NORFOLK BIODIVERSITY ACTION PLAN

LOWLAND MEADOWS & PASTURES

Ref 2/H9	Tranche 2	Habitat Action Plan 9
Plan Author:	NWT	
Plan Co-ordinator:	Farmland BAP Topic Group	
Plan Leader:	Natural England	
Date: May 2007	Stage: Final	

This plan adopts a wide-ranging approach to lowland grasslands treated as lowland meadows. They are taken to include most forms of unimproved neutral grassland across the enclosed lowland landscapes of the UK. In terms of National Vegetation Classification plant communities, they primarily embrace each type of *Cynosurus cristatus - Centaurea nigra* grassland, *Alopecurus pratensis - Sanguisorba officinalis* floodplain meadow and *Cynosurus cristatus - Caltha palustris* flood-pasture. This plan does not cover improved or semi-improved grassland, or re-created grassland that is species poor, although these are mentioned in the plan and have some value for wildlife.

1. CURRENT STATUS

National Status

- This plan concentrates on meadows and pastures associated with low-input nutrient regimes and covers the major forms of neutral grassland which have a specialist group of scarce and declining plant species. Among flowering plants, these include fritillary (*Fritillaria meleagris),* dyer`s greenweed *(Genista tinctoria),* green-winged orchid *(Orchis morio),* greater butterfly orchid *(Platanthera chlorantha)* and pepper saxifrage *(Silaum silaus)*. Lowland meadows and pastures are important habitats for skylark and a number of other farmland birds. They may also contain features such as spring-fed streams and drainage ditches, which can be important for biodiversity.

- The plan is not restricted to grasslands cut for hay, but also takes into account unimproved neutral pastures where livestock grazing is the main land use. In non-agricultural settings, such grasslands are less frequent but additional examples may be found in recreational sites, churchyards, roadside verges and a variety of other localities. Excluded from this plan are maritime grassland communities confined to coastal habitats (which are in maritime cliff and machair action plans), *Anthoxanthum odoratum - Geranium sylvaticum* grasslands (which are treated in a companion action plan for upland hay meadows) and *Molinia - Juncus* pastures (which are covered in the purple moor grass and rush pasture (*Molinia-Juncus*) plan).

- As indicated in the Habitat Statement included in *Biodiversity: The UK Steering Group Report, Volume 2* (1995), unimproved neutral grassland habitat has undergone a remarkable decline in the 20th century, almost entirely due to changing agricultural practice. It is estimated that by 1984 in lowland England and Wales, semi-natural grassland had declined by 97% over the previous 50 years to approximately 0.2million ha. Losses have continued during the 1980s and 1990s, and have been recorded at 10% per annum in some parts of England. Recent conservation survey findings in Britain and Northern Ireland reveal that the impact has been pervasive; it is estimated that only 10,521 ha of species-rich neutral grassland survive today in the UK.

- The overall outcome 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.

- Agricultural intensification has led to the extensive development of nutrient-demanding, productive *Lolium perenne* grasslands. These are managed for grazing and also silage production which has widely replaced traditional hay-making. Where fertiliser input is relaxed or in swards which have only been partially improved, *Lolium - Cynosurus* grassland is common; in many respects, this is intermediate between improved and unimproved lowland neutral grasslands, but has few uncommon species and is generally of low botanical value.

Norfolk Status

- East Anglia contains a small percentage (21%) of land occupied by permanent pasture and rough grazing (Roberts and Smyth, 1990). The Norfolk Phase 1 Habitat Survey carried out by the Norfolk Naturalists' Trust in the mid-1980s concluded that only 8% (3,376 ha) of the grassland in the county is of any conservation interest; of this, 476.74 ha is composed of the NVC types listed below, outside the Norfolk Broads (Harris, 2005). Aerial photographs show that most semi-natural grassland has been lost in the latter half of this century, with 73% of the grassland occurring in 1947 disappearing by 1984 (Smyth, 1988). This loss has been accompanied by a loss in subsidiary habitats, such as ponds and hedgerows.

- A wide range of grassland types occurs in Norfolk and their characteristics are dependent on soils, water, management and location. Much of the unimproved grassland is concentrated along the river valleys, on alluvium and peat deposits, tending to be predominantly wet. Neutral grassland is found in the Broads as extensive grazing marsh (dealt with under the Coastal and Floodplain Grazing Marsh HAP) and as fragmented meadows on the boulder clay deposited at the end of the last glaciation. These clayland grasslands form a broad belt from south-east Norfolk, through to mid-Norfolk and the north. Acid grassland is considered under the Lowland Heath HAP for Norfolk. A separate HAP has also been prepared for lowland calcareous grasslands.

