Sugar Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Sugar 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
SUGAR L @ SITKUM CR. (0500119)	2021-04-27
	2021-08-25
	2022-04-28
	2022-09-01
Total= 4 samples	

Figure 1: Aerial view of Sugar Lake

Samples contained low densities of green algae, Desmids, Cryptophyta, Dinoflagellates, micro-flagellates, and diatoms. Sugar Lake contained very low total agal densities (Figure 2).

Figure 2: 400x magnification of a typical microscopic frame, note the low levels of detritus, algae, and bacteria

Overview (continued)

Chrysophyta dominated biovolumes (Figure 3). Low densities of algae present in all samples enabled small blooms of *Dinobryon sertularia*, *Dinobryon bavaricum*, and *Dinobryon sociale* to comprise 35% of total biovolume.

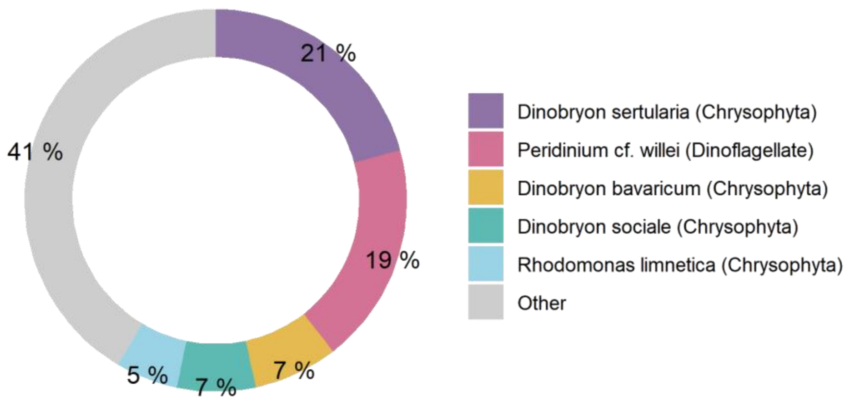

Figure 3: Dominant organisms from Sugar Lake (0500119) as percent of total biovolume

Samples collected in 2021 contained elevated densities of Chromalinales (genus *Dinobryon*). *Dinobryon* blooms are associated with unpleasant fishy odors, and one genus of *Dinobryon* is linked with a toxin that can affect fish vitality (Cantrell & Long, 2013; Conrad, 2013).

Out of the eleven species of Chrysophyta identified in Sugar Lake, three were Dinobryon (Figure 4). Fifty-one species of algal were identified in the sugar lake samples.

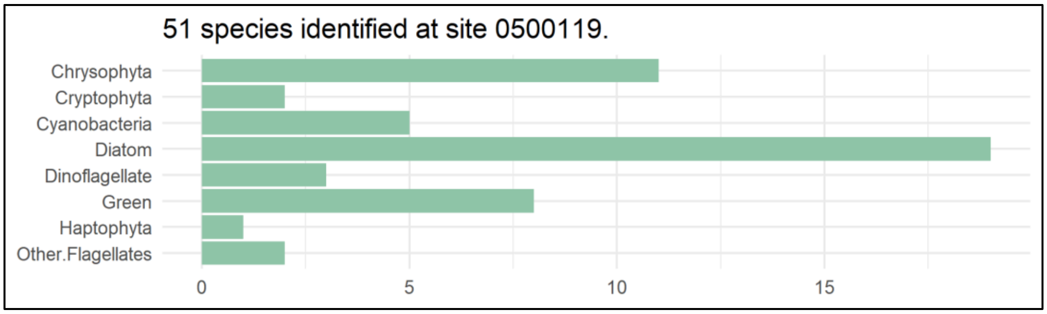

Figure 4: Distinct species observed in Sugar Lake sorted into higher level taxa

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

Samples demonstrated low cyanobacteria densities; *Aphanocapsa* was the dominant genus. *Gloeocapsa* and *Anacystis* species were also observed (Figure 5).

