# Whiteswan Lake Phytoplankton Summary Report 2021-2022

## Overview

Samples were collected from one site on Whiteswan Lake during 2021 and 2022 (Table 1; Figure 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 2021 and 2022*

| Sample Site (EMS#) | Dates |
|---|---|
| WHITESWAN LAKE (1131186) | 2021-05-17 |
| | 2021-08-19 |
| | 2022-05-11 |
| | 2022-08-10 |
| | **Total= 4 samples** |

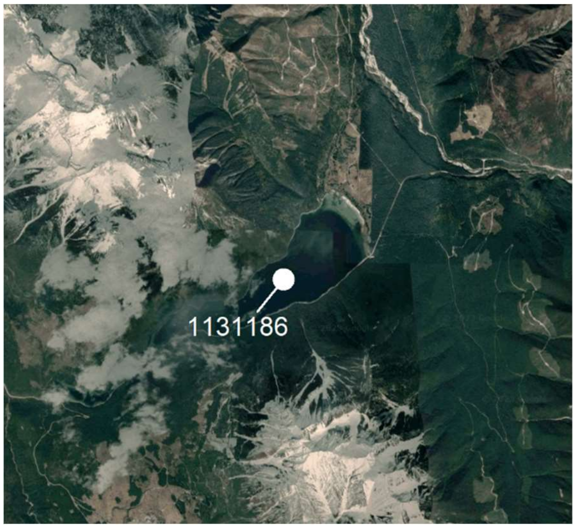


*Figure 1: Aerial view of Whiteswan Lake*

Samples contained low densities of green algae, Desmids, Dinoflagellates, and diatoms. Samples collected in 2022 contained higher densities of flagellates relative to 2021 samples.

One sample, collected on 2021-08-19, contained a small bloom of the cyanobacteria *Anacystis*. Summer samples also contained large amorphous clouds of degraded cyanobacteria and bacteria (Figure 2). Degraded cyanobacteria could represent threats to public health as cyanotoxins are usually contained within the cyanobacterial cells before cell death (EPA, 2022).

