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PERMAFROST LAKES IN THE ARCTIC FRESHWATER ARCHIPELAGO

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Lakes, ponds, rivers and water-rich floodplains are major features of the northern landscape, so much so that the Arctic is sometimes thought of as a vast circumpolar wetland¹. Another way of conceptualizing northern landscapes is as a circumpolar archipelago of freshwater islands separated by land and sea. In certain parts of the Arctic, multitudes of rock basin lakes occur over glaciated terrain, while in other regions, numerous lakes, ponds and streams are formed by thawing and eroding permafrost. The latter thermokarst systems occur across the circumpolar North, and are undergoing rapid changes in size and abundance. Our aim is to develop an improved limnological understanding of permafrost thaw lakes and ponds as biogeochemical reactors and oases of biodiversity in the northern landscape. One of our primary study sites is across the southern margin of permafrost degradation in subarctic Québec, from isolated and sporadic to discontinuous permafrost. Profiling of these subarctic thaw lakes and ponds has shown that they are all highly stratified despite their shallow depths, with hypoxic or anoxic bottom waters in summer, and concentrations of carbon dioxide and methane that are orders of magnitude above air-equilibrium². Year-long deployments of automated oxygen sensors showed that the anoxic zone expands to the entire water column in winter, and that full water column mixing only occurs in fall (B. Deshpande). ¹⁴C dating of the greenhouse gases has revealed that the ages of CO₂ and CH₄ differ by up to several thousand years, indicating major differences in their carbon sources (A. Matveev). Molecular analyses of the bacterial communities by clone library analysis of DNA³ and by high-throughput RNA sequencing (S. Crevecoeur, C. Lovejoy) has shown that methanotrophs are among the most abundant sequences at most sites, indicating the importance of methane as a bacterial energy source in these waters. Two groups of keystone herbivores thrive within these subarctic ecosystems: diverse communities of planktonic rotifers (P. N. Bégin), and a triploid *Daphnia pulex* that may be sensitive to climate warming (A. Przytulska).

¹Kling, G.W. 2009. Lakes of the Arctic. In: Likens, G.E. (ed.) *Encyclopedia of Inland Waters* vol. 2, Elsevier, Oxford, U.K., pp. 577–588.

²Laurion, I. et al. 2010. Variability in greenhouse gas emissions from permafrost thaw ponds. *Limnol. Oceanogr.* 55, 115–133.

³Rossi, P.-G. et al. 2013. Distribution and identity of Bacteria in subarctic permafrost thaw ponds. *Aquat. Microb. Ecol.* 69, 231–245.