The conservation of floodplain meadows in Great Britain: an overview

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Summary

The great burnet - meadow foxtail meadow community (NVC MG4) is largely restricted to lowland river floodplains or stream sides in England. It is considered to have high biodiversity value as stands are species-rich and may support rare vascular plants. It is now a rare biotope with less than 1500 hectares estimated as remaining. Most sites occur south and east of a line from the Tees to the Severn estuaries. A high proportion (75%) of remaining fragments are less than 10 hectares in extent.

The grassland type occurs on free-draining circum-neutral alluvial loam soils where there is a high water table in autumn/winter or surface flooding. It is sustained by low-intensity management of hay cutting and aftermath grazing. However, stands rapidly lose their nature conservation value through agricultural improvement, management neglect and more slowly through prolonged water logging caused by neglect of surface drainage or through raised water levels.

The UK Biodiversity Action Plan sets targets for the maintenance, restoration and re-creation of the Lowland meadows priority habitat which include MG4 grassland (UK Biodiversity Group 1998 which have recently been revised [see http://www.ukbap.org.uk/bapgrouppage.aspx?id=98].

Conservation of the remaining resource has been mainly achieved through statutory designation of sites as Sites of Special Scientific Interest (SSSI) with 92% of known sites having this designation. The challenge over the next decade is to ensure these and non-statutory sites are brought into favourable condition through securing appropriate management agreements on as many stands as possible and addressing external factors which may be having a deleterious impact. In addition effort will be focused on expanding the extent of the resource by restoration of semi-improved stands and re-creation from arable, around existing sites.

Introduction

The MG4 meadow foxtail – great burnet (*Alopecurus pratensis-Sanguisorba officinalis*) alluvial flood plain meadow community described by Rodwell (1992) is a focus for British conservation programmes due to its high nature conservation value. It forms part of the Lowland meadows priority habitat under the UK Biodiversity Action Plan for which there is a costed action plan (UK Biodiversity Group 1998) and is listed on Annex 1 of the EU Habitat and Species Directive (92/43/EEC) conferring status as a habitat of European significance.

Description

The sward consists of a varied mixture of dicotyledonous forbs and grasses. Table 1 lists the constant species of the community. Tall, robust perennials such as Great Burnet (*Sanguisorba officinalis*) and Meadowsweet (*Filipendula ulmaria*) are often prominent. Whilst Rodwell (1992) does not describe sub-communities for MG4, he does report considerable variation in the abundance of particular species. For example, in the Lower Derwent valley in north and east Yorkshire, MG4 has a distinctive local character with a stronger representation of the grasses Creeping bent (*Agrostis stolonifera*), Rough Meadow-grass (*Poa trivialis*), Cock's-foot (*Dactylis glomerata*) and Tufted Hair-grass (*Deschampsia cespitosa*) and, the often frequent

presence of Meadow Barley (*Hordeum secalinum*), Meadow Brome (*Bromus commutatus*) and Smooth Brome (*B. racemosus*). In addition, species such as Yorkshire-fog (*Holcus lanatus*), Daisy (*Bellis perennis*), and Common Bird's-foot-trefoil (*Lotus corniculatus*) are generally less frequent or absent in the stands of the community in this area (Jefferson 2006). Similarly in a number of the Oxfordshire meadows, Devil's-bit Scabious (*Succisa pratensis*) and Quaking Grass (*Briza media*) can be locally frequent (Baker 1937).

Table 1: Constant species of MG4 (after Rodwell (1992))

Scientific name	English name
Alopecurus pratensis	Meadow Foxtail
Cerastium fontanum	Common Mouse-ear
Cynosurus cristatus	Crested Dog's-tail
Filipendula ulmaria	Meadowsweet
Holcus lanatus	Yorkshire-fog
Lathyrus pratensis	Meadow Vetchling
Leontodon autumnalis	Autumn Hawkbit
Lolium perenne	Perennial Rye-grass
Plantago lanceolata	Ribwort Plantain
Ranunculus acris	Meadow Buttercup
Rumex acetosa	Common Sorrel
Sanguisorba officinalis	Great Burnet
Taraxacum officinale agg.	Dandelion
Trifolium pratense	Red Clover
T. repens	White Clover