- The following NVC mesotrophic grassland communities are of relevence to Norfolk; however, only those marked with an asterix are considered important in terms of nature conservation and are covered by this plan. Species lists for the NVC types are given in Appendix I.

  MG1: *Arrhenatherum elatius* coarse grassland
  MG5*: *Centaurea nigra – Cynosurus cristatus* meadow
  MG6: *Lolium perenne – Cynosurus cristatus* pasture
  MG7: *Lolium perenne* improved pasture
  MG8*: *Cynosurus cristatus – Caltha palustris* flood pasture
  MG9: *Holcus lanatus – Deschampsia caespitosa* coarse grassland
  MG10: *Holcus lanatus – Juncus effusus* rush pasture
  MG11*: *Festuca rubra – Agrostis stolonifera – Potentilla anserina* inundation grassland
  MG12*: *Festuca arundinacea* coarse grassland
  MG13*: *Agrostis stolonifera – Alopecurus geniculatus* inundation grassland.

  It should be noted that there is not an NVC type for the boulder clay grasslands, but that these do have a distinct suite of species, as shown in Appendix I.

- Lowland meadow and pasture SSSIs in Norfolk include:

  1) Thompson Water, Carr & Common: 154.90ha
  2) Dereham Rush Meadow: 22.17ha
  3) New Buckenham Common: 21.00ha
  4) Fritton Common: 19.86ha
  5) The Brinks, Northwold: 16.30ha

- The Norfolk Grassland Survey (1990) surveyed a total of 276 County Wildlife Sites, covering 1766.98 ha. Lowland meadow and pasture County Wildlife Sites of note in Norfolk include:

  1) Ivy Farm Meadows (CWS No. 1412) (TG 210215): 42.47 ha
  2) Earlham Cemetery (CWS No. 1461) (TG 210088): 22.61 ha
  3) Hales Green (CWS No. 141) (TM 373963): 17.36 ha
  4) Poors Allotment & Cotton Marsh (CWS No. 1234) (TG 435225): 13.55 ha
  5) Blickling Hall (CWS No. 1383) (TG 172289): 13.47 ha

Links with other Habitat and Species Action Plans

- It will be important to ensure that periodically flooded grasslands (usually *Alopecurus - Sanguisorba*) are taken into account during implementation of the action plan for coastal and floodplain grazing marshes; actions in the two plans need to be closely integrated.

- Lowland meadows are an important habitat for a number of farmland birds, including skylark (*Alauda arvensis*). Their requirements should also be taken into account in the implementation of the plan and in managing sites; late hay cuts every three to four years can help this species by avoiding disturbance to nests.

- Scattered scrub on grassland sites may also be used by species such as turtle dove (*Streptopelia turtur*) and again the requirements of such species should be taken into account when managing sites.

- Great crested newt (*Tristurus cristatus*) should be considered where meadows contain or are linked to ponds as these species are dependent on terrestrial habitats, especially grassland.

2. CURRENT FACTORS CAUSING LOSS OR DECLINE IN NORFOLK

The factors currently affecting lowland meadows and pastures reduce both the quality and the quantity of the habitat, whilst fragmentation brings increased risk of species extinctions in the small remnant areas. Key factors contributing to the loss and decline of the habitat include:

- Agricultural improvement through drainage, ploughing, re-seeding, fertiliser treatment, slurry application, conversion to arable and a shift from hay-making to silage production. It has also become increasingly difficult to find farmers with the equipment to make small bales of hay.

- Decline in the perceived agricultural value of species-rich pasture and hay in farming regimes. There is an attendant problem of the practicalities of managing small, isolated sites and of access to the appropriate machinery.

- Decline in grazing causing abandonment, leading to rank over-growth, dominance of coarse grasses, bracken (*Pteridium aquilinum*) and scrub encroachment.

- Supplementary stock feeding, associated with increased stocking levels, which can lead to eutrophication as well as localised poaching and establishment of pernicious weeds.

- Application of herbicides and other pesticides.

- Atmospheric pollution and climate change, the influence of which is not fully assessed.

- Reduced inundation frequency and duration, in water-meadows and floodplain grasslands associated with abandoned irrigation schemes, and lowered water tables as a result of land drainage, flood alleviation engineering, surface and ground water abstraction, floodplain gravel extraction and other activities.

- Floristic impoverishment as a consequence of heavy grazing pressure and changes in stock species and breeds.

3. CURRENT ACTION IN NORFOLK

Legal Status

- A significant proportion of Norfolk's remaining lowland meadows and pastures have been protected within SSSIs. According to the Norfolk Grassland Audit (2006), it is estimated that there are 3,461.61 ha of neutral grassland existing on SSSIs. Of this total, 57.12 ha have been defined as unimproved neutral grassland, whilst 2,425.55 ha have been defined as neutral grassland. Much of the latter is likely to comprise of unimproved stands, although this could not be confirmed using available data. Most of the sites listed in the audit and not notified as SSSIs have been notified as County Wildlife Sites.

