Kathlyn Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Kathlyn Lake during 2021 and 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
KATHLYN LAKE; NORTH BASIN (1131007)	2021-04-28
	2021-09-02
	2022-04-28
	2022-08-16
	Total= 4 samples

Figure 1: Aerial view of Kathlyn Lake

Samples contained low densities of green algae and high densities of cyanobacteria, flagellates, and Chrysophyta. Three samples had low concentrations of diatoms and a sample from site EMS#1131007 collected on 2022-04-28 contained high concentrations of the diatom *Asterionella formosa* (Figure 2).

Diatoms are integral to aquatic food webs because they are the foundation of the food web (jrobyn, 2019). Colony forming diatoms such as *Asterionella* sp. can avoid grazing pressures by developing into large colonies, reducing their availability for zooplankton and microscopic invertebrates (Baker, 2012). *Asterionella* species have been further studied for their ability to continue growth even in nutrient limiting conditions (Nicholls, 1992).

Figure 2: 400x magnification of diatom Asterionella formosa *(yellow arrows) bloom observed in EMS#1131007 collected on 2022-04-28*

Overview (continued)

Samples contained high biovolumes of *Ceratium*, *Mallomonas,* and flagellates (Figure 3; Figure 4).

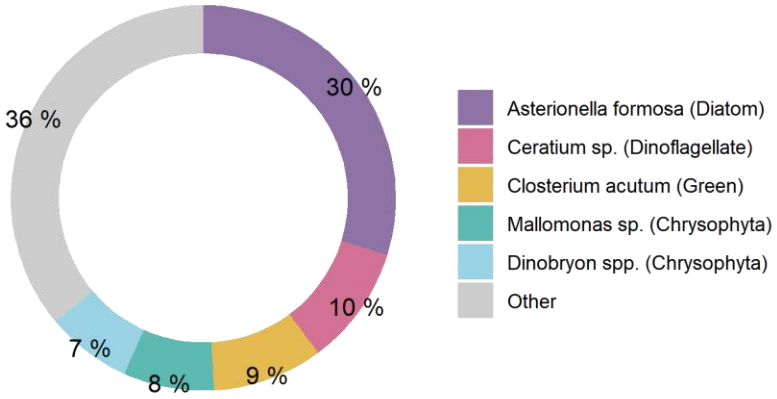

Figure 3: Dominant organisms from Kathlyn Lake North Basin (1131007) as percent of total biovolume

Synurophytes (*Mallomonas* species) are associated with negative taste and odor compounds capable of effecting water quality at high concentrations (Kim & Lee, 2011). *Dinobryon* are also associated with unpleasant fishy odors, and one species of *Dinobryon* is linked with a toxin that can affect fish vitality (Cantrell & Long, 2013; Conrad, 2013).