Biodiversity value

The high nature conservation value of MG4 stems from its species richness (mean of 28 species per $4m^2$ cited by Rodwell (1992)), its status as an ancient semi-natural grassland type and the presence of a number of threatened vascular plants. Although there is evidence that some sites may have had past brief periods of arable cultivation such as parts of the Lower Derwent valley, some such as those managed under the Lammas meadow system (Brian 1993) have clearly had a very long period of grassland habitat continuity. Indeed the earliest record for hay making on Pixey Mead, near Oxford dates as far back as 1142 (Clark 1906). Sites with populations of Wood Anemone (*Anemone nemorosa*) in central and northern England may be of considerable age as this species is unlikely to have survived any arable cultivations and re-colonisation potential would be very low as it has poor dispersal powers (Shirreffs 1985).

A number of threatened or scarce vascular plants also occurs in MG4. These are listed in Table 2. MG4 often supports a rich dandelion flora (*Taraxacum* spp.) which can include a number of rare and uncommon species (Rodwell 1992, Dudman & Richards 1997, McDonald 2000) (Table 2) although dandelion microspecies are probably under recorded. The community also provides the main habitat in the UK for Fritillary (*Fritillaria meleagris*).

Table 2: Scarce, threatened and uncommon vascular plants associated with MG4 flood-meadows

Scientific name	English name	Status
Carex filiformis	Downy-fruited Sedge	NS
Fritillaria meleagris	Fritillary	NS, VU
Oenanthe silaifolia	Narrow-leaved Water- dropwort	NS, NT
Taraxacum akteum	-	Rare
T. anglicum	-	Uncommon
T. fulgidum	-	Uncommon
T. haematicum	-	Uncommon
T. melanthoides	-	Uncommon
T. palustre	-	Uncommon
T. richardsianum	-	Uncommon
T. rubrisquamum	-	Rare
T. sublaeticolor	-	Uncommon
T. subundulatum	-	Uncommon
T. tamesense	-	Uncommon

NS = nationally scarce (Stewart et al. 1994), VU = Vulnerable, NT = Near threatened (Cheffings et al. 2005)
Dandelion species status assessed using Dudman & Richards 1997 and McDonald 2000

Larger sites can support important populations of breeding wading birds and wintering wildfowl (Jefferson 1997). Such grassland also provides important breeding sites for skylark (*Alauda arvensis*) and corn bunting (*Emberiza calandra*) both of which have undergone a rapid decline over the last 25 years and are now species of conservation concern (Gregory *et al*. 2002).

Distribution, Extent, Historic losses and current status

The community is largely restricted to England with less than 10 hectares recorded from Wales (Stevens *et al* 2007) (see Figures 1-3). Most sites occur south and east of a line from the Tees to the Severn estuaries and Jefferson (1997) estimated that 81% of the meadow type occurs in the catchments of the Severn, Trent, Yorkshire Ouse and Thames.

Figure 1: Distribution of MG4 grassland and lowland meadows BAP priority habitat (MG4, MG5 and MG8) by 10 km square (reproduced from Rodwell *et al*. 2007)

