Alta Lake Phytoplankton Summary Report 2021-2022

Overview

Samples were collected from one site on Alta Lake during 2021 and 2022 (Figure 2; Table 1). Algae were identified to the taxonomic level of genus and grouped into broad alga types for analysis.

Table 1: Sample sites and dates sampled in 2021 and 2022

Sample Site (EMS#)	Dates
ALTA LAKE, NORTH DEEP SITE (E275784)	2021-04-22
	2021-09-01
	2022-04-13
	2022-08-18
	Total= 4 samples

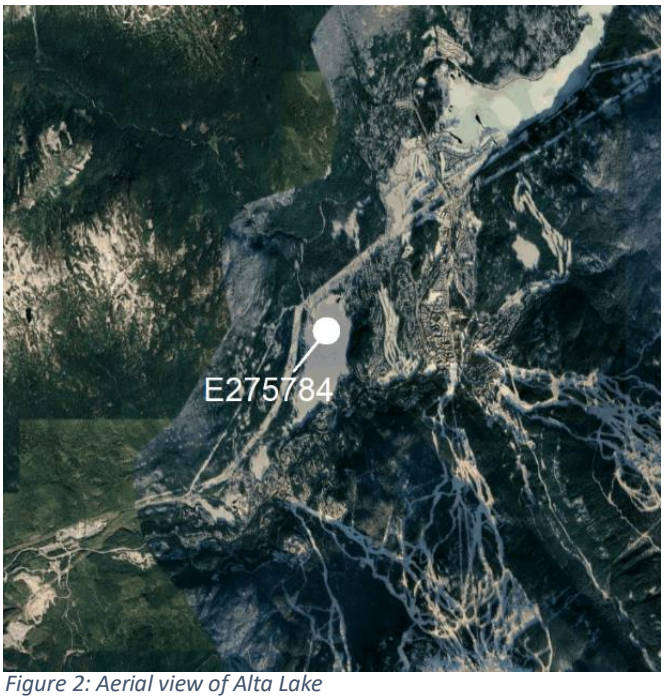

Figure 2: Aerial view of Alta Lake

Samples contained moderate concentrations of diatoms; *Aulacoseira* and *Tabellaria* species were dominant (Figure 1).

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* sp. can avoid grazing pressures by developing into large colonies reducing their availability for zooplankton and microscopic invertebrates (Baker, 2012).

Aulacoseira blooms are not linked with toxic or problematic effects, rather they are known to provide an abundant food source for various predators

