INSTREAM WOOD

as a control of microbial metabolic activity and a driver of GHG production and nutrient turnover

Ben Howard[1,2] (B.C.Howard@bham.ac.uk), Ian Baker[2] Nick Kettridge[1], Sami Ullah[1], Stefan Krause[1]

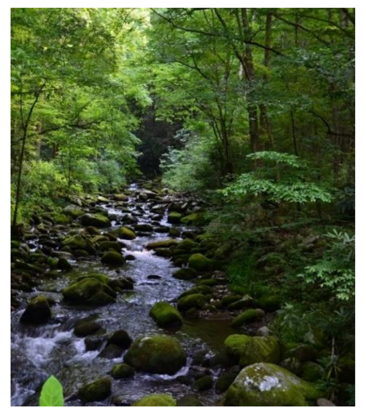
[1]University of Birmingham, Geography Earth and Environmental Sciences, BIFoR (Forest Edge); [2]Small Woods Association

BACKGROUND

Wood may make a significant contribution to streambed organic matter (OM), especially in forested catchments. OM quantity and quality is an important control of microbial metabolic activity (MMA) which drives ecosystem (dis)services like GHG production and nutrient turnover rates [1]. However, previous research investigating streambed biogeochemistry has typically ignored or explicitly removed wood. This research could have implications for estimates of GHG emissions from streams and for catchment management, which often leads to the introduction of instream wood, directly or indirectly.

Directly, e.g. installing coppice wood fascines or leaky dams.

Indirectly, e.g. replanting riparian zones or flood plains.



METHODOLOGY

Mesocosms were established for 8 treatments with 5 replicates (n=40) and left for ~1 year, allowing time for microbial communities to stabilise and for wood to begin to mineralize, thus providing a carbon source. Kept outside at EcoLaboratory (University of Birmingham, UK), temperatures fluctuate with environmental conditions. Mesocosms are spiked, incubated and sampled for water (at 0 and 24 hours) and gas (at 0, 2, 6 and 24 hours) at several points throughout the year, allowing us to observe impacts under a range of typical scenarios.

Sandstone **Chalk** **Limestone**

Mesocosm Components

- **River sediment –** 3 geologies (sandstone, chalk and limestone) and canopy covers (high forest, half riparian, no cover).
- **Hazel wood** – used to make fascines which are used in river restoration.
- **Artificial stream-water** - NO3 : 10. (mg/l) NH4 : 0.1 (mg/l). PO4 : 0.1. (mg/l)

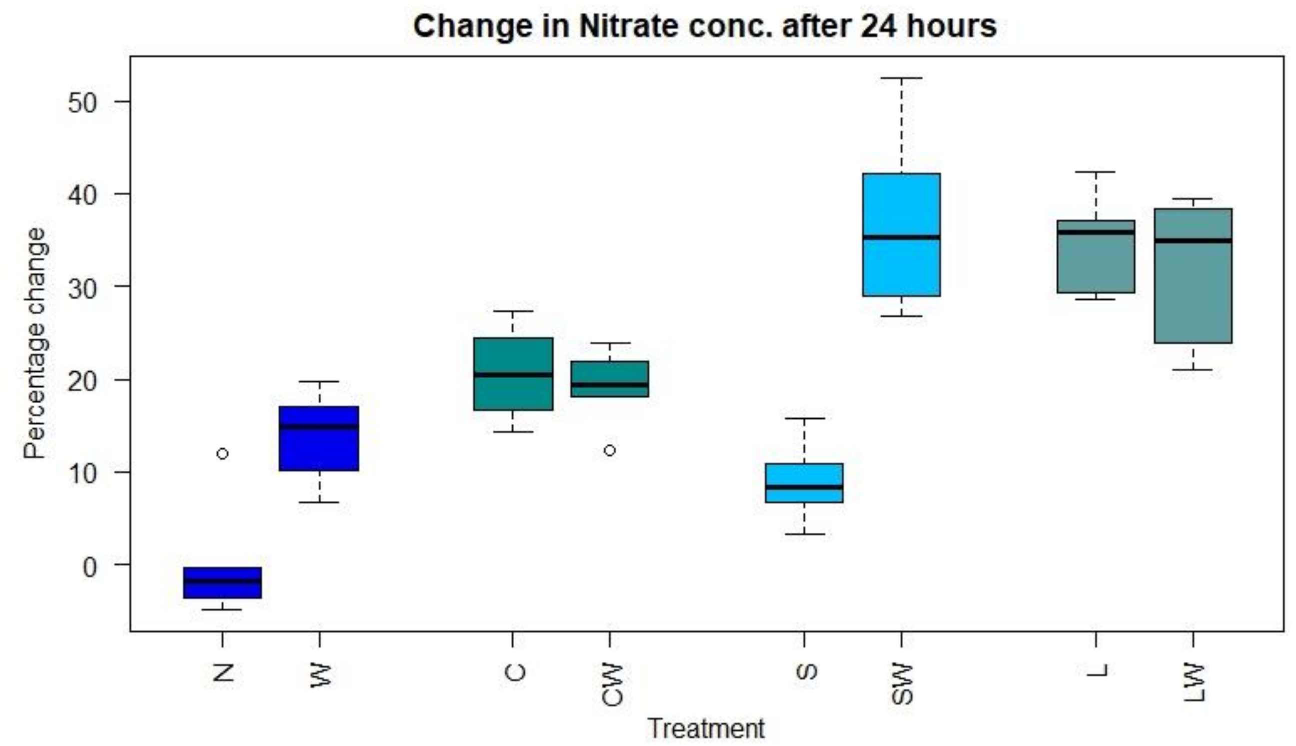
Spike Components

- **Nitrate (50 mg/l)** – to measure nutrient turnover rates.
- **Resazurin (raz)** – a reactive tracer which is irreversibly bio-transformed to resorufin (rru). As a proxy for MMA.
- **15NO3 tracers** - to quantify the production of N2 and N2O by denitrification.