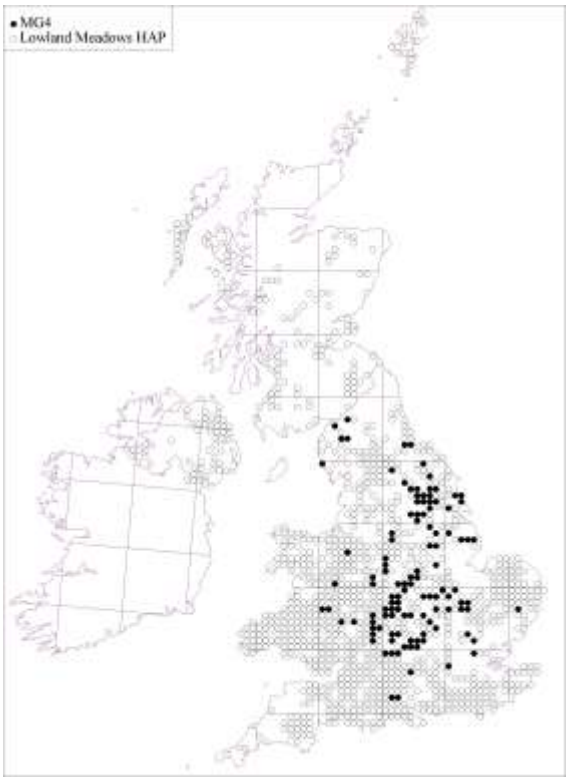


Figure 2
Distribution of MG4 by natural area

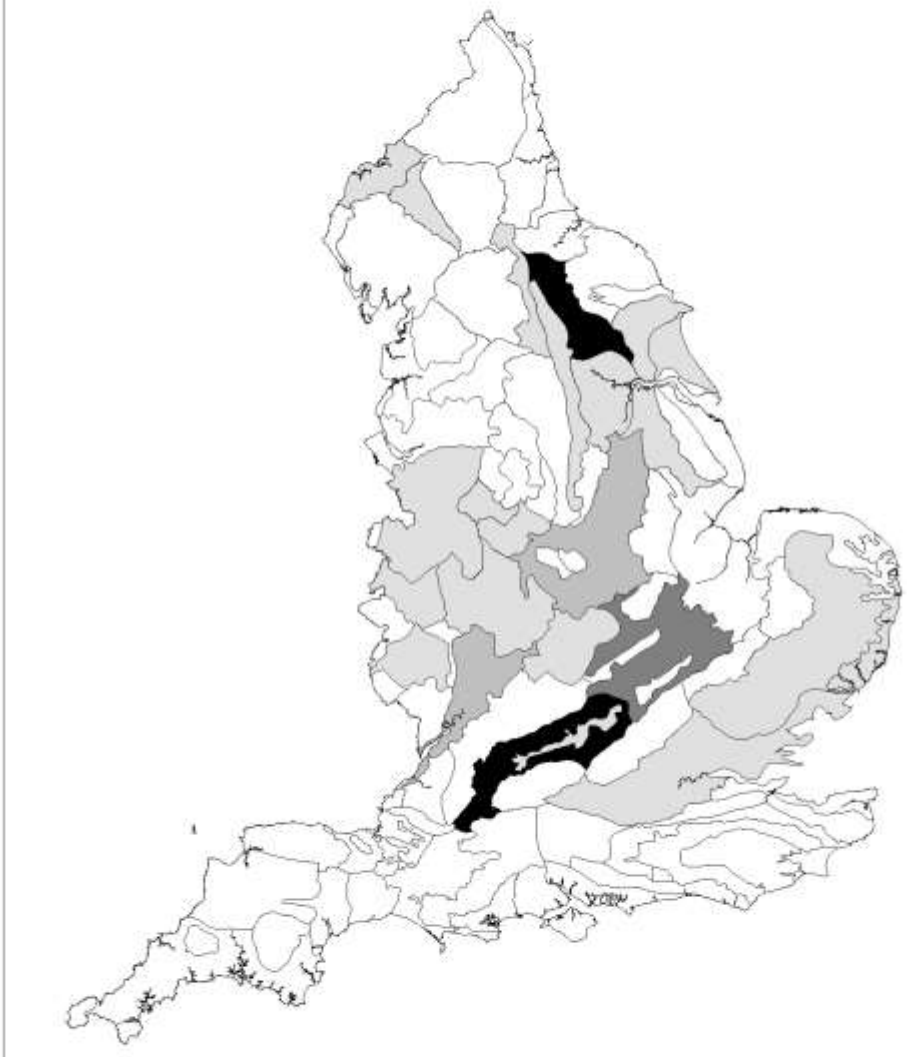
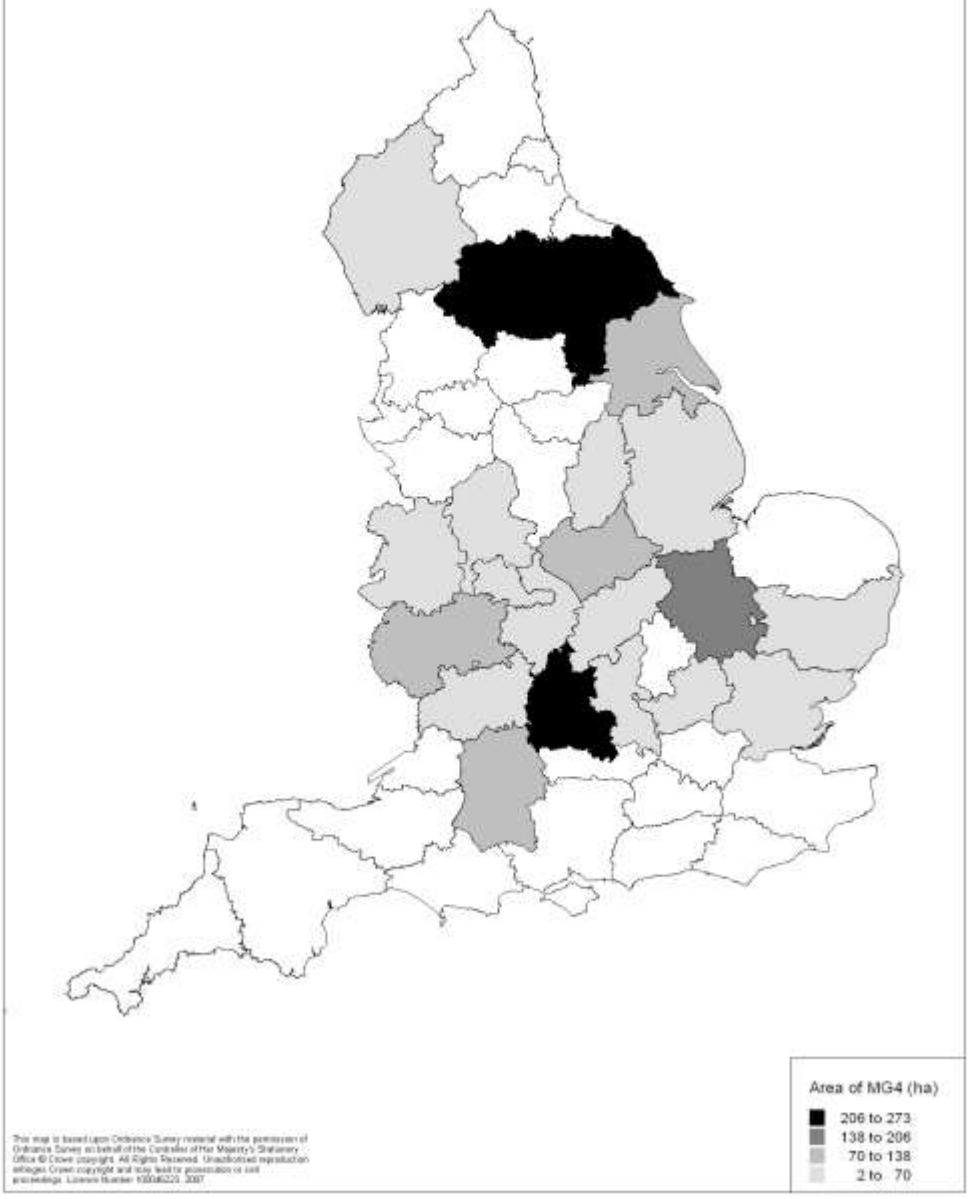