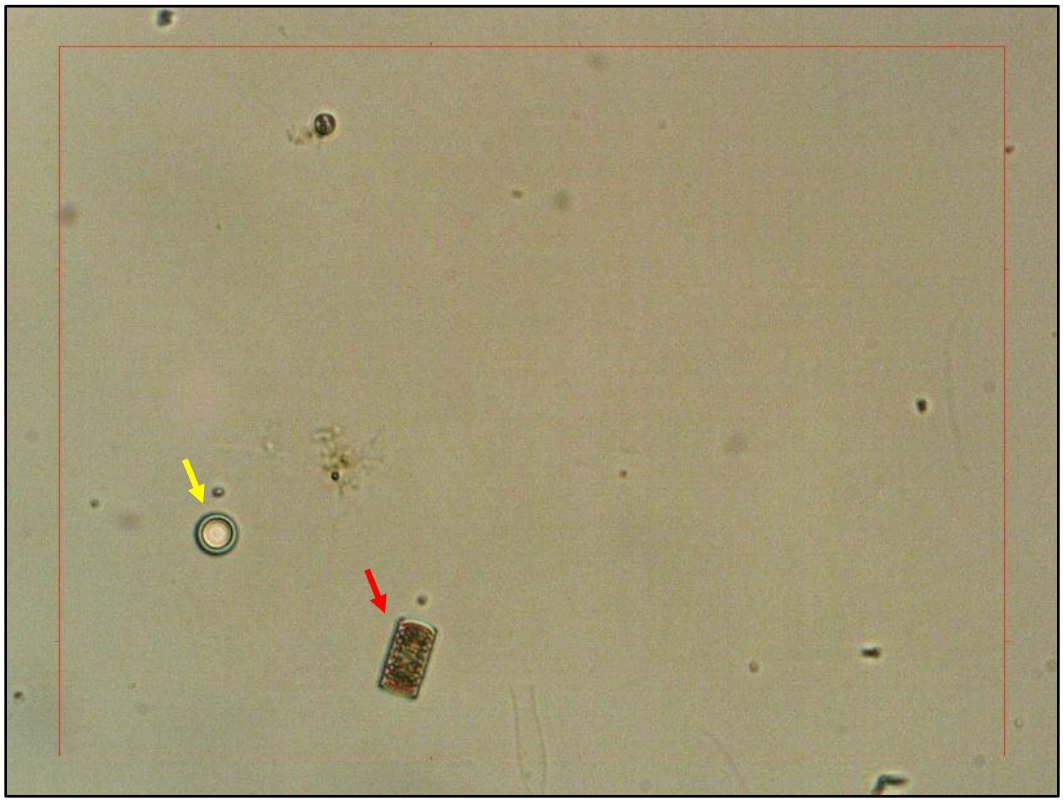

Figure 1: 400x magnification of EMS E275784 showing valve (yellow arrow) and girdle view (red arrow) of the diatom Aulacoseira.

Overview (continued)

Two samples (2021-09-01 and 2022-04-13) contained elevated densities of Chrysophyta genus *Dinobryon* (Figure 3; Figure 4).

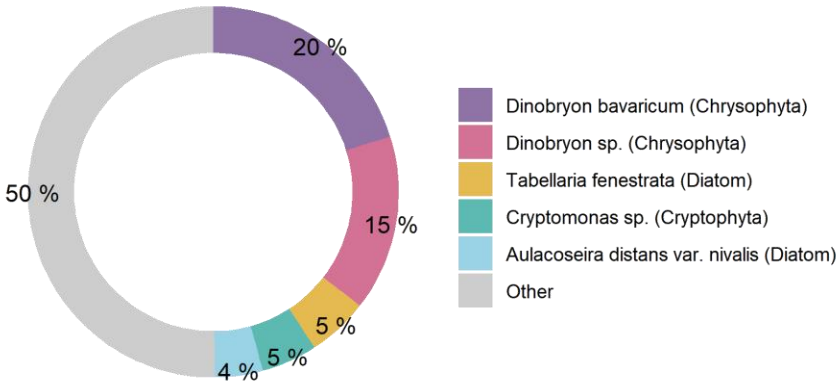

Figure 3: Dominant organisms from Alta Lake, North Deep Site (E275784) as percent of total biovolume

Dinobryon blooms are 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).

