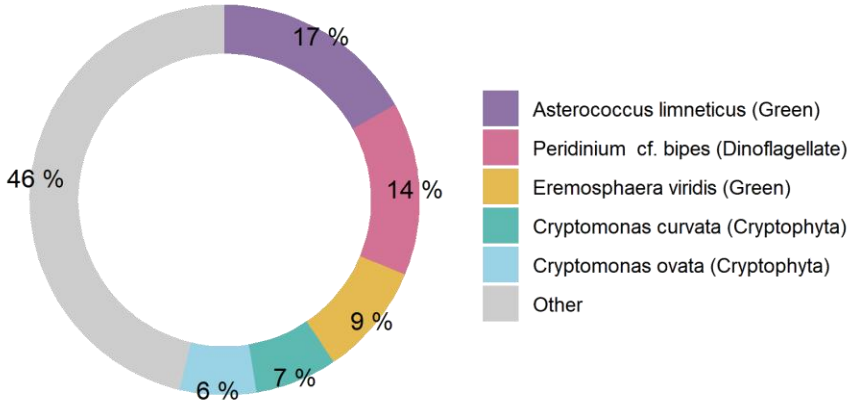

Figure 3: Dominant organisms from Quiniscoe Lake (EMS E316772) as percent of total biovolume

EMS site E316772 contained elevated levels of *Asterococcus limneticus* on 2021-09-12 *(*Figure 4). Some *Asterococcus* species have been studied for their absorption abilities, specifically their ability to absorb heavy metals including copper, zinc, cadmium, and lead (Areco et al., 2021).

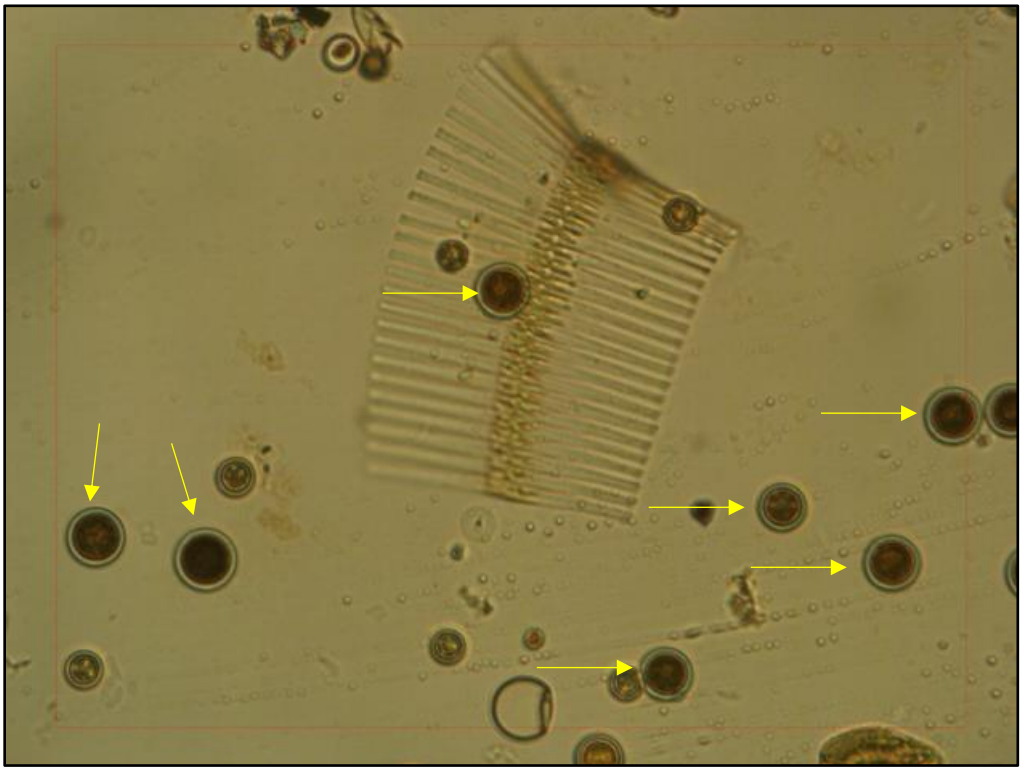

Figure 4: 400x magnification of EMS site E316772 demonstrating Asterococcus bloom in 2022-09-12 sample

Algae – why should we care?