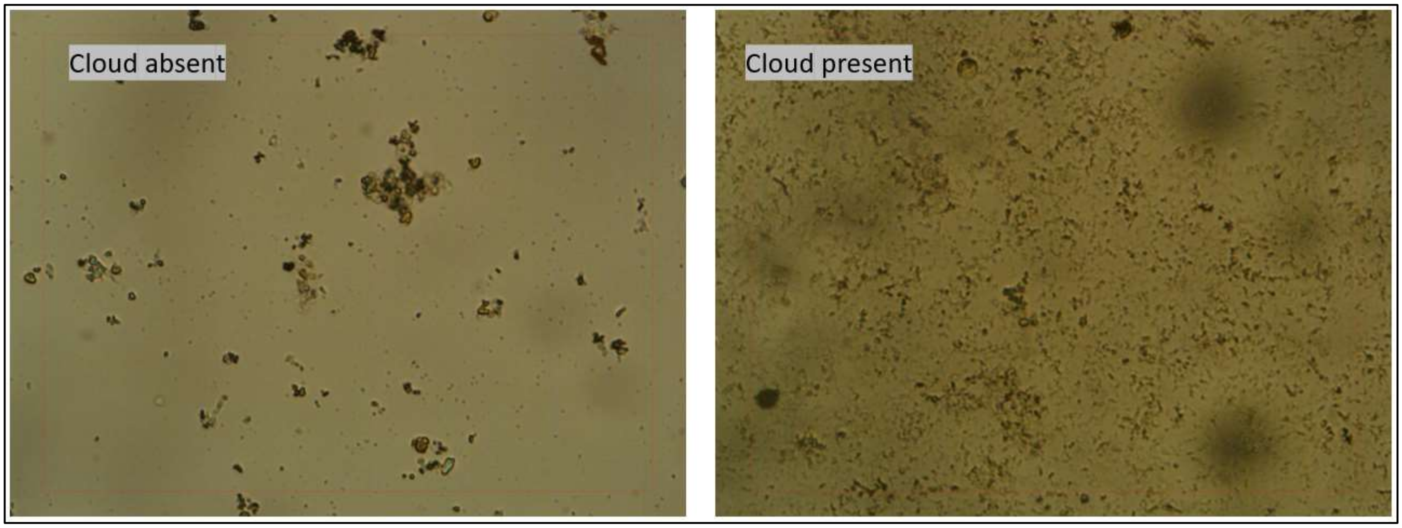


*Figure 2: Spring 2021 sample (left) vs summer 2022 sample (right). Summer samples contained large amorphous clouds of degraded cyanobacteria and bacteria*

## Overview (continued)

Chrysophyta dominated total biovolumes of Whiteswan Lake (Figure 3). Genera *Chromulina* and *Dinobryon* were responsible for a combined 89% of the total biovolume identified in Whiteswan Lake (Figure 4).

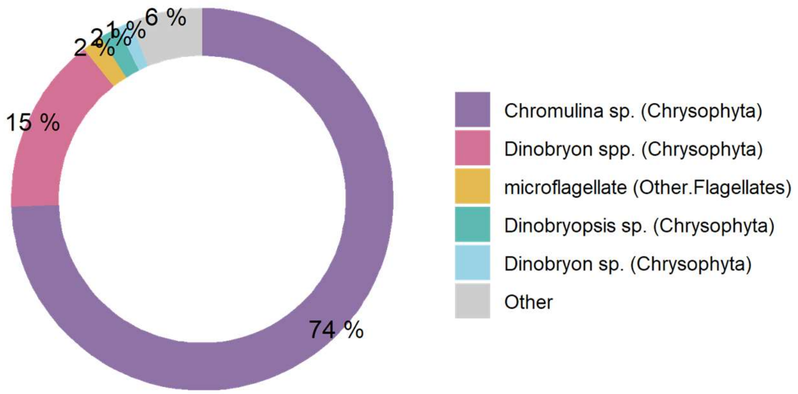


*Figure 3: Dominant organisms from Whiteswan Lake (1131186) as percent of total biovolume*

Chrysophyta taxa are advantageous and disadvantageous in freshwater systems, depending on their context. Some Chrysophytes are known to produce odor chemicals described as fishy, and others eat bacteria and reduce negative odor compounds (Wehr et al., 2015). *Dinobryon* blooms are associated with unpleasant fishy odors, and one species of *Dinobryon* is linked with toxins that can affect fish vitality (Cantrell & Long, 2013; Conrad, 2013).