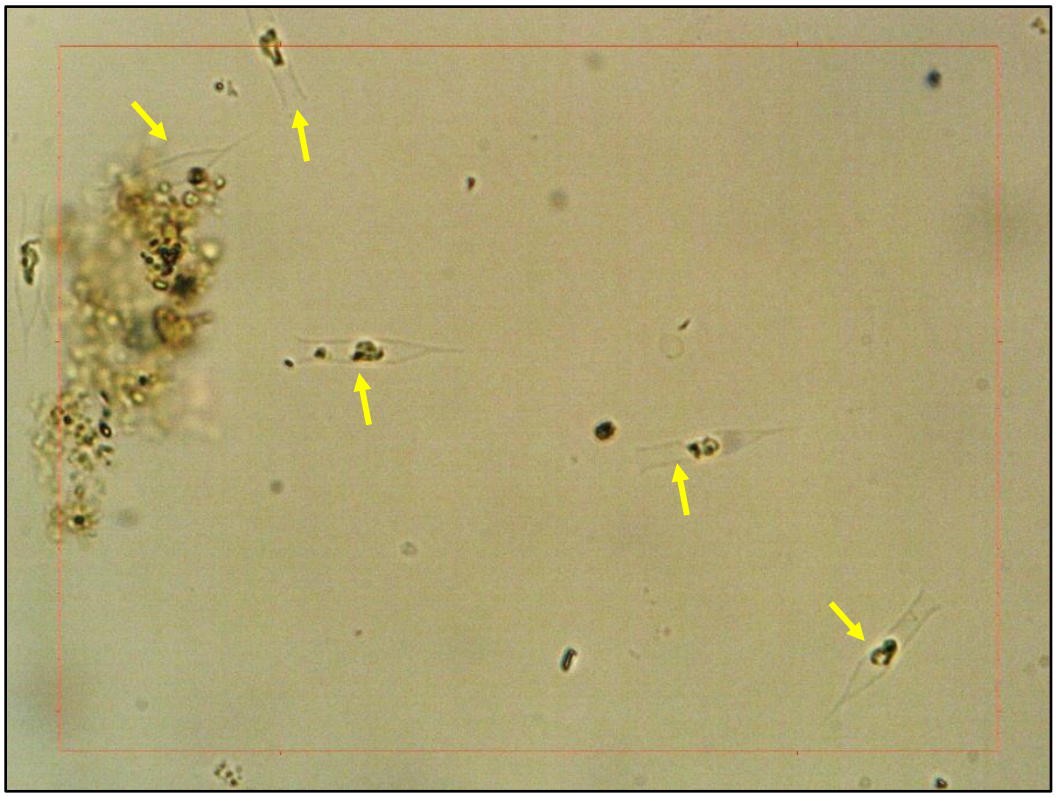

Figure 4: 400x magnification of EMS site #E275784 taken on 2022-04-13 Demonstrating density of Dinobryon (yellow arrows)

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

Cyanobacteria concentrations were much higher in the summer samples, dominant genera include *Anacystis*, *Aphanocapsa*, and *Planktolyngbya* (Figure 5).

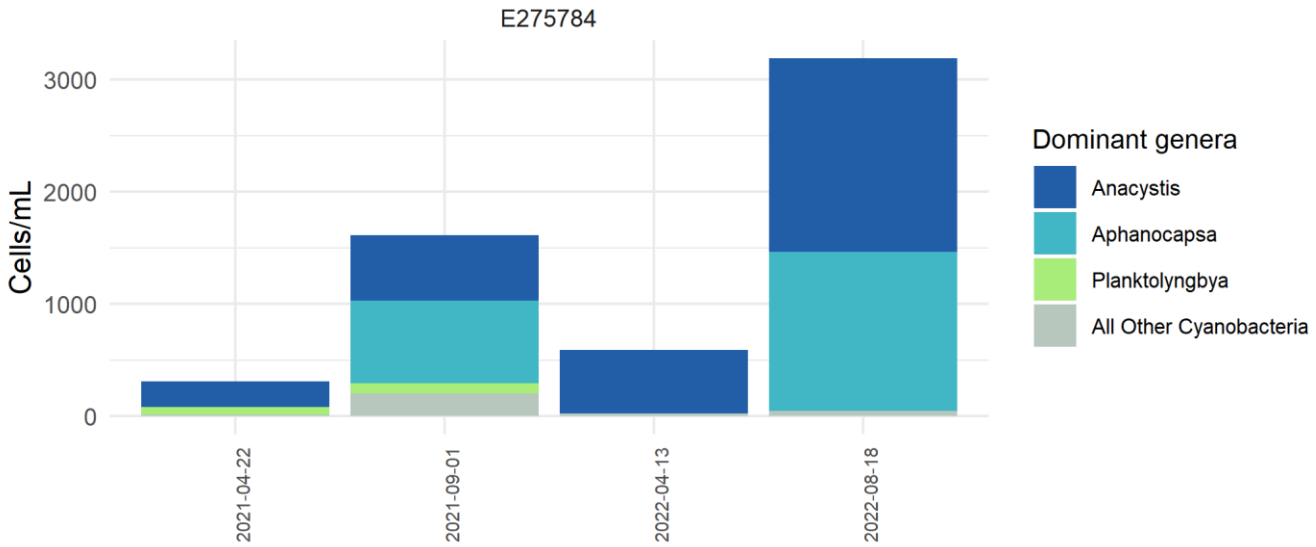

Figure 5: Cell abundance for dominant cyanobacteria genera on Alta Lake

Anacystis, *Aphanocapsa*, and *Planktolyngbya* are associated with cyanotoxins that represent risks for 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 Alta Lake and their associated toxins