Algae blooms are becoming more frequent and severe worldwide due to excessive nutrient loading and warming summer lake temperatures. Diatom blooms can cause filter clogging, and odor issues.

Intense cyanobacteria blooms can threaten human safety and aquatic health through their toxicity. Illness related to cyanotoxins can include: liver, kidney, and nerve cell damage, cancer, skin and gut irritation, and neurological issues. Cyanotoxins, including microcystins, are now known to accumulate in the food chain (Lance et al. 2014). Fish from lakes with heavy cyanobacteria blooms can have higher toxin concentrations than the lake water (Greer et al. 2021) and consuming them can increase the risk of liver disease (Zhao et al., 2020).

Cyanobacterial Presence

Cyanobacteria concentrations were low except for the sample collected on 2022-06-29. *Gloeocapsa* species dominated cyanobacteria cell counts on 2022-06-29 (Figure 5).

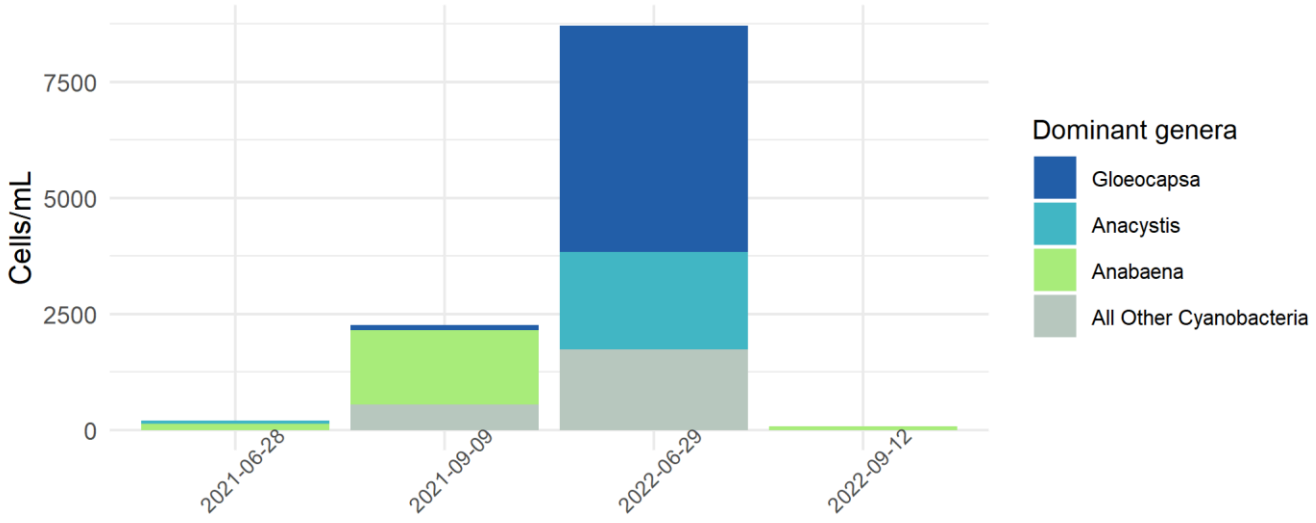

Figure 5: Cell abundance for dominant cyanobacteria genera on Quiniscoe Lake

During blooms, species of *Anabaena* can produce both negative odor/taste compounds and toxic secondary metabolites. *Anabaena* blooms can quickly accumulate, develop odor metabolites, and color water systems (EPA, 2022).

Other dominant cyanobacteria identified in the summer samples are also associated with several cyanotoxins that represent risks to public health (Table 2). Illness related to cyanotoxins can include: liver, kidney, and nerve cell damage, cancer, skin and gut irritation, and neurological issues (Lance et al., 2014). *Gloeocapsa* species are not known to produce toxins.