Figure 3
Distribution of MG4 grassland by county (Area of search)



Holmes *et al*. (2005) estimated that less than 1500 ha now remain in England. They also found that c. 75% of the MG4 area within sites were less than 10 hectares. Blackstock *et al*. (1999) provide an estimate of between 500 and 1000 ha in England and Wales. As with other lowland semi-natural grasslands of wildlife interest, MG4 has sustained large but unquantifiable losses over the last 50 years primarily as a result of agricultural intensification (Jefferson & Grice1998, Horton & Jefferson 2006), but also due to extraction for sand and gravels and urban or industrial development (Gowing *et al*. 2002). Indeed, the pre-1950 distribution of fritillary, a species showing close fidelity to this community in the Midlands and Southern

England, reveals a 38% decrease in the number of 10km squares in which the species was recorded between 1930 – 1962 and 1997 – 1999 (Preston *et al*. 2002).

Of all lowland grassland types of conservation importance, meadows have historically been most vulnerable to agricultural improvement. This is attributable to fact they are typically located on flat ground which lends itself to agricultural operations and have unimproved levels of soil fertility which are already quite high in some cases (Rodwell *et al*. 2007).

Habitat and management

The grassland is mostly restricted to level terrain on lowland river floodplains or stream-sides below 125m aod (above ordnance datum) on free-draining to moderately permeable neutral to calcareous fine-textured clay-rich or silty alluvial loam soils. Soils typically have low to moderate concentrations of macronutrients, for example, Gowing *et al*. 2002 cite available P in MG4 soils in the range 5-15mg/kg dry soil (ADAS indices 0 -1).

