Diana Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Diana 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
DIANA LAKE (E223304)	2021-05-05
	2021-08-31
	2022-04-27
	2022-08-17
Total= 4 samples	

Figure 1: Aerial view of Diana Lake

Samples contained low densities of diatoms, Desmids, Chrysophyta, Cryptophyta, Dinoflagellates, and micro-flagellates.

A small green algae bloom, primarily composed of *Botryococcus braunii* and *Crucigenia tetrapedia,* was observed at EMS site #E223304 on 2021-08-31.

Cyanobacteria blooms were observed in both summer samples (Figure 2).

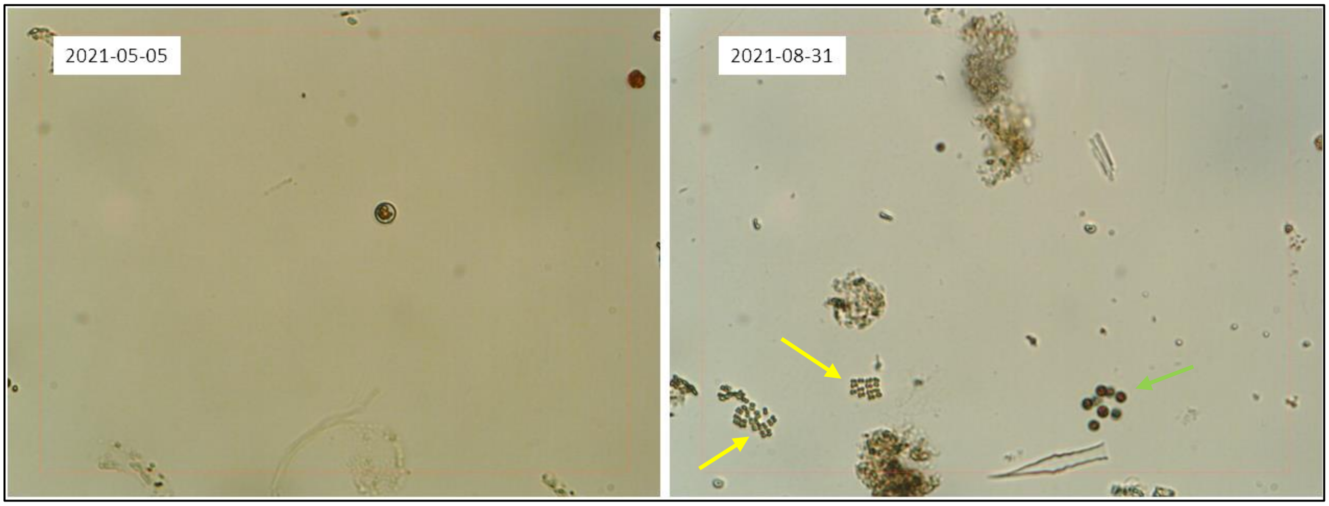

Figure 2: 400x magnification of EMS site #E223304 demonstrating a small increase in cyanobacteria (Merismopedia; yellow arrows and Gloeocapsa; green arrow) from the spring of 2021 to the summer of 2021

Overview (continued)

Cryptophyta dominated biovolumes; *Cryptomonas erosa* and *Cryptomonas ovata* comprised 27% of total biovolume (Figure 3). The Dinoflagellate *Peridinium cf. willei* was also frequently encountered (17%).

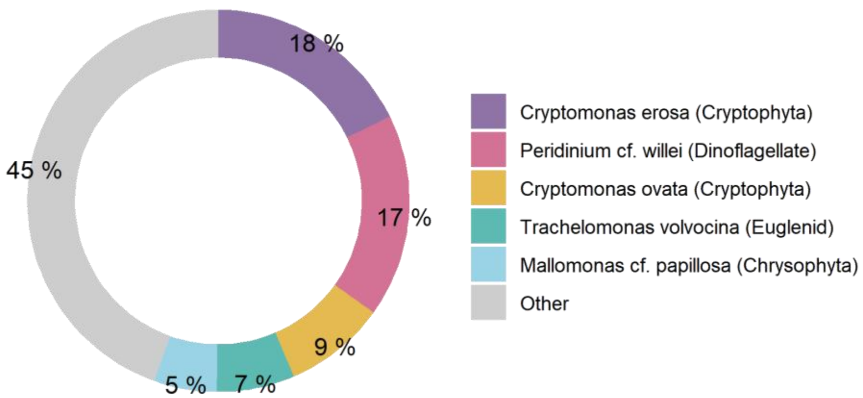

Figure 3: Dominant organisms from Diana Lake (E223304) as percent of total biovolume

