IUCN | UK Committee

Peatland Programme

Burning and Peatbogs

Prescribed burning is a widely used management tool in the uplands for grouse and livestock production. On sporting estates, burning is used to encourage new heather growth with a varied age structure for grouse (Worrall *et al.* 2010c), particularly on upland heaths on mineral soils or shallow peat. The Inquiry only addressed burning management on deep peat where the practice is mainly but not exclusively restricted to the East Highlands and Southern Uplands of Scotland and the Pennines (see Fig 1). Burning for livestock is widespread, but more sporadic in frequency and less well recorded, though individual burns tend to cover larger areas. Good practice guidance on prescribed burning has been developed in partnership with statutory agencies and moorland managers (Defra 2007; SEERAD 2008; Welsh Assembly Government 2008).

Definitions

Peatlands	Land with a carbon rich peat soil. The soil may or may not be currently covered by peat forming vegetation.
Deep peaty soil	Peat soils of depths greater than 30-50cm (see glossary in this report)
Peat-forming vegetation	Vegetation composed of species, such as *Sphagnum* mosses or cotton grass, that are tolerant of waterlogged conditions and that decompose only slowly. As a result of high water tables and cool climatic conditions, plant litter decomposition is further slowed. The resultant semi-decayed plant material forms peat – a carbon-rich organic soil.
Blanket Bog	A habitat where deposits of peat blanket the landscape. Blanket bog includes areas of peat accumulation as well as degraded areas with peat oxidation and erosion. Blanket bog is usually rich in *Sphagnum* mosses although there are many degraded variants, often with less *Sphagnum* and more sedges, grasses and heather.
Raised Bog	Bog habitat characterised by an accumulation of peat that rises above the surrounding landscape often in lowland wet floodplains and/or over the surface of existing fen peat.
Restoration	Restoration shifts damaged peatland towards a state in which peat accumulation takes place, and typical species and habitats are supported. Restoration management might include, for example, slight land management changes such as altering grazing levels, and more substantial works to change hydrology such as ditch blocking or re-vegetation of bare eroding peat.
	(for detailed definitions see JNCC 2011)

In the UK, blanket and raised bogs form 95% of all peatlands. The Commission of Inquiry therefore focussed primarily on blanket bogs and raised bogs due to their extent, condition and importance for biodiversity, drinking water and carbon. The majority of our peatlands are managed under private ownership. There is a shared agenda between land managers, NGOs and Government to restore these and, due to their large area they form the best target for carbon gains. In relation to burning management and its impact on peatlands, the Inquiry concentrated on prescribed burning on grouse moors on deep peat and not on the wider issues of burning management.

