Lizard Lake Phytoplankton Summary Report 2021-2022

Overview

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

Table 1: Sample sites and dates sampled in 2022

Sample Site (EMS#)	Dates
LIZARD LAKE DEEPEST POINT (E206283)	2021-03-03
	2021-08-26
	2022-03-02
	2022-08-16
	Total= 4 samples

Figure 1: Aerial view of Lizard Lake

Typical seasonal patterns were observed in Lizard Lake; diatom densities increased in the spring and cyanobacteria concentrations increased in the summer (Figure 2).

Spring blooms of diatoms are common and reflective of increased temperatures, light penetration, and silica in the water following ice thaw (Kong et al., 2021). Diatoms increase the resiliency and health of water systems through their ability to reduce nutrient concentrations by blooming early in the spring and prevent monoculture blooms of less desirable algae (jrobyn, 2019).

Diatoms are integral to aquatic food webs because they are the foundation of the web (jrobyn, 2019). Colony forming diatoms such as *Aulacoseira italica* and *Asterionella formosa* can avoid grazing pressures by developing into large colonies, reducing their availability for zooplankton and microscopic invertebrates (Baker, 2012).

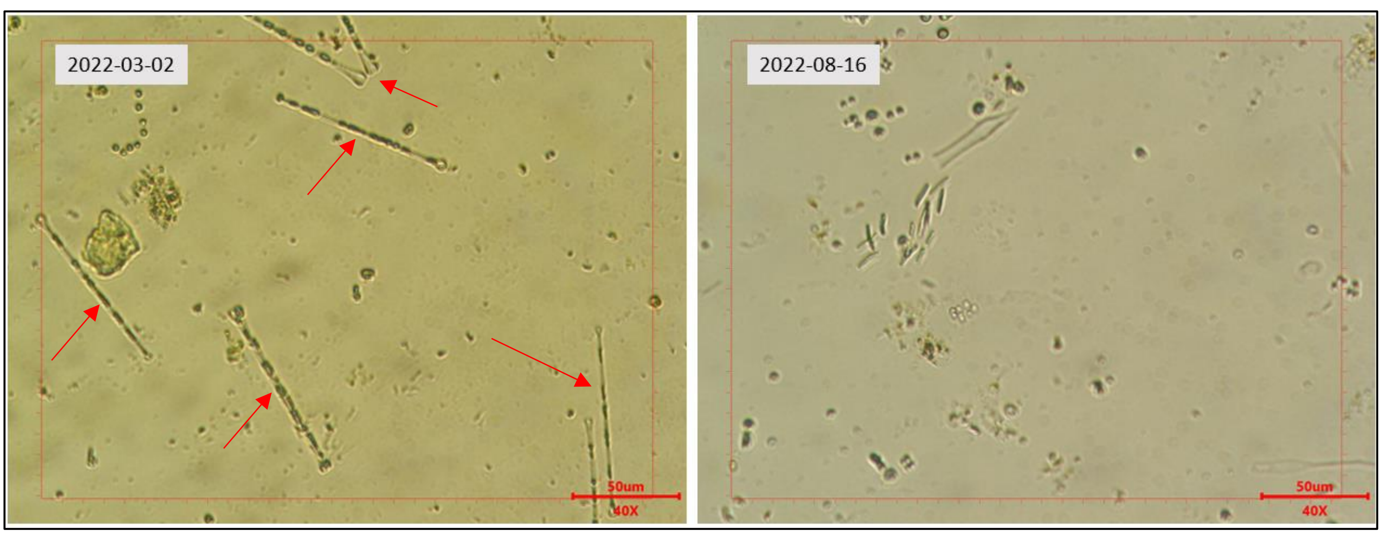

Figure 2: Compositional change from spring with high concentrations of diatoms (left) to summer with high concentrations of cyanobacteria (right)

Overview (continued)

Small quantities of the dinoflagellate *Ceratium hirundinella* were identified in Lizard Lake. Despite low numbers, this dinoflagellate represented 69% of total biovolume. *Ceratium's* large size relative to other algae contributes to it's large biovolume percentage (69%; Figure 3).