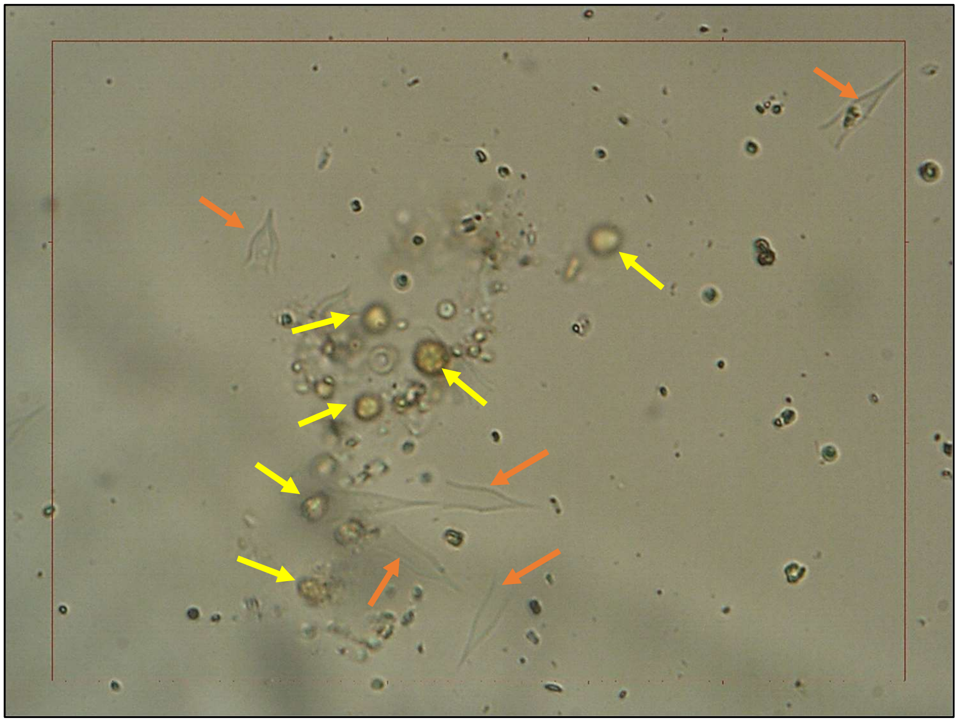

*Figure 4: 400x magnification of Chromulina (yellow arrows) and Dinobryon (orange arrows) species*

### 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

All samples except one demonstrated low cyanobacteria densities; a small *Anacystis* bloom occurred on 2021-08-19. *Anacystis* was the dominant cyanobacteria genus in 2021 and 2022. *Gloeocapsa* and *Planktolyngbya* species were also observed (Figure 5).

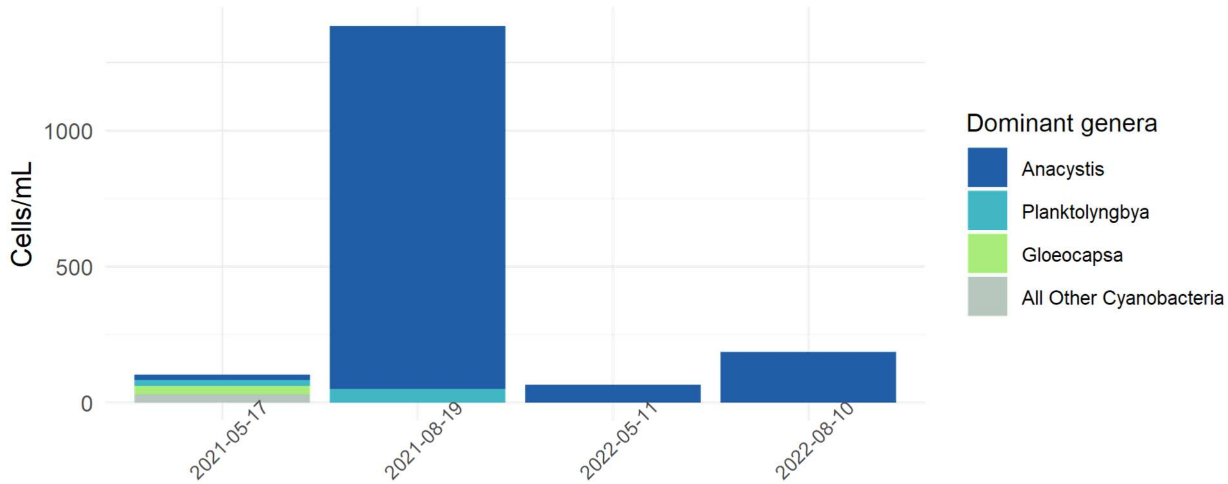


*Figure 5: cell abundance for dominant cyanobacteria genera on Whiteswan Lake*

Dominant cyanobacteria identified in samples 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 Whiteswan Lake and their associated toxins*

| Genus | Maximum Abundance* (cells/mL) | Toxins Produced |
|---|---|---|
| ***Anacystis*** | 1336 | Lyngbyatoxin LYN, Lipopolysaccharide LPS, Microcystin MC, Nodularins NOD, Anatoxins (-a) ATX, BMAA, Cyanopeptolins CPL, Anabaenopeptins APT |
| ***Planktolyngbya*** | 49 | Lyngbyatoxin LYN, Microcystin MC, BMAA |
| ***Gloeocapsa*** | 30 | |