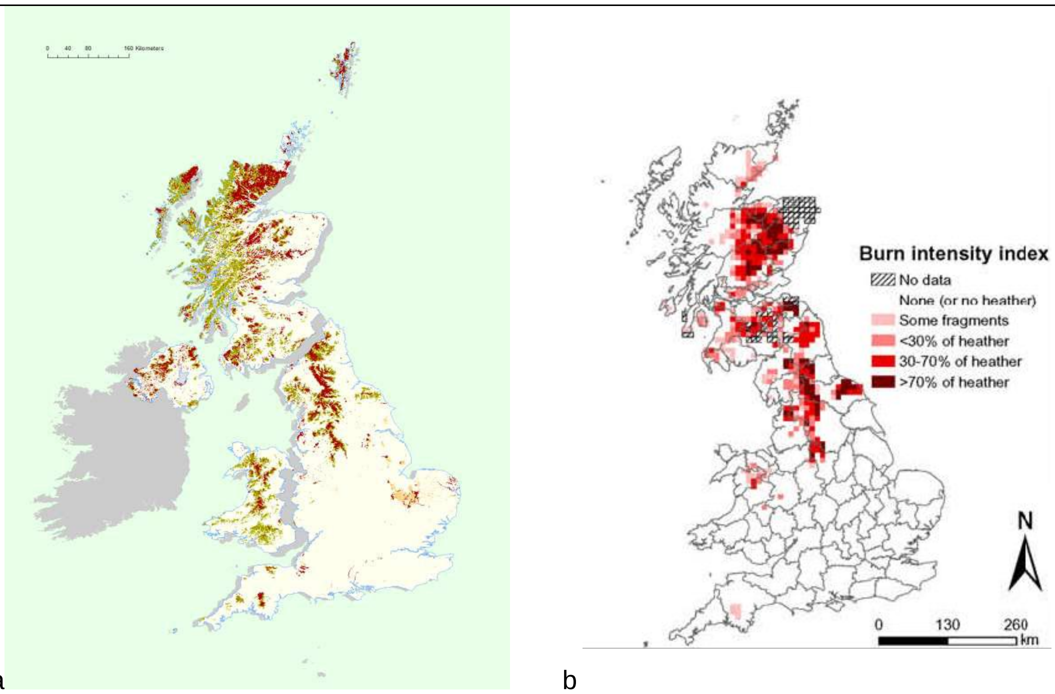

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Figure 1a, b: a) Distribution of peat soils in the UK (reproduction by permission of OS on behalf of HMSO@ Crown copyright and database Right 2010, MLURI 100019294, AFBI 1:50000 soil digital data, National soil maps @ Cranfield University, BGS 1:50000 digital data (licence 2006/072), reproduced from JNCC (2011)).
b) Burn intensity index across the UK (reprinted from (Anderson et al. 2009) with permission from Elsevier). The index of burning measures the extent of 'strip' burning at a 10 km resolution from mainly 2005 – 2006 satellite images. Note, Shetland is omitted, but no strip burning management occurs there.

The impact of burning on the functioning of a peat bog, on typical bog species and habitats and on ecosystem services, such as carbon storage or water quality, is an important issue, as bad practice (non-compliance to codes) can have severe damaging consequences for ecological, hydrological and soil processes. Further guidance on prescribed burning is being considered by a partnership including statutory agencies and moorland managers (Best Practice Burning Group, 2010). There is agreement among key stakeholders to avoid adverse impacts on active bog, where burning is largely unnecessary, and to seek to restore blanket bog on deep peat areas modified by past land management and/or atmospheric pollution.

In a changing climate with greater emphasis on mitigation and adaptation, determining appropriate burning management, specifically for deep peat areas no longer supporting blanket bog vegetation, is important. This requires further monitoring and research. A more coordinated and consistent approach to describing the different peatland types and states is urgently needed to provide relevant empirical evidence and avoid the confusion that has arisen from generic studies of 'peatlands' and 'heather moorland'.

The role of controlled burning to reduce biomass is being explored on some degraded blanket bogs where there is a high risk of wildfire (FIRES 2010). Fire breaks can be used to reduce wildfire risk, along with other wildfire risk prevention measures, such as rewetting, cutting, visitor awareness raising, ranger watches and even site closure (McMorrow *et al.* 2009).

For many sporting estates, maintaining the blanket bog on deep peat within a wider moorland context is an accepted part of the management. Estates with experienced managers, staff and equipment are important in helping maintain and restore peatlands. There is some indication that other non-heather dominated vegetation with greater percentage of grasses is also important for grouse productivity (Pearce-Higgins & Grant 2006), providing a variety of insect and plant food types. Rewetting can help to increase invertebrate food production (Carroll *et al.* 2011), and further research is required to determine the importance of such potential benefits.

On deep peat areas where past management has led to lower water tables and dominance of heather, the appropriate burning regime will depend on whether management objectives are targeted at grouse production or securing the delivery of ecosystem services, such as restoration of blanket bog for wildlife, water quality in drinking water catchments or securing the carbon store in the peat.

A range of land managers and sporting estates have been proactive in restoring peatlands which has helped encourage other estates to follow. Particularly in England, peat bog restoration, through blocking drainage ditches, has taken place or is underway over much of the resource, with associated environmental benefits including reduced risk of grouse chick deaths in ditches.