Some sites are underlain by river-terrace deposits of coarse sand or gravel. The latter may supply water during summer by sub-irrigation and facilitate sub-surface drainage in winter (Gowing 2004).

Alluvial meadows occur where autumn and winter water-tables are high including surface flooding. However, MG4 is sensitive to excessive water logging with many of the component species being intolerant of anoxic soils during the growing season (Gowing *et al*. 2002, Gowing this volume). Further information on the hydrological conditions under which the community occurs can be found in Gowing *et al*. (2002), Gowing (2004, 2006, this volume).

The nature conservation value of the flood meadow is sustained by low-intensity management of hay cutting in early July followed by aftermath grazing in the absence of applications of inorganic fertilisers and herbicides (Jefferson 1997, Gowing *et al*. 2002). The maintenance of surface drainage systems for rapidly removing water from sites is critical for ensuring the MG4 community is not replaced by inundation grassland or swamp communities (Crofts & Jefferson 1999, Gowing 2004).

Maintenance of the productivity of the community to allow for continued management for hay requires some return of nutrients to compensate for those removed in the hay. Supply of nitrogen (N) and phosphorus (P) is usually provided in particulate form from deposition during flood events (Gowing *et al*. 2002). Because of this natural input of nutrients MG4 grasslands are not subject to periodic applications of farmyard manure to maintain a productive hay crop as typically occurs on other lowland meadow NVC types

However, what constitutes a sustainable nutrient loading for the maintenance of the biodiversity interest of the community is unclear and concerns have been expressed that in some catchments the loading of P may be at levels which could potentially threaten the maintenance of botanical diversity (Gowing 2002).

Current status

In the most recent reporting round (2005) of the UK Biodiversity Action Plan, the status of the lowland meadows priority habitat type was recorded as declining-(slowing) [http://www.ukbap.org.uk/GenPageText.aspx?id=105BAP].

Of the MG4 SSSIs, 68% are currently recorded as being in favourable condition (Holmes *et al*. 2005), with a further 15% in unfavourable recovering condition. Hewins (2005) found that, of a sample of non-statutory lowland meadow sites, only 22% were in favourable condition but it should be noted that the sample did not include any MG4 sites, they were mostly MG5 crested dog's tail -common knapweed (*Cynosurus cristatus-Centaurea nigra*) grassland. However threats affecting MG5 are likely to be broadly similar to those in operation for MG4 so the findings of this study are relevant.

The principal reasons for poor condition across the 100 meadows assessed were a paucity of desirable indicator species in sufficient number and at frequency levels characteristic of good quality semi-natural grasslands. In addition, swards were generally too grass-dominated. Both these features are indicative of past or current agricultural improvement.

The conservation status of MG4 in 2007 has been assessed as "Unfavourable inadequate" by the Joint Nature Conservation Committee (JNCC), principally due the community's historic contraction in range and extent and the poor condition of greater than 25% of remaining sites. This assessment is required by the EU every five years under the Habitats & Species Directive for Annex 1 habitats of Community interest (see http://www.jncc.gov.uk/page-4092).

Conservation & key issues

Table 2 provides a summary of the key issues affecting the conservation and sustainable management of MG4 grassland.

Table 2: Key issues affecting the conservation of MG4 grassland (modified from Jefferson 2006)

Key issue	Sub-elements	Impact
Agricultural improvement	i) conversion to intensively managed grassland by ploughing and reseeding with high yielding grasses/legumes	Loss/degradation of flood-meadow biodiversity including breeding/wintering avifauna
	ii) conversion to semi-improved (MG6) or improved swards (MG7) by use of inorganic fertilisers	
	i and ii may be accompanied by improved drainage; i and ii will normally involve change from hay to silage.	
Changes in agricultural management	i) conversion to arable	Loss of semi-natural MG4 grassland
	ii) complete cessation of mowing and grazing	Successional change resulting in replacement by more species-poor communities
	iii) cessation of aftermath grazing	Reduction in botanical diversity and change towards more species-poor communities (e.g. MG1)

Table 2: Key issues affecting the conservation of MG4 grassland (modified from Jefferson 2006)

