Babine Lake Phytoplankton Summary Report 2022

Overview

Samples were collected from two sites on Babine Lake during 2022 (Figure 1;Table 1). Algae were identified to the taxonomic level genus and grouped into broad alga types for analysis.

Table 1: Sample sites and dates sampled in 2022

Sample Site (EMS#)	Dates
BABINE LAKE; STN 2. (NORTH END OF LAKE) NEAR BELL AND GRANISLE MINES (1170009)	2022-05-31 2022-08-22
BABINE LAKE; STN. 4 (GEOMETRIC CENTRE OF LAKE) (1170011)	2022-05-31 2022-08-22
	Total= 4 samples

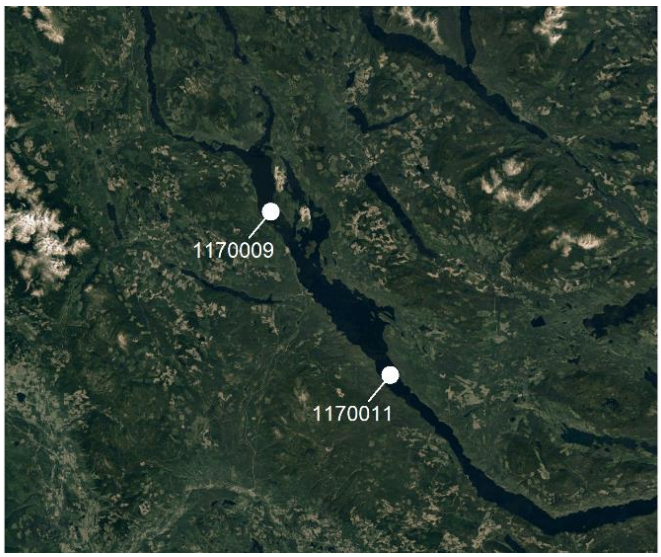

Figure 1: Aerial view of Babine Lake

Spring samples contained elevated quantities of debris. Turbidity spikes during the spring are common due to elevated wind, rain, erosion, and runoff events (Card et al., 2014). Suspended materials include clay, silt, organic and inorganic matter, algae, dissolved color compounds, and bacteria (Card et al., 2014).

One summer sample (2022-08-22; EMS site #1170011) contained low concentrations of amorphous clouds of degraded cyanobacteria (Figure 2). Degraded cyanobacteria could represent a threat to public health because cyanotoxins are usually contained within the cyanobacterial cells and released at cell death (EPA, 2022).

Diatom densities in Babine Lake increased in the summer compared to spring; *Asterionella formosa* and *Tabellaria fenestrate* were dominant summer species.

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

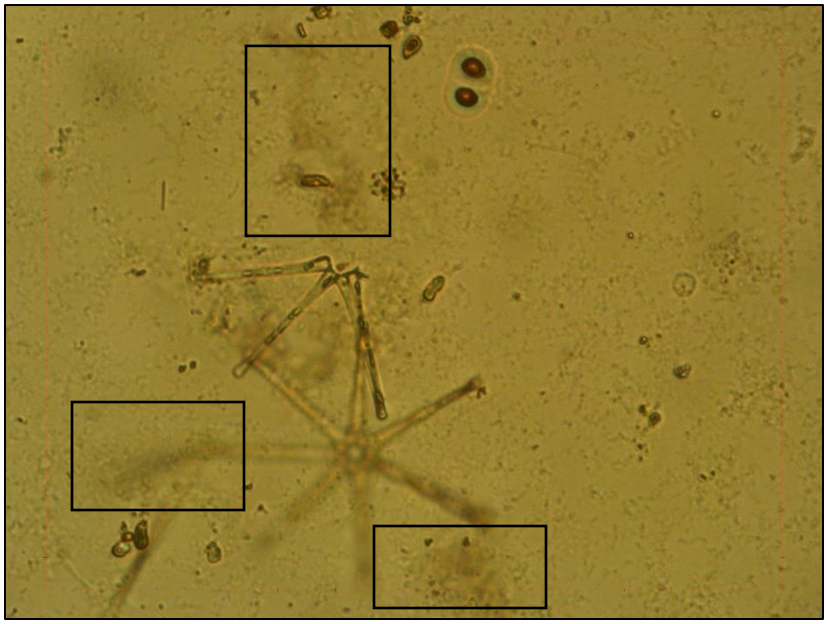

Figure 2: EMS site #1170011 collected on 2022-08-22 displaying amorphous clouds of degraded cyanobacteria (black boxes denote sections)