Other Action

- The *Norfolk Grassland Survey* (Roberts and Smyth, 1990) provided a study of key grassland sites, including NVC and rare species information. However, much of the information it contains is now out of date and Natural England is embarking upon an update of grassland information across the eastern region. NWT carried out an audit of grassland sites in 2006, collating background information on known grassland SSSIs and CWS (Harris, 2006).

- Of the 1,231 County Wildlife Sites notified in Norfolk, 750 contain grassland habitat; of these, 91 are predominantly NVC communities considered important for nature conservation. County Wildlife Sites across Norfolk are provided with free advice on management and grant aid by Norfolk Wildlife Trust and are afforded a degree of protection under the development and planning processes.

- Grassland habitats are the principal focus of the Churchyard Conservation Scheme (run by the Norfolk Wildlife Trust) and the Roadside Nature Reserve programme (run by NWT and Norfolk County Council). The latter include some of the best fragments of boulder clay grassland in South Norfolk and provide an important stronghold for the nationally scarce sulphur clover (*Trifolium ochroleucon*).

- On behalf of the Norfolk Biodiversity Partnership, NWT has undertaken an ecological network mapping project for Norfolk (Land, 2006). The report of the project highlights

areas in the county where grassland re-creation is desirable to re-connect and buffer fragmented habitats.

- The regional “under-grazing” project aims to seek solutions to the problems caused by a decline in grazing stock across East Anglia.

Management, Research and Guidance

- Management agreements have been established for many neutral grassland SSSIs, so that favourable low-intensity farming methods are maintained.

- Unimproved neutral grasslands are included in the UK agri-environment schemes which provide complementary incentives for farmers to conserve this habitat across wider agricultural landscapes. Permanent grassland managed under the ESA and Countryside Stewardship Schemes has included statutory and non-statutory designated meadows and pastures. Lowland meadow is an HLS target in most of the Joint Character Areas relevant to Norfolk. Entry Level Stewardship (ELS) offers options for low input grassland management and Higher Level Stewardship (HLS) provides a broad range of grassland maintenance, restoration and re-creation options targeted at SSSIs, BAP habitats and species, plus important grassland features characteristic of the wider landscape.

- Local authorities and non-governmental organisations in Norfolk make a major contribution to the conservation of species-rich lowland meadows; this includes those organisations that own or manage sites and the County Wildlife Site partnership, which provides advice to landowners.

- On a national level, research into various aspects of grassland management is vital. This includes gathering data on the efficacy of different grazing regimes and different stock, as well as the impact of atmospheric nutrient deposition and climate change. In Norfolk, work to redress the decline in grazing stock needs to continue and there is also a need to further investigate the possibilities for establishing species-rich grasslands and possible sources of local provenance seed.

4. ACTION PLAN OBJECTIVES AND TARGETS

National

- Maintain the current extent of lowland meadows in the UK. (Target represents no loss of BAP habitat).

- Maintain at least the current condition of lowland meadows.

- Achieve favourable or recovering condition for 7,088ha of lowland meadow by 2010.

- Restore 1,736 ha of lowland meadow from semi-improved or neglected grassland, which no longer meets the priority habitat definition by 2010.

- Re-establish 345 ha of grassland of wildlife value from arable or improved grassland, by 2010.

- 260 ha (75%) of re-established area to be adjacent to existing lowland meadows or other semi-natural habitat by 2010. (Refer to T5)

- 170 ha (50%) of re-established area to contribute to resultant habitat patches of two ha or more of lowland meadow by 2010. (Refer to T5)

Norfolk

- Establish, through audits, desk studies and field work, a more accurate figure for the extent of lowland meadow and pasture in Norfolk, building on information contained in the Norfolk Grassland Audit (2006).

- Maintain the existing resource (currently estimated as 5,480.13 ha) through advisory work, protection under the land use planning system and increased publicity about the importance of semi-natural grasslands. Management advice and site restoration or re-creation should also address the need to reduce the negative effects of fragmentation through buffering existing sites, developing ecological networks and the linkage of existing sites. This, in turn, is linked to the need to develop stronger grazing networks.

- Wherever biologically feasible, achieve favourable status of all significant stands of unimproved lowland meadow and pasture within SSSIs by 2010.

- For stands outside SSSIs, wherever biologically feasible, secure favourable condition over 75 per cent of the resource by 2015. This will focus mostly on CWS, with some attention to churchyards and Roadside Nature Reserves.

- Restore 100 ha of lowland meadow and pasture of high wildlife value from semi-improved or neglected grassland by 2010.

