Lakelse Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Lakelse 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
LAKELSE LAKE DEEP STATION (E206616)	2021-05-05
	2021-08-31
	2022-04-27
	2022-08-18
	Total= 4 samples

Figure 1: Aerial view of Lakelse Lake

Samples contained low concentrations of algae. Spring samples contained relatively elevated densities of diatoms, flagellates, and detritus compared to summer samples (Figure 2). Diatoms increase the resiliency and health of water systems by reducing nutrient concentrations and preventing monoculture blooms of less desirable algae (jrobyn, 2019).

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: Spring sample containing elevated detritus (left) vs. summer sample containing low concentrations of detritus

Overview (continued)

Samples contained moderate concentrations of diatoms including *Ulnaria acus* and *Asterionella formosa* (Figure 3). Cryptomonas ovata was also commonly observed.

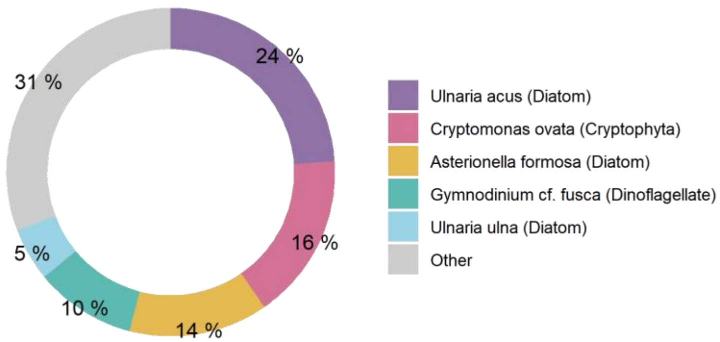

Figure 3: Dominant organisms from Lakelse L West Basin Deep Station (E105973) as percent of total biovolume

Diatoms are integral to aquatic food webs because they are the foundation of the web (jrobyn, 2019). Colony forming diatoms such as *Asterionella formosa* can avoid grazing pressures by developing into large colonies reducing their availability for zooplankton and microscopic invertebrates (Baker, 2012). Cryptomonas species are also favored elements of freshwater food chains and are selectively consumed by several zooplankton, ciliates, and dinoflagellates (Wehr et al., 2015).

Spring samples collected in Lakelse Lake also demonstrated low levels of diatom degradation indicative of lowering silica levels in the late spring (Figure 4).

Figure 4: 400x magnification of degraded Asterionella formosa (red arrows) next to un-degraded Asterionella formosa (green 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

Samples contained low densities of cyanobacteria. Dominant genera included *Anacystis*, *Planktolyngbya*, and *Aphanocapsa* (Figure 5).

