Impact of peatland restoration on water colour in a changing environment

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Structure of presentation

- Peatlands and regulation of water quality
- How water colour has changed over last 30 years
- Why water colour is an issue
- Impact of peatland restoration on water colour versus other environmental changes in the UK uplands
- Conclusion
Characteristics of water draining peatlands:

- **Low ionic strength** - due to low solute concentrations
- **Acidic** – low pH
- **Oligotrophic** - low nitrogen and phosphorus concentrations
- **Coloured** due to the presence of dissolved organic carbon (DOC)

Precipitation = main input of water and solutes
Ecosystem services of peatlands with regard to regulating water quality

1. In the UK 11.4 million people rely on peatlands for their drinking water.
2. Source of potable water due to:
   - High rainfall amount
   - Low evapotranspiration
   - Remote location
   - Low intensity land use
   - High water quality
3. Peat retains pollutants
4. Source of dilute water: can be used to dilute pollutants in other water sources
Water picks up colour (dissolved organic carbon) as it passes through the peat.

Water treatment removes colour so that customers receive a colourless water.
Water colour has increased over 20 years

Trend in colour at Water Treatment Works in the southern Pennines
Environmental Implications of increasing water colour

- **Depletion of terrestrial carbon stores**, increasing fluxes into more reactive pools (riverine, marine and ultimately atmospheric).

- **Impact for water treatment works** (increased cost) and potential effects on drinking water quality (production of carcinogenic disinfection by-products).

- **Local effects on water quality**: Water transparency; water temperature, acidity; heavy metals; ecology.
Why has water colour increased?

Decline in Acid Rain

Carbon more soluble as acidity declines
Can peatland restoration help?

- YES but often hard to detect from sampling stream water alone due to seasonal trend and long term trend
Influence of water-table position

High water table

Low water table

<table>
<thead>
<tr>
<th></th>
<th>Anaerobic (no oxygen)</th>
<th>Aerobic (oxygen)</th>
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<tbody>
<tr>
<td>DOC µg/g soil/day</td>
<td>0.52</td>
<td>1.98</td>
</tr>
<tr>
<td>DOC Q10</td>
<td>1.84</td>
<td>3.53</td>
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Less colour produced

More colour produced

Clark et al., 2009. Global Change Biology
Drainage and water colour/DOC

Impact of drain-blocking on water colour

- Many studies observed an increase in colour shortly after blocking (e.g. Worrall et al. 2007).
- Large study showed that blocking generally reduced colour (Armstrong et al., 2010). But not always - Impact of local conditions
- Re-vegetation of gullies reduces loss of peat to freshwaters
Re-vegetation of bare peat at Bleaklow

<table>
<thead>
<tr>
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<th>DOC flux</th>
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<tbody>
<tr>
<td></td>
<td>t C km⁻² yr⁻¹</td>
</tr>
<tr>
<td>Bare peat</td>
<td>34.4 – 72.1</td>
</tr>
<tr>
<td>Restored</td>
<td>13.1 – 57.7</td>
</tr>
<tr>
<td>Vegetated</td>
<td>13.0 – 95.6</td>
</tr>
</tbody>
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Worrall et al. (2011)

More peat and colour lost from bare peat

less peat and colour lost from vegetated peat
Heather Burning and DOC


However, plot scale experiments have not observed an increase in soil solution DOC following burning (e.g. Clay et al., 2009; 2010).
How will water colour change in the future?
Water colour over next 10 years

Major impact of recovery from acid rain has happened
Climate change and land use change/restoration will have more influence
A restored peatland is more resilient to climate change

Any Questions?
Acknowledgments

- Yorkshire Water – data and funding for research
- UK Uplands Water Monitoring Network – River Etherow data
- Sheila Palmer, Brian Irvine, Joseph Holden