Langford Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Langford 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
LANGFORD LAKE; CENTER (1100953)	2021-02-24
	2021-08-24
	2022-02-25
	2022-08-25
	Total= 4 samples

Figure 1: Aerial view of Langford Lake

Samples exhibited typical seasonal patterns; a small rise in diatom density in the winter followed by cyanobacteria blooms in the summer.

Aulacoseira, *Tabellaria*, and *Stephanodiscus s*pecies were dominant diatoms in the late winter samples. Spring/ winter blooms of diatoms are common and reflective of increased temperature, light penetration, and silica in the water following ice off (Kong et al., 2021). Winter samples also demonstrated diatom degradation reflective of lowering silica levels in the late spring (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 *Aulacoseira* and *Tabellaria* can avoid grazing pressures by developing into large groups, reducing their availability for zooplankton and microscopic invertebrates (Baker, 2012).

Figure 2: Degraded Stephanodiscus sp. in spring 2021 sample vs. intact silica shell in summer 2021 sample

Overview (continued)

Small quantities of dinoflagellate *Ceratium* and desmid *Staurastrum* were identified in Langford Lake. Despite low numbers, these organisms represented 34% of biovolumes. This is because of the size of these organisms relative to other algae (Figure 3; Figure 4).

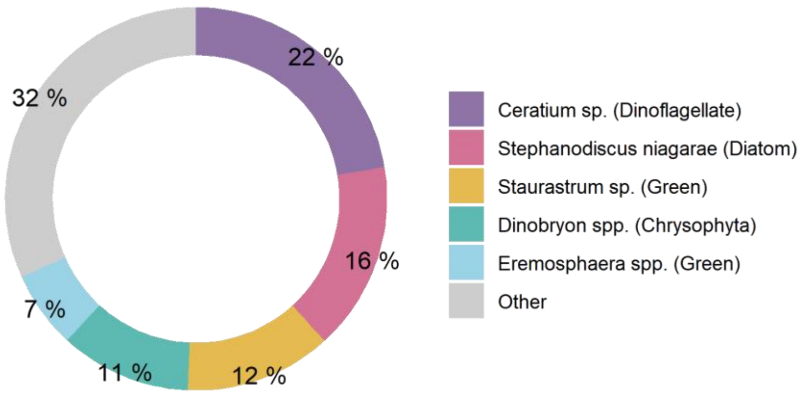

Figure 3: Dominant organisms from Langford Lake Centre (1100953) as percent of total biovolume