- Re-establish 100 ha of lowland meadow and pasture of high wildlife value on arable or other lost sites, by 2010.

- By 2010, 75 per cent (150 ha) of the restored/re-established area should be adjacent to existing lowland meadow and pasture or other semi-natural habitat, and 50 per cent (100 ha) should contribute to resultant habitat patches of 2 ha or more of lowland meadow and pasture.

Notes on Targets

Re-creation should be defined as that using local provenance seed or green hay and creating a species-rich site of wildlife value. The creation of extensive tracts of less species-rich grassland to link or buffer existing sites is extremely useful to wildlife, but should only constitute a contribution to these targets when the end result will be grassland with a suite of species typical of the NVC types occurring in Norfolk.

Lowland Meadows and Pastures - Norfolk Action Plan

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.1	**Policy and Legislation**			
5.1.1	Ensure the conservation requirements of lowland meadows are taken into account in the development and adjustment of agri-environment schemes; design measures to suit local needs and in particular target local concentrations of remnant semi-natural neutral grasslands.	Ensure relevant Environmental Stewardship options are promoted and this habitat is addressed in Joint Character Area (JCA) target statements. Accord priority to ecological networks, commons, buffering of Roadside Nature Reserves, and grassland areas on boulder clay. Reduce the negative effects of fragmentation by buffering and linking existing sites, promoting ecological networks and undertaking appropriate habitat re-creation.	NE, NWT, FWAG, NCC NE, NWT, FWAG, NCC NE, NWT, FWAG	
5.1.2	Develop and implement strategies to restore and expand the cover of unimproved neutral grassland, taking into account the need to ameliorate the negative effects of small patch size, fragmentation and isolation.	Consider a new mapping project, or a revision of the 1990 Norfolk Grassland Survey, to establish, through audits, desk studies and field work, a more accurate figure for the extent of lowland meadow and pasture in Norfolk. Use data to prioritise key areas and potential ecological networks.	NWT, FWAG, NE NWT, FWAG, NE	
5.1.3	Support initiatives to conserve unimproved neutral grassland within local government development plans and related policy, in forest management and planting schemes and by special projects.	Ensure CWS and Roadside Nature Reserves are protected within local government development plans and related policy and in forest planning.	EA, FC, LAs, NWT	

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.1.4	Ensure that the conservation requirements of floodplain hay meadows are taken into account in Water Level Management Plans.	Ensure EA has relevant information, including information held by NWT.	EA, IDBs, NWT	
5.2	**Site Safeguard and Management**			
5.2.1	Keep the extent of SSSI/ASSI coverage under review and notify further sites as necessary to fill significant gaps.	Review Norfolk SSSI series, as appropriate. Complete identification of locally important sites as County Wildlife Sites.	NE NWT	NCC, NE
5.2.2	Secure, by 2004, the uptake of positive management with owners and occupiers of SSSIs/ASSIs, where necessary to achieve favourable conservation conditions, and promote the uptake of such agreements on other wildlife sites.	Complete management plans for SSSI lowland meadows and pastures Target owners/managers of County Wildlife Site lowland meadows and pastures for advice on management and grants. Also target relevant churchyards and Roadside Nature Reserves.	NE NE, NWT, NCC	
5.2.3	Consider the need to manage further key sites as National Nature Reserves and, where appropriate, support acquisition and management by conservation organisations.	Consider need to manage further key sites as National Nature Reserves.	NE	
5.2.4	Encourage the development of new management techniques where required, eg for weed control, and the setting up of local farm networks, eg for livestock provision, that help to ensure sympathetic	Promote the results of research into new management techniques to the owners and managers of lowland meadows and pastures. Discuss solutions to management problems at	NE, FWAG, NWT Farming & Biodiversity	

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
	management.	Norfolk Farming and Biodiversity Practitioners' Forum.	Practitioners Forum	
5.2.5	Contribute to the implementation of relevant species action plans for rare and declining species associated with lowland meadows in conjunction with the relevant species steering group.	Ensure management plans and advice for lowland meadows and pastures take relevant Species Action Plans into account Develop strategy for recovery of boulder clay grassland species.	NE, NWT NCC, NWT, NFG	
5.3 **5.3.1**	**Advisory** Encourage, develop and disseminate best practice for unimproved neutral grassland management, in particular the integration of conservation management into agricultural practice.	Use a prioritised approach to develop and disseminate advice on best practice targeted to managers and landowners. Include links to agricultural practice, management of horse grazed fields and agri-environment grants.	NE, LAs, NWT, FWAG	
5.3.2	Produce and disseminate guidelines for appropriate methods and approaches to establish new stands of lowland hay meadow of wildlife value.	Develop and promote advice and the use of seed from local donor sites. Develop and promote advisory information on lowland meadow and pasture re-creation, including information on seed from local donor sites.	NE, FWAG, NWT NE, FWAG, NWT	Horse and pony owners, riding clubs Horse and pony owners, riding clubs
5.3.3	Encourage the use and establishment of private and public demonstration sites, with special linkage to agri-environment schemes.	Include lowland meadow and pasture management in existing programmes of farm walks and Farmland Practitioners' Forum.	FWAG, Farming & Biodiversity Practitioners Forum	
5.4 **5.4.1**	**International** Promote conservation and management of Special Areas of Conservation as part of a European network and if a review of	Support national initiatives as relevant.	NE	

