BIFoR
Birmingham Institute of Forest Research

University of Birmingham

SmallWoods

# Wood in Rivers

## Investigating the impact on nutrient turnover and greenhouse gas production


**Ben Howard[1,2]**
(BCH823@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


## Sources

Management schemes often include the addition of wood into rivers:

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

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

## Potential Impacts

**Nutrient turnover:** nitrate ($NO_3$) is the most problem nutrient pollutant in UK rivers. It can be transformed by micro-organisms in a process called **denitrification,** removing it from the water. When nitrate concs. are high, carbon (as an electron donor and source of cellular carbon) is limiting [1]. **Wood additions could provide a source of carbon to increase the removal of nutrients.**

**Greenhouse Gases (GHG):** wood additions could also increase the production of GHG[2]. For example, nitrous oxide ($N_2O$) is produced in incomplete denitrification and methane ($CH_4$) is produced if carbon is used as a terminal electron acceptor – both are more harmful than carbon dioxide ($CO_2$).

| GHG | $N_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|
| Approx. 100 yr global warming potential [3] | 0 | 1 | 30 | 300 |

## What Goes In?

- **River sediment** – 3 treatments containing different amounts of organic matter and different grain size distributions.

Sandstone Chalk Limestone

- **Coppice wood** – used to make fascines which are used in river restoration. Potential source of labile carbon.
- **Artificial stream-water** - $NO_3$ : 10. $NH_4$ : 0.1. $PO_4$ : 0.1. (all mg/l)
- **Nitrate (50 mg/l)** – injected monthly to see how much of it is transformed.
- **Resazurin** – a reactive tracer which is irreversibly bio-transformed to resorufin and characterises microbial metabolic activity. Also injected monthly.
- **$^{15}NO_3$ tracers** - to quantify the production of $N_2$ and $N_2O$ by denitrification. The effect of oxygen conc. will also be investigated.

**Mesocosms simulate real-life scenarios under controlled conditions. Here they are used to investigate the impact of wood in river sediments on biogeochemistry.**

## What Comes Out?

After injection of nitrate and resazurin (every 4 weeks), samples will be taken from the water column and the headspace through tubes with stopcocks, so that the mesocosm can remain closed. Dissolved oxygen, PH and temperature will be monitored.

| Time after injection (hours) | 0 | 2 | 4 | 24 |
|---|---|---|---|---|
| Water column sampling | ✓ | X | X | ✓ |
| Headspace sampling | ✓ | ✓ | ✓ | ✓ |

**Headspace Samples**

| Parameter | Technique | Units |
|---|---|---|
| $CO_2$ | Gas chromatography | mg C-$CH_2$ $m^{-2}$ $h^{-1}$ |
| $CH_4$ | Gas chromatography | mg C-$CH_4$ $m^{-2}$ $h^{-1}$ |
| $N_2O$ | Gas chromatography | mg N-$N_2O$ $m^{-2}$ $h^{-1}$ |

**Water Samples**

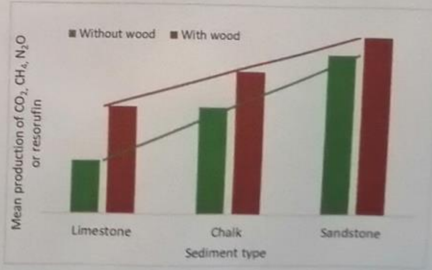
| Parameter | Technique | Units |
|---|---|---|
| $NO_3$ | Skalar | mg/l |
| $NO_2$ | Skalar | mg/l |
| $NH_4$ | Skalar | mg/l |
| $PO_4$ | Skalar | mg/l |
| Total dissolved Nitrogen | Shimadzu | mg/l |
| Total dissolved Phosphorus | Shimadzu | mg/l |
| Total organic Carbon | Shimadzu | mg/l |
| Carbon quality | Specific ultraviolet absorbance | $mg^{-1}$ $m^{-1}$ |
| Microbial metabolic activity | Fluorometer | μg rru $h^{-1}$ (Production of resorufin) |

**Sediment Samples (before incubation)**

| Parameter | Technique | Units |
|---|---|---|
| Organic matter (OM) content | Loss on ignition | % Organic matter |
| Carbonate content | Loss on ignition | % Carbonate |

## What Do We Expect?

It is hypothesised that:
- Microbial metabolic activity will be higher in mesocosms containing wood.
- Increases in microbial metabolic activity will be higher in sediments with lower OM.




**About the Author**

@Wood_n_Water

My background is in conservation biology and forest management. I am interested in ecosystem services, nature-based solutions, and how research impacts practice, policy and industry


References: [1] Strauss, E.A. and Lamberti, G.A. (2002). Effect of dissolved organic carbon quality on microbial decomposition and nitrification rates in stream sediments. Freshwater Biology, 47(1), pp.65-74. [2] Romeijn, P., Comer-Warner, S., Ullah, S., Hannah, D. and Krause, S. (2019). [illegible]