Scafell from Coniston Old Man. Lake District, Cumbria

25. Montane habitats

Climate Change Vulnerability: **High**

Introduction

These are a group of habitats with a restricted range, determined largely by low temperatures. They include a number of arctic-alpine plant species which are adapted to low temperatures and short growing seasons, and many are at the southern limits of their world distribution in Britain. As temperatures increase, community composition will change with more widespread upland plants starting to out compete those particularly adapted to cold conditions (eg Britton *et al*).

Much of this habitat in England is in poor condition due to past over-grazing by sheep. Although grazing pressure has been reduced in many areas in recent years, environmental conditions at these altitudes mean that recovery can be slow. Mountains are already popular for public access, and any climate change related increase in visitor numbers could exacerbate existing problems of trampling and erosion along access routes.

Habitat Description

Montane habitats consist of a range of near-natural vegetation which lie above the natural tree-line. In England, this is generally found above 600m, although the precise altitude varies across the country depending on local variations in temperature, shelter and humidity (Upland Management Handbook).

The montane zone consists mainly of high plateaus with steep sided corries, rocky cliffs, peaks, boulder fields and scree slopes. The vegetation is influenced by factors such as rainfall, geology, aspect, soil type and depth, exposure, and extent of snow cover.

Montane habitats are generally regarded as climax communities. The vegetation within these habitats includes dwarf-shrub heaths, grass-heaths, dwarf-herb communities, willow scrub, and snowbed communities. The most abundant vegetation types are heaths dominated by heather *Calluna vulgaris* and billbery *Vaccinium myrtillus*, typically with abundant bryophytes (eg woolly fringe-moss *Racomitrium lanuginosum*) and/or lichens (eg *Cladonia* species); and siliceous alpine and boreal grasslands with stiff sedge *Carex bigelowii* and moss heaths. Rarer vegetation types include snow-bed communities with dwarf willow *Salix herbacea* and various bryophytes and lichens, and sub-arctic willow scrub (as described in McLeod and others, 2005).

Montane habitats are extensive in the Scottish Highlands, but are highly localised in England and Wales and tend to be relatively small and fragmented, and support a more limited range of species. They are significant because they are at the southern-most limit of their range in Britain. These habitats have not been fully surveyed, but it is estimated that they cover approximately 2300 ha in England.

Potential climate change impacts

Cause	Consequence	Potential Impacts
Increased mean temperatures	Longer growing season Warmer summers	■ Increased growth of grasses and dwarf shrub species could lead to these out-competing montane heathland species, especially mosses and lichens. ■ Temperature is frequently a limiting factor for insect and microbial performance. Warmer temperatures are likely to result in increased herbivory and faster nutrient cycling.
Hotter summers	Possible increase in visitor numbers	■ Higher visitor numbers could lead to increased erosion on access routes and increased risk of wildfire (Albertson et al 2010).
Drier summers	Drought Drier ground conditions	■ Drier conditions could lead to changes in community composition, increased susceptibility to wildfire, and greater susceptibility to peat and soil damage under wildfire. ■ Drier conditions could make upland areas more accessible for visitors, exacerbating existing problems of erosion and fire risk.
Wetter winters	Increased surface runoff	■ Higher surface run-off could increase erosion, particularly on footpaths and on mountain summits. ■ Higher rainfall could benefit some plant communities that occur on leached soils.
Storm events	Increased rainfall intensity	■ Increased erosion (see above).
In combination		■ Climate change could result in a loss of suitable climate for key species such as dwarf willow (Salix herbacea), trailing azalea (Loiseleuria procumbens) and montane lichens (Holman et al 2002, Berry et al 2005). It could also lead to the local extinction of the mountain ringlet butterfly (Erebia epiphron), which, in England, is only found in the Lake District. ■ Increased winter rainfall and milder conditions may adversely affect arctic species, such as Alpine forget-me-not Myosotis alpestris, which thrive under winter snow cover but cannot withstand longer periods of damp conditions (Elkington, T.T).
Global impacts	Potential changes to the economics of upland grazing and shooting systems	■ Some alpine heaths have been shown require grazing to survive and could be lost if grazing is removed (Miller, G.R. et al).

Adaptation responses

The distribution and condition of many montane communities has been heavily influenced by over-grazing, trampling, Victorian plant collecting, and nitrogen-deposition. Reducing these pressures and allowing the habitat to recover may help to reduce their vulnerability to climate change, though there is a possibility that upland generalist species will grow more and out compete the rarities, leading to the development of acid grassland and upland heath.

Most of the arctic alpine flora is limited by competition rather than an inability to tolerate higher temperatures and it may be possible to exploit this. In cases of extreme rarity, direct targeted management to remove or limit the growth of more competitive species is worth considering. It may also be possible to adjust grazing to ensure that sward height does not become too high and prevent scrub encroachment, although this is difficult in an extensively managed system.

