Upland hay meadow, Wensleydale.

24. Upland hay meadow

Climate Change Sensitivity: **Medium**

Introduction

Many species that make up upland hay meadows are expected to be relatively resilient to projected climate change (Berry *et al* 2005). However, key species such as wood cranesbill *Geranium sylvaticum* and melancholy thistle *Cirsium heterophyllum*, which belong to boreal-montane floristic elements, are likely to decline due to increased competition from lowland species (Carey 2013). upland hay meadows are also highly susceptible to changes in the economics of upland grazing systems, though around 53% is under protective SSSI designation.

Habitat Description

The habitat comprises of *Anthoxanthum odoratum - Geranium sylvaticum* grassland[9] and is characterised by a dense growth of grasses and herbaceous plants up to 60 - 80 cm high. No single grass species is consistently dominant and the most striking feature of the vegetation is generally the variety and abundance of flowering plants, including wood crane's-bill *Geranium sylvaticum*, pignut *Conopodium majus*, great burnet *Sanguisorba officinalis* and lady's mantles *Alchemilla spp.*

Most of the variation within this habitat is attributable to management treatments. The fields are grazed in winter, mainly by sheep, except in the worst weather. In late April to early May the meadows are shut up for hay. Mowing takes place in mid to late July, though in unfavourable seasons it may be delayed to as late as September. The aftermath is then grazed once more until the weather deteriorates. Traditionally, the meadows have been given a light dressing of farmyard manure in the spring, and this, together with occasional liming, may have helped maintain the distinctive floristic composition of these species-rich grasslands.

Upland hay meadows are confined to areas where non-intensive hay meadow management has been applied in a sub-montane climate. They are most characteristic of brown earth soils on level to moderately sloping sites between 200m and 400m altitude. Stands of *Anthoxanthum - Geranium* meadow are typically found in isolated fields or groups of fields, where many are still managed as hay meadows, but they are also recorded on river banks, road verges, and in woodland clearings. Most stands of the habitat are less than 2 ha in extent.

The main concentrations of upland hay meadow are in the northern Pennines of North Yorkshire, Durham and east Cumbria, but there are scattered locations in west Cumbria, Lancashire and Northumberland. The most important centres are Teesdale, Lunedale, Weardale and Baldersdale in Durham, Swaledale and Wharfedale in North Yorkshire, and around Tebay, Orton and Ravenstonedale in Cumbria. Recent estimates indicate that there are less than 1,000 ha in northern England.

9 Upland forms of MG8 *Cynosurus cristatus -Caltha palustris* grassland are now included in the Priority Habitat definition for upland hay meadow. However, this is dealt with under the lowland meadows account.

Potential climate change impacts

Typical species of these grasslands include those that are adapted to cooler climates. As the climate becomes warmer, these more boreal species will be outcompeted by those adapted to higher temperatures already present within the grassland community and over time by more southerly species which may colonise. Alongside any direct impacts, the influence of climate change on the economics of upland grazing systems may also be important, particularly in sites that are not protected.

Cause	Consequence	Potential impacts
Hotter summers Warmer winters	Longer growing season Fewer frosts	■ Phenology may change significantly, with flowering and seed-setting occurring earlier in the season. Earlier warming in spring may give competitive species, especially grasses, an advantage over slower-growing stress-tolerant species, leading to detrimental floristic change. ■ Boreal-montane species are likely to be increasingly out-competed by species with more southerly distributions as temperatures increase. ■ Southern species may start to colonise new sites. ■ Key species such as *Geranium sylvaticum* that require vernalisation may become less competitive and be lost (Rodwell *et al* 2007).
Drier summers	Drought	■ An increased frequency of drought would favour stress-tolerant and deep-rooted species. It could also potentially favour ruderal species where there are open gaps in the sward. This may lead to the decline of representative plant species such as wood cranes bill and lady's mantle (Carey 2013). It should however be noted that climate projections indicate lower summer rainfall in the north and west where these grasslands are found, though the declines are less than in the south and east. Rainfall is also higher to start with in many upland areas.
Wetter winters	Higher water tables and increased water-logging	■ Wetter conditions could reduce accessibility for management operations, which could lead to an increase in rushes *Juncus spp*, which may need controlling.
In combination	Changed economics of pastoral systems	■ Climate change could increase pressure for intensification of existing low input grasslands, or reduce their economic viability, leading to under-grazing and possible land abandonment.

Adaptation responses

Adaptation is likely to focus on increasing the resilience of grassland by minimising other sources of harm. Management of sites will need to be flexible, and adjusted to reflect changing conditions and community composition.