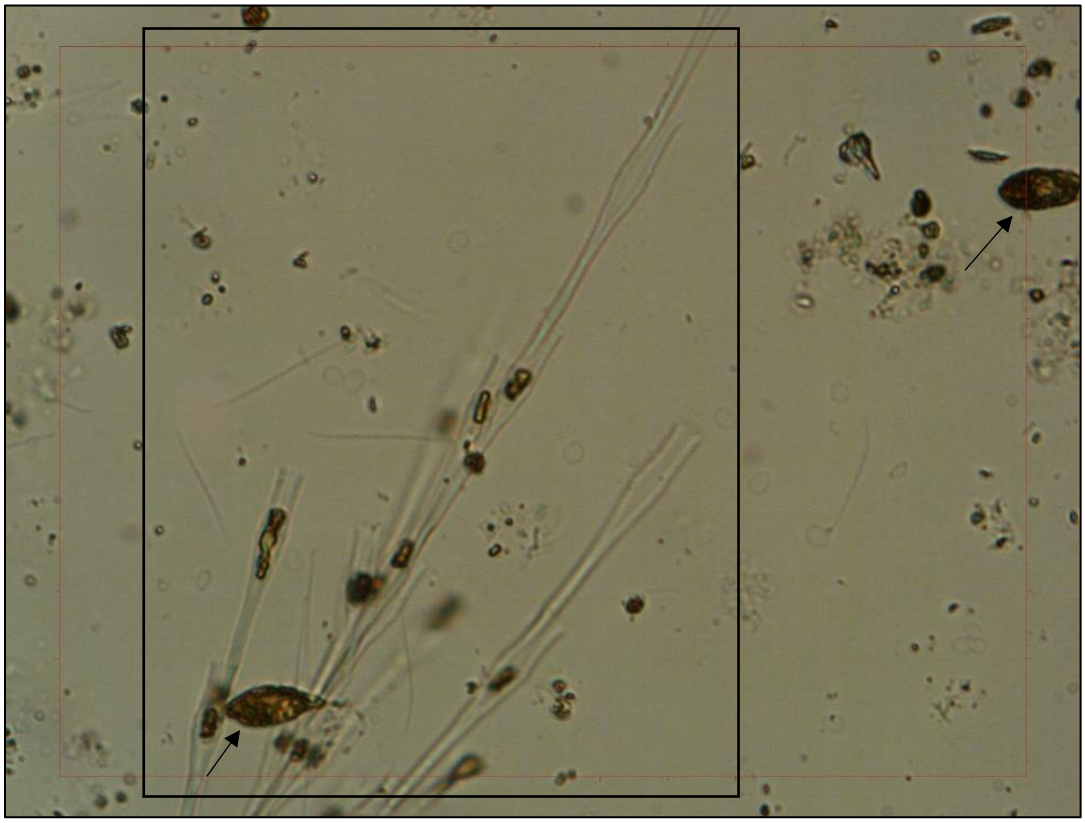

Figure 4: 400x magnification of Dinobryon cluster (box) with two Mallomonas species (arrows)

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 moderate concentrations of cyanobacteria. Dominant Genera include *Anacystis, Anabaena*, and *Planktolyngbya* (Figure 5).

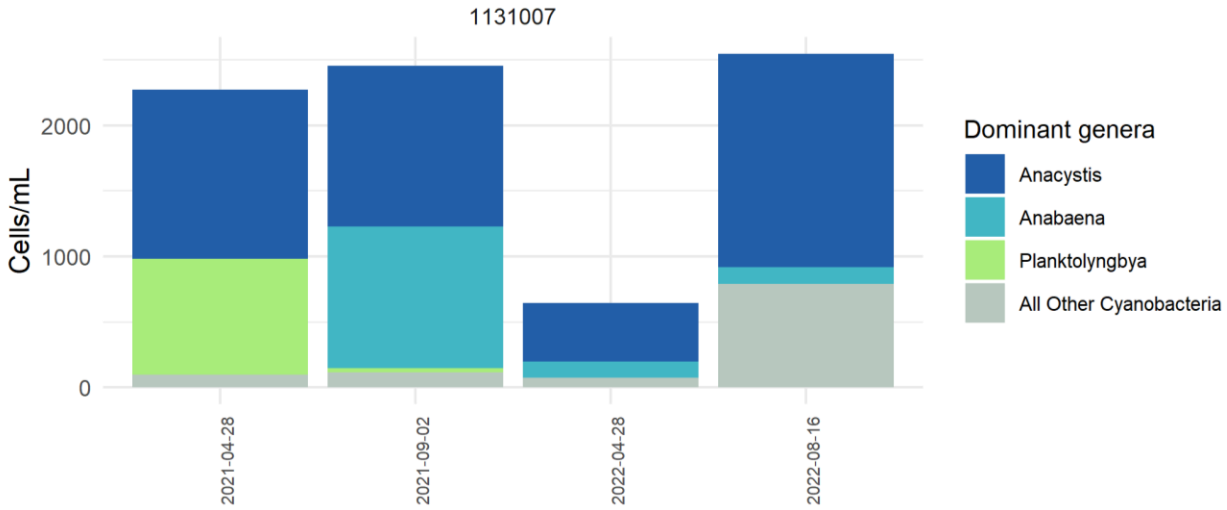

Figure 5: cell abundance for dominant cyanobacteria genera on Kathlyn Lake

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

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Anacystis	1290	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Anabaena	1078	Lyngbyatoxin LYN, Apoptogen Toxin (ApopTX), Lipopolysaccharide LPS, Cylindospermopsin CYN, Microcystin MC, Anatoxins (-a) ATX, Saxitoxins SAX neosaxitoxin NEO, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT, Taste and Odor
Planktolyngbya	888	Lyngbyatoxin LYN, Microcystin MC, BMAA

Note: * = counted in samples

Cyanobacterial Presence (Continued)

Dominant species of cyanobacteria found in Kathlyn Lake can produce cyanotoxins (Table 2).

