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Microbial responses to peatland degradation and restoration

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Peatlands host the largest store of terrestrial carbon on Earth but drainage and degradation has turned them from a net carbon sink to a major source of greenhouse gases and dissolved organic carbon. Microorganisms are a major control on the cycling and release of carbon in peatlands. Understanding how degradation and restoration alters peatland microbial communities is therefore key to predicting the success of peatland restoration measures. We investigated a severely degraded upland blanket bog in South Wales (UK) that has experienced historic drying, erosion and a complete loss of surface vegetation. Over almost two decades, attempts have been made to raise the water table, stabilize the peat surface and re-establish surface vegetation. Continuous water table monitoring and regular pore water collection was conducted over 1 year in areas of the bog that remain degraded, those where vegetation has re-established and in a region that has remained in a near-natural state. The water table in the restoration area was elevated relative to the degraded bog, although these areas remain more sensitive to variations in precipitation than the natural region. However, porewater profiles of dissolved organic carbon, CH_4 and CO_2 remained more similar between degraded and restored regions. Microbial communities at each site were distinct in the surface layers, with degraded regions showing highest microbial diversity whilst the near-natural region had lowest diversity. Microbial community composition converged to become highly similar at depths greater than 50 cm regardless of the status of the surface peat. This work demonstrates that even when restoration is successful in restoring surface vegetation in degraded peatlands, the biogeochemistry and microbiology of restored peatlands is not dictated by water table behaviour alone.