Some species will suffer declines due to climate change (eg alpine saxifrage *Saxifraga nivalis*), but for others (eg purple saxifrage *Saxifraga oppositifolia* and mossy saxifrage *Saxifraga bryoides*) where non-climatic factors are more important, appropriate management can limit any decline. Monitoring and research is required to identify changes in community composition, species distribution and abundance and to determine the causes of any future change.

Microclimate variability can be very large in mountain areas, with large differences in temperature between north and south facing slopes as well as with altitude. Cold air drainage can also create temperature inversions with lower than expected temperatures in localised pockets. Recognising such small scale refugia and ensuring their protection, and prioritising the reduction of other pressures in these areas, may be the most effective element of adaptation in a local area.

While at the present time it would premature to simply accept the loss of a species vulnerable to climate change in these habitats, it is important to take a view on the status of the species and communities across their whole range. This will allow decisions to be made that prioritise action where the need is greatest and the chances of success are highest.

Some of the potential adaptation options for this habitat are outlined below.

- Ensure appropriate management through the control of grazing. Many of these habitats would naturally be controlled by climate and not grazing management, so shepherding and (where appropriate) fencing can be used to exclude livestock from sensitive areas. Changing climate may change the optimum stocking density required to maintain montane community composition (for example grass growth will increase with longer growing seasons and higher temperatures), so flexibility is needed.
- Develop fire contingency plans across the whole upland habitat mosaic, to include adapting the design and management of habitats to reduce fire risk, and closing some areas at times of high risk.
- Minimise erosion through the management of access and grazing.
- Within individual upland units or sites, identify areas that might act as potential refugia from the impacts of climate change, such as areas with north facing slopes, complex micro-topography, robust hydrology, or high species diversity, and ensure that these are managed appropriately.
- Maintain the full diversity of montane habitats to provide a wide range of micro habitats and niches, including, where possible, bare rock and areas characterised by mosses and lichens, low herbs, dwarf shrubs of diverse age classes, wet heath and mire, and scattered trees and shrubs.
- Take the whole of the species range into account in deciding the priority attached to intensive conservation measures in a particular location.
- Translocation to establish new populations of species in climatically suitable locations which are likely to remain so in future might be considered, although this would require a detailed study and be dealt with on a case by case basis.
- When developing management plans, consider the wider mosaic of upland habitats and not just montane habitats in isolation.

The loss of suitable climate space could lead to the local extinction of the mountain ringlet butterfly

Relevant Environmental Stewardship options

HL9 Maintenance of moorland

This option aims to maintain areas of moorland habitats that are currently in good condition to benefit upland wildlife, retain historic features and strengthen the landscape character. The option can also promote good soil management, which will reduce diffuse pollution.

HL10 Restoration of moorland

This option is aimed at restoring moorland where not all habitats are in good condition, to benefit upland wildlife, retain historic features and strengthen the landscape character. This option can also promote good soil management, which will reduce diffuse pollution. In addition it may, in the right situation, provide an area of flood storage and some benefits to flood risk management.

Further information and advice

Natural England (2001) Upland Management Handbook
The upland management handbook pools the expertise of many of the country's leading wildlife, farming and land management specialists to provide a blueprint for the practical delivery of land management that will benefit upland wildlife.

Tayside Biodiversity Partnership Montane (habitats above the treeline).

Natural England (2008) Responding to the impacts of climate change on the natural environment: Cumbria High Fells
Report of a study undertaken by Natural England to assess the vulnerability of the Cumbria High Fells National Character Area to climate change and identify possible adaptation responses.

JNCC (2008) UK BAP habitat description Mountain Heaths and Willow Scrub

Key evidence documents

Berry PM, Butt N, Crick HPQ, Freeman S, Harrison PA, Hossell JE, Masters G, Scholefield P & Ward N. (2005). Impacts for the Central Highlands case study area In MONARCH 2 Final Report – Chapter 7. 148-188.

Britton et al. Biodiversity gains and losses: Evidence for homogenisation of Scottish alpine vegetation. 2009. Biol Cons. 142, 1728-1739.

Elkington TT. Experimental taxonomy of some members of the Teesdale flora [Doctoral dissertation]. Durham University; 1962.

Holman, I.P., Loveland, P.J., Nicholls, R.J., Shackley, S., Berry, P.M., Rounsevell, M.D.A., Audsley, E., Harrison, P.A. & Wood, R. (2002) REGIS - Regional Climate Change Impact Response Studies in East Anglia and North West England.

Miller, G.R. Et al. 2010. Effects of excluding sheep from an alpine dwarf-herb community. Plant Ecology & Diversity Vol 3 No1. 87-93.