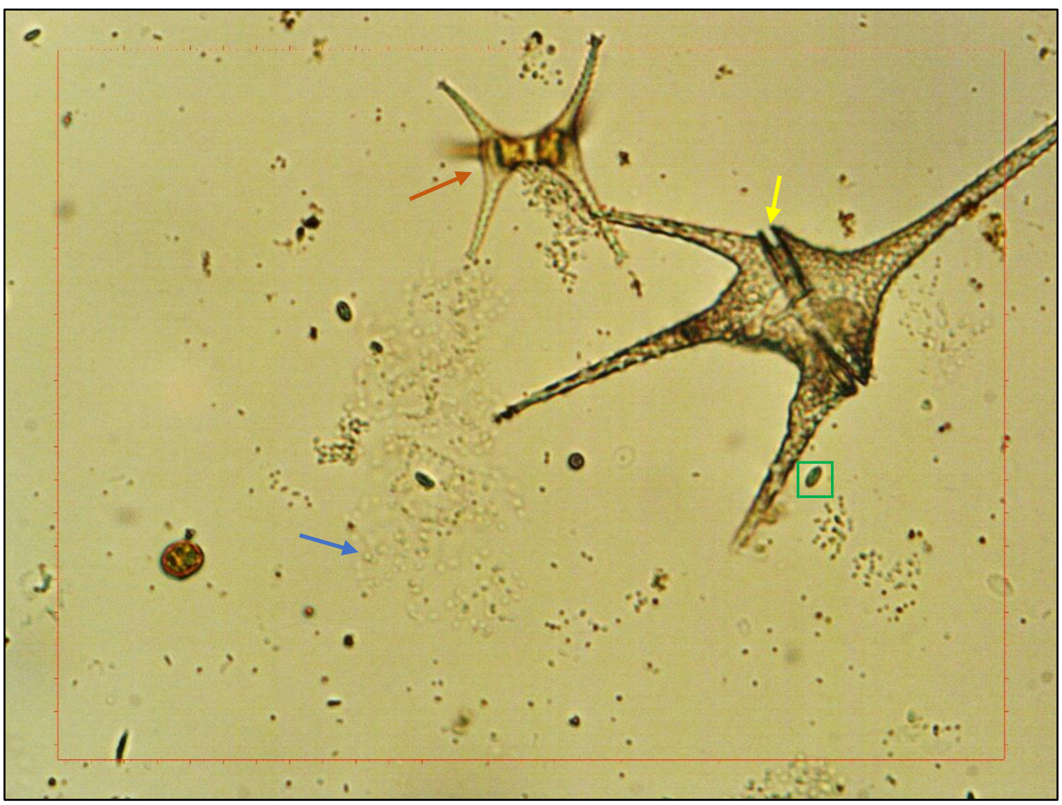

Figure 4: Size difference between dinoflagellate Ceratium (yellow arrow) and desmid Staurastrum (brown arrow) vs. green algae Oocystis (green box) and cyanobacteria Anacystis (blue arrow)

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 elevated concentrations of cyanobacteria. In counts cyanobacteria were the dominant taxa. In biovolumes cyanobacteria were low (Figure 3). Dominant cyanobacteria included genera *Woronichinia*, *Aphanizamenon*, and *Anacystis* (Figure 5).

