ERODING PEATLANDS THREATEN RIVER BIODIVERSITY

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Briefing Note No. 2, November 2018

Peatland erosion occurs naturally due to bank erosion (left) but it is amplified by land management activities such as artificial drainage (centre) and vegetation removal (right)

RESEARCH SUMMARY

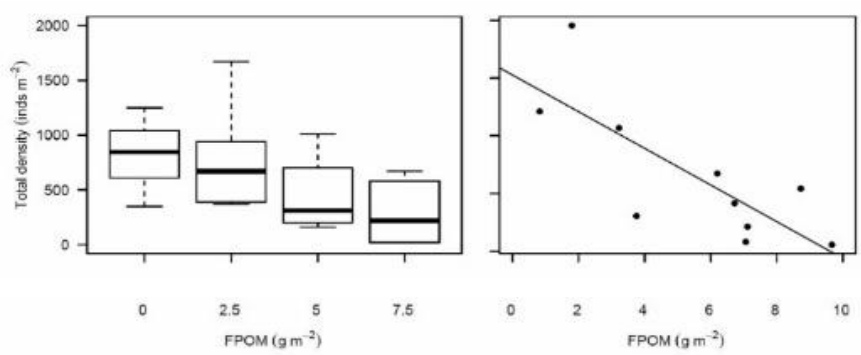
Land use (e.g. agriculture, forestry, urbanisation) and climate change can lead to widespread modification of streams and rivers. In the northern hemisphere, many rivers start (aka headwaters) in peatlands where land management, such as artificial drainage or vegetation removal and climate change have been shown to cause peat erosion and its deposition in rivers, leading to smothering of the river bed. These land management techniques have been practiced for several decades but their effects on river ecosystems, including the intricate network of linkages between plants-invertebrates-fish-birds, remain poorly understood.

Our research, undertaken since 2009 in the Pennines of northern England, has shown a consistent negative effect of sediment deposition on the biodiversity of river invertebrates (i.e. insect larvae, worms, beetles) measured in terms of their density (numbers per unit area of river) and diversity (number of different types of invertebrates).

As further climate change and land-use alterations can be expected to enhance peatland erosion into the future, significant alterations to invertebrate biodiversity is to be expected where these eroded soils are deposited in rivers. This may lead to knock-on effects on fish, birds and amphibians which feed on aquatic invertebrates, and therefore affect other benefits that we gain from rivers. The research aim was to determine the effects of current land management on biodiversity loss, raise awareness of problems with peatland erosion, and to inform land-owners, legislators, NGO's and the public who have interests in maintaining the health of our uplands.

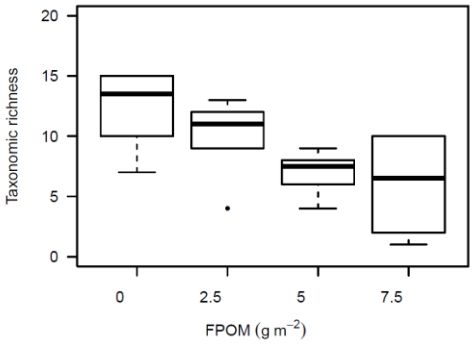
PROJECT DETAILS

→ The research was undertaken in 24 experimental river channels (left panel) which allow us to control sediment inputs, and 10 rivers with natural sediment inputs (right panel). In both systems, sediment deposition gradients were studied from ~0 g FPOM per m^2 to>7.5g FPOM per m^2 (FPOM = fine particulate organic matter; dried weight). The highest values are indicative of sediment deposition found in Pennine rivers draining eroded peatland rivers.

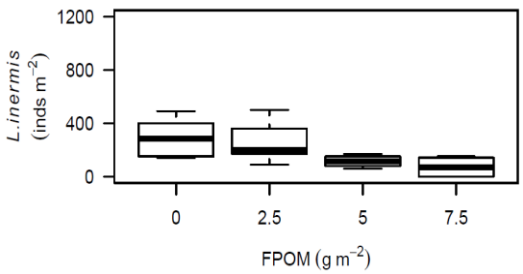


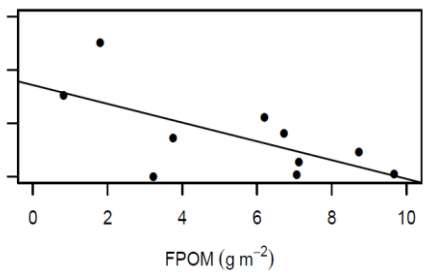
← Compared to rivers with no/low sediment deposition (i.e. un-impacted systems), peat addition at the highest levels caused 65% decreases in density (median 823 to 288 individuals per m^2) in the experiment (left panel), and 95% decreases (1956 to 56 individuals per m^2 in headwaters (right panel).

→ In the experimental rivers, invertebrate diversity declined from a median of 12 types in rivers with no peat addition, down to 6 types in the highest sediment additions.



↓ The most abundant species found in both systems, the stonefly *Leuctra inermis*, decreased in density by 75% on average in experimental rivers (left panel) and was not found at all in headwater rivers with the highest sedimentation (right panel).





WHAT'S NEXT?

Our research provides clear evidence that eroded peat is a significant stressor for aquatic biodiversity, corroborating our earlier results obtained from rivers influenced by real-world land management activities such as artificial drainage, heather burning and forestry activity.

Our other previous work shows that sediment loss from peatlands is forecast to increase by typically around 14 % by 2100 under climate change due to increasing temperature and enhanced occurrence of summer drying, with some sites forecast to have more than double their current annual peat loss. These sediments can be expected to affect aquatic ecosystems that receive runoff from peatlands.

The knock-on effects of changes to invertebrates, on organisms such as fish and birds, now also need to be studied. In a practical sense, to limit the erosion and delivery of peat to aquatic systems, and therefore reduce harm to aquatic ecosystems and their biodiversity, it is necessary to widen the use of approaches such as: ditch and gully blocking, preventing peat exposure due to vegetation removal, reseeding and planting bare areas, creating peatland pool systems to trap sediment and reduce rates of overland flow, and creating buffer zones and sediment traps when harvesting peatland forests.

This briefing is based on Brown, L.E., Aspray, K.L., Ledger, M.E., Mainstone, C., Palmer, S.M., Wilkes, M. & Holden, J. 2019. Sediment deposition from eroding peatlands alters headwater invertebrate biodiversity. *Global Change Biology,* and can be accessed here: https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.14516

Funding details
NERC (NE/G00224X/1, NE/F/013663/1), Natural England, Yorkshire Water, British Ecological Society

Suggested citation
Brown, L.E. & Holden, J. (2018) 'Eroding peatlands threaten river biodiversity.' University of Leeds School of Geography Briefing Note Series: Briefing Note No. 2.

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