Peak District Moorland
Carbon Flux

Moors for the Future Research Note No 12 June 2007

Peatlands as carbon reserve

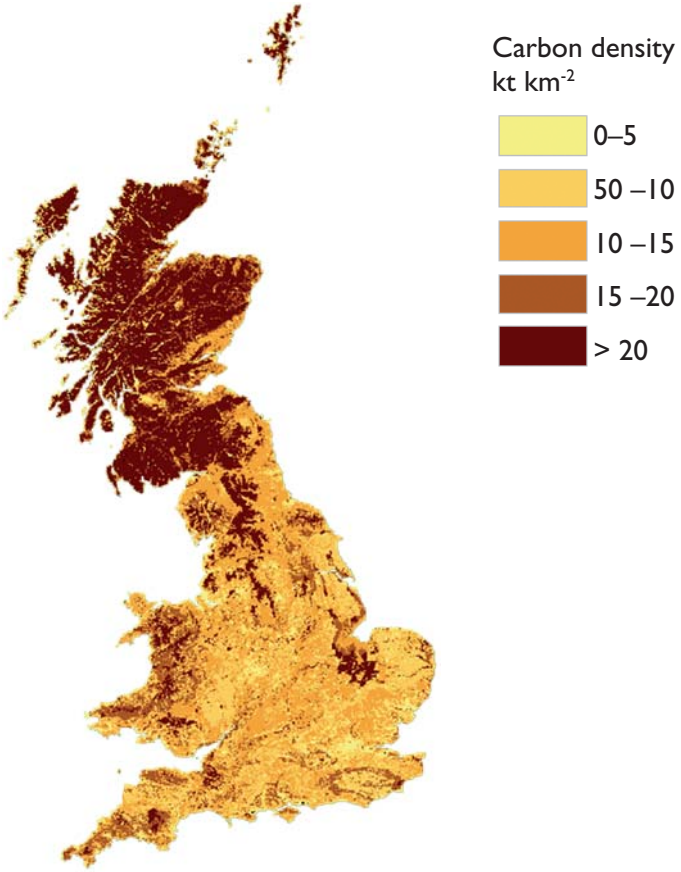
- Peatlands are the single largest carbon reserve in the UK. With around 3 billion tonnes of carbon, more carbon is stored in UK peat than in the forests of Britain and France combined. The entire UK woodland estate contains only around 150 million tonnes of carbon in comparison.

  Between 40-50% of UK soil carbon is stored in 8% of its land area. This is equivalent to 20 years of UK CO_2 output. The Peak District moorlands store between 16 and 20 million tonnes of carbon.

Peatlands as carbon sinks

- Peat bogs can actively sequester carbon. Scientists from Durham estimate that all of the peatlands in England and Wales could absorb around 400,000 tonnes of carbon a year if in pristine condition.

  The Peak District moorlands have the potential to sequester up to 13,000 tonnes of carbon per year.



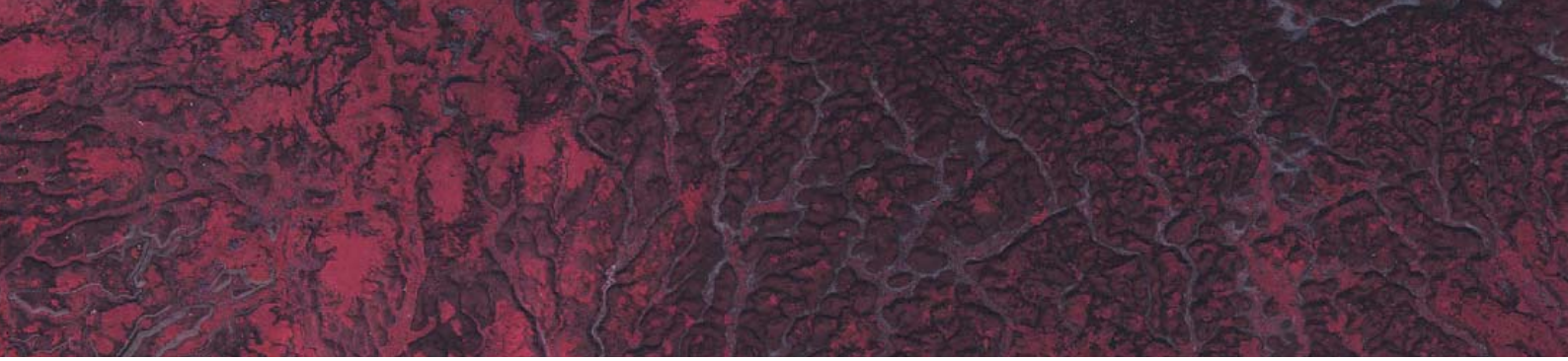
Distribution of soil carbon in UK (after Bradley, Milne et al, DEFRA)

