Peak District Moorland
Stream Survey

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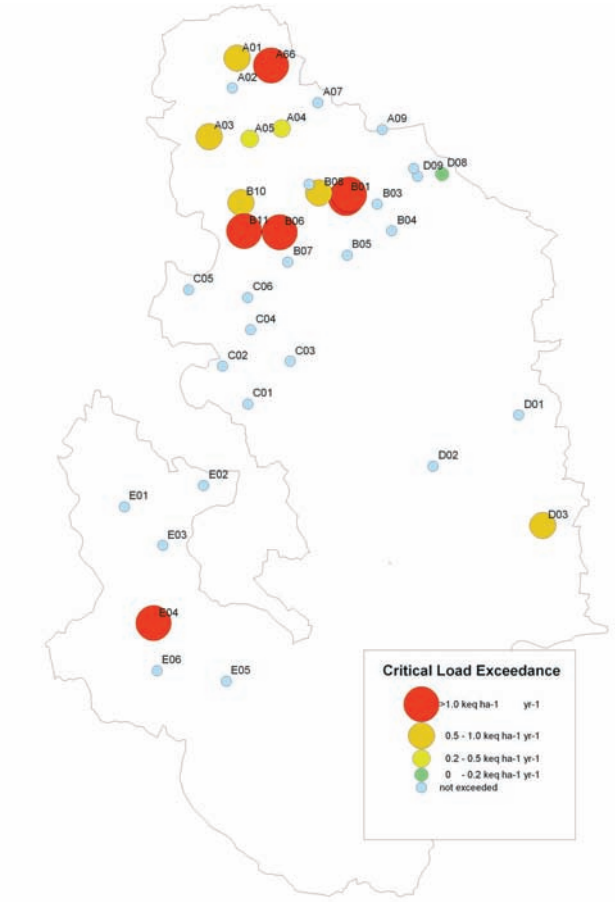
Moorland Streams

- Moorland streams are a fundamental element of the Peak District landscape. Despite potential impacts from acid deposition, systematic information on the chemical and ecological status of the moorland stream network has been lacking to date.

Nitrogen Deposition

- Elevated emissions of anthropogenic NO_x and NH_x from greater vehicle usage and agricultural intensification, have led to high rates of sustained nitrogen deposition in UK upland regions, of which the Pennines are amongst the highest.
- High inorganic N-concentrations in the sensitive headwater regions of moorland catchments can lead to severe acidification.

Fairbrook. Photograph by Ray Manley. ©Copyright Peak District National Park Authority.



Peak District Stream Survey (PD-MSS) Sites

Survey 2004

- Supported by Moors for the Future, a survey of moorland streams within the Peak District National Park was carried out in spring 2004 by a team of researchers from The University of Manchester and the Metropolitan University of Manchester.
- Survey results confirm that the aquatic moorland habitats of the Peak District are acidified in many places and the fauna is partly impoverished. The cause of this acidification is attributed to atmospheric acid deposition.

Study Sites

The Peak District Moorland Stream Survey (PD-MSS) included 37 third-order streams (see map page 1) representing approximately 50% of third-order streams draining moorlands within the National Park.

In addition, a detailed survey of the water chemistry of catchments in the Bleaklow and Black Hill area focused on the inorganic nitrogen status of headwater streams by covering seven catchments (see below).

Sampling

All sampling occurred during summer base-flow conditions when N-retention by vegetation is greatest. Therefore results are conservative.

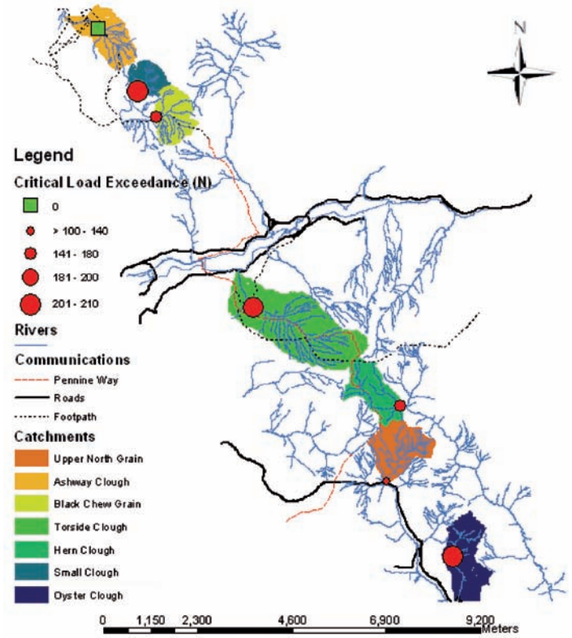
Critical Load Exceedance

Barber (2004) used critical load* models to evaluate the acidification status of the stream network. Applying the Steady-State Water Chemistry (SSWC) and Empirical Diatom Models, over a third of the sampled streams exceeded their safe levels for sustaining the ecological functions (see map page 1). This is alarming as the applied models represent 'best-case' scenarios as sampling was undertaken at base flow conditions. Many of these sites are situated in the Dark Peak and characterised by high levels of erosion.

Nitrogen Saturation of Headwaters

Hall (2004) found that nitrogen saturation within Dark Peak catchments as a result of atmospheric N-deposition is severe. With summer mean NO3 concentrations of 16.8 µeq l^{-1} and more significant mean ammonium (NH4) concentrations of 37.8 µeq l^{-1}, concentrations are significantly higher than reported for other upland regions of the UK.