Overview (continued)

Asterionella formosa and *Tabellaria fenestrate* dominated biovolumes (Figure 3). All sites contained moderate to high levels of micro-flagellates, specifically cryptomonad *Rhodomonas lacustris* and *Cryptomonas curvata* (Figure 4).

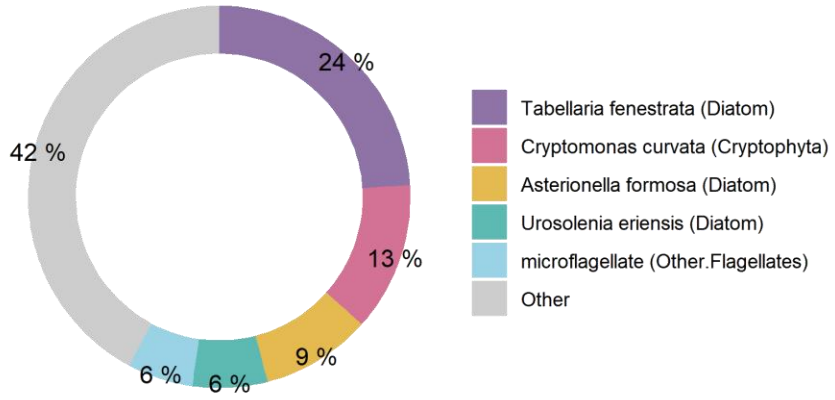

Figure 3: Dominant organisms from Babine Lake as percent of total biovolume

Cryptomonads are favored elements of freshwater food chains and are selectively consumed by several zooplankton, ciliates, and dinoflagellates (Wehr et al., 2015).

Figure 4: EMS Site #1170009 collected on 2022-08-22 containing a small Tabellaria fenestrate chain (yellow arrows), Rhodomonas lacustris (red arrow), Cryptomonas curvata (blue arrow), and other varieties of algae

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 cyanobacteria densities. Dominant genera included *Anacystis*, *Aphanothece,* and *Planktolyngbya* (Figure 5).