Vulnerability

- A recent paper in *Nature* gives the alarming figures that 80% of all carbon losses from UK soils are derived from upland peat soils. If moorlands are damaged by wildfires, air pollution or inappropriate land management such as over-grazing, excessive burning or drainage, resulting in erosion and drainage, scientists estimate UK peatlands could emit up to 381,000 tonnes of carbon a year.

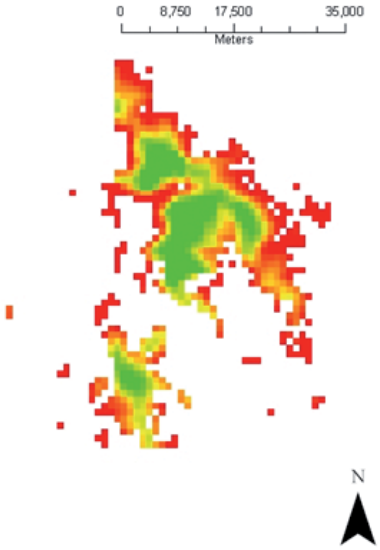
  In the Peak District, up to 100 tonnes of carbon are lost annually per km² in some eroding catchments where wildfires have caused large areas of bare peat devoid of vegetation (Evans & team).

Deep erosion scars of bare peat after decades of wildfires on Bleaklow

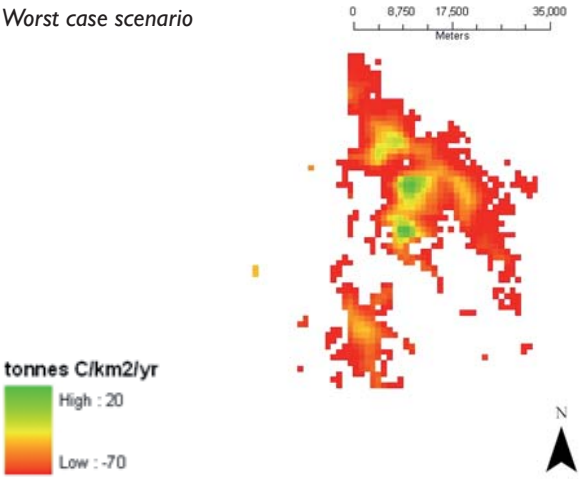


Infrared imagery showing bare peat areas on Bleaklow that are heavily dissected by erosion gullies *2005 UKPerspectives Imagery*

Ideal case scenario



Worst case scenario



Model for Peak District moorlands: green –carbon sink, red –carbon loss
Sphagnum mosses actively fix carbon and build up peat

