Air Pollution
in the Peak District

Moors for the Future Research Note No 9 October 2006

Tarnished beauty

The Peak District National Park is widely recognised as one of the most beautiful areas of the United Kingdom. It became England's first national park in 1951 and most moorlands are now subject to national and international protective designations such as Sites of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Special Area of Conservation (SAC).

Yet, since the industrial revolution, the heather moorlands of the Peak District have been subject to a legacy of air pollution from sulphur ('acid rain') and nitrogen. Although, sulphur emissions have been falling steadily since the 1970's, nitrogen pollution remains high.

Broad Clough June 2004

Vulnerability

The Peak District is particularly vulnerable due to its location and topography. Due to a prevailing wind from the south west much of the national park lies downwind of Greater Manchester, one of the country's largest industrial areas, and also two of Britain's key farming areas - the England-Wales border and Cheshire. Main emission sources are therefore fossil fuel combustion from industry and road traffic (NO_x) and agricultural livestock (ammonia NH_3) production.

Additionally, much of the moorland is at high-level altitudes. This results in considerable N inputs through rain and cloud water deposition. Nationally modelled N deposition over much of the heathland of the Peak District National Park is above that at which adverse effects on vegetation may occur and critical loads are exceeded. In a UK comparison the Peak District is a hotspot of N-pollution (Fig. 1).

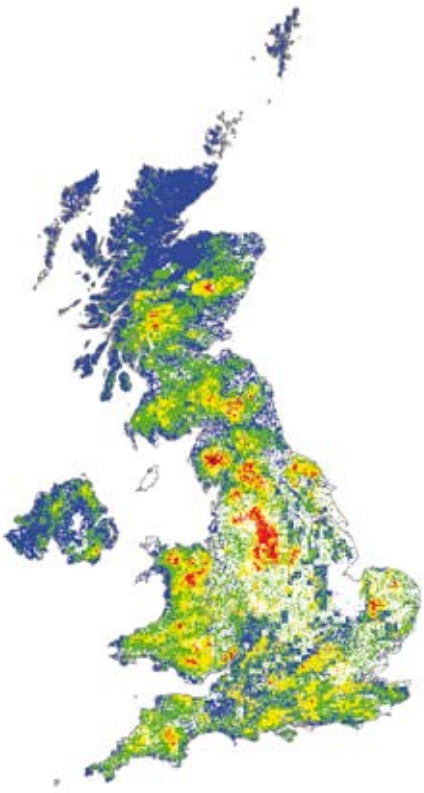

Figure 1. Exceedance of nutrient nitrogen critical loads by total nitrogen deposition for 2000-2004 (CEH Monks Wood)

2004 Moss Survey

In 2004, the Moors for the Future Partnership provided a grant to Manchester Metropolitan University to study the nitrogen content of mosses in the Peak District as a bio-indicator of atmospheric pollution and its potential affects on vegetation at a local level.

Mosses have been widely used as indicators of environmental conditions, including testing for atmospheric pollutants for many years. Certain mosses are particularly suitable as they depend entirely on nutrients from the atmosphere.

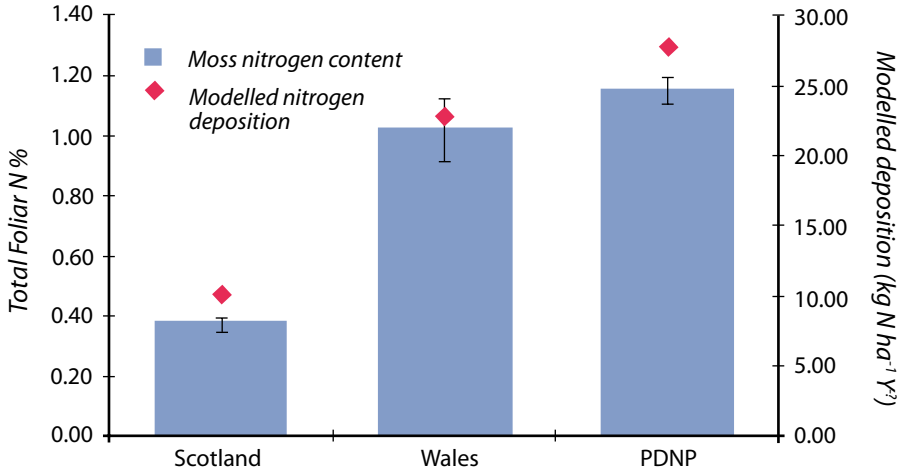

Figure 3. Nitrogen deposition in the Peak District is much higher than in Scotland or Wales.

Peak District moorland nitrogen deposition

- Across the Peak District moorlands representative samples of a moss common to heather moorland, *Hypnum jutlandicum*, were collected from 29 sites in June 2004. Samples were taken close to footpaths or tracks.
- All moss samples were analysed for total nitrogen (N) and phosphorus (P) content.