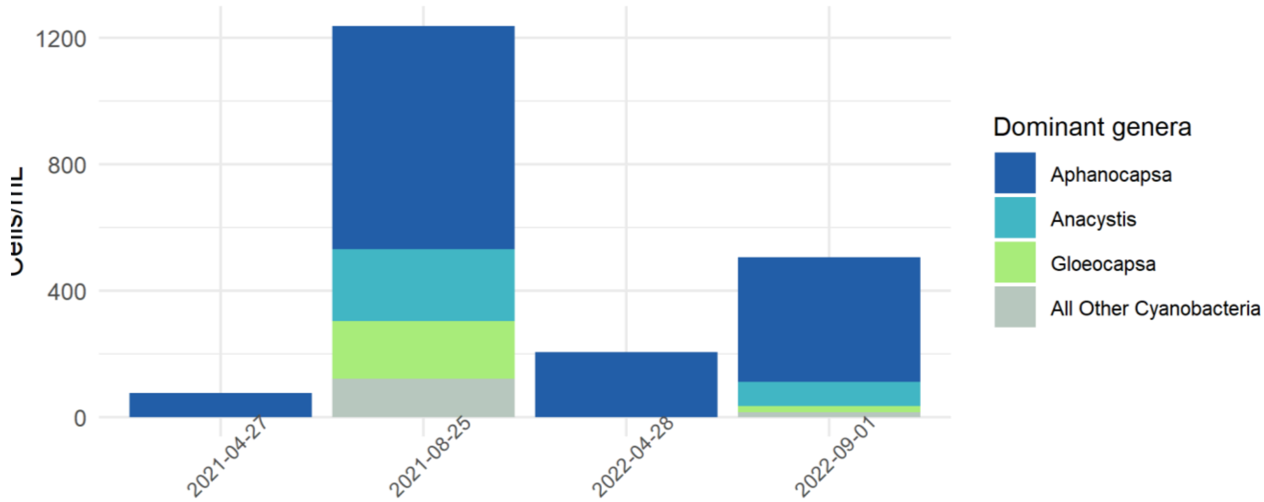

Figure 5: cell abundance for dominant cyanobacteria genera on Sugar Lake

When *Aphanocapsa* is present in high concentrations, it can be associated with several cyanotoxins that represent risks to public health (Table 2). Other dominant cyanobacteria identified in Sugar Lake samples are also associated with several cyanotoxins. Concentration of cyanobacteria observed in Sugar Lake were too low to represent risks to human health (Lance et al., 2014). *Gloeocapsa* species are not known to produce toxins. Concentration of cyanobacteria observed in Sugar Lake were too low to represent risks to human health.

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

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Aphanocapsa	706	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, BMAA
Anacystis	228	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Gloeocapsa	182	No toxins identified

Note: * = counted in samples

Cyanobacterial Presence (Continued)

Dominant species of cyanobacteria found in Sugar Lake are capable of producing cyanotoxins (Table 2).

Sugar Lake displayed cyanobacteria levels in the negligible risk category, with a mean cyanobacteria abundance of 506 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Sugar Lake compared to alert levels defined by several authorities including the WHO and EPA.

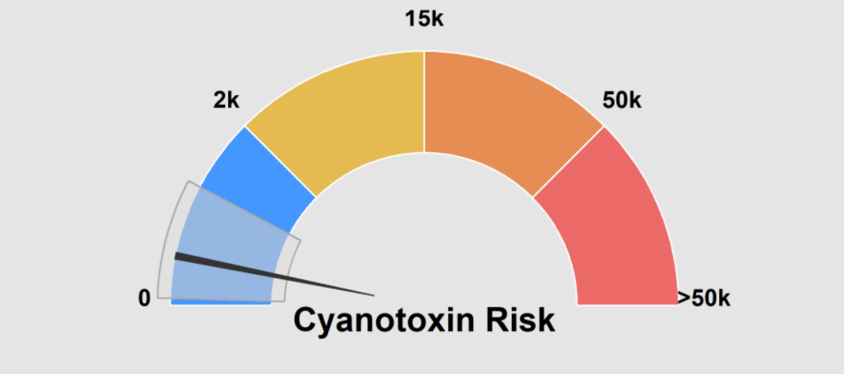

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Sugar Lake

Algae are a diverse morphological group. This is highlighted in Figure 7 where a single *Dinobryon cell* dwarfs the adjacent micro-flagellates.

