Kempley Daffodil Meadow SSSI, Gloucestershire.

22. Lowland meadow

Climate Change Sensitivity: **Medium**

Introduction

The character of lowland meadows, particularly the wetter types, is influenced by the availability of water and the seasonal variation in the water table. They will therefore be sensitive to changes in the seasonal pattern of rainfall and the interacting effects of increased summer temperature on water usage. Reductions in summer rainfall and increased summer evaporation will put stress on wet meadow communities in late summer and autumn, and rain fed systems will be more affected than those dominated by river inflows (Acreman 2009).

As lowland meadows are actively managed, climate change driven changes to the economics of livestock grazing systems may also have a significant impact.

Habitat Description

Lowland neutral meadows and pastures consist of a rich mixture of native grasses and broad-leaved herbs. They occur throughout lowland UK, often on shallow slopes or level ground with relatively deep soils that are neither strongly acidic nor lime-rich. The meadows may be managed for hay cropping, usually with grazing of the aftermath (vegetation that re-grows following cutting), or by grazing as permanent pasture.

Up to 35 or more plant species may occur in a 2mx2m sample, including grasses such as crested dog's-tail *Cynosurus cristatus* and red fescue *Festuca rubra*, and herbs such as knapweed *Centaurea nigra*, bird's-foot trefoil *Lotus corniculatus* and ox-eye daisy *Leucanthemum vulgare*. Some pastures may be important for waxcap and earth-tongue fungi. Old meadows and pastures can support a rich insect community, including butterflies, grasshoppers, bumblebees and yellow meadow ants. They can also provide important feeding areas for birds such as the linnet *Carduelis cannabina* and meadow pipit *Anthus pratensis*, and bats and small mammals such as the field vole *Microtus agrestis*.

The flora of lowland meadows can include rare and scarce species such as snakes's head fritillary *Fritillaria meleagris*, sulphur clover *Trifolium ochroleucon*, field gentian *Gentianella campestris*, and green-winged orchid *Orchis morio*. This may be matched by a scarce invertebrate fauna, including hornet robber-fly *Asilus crabroniformis* and shrill carder bee *Bombus silvarum*.

Lowland meadows include the now scarce flood-meadows of central England and eastern Wales, which rely on seasonal flooding in winter, and support tall, moisture-loving species such as great burnet *Sanguisorba officinalis*, meadowsweet *Filipendula ulmaria*, and pepper-saxifrage *Silaum silaus*.

Lowland grassland habitats and their associated species face a number of pressures and threats, which conservation initiatives are trying to address. Most grassland in the UK has undergone agricultural improvement through ploughing and re-sowing, heavy inputs of fertilisers, and intensive cutting or grazing. This remains an important threat, as does over-grazing or cutting at the wrong time of year. Increasingly, grasslands are also threatened by under-management or abandonment of traditional grazing or cutting.

The overall result of habitat change in the lowland agricultural zone is that *Cynosurus - Centaurea* grassland, the mainstream community of unimproved hay meadows and pastures over much of Britain, is now highly localised, fragmented and in small stands.

There is an especially important concentration in Worcestershire, and other particularly important areas include south-west England (Somerset, Dorset and Wiltshire), and in the East Midlands and East Anglia (Leicestershire, Northamptonshire, Cambridgeshire and Suffolk).

Unimproved seasonally-flooded grasslands are less widely distributed. They have lower overall cover, but there are still a few quite large stands. *Alopecurus - Sanguisorba* flood-meadow has a total cover of less than 1500 ha and is found in scattered sites from the Thames valley through the Midlands and Welsh borders to the Ouse catchment in Yorkshire. These include well known but now very rare Lammas meadows, such as North Meadow, Cricklade, and Pixey and Yarnton Meads near Oxford, which are shut up for hay in early spring, cropped in July, with aftermath grazing from early August; and where nutrients are supplied by flooding episodes in winter. *Cynosurus - Caltha* flood-pasture is also now scarce and localised, with less than 1000 ha in England. In total, there are an estimated 7,245ha of lowland meadow in England.

Snake's head fritillary. North Meadow, Cricklade NNR.

Potential climate change impacts

Cause	Consequence	Potential impacts
Hotter summers	Longer growing season	■ Phenology may change significantly, with flowering and seed setting occurring earlier in season.
Drier summers	Drought	■ Drier conditions will favour stress-tolerant (e.g. deep-rooted) and ruderal species due to the increased gaps/bare ground in swards. However, species which are intermediate between stress tolerant and competitive will be retarded by drier summers. ■ Changes in species communities and composition, including possible movement from MG4 and MG8 vegetation types to MG5 (Carey 2013). ■ On wetter lowland meadows, increased abstraction during warmer weather, leading to reduced water tables and water availability, may result in a shift in the botanical composition to species associated with drier conditions, and a decline in the wetland species component. ■ Drier conditions could favour a switch from silage production to hay making, which would generally bring biodiversity benefits.
Wetter winters	Winter flooding Higher winter water table	■ More frequent inundation of wetter sites may lead to changes in floodplain wetlands as the component plants of the community are more prone to increasing wetness than to summer drought (Toogood, Joyce & Waite 2008). ■ Higher spring soil moisture levels, combined with higher spring temperatures, may increase total biomass and favour more competitive species. ■ Any increase in hard flood defences could lead to changes in the hydrology of sites. ■ Longer flooding events may lead to increased phosphorus levels in floodplain soils, with the potential for altering plant community composition. ■ MG4 flood plain meadows are particularly vulnerable to larger and longer flooding events, in particular those that occur outside of the autumn/winter period. Such events will cause adverse vegetation change towards less highly valued types such as swamp and inundation grassland.
Altered seasonal rainfall patterns	Altered flow regimes Increased fluctuation in water tables (Thompson *et al* 2009)	■ On wetter sites, specialist wetland plant species may be outcompeted by more generalist species adapted to drier and or fluctuating conditions, leading to changes in community composition (Toogood, Joyce & Waite 2008). Floodplain wetlands that are dependent on marked flow peaks and troughs are especially sensitive. ■ Increased disturbance could increase susceptibility to the spread of invasive species (Stromberg *et al* 2007, Knight *et al* 2014).
More extreme events	Flooding	■ Increased summer flooding events, especially if regular and prolonged, would lead to replacement of the floodplain-meadow plant community with swamp communities, in which the species are better adapted to cope with waterlogged soil. ■ Increased deposition of phosphorous (Gowing 2008). ■ Increased pollution risk.
In combination	Changed economics of livestock grazing systems Increased pollution	■ Changes in the economics of grazing could increase pressure for the intensification of existing low input grasslands or, conversely, could lead to increased land abandonment and under-grazing. ■ Increased nitrogen loading in watercourses due to increased mineralisation at higher temperatures, combined with reduced dilution due to lower flows (Whitehead *et al* 2006). For the wetter meadows increased N input via groundwater/floodwater will favour competitive, often less desirable, plant species, at the expense of the slower growing species that often characterise high value semi-natural meadow communities.