Note: * = counted in samples

## Cyanobacterial Presence (Continued)

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

Whiteswan Lake displayed a range of cyanobacteria levels in the negligible risk category, with a mean cyanobacteria abundance of 434 cells/mL (Figure 6). Figure 6 exhibits the range of cyanobacterial abundance observed in Whiteswan Lake compared to alert levels defined by authorities including the WHO and EPA.

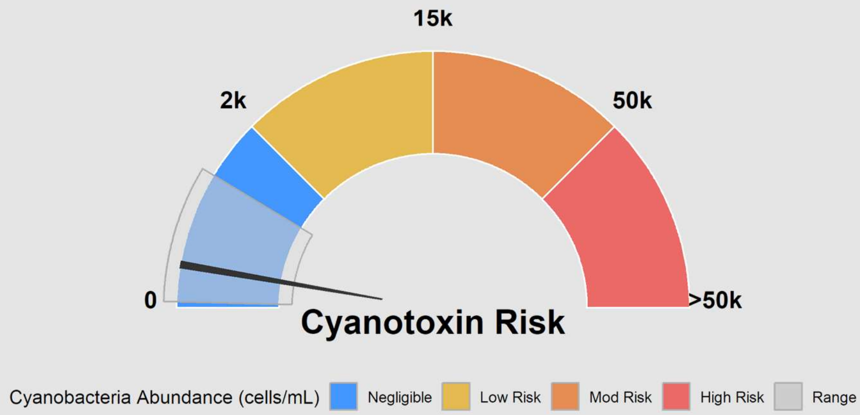


*Figure 6: Cyanotoxin risk posed by cyanobacteria blooms in Whiteswan Lake*

Micro-flagellate and 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 (*Ulnaria*) is an equivalent size to approximately 50 micro-flagellates.