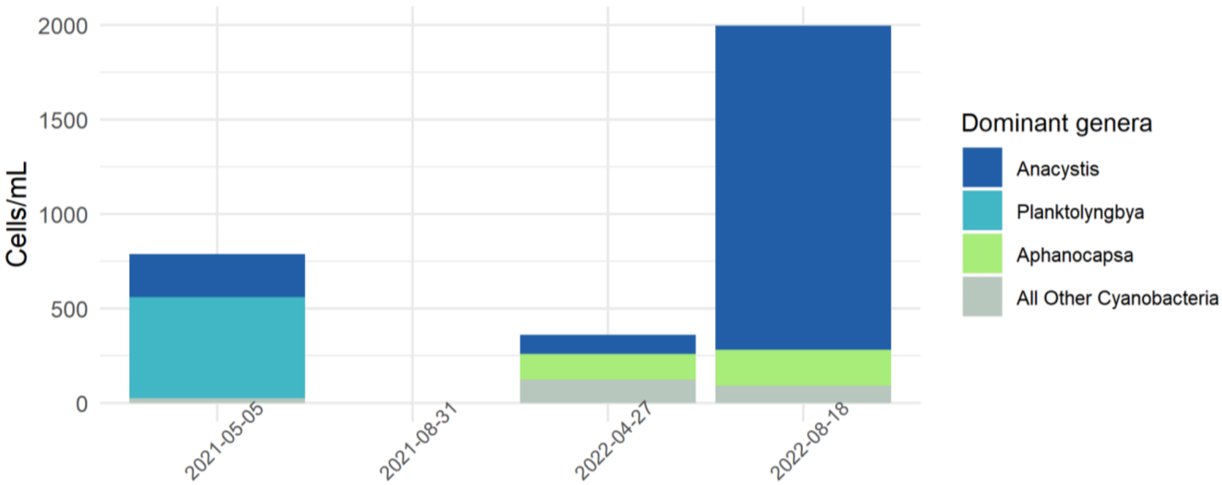

Figure 5: cell abundance for dominant cyanobacteria genera on Lakelse Lake

Anacystis, Planktolyngbya, and *Aphanocapsa* are associated with several cyanotoxins that represent risks to public health (Table 2). Illness related to cyanotoxins include: liver, kidney, and nerve cell damage, cancer, skin and gut irritation, and neurological issues (Lance et al., 2014). Concentration of cyanobacteria observed in Lakelse Lake were too low to represent risks to human health.

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Anacystis	1480	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Planktolyngbya	535	Lyngbyatoxin LYN, Microcystin MC, BMAA
Aphanocapsa	190	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, BMAA

Note: * = counted in samples

Cyanobacterial Presence (Continued)

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

Lakelse Lake displayed a range of cyanobacteria levels in the negligible risk category, with a mean cyanobacteria abundance of 1,047 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Lakelse Lake compared to several authorities including the WHO and EPA.

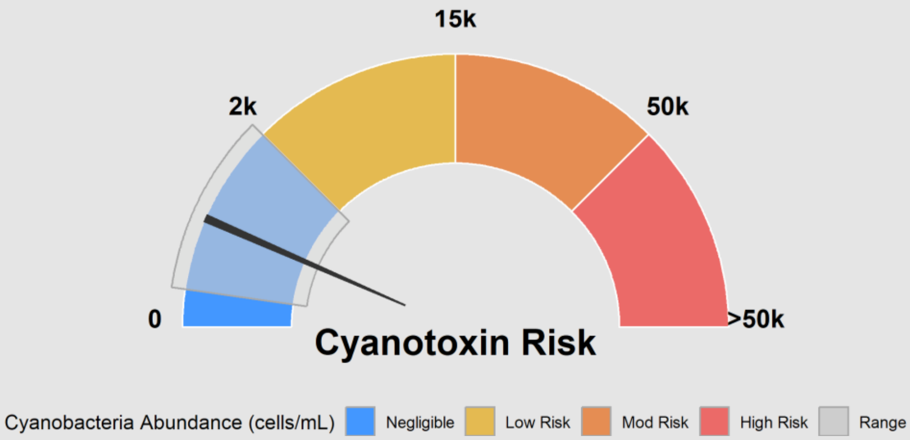

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Lakelse Lake

Cyanobacteria frequently dominate algal communities in total cell count, but because of their small cell size their biovolume is usually low relative to other types of algae present. This is highlighted in Figure 7 where a *Polyarthra (*rotifer), *Heliozoan* (ciliate), *Lindavia* (diatom), and *Anacystis* (cyanobacteria) demonstrate differences in size.