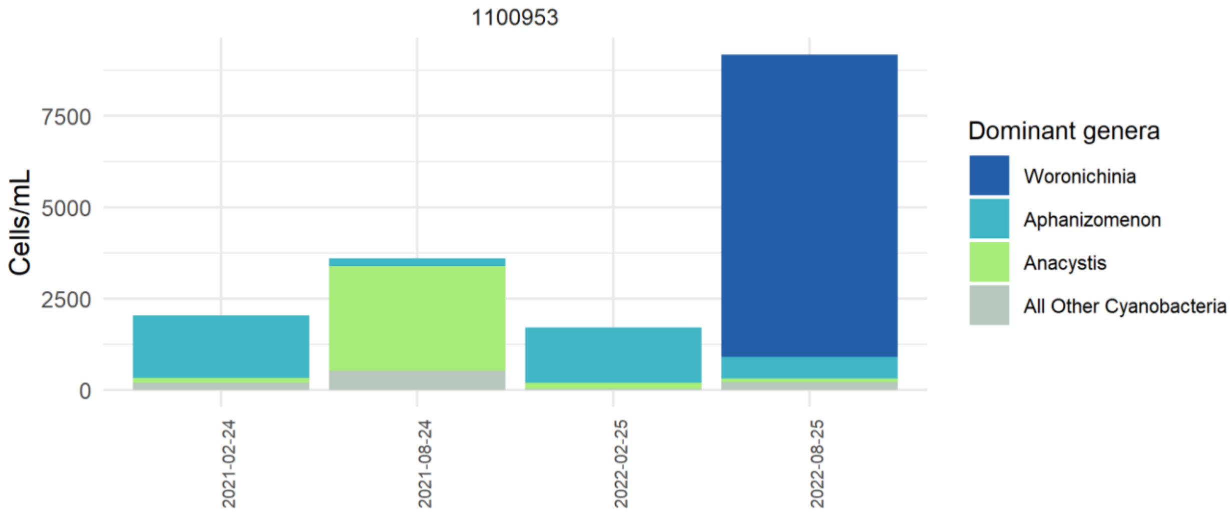

Figure 5: cell abundance for dominant cyanobacteria genera on Langford Lake

Samples from site EMS#1100953 collected on 2022-08-25, included a degraded *Woronichinia* bloom. *Woronichinia* is currently not associated with cyanotoxins but is known to bloom in association with toxic-bloom forming cyanobacteria (Services CRD, 2018). *Aphanizomenon* is a filamentous, nitrogen-fixing cyanobacteria capable of forming dense, odorous, and toxic blooms (Cirés & Ballot, 2016). *Anacystis* and *Aphanizomenon* are associated with several cyanotoxins that represent risks to public health. Illness related to cyanotoxins can include liver, kidney, and nerve cell damage, cancer, skin and gut irritation, and neurological issues (Table 2; Lance et al., 2014).

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Woronichinia	8265	No known toxins
Anacystis	2698	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Aphanizomenon	1719	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Cylindospermopsin CYN, Microcystin MC, Anatoxins (-a) ATX, Saxitoxins SAX neosaxitoxin NEO, BMAA, Anabaenopeptins APT, Taste and Odor

Note: * = counted in samples

Cyanobacterial Presence (Continued)

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

Langford Lake displayed a range of cyanobacteria levels in the negligible-low risk categories, with a mean cyanobacteria abundance of 4,136 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Langford Lake compared to several authorities including the WHO and EPA.

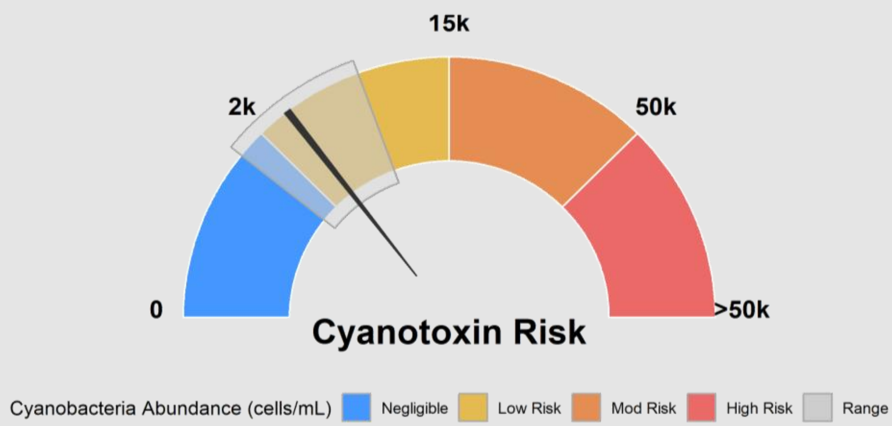

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Langford Lake

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 d*inoflagellate* cell is an equivalent size to approximately 100 cyanobacteria cells.