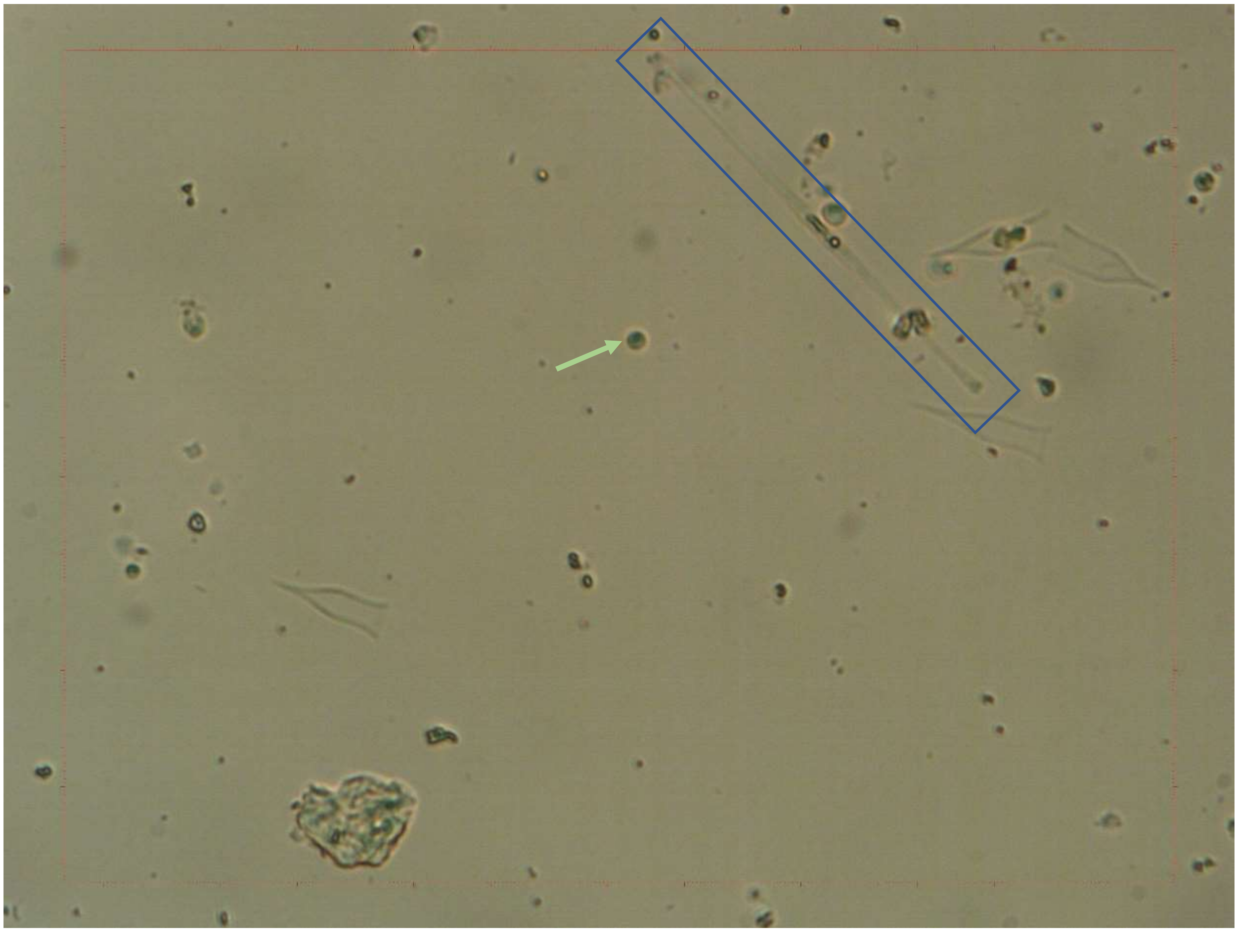

*Figure 7: Size comparison of Ulnaria cell (blue box) to a micro-flagellate (green arrow)*