There is a need for further research on the impacts of prescribed burning and guidance on the appropriate management for maintaining and restoring blanket bog habitat along with its typical species such as *Sphagnum* and for a shared understanding about the nature and extent of the different peatland habitat types. More targeted funding, support and advice is also required to help extend good practice and experience to other deep peat areas.

***Sphagnum* mosses are key to peatland ecosystem functioning**

Sphagnum mosses are keystone species for providing a range of ecosystem services. *Sphagnum* mosses are the main peat forming species, thereby contributing to carbon sequestration and storage. Furthermore, *Sphagnum*-dominated peatlands do not release as much methane as those dominated by vascular plants.

Photo: Norman Russell

Some species can hold up to 20 times their dry weight in water, and together with their fibrous structure can play a significant role in moderating water flow and thus reducing downstream impacts of heavy rain.

There are 34 *Sphagnum* species in the UK, of which only five are major active peat formers, and two of these are rare today. The peat forming *Sphagnum* bog-mosses have their growing points at the tips and are therefore easily damaged or destroyed by grazing, burning, trampling and drainage.

Scientific evidence of impacts of burning on blanket bogs

Recent empirical reviews of burning management on peat bogs (e.g. Stewart *et al.* 2004; Tucker 2004; MacDonald 2008; Lindsay 2010) point to limitations in the available data, but support the established view that certain burning regimes can degrade bog habitat, leading to reductions or loss of key bog species (plants and animals), reduced structural diversity and dominance of more typically heath species (e.g. Pearsall 1950; Ratcliffe 1964; Rowell 1990). Ramchunder *et al.* (2009) showed an impact of burning on the composition of the aquatic invertebrate community of watercourses connected to peatland catchments. The impacts of burning on blanket bog and particularly the main peat forming *Sphagnum* species' ability to recover, depends on the frequency and intensity of the burn along with other factors such as water levels, intensity of livestock trampling and altitude as well as the starting abundance and condition. There is a view that 'cool' burns under the right conditions may be compatible with the initial stages of peatland restoration, along with controlling other factors such as water levels and grazing, aimed at reducing competing vegetation. There are few studies on the benefits and practicalities over other non-burning techniques such as cutting (Lunt *et al.* 2010). In bogs with high water tables and ample *Sphagnum* growth, burning to control heather should not be necessary as the growth of *Sphagnum* will help maintain the heather in a steady state through *Sphagnum* layering, which forces heather to generate new shoots as the peat builds up (Adamson & Kahl 2003).

Studies suggest that there are benefits for carbon budgets from the absence of burning on deep peat compared to burning (MacDonald 2008; Worrall *et al.* 2010a). Garnett *et al.* (2000) measured peat depth accumulation in blanket bog and showed a net carbon loss for a ten year burning cycle. The specific impacts of 'cool' burning over other forms of burning is not yet clear however (Worrall *et al.* 2010b,c).

A number of studies point to the importance of vegetation type being associated with different greenhouse gas balances. *Sphagnum* dominated vegetation with a high water table is shown to have greenhouse gas benefits over heather dominated bog on deep peat (Lindsay 2010; Couwenberg *et al.* in press). If management alters the vegetation cover of sites then this might alter the greenhouse gas balance (Worrall *et al.* 2010b). In active blanket bog, the growing *Sphagnum,* acrotelm layer, holds more carbon than upper layers of heather and can transfer more carbon into the peat for long term storage (see Figure 2, Lindsay 2010). In contrast, heather-dominated deep peat tends to have a greater concentration of subsurface peat pipes (Holden 2005), associated with peat drying and potential loss of stored carbon.

Water quality and especially water colour is a major concern in drinking water catchments and is also a form of carbon loss**.** The balance of evidence suggests that moorland burning impacts on raw water quality and results in increased colour in raw water (Yallop & Clutterbuck 2009; reports reviewed by Holden *et al.* 2011). Other reasons for increased dissolved organic carbon put forward include recovery from the effects of acid rain (Monteith *et al.* 2007). These processes act at a large spatial and temporal scale, while land management influences individual catchment characteristics at a local scale over shorter time scales (Clark *et al.* 2010). Vegetation type may be an important driver influencing water colour (reports to Yorkshire Water reviewed by Holden *et al.* 2011) with *Sphagnum* associated with the lowest levels of colour (Armstrong *et al.* in review). Areas of heather dominant vegetation on deep peat, and areas of new burn on deep peat have been associated with increased water colour (Yallo*p et al.* 2010), though more work is needed to disentangle the effects of these inter-related factors. Further work is required to determine whether the source of this colour results from the act of burning itself or indirectly through the subsequent dominance of vascular plants over *Sphagnum*.

