Title: Microbial Response to the SPRUCE Deep Peat Heating Experiment

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Abstract:
The Spruce and Peatland Responses Under Climatic and Environmental Change (SPRUCE) experiment is a large-scale ecosystem manipulation designed to examine how peatland ecosystems respond to increased temperature and CO_2 levels. This experiment is expected to lead to various changes in ecosystem processes, including microbially mediated biogeochemical cycling, thus ultimately altering the overall C balance of these ecosystems. The initial phase of this experiment began over the summer of 2014 by heating deep subsurface peat to +2.25, +4.5, +6.75, and +9.0 °C above ambient plots with a target heating zone of 1.5-2 meters depth. Peat cores were collected in June 2014, September 2014 and June 2015, and microbial communities were examined at eleven discrete depths across the peat profile to a depth of 200 cm. One year of warming, microbial community structure and abundance of bacterial, archaeal, fungal, and methanogenic populations show strong vertical stratification across the peat depth profile yet no clear response to the temperature treatments. In an effort to identify factors that may be limiting decomposition and microbial community change, we conducted a microcosm incubation of deep peat (150-200 cm depth) at 6 and 15 °C to mimic ambient and +9 °C SPRUCE conditions. Additional treatments included elevated pH and the addition of N and P. Incubation microcosms were monitored for CO_2 and CH_4 production, and microbial community dynamics were assessed using qPCR and amplicon sequencing. Increasing temperature elevated both CO_2 and CH_4 production while elevated pH only resulted in greater CH_4 production. The effects of elevating temperature and pH in combination with N, P, or N+P additions were more variable. Although temperature had little effect on the overall microbial community structure, there was a shift in the size of bacterial and archaeal populations. In contrast, elevated pH and N additions seemed to have the largest influence on community structure and suggest that response in the deep peat may be limited by factors other than temperature.