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Does size matter in peatland open-water pool biogeochemistry?

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Open-water pools are common features in boreal peatlands but their influence on ecosystem biogeochemistry is poorly known. As nitrogen (N) and phosphorus (P) are often limited in such environments, nutrient cycles in pools might have an effect on the surrounding peat, or *vice versa*. We studied C, N and P biogeochemistry in open-water pools of an undisturbed sub-boreal ombrotrophic peatland in Québec, Canada. We assessed the relationship between the pool's physical characteristics and biogeochemistry, and quantified the temporal evolution of C, N and P concentrations in pools of different size and depth over a growing season.

A one-time survey of 62 of the ∼650 pools in the peatland revealed that pool depth and area vary from 0.15 to 2.19 m and from 34 to 1977 m^2, respectively. Dissolved organic carbon (DOC) concentration ranged from 8.6 to 36.9 mg L^{-1}, negatively correlated to pool depth, and pH varied from 3.72 to 4.33. Total P was extremely low (mean = 17.3 μg L^{-1}) in all pools and total N (0.71 to 0.27 mg L^{-}) was negatively correlated with pool depth.

Nine pools, selected to represent extremes in depth and area, were surveyed every 2 to 3 weeks from mid-May to late October, 2016. Average DOC concentrations slightly increased in deep pools from 10.0 mg L^{-1} in May to 15.6 mg L^{-1} in October, but there was a stronger increase in shallow pools (from 15.4 to 33.5 mg L^{-1}). Water acidity tended to increase in large and small shallow pools (mean pH = 4.02 to 3.81) but decreased in deep pools (pH = 4.17 to 4.46). Mean total P ranged from 37.7 in May to 16.3 μg L^{-1} in October with a minimum of 8.0 μg L^{-1} in mid-August. Total N tended to increase (0.27 to 0.53 mg L^{-1}) in all pools, but deeper pools tended to have lower total N (0.25 to 0.46 mg L^{-1}) than shallow pools. Throughout, NH_4^+ (mean = 9 μg L^{-1}) and soluble reactive phosphorus (mean = 7 μg L^{-1}) were extremely low in all pools. In May, NO_3^- was higher in deep pools (42.3 μg L^{-1}) than in shallow pools (large 12.0 μg L^{-1}, small 14.3 μg L^{-1}), but decreased (mean = 6 μg L^{-1}) in July and remained low for the rest of the season. DON dominated TDN, ranging seasonally from 91 to 96%. The TDN:TP ratio rose from 7:1 in spring, to 60:1 in summer and 30:1 in autumn, with the largest ratio in the shallow pools, indicative of P-limitation.

The results suggest largest productivity in shallow pools. This study being one of the first to focus on peatland open-water pool biogeochemistry, further investigations are needed to better understand the relationship between pools and the surrounding peat, especially at the soil/water interface.