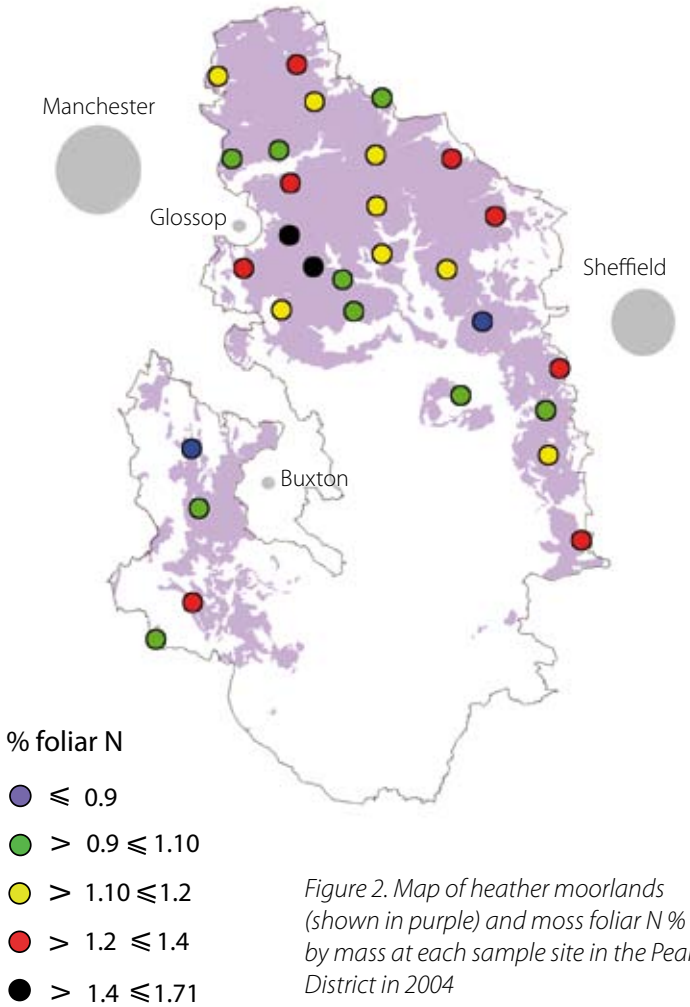

Figure 2. Map of heather moorlands (shown in purple) and moss foliar N % by mass at each sample site in the Peak District in 2004

- The highest nitrogen concentrations were found in moss sampled to the east of Glossop at Ashop Clough and Snake Pass with 1.63% and1.71% respectively. The lowest moss nitrogen concentrations were obtained in samples from Cats Tor west of Buxton (0.81%) and Moscar Moor west of Sheffield (0.87%) (see Fig. 2).
- There was no general spatial pattern over the survey area and most results fell within a comparatively narrow range of between 1.1% and 1.4%.
- The findings reflect the narrow range of nationally modelled nitrogen deposition for the sites, although no close relationship between modelled deposition and moss nitrogen was found.

A national comparison

- For comparison, additional samples were collected from less polluted areas in Scotland and North Wales (Fig. 3). Samples taken in the Peak District had significantly higher nitrogen values.
- This suggests that the Peak District moorlands are more vulnerable to pollutant nitrogen emissions than those in Wales or Scotland.

Road traffic as local pollutant

- To test the effect of road traffic on moss nitrogen, samples were taken at increasing distances downwind from a busy road (the A537, near the Cat and Fiddle Pub).
- High levels of moss nitrogen close to the road demonstrate the responsiveness of moss to a local source of pollution. Nitrogen levels on the windward side fell rapidly as distance increased (Fig. 4).

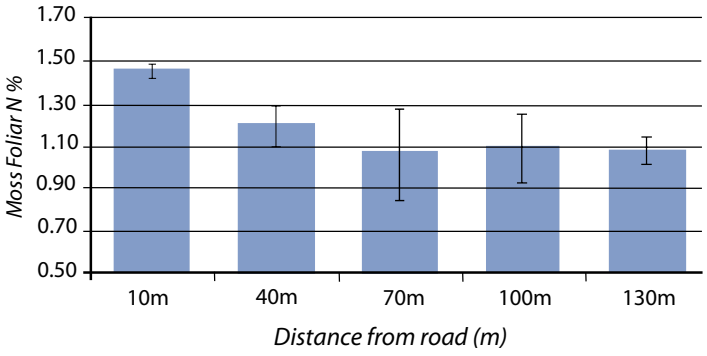

Figure 4. Bar chart showing reducing moss foliar nitrogen as distance from road increases

Nitrogen : Phosphorus ratio

- Both nitrogen (N) and phosphorus (P) are vital nutrients for plants. A shortage of either limits plant growth.
- N:P ratios are therefore useful in indicating the nature of nutrient limitation. The 'natural' state of heather moorland is nitrogen limitation, with N:P ratios often less than 10:1. Growth limitation by phosphorus alone is thought to exist above ratios of 20:1.
- Although there is no clear spatial pattern of N:P ratios across the study area, the highest N:P ratios are found to the east of Glossop stretching across the Bleaklow Plateau (Fig 5). The ratios are indicative of a shift in primary nutrient limitation from N to P limitation or to a N & P co-limitation over much of the Peak District.