Kathlyn Lake displays a range of cyanobacteria levels in the negligible-low risk categories, with a mean cyanobacteria abundance of 1,980 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Kathlyn Lake as compared to several authorities including the WHO and EPA.

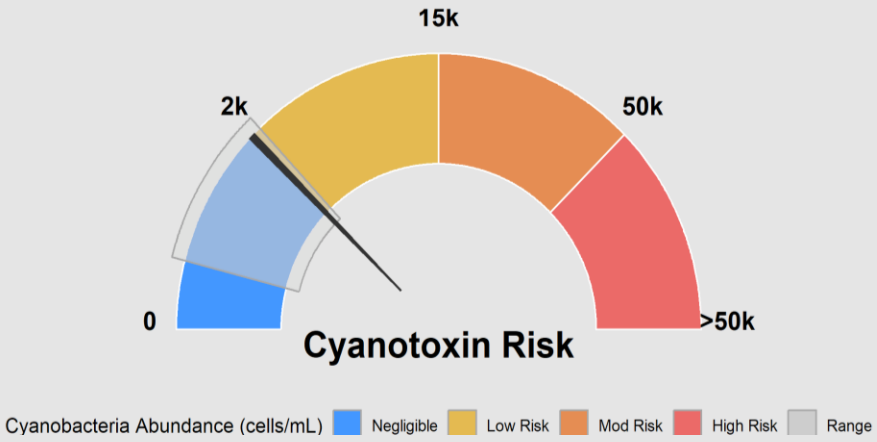

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Kathlyn Lake

Cyanobacteria frequently dominate algal communities in total cell count, but because of their small cell size their biomass is usually low relative to the other types of algae present. This is highlighted in Figure 7 where a single *Ulnaria* cell is similar size to approximately 50 cyanobacteria cells on the adjacent filaments.