Figure 7: Size comparison of a Dinobryon cell (red box) to micro-flagellates (green arrows)

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.

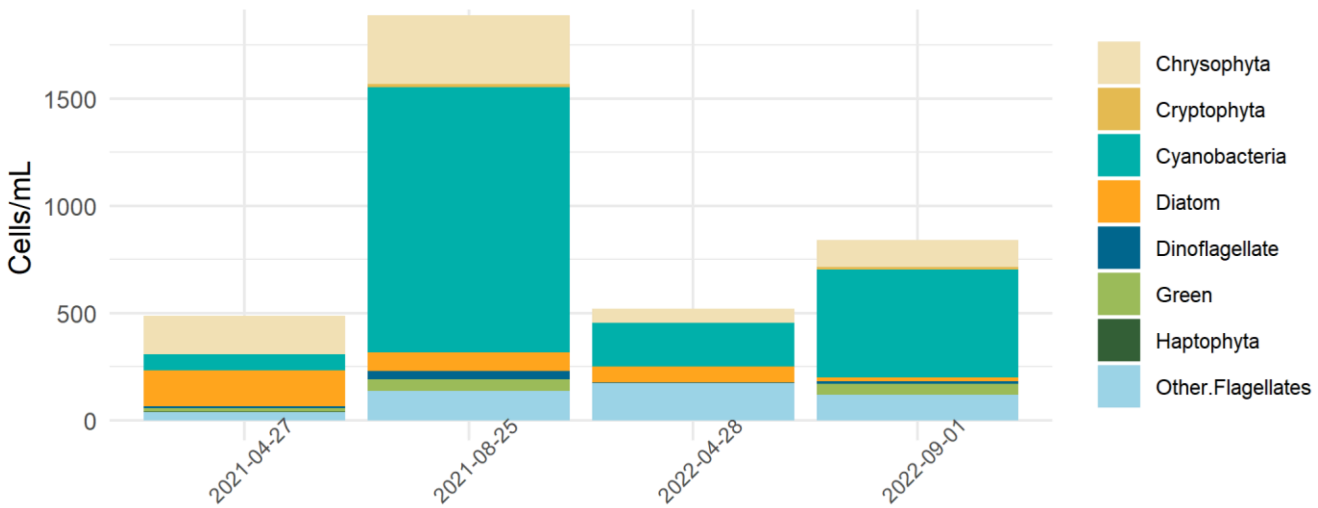

Figure 8: Cell abundance of high-level taxa groups on Sugar Lake

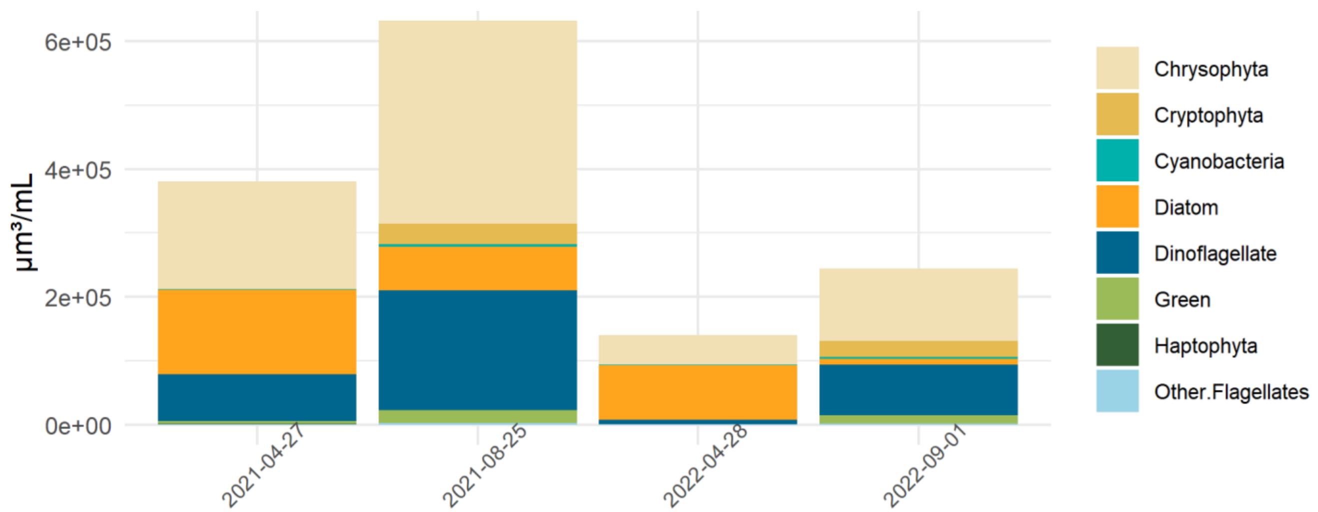

Figure 9: Biovolume of high-level taxa groups on Sugar Lake

References

Cantrell, R., & Long, B. (2013). *Dinobryon*. PBWorks. http://ohapbio12.pbworks.com/w/page/51731561/Dinobryon

Conrad, J. (2013). *DINOBRYON, a Golden Alga*. Jim Conrad's Naturalist Newsletter. https://www.backyardnature.net/n/x/dinobryo.htm

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.

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: 0500119	**Total Abundance (cells/mL):**	**487**	
Collection Date: 2021-04-27	Total Biovolume (µm³/mL):	380650	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chroomonas acuta	15	8103	Chrysophyta
Dinobryon bavaricum	4	8706	Chrysophyta
Dinobryon sertularia	46	56562	Chrysophyta
Dinobryon sociale	61	74432	Chrysophyta
Kephyrion sp.	11	2304	Chrysophyta
Chrysococcus sp.	8	2656	Chrysophyta
Ochromonas spp.	19	3790	Chrysophyta
Chromulina sp.	4	7069	Chrysophyta
Rhodomonas limnetica	8	4189	Chrysophyta
Chrysopyxis sp.	4	1072	Chrysophyta
Aphanocapsa elachista	76	212	Cyanobacteria
Achnanthidium minutissima	15	1590	Diatom
Asterionella formosa	4	2785	Diatom
Cyclotella glomerata	38	23911	Diatom
Lindavia ocelata	23	16258	Diatom
Diatoma hiemale	4	4212	Diatom
Fragilaria crotonensis	8	3884	Diatom
Meridion circulare	4	3344	Diatom
Nitzschia sp.	8	734	Diatom
Nitzschia linearis	4	5047	Diatom