## 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.

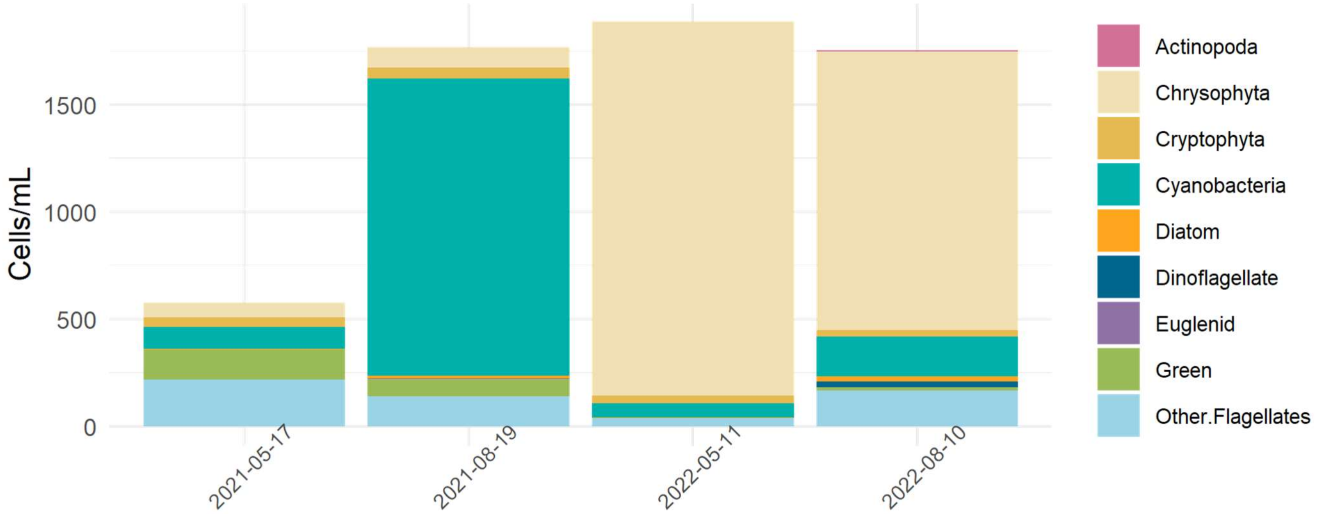


*Figure 8: Cell abundance of high-level taxa groups on Whiteswan Lake*

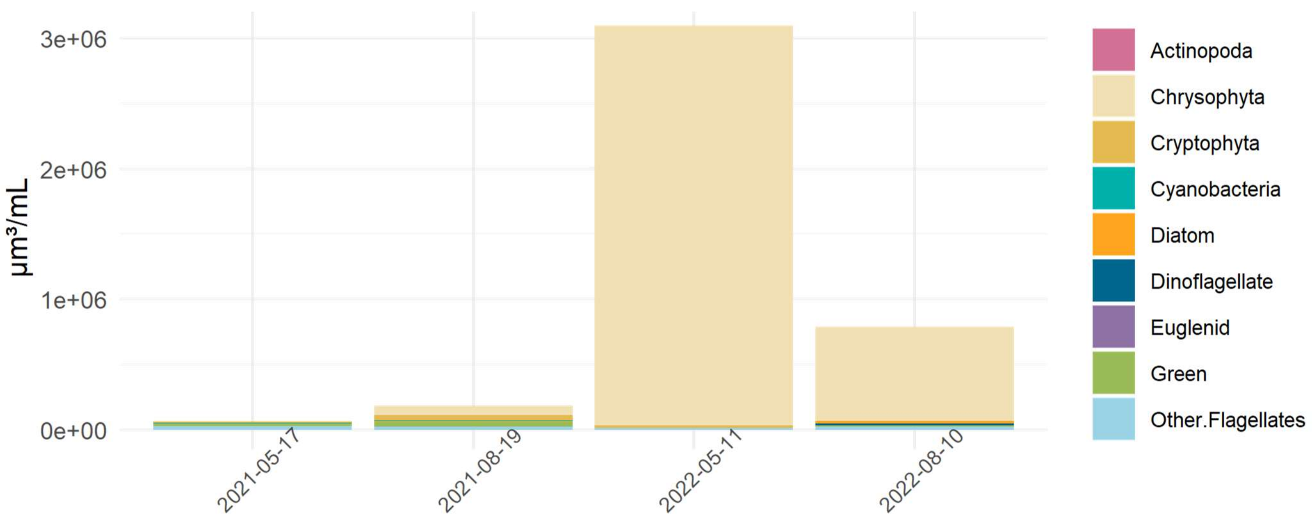


*Figure 9: Biovolume of high-level taxa groups on Whiteswan Lake*

## 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

EPA. (2022, September). *Learn about Cyanobacteria and Cyanotoxins*. United States Environmental Protection Agency.

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

Wehr, J. D., Sheath, R. G., & Kociolek, P. (2015). *Freshwater Algae of North America* (Second). Elsevier Inc.

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



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# Appendix

Additional figures and raw data are listed below:

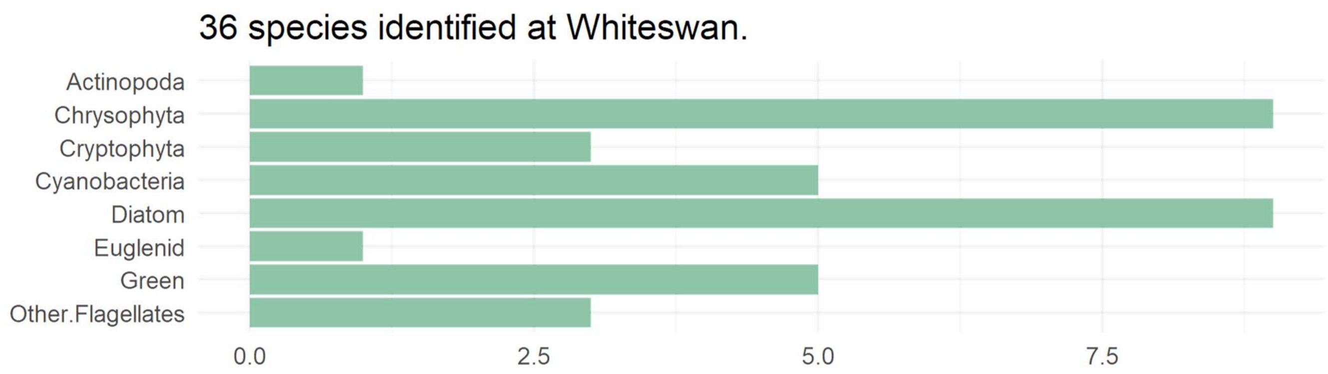


*Figure 10: Identified species sorted into categories of higher-level taxa*

| EMS ID: 1131186 | **Total Abundance (cells/mL):** | **577** | | |
|---|---|---|---|---|
| Collection Date: 2021-05-17 | **Total Biovolume (µm³/mL):** | **79041** | | |
| | | | | |
| **Report.Name** | **Abundance (cells/mL)** | **Biovolume (µm³/mL)** | **High.Level.Taxa** | **ITIS Genus Number** |
| Ochromonas sp. | 11 | 2355 | Chrysophyta | 1455 |
| Chrysochromulina sp. | 57 | 2192 | Chrysophyta | 2160 |
| Dinobryopsis sp. | 34 | 9133 | Chrysophyta | 1557 |
| Cryptomonas sp. | 4 | 7408 | Cryptophyta | 10635 |
| Rhodomonas lacustris | 42 | 4560 | Cryptophyta | 10663 |
| Anacystis sp. | 19 | 36 | Cyanobacteria | 609 |
| Dactylococcopsis sp. | 15 | 1021 | Cyanobacteria | 6446 |
| Gloeocapsa punctata | 30 | 126 | Cyanobacteria | 682 |
| Planktolyngbya limnetica | 23 | 118 | Cyanobacteria | |
| Merismopedia punctata | 15 | 97 | Cyanobacteria | 727 |
| Fragilaria crotonensis | 4 | 1942 | Diatom | 2932 |
| Crucigenia tetrapedia | 137 | 16782 | Green | 6225 |
| Monoraphidium sp. | 4 | 2650 | Green | 5990 |
| microflagellate | 182 | 30621 | Other.Flagellates | |

*Figure 11: Raw data from 2021-05-17 EMS site 1131186*

| EMS ID: 1131186 | Total Abundance (cells/mL): | 1769 | | |
|---|---|---|---|---|
| Collection Date: 2021-08-19 | Total Biovolume (µm³/mL): | 188979 | | |
| | | | | |
| **Report.Name** | **Abundance (cells/mL)** | **Biovolume (µm³/mL)** | **High.Level.Taxa** | **ITIS Genus Number** |
| Dinobryon sp. | 23 | 34546 | Chrysophyta | 1515 |
| Ochromonas sp. | 27 | 5780 | Chrysophyta | 1455 |
| Chrysochromulina sp. | 11 | 423 | Chrysophyta | 2160 |
| Chromulina sp. | 15 | 26507 | Chrysophyta | 1717 |
| Chrysococcus sp. | 19 | 6308 | Chrysophyta | 1751 |
| Cryptomonas sp. | 15 | 27781 | Cryptophyta | 10635 |
| Cryptomonas ovata | 4 | 8704 | Cryptophyta | 10635 |
| Rhodomonas lacustris | 34 | 3692 | Cryptophyta | 10663 |
| Anacystis sp. | 1336 | 2542 | Cyanobacteria | 609 |
| Planktolyngbya limnetica | 49 | 251 | Cyanobacteria | |
| Lindavia intermedia | 4 | 3536 | Diatom | |
| Navicula spp. | 4 | 2356 | Diatom | 3649 |
| Nitzschia sp. | 4 | 367 | Diatom | 5070 |
| Euglena sp. | 4 | 2304 | Euglenid | 9620 |
| Crucigenia rectangularis | 46 | 14088 | Green | 6225 |
| Mougeotia sp. | 34 | 26239 | Green | 7055 |
| microflagellate | 140 | 23555 | Other.Flagellates | |