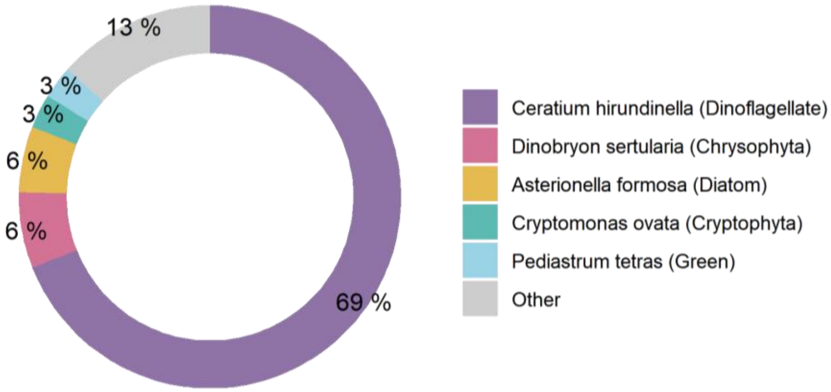

Figure 3: Dominant organisms Lizard Lake Deepest Point as percent of total biovolume

One sample contained elevated densities of Chromalinales (genus *Dinobryon;* Figure 4). *Dinobryon* blooms are associated with unpleasant fishy odors, and one species of *Dinobryon* is linked with toxins that can affect fish vitality (Cantrell & Long, 2013; Conrad, 2013).

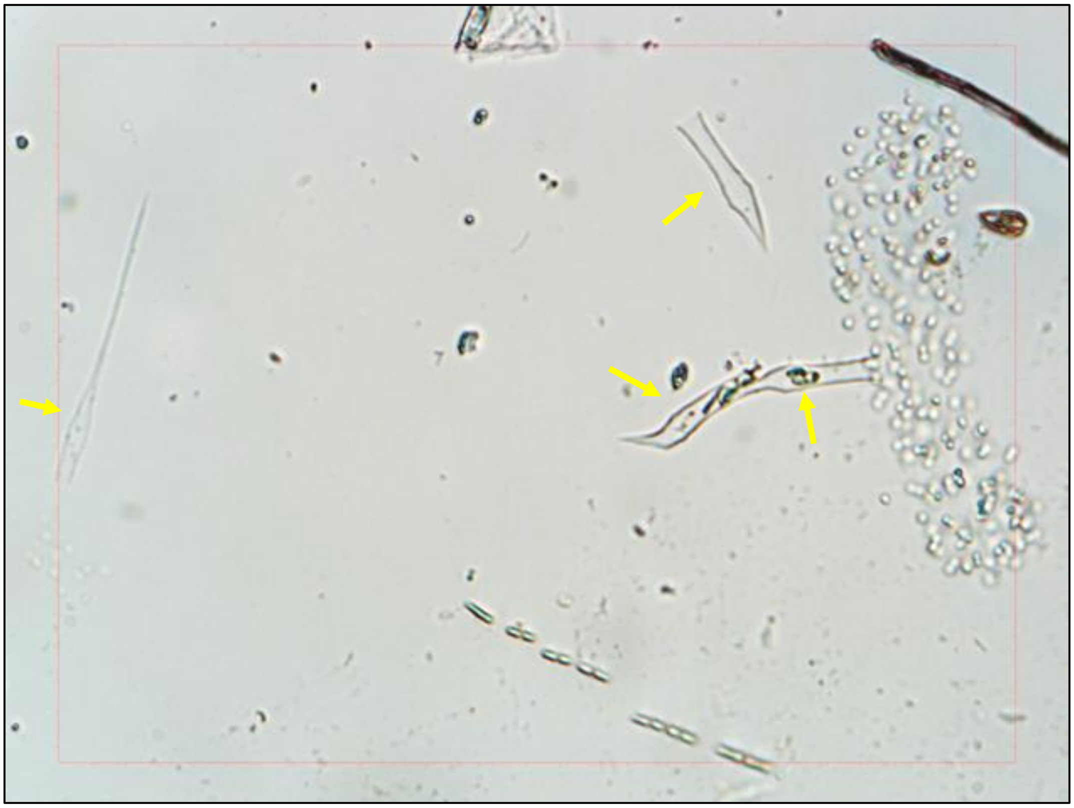

Figure 4: Sample site EMS site E206283 collected on 2021-03-03 showing four Dinobryon sp. (yellow arrows)

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

Summer samples contained elevated concentrations of cyanobacteria relative to spring samples. Dominant genera included *Merismopedia*, *Anacystis*, and *Aphanocapsa* (Figure 5).