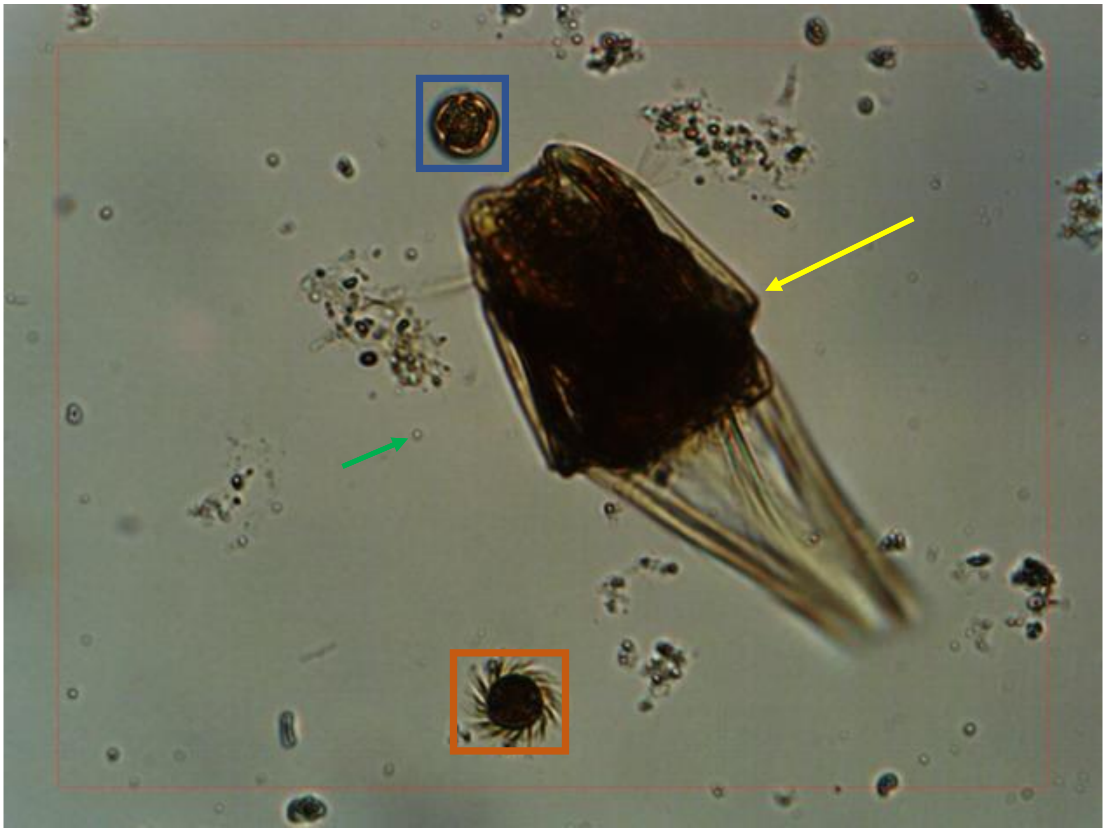

Figure 7: Size comparison of a single Lindavia cell (blue box) to an Anacystis cell (green arrow), a Heliozoan (orange box) and a Polyarthra (yellow arrow) were also captured in this frame.

Species Composition

Algae samples were identified to the species 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.