Cryptomonas erosa and *Cryptomonas ovata* were two of forty-two species identified in the Diana Lake samples (Figure 4). Cryptomonas species are favored elements of freshwater food chains and are selectively consumed by several zooplankton, ciliates, and dinoflagellates (Wehr et al., 2015).

Species identified in Diana samples were dominantly composed of cyanobacteria, Chrysophyta, and green algae groups.

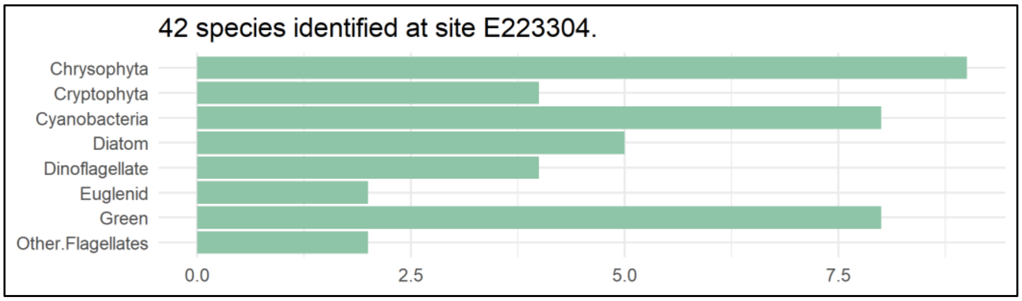

Figure 4: Unique species observed in Diana Lake sorted into higher level taxa

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

Two samples contained elevated densities of cyanobacteria (2021-05-05 and 2022-08-17). *Merismopedia* was the dominant genus, but *Gloeocapsa* and *Anacystis* species were also observed (Figure 5).

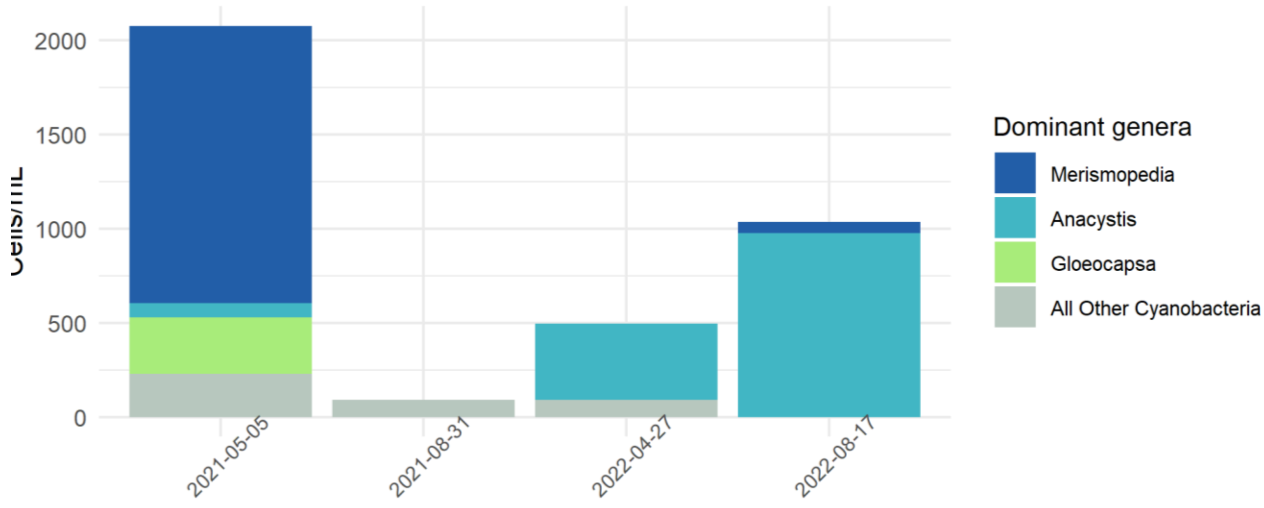

Figure 5: cell abundance for dominant cyanobacteria genera on Diana Lake

Merismopedia and *Anacystis* species 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). There are no toxins linked with *Gloeocapsa.* Concentration of cyanobacteria observed in Diana Lake were too low to represent risks to human health.