Genus	Maximum Abundance* (cells/mL)	Toxins Produced
Anacystis	1727 cells/mL	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT
Aphanocapsa	1419 cells/mL	Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, BMAA
Planktolyngbya	133 cells/mL	Lyngbyatoxin LYN, Microcystin MC, BMAA

Note: * = counted in samples

Cyanobacterial Presence (Continued)

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

Alta Lake contained cyanobacteria concentrations in the negligible risk category, with a mean cyanobacteria abundance of 1,426 cells/mL. (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Alta Lake as compared to alert levels defined by several authorities including the WHO and EPA.

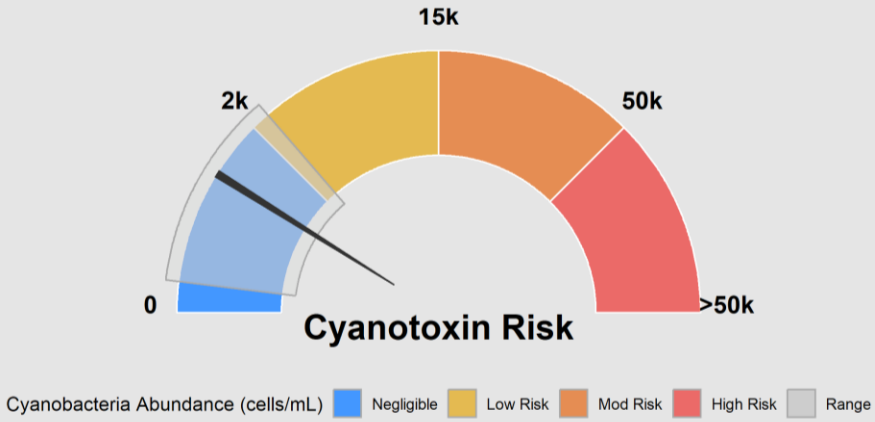

Figure 6: Cyanotoxin risk posed by cyanobacteria blooms on Alta Lake

Cyanobacteria and micro-flagellates 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 (Figure 7).