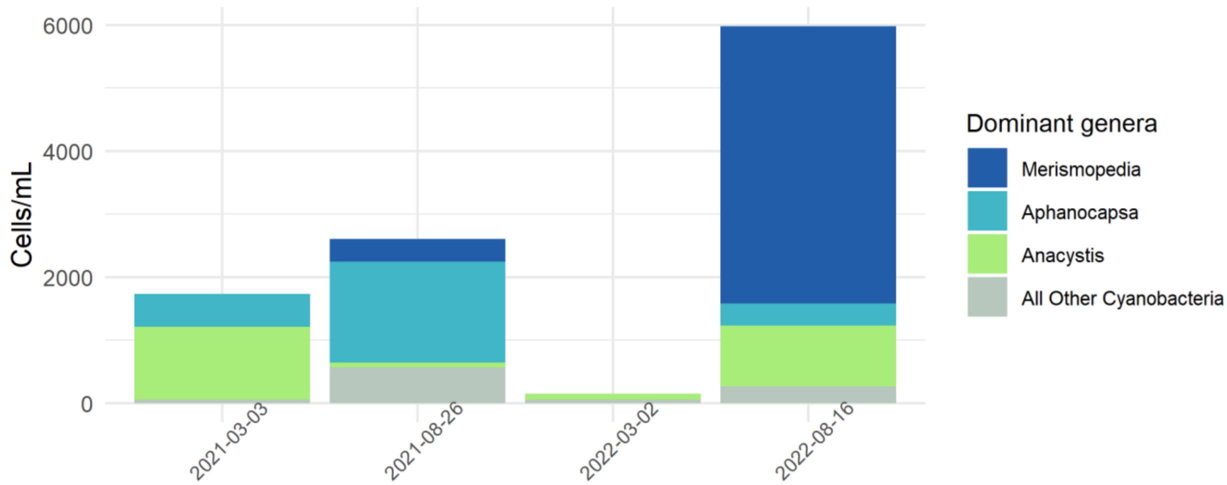

Figure 5: cell abundance for dominant cyanobacteria genera on Lizard Lake

Dominant cyanobacteria identified are 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).

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Merismopedia	4402	Microcystin MC, BMAA
Aphanocapsa	1605	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, BMAA
Anacystis	1157	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT

Note: * = counted in samples

Cyanobacterial Presence (Continued)

Dominant species of cyanobacteria identified in Lizard Lake can produce cyanotoxins, listed above (Table 2).

Lizard Lake displayed a range of cyanobacteria levels in the negligible-low risk categories, with a mean cyanobacteria abundance of 2,618 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Lizard Lake as compared authorities including the WHO and EPA.

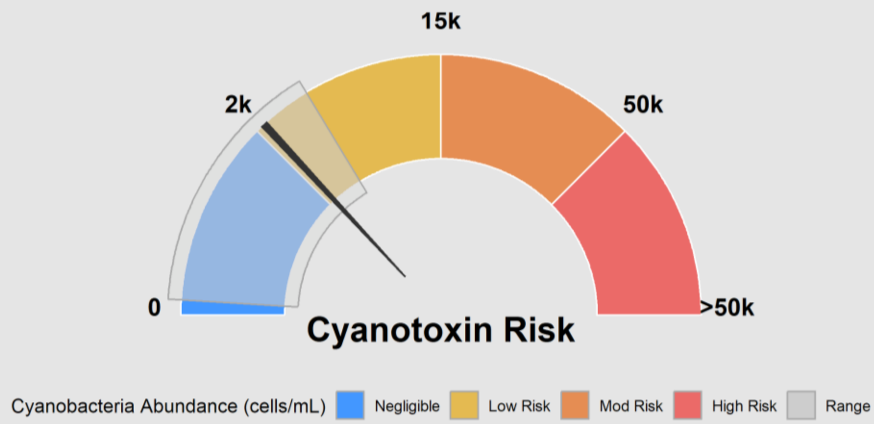

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Lizard Lake

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 a single *Ceratium hirundinella* is approximately the size of 1,000 adjacent cyanobacterial cells (*Aphanocapsa pair*).