Nitzschia palea	8	1682	Diatom
Ulnaria acus	15	15627	Diatom
Ulnaria nana	8	21000	Diatom
Tabellaria fenestrata	8	21502	Diatom
Tabellaria flocculosa	4	10751	Diatom
Staurosira construens	15	636	Diatom
Peridinium cf. willei	4	65462	Dinoflagellate
Glenodinium sp.	4	7992	Dinoflagellate
Sphaerocystis schroeteri	15	3245	Green
Derepyxis sp.	4	1257	Haptophyta
nanoflagellates	19	572	Other.Flagellates
picoflagellates	19	64	Other.Flagellates

Figure 10: Raw data from 2021-04-27 EMS site 0500119

EMS ID: 0500119	**Total Abundance (cells/mL):**	**1889**	
Collection Date: 2021-08-25	Total Biovolume (µm³/mL):	632535	
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**
Chroomonas acuta	34	18367	Chrysophyta
Dinobryon bavaricum	19	41354	Chrysophyta
Dinobryon sertularia	148	181983	Chrysophyta
Dinobryon sociale	15	18303	Chrysophyta
Chrysococcus sp.	15	4980	Chrysophyta
Ochromonas spp.	15	2992	Chrysophyta
Chromulina sp.	8	14137	Chrysophyta
Rhodomonas limnetica	68	35605	Chrysophyta
Cryptomonas ovata	15	32638	Cryptophyta
Aphanocapsa elachista	706	1971	Cyanobacteria
Gloeocapsa punctata	182	762	Cyanobacteria
Planktolyngbya limnetica	121	619	Cyanobacteria
Anacystis cyanea	228	343	Cyanobacteria
Asterionella formosa	83	57795	Diatom
Tabellaria fenestrata	4	10751	Diatom
Peridinium cf. willei	8	130924	Dinoflagellate
Peridinium inconspicuum	19	34797	Dinoflagellate
Glenodinium sp.	11	21979	Dinoflagellate
Crucigenia rectangularis	30	9188	Green
Mougeotia sp.	4	3087	Green
Oocystis parva	4	899	Green
Schroederia setigera	4	1018	Green
Spondylosium planum	11	5149	Green
nanoflagellates	91	2740	Other.Flagellates
picoflagellates	46	154	Other.Flagellates