Important components of upland hay meadows will inevitably lose climate space, so identifying and protecting potential climate change refugia will be important. Local climatic variations can be large in upland areas and vulnerabilities of sites may vary considerably within the same geographic area. Targeted habitat creation and restoration will also be important to ensuring the resilience of upland ecological networks.

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

- Adopt greater flexibility in the management of sites in response to increasing fluctuations in seasonal growing conditions. For example, recent evidence suggests that the impacts of grazing later into spring are more pronounced in warm (advanced) springs as plants are repeatedly arrested in their development through continual defoliation. While perennial species, including grasses, may tolerate periods of prolonged grazing into the growing season, annuals such as hay rattle *Rhinanthus minor* can suffer from high losses of germinating seedlings (Smith *et al* 2012). Over a number of years extending grazing into May resulted in reduced species diversity and a shift towards a more semi-improved grassland sward. Adaptive management may include varying the timing of the hay cut, bringing forward the date when grazing is stopped in order to grow hay, or changing the timing, duration and extent of aftermath grazing.
- Identify areas that might act as potential refugia to climate change, particularly areas with relatively cool and damp local climates, and ensure that these are properly protected and managed.
- Where possible, expand the area of upland hay meadows by restoring semi-improved grasslands and re-creating hay meadows on improved grassland and arable land. This should be targeted to ensure expansion and linkage of existing sites.
- Increase the structural heterogeneity of meadows in larger sites by varying the type and timing of management interventions.

Hay meadow prior to cutting. Gowk Bank NNR, Cumbria.

Relevant Countryside Stewardship options

GS6 Management of species-rich grassland

This option is targeted at the maintenance and protection of areas of species-rich grassland.

GS7 Restoration towards species-rich grassland

This option is targeted at grasslands that are potentially rich in plant and associated animal life. They are often on difficult ground and may have suffered from management neglect or been selected for agricultural improvement. The botanical diversity of such grassland may be enhanced by simply amending existing management practices. However, on many sites, pro-active restoration management will be required, involving the introduction of seeds and the creation of gaps for their establishment. Substantial changes of livestock type, timing of grazing or control of dominant species may also be required. The option can also contribute to protecting valued landscapes and archaeology, and the promotion of good soil conditions.

GS8 Creation of species-rich grassland

This option is aimed at creating species-rich grassland on former arable land, ley grassland or set-aside.

Supplementary options

GS15 Haymaking supplement

This option aims to ensure the continuation or re-introduction of haymaking on sites where the ready availability of livestock and/or the climatic difficulty of haymaking means they would otherwise be grazed and not cut. Sites will have high existing or potential value as meadow land. It will also help ensure haymaking techniques and traditions are not lost to future generations.

GS16 Rush infestation control supplement

This supplement is aimed at reducing rush cover in parcels with heavy infestations to help prevent loss of botanically-rich wet grasslands and/or provide nesting areas benefit breeding wading birds.

Further information and advice

JNCC (2008) UK BAP habitat description **Upland Hay Meadows**.

The European context of British Lowland Grasslands. Rodwell, J.S., Morgan, V., Jefferson, R.G. & Moss, D. (2007). JNCC Report, No. 394.

Monitoring the condition of lowland grassland SSSIs: **Pt 1 English Nature's rapid assessment method (ENRR315)**.

Relevant case study examples

Hay Time
The Hay Time project was set up to co-ordinate restoration schemes using locally-harvested meadow seed in the Yorkshire Dales. The project aimed to restore at least 200 ha of upland and lowland meadows within and close to the Yorkshire Dales National Park.

Key evidence documents

Berry, P.M., Harrison, P.A., Dawson, T.P. & Walmsley, C.A. (2005) Monarch 2: modelling natural resource responses to climate change. UK Climate Change Impacts Programme, Oxford.

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Pinches, C.E., Gowing, D.J.G., Stevens, C.J., Fagan, K. & Brotherton, P.N.M. 2013. Natural England review of upland evidence, **Upland Hay Meadows: What management regimes maintain the diversity of meadow flora and populations of breeding birds?** Natural England Evidence Review number 005.

Rodwell, J.S. ed. 1992. British Plant Communities. Volume 3, Grasslands and Montane Communities. Cambridge, UK: Cambridge University Press.

Smith, R.S., Sheil, R.S., Millward, D., Simkin, J., & Pratt, S. 2012. **Spring grazing in northern hay meadows:influence of the timing and intensity of sheep grazing on the floral diversity and restorative potential** Report to Defra.