Figure 7: Size comparison of a Ceratium hirundinella cell (blue box) to a pair of Aphanocapsa cells (green arrow)

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.

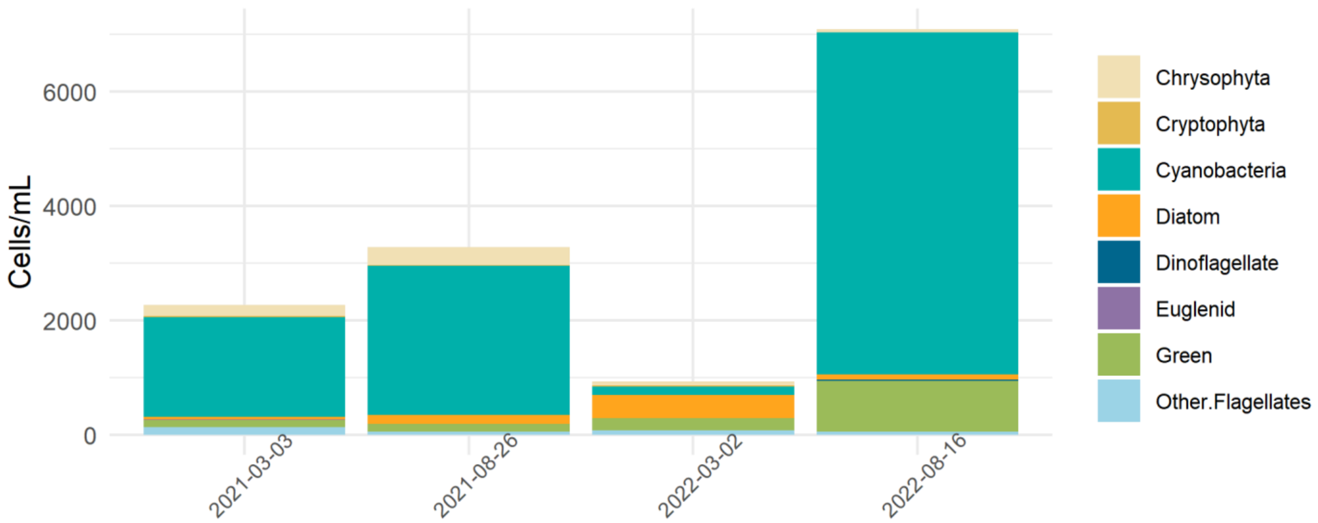

Figure 8: Cell abundance of high-level taxa groups on Lizard Lake

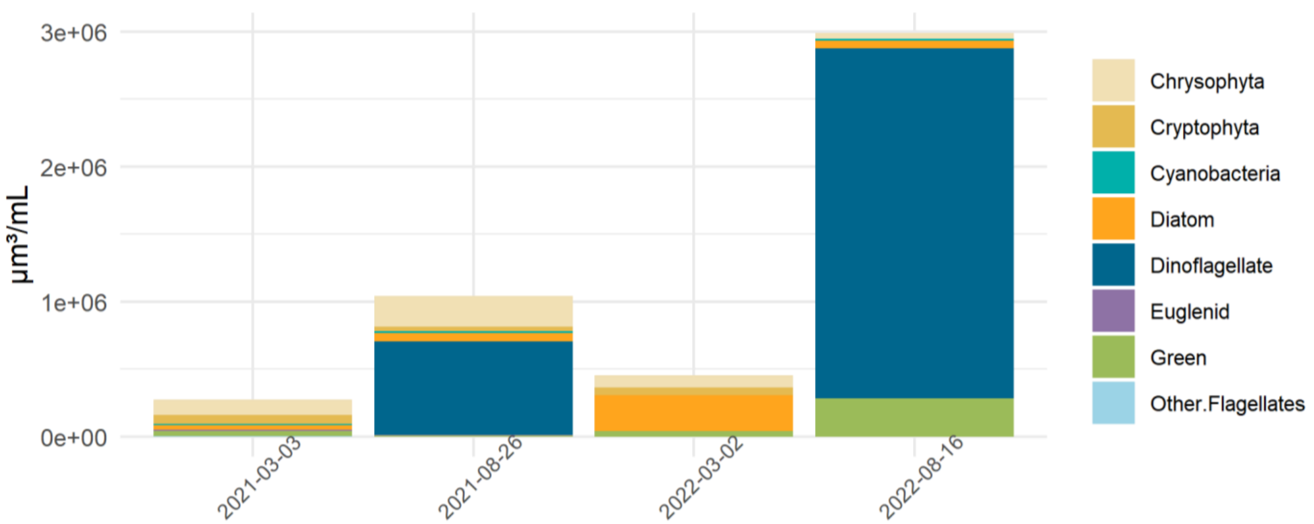

Figure 9: Biovolume of high-level taxa groups on Lizard Lake

References

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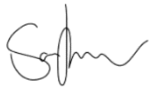

Appendix

Additional figures and raw data are listed below:

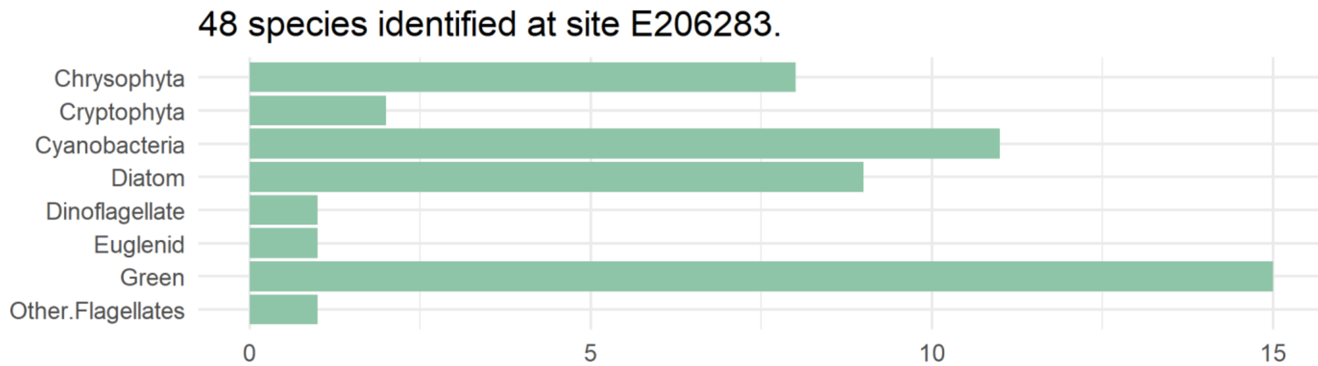

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: E206283	**Total Abundance (cells/mL):**	**2270**	
Collection Date: 2021-03-03	Total Biovolume (µm³/mL):	271246	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon sp.	8	12016	Chrysophyta
Dinobryon sertularia	68	83614	Chrysophyta
Ochromonas sp.	49	10489	Chrysophyta
Rhodomonas sp.	68	8107	Chrysophyta
Cryptomonas ovata	30	65276	Cryptophyta
Aphanocapsa elachista	520	1452	Cyanobacteria
Anacystis aeruginosa	1157	6102	Cyanobacteria
Oscillatoria cf. tenuis	57	752	Cyanobacteria
Asterionella formosa	11	7660	Diatom
Aulacoseira italica	27	13479	Diatom
Cocconeis placentula	4	6517	Diatom
Ulnaria acus	4	4167	Diatom
Nitzschia sp. small	4	2827	Diatom
Trachelomonas volvocina	8	6371	Euglenid
Pediastrum tetras	15	18531	Green
Scenedesmus denticulatus	8	1715	Green
Schroederia setigera	8	2036	Green
Sphaerocystis planctonica	91	19689	Green
picoflagellates	133	446	Other.Flagellates