Figure 11: Raw data from 2021-08-25 EMS site 0500119

EMS ID: 0500119	**Total Abundance (cells/mL):**	**521**		
Collection Date: 2022-04-2	**Total Biovolume (µm³/mL):**	**140453**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Bitrichia sp.	4	459	Chrysophyta	
Chroomonas acuta	8	4322	Chrysophyta	10613
Dinobryon bavaricum	4	8706	Chrysophyta	1515
Dinobryon sertularia	8	9837	Chrysophyta	1515
Kephyrion sp.	4	838	Chrysophyta	1764
Ochromonas spp.	8	1596	Chrysophyta	1455
Chromulina sp.	4	7069	Chrysophyta	1717
Rhodomonas limnetica	27	14137	Chrysophyta	10663
Aphanocapsa elachista	205	572	Cyanobacteria	625
Asterionella formosa	4	2785	Diatom	3116
Cyclotella glomerata	27	16989	Diatom	2439
Lindavia ocellata	8	1327	Diatom	
Diploneis sp.	4	15217	Diatom	4325
Gomphonema minutum	8	11017	Diatom	4911
Nitzschia sp.	11	1009	Diatom	5070
Nitzschia linearis	4	5047	Diatom	5070
Ulnaria nana	4	10500	Diatom	970000
Ulnaria ulna	4	21019	Diatom	970000
Peridinium inconspicuum	4	7326	Dinoflagellate	10212
nanoflagellates	4	120	Other.Flagellates	
picoflagellates	167	561	Other.Flagellates	

Figure 12: Raw data from 2022-04-28 EMS site 0500119

EMS ID: 0500119	**Total Abundance (cells/mL):**	**839**		
Collection Date: 2022-09-01	**Total Biovolume (µm³/mL):**	**244652**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Chroomonas acuta	8	4322	Chrysophyta	10613
Dinobryon bavaricum	19	41354	Chrysophyta	1515
Dinobryon sertularia	34	41807	Chrysophyta	1515
Kephyrion sp.	8	1676	Chrysophyta	1764
Chrysococcus sp.	8	2656	Chrysophyta	1751
Ochromonas spp.	8	1596	Chrysophyta	1455
Rhodomonas limnetica	38	19897	Chrysophyta	10663
Cryptomonas marssonii	4	8167	Cryptophyta	10635
Cryptomonas ovata	8	17407	Cryptophyta	10635
Aphanocapsa elachista	395	1103	Cyanobacteria	625
Gloeocapsa punctata	19	80	Cyanobacteria	682
Chroococcus limneticus	15	1915	Cyanobacteria	654
Anacystis cyanea	76	114	Cyanobacteria	609
Cyclotella glomerata	11	6922	Diatom	2439
Lindavia ocellata	8	1327	Diatom	
Peridinium cf. willei	4	65462	Dinoflagellate	10212
Peridinium inconspicuum	8	14652	Dinoflagellate	10212
Crucigenia rectangularis	15	4594	Green	6225
Spondylosium planum	8	3745	Green	8468
Chlamydomonas spp.	4	3970	Green	5448
Tetrastrum sp.	23	473	Green	6260
nanoflagellates	38	1144	Other.Flagellates	
picoflagellates	80	269	Other.Flagellates	

Figure 13: Raw data from 2022-09-01 EMS site 0500119