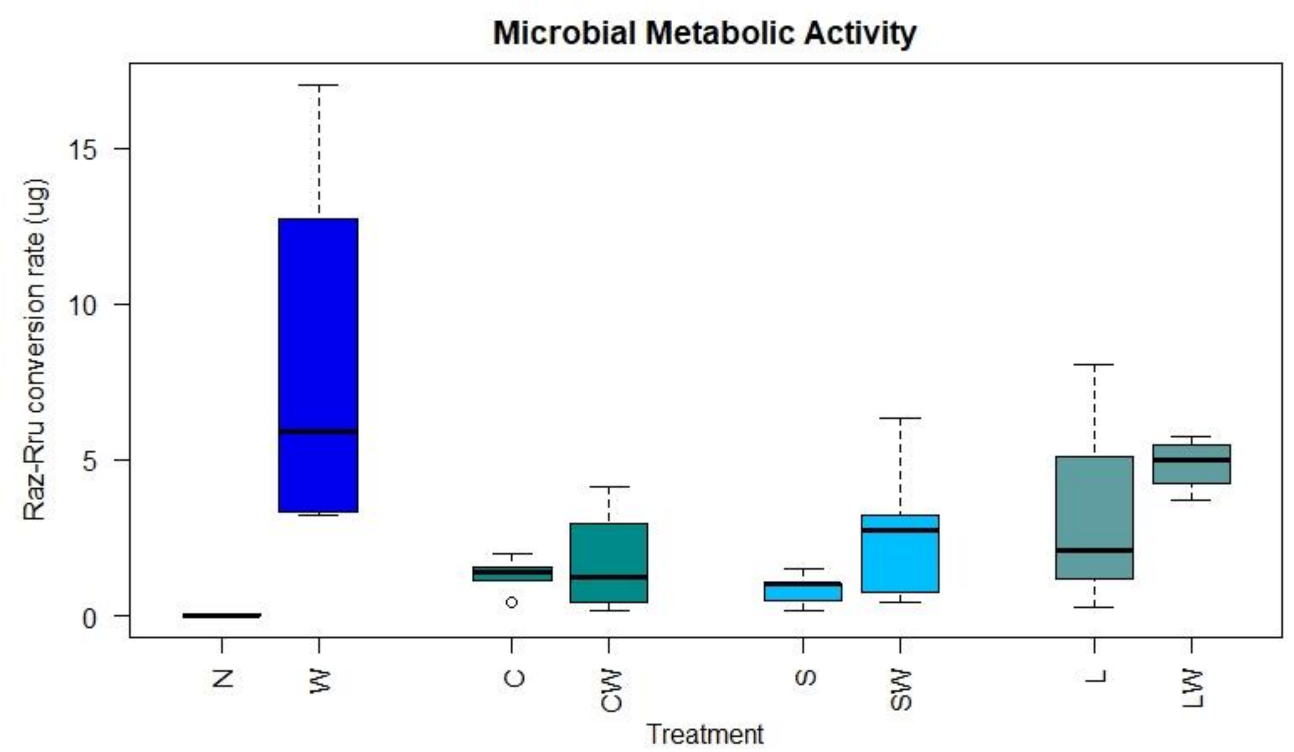
RESULTS

Preliminary results are presented for one incubation only, in December 2020. With the mean temperature of the mesocosms at 1.0°C before and 4.4°C after incubation, MMA and associated parameters are expected to be low, relative to when temperatures are higher [2].

In the following graphs, N= no sediment or wood, W= wood only, C= chalk only, CW= chalk and wood, S= sandstone only, SW= sandstone and wood, L= limestone only, LW= limestone and wood.



For the control (i.e. without sediment) and sandstone the addition of wood increased NO3 transformation rates, but not for chalk or limestone. Differences may be due to carbon quantity and/or quality, but also grain size of sediment (i.e. hydraulic conductivity).



MMA (as µg rru produced per µg of added raz) was highest in the control with wood, which is to be expected because raz is reduced in aerobic conditions.

Management of forests and rivers leads to the input of wood into river sediments, with potentially unforeseen impacts on ecosystem (dis)services like pollutant removal and greenhouse gas production.

Left: Schematic showing the composition of a mesocosm with sediment and wood.
Below: 40 mesocosms randomly ordered at EcoLaboratory, Birmingham, UK.

[1] Romeijn, P., Comer-Warner, S., Ullah, S., Hannah, D. and Krause, S. (2019). Streambed Organic Matter Controls on Carbon Dioxide and Methane Emissions from Streams. *Environmental Science & Technology*, 53(5), pp.2364-2374.
[2] Comer-Warner, S., Gooddy, D. C., Ullah, S., Glover, L., Percival, A., Kettridge, N. and Krause, S. (2019). Seasonal variability of sediment controls of carbon cycling in an agricultural stream. *STOTEN*. 688, pp 732-741.