Carbon Loss through Moorland Erosion

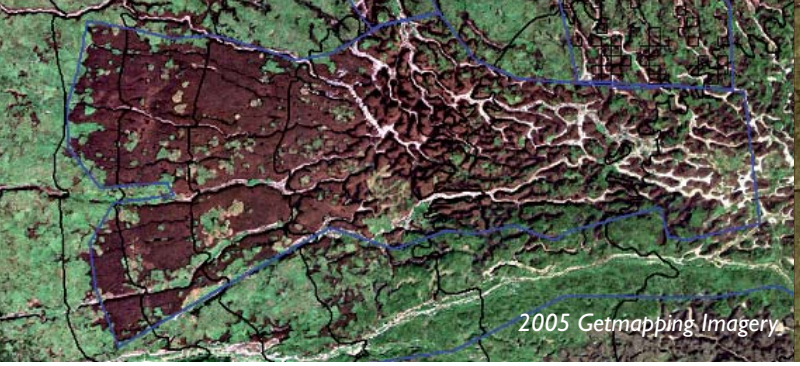
Acidification through atmospheric deposition, wildfires and past inappropriate land management such as e.g. over-grazing have led to extensive peat erosion in the Peak District with 9km^2 bare peat and 22km^2 damaged moorlands in 2000. Carbon loss and gain has many pathways, including particulate organic carbon (POC) in surface erosion, dissolved organic carbon (DOC) in riverine export, flux gases at the soil surface, such as soil respiration of carbon dioxide (CO_2) and methane (CH_4) and uptake through primary productivity (CO_2). Erosion and subsequent POC loss is one of the main drivers of carbon loss in the Peak District. Ongoing research indicates that up to 20% of POC may be converted to DOC in-stream processes, and up to 30% of POC oxidise to CO_2 when deposited on floodplains (Evans & team).

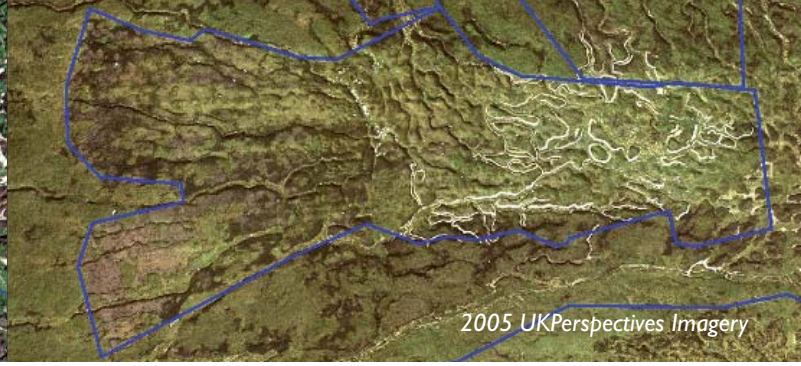
Deterioration of Water Colour

Water colour is a major water quality limitation. Water companies are concerned about continually rising water discolouration over the last decades from upland catchments, costing millions of pounds per year to remove (aesthetic issues) with significant increases in dissolved organic carbon (DOC) concentrations in 68% of UK streams. In the Peak District this trend is also evident at Ladybower reservoir. DOC is produced when peat oxidises. Usually, in water logged moorlands, peat decomposition is inhibited due to a shortage of oxygen. However, dry summers or wildfires lead to peat aeration & decomposition and DOC release into rivers. This process is hard to stop once started. With ongoing climate change, release of 1 mega-tonne of Carbon per year by 2010 from UK rivers is predicted (Worrall & team).

Carbon Flux models

Scientists from Durham University have produced first model predictions for carbon flux in the Peak District, based on topography, climate, local erosion rates and different management scenarios. If all moorlands were in ideal pristine condition, they could on average fix 18.9 (max 35±12.6) tonnes Carbon/km^2 per year across all habitats within the Peak District. In a worst case scenario, they could on average emit up to 7 (max 100) tonnes Carbon/km^2 per year.





Moors for the Future re-vegetation of bare peat on Bleaklow, Sykes Moor. 2002: large areas to bare peat (brown) and minerals soils in gullies (white). 2005: After 2 years of treatment a cover of 40-70 % vegetation cover is restored, gullies are lined with geojute (white) to stabilise against erosion.