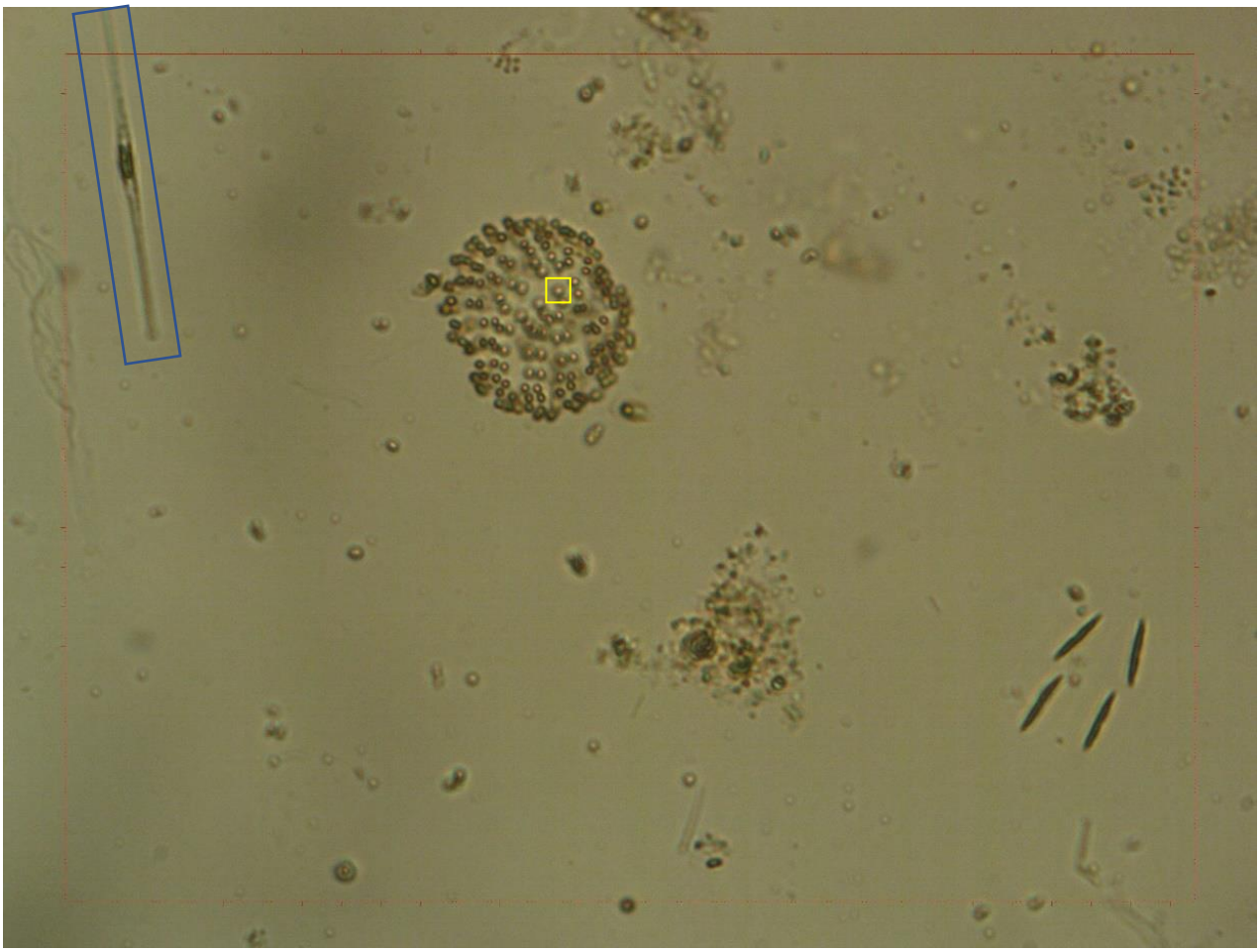

Figure 7: Size comparison of Ulnaria cell (blue box) to Snowella cell (yellow box)

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.