Effects on vegetation

A shift in N:P ratios suggests that traditional heathland species may face increased competition from nitrogen loving species such as some grasses and graminoids.

There may be direct negative affects of nitrogen deposition on sensitive species such as lichens and bryophytes.

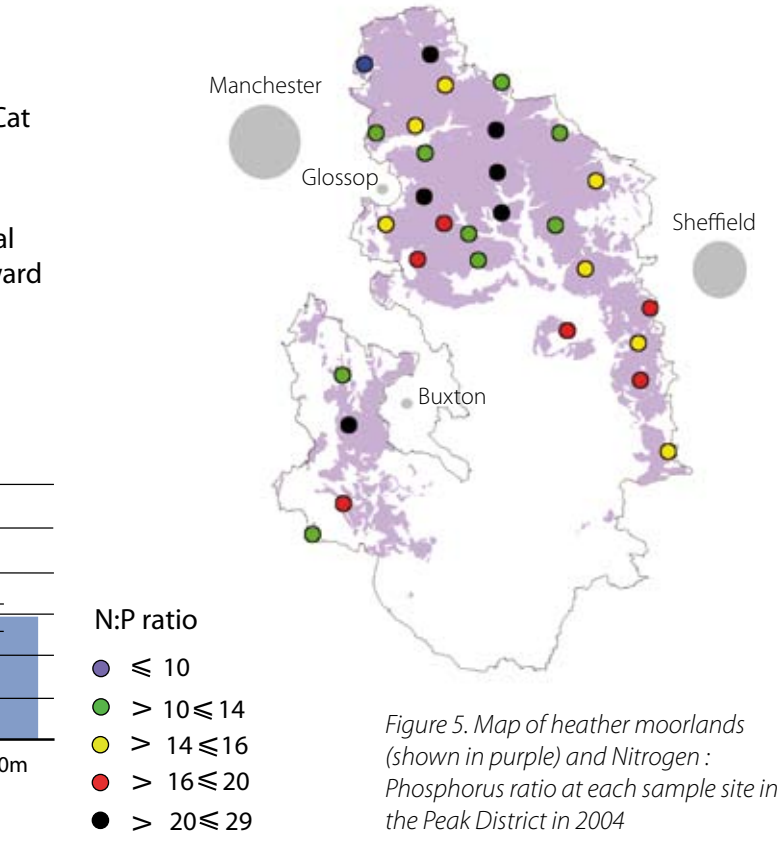

Figure 5. Map of heather moorlands (shown in purple) and Nitrogen : Phosphorus ratio at each sample site in the Peak District in 2004

Conclusion

Results highlight that the area east of Glossop is particularly susceptible to nitrogen pollution.

Comparisons between modelled deposition data and data from this study suggest an exceedance of critical loads across much of the national park.

Biomonitoring is a potentially useful tool to assess habitat quality, especially in remote areas.

Further research

To investigate effects of potential recovery from nitrogen pollution and effects of climate change on moorland vegetation, CEH Bangor is currently carrying out experiments on Bleaklow (more information see Moors for the Future website).

CEH recovery Roofs

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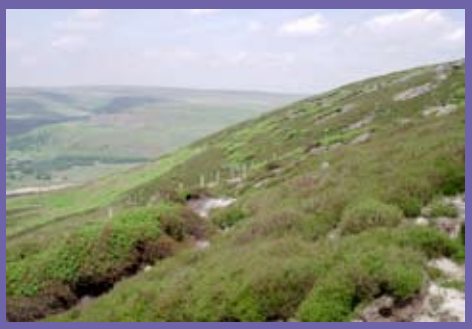

This work was made possible by a Small Research Grant from Moors for the Future.

Acknowledgements / Data availability

- The research was conducted by Chris Field and Simon Caporn of Manchester Metropolitan University. Copyright of all data and maps remains with the authors.
- The critical loads map was kindly supplied by UK National Focal Centre for Critical Loads Mapping and Modelling, CEH Monks Wood http://critloads.ceh.ac.uk/contract_reports.htm. Modelled nitrogen deposition data was obtained from the Air Pollution Information System. (www.apis.ac.uk)
- 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

Field, C.D. (2005) Biomonitoring of nitrogen deposition and its impacts to the upland heaths of the Peak District National Park. Unpublished MSc Disertation, Manchester Metropolitan University.

http://www.egs.mmu.ac.uk/research.htm

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Contact Us

Moors for the Future Partnership, The Moorland Centre, Edale, Hope Valley, S33 7ZA
Tel: 01629 816581
www.moorsforthefuture.org.uk
Email: moors@peakdistrict.gov.uk

The Moors for the Future Partners are:

Natural England, National Trust, Peak District National Park Authority, United Utilities, Severn Trent Water, Yorkshire Water, Sheffield City Council, Moorland Association, Defra, Country Land and Business Association, National Farmers Union

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