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Impact of peatland restoration on water treatability

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Introduction

- Current UK catchment management practices have attempted to maintain or enhance the ability of peat to immobilize organic carbon (OC).
- As such, research focus has tended towards variability of the OC flux within runoff rather than OC size and chemical character.
- These characteristics may control the lability of the OC as well as the ease at which the water treatment process can make the runoff potable.
- This study will examine the physical and chemical composition of runoff derived from the opposite end members of current management programmes; moss-covered peat and bare peat (Worrall *et al.* 2004).
- The influence of runoff OC on water treatability will be assessed by examining how the type, composition and concentration of the runoff OC load affects the flocculation of $Fe(OH)_3$.

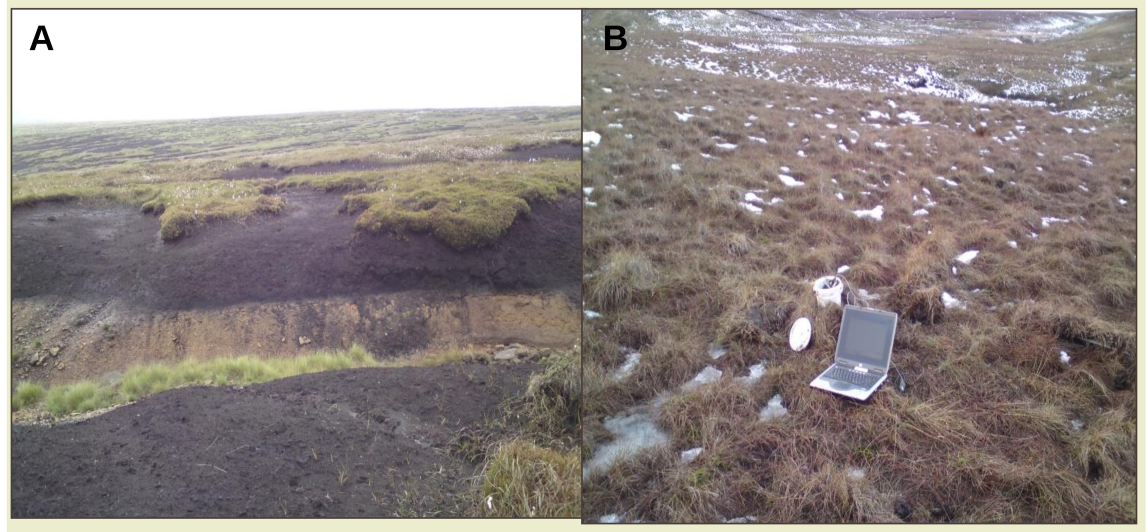

Figure 1. Two subcatchments of Crowden Great Brook, South Pennines, UK representing two possible end members of peatland catchment management; **A**: Bare peat, **B**: Vegetated peat.

Methods

- Synthetic runoff generated by passing de-ionised water through columns of intact bare peat and moss material collected from Crowden Great Brook field site.
- Physical and chemical character of runoff OC determined through TOC analysis and Py-GC/MS.
- Fe^{3+}, commonly used as a flocculant in drinking water treatment (Judd & Hillis, 2001), was added to synthetic runoff solutions made up with different types, sizes and concentrations of OC.
- Rate and degree of $Fe(OH)_3$ flocculation measured via analysis of Fe present in <1µm and <0.2µm solution filtrate using ICP-AES.

Physical and Chemical Character of Runoff OC

Particle Size Distribution (PSD) of Runoff OC

- PSD of OC within synthetic runoff analysed and compared with *in situ* data collected from the Crowden Great Brook peatland catchment.
- Moss-derived runoff demonstrated to exhibit a significantly smaller PSD than runoff derived from bare peat.
- Moss-derived runoff also has a PSD more similar to *in situ* streamwaters.