Figure 11: Raw data from 2021-03-03 EMS site E206283

EMS ID: E206283	**Total Abundance (cells/mL):**	**3280**	
Collection Date: 2021-08-26	Total Biovolume (µm³/mL):	1042157	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chroomonas acuta	23	12425	Chrysophyta
Dinobryon bavaricum	11	23942	Chrysophyta
Dinobryon divergens	4	3448	Chrysophyta
Dinobryon sertularia	140	172146	Chrysophyta
Kephyrion sp.	4	838	Chrysophyta
Ochromonas sp.	8	1713	Chrysophyta
Rhodomonas sp.	125	14902	Chrysophyta
Cryptomonas sp.	8	14816	Cryptophyta
Cryptomonas ovata	8	17407	Cryptophyta
Anacystis sp.	76	145	Cyanobacteria
Aphanocapsa elachista	1605	4482	Cyanobacteria
Planktolyngbya limnetica	452	2312	Cyanobacteria
Merismopedia tenuissima	364	958	Cyanobacteria
Chroococcus cf. dispersus	57	8196	Cyanobacteria
Rhabdoderma lineare	53	390	Cyanobacteria
Aulacoseira italica	95	47424	Diatom
Cyclotella glomerata	4	2517	Diatom
Aulacoseira alpigenia	53	11968	Diatom
Ceratium hirundinella	4	690615	Dinoflagellate
Trachelomonas volvocina	4	3185	Euglenid
Gloeocystis vesicularis	61	1369	Green
Gloeocystis planctonica	53	5145	Green
Scenedesmus bijuga	15	1636	Green
picoflagellates	53	178	Other.Flagellates

Figure 12: Raw data from 2021-08-26 EMS site E206283

EMS ID: E206283	**Total Abundance (cells/mL):**	**925**	
Collection Date: 2022-03-02	**Total Biovolume (µm³/mL):**	**453956**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon bavaricum	35	76179	Chrysophyta
Dinobryon sertularia	10	12296	Chrysophyta
Ochromonas sp.	15	3211	Chrysophyta
Cryptomonas ovata	25	54397	Cryptophyta
Anacystis sp.	96	183	Cyanobacteria
Gloeocapsa cf. punctata	56	2794	Cyanobacteria
Achnanthidium sp.	5	948	Diatom
Asterionella formosa	309	215163	Diatom
Aulacoseira italica	35	17472	Diatom
Aulacoseira alpigena	51	27657	Diatom
Cyclotella glomerata	5	3146	Diatom
Gloeocystis planctonica	152	14757	Green
Monoraphidium arcuatum	10	2830	Green
Monoraphidium cf. tortile	10	6625	Green
Nephrocytium sp.	30	14891	Green
Oocystis solitaria	5	1152	Green
picoflagellates	76	255	Other.Flagellates

Figure 13: Raw data from 2022-03-02 EMS site E206283

EMS ID: E206283	**Total Abundance (cells/mL):**	**7089**	
Collection Date: 2022-08-16	**Total Biovolume (µm³/mL):**	**2989323**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon sertularia	30	36888	Chrysophyta
Ochromonas sp.	15	3211	Chrysophyta
Rhodomonas sp.	15	1710	Chrysophyta
Anacystis sp.	61	116	Cyanobacteria
Anacystis cyanea	911	1371	Cyanobacteria
Aphanocapsa elachista	349	975	Cyanobacteria
Planktolyngbya limnetica	152	778	Cyanobacteria
Gloeocapsa aeruginosa	30	424	Cyanobacteria
Merismopedia tenuissima	4402	11587	Cyanobacteria
Rhabdoderma lineare	76	559	Cyanobacteria
Asterionella formosa	61	42476	Diatom
Aulacoseira alpigena	30	16269	Diatom
Ceratium hirundinella	15	2589807	Dinoflagellate
Elakatothrix gelatinosa	76	13424	Green
Elakatothrix viridis	91	16314	Green
Gloeocystis planctonica	258	25048	Green
Nephrocytium sp.	46	22833	Green
Pediastrum duplex	304	85954	Green
Pediastrum tetras	91	112424	Green
Scenedesmus pseudopoliensis	30	7001	Green
picoflagellates	46	154	Other.Flagellates

Figure 14: Raw data from 2022-08-16 EMS site E206283