Table 2: Dominant genera of cyanobacteria on Quiniscoe Lake and their associated toxins

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Gloeocapsa	4872 cells/mL	No toxins identified
Anacystis	2110 cells/mL	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Anabaena	1412 cells/mL	Lyngbyatoxin LYN, Apoptogen Toxin (ApopTX), Lipopolysaccharide LPS, Cylindospermopsin CYN, Microcystin MC, Anatoxins (-a) ATX, Saxitoxins SAX neosaxitoxin NEO, NA, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT, Taste and Odor

Note: * = counted in samples

Cyanobacterial Presence (Continued)

Dominant species of cyanobacteria identified in Quiniscoe Lake can produce cyanotoxins (Table 2).

Quiniscoe Lake contained cyanobacteria concentrations in the negligible to low-risk category, with a mean cyanobacteria abundance of 2,812 cells/mL. (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Quiniscoe Lake as compared to alert levels defined by several authorities including the WHO and EPA.

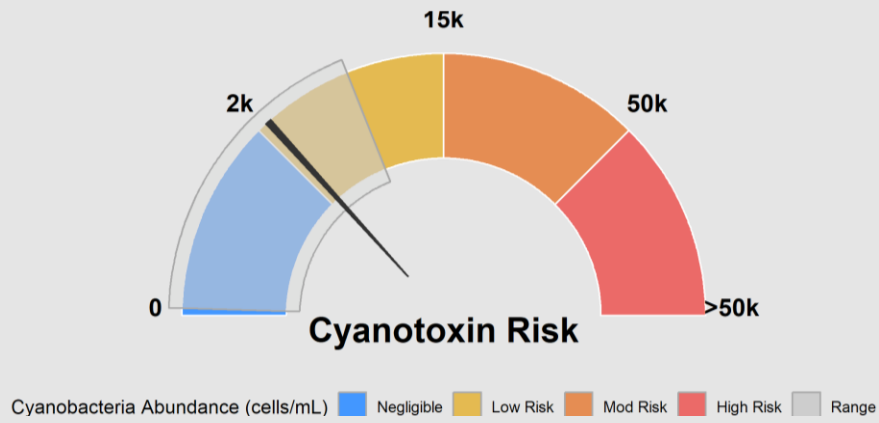

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms on Quiniscoe Lake

Cyanobacteria frequently dominate algal communities in total cell count, but because of their small cell size their biovolume is usually low relative to the other types of algae present. This is highlighted in Figure 7 where four Desmid cells dwarf four adjacent cyanobacteria cells.