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
	community coverage of Annex 1 of the Habitats Directive is undertaken support adequate coverage of this habitat within the site network.			
5.4.2	Recommend favourable measures for unimproved lowland grassland conservation during future negotiations in Europe to revise the Common Agricultural Policy.	Support national efforts to include lowland meadows and pastures in CAP reform.	NE	
5.4.3	Encourage actions at a European and international level which will help improve our understanding of the conservation of the resource at a UK level and promote measures which will strengthen the conservation of this habitat in Europe and elsewhere.	Support European and national actions where appropriate and supply information on the resource in Norfolk, as required.	NE	
5.5	**Future Research and Monitoring**			
5.5.1	Contribute information to a World Wide Web based catalogue of survey information as a means of improving access to information on lowland meadows.	Supply website co-ordinators with any updates of survey information on lowland meadows in Norfolk.	NE	
5.5.2	Undertake vegetation survey and assessment of unimproved neutral grasslands in parts of UK with poor survey coverage, using standardised and repeatable methodology.	Use existing data, including 2006 Grassland Audit, to inform national update of grassland information. Continue to add data to Norfolk Grassland Audit.	NE, NWT NWT	
5.5.3	Formulate quantified and spatially referenced targets to expand the total cover of lowland meadows of wildlife value across the	Identify key areas or sites. Main targets should be linkage and buffering of existing sites, not just SSSIs, but clusters of	NE, NWT	

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
	UK, with particular emphasis on amelioration of habitat fragmentation, by 2005.	existing sites and key NWT reserves.		
5.5.4	Review and promote research into the best ways of integrating modern agricultural practices with the conservation of species-rich grasslands in lowland farmland.	Disseminate information on integrating modern agricultural practices with the conservation of species rich grassland in lowland farmland to meadow owners and farming organisations. Continue participation in regional under-grazing project	NE, FWAG NE, FWAG	
5.5.5	Review current research and where appropriate promote applied research to inform the conservation and restoration of different forms of dry and floodplain neutral grasslands.	Disseminate information to local conservation organisations, as appropriate.	NE, FWAG	
5.5.6	Review current research and where appropriate promote research on the establishment and expansion of species-rich neutral meadows and pastures, covering methodology and landscape ecological components.	Disseminate information from research to advisors, managers and owners, including commons, churchyards, road verges and restoration projects.	NE , FWAG	
5.5.7	Encourage and support conservation studies on scarce animal and plant taxa associated with unimproved neutral grasslands with particular relevance to amelioration of damaging impacts from habitat depletion and fragmentation.	Initiate specific research as appropriate.	Farmland BAP Topic Group	
5.5.8	Evaluate the need for impact assessment of the	Implement national actions arising from this research	EA, NE	

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
	effect of atmospheric nutrient deposition and climate change on community composition, and commission research as appropriate.	on a Norfolk level. Identify any sites likely to be lost to sea level rise and possible replacements.	EA, NE	
5.5.9	Develop and implement appropriate surveillance and monitoring programmes to assess progress towards achieving action plan targets.	Monitor progress against targets as part of BAP working group.	Farmland BAP Topic Group	
5.6 **5.6.1**	**Communications and Publicity** Seek opportunities to present neutral meadow and pasture conservation in the scientific press and popular media.	Develop media stories around successful lowland meadow and pasture projects, including road verges and churchyards.	NE, NWT, FWAG	
5.6.2	Encourage appropriate public access for observation and enjoyment of lowland meadows.	Where appropriate, use public access for education about the habitat.	NE, NWT, FWAG	
5.6.3	Consider commissioning marketing studies into ways to promote agricultural products from unimproved neutral grassland.	Promote any developments arising from this research. Publicise the “undergrazing project” and local success stories.	NE, FWAG, NWT	

Abbreviations

EA	Environment Agency
FC	Forestry Commission
FWAG	Farming and Wildlife Advisory Group
IDB	Internal Drainage Board
LA	Local Authority
NBRC	Norfolk Biological Records Centre
NCC	Norfolk County Council
NE	Natural England
NFG	Norfolk Flora Group
NWT	Norfolk Wildlife Trust

NORFOLK DISTRIBUTION

Please refer to the list of sites on page 3.