Adaptation responses

Lowland meadows are actively managed through grazing, cutting or a combination of the two. Increased flexibility in both the date and intensity of these management options in response to both long term changes and seasonal variability in growing conditions will become increasingly important for maintaining the biodiversity interest of these habitats.

For wet grasslands, ensuring an adequate supply, temporal variation and quality of water is a key adaptation objective. In the short term, this is likely to take the form of restoring and maintaining ditch networks, but over the longer term will require planning at the catchment level to restore the capacity of catchments to hold, retain and maintain flows under both wet and dry conditions.

Successful adaptation will require both site–based and catchment scale solutions to be considered. Some of the potential adaptation options for this habitat are outlined below.

- Increase the flexibility of site management to respond to the increased variation in seasonal growing conditions. For example, vary the timing of the hay cut or the timing, duration and extent of aftermath grazing.
- Move cutting and grazing dates to align with climate driven changes to flowering dates.
- At the site level, take action to maintain or restore water level management, including actions to increase the water holding capacity of sites such as restoring ditch networks and reviewing the use of water management structures.
- Monitor and ensure the control of potential invasive species. Actions could include introducing biosecurity measures to minimise colonisation by invasive non-native species and increasing surveillance to identify the presence of any invasive non-native species before they become too widespread.
- Expand the area of lowland meadows by restoring semi-improved grasslands and re-creating lowland meadows on improved grassland and arable land. Where possible, action should be targeted at expanding and linking existing sites.
- Increase the structural heterogeneity of meadows in larger sites through varying the type and timing of management interventions.

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 the subject of 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 hay-making 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 hay-making 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.

SP2 Raised water levels

This supplement is aimed at raising water levels in ditches, and thus adjacent land, at key periods of the year. It will enhance the grassland habitat for wetland plants, as well as the diversity of fauna and flora of the ditches, and may, in the right situation, provide an area of flood storage.

SP6 Cattle grazing supplement

This supplement promotes grazing by cattle where this is likely to be beneficial in meeting environmental objectives.

Further information and advice

JNCC (2008) UK BAP habitat description **Lowland Meadow**.

Rodwell JS, Morgan V, Jefferson RG & Moss D. (2007) **The European context of British Lowland Grasslands** JNCC Report, No. 394.

Natural England (2008) **State of the Natural Environment**. This provides an overview of the state of England's grasslands – their extent, trends, key drivers of change, and actions to achieve favourable condition of the resource.

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

Natural England Technical Information Note **National Vegetation Classification: MG5**. (TIN 147)

The Floodplain Meadow Partnership. Useful information about floodplain meadows and their management.

Relevant case study examples

Floodplain Meadows Partnership Restoration Case Study – Broadmeadow and Middle Park
The aim of this project was to re-create areas of species-rich grassland using the Environmental Stewardship Higher Level Scheme (HLS). The first meadows were re-created in 2008, with others re- created during the autumn and spring of 2010-11.

Monmouthshire Meadows Group
The aim of this group is to conserve and restore flower rich grasslands in Monmouthshire by enabling members to manage their own fields and gardens effectively.

Key evidence documents

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Gowing, D. (2008). Urgency application: Impact of summer flooding on floodplain biodiversity via nutrient deposition. NE/F009232/1.

Jefferson, R.G. & Pinches, C.E. (2009). The conservation of floodplain meadows in Great Britain: an overview. *Fritillary* 5, 4-17.

Knight, S., Collins, L., Conyers, S., Crowe, A., Eyre, D., Parrott, D., Roy, S., Somerwill, K., Williams, J. & Boatman, N. (2014) **Increasing landscape connectivity: evaluating the risks that this will encourage invasive non-native species**. NE Commissioned Research Report 146. Natural England, York.

Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.J., Tew, T.E., Varley, J. & Wynne, G.R. (2010). *Making space for nature: a review of England's wildlife sites and ecological network*. Defra, London.

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Stromberg, J.C., Lite S.J., Marler R., Paradzick C., Shafroth P.B., Shorrock D., White J.M. & White M.S. (2007). **Altered stream-flow regimes and invasive plant species: the Tamarix case**. *Global Ecology and Biogeography*, 16, 381–393.

Thompson, J. R., Gavin, H., Refsgaard, A., Refstrup Sørenson, H. & Gowing, D. J. (2009). Modelling the hydrological impacts of climate change on UK lowland wet grassland. *Wetlands Ecology and Management*, 17, 503–523.

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