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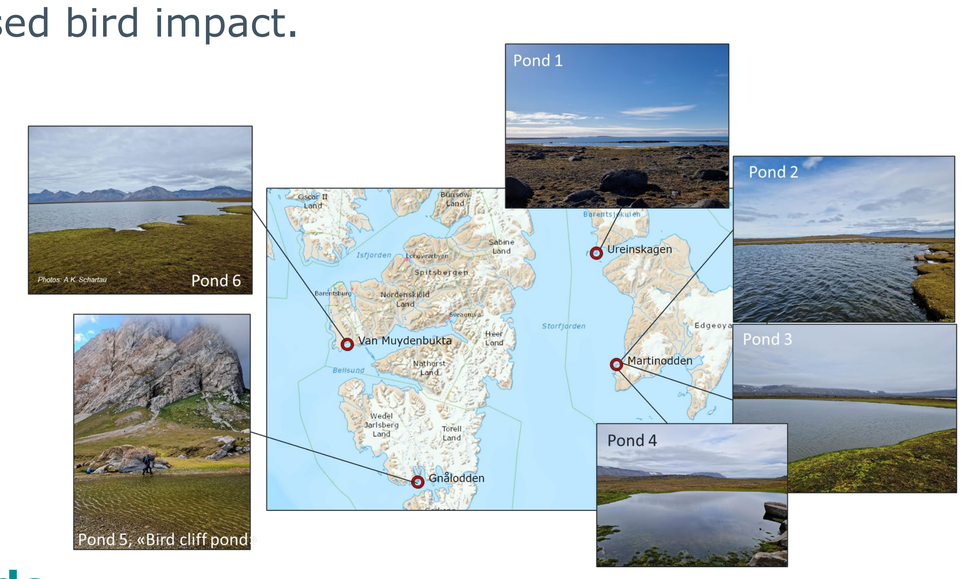
Introduction

Small ponds and lakes and their surrounding riparian zone are ecological hot spots in the arctic landscape. They are important for the biogeochemical cycling as well as habitats for both terrestrial and aquatic organisms (Arctic Council 2013).

Birds may have a strong impact on these small ponds. For example, seabirds may provide a substantial input of marine derived nutrients to water bodies on their fly ways or close to bird cliffs (Gonzalez-Bergonzoni et al. 2017). Also, the increasing goose populations on Svalbard and elsewhere in the Arctic are strongly associated with ponds and may have a significant influence on the chemical/physical properties and the ecological communities, for example by contributing nutrients directly via feces, and indirectly via grubbing and physical disturbance leading to increased erosion and run-off (van Geest et al 2007).

Our aim was to examine how the aquatic ecosystems, including the communities (phytoplankton, zooplankton) respond to increased bird impact.



Methods

A number of ponds differentially impacted by birds was sampled on Svalbard in summer 2022 during the Dutch SEES.NL/2022 expedition. Sampling and analysis:

- Goose/bird impact (droppings density)
- Water and sediment chemistry
- Phytoplankton
- Zooplankton/invertebrates
- Methane flux

Results and discussion

High bird impact implied:

- Strong increase in nutrients in the pond water but not in the sediment
- Increase in phytoplankton biomass and change in the phytoplankton community with dominance of mixotrophic species
- Reduction of metazoan zooplankton abundance and increase in ciliate abundance.
- Phytoplankton and metazoan zooplankton taxa richness decreased at the highest bird impact.
- Higher flux of methane

Thus, high bird impact was associated with hypereutrophic pond conditions characterized by decreased diversity and likely a stimulation of the microbial loop. The results may hint to some of the future changes in arctic ecosystems in ponds increasingly influenced by birds and climate change.