MANAGEMENT GUIDANCE

(This guidance is a general summary; for more detailed information or advice, please consult the references or contacts below.)

Most types of grassland are a phase in a process of succession and without management, in the form of grazing or cutting, would undergo changes in vegetation resulting in the development of scrub and woodland.

Grasslands are sensitive habitats and cessation or alterations in management frequency and intensity can result in changes from one type of grassland to another and from grassland to scrub.

It is important to remember that all sites will require individual assessments of management requirements dependent on their condition and often what is practical in the circumstances. This is especially so in Norfolk, where lowland meadows and pastures often form part of a mosaic of habitats on a single site. However, general principles for the management of lowland meadows are given below.

Grazing

The best kind of management for grasslands is extensive grazing, which, in the case of lowland meadows, is often traditionally preceded by cutting for hay. By maintaining low stocking rates, (approximately one animal per hectare), invasive plant species will be controlled whilst maintaining the invertebrate fauna that depend on the grasses. The aim is for a mosaic of longer and shorter grass that will benefit different forms of wildlife.

The composition, structure and height of the sward should be used to assess the condition and guide the management of the site. If a grazing regime is already in place that appears to be maintaining the conservation value of the grassland, it should be continued.

Maintaining the condition of a grazed pasture depends on each year's vegetation growth being removed before the start of the next growing season.

Grazing consists of three major components: defoliation, trampling and manuring/nutrient cycling.

Defoliation involves the removal of some or all of the above ground parts of the plants (leaves, stem and flowers) whether dead or alive. The selectivity of grazers (cattle, sheep and horses have different preferences) can significantly affect the floristic composition and structure of the sward and can lead to changes in community type. Through the continual removal of new growth, grazing limits the ability of competitive species to dominate the sward, encouraging greater floristic diversity. Increased stocking rates can be used to bring neglected grasslands into favourable condition and to control unpalatable species. In order to maintain pastures in a favourable condition, stocking rates must be considered to prevent undergrazing and overgrazing. Undergrazing allows the spread of unpalatable plants and rank grasses, whilst overgrazing can result in weed invasion and excessive poaching. Both can cause a loss in floral and faunal diversity. Stocking rates vary depending on the specific requirements of the site in question.

Trampling can affect structure and botanical composition of the grassland. Moderate trampling can be beneficial especially in neglected swards; the hoof action of heavy livestock breaks up the litter layer and crushes/tramples course vegetation, often creating bare patches enabling the establishment of seedlings. Bare patches can also benefit many invertebrates. Heavy poaching caused by excessive stocking rates can result in erosion, excessive bare ground and invasion by problem weed species

Manuring/nutrient cycling: Lowland grasslands of conservation value (which usually have a much lower nutrient budget than improved pastures) are negatively affected by nutrient enrichment by encouraging the growth of courser/weedy species. Monitoring of the effects of stocking and appropriate action to vary it will be needed on many sites.

Sheep

Sheep tend to be most selective when grazing, unless stocking rates are high. They tend to produce a mosaic of short-cropped areas interspersed with areas of ranker growth, by concentrating on the most palatable vegetation. Although this variation in structure can benefit invertebrates, it can encourage the spread of unpalatable species and alter the sward composition.

Sheep grazing is generally the best method of managing calcareous grassland sites and sheep are very suitable for grazing some lowland meadows, especially the drier sites.

Cattle

Cattle are less selective and tend to graze more evenly, consuming a wider range of coarser species. Cattle can create a more open sward as they tear at vegetation (rather than bite like sheep) and being heavier, their trampling tends to expose more bare soil. The action of cattle will break up mats on pastures where plant litter has built up more quickly than sheep and so encourage new growth.

Cattle are frequently the best stock to graze lowland meadows.

Horses

Horses are very selective, resulting in a mix of overgrazed patches and areas of tall coarse species. Horses dung in the same areas, so encouraging the spread of coarse, quick-growing species through nutrient enrichment.

Although horse grazing has been out of favour with conservationists for some years, it is possible to manage some sites by light and extensive grazing with hardier breeds.

Rabbits

Rabbits can also be an effective grazing tool, but unless controlled, can rapidly overgraze a pasture. Rabbit populations should be considered when calculating stocking rates.

Mixed Stocking

Where mixed stocking regimes are used, the sward tends to lack structural variation but the spread of vigorous, coarse and unpalatable species is more controlled.