*Figure 12: Raw data from 2021-08-19 EMS site 1131186*

| EMS ID: 1131186 | Total Abundance (cells/mL): | 1889 | | |
|---|---|---|---|---|
| Collection Date: 2022-05-11 | Total Biovolume (µm³/mL): | 3099277 | | |
| | | | | |
| **Report.Name** | **Abundance (cells/mL)** | **Biovolume (µm³/mL)** | **High.Level.Taxa** | **ITIS Genus Number** |
| Chrysochromulina sp. | 8 | 308 | Chrysophyta | 2160 |
| Chrysococcus sp. | 4 | 1328 | Chrysophyta | 1751 |
| Dinobryon sp. | 8 | 12016 | Chrysophyta | 1515 |
| Chromulina sp. | 1727 | 3051861 | Chrysophyta | 1717 |
| Cryptomonas ovata | 8 | 17407 | Cryptophyta | 10635 |
| Rhodomonas lacustris | 27 | 2932 | Cryptophyta | 10663 |
| Anacystis sp. | 65 | 124 | Cyanobacteria | 609 |
| Navicula veneta | 4 | 3084 | Diatom | 3649 |
| microflagellates | 38 | 10217 | Other.Flagellates | |

*Figure 13: Raw data from 2022-05-11 EMS site 1131186*

| EMS ID: 1131186 | **Total Abundance (cells/mL):** | **1753** | | |
|---|---|---|---|---|
| Collection Date: 2022-08-10 | **Total Biovolume (µm³/mL):** | **790784** | | |
| | | | | |
| **Report.Name** | **Abundance (cells/mL)** | **Biovolume (µm³/mL)** | **High.Level.Taxa** | **ITIS Genus Number** |
| Actinophryida | 4 | 673 | Actinopoda | |
| Chrysochromulina sp. | 615 | 23655 | Chrysophyta | 2160 |
| Chromalinales | 15 | 2524 | Chrysophyta | |
| Dinobryon spp. | 391 | 620310 | Chrysophyta | 1515 |
| Ochromonas sp. | 19 | 4067 | Chrysophyta | 1455 |
| Dinobryopsis sp. | 250 | 67152 | Chrysophyta | 1557 |
| Spumella sp. | 11 | 81 | Chrysophyta | 1491 |
| Rhodomonas lacustris | 30 | 3257 | Cryptophyta | 10663 |
| Anacystis sp. | 186 | 354 | Cyanobacteria | 609 |
| Asterionella formosa | 11 | 7660 | Diatom | 3116 |
| Cyclotella sp. | 4 | 1062 | Diatom | 2439 |
| Nitzschia acicularis | 4 | 3158 | Diatom | 5070 |
| Ulnaria acus | 4 | 4167 | Diatom | 970000 |
| Parvodinium sp. | 27 | 14886 | Dinoflagellate | |
| Monoraphidium sp. | 11 | 7288 | Green | 5990 |
| Chlamydomonas sp. | 4 | 2393 | Green | 5448 |
| microflagellate | 167 | 28097 | Other.Flagellates | |

*Figure 14: Raw data from 2022-08-10 EMS site 1131186*