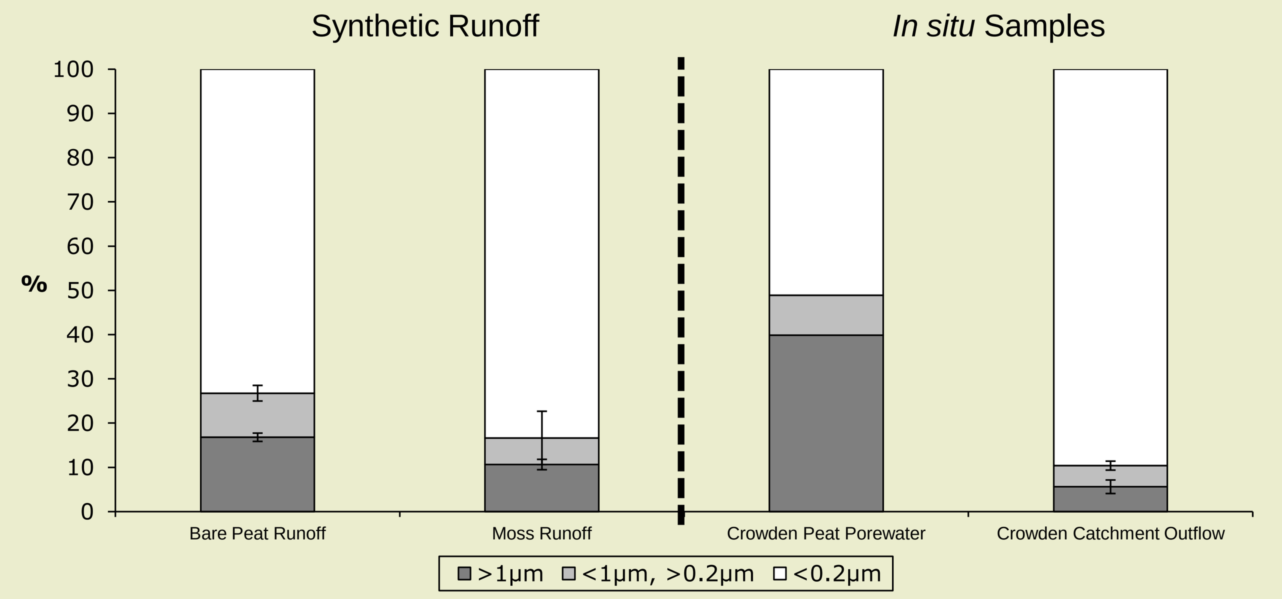

Figure 2.Proportions of average OC (% mass of total OC) within the synthetic bare peat and moss runoff, alongside Crowden streamwater and peat porewater samples. Standard error bars generated with n=3.

Chemical Composition of Runoff OC

- Aliquots of synthetic bare peat runoff and moss runoff analysed via Py-GC/MS (Agilent 5890 GC/MS).
- Major chromatogram peaks identified and classified according the classification scheme presented by Vancampenhout *et al.* (2009).
- Runoff from bare peat characterised by abundance of phenolitic compounds.
- Runoff OC from vegetated peat dominated by polysaccharide compounds.