Other Factors

There are other factors to consider when applying conservation grazing. Pastures can be grazed extensively all through the year; however, grazing during spring and summer may prevent plants from establishing and flower heads may be eaten so preventing the seed source establishing. Winter grazing may result in soil becoming poached by hooves. As a rule of thumb: the stocking rates should be dictated by the number of animals the area can support during the winter when available vegetation is low. This way, both animal welfare and the grassland interest will be maintained

CUTTING/MOWING

Lowland meadows are traditionally managed by cutting or mowing for hay in late summer, followed by a period of "aftermath" grazing to control vegetation re-growth after the hay cut. Aftermath grazing is essential, partly to control competitive coarse grasses and to encourage the germination of seedlings in the bare patches created by trampling. Hay management by cutting alone can quickly result in less species rich communities.

Inorganic fertilisers should not be used. Any cut material should be removed to avoid nutrient enrichment which would encourage the growth of undesirable grasses and herbs

Although mowing is generally associated with the production of hay/silage, it can be used as an alternative to grazing on pastures where the use of animals is impractical.

- Avoid very low cutting heights as this can create excessive bare patches open to invasion by competitive species and is more damaging to ground nesting birds. However, small-scale disturbance can be beneficial for seed germination and invertebrates.

- Cutting from the centre of the field outwards allows breeding birds and mammals to escape.

- Avoid use of heavy machinery on damp meadows. This prevents rutting and reduces the chances of invasion by undesirable species.

- Hay bales should be removed from site within 3-4 weeks to reduce sward damage. Small bales and light machinery are generally preferable.

- Sustained early hay cuts should be avoided, they have been shown to reduce species richness in meadows.

- Depending on locality and the weather, cutting dates will vary but usually will range from late June to late July. Cutting should not occur before breeding birds have hatched and should not occur before 'desirable' plant species (largely, those reliant on seed production for regeneration) have set seed.

- Lowland flood meadows can support important numbers of breeding waders and wildfowl. Cutting on or after 1 July is preferable in this situation.

- Where possible, allow a late hay cut (late August/September) at least once every five years to support late flowering species. This is especially important on sites with a high proportion of such plants.

- Aftermath grazing in late summer / autumn often follows the removal of the hay crop (see above).

- Sward height at the end of autumn / winter grazing should be no more than 3 cm for meadows supporting wintering wildfowl or spring-nesting waders. Where bird populations are less important, sward height should be no more than 10 cm. However, variations in sward height across a site are desirable in many instances.

- In some instances, especially meadows with large proportions of early flowering species, it can be beneficial to split the site in two, and cut each half, every other year on rotation.

- The presence of rare or scarce invertebrates in a meadow may affect the management regime, depending on any specific requirements according to their life cycles.

Importance of Scrub

Although looked upon as an invader of important grassland sites and both costly and time-consuming to control, the individual species collectively known as 'scrub' are important habitats in their own right. As with all conservation advice, advice on scrub control will need to be tailored to individual sites, but some scrub is desirable on most sites and management plans should aim for a mix of scrub in succession present, from bramble that is at ground level to more mature bushes that have trunks. Grazing animals can also help to manage scrub; some animals do better at browsing than others, although most will nibble down developing scrub seedlings

Invertebrate and bird surveys can help inform scrub management plans. Annual removal of a little scrub at different stages of development saves a lot of hard work in the long-term whilst maintaining vitally important habitat and food source for birds.

Arable Reversion to Grassland

Grassland can be restored through reversion of arable fields on the correct soil type, although reducing nutrients to the low level required by neutral grassland plant species can be a lengthy process. There are payment incentives available to landowners for arable reversion through the Environmental Stewardship grant scheme.

Fields in areas that are difficult to cultivate, those that buffer existing sites, those that historically provide poor yield or are perhaps frequently used by the public due to footpaths may make excellent sites for reversion to permanent grassland. A soil test will be required initially to determine the level of nutrients in the soil; if the nutrient levels are low and the land is adjacent to existing species-rich grassland, natural regeneration with annual cutting or grazing to deter seeding of problem weeds and scrub development may be ideal. If nutrients are high, a crop may need to be planted to remove the nutrients, followed by a hay or silage cut, removing the cuttings, and extensive grazing. When nutrient levels have been lowered, seeding may take place using local provenance seed. The use of locally source green hay as a seed source is highly desirable and should be employed wherever practical.

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APPENDIX 1 - SPECIES LISTS FOR LOWLAND MEADOWS AND PASTURES IN NORFOLK

NVC MG5: *Cynosurus cristatus – Centaurea nigra* grassland. Includes frequent species associated with MG5a and MG5b, both of which are important sub-communites in Norfolk.