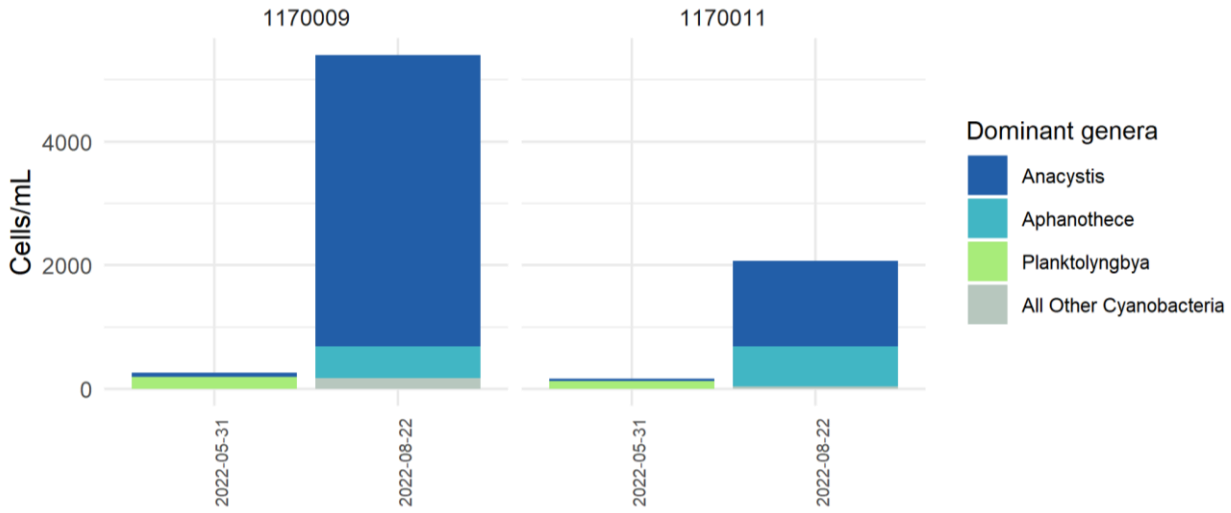

Figure 5: cell abundance for dominant cyanobacteria genera on Babine Lake

Anacystis, *Aphanothece,* and *Planktolyngbya* 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 Babine Lake and their associated toxins

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Anacystis	3115	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Aphanothece	649	Microcystin MC
Planktolyngbya	194	Lyngbyatoxin LYN, Microcystin MC, BMAA

Note: * = counted in samples

Cyanobacterial Presence (continued)

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

Babine Lake displayed cyanobacteria levels in the negligible-low risk category, with a mean cyanobacteria abundance of 1,976 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Babine Lake compared to alert levels defined by several authorities including the WHO and the EPA.

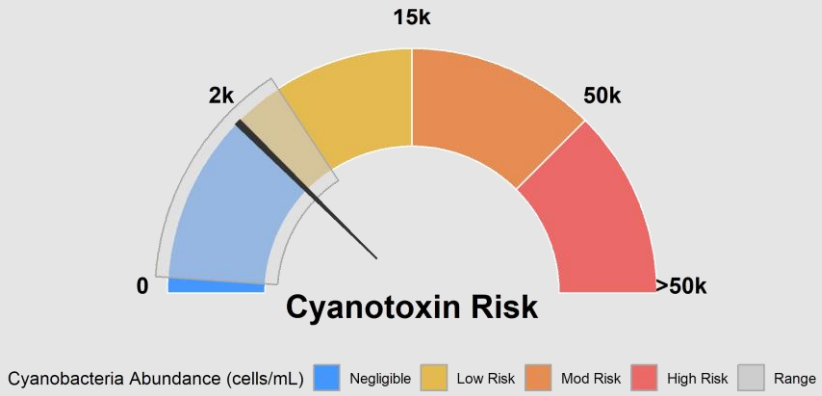

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Babine Lake

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 diatom cell is an equivalent size to approximately 100 cyanobacteria cells.

