EGU24-8400, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-8400
EGU General Assembly 2024

Microbial response to climate-induced nutrient alterations in high Arctic freshwaters

Nicolas Valiente[1,2], Laurent Fontaine[2], Andrea L. Popp[3,4], Anja Sundal[4,5], Jing Wei[2], Peter Dörsch[6], Sigrid Trier Kjær[6], Dag O. Hessen[2], and Alexander Eiler[2]

[1]Department of Science and Agroforestry Technology and Genetics, University of Castilla-La Mancha, Campus Universitario s/n, 02071 Albacete, Spain (nicolas.valiente@uclm.es)

[2]Centre for Biogeochemistry in the Anthropocene, Department of Biosciences, Section for Aquatic Biology and Toxicology, University of Oslo, PO Box 1066, Blindern, 0316 Oslo, Norway

[3]Hydrological Research Unit, Swedish Meteorological and Hydrological Institute (SMHI), 60176 Norrköping, Sweden

[4]Department of Geosciences, University of Oslo, PO Box 1066, Blindern, 0316 Oslo, Norway

[5]Norwegian Space Agency, Drammensveien 165, 0277 Oslo, Norway

[6]Faculty of Environmental Sciences and Natural Resource Management, Norwegian University of Life Sciences, 1432 Ås, Norway

In the Arctic, climate change leads to increased nutrient levels and organic carbon in freshwaters, caused by factors like permafrost thaw and growing populations of geese. Such alterations significantly impact freshwater ecosystems, potentially influencing community composition and diversity across various levels, including general microbial metabolism. We tested the hypothesis that a transition from autotrophy to heterotrophy occurs across a chronosequence of lakes in the high Arctic as a result of glacier retreat, influenced by distinct nutrient supplies and varying ecological succession statuses. To do so, we studied 5 lakes in the vicinity of Ny-Ålesund (Svalbard) following a chronosequence. The older lakes, closer to the fjord, were strongly impacted by birds, notably geese. For each lake, we tested the response to nutrients by adding an artificial nutrient solution with N and P, and the response to light or dark conditions. We incubated unfiltered water samples (80 mL) at 4 °C in 120 mL flasks with atmospheric air as headspace. After 24h, samples for gases (O_2, CO_2, CH_4 and N_2O), nutrients (organic C, P and N) and eDNA (16S metabarcoding) were collected. Ar-corrected gas saturation of each GHG was used as a proxy of net metabolic changes. Regardless of the treatment applied, our results showed an increase in N_2O saturation coupled with a decrease in O_2 saturation after 24h in bird-impacted lakes, likely related to heterotrophic microbial activity. In such lakes, dark conditions promoted P accumulation, while N accumulated equally in light and dark incubations. In younger lakes (i.e., not impacted by birds), increased O_2 saturation after 24h of incubation suggested that phototrophic metabolism was dominant. For nutrients, no significant pattern was observed for both light and dark incubations in younger lakes. Bacterial community composition differed between locations after 24h of incubation with a greater uniformity of species in younger lakes. This research advances our understanding of how nutrient enrichment affects biodiversity in the Arctic and metabolism in freshwater ecosystems.