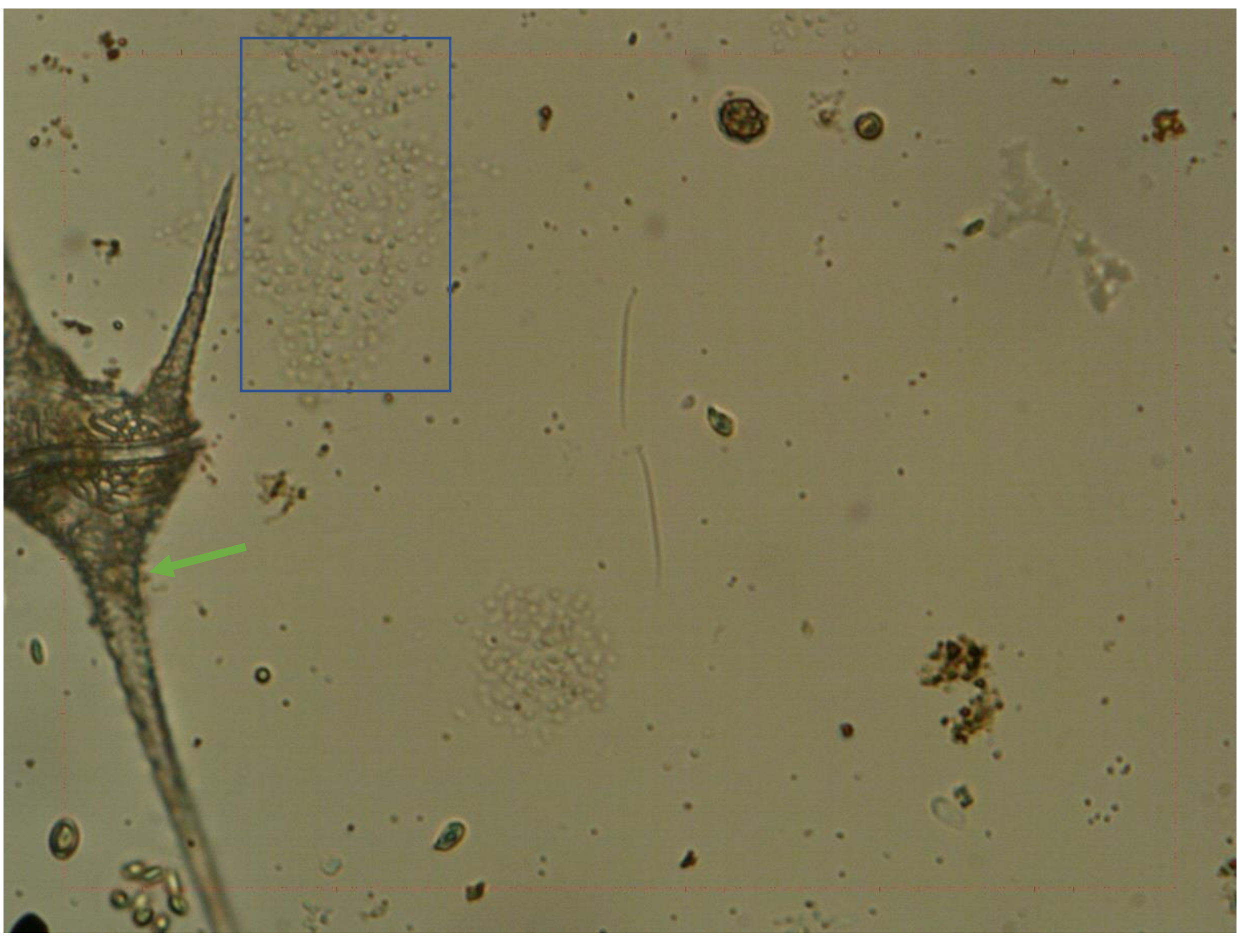

Figure 7: Size comparison of one cell of Ceratium (green arrow) to approximately 100 Anacystis cells (blue box)

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.

