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Peatland-ES-UK: a long-term, deep and holistic look at climate and management impacts on grousemoor managed UK blanket bog peatlands - carbon, water, biodiversity

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Large parts of the rather cold and wet UK uplands are dominated by peatlands, specifically blanket bogs. During most of the Holocene, those peatlands have locked away carbon for many thousands of years due to water logged conditions leading to low decomposition rates and long-term accumulation of soil organic matter as peat. Importantly, this peat accumulation not just increases carbon but also water storage and provides many other associated and vital ecosystem services to societies across the UK, such as drinking water.

However, since around 1850, much of the UK uplands have been under grousemoor management to encourage red grouse populations as part of shooting estates, including controversial drainage, heather burning, and more recently, alternative cutting. Due to the rather weak and often conflicting evidence base around impacts of such management more research is needed to unravel climate and management impacts on ecosystem functions and associated ecosystem services. Much of the controversial evidence base is based on short-term monitoring of only a few years (potentially misinterpreting short-term disturbance effects as long-term impacts), single site studies (not capturing edaphic and climatic variability) and space-for-time studies, often with different treatments located at different sites (and thus limited in their ability or even unable to disentangle confounding variables such as site environmental conditions/history from actual management impacts).

We present long-term data from a previously government-funded, and currently multi-funded and to 10 years extended, peatland management project investigating ecosystem functions from plot-to-catchment scales on three grousemoor sites across Northern England. The **Peatland-ES-UK** project is part of the Ecological Continuity Trust's long-term monitoring network and is based on a Before-After Control-Impact design approach. Each of three replicated field sites consist of two paired 10 ha catchments under previous burn rotation management and part of current peatland restoration work. After one year of pre-treatment monitoring, catchments were allocated either a continuation of burning or an alternative mowing post-treatment catchment management

rotation (the latter containing several 5x5 m sub-treatment monitoring plots including no management). Monitoring includes assessing hydrology, water budgets, carbon cycling, greenhouse gas emissions, peat properties, vegetation composition and key biodiversity.

We shall provide new and sometimes surprising and even challenging insights into blanket bog ecosystem functioning in an ecosystem services and habitat status context, highlighting the importance of long-term monitoring, experimental design, spatio-temporal changes and remaining uncertainties. Specifically, we shall present findings about water storage (water tables and stream flow), long-term carbon accumulation rates (peat cores), recent carbon budgets (flux chambers) and net greenhouse gas emissions (including methane). We also present some peatland model predictions around various land use impacts on past, present and future carbon storage potential. Finally, we call for a joint funding commitment across research, policy and land user organisations to ensure the continuation of such joined-up 'real-world' experimental and long-term monitoring work, as part of a national applied research platform network, as it provides the "gold standard" to inform evidence-based policy directly related to practitioner needs.