The future of fire management in the uplands

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Introduction

Fire has been a dominant force in the ecology of the uplands throughout the Holocene and human manipulation of fire regimes probably stretches back almost as far (Froyd 2006). The effects of both natural and anthropogenic fire have had enormous influence in shaping landscapes. Any cessation, decrease or increase in the amount of burning within the uplands will have significant effects. Though there is argument about exactly how much burning takes place (Yallop 2006), fire nevertheless plays a central role in carbon and nutrient budgets, landscape and patch biodiversity and has an influence on hydrology, erosion and water quality.

Environmental, social and climatic changes over the course of the next century are likely to cause changes in fire regimes. Decisions made in the next decade will be important in allowing us to manage these changes. Fires will happen regardless of management intentions and there is now a need for us to learn to live with fire and to manipulate fire regimes to our advantage.

Prescribed fire is a powerful management tool that can be used for multiple objectives and is not just suitable for grouse moor management. Wildfires can cause massive environmental damage, but through prescribed burning we can manipulate the fire regime of the British uplands to both maximise the ecological benefits of fire and manage the threat of wildfires. Defining future fire regimes will involve setting both strategic and local-level policies for fire risk management as well as targets for future landscape type that inform land-management strategy.

Observing that there is considerable variation in the quantity and quality of burning as a management tool in the UK we argue for an ecological basis for the use of fire. This should consider vegetation structure, flammability and plant traits to predict the impacts of burning *a-priori*. In many cases this will require further research. We seek to develop best-practice approaches to the management of fire including, where appropriate, complete protection from fire. Here we present three case study examples that describe how fire might be used in the future.

Moorland Management

Heather moorlands are a globally rare habitat type and there is growing concern at a Europe-wide decline in their area. Current management in the UK is based on 200 hundred years'-worth of controlled burning and grazing designed to increase the productivity of red grouse, sheep and deer (Figure 1). Traditional heather moorlands are an important part of the economy of the uplands and also support important animal populations (e.g. hen harriers, golden plover, curlew, mountain hare). Future research should identify fire-follower and fire-sensitive species in a UK context.

Figure 1. A traditionally managed grouse moor in the Scottish Highlands. Fire plays a key role in maintaining such characteristic landscapes. The network of different-aged burns promotes greater diversity at the landscape scale and breaks up extensive fuel beds into smaller areas (picture courtesy of the Game Conservancy Trust).

Fire on moorland needs to be managed in order to maintain the economic system, which funds the majority of land-management, whilst seeking to maximise the biodiversity benefits of burning. Traditional management techniques can be appropriate for managing threatened species such as hen harriers, results in greater diversity at the landscape scale and helps to ensure ecosystem robustness to environmental change.

Fire free areas will allow potential fire sensitive species to prosper and should help prevent steep slopes, gullies and scree from burning. Such areas will be protected from wildfire by the breaking up of the landscape by continued muirburn around them. Most effort should be placed on burning younger heather where regeneration is best and fires easier to control (Davies 2005). Moorland management plans should be drawn up identifying fire free areas and allowing the establishment of multiple fire regimes within individual management units.

Whilst continued burning will be valuable in mitigating the risk of wildfires managers should seek to engage local fire partnerships and to develop formal collaboration for fighting wildfires.

Forest Management

Fire can be used as a tool to develop diverse forest habitats, to reach conservation objectives as well as to maximise pine-wood regeneration (Hancock et al. 2005). Deciduous trees including birch and willow tend to sprout vigorously following fire.

Burning within forests can serve to promote beta level diversity and alter ground structure in a way that may be beneficial in managing endangered species such as Capercaillie. Such management will also help prevent fuel-build up and the risk of intense, stand-replacing wild and crown fires and should be used to protect specific features of interest where fire may not be desirable. This includes at the forest edge where there is a desire to prevent fire damage to trees from prescribed or wild fires on adjacent lands (Figure 2). This may be particularly relevant where young trees on regenerating areas have reached the thicket stage and the risk of crown fires is greatest.

Figure 2. A wildfire spreading from moorland into semi-natural pine forest. Fuel management at the forest edge can help to prevent such fires and reduce their intensity, decreasing the likelihood of crown-fire behaviour (picture courtesy of Michael Bruce).

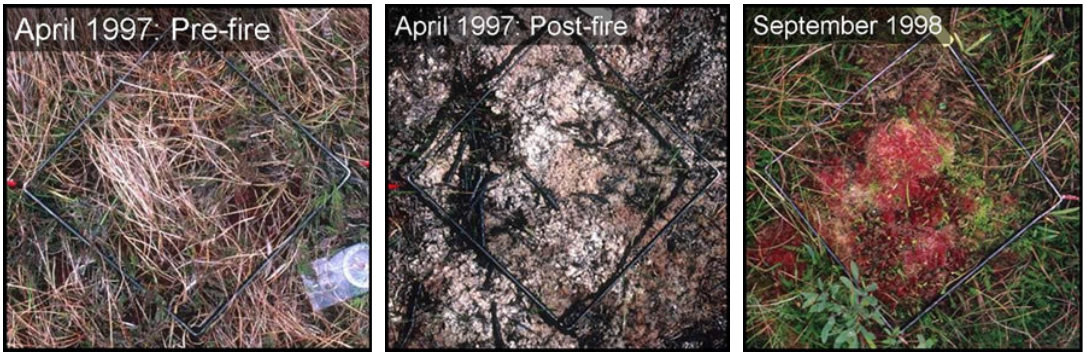
Wildfire planning should be built into forest management and design including requirements for access and water for fire fighting but also through the manipulation of species balance. Larch for example can be used in plantations to suppress ground cover and to create fire-breaks whereas in semi-natural forests increased proportions of deciduous species will have a dampening effect on fire spread.

Carbon Management

The role of fire in the carbon balance of upland peatlands has been somewhat controversial and evidence as to its effects has been somewhat contradictory (Gray 2006). Fire can be used to promote peat-building species such as *Sphagnum capillifolium* and low intensity grass-dominated moorland fires can result in generally good recovery following burning (Hamilton 2000). Fire removes thick layers of *Molinia*

litter, reduces shading thereby encouraging *Sphagnum* growth and avoids levels of fuel build-up that might lead to intense, damaging burns (Figure 3).

Figure 3. Recovery of *Sphagum capillifolium* following burning can be rapid where fuel loads are low and fires are of low severity (pictures by Alistair Hamilton).



The relationships between fire, drainage and grazing on bogs needs to be better understood. Manipulation of fire, water tables and grazing regimes is the only way to ensure that carbon is locked up in peat or that losses are reduced (Gray 2006). If burning declines on dry or degraded sites because of concern over carbon emissions it should be remembered that land-management is required to reduce the risk of severe wildfires. These fires can ignite peat, release large amounts of CO_2 and destroy carbon fixing vegetation. If forest invades or is planted this may lead to drying of peat deposits and further carbon losses both from slow oxidation and due to an increased likelihood of peat smouldering (Figure 4).

Figure 4. Extensive smouldering around the base of trees in a Douglas fir plantation following the spread of a wildfire from adjacent moorland (picture by Guillermo Rein).

Conclusion

Fire is a cheap and powerful management tool and an integral part of the ecology of the uplands. Fire should be an integral part of the ecologists' tool kit even when their primary goal is to minimise fire. A change in fire regimes will come to the uplands whether we like it or not and it is now up to us to decide whether we manage that change and manipulate it to our advantage or deal with the consequences of taking no action.

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