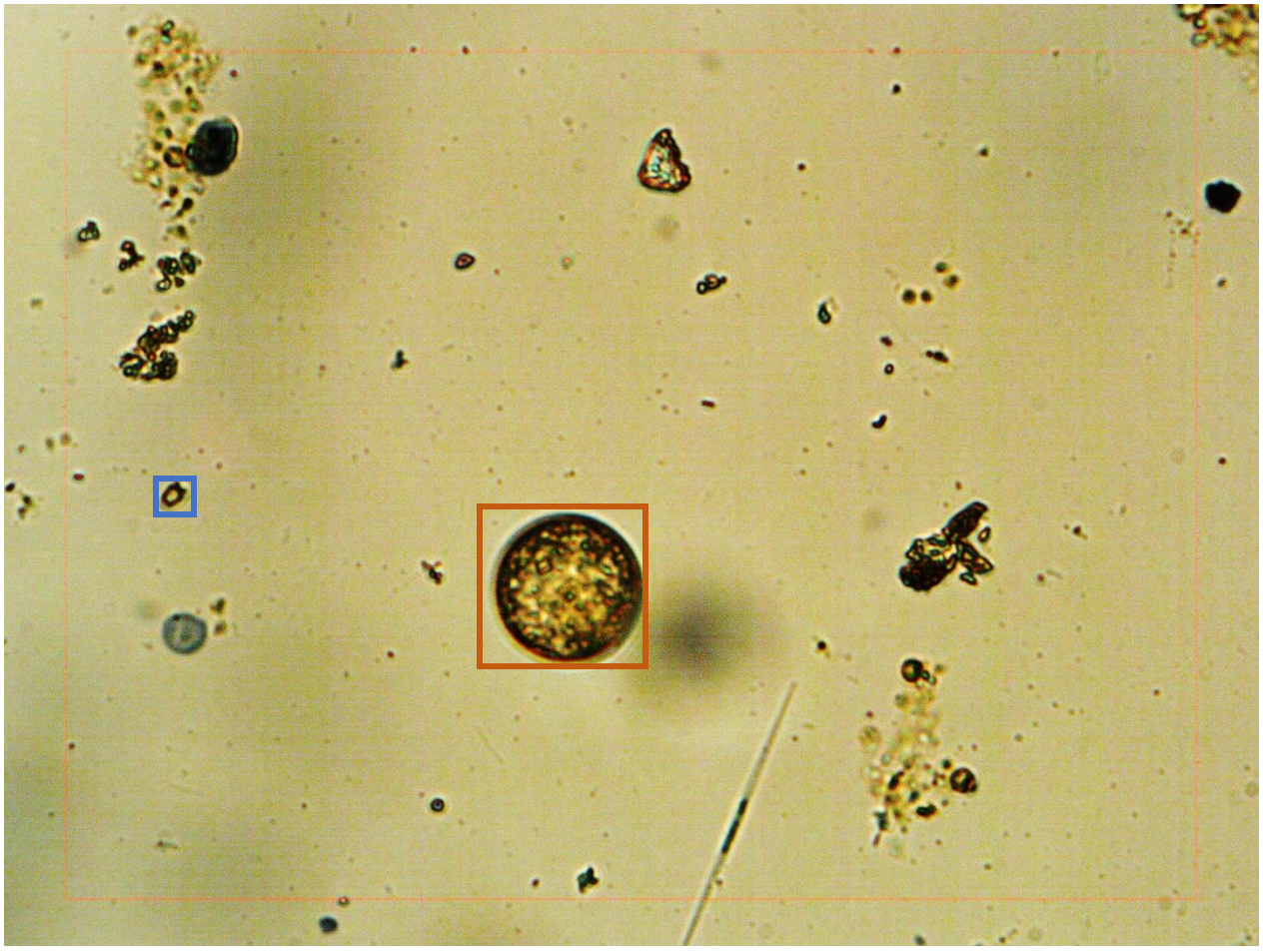

Figure 7: Size comparison of a cell of Lindavia (brown box) vs a micro-flagellate (blue box)

Species Composition

Algae samples were identified to the genus level and grouped into broad alga types for analysis. 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.