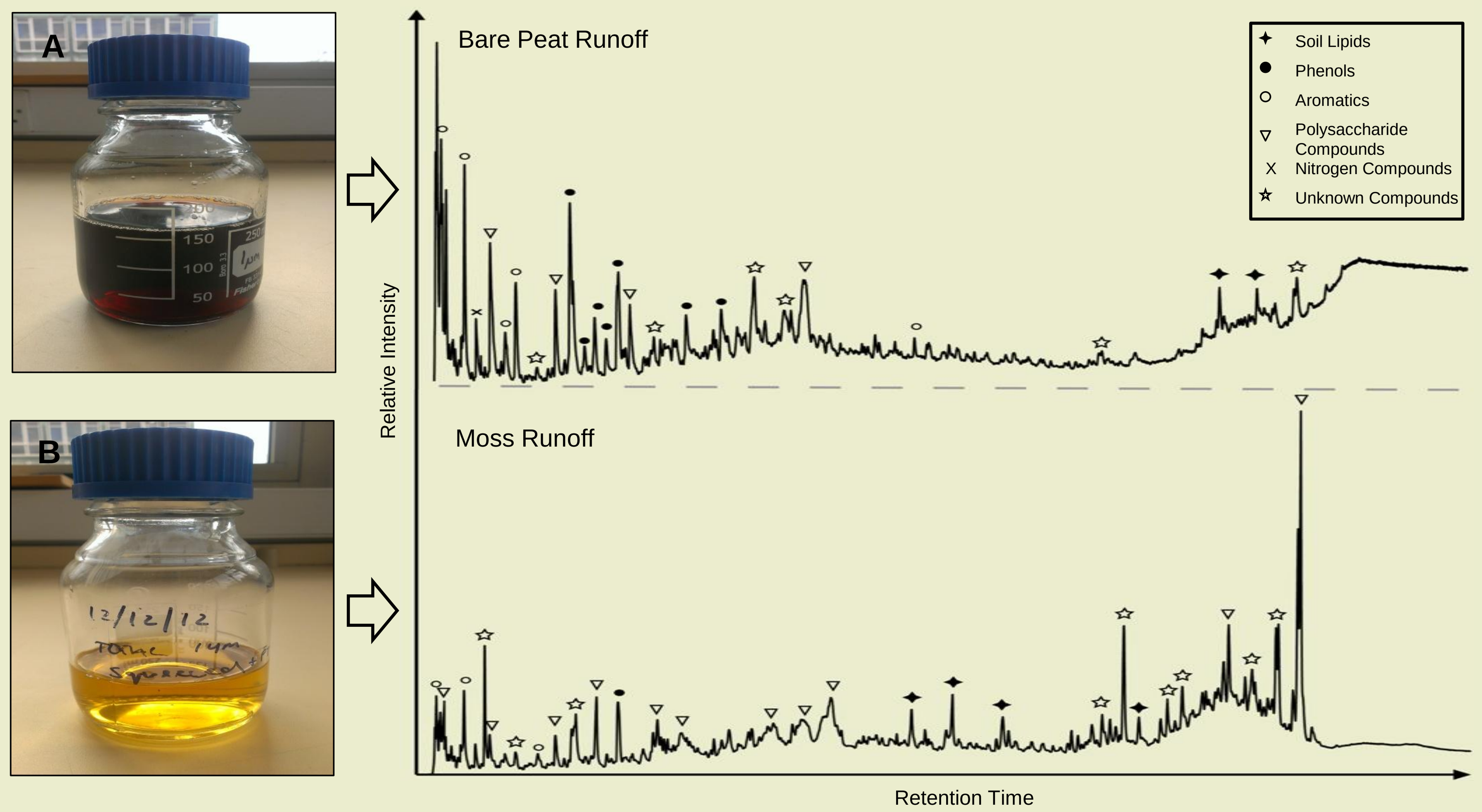

Figure 3. Total ion chromatogram of the bare peat and vegetation peat runoff OC load. Major chromatogram peaks are labelled in accordance with the classification scheme of Vancampenhout *et al.* (2009). **A** shows a sample of the synthetic runoff derived from bare peat, **B** shows a sample of the synthetic runoff produced from moss material.

Effect of OC size, concentration and type on $Fe(OH)_3$ flocculation

- Solutions of runoff OC were made up to 10ppm Fe^{3+}. Concentrations of OC and Fe^{3+} used in simulations reflective of Crowden Great Brook *in situ* concentrations (Gaffney *et al.* 2008).
- For both moss- and bare peat- derived OC the proportion of $Fe(OH)_3$ flocculated in >1µm particles increases with reducing OC concentration.
- Flocculation of $Fe(OH)_3$ was inhibited from 20 mg/L (OC) to as low as 5 mg/L (OC).
- At lower OC concentrations (<20 mg/L) bare peat-derived OC proves to be a more efficient anti-flocculant than moss-derived OC.
- For both runoff types, increasing the relative abundance of <0.2µm OC reduces the proportion of $Fe(OH)_3$ that flocculates as >1µm particles.

