Master project in Limnology:

Can harmful algal blooms turn boreal lakes into CO_2 sinks?

Importance

Harmful algal blooms are predicted to become more frequent in a warming climate and the associated CO_2 uptake by algae might reduce CO_2 concentrations in lakes.

In this project, we will investigate if high abundances in the harmful algal species *Gonyostomum semen*, can turn boreal lakes into CO_2 sinks.

Introduction

Most inland waters on Earth are supersaturated with CO_2 (Duarte and Prairie 2005), and thus emit CO_2 to the atmosphere. However, CO_2 uptake by phytoplankton can reduce CO_2 concentrations (often measured as partial pressure of CO_2, pCO_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 CO_2 into organic matter. Until now, it has not been studied, if blooms of *Gonyostomum semen* reduce the pCO_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 CO_2 dynamics of lakes, since a reduced pCO_2 could result in lower CO_2 emissions into the atmosphere.

In this project, we aim to measure pCO_2 in lakes of different characteristics with a focus on lakes with high algal biomass of *Gonyostomum semen* and relate measured and calculated pCO_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 CO_2 source into a CO_2 sink?
- How large is the range in measured pCO_2 in boreal lakes of different characteristics and how much do the measured pCO_2 values differ from calculated pCO_2?

Major project tasks

- Measure pCO_2 (and some additional biological and physico-chemical parameters) in boreal lakes and calculate pCO_2 using the pCO_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 pCO_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 the student`s suggestions, and there will be 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.