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Stable isotopes and Digital Elevation Models to study nutrient inputs in high-Arctic lakes

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Ice cover, run-off from the watershed, aquatic and terrestrial primary productivity, guano deposition from birds are key factors controlling nutrient and organic matter inputs in high-Arctic lakes. All these factors are expected to be significantly affected by climate change. Quantifying these controls is a key baseline step to understand what combination of factors subtends the biological productivity in Arctic lakes and will drive their ecological response to environmental change. Basing on Digital Elevation Models, drainage maps, and C and N elemental content and stable isotope analysis in sediments, aquatic vegetation and a dominant macroinvertebrate species (Lepidurus arcticus Pallas 1973) belonging to Tvillingvatnet, Storvatnet and Kolhamna, three lakes located in North Spitsbergen (Svalbard), we propose an integrated approach for the analysis of (i) nutrient and organic matter inputs in lakes; (ii) the role of catchment hydro-geomorphology in determining inter-lake differences in the isotopic composition of sediments; (iii) effects of diverse nutrient inputs on the isotopic niche of Lepidurus arcticus. Given its high run-off and large catchment, organic deposits in Tvillingvatnet where dominated by terrestrial inputs, whereas inputs were mainly of aquatic origin in Storvatnet, a lowland lake with low potential run-off. In Kolhamna, organic deposits seem to be dominated by inputs from birds, which actually colonise the area. Isotopic signatures were similar between samples within each lake, representing precise tracers for studies on the effect of climate change on biogeochemical cycles in lakes. The isotopic niche of L. aricticus reflected differences in sediments between lakes, suggesting a bottom-up effect of hydro-geomorphology characterizing each lake on nutrients assimilated by this species. The presented approach proven to be an effective research pathway for the identification of factors subtending to nutrient and organic matter inputs and transfer within each water body, as well as for the modelling of expected changes in nutrient content associated to changes in isotopic composition of sediments.
Key words: nitrogen; carbon, sediment; biogeochemical cycle; climate change; hydro-ecology; isotopic niche; Svalbard