# Scoping potential microbial responses to warming and drying in the SPRUCE peatland ecosystem.

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The SPRUCE experiment is expected to lead to various changes in ecosystem properties, beyond direct effects of warming that may alter biogeochemical processes mediated by microbial communities. Here we present two lab-scale experiments to scope effects of warming and drying on peat microbial responses.

We examined temperature effects on peat enzyme metrics and how these vary with depth and season. We hypothesized winter and summer communities in near surface peat would show differential enzyme activities and increased temperature response compared to deeper depths where community optima would be narrowly constrained. We measured activity of three enzymes involved in C, N and P cycling using a custom aluminum heat block to obtain highly resolved curves from 2-65°C in ~3°C intervals. Enzyme activity, temperature sensitivity, and C:N enzyme stoichiometry decreased with depth, but showed no seasonal response. Peat N increases with depth whereas C is constant, this is reflected in a concomitant decline in the enzyme C:N mineralization ratio. Proteases were less responsive to temperature (Ea<20) compared to enzymes for C and P depolymerization (Ea=20-60). The stable temperatures in deep peat may result in communities and enzymes specialized for narrow temperature ranges, reflected by a decreased temperature response compared to surface peat that experiences large temperature swings. The small response in protease activity indicates a possibility for decoupling of N, from C and P cycling in the peat with warming.

Warming will likely lower water levels in the SPRUCE chambers, causing strong declines in hummock moisture and moderate declines in hollow moisture. Using laboratory incubations, we compared effects of 75 and 50% of ambient moisture on near surface hollow and hummock peat. We measured enzyme activity, microbial and invertebrate community abundance and composition, microbial biomass, and DOC 2, 13, 42, 91, and 112 days post drying. $CO_2$ was measured cumulatively. Hummock and hollow peat responded differentially to drying, with hollow communities most affected. Hollow samples at 50% moisture resulted in declines in 6 of 7 enzyme activities within two days that was maintained throughout the experiment. In hollow peat, there was a decline in fungal abundance with drought within 13 days. In hummock samples, two peptidase activities increased with drought, while other enzymes were unaffected. $CO_2$ respiration was similar among treatments, however 2X more $CO_2$ was respired from hummock than hollow samples. Overall, hummock microbial communities/processes were largely unaffected by moisture stress, perhaps reflecting the variable moisture levels experienced in native bogs.