Investigating the role and diversity of Microalgae in the Lake District

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AIMS: To establish a profile of lake ecology and isolate Nitrogen fixers for future studies and to complement historical nutrient and environmental data.

1. Introduction

The Lake District (LD) is one of the most heavily studied freshwater ecosystem in the UK (Moorhouse et al., 2014). There is extensive environmental and time series data. However, our understanding of the microbial ecology is only surface level, with taxonomic diversity only rarely being reported (Maberly, Chao and Finlay, 2022).

However, microalgae are intimately related to environmental changes in the lakes, producing algae blooms, modulating water quality and cycling organic matter. As such they are often used as indicators of ecosystem health. A greater understanding of their ecology and diversity may help us understand their role in the ecosystem and how environmental changes in the lakes affect the microbial community.

2. Methods

1) Regular sampling of live cells, cells preserved with glutaraldehyde, and filtered nutrients with 1 round of sampling for 18/16S rRNA gene sequencing (Fig 1.)

2A) Isolation, culture and subculturing of potential nitrogen fixers with nitrogen depleted media (Fig 2.).

2B) Sedgewick rafter cell counts and microscopy identification/abundance Analysis (Fig 2.).

3)* Sequencing and nutrient analysis to be completed.

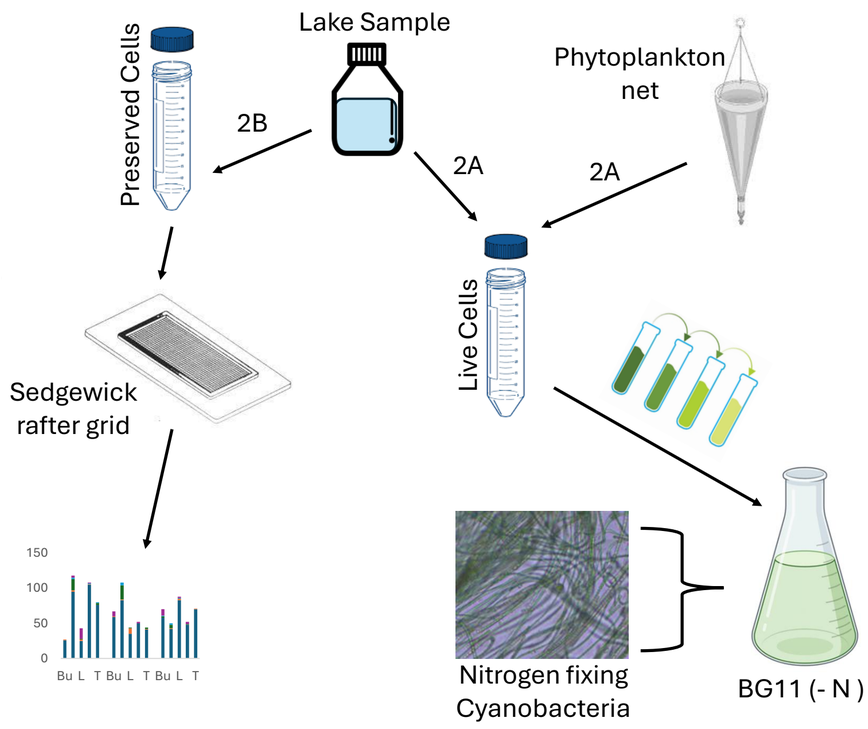


Fig 2. Diagrammatic representation of methods

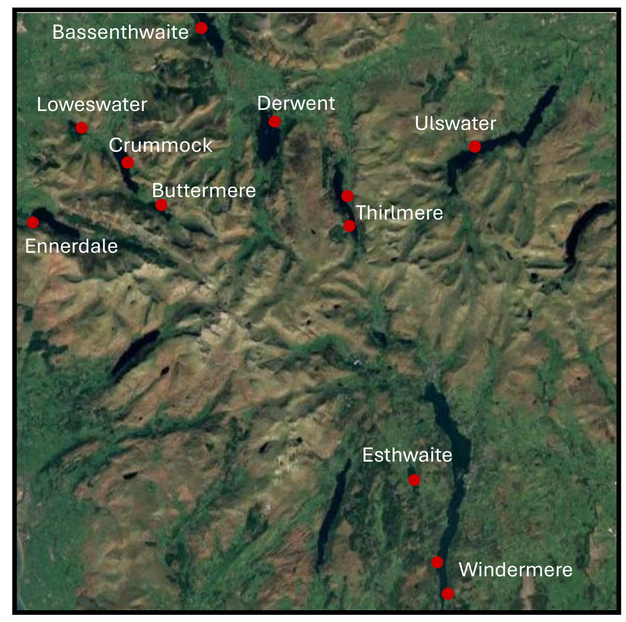


Fig 1. Sample locations (red) in LD

3. Results and Discussion

A) 2 *Anabaena* lines were isolated and are in culture. These new lines may support further studies in diazotroph physiology, which can aid our understanding of the lake ecosystems, of which the nitrogen fixing cyanobacteria are thought to be bloom producers (Beversdorf, Miller and McMahon, 2013; Gray et al., 2019).