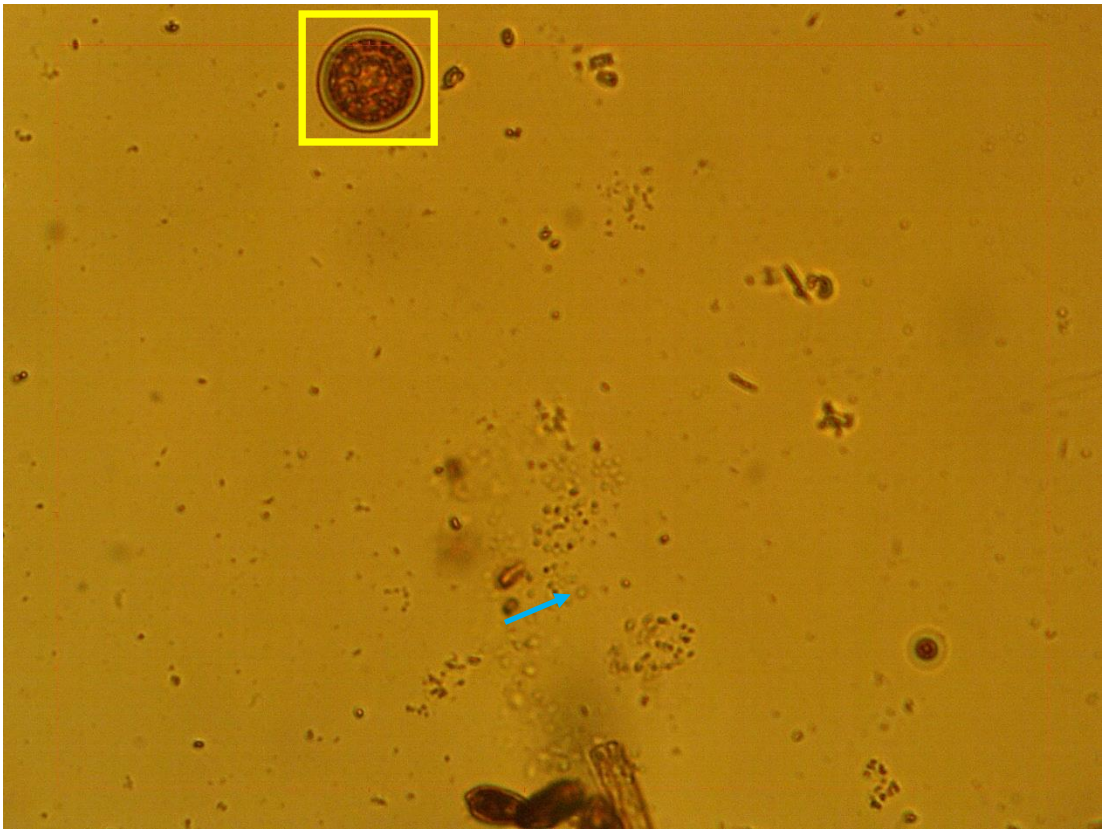

Figure 7: Size comparison of a Lindavia cell (yellow box) to an Anacystis cell (blue arrow)

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.