Results indicate that existing models of nitrogen cycling are unreliable for future predictions in these eroding blanket peat catchments.



Detailed headwater study sites

Detailed headwater study area in the Peak District National Park

* A critical load is 'a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge'

Erosion & Stream Acidification

- A positive relationship between NO_3 concentrations and the extent of eroded peat was evident, suggesting that there is less retention / utilisation of N-deposition inputs within these degraded systems.

Stream Invertebrate Fauna

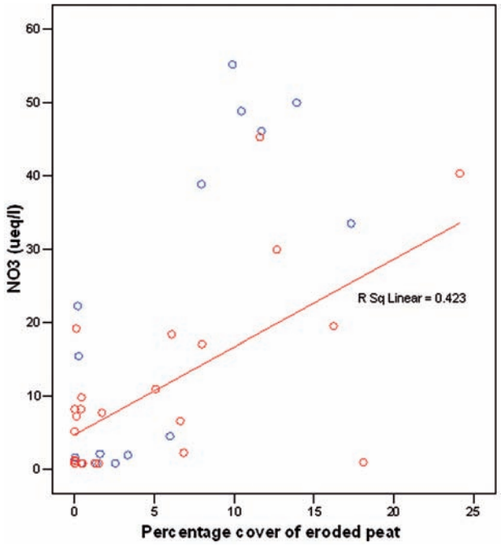
- Allen (2004) could show that in general, the invertebrate populations of the Peak District streams are similar to those of other acid-sensitive upland regions of the UK. However, several sites contained impoverished macro-invertebrate assemblages. These represent the most acidic streams with extremely low pH levels and many exceeding critical loads for acidity.
- Parts of the Peak District moorland stream network are therefore of relatively poor ecological status in comparison to other UK upland regions such as Wales and Galloway.

Biodiversity

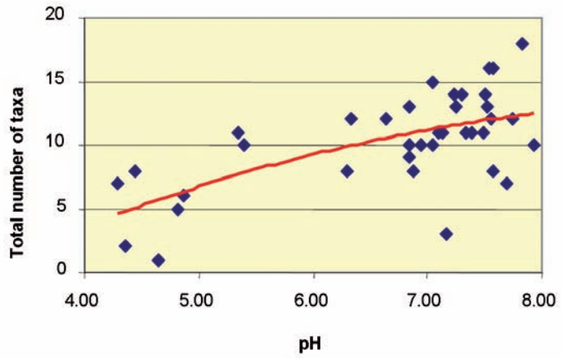
- Results of statistical data analyses showed that the number of species groups (taxa) varied most significantly with alkalinity, pH and calcium concentrations (positive relationship) and aluminium concentration and altitude (negative relationship).

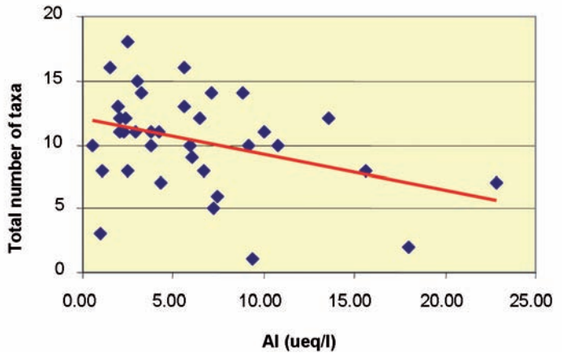
Conclusion & Outlook

- The results of the PD-MSS confirm that the Peak District moorland stream network has been significantly affected by atmospheric acid deposition, with associated ecological impacts.
- However, data from acidified South Pennine reservoirs indicate some chemical recovery after recent significant declines in acid deposition.
- Therefore there is a clear need to monitor the chemical and biological trends in the moorland stream network to evaluate the recovery process in these sensitive environments.



Relationship between NO_x concentrations (µeq l^{-1}) and percentage cover of eroded peat.





Relationship between pH and aluminium (Al) concentration and numbers of species groups (taxa).

Restoration Works

- Re-vegetation of bare peat areas by Moors for the Future may help increase N-retention due to vegetation uptake and to reduced rates of soil nitrification and therefore may help lessen stream acidification.

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PARTNERSHIP

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Acknowledgements / Data availability

- The research was conducted by Sarah Allen, Simon Barber, James Hall as well as Tim Allott and Mike Dobson from The University of Manchester and the Metropolitan University of Manchester.

- 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

Allen, SL (2004) A macroinvertebrate focused ecological survey of the moorland stream network in the Peak District National Park. Unpublished MSc Dissertation, The University of Manchester.

Barber, SD (2004) A critical load evaluation of the Peak District moorland stream network. Unpublished MSc Dissertation, The University of Manchester.

Hall, JR (2004) An assessment of inorganic nitrogen (N) concentrations in headwater streams of the Dark Peak, southern Pennines and their relationship with eroded peat: Implications for N saturation status and the utility of the First-order Acidity Balance (FAB) model. Unpublished MSc Dissertation, The University of Manchester.

www.sed.manchester.ac.uk/geography/staff/allott_tim.htm
www.egs.mmu.ac.uk/dobson.htm
www.sed.manchester.ac.uk/geography/research/uperu/projects.htm

Moors for the Future Research notes

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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