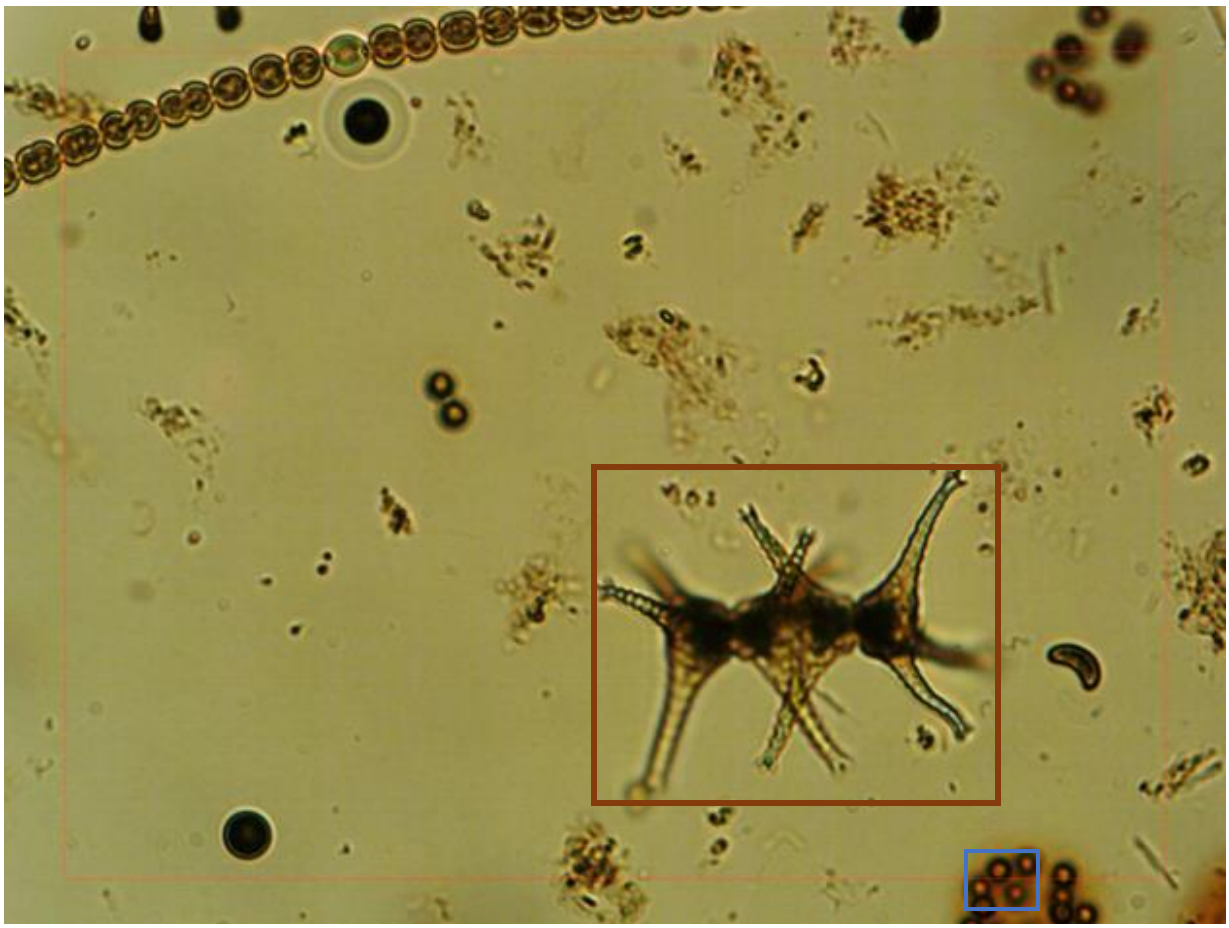

Figure 7: Size comparison of Desmid cells (brown box) vs cyanobacteria cells (blue box)

Species Composition

Algae samples were identified to the genus level and grouped into broad alga types for analysis. The figures below display total cell counts for each broad algae group alongside their biovolume. The difference between Figure 8 (cell abundance) and Figure 9 (biovolume) illuminates the difference between cell abundance and biovolume.