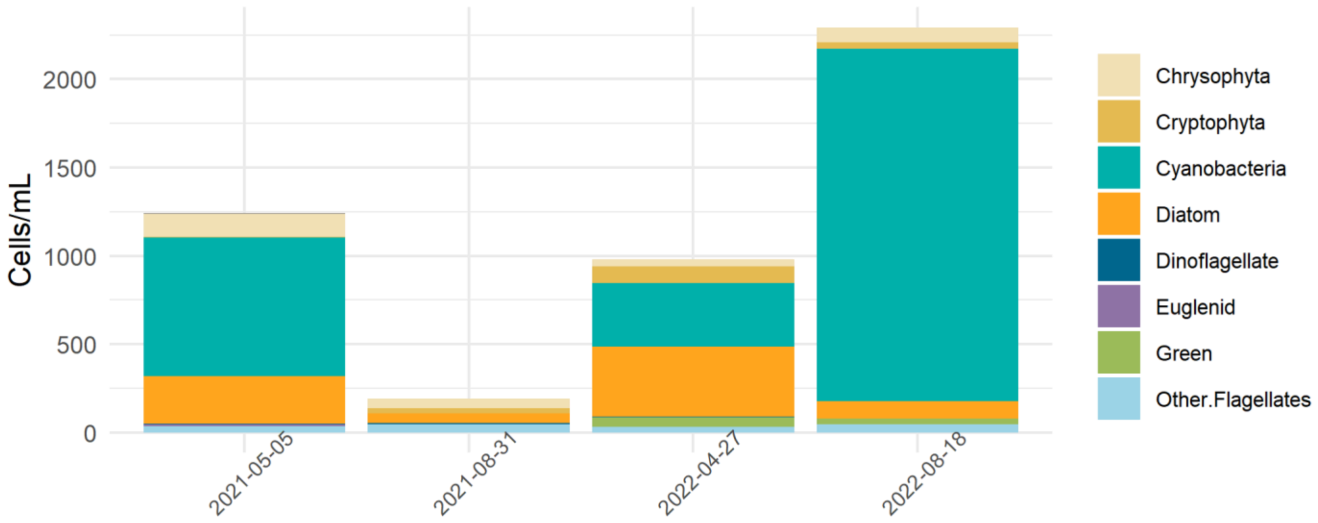

Figure 8: Cell abundance of high-level taxa groups on Lakelse Lake

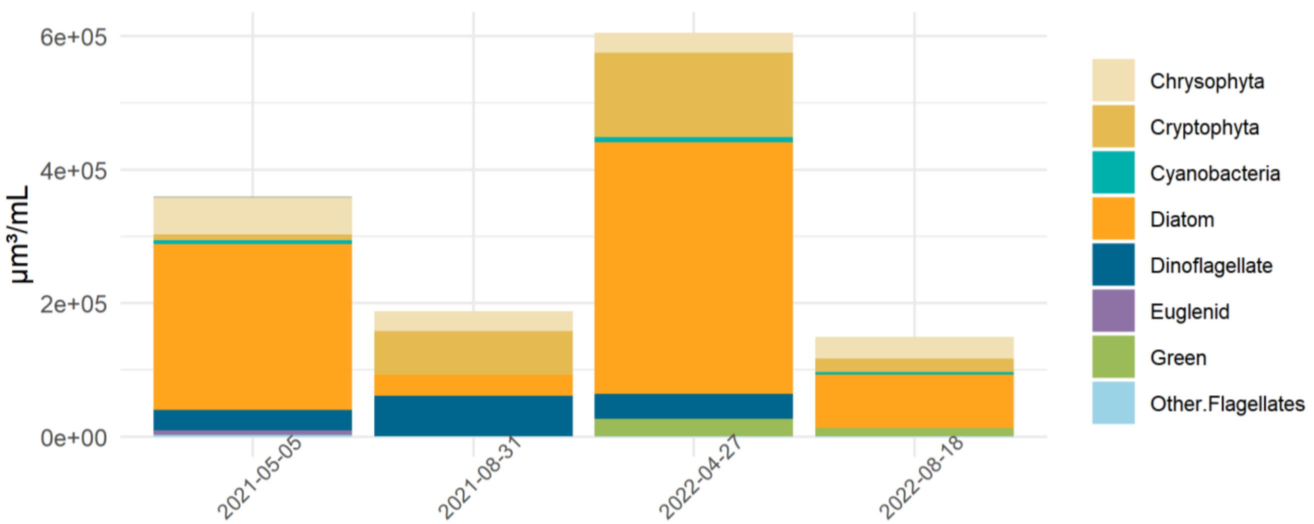

Figure 9: Biovolume of high-level taxa groups on Lakelse Lake

References

Baker, A. L. et al. (2012). *Phycokey -- an image based key to Algae (PS Protista), Cyanobacteria, and other aquatic objects.* University of New Hampshire Center for Freshwater Biology. http://cfb.unh.edu/phycokey/phycokey.htm

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

jrobyn. (2019). *How Diatoms Benefit a Body of Water - BioNova®*. BioNova. https://bionovanaturalpools.com/how-diatoms-benefit-a-body-of-water/

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.