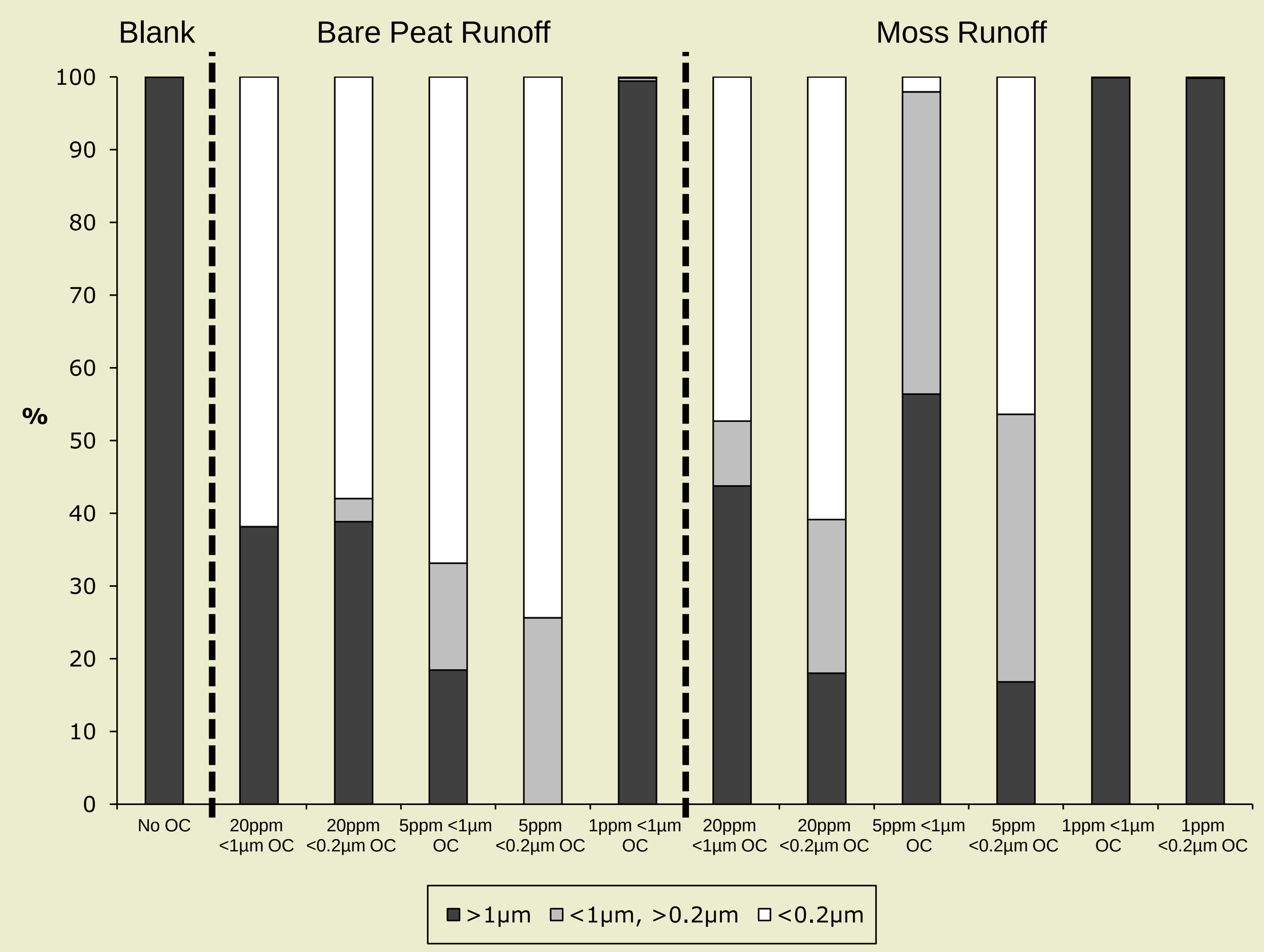

Figure 4. Average proportions of Fe (% mass of total Fe) in laboratory simulations at the point at which H^+ production has stopped. N=3. Samples are labelled with OC concentration and OC size.

Discussion

- The data presented here suggests that current catchment management practices aimed at restoring vegetation in order to minimise greenhouse gas production may have the additional benefit of making catchment waters easier to treat with Fe^{3+}.
- Runoff from bare peat proves more efficient at inhibiting flocculation of Fe complexes; this may be due to a relative abundance of phenolic groups (Garcia-Mina, 2006).
- This suggests a shift towards vegetated peat could generate more easily-treatable runoff within eroding peat catchments.
- However, the synthetic runoff produced in this study suggests a transition towards vegetated peat may increase the proportion of <0.2µm OC in catchment streams. This may offset any possible benefit associated with changes in the runoff OC chemical character.
- Further research is therefore needed into the magnitude and composition of runoff from *in situ* areas of vegetated peat.

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