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Towards unravelling the 'Black Box' of peatland carbon: Linking peatland habitat condition and management to water chemistry and quality

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In the UK, peatlands are a significant provider of many ecosystem services including drinking water provision and carbon sequestration. However, a history of intense management and other environmental factors such as air pollution has led to large scale peatland degradation. In fact, a large proportion of UK peatland habitat, particularly upland blanket bog, is no longer being classified as 'active'. Such degraded peatlands are characterised by lower water tables, causing increased peat decomposition and thus loss of carbon. Carbon is mainly lost via respiration (CO2 and CH4) and as dissolved organic carbon (DOC), the latter leading to a potential associated decline in water quality (affecting colour and taste); however, separating climatic from vegetation impacts and attributing negative impacts to management remains a challenge.

A particular issue in the UK is water quality from uplands containing blanket bog, as they provide most of the UK's drinking water. Over recent decades drinking water quality has deteriorated as seen in increasing DOC concentrations. Whilst previous work has explored links between rising DOC and management practices, particularly grousemoor management involving rotational burning of vegetation to encourage red grouse populations on shooting estates, there continues to be a lack of understanding linkages in relation to alternative management/restoration, vegetation composition and, in particular, underpinning peat chemical processes. Understanding such linkages is becoming ever more important as many degraded peatlands are currently being restored by revegetation and rewetting as well as exploring alternative management such as mowing of vegetation.

Unravelling the underpinning peat chemistry and plant-soil processes regulating carbon cycling, and producing and/or altering DOC and its various constituent components, is key to understand impacts upon water treatment requirements. Of particular concern is that chemical (coagulant) water treatment has potential health implications via disinfectant by-product formation following chlorination of DOC rich water supply. Thus, ill-informed land management and/or restoration

alongside climatic change may incur additional water treatment pressures and costs, putting increased pressure on an already strained system. Therefore, it is important to understand the role of catchment-scale peat plant-soil chemical processes and adapt best-practice land management options for supporting drinking water quality at the peatland source.

Here, insights into peat physical and chemical properties are presented, towards enabling management decisions based on 'treatment at source' rather than the conventional 'end of pipe' drinking water treatment. Field samples and monitoring of peat mesocosm cores taken from across a spectrum of 'intact' to degraded and restored UK blanket bogs (including conventionally burnt and alternatively mown grousemoors) are routinely monitored for gaseous carbon fluxes, DOC and water quality parameters relating DOC properties (e.g. UV-spectra) to vegetation, habitat condition and management. Mesocosms also included sampling from individual vegetated cores, each with two attached plant-free cores, either with or without roots. We compare findings from controlled mesocosms to samples from field sites, assess potential methodological aspects affecting DOC collection and characterisation, unravel potential links to specific vegetation types and management/habitat condition, and explore the characterisation of DOC compounds linked to colour, high coagulant demand and the formation of disinfectant by-products.