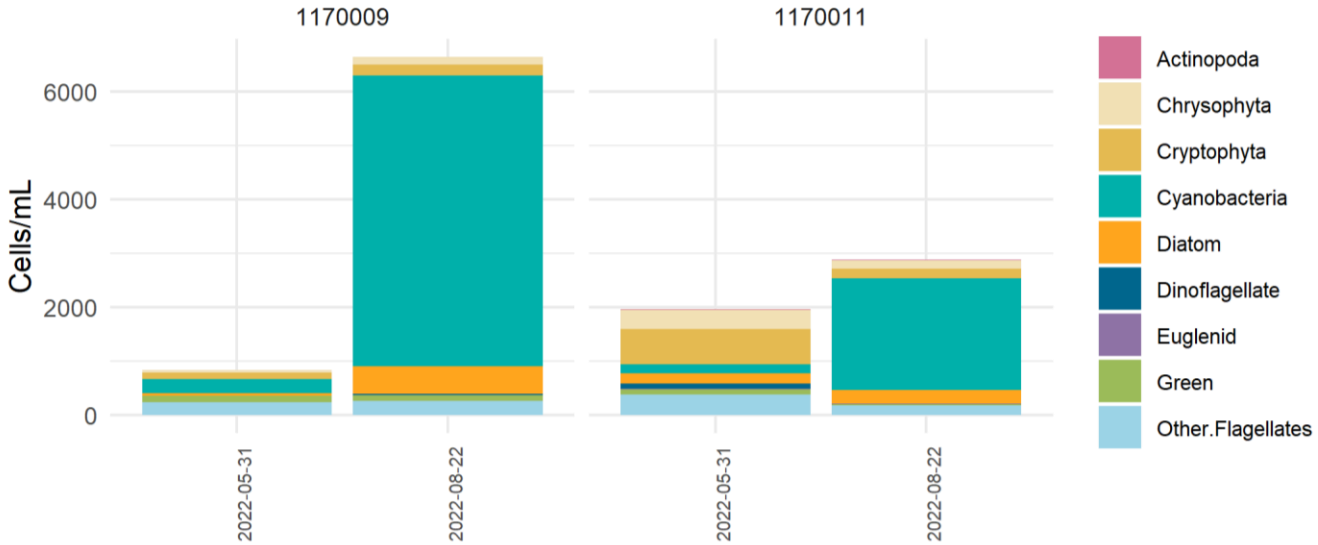

Figure 8: Cell abundance of high-level taxa groups on Babine Lake

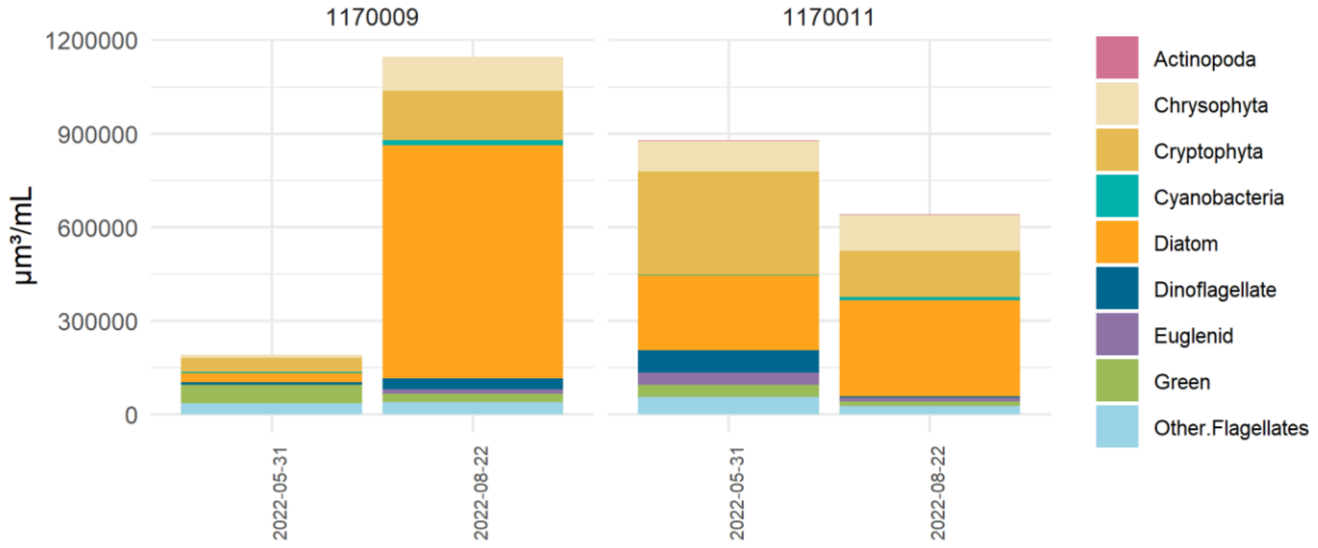

Figure 9: Biovolume of high-level taxa groups on Babine Lake

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

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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

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Appendix

Additional figures and raw data are listed below:

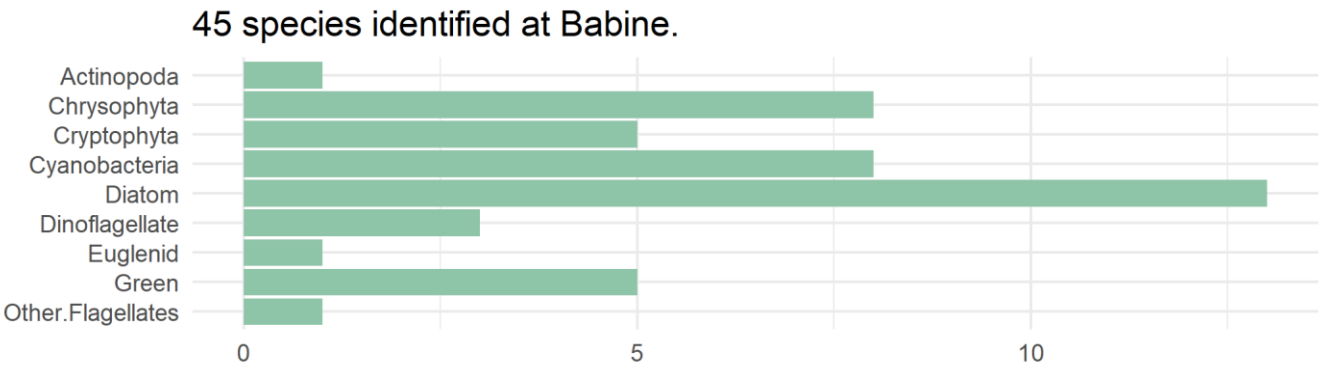

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: 1170009	**Total Abundance (cells/mL):**	**833**		
Collection Date: 2022-05-31	**Total Biovolume (µm³/mL):**	**195719**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Chroomonas sp.	11	2501	Chrysophyta	10613
Chrysochromulina sp.	27	1038	Chrysophyta	2160
Chromulina sp.	4	7069	Chrysophyta	1717
Cryptomonas sp.	4	7408	Cryptophyta	10635
Cryptomonas curvata	4	25200	Cryptophyta	10635
Rhodomonas lacustris	114	12378	Cryptophyta	10663
Anacystis sp.	68	129	Cyanobacteria	609
Planktolyngbya sp.	194	2411	Cyanobacteria	
Aulacoseira ambigua	8	2475	Diatom	590863
Fragilaria crotonensis	30	14567	Diatom	2932
Nitzschia palea var. debilis	4	1579	Diatom	5070
Tabellaria fenestrata	4	10751	Diatom	3241
Gymnodinium ordinatum	4	7800	Dinoflagellate	10031
Ankistrodesmus falcatus	19	2686	Green	5877
Chlamydomonas sp.	95	56843	Green	5448
microflagellate	243	40884	Other.Flagellates	

Figure 11: Raw data from 2022-05-31 EMS site 1170009

EMS ID: 1170011	Total Abundance (cells/mL):	1967			
Collection Date: 2022-05-31	Total Biovolume (µm³/mL):	886450			
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**	**kingdom**
Actinophryida	11	1851	Actinopoda		
Chrysococcus sp.	19	6308	Chrysophyta	1751	Chromista
Chrysochromulina sp.	57	2192	Chrysophyta	2160	Chromista
Chromulina sp.	15	26507	Chrysophyta	1717	Chromista
Dinobryon spp.	4	6346	Chrysophyta	1515	Chromista
Ochromonas sp.	243	52019	Chrysophyta	1455	Chromista
Dinobryopsis sp.	15	4029	Chrysophyta	1557	Chromista
Cryptomonas sp.	46	85194	Cryptophyta	10635	Chromista
Cryptomonas curvata	23	144899	Cryptophyta	10635	Chromista
Cryptomonas ovata	11	23935	Cryptophyta	10635	Chromista
Cryptomonas erosa	8	14175	Cryptophyta	10635	Chromista
Rhodomonas lacustris	577	62649	Cryptophyta	10663	Chromista
Anacystis sp.	38	72	Cyanobacteria	609	Bacteria
Planktolyngbya sp.	129	1603	Cyanobacteria		
Asterionella formosa	95	66151	Diatom	3116	Chromista
Aulacoseira sp.	11	18102	Diatom	590863	Chromista
Fragilaria crotonensis	4	1942	Diatom	2932	Chromista
Nitzschia palea var. debilis	8	3158	Diatom	5070	Chromista
Tabellaria fenestrata	46	123638	Diatom	3241	Chromista
Ulnaria acus	27	28129	Diatom	970000	Chromista
Gymnodinium sp.	4	8474	Dinoflagellate	10031	Chromista
Gymnodinium ordinatum	11	21449	Dinoflagellate	10031	Chromista
Parvodinium sp.	76	41903	Dinoflagellate		
Trachelomonas sp.	11	38877	Euglenid	9690	Protozoa
Ankistrodesmus falcatus	27	3817	Green	5877	Plantae
Elakatothrix cf. gelatinosa	15	2880	Green	9412	Plantae
Chlamydomonas sp.	53	31712	Green	5448	Plantae
microflagellate	383	64439	Other.Flagellates		

