EMBER

EFFECTS OF MOORLAND BURNING ON THE ECOHYDROLOGY OF RIVER BASINS

RESEARCH INTO MOORLAND BURNING AT WATER@LEEDS

EMBER PROJECT EXECUTIVE SUMMARY

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THE EMBER PROJECT

This document summarises findings of a study into the effects of moorland burning on peatlands, carried out by scientists working on the EMBER project. The EMBER project was funded by the Natural Environment Research Council with additional support from Yorkshire Water. The comprehensive five year study assessed the impacts of prescribed vegetation burning by comparing five burned and five unburned river basins across the English Pennines. The EMBER project compared the hydrology, water chemistry, soil properties and aquatic ecosystems of these burned and unburned areas.

The uplands of the UK are an important source of river water, form valuable habitats, provide a large store of carbon and deliver diverse environments for recreation and farming. There has been concern about prescribed vegetation burning in the uplands in terms of its impacts on river water quality and flows, river ecology, peatland hydrology, soil physical properties and carbon storage. There are ongoing debates about the wider environmental impacts of burning, although the evidence base to date is minimal because there has been a lack of co-ordinated research into how burning affects upland environments. The EMBER project has provided new integrated understanding across multiple linked river basin processes (soils to streams), using comparable methods at replicated study sites and over a broad geographical region (Pennines).

KEY FINDINGS ARE

- Prescribed burning on peatlands was shown to have clear effects on peat hydrology, peat chemistry and physical properties, river water chemistry and river ecology.
- Burning reduces the organic matter content of the upper peat layers. The net result is that the peat is less able to retain important particles known as exchangeable cations. In other words, the peat in burned sites is deprived of chemicals which are important for plant growth and for buffering acidic rainfall.
- Lower concentrations of nutrient elements found in peat soils in burned river basins do not support the idea that burning enriches the peat with nutrients from ash.
- Rivers draining burned catchments were characterised by lower calcium concentrations and lower pH relative to rivers draining unburned catchments. Rivers draining burned sites had higher concentrations of silica, manganese, iron and aluminium compared to unburned catchments.
- There was no difference between burned and unburned catchments in peat nitrogen concentrations or in carbon to nitrogen ratios (high C/N is considered unfavourable to microbial decomposition of peat), and no significant changes in peat pH.
- Water-table depth is very important in peatlands for maintaining their stability and function as a carbon store. Water tables were found to be significantly deeper for burned catchments than for unburned ones. Deeper water tables would suggest a greater scope for degradation of the peat and loss of carbon to the atmosphere.
- *Sphagnum* is an important peat-forming species. Changes in the hydrological properties of the peat after fire make the peat less conducive to *Sphagnum* moss growth.
- River flow in catchments where burning has taken place appears to be slightly more prone to higher flow peaks during heavy rain. However, this was not a conclusive finding.
- Burning vegetation alters the natural peat hydrology in the upper layers of the peat affecting the balance of where water flow occurs. Recovery of many hydrological properties appears to be possible if a site is left unburned over many years.
- Prescribed peatland vegetation burning leads to significant increases in mean and maximum near-surface soil temperatures in the years following burning as well as lower minima (and thus wider thermal variability).
- Thermal regimes appear to recover as vegetation regrows. This recovery was also seen in soil hydrology data from burned plots of different ages.
- Macroinvertebrates play a vital role in aquatic food webs by feeding on algae, microbes and detritus at the base of food chains before they themselves are consumed by birds, fish and amphibians. The research found that river macroinvertebrate population diversity was reduced in burned sites.
- Particulate organic matter (predominantly peat) deposits were increased up to four-fold in the bed sediments of burned rivers compared to unburned rivers.
- In burned sites, river macroinvertebrate populations were dominated by groups that are commonly found in higher abundance in disturbed river systems, such as non-biting midge larvae (Chironomidae) and burrowing stonefly larvae (Nemouridae).
- Increases in the abundance of disturbance-tolerant taxa counteract declines and/or losses amongst some groups (i.e. mayflies) which are typically sensitive to reduced pH, increased aluminium and deposition of fine sediments. These changes show that burning increases the effect of biological stressors compared to unburned rivers.

A full report can be downloaded from:
www.wateratleeds.org/ember

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