**Assessing the impact of peatland restoration on freshwater ecosystems**

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**Full Project Description**

Decades of degradation have turned the UK’s peatlands from sinks to sources of organic carbon, with adverse consequences for adjacent freshwater ecosystems. These include the dystrophication of waters and reduced light penetration to benthic communities, as well as the provision of a nutrient and energy resource rapidly degraded and assimilated by the microbiota and higher plants. However, restoration efforts which broadly aim to raise the water table and re-establish vegetation are accelerating. Restoration not only slows erosion and thus particle export to rivers and streams, it also fundamentally alters the soil processes which dictate chemical composition of the waters exported. Outflow water composition is governed by a dynamic array of biological, hydrological and geochemical processes occurring in the peat itself, thus the results can be highly site dependent and difficult to predict. For example, restored peatlands designed to limit organic matter export can still export much higher concentrations of dissolved organic carbon, phosphorus and nitrogen (DOC, DOP, DON) than undisturbed peatlands for many years. Such unforeseen interactions could limit the success of these measures in safe-guarding nearby freshwater ecosystems. Thus it is of critical importance to quantify the effect restoration has on the biogeochemistry of the peatland itself in order to predict its effect on surrounding freshwater ecosystems.

We have developed a project with the Brecon Beacons National Park Authority (BBNPA) to:

1) Determine how soil biogeochemistry changes during peatland restoration

2) Identify how these changes impact water quality in surrounding rivers and streams.

The BBNPA have expanded peatland restoration efforts in recent years as a direct consequence of adverse water quality issues caused by peat erosion and DOC flux, yet there exists little data on the success of these measures in improving water quality downstream. Two sites, Waun Fach and Waun Fignen Felin, in the Black Mountains and Mynydd Du SSSIs respectively, were chosen based on differing lithology, restoration degree and specific water quality issues. Porewater depth profiles will be collected across areas of undisturbed, degraded and restored peat throughout the year, tracing the flow of water into surrounding rivers and streams. Porewater will be geochemically characterized (pH, nutrient fractions including the dissolved and particulate organic fractions, DOC, trace elements, iron redox state) and compared to solid phase analyses of peat cores collected in the same area (geochemistry, mineralogy and microbial community structure). Stream water samples will also be analysed at increasing distances from the source to determine the extent to which processes in the streams themselves influence nutrient fractionation and organic matter content. Organic matter processing within the streams and the impact of these fluxes on freshwater microbiota will be further simulated in the lab using incubations of outflow water, incorporating both microbial and abiotic processes. The student will benefit from training in specialized labs across the GW4. Using the Biogeochemistry Research Platform at the University of Bristol (Earth Sciences, Geographical Sciences, Chemistry), the student will be trained by Dr Bryce in a wide range of techniques for field sampling, analytical geochemistry and microbial cultivation. Support will also be provided by Dr Gallego-Sala (U of Exeter) who has extensive experience in peatland ecology, including at Waun Fignen Felin. Microbial community analysis will be supported by Dr Griffiths (CEH) with access to sequencing facilities at CEH Wallingford. Characterization of DOM processing will be supported by the expertise of Prof. Johnes and Prof. Pancost who have pioneered a range of novel analytical techniques to characterise the nature, origins and ecological significance of DOM in freshwaters.

**Real Life challenges this project will address**

Poor water quality as a result of peatland degradation damages vulnerable river ecosystems and spoils drinking water resources. This project will direct restoration strategies by providing quantitative evidence for the success of restoration and by assessing its impact on the flux of DOM and nutrient fractions to adjacent freshwater ecosystems.

**What you should know about this project**

This project will determine how the quality of water exported from peatlands to freshwater changes as a result of peatland restoration, which is accelerating globally. The supervisory team span numerous disciplines, enabling assessment of the dynamic array of biological, hydrological and geochemical processes governing the impact of restoration on nearby freshwater ecosystems.

**What expertise you will develop**

Field skills will be developed during regular sampling in the Brecon Beacons, and a wide set of lab skills will be developed with which the student will characterize changes in water/soil biogeochemical fluxes from peatlands to adjacent freshwater ecosystems. Methods range from routine analytical geochemistry to sophisticated microbial community sequencing and mass spectrometry.

**Why this project is novel**

This project aims to capture the connectivity between peatlands and other freshwater bodies which are often studied in isolation. The mechanistic approach taken will not only quantify changes in water chemistry, but identify underlying driving forces, thus improving our ability to provide advice applicable across other sites.

**Rest of Supervisory Team:**

**Stakeholder Organisation** Brecon Beacons National Park Authority

**Stakeholder Supervisor** Bradley Welch

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