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Impairing pipe-to-stream connectivity in a heavily degraded blanket bog: the results of a pipe outlet blocking trial

Taco Regensburg[1], Pippa Chapman[1], Michael Pilkington[2], David Chandler[2], Martin Evans[3], and Joseph Holden[1]

[1]University of Leeds, School of Geography, Leeds, United Kingdom (gytr@leeds.ac.uk)
[2]Moors for the Future Partnership, The Moorland Centre, Edale, United Kingdom
[3]School of Environment, Education, and Development, University of Manchester, Manchester, United Kingdom

As part of the EU-funded MoorLIFE2020 project, we assessed the impact of pipe blocking on the hydrological responses at pipe and stream level in a heavily degraded blanket bog in the Peak District of northern England. The study catchment, Upper North Grain, has a blanket peat cover up to four meters thick at places, with a branching network of deep gullies that incise into the bedrock. Earlier survey work has shown piping to be ubiquitous to the site, with 346 pipe outlets found and a mean frequency of 22.8 km^{-1} gully bank. Topographic position was an important control on the size and depth of pipe outlets. Pipe outlets on streambanks with signs of headward retreat (head pipes) were significantly larger and closer to the peat surface compared to pipe outlets that issued onto uniform streambank edges (edge pipes). In the context of peatland restoration, managers are keen to understand how these pipes contribute to hydrological responses of streams and associated export of fluvial carbon borne away in stream waters. However, little is known about pipe-to-stream connectivity and whether blocking methods used to impede flow in open ditch networks and gullies also work on pipe networks. Results will be presented on a before-after-control-intervention experiment in which we investigated: 1) whether impeding drainage from pipe networks alters the streamflow response at the catchment outlet; 2) how such intervention affects the hydrological functioning of the pipe network and the surrounding peat; 3) the scale of fluxes of particulate organic carbon (POC) and dissolved organic carbon (DOC) from a head pipe before and after pipe outlet blocking; and 4) whether pipe outlet blocking alters DOC and POC export in streams. Four blocking methods were trialed: peat-plugs, peat and stone, wooden planks, and plastic pilling. Results show that pipe outlet blocking led to new pipe outlets appearing or seepage around blocks within 90 days of blocking. Over a period of 17 months, four individual pipe outlets (2 head and 2 edge) produced 11.3 % of streamflow. Head pipes produced significantly larger peak flows and storm contributions to streamflow compared to edge pipes. A distinctive distance-decay effect of the water table around pipe outlets was observed, with deeper water tables around the outlets of edge pipes. To avoid further erosion in gully edge zones, we propose that future pipe blocking efforts prioritize increasing the residence time of pipe water by forming surface storage higher up in the pipe network. Further results will be presented from ongoing analyses of the effect of pipe blocking on the export of particulate and dissolved organic carbon from pipes and streams.