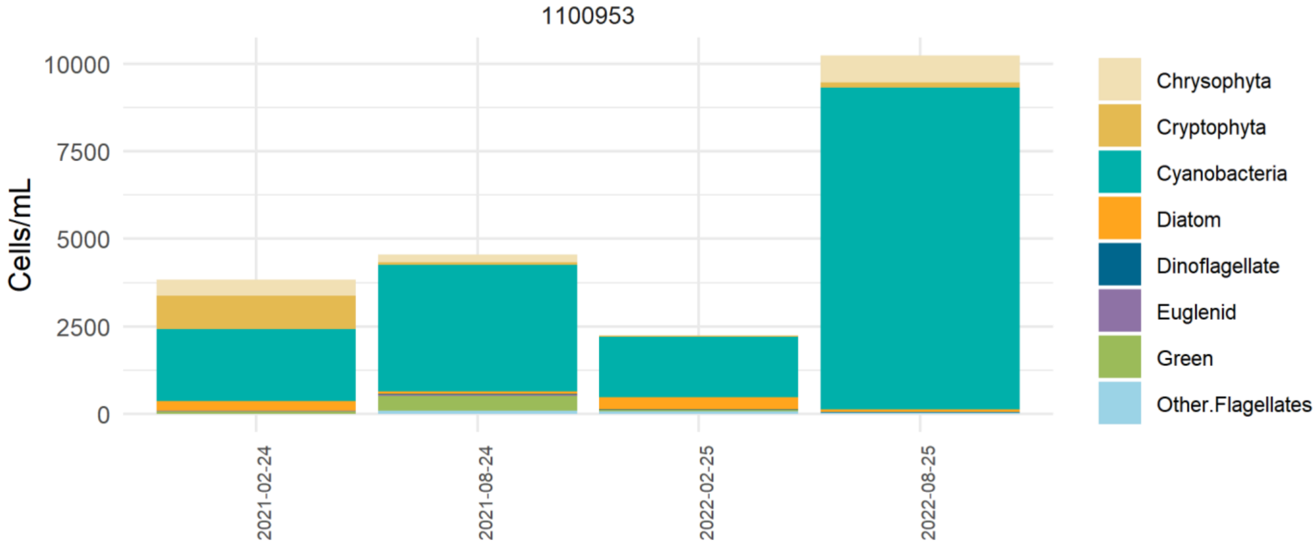

Figure 8: Cell abundance of high-level taxa groups on Langford Lake

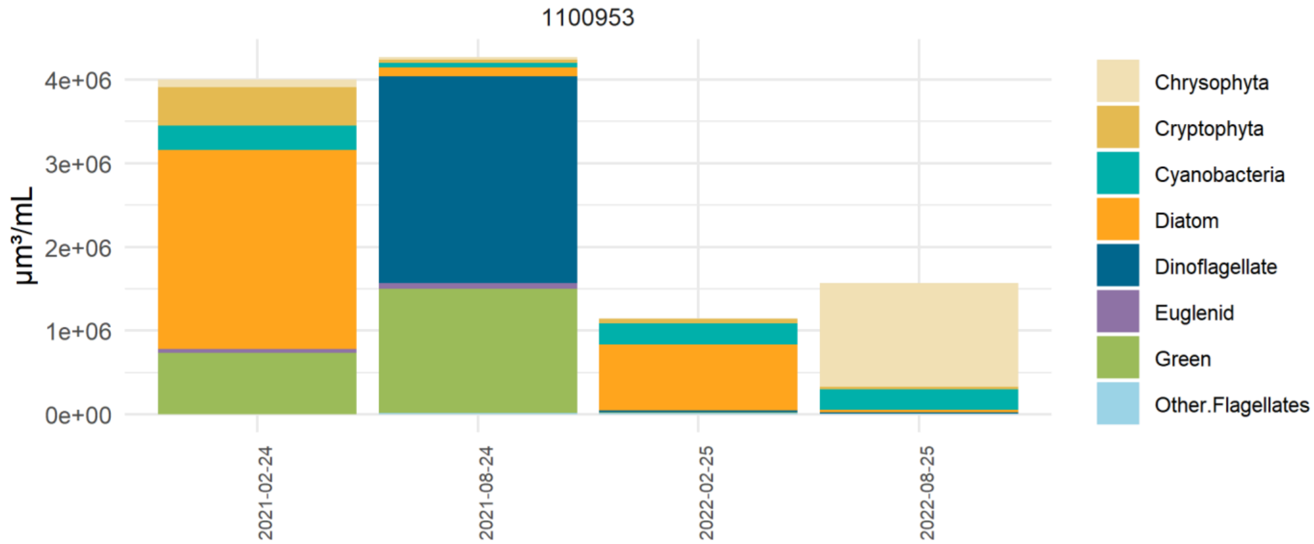

Figure 9: Biovolume of high-level taxa groups on Langford Lake

References

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Appendix

Additional figures and raw data are listed below:

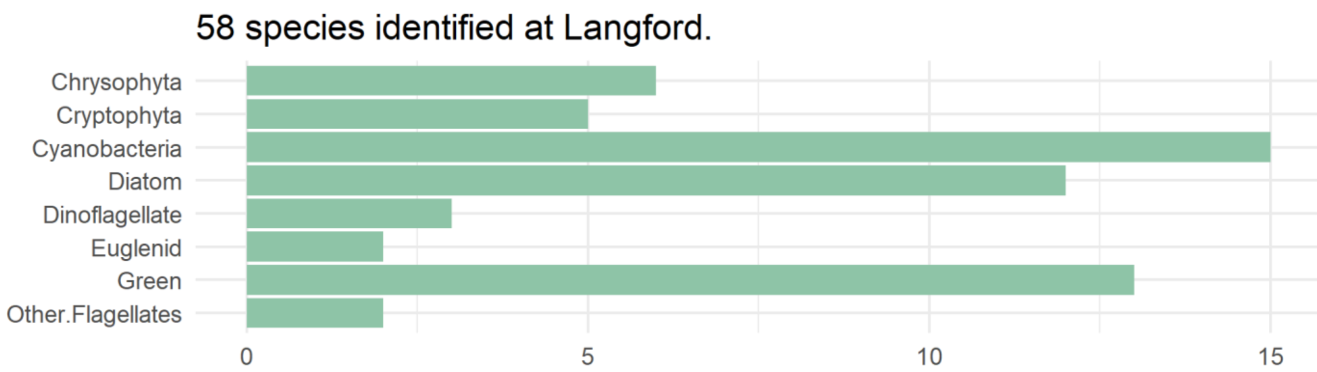

Figure 10: Identified species sorted into categories of higher-level taxa

EMS ID: 1100953	**Total Abundance (cells/mL):**	**3831**		
Collection Date: 2021-02-24	**Total Biovolume (µm³/mL):**	**4004014**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Ochromonas sp.	417	89267	Chrysophyta	1455
Chrysochromulina sp.	34	1308	Chrysophyta	2160
Chrysococcus sp.	11	3652	Chrysophyta	1751
Cryptomonas sp.	30	55561	Cryptophyta	10635
Cryptomonas curvata	46	289797	Cryptophyta	10635
Cryptomonas ovata	11	23935	Cryptophyta	10635
Rhodomonas lacustris	854	92725	Cryptophyta	10663
Aphanizomenon flos-aquae	1719	286221	Cyanobacteria	1191
Anacystis sp.	125	238	Cyanobacteria	609
Chroococcus sp.	8	268	Cyanobacteria	654
Planktolyngbya limnetica	106	542	Cyanobacteria	
Limnothrix sp.	91	1286	Cyanobacteria	
Aulacoseira granulata	23	7565	Diatom	590863
Lindavia ocellata	8	1327	Diatom	
Nitzschia sp.	4	367	Diatom	5070
Stephanodiscus hantzschii	91	655989	Diatom	2415
Stephanodiscus niagarae	163	1711703	Diatom	2415
Trachelomonas sp.	11	38877	Euglenid	9690
Euglena sp.	11	6336	Euglenid	9620
Eremosphaera spp.	11	719948	Green	5984
Mougeotia sp.	11	8489	Green	7055
Oocystis solitaria	19	4377	Green	5827
Tetrastrum sp.	15	1696	Green	6260
Scenedesmus cf. elliptica	8	1867	Green	6104
microflagellate	4	673	Other.Flagellates	