Key issue	Sub-elements	Impact
	iv) change from mowing/aftermath grazing to spring-autumn pasture for livestock including horses	Botanical change including loss of spring-flowering species dependent on seed production for population maintenance (e.g. *Fritillaria meleagris*) and reduction in the abundance of tall chamaephytes
Hydrological changes and soil compaction	i) lowering of water tables and reduction/cessation of winter flooding caused by water abstraction, mineral extraction, and flood alleviation). Interruption of lateral water movement in shallow aquifers by nearby mineral extraction or heavy silt deposition within watercourses	Conversion to drier grassland communities Reduction/cessation of inputs of nutrients from river silt due to reduction in flooding frequency. This will reduce hay yields leading to pressure to add nutrients from other sources.
	ii) River engineering including deepening, straightening or embanking rivers.	
	iii) raised spring/summer water levels	Conversion to wetter grassland/swamp communities
	iv) cessation of ditch/drain maintenance	
	v) higher water levels/ponding resulting from artificially raised river levels preventing water returning to river via outfalls	
	vi) soil compaction by vehicles or livestock resulting in reduction in soil water capacity	
Development	i) Gravel extraction in or near sites	Loss /degradation of flood-meadow biodiversity
	ii) Other development	
Restoration /rehabilitation /re-creation	i) Reinstatement of favourable management on semi-natural sites	Return of MG4 to favourable condition provided management neglect is short-term
	ii) Restoration/re-creation of vegetation similar in floristic composition by introduction of seed on arable reversion/improved/semi-improved grassland.	Increased biodiversity
Nutrient enrichment	i) Atmospheric deposition of nitrogen	Degradation of flood-meadow plant biodiversity
	ii) Deposition of particulate phosphorous and nitrogen from flood water	
Climate change	i) shift in species distributions as result of changes in climatic parameters (temperature and rainfall patterns)	Changes in species composition and potentially plant community type?
	ii) alteration of hydrological status	
	iii) change in agricultural practice	

Addressing the key issues

Site designation and targeting of agri-environment scheme agreements

The issues relating to the protection and conservation of existing sites listed in Table 2 have or are being addressed in part by the continued designation of sites as SSSIs (and the best examples as Special Areas of Conservation (SACs) under the Habitats & Species Directive). Holmes *et al.* (2005) estimated that 95% of the total area of MG4 was included within SSSIs and 70% by number of sites. Jefferson (1997) estimated that 22% and 39% by area had been declared as National Nature Reserves (NNRs) and SACs respectively.

In addition, site acquisition by conservation bodies and the conclusion of incentive agreements with owners and occupiers should ensure that improvements will be made

in the condition of both designated and non-statutory sites through securing appropriate management. The latter will largely be achieved through the use of the Environmental Stewardship (ES) - Higher Level Scheme (HLS), an agri-environment scheme launched in 2005 to replace the Countryside Stewardship and Environmentally Sensitive Areas schemes (Radley 2005). However, even with the availability of the ES scheme, ensuring continuation of mowing and grazing will be challenging as lack of management is now the key issue affecting lowland semi-natural grasslands (Hewins *et al*. 2005).

Indeed remaining species-rich grasslands are frequently no longer integral parts of the economic lowland farm businesses, particularly in areas where the predominant land use is arable farming. It is increasingly likely that many such grasslands will be left un-grazed or under managed unless the landowner is receiving sufficient payments to incentivise good management. For MG4 this is likely to include payment of the hay making supplement at £75 per ha on top of the standard payment of £200 per ha for maintenance or restoration of species rich semi-natural grassland.

EU Directives and UK implementation

The potential issue of nutrient enrichment on sites from phosphorus and nitrogen in floodwater is being partially addressed through the Review of Consents process under the Conservation (Natural Habitats, &c.) Regulations 1994 for the MG4 SACs. In order to meet obligations to avoid deterioration to SAC sites, competent authorities are required to review those consents, permissions or authorisations which may affect the integrity of these sites. The Environment Agency is reviewing consents for effluent discharges into rivers which may affect the integrity of MG4 sites such as at North Meadow, Cricklade.