Figure 10: Raw data from 2022-05-31 EMS site 1170011

EMS ID: 1170009	Total Abundance (cells/mL):	6650		
Collection Date: 2022-08-22	Total Biovolume (µm³/mL):	1155083		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Actinophryida	8	1346	Actinopoda	
Chrysococcus sp.	4	1328	Chrysophyta	1751
Chrysochromulina sp.	34	1308	Chrysophyta	2160
Chromulina sp.	34	60083	Chrysophyta	1717
Mallomonas sp.	11	33267	Chrysophyta	1598
Ochromonas sp.	49	10489	Chrysophyta	1455
Dinobryopsis sp.	4	1074	Chrysophyta	1557
Cryptomonas sp.	4	7408	Cryptophyta	10635
Cryptomonas curvata	15	94499	Cryptophyta	10635
Cryptomonas ovata	15	32638	Cryptophyta	10635
Cryptomonas erosa	4	7087	Cryptophyta	10635
Rhodomonas lacustris	163	17698	Cryptophyta	10663
Anacystis sp.	3115	5927	Cyanobacteria	609
Anacystis delicatissima	1594	3482	Cyanobacteria	609
Aphanizomenon sp.	95	3358	Cyanobacteria	1191
Aphanothece sp.	516	1645	Cyanobacteria	636
Gloeocapsa punctata	80	335	Cyanobacteria	682
Asterionella formosa	182	126731	Diatom	3116
Fragilaria crotonensis	87	42244	Diatom	2932
Lindavia antiqua	19	16795	Diatom	
Lindavia bodanica	8	8348	Diatom	
Tabellaria fenestrata	171	459610	Diatom	3241
Ulnaria acus	8	8335	Diatom	970000
Urosolenia eriensis	38	85878	Diatom	590843
Gymnodinium uliginosa	8	31621	Dinoflagellate	10031
Parvodinium sp.	11	6065	Dinoflagellate	
Trachelomonas sp.	4	14137	Euglenid	9690
Ankistrodesmus falcatus	53	7493	Green	5877
Elakatothrix sp.	4	768	Green	9412
Monoraphidium sp.	8	5300	Green	5990
Tetrastrum sp.	15	270	Green	6260
Chlamydomonas sp.	23	13762	Green	5448
microflagellate	266	44754	Other.Flagellates	

Figure 11: Raw data from 2022-08-22 EMS site 1170009

EMS ID: 1170011	**Total Abundance (cells/mL):**	**2889**		
Collection Date: 2022-08-22	**Total Biovolume (µm³/mL):**	**644474**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Actinophryida	11	1851	Actinopoda	
Chrysococcus sp.	4	1328	Chrysophyta	1751
Chrysochromulina sp.	42	1615	Chrysophyta	2160
Chromulina sp.	19	33576	Chrysophyta	1717
Dinobryon spp.	34	53940	Chrysophyta	1515
Mallomonas sp.	4	12097	Chrysophyta	1598
Ochromonas sp.	49	10489	Chrysophyta	1455
Dinobryopsis sp.	4	1074	Chrysophyta	1557
Cryptomonas sp.	11	20372	Cryptophyta	10635
Cryptomonas curvata	15	94499	Cryptophyta	10635
Cryptomonas ovata	8	17407	Cryptophyta	10635
Rhodomonas lacustris	148	16070	Cryptophyta	10663
Anacystis sp.	1389	2643	Cyanobacteria	609
Aphanothece sp.	649	2069	Cyanobacteria	636
Chroococcus turgidus	15	5082	Cyanobacteria	654
Gloeocapsa punctata	15	63	Cyanobacteria	682
Gloeothece sp.	8	524	Cyanobacteria	703
Asterionella formosa	106	73810	Diatom	3116
Fragilaria sp.	4	1942	Diatom	2932
Lindavia intermedia	11	9723	Diatom	
Nitzschia actinastroides	23	9080	Diatom	5070
Tabellaria fenestrata	34	91384	Diatom	3241
Ulnaria acus	27	28129	Diatom	970000
Urosolenia eriensis	42	94918	Diatom	590843
Parvodinium sp.	4	2205	Dinoflagellate	
Trachelomonas sp.	4	14137	Euglenid	9690
Ankistrodesmus falcatus	4	565	Green	5877
Monoraphidium sp.	19	12588	Green	5990
microflagellate	186	31294	Other.Flagellates	

Figure 12: Raw data from 2022-08-22 EMS site 1170011