Sphagnum dominated vegetation is more effective in slowing run-off than bare peat or other types of vegetation (Holden *et al.* 2008; Grayson *et al.* 2010). A *Sphagnum* rich blanket bog, in comparison to a damaged one with little moss cover, may therefore help reduce run-off and ameliorate flood risks.

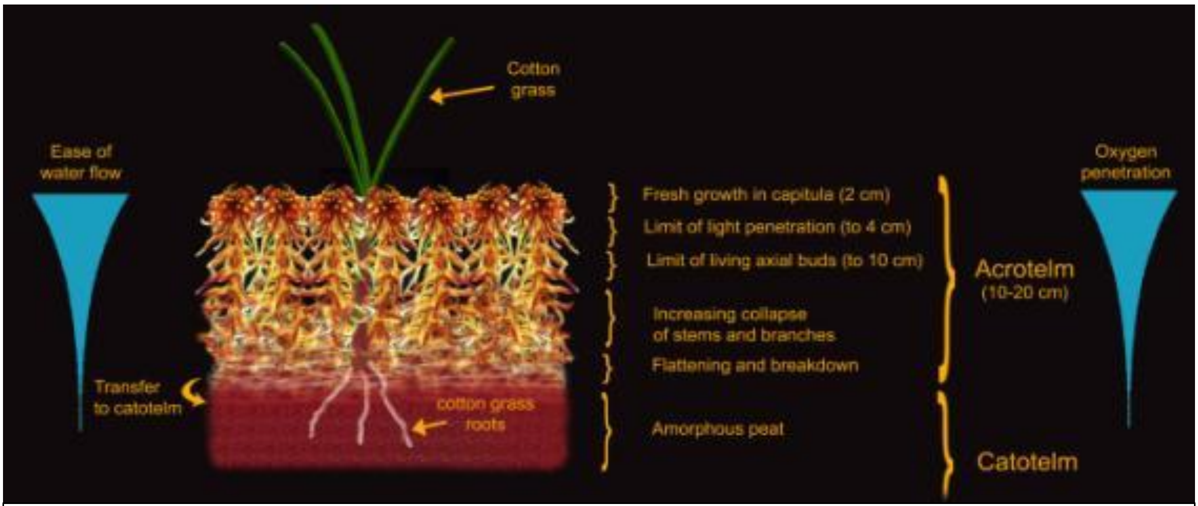

Figure. 2: Peat structure (reproduced with permission from Lindsay (2010), based on Clymo (1992)

Active peat forming blanket bogs and raised bogs are characterised by having a two-layered structure, which influences the way peat is formed, carbon is fixed and water flows.

The **surface layer,** the acrotelm, is composed of the most recently deposited material (top 10-20 cm). This top layer has a live matrix of growing plants, most often bog moss. Here carbon is sequestered and peat is formed and passed to the lower layer, the catotelm.

The **base layer**, the catotelm, remains permanently waterlogged and anaerobic. The lack of oxygen slows decomposition to extremely low levels. This layer therefore acts as a passive storage layer of deposited peat for millennia. Without the living acrotelm, peat does not accumulate in the catotelm (Lindsay 2010). If the peat is eventually buried under other sediments, the peat layer changes to lignite and eventually coal under the influence of pressure and higher temperatures.

Within the surface peat layer, the water table fluctuates and water moves quite freely; in the permanently water-logged catotelm water movement is extremely slow. Run-off and nutrient transfer almost all occurs in the upper peat layer, with up to 95% of run-off confined to the top 10 cm (Holden 2009)

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