In addition, the Water Framework Directive (2000/60/EC) requires Member States to improve the quality of water bodies. Diffuse pollution (including nutrients) from agriculture is often a key reason for poor water quality and this is being addressed in part by the DEFRA Catchment Sensitive Farming Delivery Initiative which aims to work with stakeholders in priority catchments to promote voluntary action on the ground. However, at present there are no obligatory mechanisms in place to ensure that land owners act to control phosphorous and sediment losses from their land. Consequently for stands of MG4 in eutrophic catchments input of phosphorous from floodwater may represent a significant threat to the integrity of the community.

Implementation of the EC Nitrates Directive (91/676/EEC) should help to reduce nitrate pollution from agriculture and to prevent further pollution arising. It requires Member States to establish an Action Programme of control measures designed to reduce nitrate loss from agricultural practices and apply it throughout the country or in designated areas which are vulnerable to nitrate pollution (Nitrate Vulnerable Zones (NVZs).

Nitrogen deposition from the atmosphere is also a cause of eutrophication of terrestrial ecosystems. The pollutants that contribute to nitrogen deposition derive mainly from nitrogen oxides (NO_X) and ammonia (NH_3) emissions and the National Emission Ceilings Directive 2001/81/EC seeks to reduce emissions of those pollutants that cause acidification, eutrophication and ground-level ozone in order to protect the environment and human health.

In situations where nutrient inputs from external sources are very heavy or where aggressive or rank vegetation is becoming problematic, Gowing *et al*. (2002) have suggested that a second hay cut or earlier cuts may be necessary to aid recovery of MG4.

The Environmental Impact Assessment Regulations (Agriculture) England (No. 2) implement the EU Environmental Impact Assessment Directive 2003/35/EC for uncultivated/semi-natural areas. The Regulations are intended to protect environmentally significant, uncultivated land and semi-natural areas (including semi-natural meadows) from being damaged by projects which increase agricultural productivity. Sites less than 2 ha are not caught by the Regulations unless the competent Authority applies a screening notice and thus only larger areas of MG4 will be protected by these regulations in England.

Development control

As discussed above, MG4 sites have been lost to both urban and industrial development in the past. The vast majority of MG4 sites (SSSIs and Sites of Nature Conservation Importance (SINCs)) should now be identified in Local Authority Development Plans and planning policies exist which should safeguard such sites from development. These policies have recently been strengthened through the introduction of Section 40 of the Natural Environment and Rural Communities Act which came into force on October 1st 2006. This places a duty on all public authorities to have regard to the purpose of conserving biodiversity, specifically stating that, "Every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity". A key principal enshrined within the revised policy is that the potential impacts of planning decisions on biodiversity and geological conservation are fully considered, and that planning authorities should seek to avoid direct harm to biodiversity and geology recognising that certain natural habitats such as ancient meadows and woodlands cannot be replaced.

UK Biodiversity Action Plan targets

The UK Biodiversity Action Plan has set targets for the maintenance, restoration and re-creation of the Lowland meadows priority habitat (UK Biodiversity Group 1998). These were revised in 2006. It is envisaged that these targets will be largely achieved through existing measures such as those outlined in this section but in particular through the use of HLS. Special projects funded by the Heritage Lottery Fund or charitable trusts may also have a role in meeting the targets. One such example is the Flood Meadows Partnership Project led by the Open University and funded by the Garfield Weston and Esmée Fairbairn Trusts.

Projects to restore and re-create MG4 grassland by seed addition are currently in progress and an example of the latter is reported by McDonald (1999).

Climate change

Climate change is likely to pose challenges for bringing the MG4 resource into favourable conservation status across its range. For existing sites, maintenance and restoration of existing drainage channels will be essential under a change scenario

involving an increased incidence of flooding. In addition, consideration may need to be given to removal of flood defence structures to re-instate more natural flooding regimes. Areas of floodplain grassland may also provide flood alleviation by water storage, lessening floodwater flow and slowing water discharge rates following storm events (Hickman et al 2001). Targeted re-creation of MG4 grassland to enlarge and link existing sites to meet biodiversity objectives, as reflected in the revised BAP targets, may also assist adaptation to climate change.

It is also possible that the phenology of characteristic MG4 plant species may change significantly in response to climatic prompts, thereby necessitating a more flexible approach to site management, for example varying the timing of the hay cut.

Research requirements

A particularly pressing research requirement is the need to obtain a better understanding of the dynamics of nutrients, particularly phosphorus and nitrogen, in floodplains and their impact on flood meadow biodiversity. Other research needs are detailed in Gowing *et al*. (2002).

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