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Merismopedia	1472	Microcystin MC, BMAA
Anacystis	976	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Gloeocapsa	163	No recorded toxins

Note: * = counted in samples

Cyanobacterial Presence (Continued)

Several dominant species of cyanobacteria found in Diana Lake are capable of producing cyanotoxins (Table 2).

Diana Lake displayed cyanobacteria levels in the negligible risk category, with a mean cyanobacteria abundance of 925 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Diana Lake compared to alert levels defined by several authorities including the WHO and EPA.

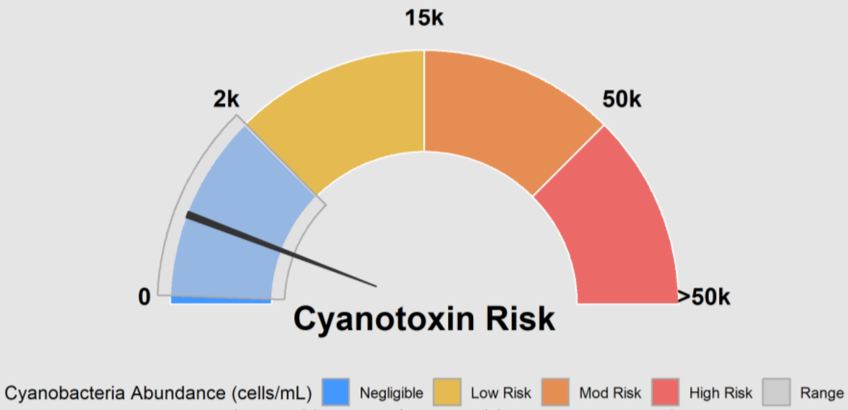

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Diana Lake

Cyanobacteria and micro-flagellates 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 can be seen in Figure 7 where a diatom cell dwarfs the adjacent colony of cyanobacteria cells.