Restoration for Carbon Credits

- The restoration and enhancement of UK peatlands could save around 400,000 tonnes carbon a year (Worrall). This is equivalent to the greenhouse gas emissions from 1.1 billion car miles or 84,000 family-sized cars per year.

  - **Bare peat re-vegetation**

  Re-vegetation of bare peat can lead to a 40-70% vegetation cover within 2 years and thereby stabilise peat. This reduces carbon loss and enhances carbon sequestration through primary productivity. Intact bog vegetation can fix up to 35±12.6 tonnes Carbon/km^2 per year (Evans & team).

  - **Gully blocking / Grip blocking**

  Gully blocking can accumulate sediment layers of up to 40 cm height behind blocks within 1 year and can raise water tables. Gully lining with geojute also promotes re-vegetation and limits erosion. On Peak District plateaus, gully restoration affects carbon fixation rates in order of importance by increasing vegetation cover > minimising erosion (POC loss) > reducing drainage. The combined created sink and avoided loss by gully/grip blocking could equate to 64-135 tonnes Carbon/km^2 per year (Evans, Worrall & team).

- In addition, land managers can contribute to sympathetic carbon land management. For reducing grazing, drainage or burning to enhance carbon storage potential and help to revert major UK carbon sources to carbon sinks.

Gully block in erosion channel / Moorland drainage grip

- If carbon gains could be marketed as Certified Emission Reductions on the carbon offset market, this could finance large-scale restoration. This takes advantage of natural processes for carbon capture that consume little energy, do not use extra land resources, are self-contained and permanent.

Natural Resource Protection

- Moorland restoration for carbon has multiple public benefits:

  - **Improvement of biodiversity**

  Peatl and restoration can help to enhance wildlife habitats and restore species diversity.

  - **Reduction in water colour**

  Water companies spend millions of pounds removing colour from water coming from upland catchments. Strong evidence suggests peatland restoration can significantly reduce colouration.

  - **Reduction in flood events and sedimentation**

  Peatland drainage in particular has been blamed for down-stream flash flooding (such as in York) and sedimentation of salmon spawning beds.

  - **Reduction in wildfire risk**

  Degraded peatlands are at high risk to accidental wildfires. Fires severely damage long term carbon stocks and fire fighting costs the UK economy more than a million pounds each year.

  - **Improvement of natural beauty and recreational value**

  Uplands are among the most popular tourist destinations. Tourism is one of the main income streams to upland communities.

- These issues have significant economic impacts, which could be mitigated through large-scale restoration of peatland supstream.

Initial stages of restoration on Bleaklow by Moors for the Future

MOORS FOR THE FUTURE

PARTNERSHIP

Acknowledgements / Data availability

- The research reported is in ongoing (figures from June 07) and conducted mainly by Fred Worrall, Durham University, and Martin Evans, Manchester University and their teams in collaboration with Moors for the Future. Much of this work was made possible through collaboration within the 'Sustainable Uplands' Rural Economy and Land Use project (RELU) and additional funding by Natural England.
- The UK soil carbon map was kindly supplied by Ian Bradley, Ronnie Milne and teams (Cranfield University, CEH Edinburgh, Macaulay Institute), funded by DEFRA and contributions by SEERAD and NAW.
- Copies of the research reports are held in the Moors for the Future library.
- Views expressed in this research note do not necessarily reflect those of all Moors for the Future Partners.

References / Links

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No 1 Breeding Bird Survey of the Peak District Moorlands
No 2 Gully Blocking in Deep Peat
No 3 Peak District Moorland Stream Survey
No 4 Heavy Metal Pollution in Eroding Peak District Moorlands
No 5 Visitors on Peak District Moorlands
No 6 Rapid Assessment Protocol for Monitoring Burning
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The Moors for the Future Partners are:

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