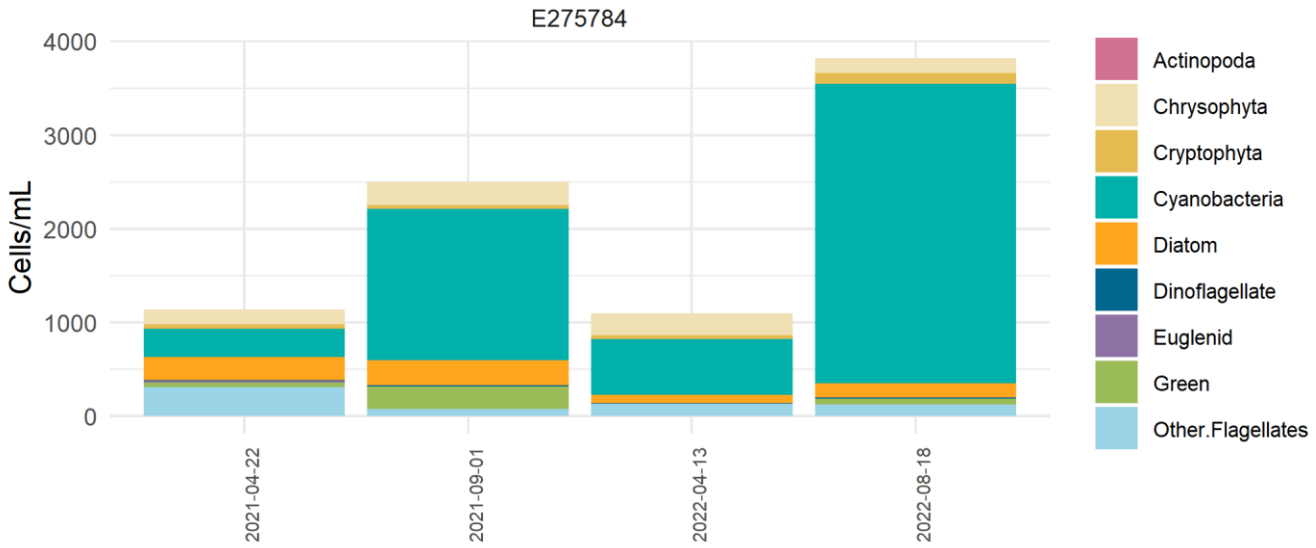

Figure 8: Cell abundance of high-level taxa groups on Alta Lake

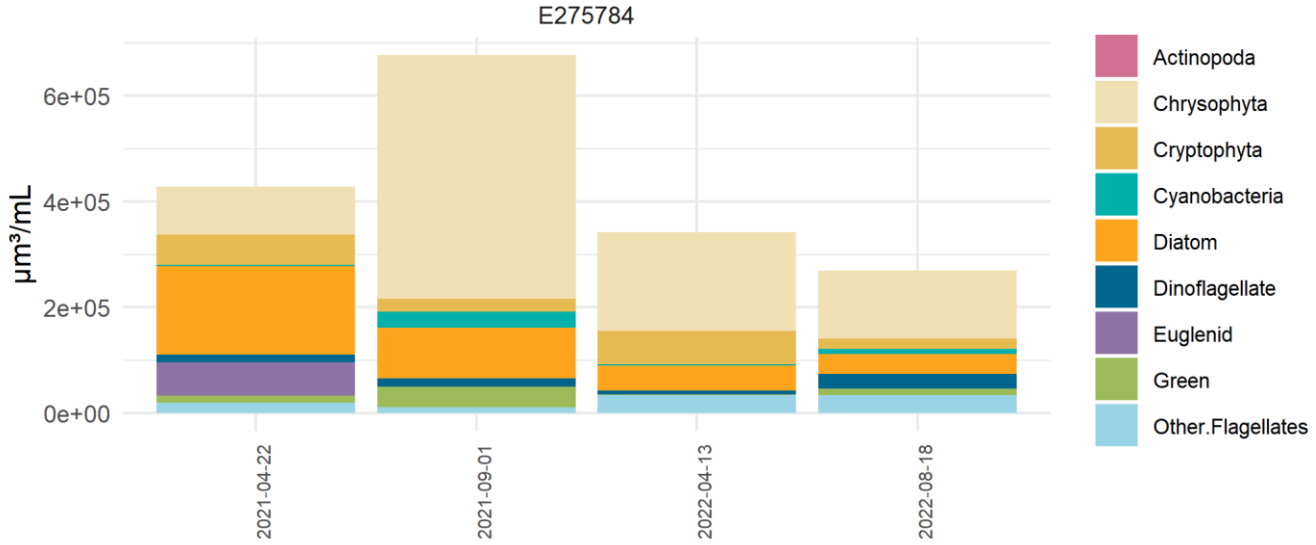

Figure 9: Biovolume of high-level taxa groups on Alta Lake

References

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Appendix

Additional figures and raw data are listed below:

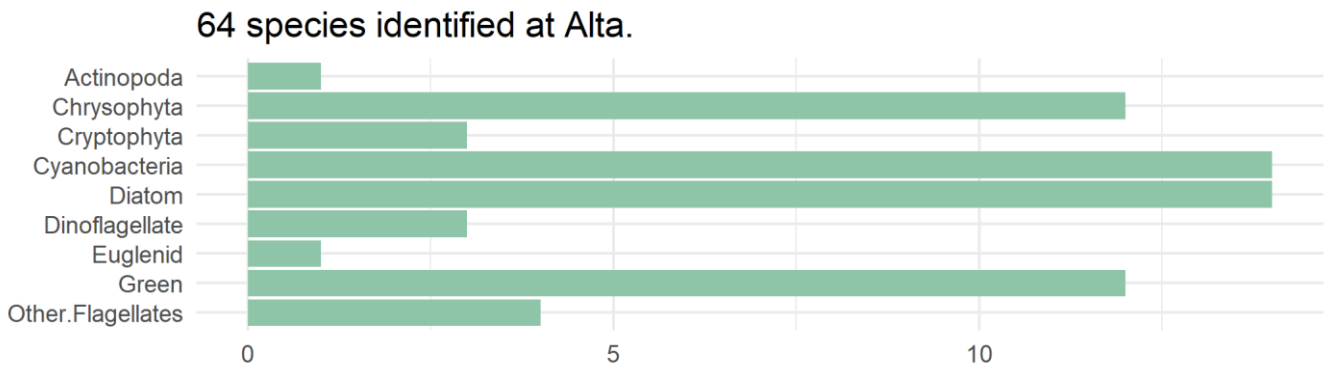

Figure 10: Identified species sorted into categories of higher-level taxa

EMS: E275784	**Total Abundance (cells/mL):**	**1140**		
Collection Date: 2021-04-22	**Total Biovolume (µm³/mL):**	**483813**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon divergens	65	56027	Chrysophyta	1515
Dinobryon sp.	4	6008	Chrysophyta	1515
Mallomonas sp.	4	12097	Chrysophyta	1598
Ochromonas sp.	23	4924	Chrysophyta	1455
Chrysochromulina sp.	34	1308	Chrysophyta	2160
Chrysococcus sp.	30	9961	Chrysophyta	1751
Dinobryopsis sp.	220	59093	Chrysophyta	1557
Cryptomonas sp.	30	55561	Cryptophyta	10635
Rhodomonas lacustris	15	1629	Cryptophyta	10663
Aphanizomenon flos-aquae	11	1832	Cyanobacteria	1191
Anacystis cyanea	228	343	Cyanobacteria	609
Planktolyngbya limnetica	68	348	Cyanobacteria	
Achnanthidium minutissimum	27	5121	Diatom	590864
Aulacoseira granulata	114	37498	Diatom	590863
Asterionella formosa	8	5571	Diatom	3116
Cyclotella sp.	4	1062	Diatom	2439
Lindavia bodanica	15	15652	Diatom	
Lindavia intermedia	4	3536	Diatom	
Cymbella sp.	4	6773	Diatom	4795
Nitzschia sp.	15	1375	Diatom	5070
Ulnaria acus	27	28129	Diatom	970000
Tabellaria fenestrata	23	61819	Diatom	3241
Peridinium inconspicuum	8	14652	Dinoflagellate	10212
Trachelomonas scabra	19	63034	Euglenid	9690
Crucigenia tetrapedia	30	3675	Green	6225
Mougeotia sp.	4	3087	Green	7055
Oocystis sp.	4	75	Green	5827
Chlamydomonas sp.	11	6582	Green	5448
Kephyrion ampulla	42	8797	Other.Flagellates	1764
microflagellate	49	8244	Other.Flagellates	

Figure 11: Raw data from 2021-04-22 EMS site E275784

EMS ID: E275784	Total Abundance (cells/mL):	2501		
Collection Date: 2021-09-01	Total Biovolume (µm³/mL):	678255		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Dinobryon bavaricum	159	346068	Chrysophyta	1515
Dinobryon sp.	65	97630	Chrysophyta	1515
Mallomonas sp.	4	12097	Chrysophyta	1598
Ochromonas sp.	19	4067	Chrysophyta	1455
Chrysococcus sp.	4	1328	Chrysophyta	1751
Cryptomonas sp.	11	20372	Cryptophyta	10635
Rhodomonas lacustris	30	3257	Cryptophyta	10663
Aphanocapsa elachista var. planctonica	736	6021	Cyanobacteria	625
Anacystis sp.	584	1111	Cyanobacteria	609
Anabaena flos-aquae	110	21409	Cyanobacteria	1100
Chlorogloea sp.	30	673	Cyanobacteria	824
Aphanothece pallida	23	76	Cyanobacteria	636
Gloeocapsa sp.	30	1305	Cyanobacteria	682
Gloeocapsa punctata	8	34	Cyanobacteria	682
Planktolyngbya limnetica	91	466	Cyanobacteria	
Achnanthidium minutissimum	15	2845	Diatom	590864
Aulacoseira distans var. nivalis	197	39609	Diatom	590863
Aulacoseira granulata	4	1316	Diatom	590863
Cocconeis placentula	4	6517	Diatom	3577
Cyclotella sp.	27	7168	Diatom	2439
Lindavia bodanica	4	4174	Diatom	
Lindavia intermedia	4	3536	Diatom	
Nitzschia sp.	4	367	Diatom	5070
Tabellaria fenestrata	11	29566	Diatom	3241
Peridinium inconspicuum	4	7326	Dinoflagellate	10212
Peridinium willei	4	8579	Dinoflagellate	10212
Crucigenia tetrapedia	91	11148	Green	6225
Elakatothrix gelatinosa	72	12717	Green	9412
Oocystis sp.	30	565	Green	5827
Didymocystis bicellularis	23	6196	Green	55858
Scenedesmus sp.	23	5367	Green	6104
Chlamydomonas sp.	4	2393	Green	5448
Kephyrion ampulla	4	838	Other.Flagellates	1764
microflagellate	72	12114	Other.Flagellates	

