

Master project in Limnology:

Can harmful algal blooms turn boreal lakes into CO₂ sinks?

Importance

Harmful algal blooms are predicted to become more frequent in a warming climate and the associated CO₂ uptake by algae might reduce CO₂ concentrations in lakes.

In this project, we will investigate if high abundances in the harmful algal species *Gonyostomum semen*, can turn boreal lakes into CO₂ sinks.

Introduction

Most inland waters on Earth are supersaturated with CO₂ (Duarte and Prairie 2005), and thus emit CO₂ to the atmosphere. However, CO₂ uptake by phytoplankton can reduce CO₂ concentrations (often measured as partial pressure of CO₂, $p\text{CO}_2$). A phytoplankton taxa that has expanded in Swedish lakes since 1988 is the bloom-forming nuisance species *Gonyostomum semen* (Lebret et al. 2015; Rengefors et al. 2012). During blooms these algae strongly increase the phytoplankton biomass in lakes and by this transforms CO₂ into organic matter. Until now, it has not been studied, if blooms of *Gonyostomum semen* reduce the $p\text{CO}_2$ in such lakes. If this would be the case, blooms of *Gonyostomum semen* would not only have a negative effect on water quality, but would also affect the CO₂ dynamics of lakes, since a reduced $p\text{CO}_2$ could result in lower CO₂ emissions into the atmosphere.

In this project, we aim to measure $p\text{CO}_2$ in lakes of different characteristics with a focus on lakes with high algal biomass of *Gonyostomum semen* and relate measured and calculated $p\text{CO}_2$ values to lake water chemical and biological characteristics (e.g. occurrence of *Gonyostomum semen*, alkalinity phytoplankton biomass) in these lakes.

Research questions

- Can *Gonyostomum semen* turn a lake from a CO₂ source into a CO₂ sink?
- How large is the range in measured $p\text{CO}_2$ in boreal lakes of different characteristics and how much do the measured $p\text{CO}_2$ values differ from calculated $p\text{CO}_2$?

Major project tasks

- Measure $p\text{CO}_2$ (and some additional biological and physico-chemical parameters) in boreal lakes and calculate $p\text{CO}_2$ using the $p\text{CO}_2$ -pH-alkalinity equilibrium for comparison
- Analyse phytoplankton and water chemistry data for the sampled lakes from public databases
- Relate the field measurements to the data from public databases, and analyse in particular the relation between $p\text{CO}_2$ and *Gonyostomum semen* in these lakes

Time

30 or 45 credits project, between June 2019 and July 2020 (start flexible)

Requirements

We are looking for a student having taken courses in Limnology and who is interested in aquatic biogeochemistry.

The project will be open to the student's suggestions, and there will be a possibility to bring in own ideas and contribute to planning.

Place

Limnology, Department of Ecology and Genetics, Evolutionary Biology Centre

Supervisors

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References

- Duarte, C. M., and Y. T. Prairie. 2005. Prevalence of heterotrophy and atmospheric CO₂ emissions from aquatic ecosystems. *Ecosystems* **8**: 862-870.
- Lebret, K., S. V. Tesson, E. S. Kritzberg, C. Tomas, and K. Rengefors. 2015. Phylogeography of the freshwater raphidophyte *Gonyostomum semen* confirms a recent expansion in northern Europe by a single haplotype. *Journal of phycology* **51**: 768-781.
- Rengefors, K., G. A. Weyhenmeyer, and I. Bloch. 2012. Temperature as a driver for the expansion of the microalga *Gonyostomum semen* in Swedish lakes. *Harmful algae* **18**: 65-73.