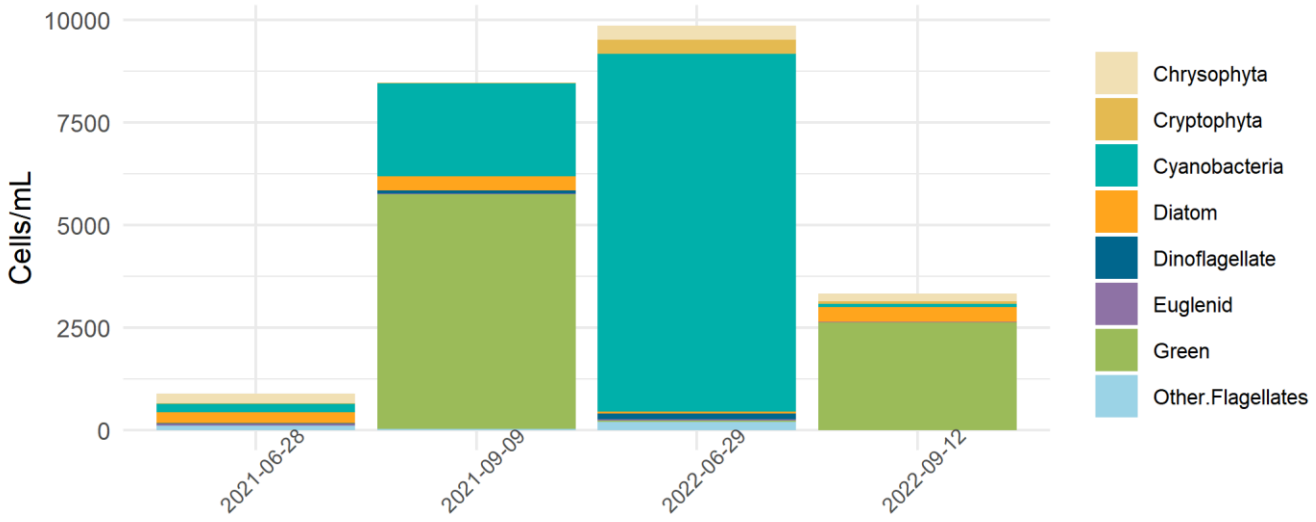

Figure 8: Cell abundance of high-level taxa groups on Quiniscoe Lake

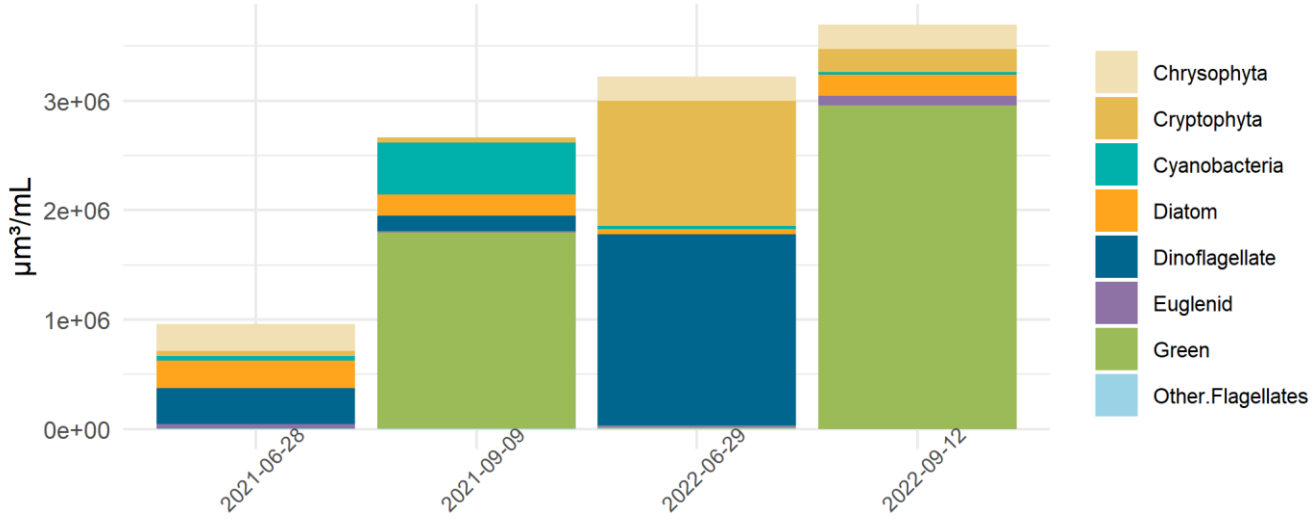

Figure 9: Biovolume of high-level taxa groups on Quiniscoe Lake

References

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Card, A., Fitch, K., Kelly, D., Kemker, C., & Rose, K. (2014, June 13). *Turbidity, Total Suspended Solids & Water Clarity*. FONDRIEST.

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Lance, E., Petit, A., Sanchez, W., Paty, C., Gérard, C., & Bormans, M. (2014). Evidence of trophic transfer of microcystins from the gastropod Lymnaea stagnalis to the fish Gasterosteus aculeatus. *Harmful Algae*, *31*, 9–17. https://doi.org/10.1016/J.HAL.2013.09.006

Water Science School, Swanson, H. A., & Baldwin, H. L. (2018, June 18). *Turbidity and Water* . USGS.