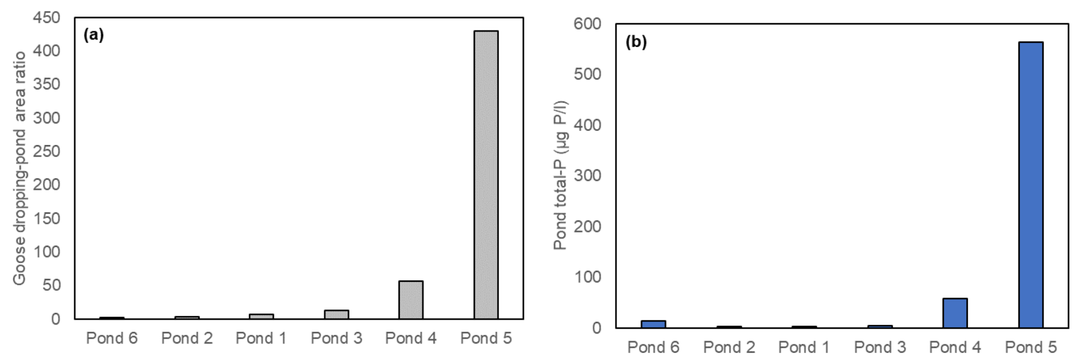
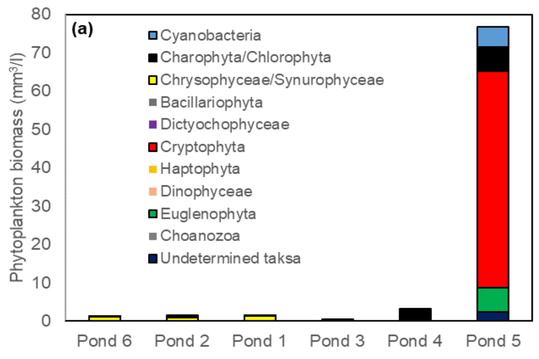
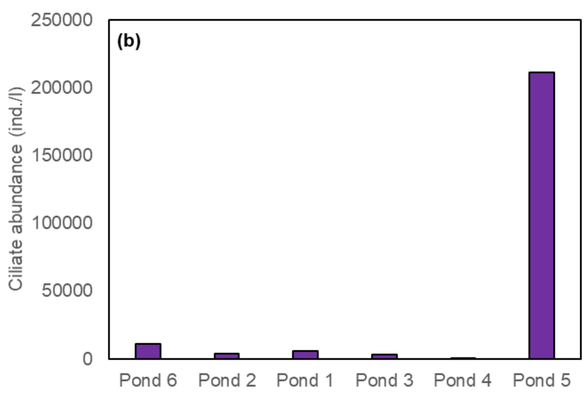


Fig. 1 Goose dropping-lake area ratio (a), order of ponds according to increasing bird impact, i.e. increasing goose dropping-pond area ratio. Additionally, pond 5 was located in front of a bird cliff, and thus received additional nutrient input from seabirds. Concentrations of total phosphorus (b).





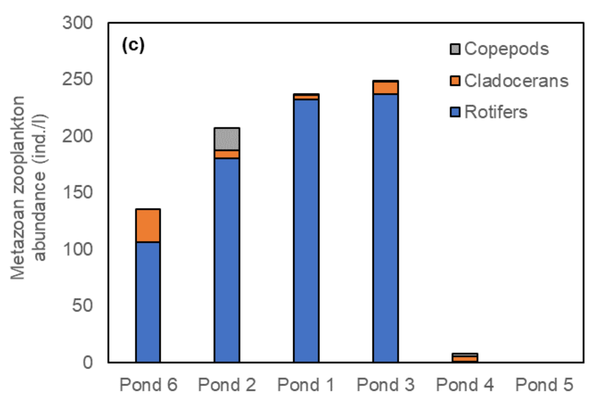


Fig. 2 Phytoplankton biomass (a). Abundance of ciliates (b) and metazoan zooplankton, rotifers, cladocerans and copepods (c).

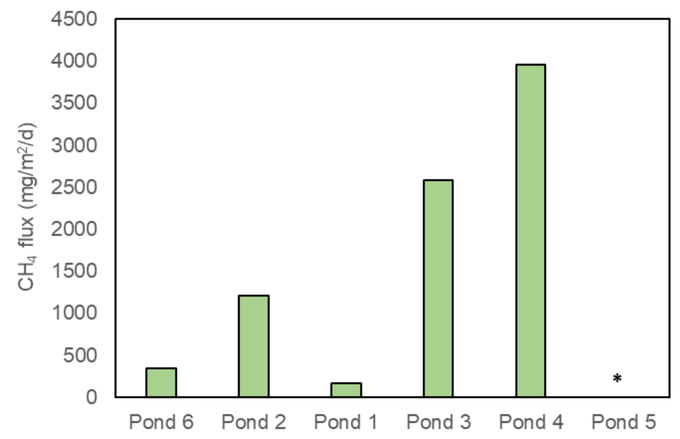


Fig. 3 Methane flux. Missing values ("*") in pond 5.

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Cooperation and expertise for a sustainable future