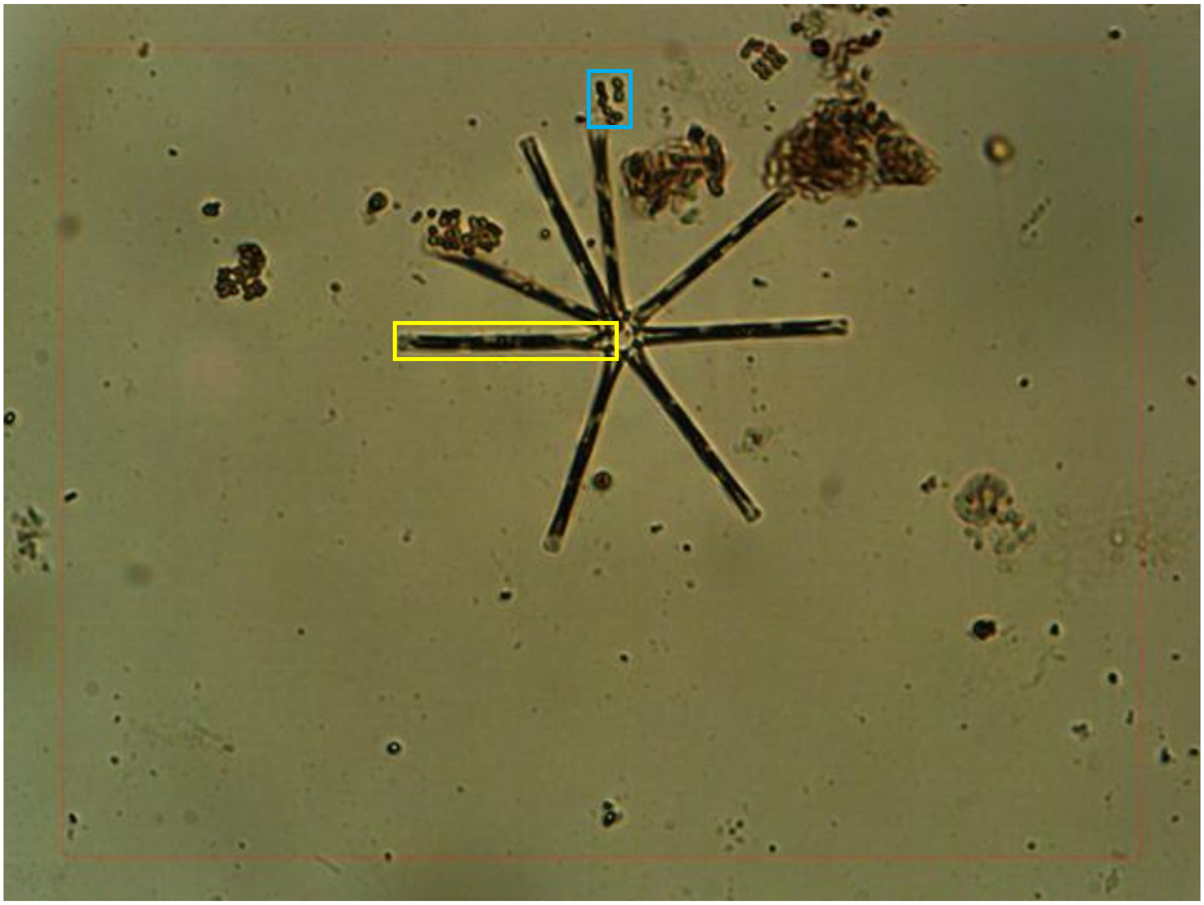

Figure 7: Size comparison of a Asterionella formosa cell (blue box) to eight Anacystis cells (green box)