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Appendix

Additional figures and raw data are listed below:

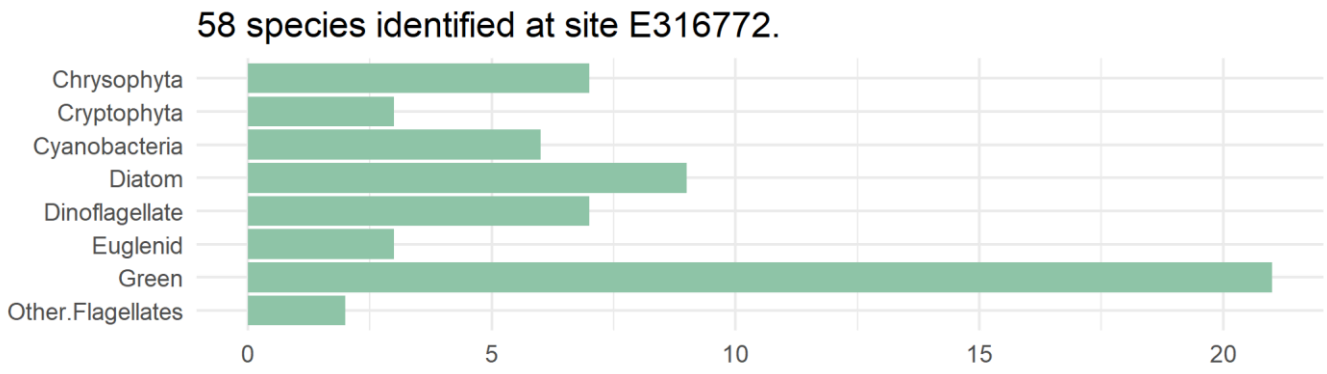

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: E316772	**Total Abundance (cells/mL):**	**883**	
Collection Date: 2021-06-28	Total Biovolume (µm³/mL):	955997	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon bavaricum	49	106650	Chrysophyta
Dinobryon divergens	42	36202	Chrysophyta
Dinobryon sertularia	49	60251	Chrysophyta
Ochromonas sp.	11	2355	Chrysophyta
Chroomonas acuta	11	5942	Chrysophyta
Chrysococcus sp.	57	18925	Chrysophyta
Chromulina sp.	8	14137	Chrysophyta
Cryptomonas erosa	4	7087	Cryptophyta
Cryptomonas ovata	19	41342	Cryptophyta
Anabaena affinis	133	38118	Cyanobacteria
Anacystis cyanea	68	102	Cyanobacteria
Achnanthidium cf. microcephalum	4	594	Diatom
Asterionella formosa	243	169206	Diatom
Fragilariforma sp.	15	81675	Diatom
Peridinium cf. bipes	8	143793	Dinoflagellate
Peridinium inconspicuum	4	7326	Dinoflagellate
Peridinium cf. willei	11	180021	Dinoflagellate
Trachelomonas volvocina	30	23890	Euglenid
Trachelomonas planctonica	11	14171	Euglenid
Oocystis parva	11	2473	Green
nanoflagellates	53	1596	Other.Flagellates
picoflagellates	42	141	Other.Flagellates

Figure 11: Raw data from 2021-06-28 EMS site E316772

EMS ID: E316772	**Total Abundance (cells/mL):**	**8470**	
Collection Date: 2021-09-09	Total Biovolume (µm³/mL):	2661187	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Cryptomonas erosa	8	14175	Cryptophyta
Cryptomonas ovata	15	32638	Cryptophyta
Anabaena planctonica	197	67248	Cyanobacteria
Anabaena affinis	1412	404677	Cyanobacteria
Gloeocapsa fuscolutea	106	444	Cyanobacteria
Aphanothece sp.	546	1741	Cyanobacteria
Epithemia cf. turgida	8	26389	Diatom
Fragilaria crotonensis	342	166061	Diatom
Pandorina morum	61	19615	Dinoflagellate
Peridinium sp. Large	8	117496	Dinoflagellate
Trachelomonas volvocina	8	6371	Euglenid
Trachelomonas planctonica	8	10306	Euglenid
Cosmarium depressum	30	17513	Green
Gloeocystis gigas	668	349764	Green
Gloeocystis planctonica	3521	341834	Green
Gloeocystis vesiculosa	220	64682	Green
Nephrocytium limneticum	205	70622	Green
Oocystis borgei	106	67151	Green
Oocystis lacustris	68	33638	Green
Oocystis solitaria	38	8755	Green
Oocystis parva	30	6744	Green
Scenedesmus bijuga	30	3271	Green
Sphaerocystis schroeteri	455	98444	Green
Spondylosium planum	106	49618	Green
Staurastrum planctonicum	23	361283	Green
Staurodesmus cf. cuspidatus	8	67152	Green
Asterococcus limneticus	220	253076	Green
nanoflagellates	15	452	Other.Flagellates
picoflagellates	8	27	Other.Flagellates