Wehr, J. D., Sheath, R. G., & Kociolek, P. (2015). *Freshwater Algae of North America* (Second). Elsevier Inc.

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.

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

Reviewed by:

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

Appendix

Additional figures and raw data are listed below:

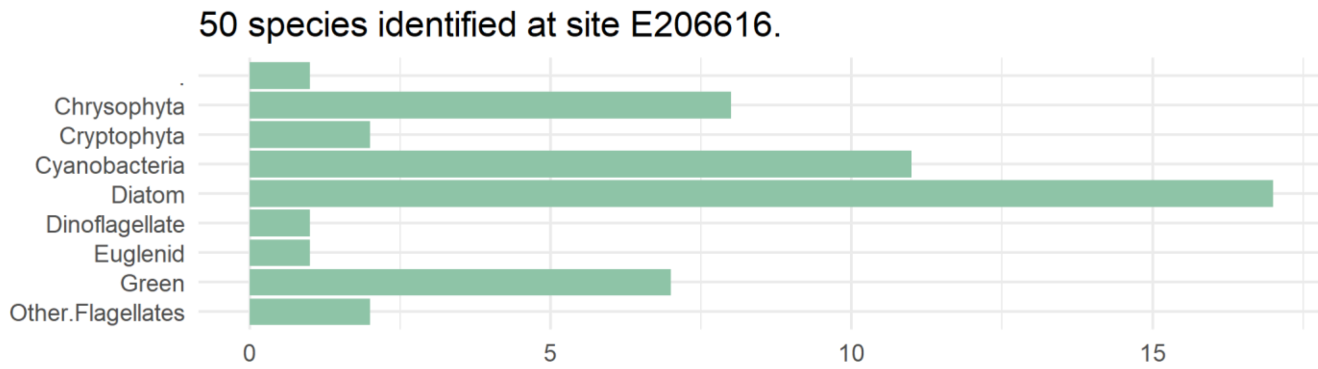

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: E206616	**Total Abundance (cells/mL):**	**1241**	
Collection Date: 2021-05-05	Total Biovolume (µm³/mL):	359000	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
	4	570	.
Chroomonas acuta	38	20528	Chrysophyta
Chrysococcus sp.	38	12617	Chrysophyta
Rhodomonas sp.	8	954	Chrysophyta
Dinobryon divergens	4	3448	Chrysophyta
Dinobryon sertularia	8	9837	Chrysophyta
Ochromonas sp.	30	6422	Chrysophyta
UID Chrysophyta	4	2094	Chrysophyta
Cryptomonas ovata	4	8704	Cryptophyta
Dactylococcopsis sp.	8	545	Cyanobacteria
Gloeocapsa sp.	15	652	Cyanobacteria
Planktolyngbya limnetica	535	2737	Cyanobacteria
Anacystis aeruginosa	228	1203	Cyanobacteria
Achnanthidium microcephalum	4	580	Diatom
Asterionella formosa	129	89826	Diatom
Cyclotella sp.	4	1062	Diatom
Lindavia bodanica	4	4174	Diatom
Cyclotella glomerata	42	26428	Diatom
Diatoma tenue var. elongatum	4	1434	Diatom
Aulacoseira italica	11	5491	Diatom
Navicula spp.	8	4712	Diatom
Ulnaria acus	42	43757	Diatom
Ulnaria ulna	8	42038	Diatom
Tabellaria fenestrata	11	29566	Diatom
Gymnodinium cf. fusca	4	30411	Dinoflagellate
Euglena sp.	11	6336	Euglenid
UID flagellate	8	2783	Other.Flagellates
picoflagellates	27	91	Other.Flagellates