Species Composition

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

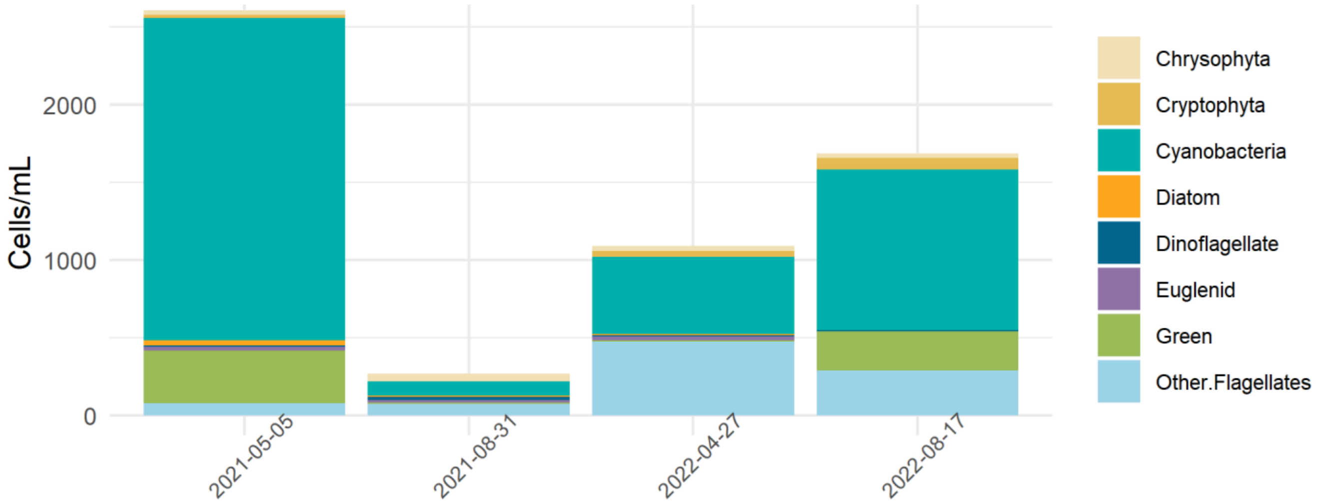

Figure 8: Cell abundance of high-level taxa groups on Diana Lake

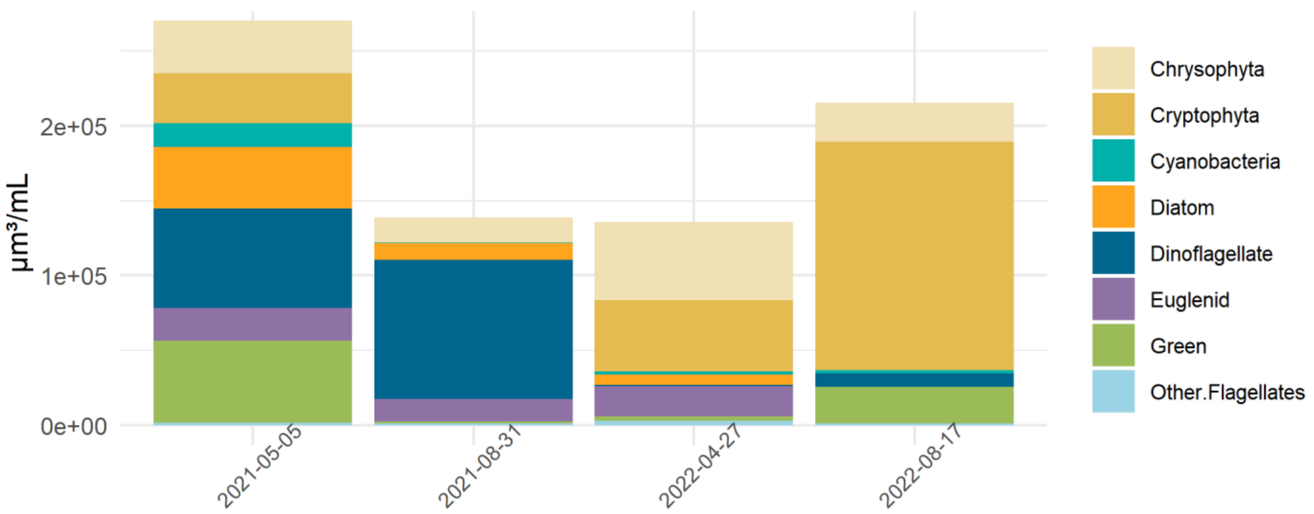

Figure 9: Biovolume of high-level taxa groups on Diana Lake

References

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

Zhao, Y., Yan, Y., Xie, L., Wang, L., He, Y., Wan, X., & Xue, Q. (2020). Long-term environmental exposure to microcystins increases the risk of nonalcoholic fatty liver disease in humans: A combined fisher-based investigation and murine model study. *Environment International*, *138*, 105648. https://doi.org/10.1016/J.ENVINT.2020.105648

Report prepared by: Larratt Aquatic Consulting Ltd.

Stephanie Butt: Taxonomist, H. B.Sc., BIT.

Stephanie Butt

Jamie Self: Senior Aquatic Biologist, R.P. Bio

Reviewed by:

Sara Knezevic: Senior Field Biologist, B.Sc., BIT.

Appendix

Additional figures and raw data are listed below:

EMS ID: E223304	**Total Abundance (cells/mL):**	**2607**	
Collection Date: 2021-05-05	Total Biovolume (µm³/mL):	270366	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon bavaricum	8	17412	Chrysophyta
Kephyrion obliquum	4	838	Chrysophyta
Mallomonas cf. pseudocoronata	8	14778	Chrysophyta
Ochromonas sp.	4	856	Chrysophyta
Chrysococcus sp.	4	1328	Chrysophyta
Cryptomonas ovata	15	32638	Cryptophyta
Rhodomonas lacustris	8	869	Cryptophyta
Gloeocapsa planctonica	163	10280	Cyanobacteria
Planktolyngbya limnetica	76	389	Cyanobacteria
Merismopedia tenuissima	1472	3875	Cyanobacteria
Gloeocapsa punctata	137	574	Cyanobacteria
Anacystis cyanea	76	114	Cyanobacteria
Aphanocapsa elachista	152	424	Cyanobacteria
Asterionella formosa	8	5571	Diatom
Aulacoseira italica	8	3994	Diatom
Navicula spp.	4	2356	Diatom
Tabellaria fenestrata	11	29566	Diatom
Peridinium cf. willei	4	65462	Dinoflagellate
UID Dinoflagellate	4	570	Dinoflagellate
Lepocinclis sp.	8	6896	Euglenid
Trachelomonas volvocina	19	15130	Euglenid
Botryococcus braunii	228	37489	Green
Crucigenia tetrapedia	91	11148	Green
Oocystis parva	11	2473	Green
Oocystis lacustris	8	3957	Green
nanoflagellates	42	1265	Other.Flagellates
picoflagellates	34	114	Other.Flagellates

Figure 10: Raw data from 2021-05-05 EMS site E223304

EMS ID: E223304	**Total Abundance (cells/mL):**	**267**	
Collection Date: 2021-08-31	Total Biovolume (µm³/mL):	138850	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chroomonas acuta	4	2161	Chrysophyta
Kephyrion obliquum	4	838	Chrysophyta
Chrysococcus sp.	42	13945	Chrysophyta
Aphanocapsa elachista	91	254	Cyanobacteria
Eunotia sp.	4	595	Diatom
Tabellaria fenestrata	4	10751	Diatom
Peridinium cf. willei	4	65462	Dinoflagellate
Peridinium inconspicuum	15	27472	Dinoflagellate
Trachelomonas volvocina	19	15130	Euglenid
Tetraedron minimum	8	984	Green
nanoflagellates	38	1144	Other.Flagellates
picoflagellates	34	114	Other.Flagellates

Figure 11: Raw data from 2021-08-31 EMS site E223304

EMS ID: E223304	**Total Abundance (cells/mL):**	**1091**	
Collection Date: 2022-04-27	**Total Biovolume (µm³/mL):**	**135637**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon sertularia	5	6148	Chrysophyta
Mallomonas cf. papillosa	10	40715	Chrysophyta
Ochromonas sp.	10	2141	Chrysophyta
Chrysococcus sp.	10	3320	Chrysophyta
Cryptomonas ovata	5	10879	Cryptophyta
Cryptomonas erosa	20	35437	Cryptophyta
Rhodomonas lacustris	10	1086	Cryptophyta
Planktolyngbya sp.	91	1131	Cyanobacteria
Anacystis cf. cyanea	405	885	Cyanobacteria
Asterionella formosa	10	6963	Diatom
Parvodinium sp.	10	1047	Dinoflagellate
Trachelomonas volvocina	25	19908	Euglenid
Monoraphidium cf. kormakovae	5	3313	Green
nanoflagellates	40	1204	Other.Flagellates
picoflagellates	435	1460	Other.Flagellates

Figure 12: Raw data from 2022-04-27 EMS site E223304

EMS ID: E223304	**Total Abundance (cells/mL):**	**1684**	
Collection Date: 2022-08-17	**Total Biovolume (µm³/mL):**	**215497**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon sertularia	5	6148	Chrysophyta
Mallomonas hamata	5	14541	Chrysophyta
Ochromonas sp.	10	2141	Chrysophyta
Chrysococcus sp.	10	3320	Chrysophyta
Cryptomonas ovata	10	21759	Cryptophyta
Cryptomonas curvata	5	31500	Cryptophyta
Cryptomonas erosa	56	99224	Cryptophyta
Merismopedia tenuissima	61	161	Cyanobacteria
Anacystis cf. cyanea	976	2132	Cyanobacteria
Peridinium inconspicuum	5	9157	Dinoflagellate
Crucigenia tetrapedia	20	2450	Green
Gloeocystis planctonica	157	15242	Green
Gloeocystis cf. vesiculosa	76	6621	Green
nanoflagellates	5	151	Other.Flagellates
picoflagellates	283	950	Other.Flagellates

Figure 13: Raw data from 2022-08-17 EMS site E223304