Figure 11: Raw data from 2021-02-24 EMS site 1100953

EMS ID: 1100953	Total Abundance (cells/mL):	4551		
Collection Date: 2021-08-24	Total Biovolume (µm³/mL):	4295675		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Ochromonas sp.	148	31682	Chrysophyta	1455
Chrysochromulina sp.	72	2769	Chrysophyta	2160
Chrysococcus sp.	4	1328	Chrysophyta	1751
Cryptomonas sp.	8	14816	Cryptophyta	10635
Cryptomonas ovata	4	8704	Cryptophyta	10635
Rhodomonas lacustris	68	7383	Cryptophyta	10663
Aphanizomenon flos-aquae	216	35965	Cyanobacteria	1191
Anacystis sp.	2698	5134	Cyanobacteria	609
Anacystis nidulans	167	365	Cyanobacteria	609
Gloeocapsa punctata	137	574	Cyanobacteria	682
Gloeothece sp.	205	13417	Cyanobacteria	703
Limnothrix sp.	23	325	Cyanobacteria	
Schizothrix calcicola	129	1824	Cyanobacteria	
Synechococcus sp.	34	146	Cyanobacteria	773
Asterionella formosa	30	20890	Diatom	3116
Fragilaria capucina	15	7283	Diatom	2932
Nitzschia sp.	4	367	Diatom	5070
Stephanodiscus niagarae	4	42005	Diatom	2415
Ulnaria nana	15	39375	Diatom	970000
Ceratium sp.	15	2454369	Dinoflagellate	10397
Gymnodinium sp.	4	8474	Dinoflagellate	10031
Trachelomonas sp.	19	67152	Euglenid	9690
Euglena sp.	15	8639	Euglenid	9620
Chlorella vulgaris	4	279	Green	5811
Oocystis sp.	167	3148	Green	5827
Oocystis solitaria	30	6912	Green	5827
Tetraedron caudatum	4	561	Green	5661
Tetrastrum sp.	15	1696	Green	6260
Closteriopsis acicularis	83	97782	Green	5926
Cosmarium sp.	8	4002	Green	7848
Staurastrum sp.	99	1389785	Green	7440
Scenedesmus cf. elliptica	8	1867	Green	6104
microflagellate	99	16657	Other.Flagellates	

Figure 12: Raw data from 2021-08-24 EMS site 1100953

EMS ID: 1100953	Total Abundance (cells/mL):	2244		
Collection Date: 2022-02-25	Total Biovolume (µm³/mL):	1148839		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Chrysochromulina sp.	4	154	Chrysophyta	2160
Chromulina sp.	4	7069	Chrysophyta	1717
Cryptomonas ovata	8	17407	Cryptophyta	10635
Cryptomonas erosa	4	7087	Cryptophyta	10635
Cryptomonas curvata	4	25200	Cryptophyta	10635
Rhodomonas lacustris	23	2497	Cryptophyta	10663
Aphanizomenon flos-aquae	1506	250756	Cyanobacteria	1191
Anacystis delicatissima	171	374	Cyanobacteria	609
Planktolyngbya sp.	34	423	Cyanobacteria	
Aulacoseira sp.	83	136585	Diatom	590863
Lindavia bodanica	53	55305	Diatom	
Tabellaria fenestrata	224	602062	Diatom	3241
Peridinium bipes	4	17008	Dinoflagellate	10212
Ankistrodesmus sp.	19	2987	Green	5877
Elakatothrix sp.	23	4416	Green	9412
Oocystis sp.	8	151	Green	5827
microflagellates	72	19358	Other.Flagellates	

Figure 13: Raw data from 2022-02-25 EMS site 1100953

EMS ID: 1100953	**Total Abundance (cells/mL):**	**10234**		
Collection Date: 2022-08-25	**Total Biovolume (µm³/mL):**	**1571801**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon spp.	767	1216823	Chrysophyta	1515
Mallomonas sp.	8	24194	Chrysophyta	1598
Cryptomonas sp.	8	14816	Cryptophyta	10635
Rhodomonas lacustris	137	14875	Cryptophyta	10663
Anabaena sp.	23	1725	Cyanobacteria	1100
Anabaena flos-aquae	137	26663	Cyanobacteria	1100
Aphanizomenon flos-aquae	600	99903	Cyanobacteria	1191
Anacystis nidulans	91	199	Cyanobacteria	609
Gloeocapsa punctata	61	256	Cyanobacteria	682
Woronichinia naegeliana	8265	112547	Cyanobacteria	
Fragilaria crotonensis	76	36902	Diatom	2932
Parvodinium sp.	23	12681	Dinoflagellate	
microflagellates	38	10217	Other.Flagellates	

Figure 14: Raw data from 2022-08-25 EMS site 1100953