Latin Name	**Common Name**
Achillea millefolium	Yarrow
Agrostis capillaris	Common bent grass
Anthoxanthum odoratum	Sweet vernal-grass
Bellis perennis	Daisy
Brachythecium rutabulum	Bryophyte
Briza media	Quaking-grass
Centaurea nigra	Common knapweed
Cerastium fontanum	Common mouse-ear
Cynosurus cristatus	Crested dog's-tail grass
Dactylis glomerata	Cock's-foot grass
Galium Verum	Lady's bedstraw
Festuca rubra	Red fescue
Holcus lanatus	Yorkshire fog
Hypochaeris radicata	Cat's-ear
Lathyrus pratensis	Meadow vetchling
Leontodon autumnalis	Autumn hawkbit
Leontodon hispidus	Rough hawkbit
Leucanthemum vulgare	Ox-eye daisy
Lolium perenne	Perennial rye grass
Lotus corniculatus	Common birdsfoot trefoil
Luzula campestris	Field woodrush
Plantago lanceolata	Ribwort plantain
Prunella vulgaris	Self-heal
Ranunculus acris	Meadow buttercup
Ranunculus bulbosus	Bulbous buttercup
Rumex acetosa	Sheep's sorrell
Taraxacum officinale agg	Dandelion
Trifolium pratense	Red clover
Trifolium repens	White clover
Trisetum flavescens	Yellow oat-grass

NVC MG8: *Cynosurus cristatus – Caltha palustris* grassland

Latin Name	**Common Name**
Anthoxanthum odoratum	Sweet vernal-grass
Caltha palustris	Marsh marigold
Cerastium fontanum	Common mouse-ear
Cynosurus cristatus	Crested dog's-tail grass
Festuca rubra	Red fescue
Holcus lanatus	Yorkshire fog
Leontodon autumnalis	Autumn hawkbit
Poa trivialis	Rough meadow-grass
Ranunculus acris	Meadow buttercup
Rumex acetosa	Common sorrell
Trifolium repens	White clover

NVC MG11: *Festuca rubra – Agrostis stolonifera – Potentilla anserina* grassland. Includes frequent species associated with subcommunity MG11a

Latin Name	**Common Name**
Agrostis stolonifera	Creeping bent
Festuca rubra	Red fescue
Potentilla anserina	Silverweed
Lolium perenne	Perennial rye-grass
Holcus lanatus	Yorkshire fog
Trifolium repens	White clover
Cerastium fontanum	Common mouse-ear

NVC MG12: *Festuca arundinacea* grassland. Includes frequent species associated with MG12a and MG12b.

Latin Name	**Common Name**
Agrostis stolonifera	Creeping bent
Carex distans	Distant sedge
Carex otrubae	False fox sedge
Eleocharis uniglumis	Slender spike-rush*
Elymus pycnanthus	Sea couch
Elymus repens	Common couch-grass
Festuca arundinacea	Tall fescue
Festuca rubra	Red fescue
Glaux maritima	Sea milkwort
Holcus lanatus	Yorkshire fog
Juncus gerardii	Saltmarsh rush
Leodonton autumnalis	Autumn hawkbit
Lolium perenne	Perennial rye-grass
Oenanthe lachenalii	Parsley water-dropwort
Potentilla anserina	Silverweed
Phragmites australis	Common reed
Ranunculus acris	Meadow buttercup
Sonchus arvensis	Perennial sow-thistle
Trifolium repens	White clover
Vicia cracca	Tufted vetch

* Scarce in Norfolk

NVC MG13: *Agrostis stolonifera – Alopecurus geniculatus* grassland

Latin Name	**Common Name**
Agrostis stolonifera	Creeping bent
Alopecurus geniculatus	Marsh foxtail
Ranunculus repens	Creeping buttercup
Holcus lanatus	Yorkshire fog
Poa trivialis	Rough meadow-grass
Juncus effusus	Soft rush
Glyceria fluitans	Floating sweet-grass

Additional plants typical of mesotrophic grassland in Norfolk:

Latin Name	**Common Name**
Alopecurus pratensis	Meadow fox-tail
Arrhenatherum elatius	False oat-grass
Carex hirta	Hairy sedge
Deschampsia cespitosa	Tufted hair-grass
Festuca pratensis	Meadow fescue
Juncus articulatus	Jointed rush
Juncus inflexus	Hard rush
Poa pratensis	Meadow grass
Saxifraga granulata	Meadow saxifrage
Veronica chamaedrys	Germander speedwell

Typical plants of boulder clay meadows:

Latin Name	**Common Name**
Anacamptis pyramidalis	Pyramid orchid
Arum maculatum	Lords and ladies
Genista tinctoria	Dyer's greenweed*
Orchis mascula	Early purple orchid
Orchis morio	Green-winged orchid
Primula veris	Cowslip
Saxifraga granulata	Meadow saxifrage
Silaum silaus	Pepper-saxifrage
Trifolium ochroleucum	Sulphur clover**

* Scarce in Norfolk.
**Nationally scarce, with a stronghold in Norfolk.