Figure 11: Raw data from 2021-05-05 EMS site E206616

EMS ID: E206616	**Total Abundance (cells/mL):**	**191**	
Collection Date: 2021-08-31	Total Biovolume (µm³/mL):	187237	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chroomonas acuta	8	4322	Chrysophyta
Chrysococcus sp.	11	3652	Chrysophyta
Dinobryon divergens	4	3448	Chrysophyta
Dinobryon sertularia	8	9837	Chrysophyta
Kephyrion sp.	11	2304	Chrysophyta
UID Chrysophyta	11	5760	Chrysophyta
Cryptomonas ovata	30	65276	Cryptophyta
Achnanthidium microcephalum	8	1159	Diatom
Lindavia bodanica	8	8348	Diatom
Cyclotella glomerata	11	6922	Diatom
Eunotia cf. monodon	4	1223	Diatom
Aulacoseira italica	15	7488	Diatom
Navicula spp.	4	2356	Diatom
Ulnaria acus	4	4167	Diatom
Gymnodinium cf. fusca	8	60821	Dinoflagellate
picoflagellates	46	154	Other.Flagellates

Figure 12: Raw data from 2021-08-31 EMS site E206616

EMS ID: E206616	**Total Abundance (cells/mL):**	**980**	
Collection Date: 2022-04-27	**Total Biovolume (µm³/mL):**	**604906**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chrysococcus sp.	10	3320	Chrysophyta
Dinobryon sertularia	20	24592	Chrysophyta
Ochromonas sp.	10	2141	Chrysophyta
Cryptomonas ovata	56	121849	Cryptophyta
Rhodomonas lacustris	40	4343	Cryptophyta
Anacystis cyanea	101	152	Cyanobacteria
Aphanocapsa elachista	137	383	Cyanobacteria
Merismopedia tenuissima	20	53	Cyanobacteria
Pseudanabaena catenata	101	7372	Cyanobacteria
Asterionella formosa	66	45957	Diatom
Cocconeis placentula	5	8146	Diatom
Lindavia bodanica	10	10435	Diatom
Nitzschia palea	5	1051	Diatom
Ulnaria acus	238	247954	Diatom
Ulnaria ulna	5	26273	Diatom
Tabellaria fenestrata	10	26878	Diatom
UID Pennate Diatom	10	1472	Diatom
cf. Dinobryon cyst	46	8261	Diatom
Gymnodinium cf. fusca	5	38013	Dinoflagellate
Ankistrodesmus fractus	5	899	Green
Monoraphidium cf. caribeum	10	6625	Green
Monoraphidium contortum	20	11339	Green
Monoraphidium indicum	10	6625	Green
Scenedesmus abundans	10	672	Green
picoflagellates	30	101	Other.Flagellates

Figure 13: Raw data from 2022-04-27 EMS site E206616

EMS ID: E206616	**Total Abundance (cells/mL):**	**2293**	
Collection Date: 2022-08-18	**Total Biovolume (µm³/mL):**	**149602**	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Dinobryon sertularia	15	18444	Chrysophyta
Kephyrion sp.	15	3142	Chrysophyta
Ochromonas sp.	53	11346	Chrysophyta
Cryptomonas ovata	8	17407	Cryptophyta
Rhodomonas lacustris	30	3257	Cryptophyta
Anacystis cyanea	1480	2228	Cyanobacteria
Anacystis sp.	235	447	Cyanobacteria
Aphanocapsa incerta	190	600	Cyanobacteria
Anathece cf. smithii	91	381	Cyanobacteria
Asterionella formosa	61	42476	Diatom
Lindavia bodanica	15	15652	Diatom
Pinnularia brebissonii	8	5152	Diatom
Ulnaria acus	15	15627	Diatom
Elakatothrix genevensis	15	2689	Green
Monoraphidium cf. caribeum	8	5300	Green
Monoraphidium cf. obtusum	8	5300	Green
picoflagellates	46	154	Other.Flagellates

Figure 14: Raw data from 2022-08-18 EMS site E206616