Figure 12: Raw data from 2021-09-01 EMS site E275784

EMS ID: E275784	Total Abundance (cells/mL):	1096		
Collection Date: 2022-04-13	Total Biovolume (µm³/mL):	341050		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Chroomonas sp.	11	2501	Chrysophyta	10613
Ochromonas sp.	23	4924	Chrysophyta	1455
Dinobryon sp.	106	159212	Chrysophyta	1515
Kephyrion sp.	95	19899	Chrysophyta	1764
Cryptomonas marssonii	30	61256	Cryptophyta	10635
Rhodomonas lacustris	11	1194	Cryptophyta	10663
Anabaena sp.	23	1725	Cyanobacteria	1100
Anacystis sp.	569	1083	Cyanobacteria	609
Aulacoseira distans var. nivalis	49	9852	Diatom	590863
Asterionella formosa	11	7660	Diatom	3116
Achnanthidium minutissimum	19	3604	Diatom	590864
Fragilaria sp.	8	3884	Diatom	2932
Ulnaria ulna	4	21019	Diatom	970000
Glenodinium sp.	4	7992	Dinoflagellate	10174
Tetraedron incus	4	561	Green	5661
microflagellates	129	34684	Other.Flagellates	

Figure 13: Raw data from 2022-04-13 EMS site E275784

Collection Date: 2022-08-18+B18:F44	**Total Abundance (cells/mL):**	**3820**		
Collection Date: 2022-08-18	**Total Biovolume (µm³/mL):**	**269615**		
Report.Name	**Abundance (cells/mL)**	**Biovolume (µm³/mL)**	**High.Level.Taxa**	**ITIS Genus Number**
Actinophryida	4	673	Actinopoda	
Chrysochromulina sp.	30	1154	Chrysophyta	2160
Chrysococcus sp.	46	15273	Chrysophyta	1751
Chromulina sp.	27	47713	Chrysophyta	1717
Dinobryon spp.	38	60286	Chrysophyta	1515
Kephyrion sp.	4	838	Chrysophyta	1764
Dinobryopsis sp.	11	2955	Chrysophyta	1557
Cryptomonas sp.	4	7408	Cryptophyta	10635
Rhodomonas lacustris	114	12378	Cryptophyta	10663
Anacystis sp.	1727	3286	Cyanobacteria	609
Aphanocapsa sp.	1419	4483	Cyanobacteria	625
Gloeocapsa aeruginosa	15	212	Cyanobacteria	682
Gloeothece sp.	30	1963	Cyanobacteria	703
Achnanthidium minutissimum	8	1517	Diatom	590864
Aulacoseira distans var. nivalis	110	22117	Diatom	590863
Cyclotella sp.	8	2124	Diatom	2439
Fragilaria sp.	23	11168	Diatom	2932
Peridinium inconspicuum	15	27472	Dinoflagellate	10212
Ankistrodesmus falcatus	4	565	Green	5877
Elakatothrix sp.	46	8832	Green	9412
Monoraphidium sp.	4	2650	Green	5990
Oocystis sp.	4	75	Green	5827
Sphaerocystis sp.	4	865	Green	9169
microflagellates	125	33608	Other.Flagellates	

Figure 14: Raw data from 2022-08-18 EMS site E275784