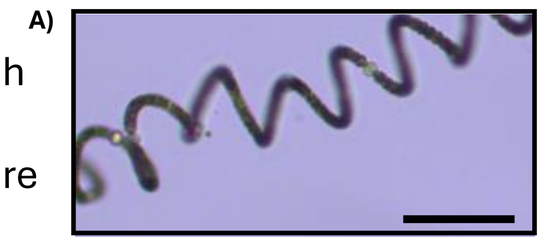


Fig 3. A) *A.circinalis*. B) *A.cylindricus* or *A.ineaqualis**. 100x magnification, scale bar = 50 µm.

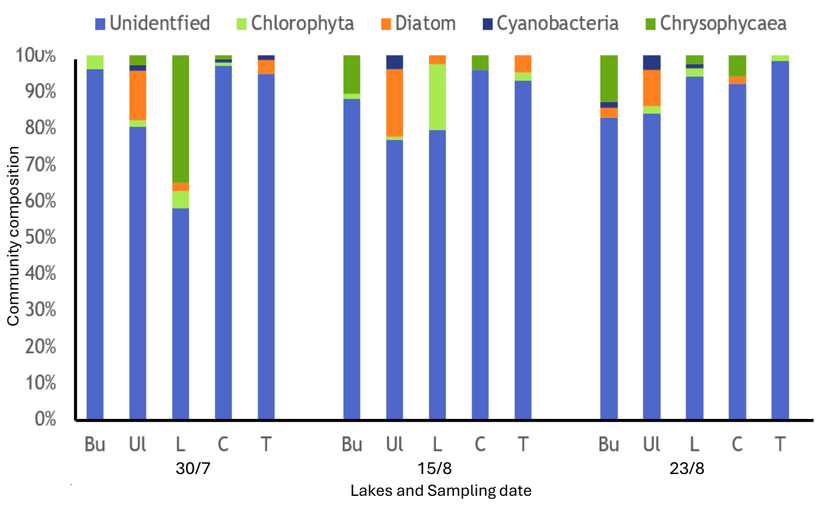


Fig 4. Percentage community composition of 5 lakes recorded 3 times across a 1-month period. Identification via microscopy and morphological keys.

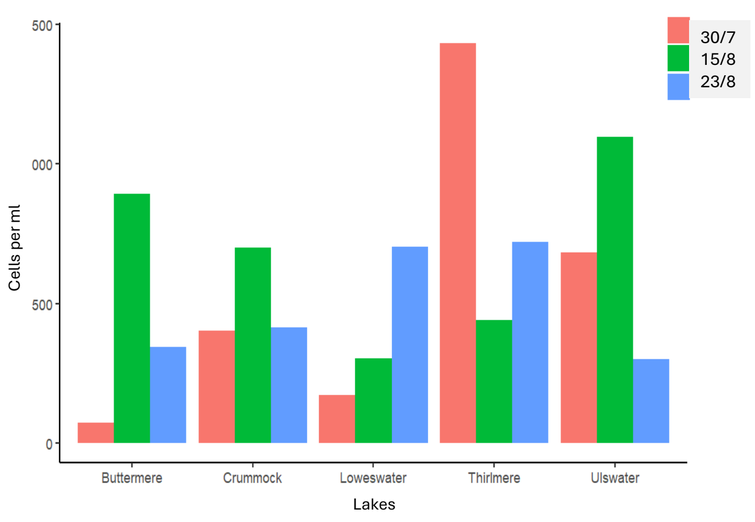


Fig 5. Cell concentrations in 5 lakes in the northern LD.

B) Microscopy-based identification of preserved cells was limited to 100x magnification, and many cells were damaged, likely due to the glutaraldehyde, which lead to many cells remaining unidentified (Fig 4.). Despite this some patterns could still be found. Ulswater has a somewhat unique assemblage with a large proportion of the known community being the Diatom *Fragilaria*. Cell densities appear to change dramatically across a 1-month period (Fig 5.). However, the mechanisms behind this flux are likely varied and troublesome to disentangle.

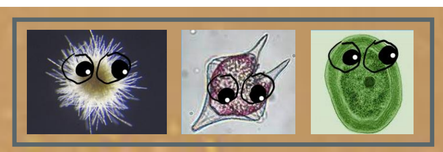
OUTLOOK: We aim to utilise the current cell lines for physiological studies of heterocystous nitrogen fixation. Future molecular efforts hope to complement and overcome the microscopy-based ecological profiling and its difficulties.

References

Beversdorf, Miller and McMahon (2013) **doi**:https://doi.org/10.1371/journal.pone.0056103.

Gray et al (2019) **doi**:https://doi.org/10.1111/fwb.13402. Moorhouse et al (2014) **doi**:https://doi.org/10.1111/fwb.12457.

Maberly, Chao and Finlay (2022) **doi**:https://doi.org/10.1016/j.protis.2022.125925.



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