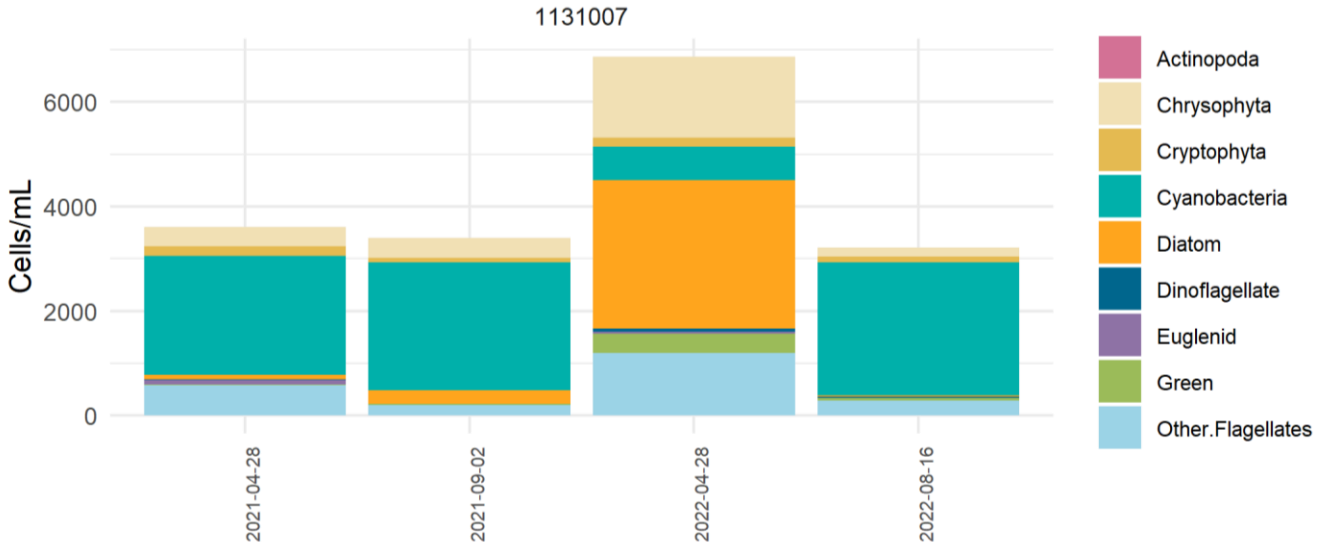

Figure 8: Cell abundance of high-level taxa groups on Kathlyn Lake

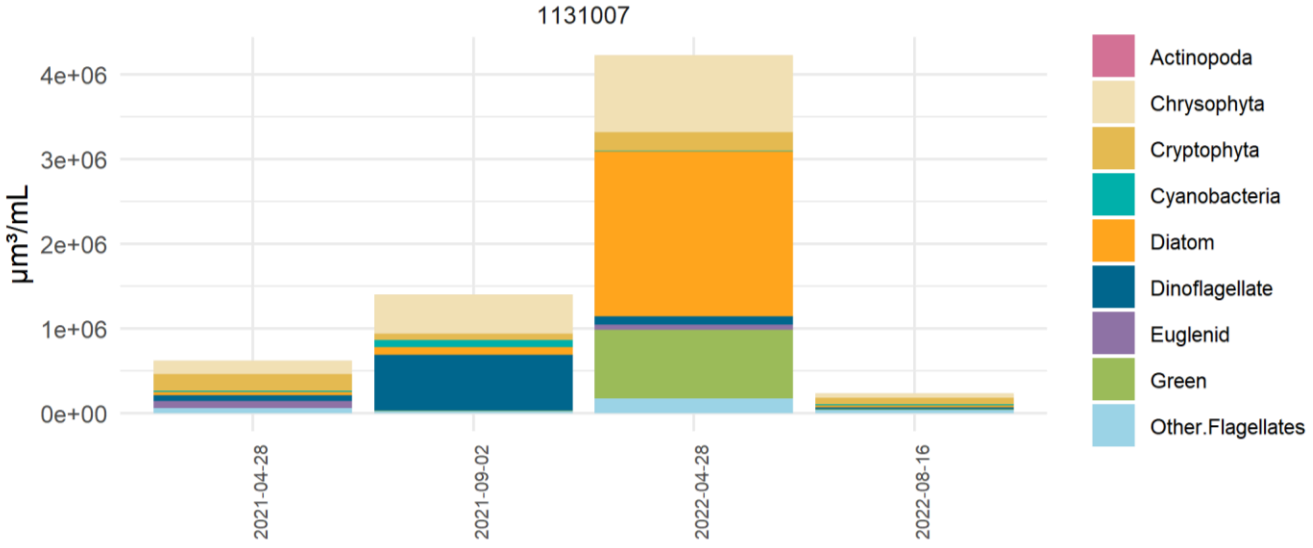

Figure 9: Biovolume of high-level taxa groups on Kathlyn Lake

References

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Appendix

Additional figures and raw data are listed below:

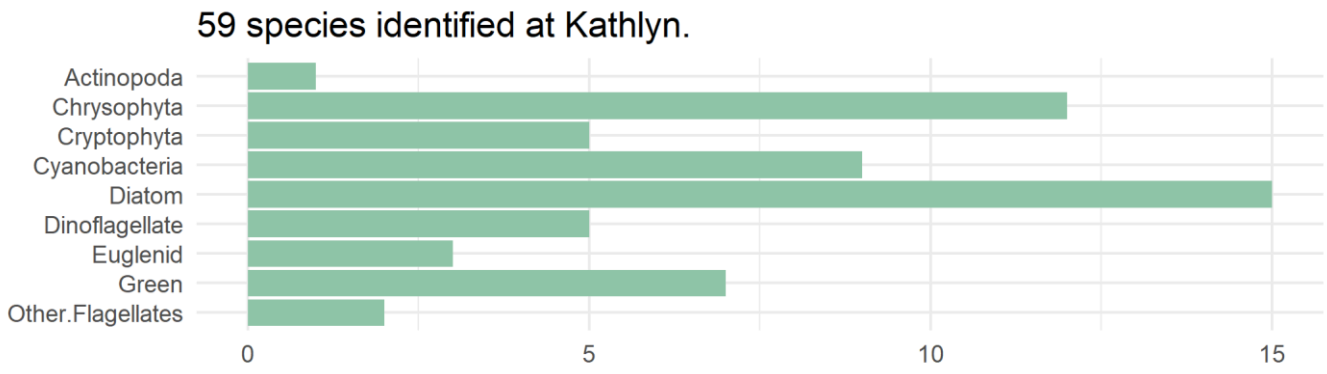

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: 1131007	**Total Abundance (cells/mL):**	**3603**		
Collection Date: 2021-04-28	**Total Biovolume (µm³/mL):**	**630253**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon sp.	30	45060	Chrysophyta	1515
Mallomonas sp.	23	69559	Chrysophyta	1598
Ochromonas sp.	91	19480	Chrysophyta	1455
Chrysochromulina sp.	178	6846	Chrysophyta	2160
Chrysococcus sp.	49	16269	Chrysophyta	1751
Cryptomonas sp.	102	188908	Cryptophyta	10635
Rhodomonas lacustris	83	9012	Cryptophyta	10663
Anacystis sp.	1290	2455	Cyanobacteria	609
Pseudanabaena sp.	95	1059	Cyanobacteria	1175
Planktolyngbya sp.	888	11038	Cyanobacteria	
Cyclotella comensis	27	12245	Diatom	2439
Nitzschia acicularis	34	26844	Diatom	5070
Nitzschia sp.	23	2109	Diatom	5070
Peridinium sp.	15	67663	Dinoflagellate	10212
Trachelomonas sp.	11	38877	Euglenid	9690
Euglena sp.	72	41469	Euglenid	9620
Spondylosium planum	8	3745	Green	8468
Pseudokephrion pseudospirale	258	12766	Other.Flagellates	
microflagellate	326	54849	Other.Flagellates	

Figure 11: Raw data from 2021-04-28 EMS site 1131007

EMS ID: 1131007	Total Abundance (cells/mL):	3402		
Collection Date: 2021-09-02	Total Biovolume (µm³/mL):	1407290		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon sp.	171	256842	Chrysophyta	1515
Mallomonas sp.	61	184483	Chrysophyta	1598
Bitrichia sp.	4	459	Chrysophyta	
Ochromonas sp.	49	10489	Chrysophyta	1455
Chrysochromulina sp.	72	2769	Chrysophyta	2160
Chrysococcus sp.	30	9961	Chrysophyta	1751
Cryptomonas sp.	38	70378	Cryptophyta	10635
Rhodomonas lacustris	42	4560	Cryptophyta	10663
Aphanocapsa sp.	114	360	Cyanobacteria	625
Anacystis sp.	1229	2339	Cyanobacteria	609
Anabaena sp.	1078	80828	Cyanobacteria	1100
Dactylococcopsis sp.	8	545	Cyanobacteria	6446
Planktolyngbya limnetica	34	174	Cyanobacteria	
Snowella lacustris	106	1162	Cyanobacteria	
Achnanthidium minutissimum	4	759	Diatom	590864
Asterionella formosa	114	79381	Diatom	3116
Cyclotella comensis	8	3628	Diatom	2439
Cyclotella meneghiniana	4	1814	Diatom	2439
Navicula spp.	4	2356	Diatom	3649
Nitzschia sp.	4	367	Diatom	5070
Ceratium sp.	4	654498	Dinoflagellate	10397
Closteriopsis sp.	11	1970	Green	5926
Cosmarium abbreviatum	8	7666	Green	7848
Pseudokephrion pseudospirale	42	2078	Other.Flagellates	
microflagellate	163	27424	Other.Flagellates	