Figure 12: Raw data from 2021-09-09 EMS site E316772

EMS ID: E316772	Total Abundance (cells/mL):	9857		
Collection Date: 2022-06-29	Total Biovolume (µm³/mL):	3219804		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon sertularia	53	65170	Chrysophyta	1515
Ochromonas sp.	114	24404	Chrysophyta	1455
Chrysococcus sp.	121	40175	Chrysophyta	1751
Chromulina sp.	53	93659	Chrysophyta	1717
Cryptomonas erosa	15	26578	Cryptophyta	10635
Cryptomonas ovata	250	543970	Cryptophyta	10635
Cryptomonas curvata	91	573295	Cryptophyta	10635
Gloeocapsa fuscolutea	4872	20408	Cyanobacteria	682
Anacystis cyanea	2110	3176	Cyanobacteria	609
Aphanocapsa sp.	1730	5465	Cyanobacteria	625
Achnanthidium cf. microcephalum	15	2845	Diatom	590864
Diatoma sp.	23	27957	Diatom	3214
Gomphonema sp.	8	11017	Diatom	4911
Nitzschia sp.	8	734	Diatom	5070
UID dinoflagellate cyst	8	1177	Dinoflagellate	
Gymnodinium cf. ordinatum	30	118581	Dinoflagellate	10031
Peridinium cf. bipes	76	1366036	Dinoflagellate	10212
Peridinium inconspicuum	8	14652	Dinoflagellate	10212
Peridinium cf. willei	15	245483	Dinoflagellate	10212
Trachelomonas volvocina	23	18316	Euglenid	9690
Chlamydomonadales	30	4314	Green	
Monoraphidium indicum	15	9938	Green	5990
nanoflagellates	68	2048	Other.Flagellates	
picoflagellates	121	406	Other.Flagellates	

Figure 13: Raw data from 2022-06-29 EMS site E316772

EMS ID: E316772	Total Abundance (cells/mL):	3317		
Collection Date: 2022-09-12	Total Biovolume (µm³/mL):	3695271		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon sertularia	182	223790	Chrysophyta	1515
Ochromonas sp.	8	1713	Chrysophyta	1455
Cryptomonas erosa	8	14175	Cryptophyta	10635
Cryptomonas ovata	23	50045	Cryptophyta	10635
Cryptomonas curvata	23	144899	Cryptophyta	10635
Anabaena planctonica	76	25943	Cyanobacteria	1100
Asterionella formosa	68	47350	Diatom	3116
Fragilaria crotonensis	281	136442	Diatom	2932
Nitzschia cf. linearis	15	5922	Diatom	5070
Trachelomonas obtusa	8	87114	Euglenid	9690
Eremosphaera viridis	15	981748	Green	5984
Coelastrum cf. reticulatum	121	26728	Green	6273
Cosmarium abbreviatum	46	44078	Green	7848
Cosmarium depressum	38	22183	Green	7848
Gloeocystis gigas	319	167028	Green	6355
Gloeocystis planctonica	243	23591	Green	6355
Gloeocystis vesiculosa	30	8820	Green	6355
Nephrocytium limneticum	197	67866	Green	5964
Oocystis borgei	38	24073	Green	5827
Oocystis lacustris	15	7420	Green	5827
Oocystis solitaria	83	19122	Green	5827
Oocystis parva	61	13713	Green	5827
Oocystis solitaria var. major	53	15626	Green	5827
Sphaerocystis schroeteri	38	8222	Green	9169
Asterococcus limneticus	1328	1527660	Green	9178

Figure 14: Raw data from 2022-09-12 EMS site E316772