Figure 12: Raw data from 2021-09-02 EMS site 1131007

EMS ID: 1131007	Total Abundance (cells/mL):	6868		
Collection Date: 2022-04-28	Total Biovolume (µm³/mL):	4257653		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Actinophryida	8	1346	Actinopoda	
Chrysococcus sp.	8	2656	Chrysophyta	1751
Chrysochromulina sp.	152	5846	Chrysophyta	2160
Dinobryon spp.	292	463249	Chrysophyta	1515
Mallomonas sp.	15	45365	Chrysophyta	1598
Ochromonas sp.	49	10489	Chrysophyta	1455
Dinobryopsis sp.	118	31696	Chrysophyta	1557
Mallomonas sp.	65	196580	Chrysophyta	1598
Synura sp.	842	151218	Chrysophyta	1655
Cryptomonas sp.	38	70378	Cryptophyta	10635
Cryptomonas curvata	15	94499	Cryptophyta	10635
Cryptomonas ovata	8	17407	Cryptophyta	10635
Cryptomonas erosa	15	26578	Cryptophyta	10635
Rhodomonas lacustris	95	10315	Cryptophyta	10663
Anabaena sp.	121	9073	Cyanobacteria	1100
Anacystis sp.	448	852	Cyanobacteria	609
Aphanocapsa sp.	76	240	Cyanobacteria	625
Asterionella formosa	2664	1855001	Diatom	3116
Fragilaria crotonensis	8	3884	Diatom	2932
Fragilaria tenera	106	51469	Diatom	2932
Fragilaria cf. radians	38	18451	Diatom	2932
Nitzschia spp.	11	4343	Diatom	5070
Ulnaria acus	11	11460	Diatom	970000
Gymnodinium ordinatum	34	66296	Dinoflagellate	10031
Parvodinium sp.	23	12681	Dinoflagellate	
Glenodinium sp.	11	21979	Dinoflagellate	10174
Trachelomonas volvocinopsis	15	49764	Euglenid	9690
Euglena sp.	23	13247	Euglenid	9620
Closterium acutum	15	603134	Green	7257
Chlamydomonas sp.	345	206428	Green	5448
microflagellate	1199	201729	Other.Flagellates	

Figure 13: Raw data from 2022-04-28 EMS site 1131007

EMS ID: 1131007	Total Abundance (cells/mL):	3217		
Collection Date: 2022-08-16	Total Biovolume (µm³/mL):	245554		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Actinophryida	4	673	Actinopoda	
Chrysococcus sp.	19	6308	Chrysophyta	1751
Chrysochromulina sp.	68	2615	Chrysophyta	2160
Bitrichia chodatii	4	1335	Chrysophyta	
Mallomonas hamata	11	31990	Chrysophyta	1598
Ochromonas sp.	53	11346	Chrysophyta	1455
Dinobryopsis sp.	19	5104	Chrysophyta	1557
Spumella sp.	4	29	Chrysophyta	1491
Cryptomonas sp.	30	55561	Cryptophyta	10635
Cryptomonas erosa	4	7087	Cryptophyta	10635
Rhodomonas lacustris	68	7383	Cryptophyta	10663
Anabaena sp.	129	9672	Cyanobacteria	1100
Anacystis sp.	683	1300	Cyanobacteria	609
Anacystis delicatissima	945	2064	Cyanobacteria	609
Aphanocapsa sp.	114	360	Cyanobacteria	625
Snowella sp.	675	2898	Cyanobacteria	
Lindavia intermedia	4	3536	Diatom	
Nitzschia actinastroides	4	1579	Diatom	5070
Ulnaria acus	15	15627	Diatom	970000
Gymnodinium sp.	4	8474	Dinoflagellate	10031
Parvodinium sp.	27	14886	Dinoflagellate	
Ankistrodesmus sp.	11	1729	Green	5877
Elakatothrix sp.	15	2880	Green	9412
Tetrastrum sp.	15	270	Green	6260
Chlamydomonas sp.	4	2393	Green	5448
microflagellate	288	48455	Other.Flagellates	

Figure 14: Raw data from 2022-08-16 EMS site 1131007