

NORFOLK BIODIVERSITY ACTION PLAN

LOWLAND CALCAREOUS GRASSLAND

The definition of calcareous grassland covers a range of plant communities in which lime-loving plants are characteristic. In the context of this action plan, lowland types are defined as the first nine calcareous grassland National Classification communities, CG1 to CG9.

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1. CURRENT STATUS

National Status

- Lowland calcareous grasslands are developed on shallow lime-rich soils generally overlying limestone rocks, including chalk. These grasslands are now largely found on distinct topographic features such as escarpments or dry valley slopes and sometimes on ancient earthworks in landscapes strongly influenced by the underlying limestone geology. More rarely, remnant examples occur on flatter topography such as in Breckland and on Salisbury Plain. They are typically managed as components of pastoral or mixed farming systems, supporting sheep, cattle or sometimes horses; a few examples are cut for hay.
- The cover of lowland calcareous grassland has suffered a sharp decline in extent over the last 50 years. There are no comprehensive figures, but a sample of chalk sites in England surveyed in 1966 and 1980 showed a 20% loss in that period.
- Current estimates put the amount of lowland calcareous grassland remaining in the United Kingdom at 40,594 ha.
- Lowland calcareous grasslands support a very rich flora including many nationally rare and scarce species such as pasque flower (*Pulsatilla vulgaris*). The invertebrate fauna of calcareous grassland is also diverse and includes the wart-biter cricket (*Decticus verrucivorus*). These grasslands also provide feeding or breeding habitat for a number of scarce or declining birds including stone curlew (*Burhinus oediconemus*) and skylark (*Alauda arvensis*).
- Scrub is frequently associated with calcareous grassland and can contribute to local biodiversity by providing shelter for invertebrates and scrub edge conditions suitable for species such as bloody cranesbill (*Geranium sanguineum*). Dwarf shrubs and herbs characteristic of acid soils are also sometimes associated with calcareous grassland, forming chalk or limestone heath.

Norfolk Status

- Although chalk underlies about 60% of Norfolk, there is very little typical chalk grassland due to the glacial drift deposits which cover the county. The main sites which survive are in north-west Norfolk and Breckland, where natural features such as steep slopes or patterned ground support chalk grassland. Man-made features also support chalk grassland and these range from ancient sites to the more modern, such as the disused railway line at Narborough and Alderford quarry.

- The boulder clay grasslands of south-east Norfolk sometimes show a strong calcareous influence, but these are largely treated as lowland meadows unless there is a significant calcareous grassland interest. Occasionally, more neutral meadows have chalk springs arising, leading to localised chalk flora; thus, it should be noted that this plan deals with those grasslands defined by the NVC types and typically resulting from thin soils over chalk.
- The main chalk grassland communities found in Norfolk are: CG2 (*Festuca ovina-Avenula pratensis*); and CG7 (*Festuca ovina-Hieracium pillosella-Thymus pulegiodes*), which is characteristic in the Brecks and better developed here than elsewhere in the country. CG6 (*Helictotrichon pubescens*) is rare, but does occur on a few sites, including within the Stanford Training Area.
- In Breckland, CG7b and CG7c occur in close association with acid grassland. Patches of calcareous grassland, within a mosaic of Brecks heath, are more common than large tracts, requiring different management from lowland calcareous grasslands in other areas. Most sites within Breckland occur within existing SSSIs or CWS, except for rides within Thetford Forest, which are largely not notified, plus isolated churchyards and road verges.

Links with Species Action Plans

- Lowland calcareous grassland is an important habitat for a number of priority invertebrate, plant and bird species. During plan implementation, their requirements should be taken into account. The priority species relevant to Norfolk include: the pale shining brown moth (*Polia bombycina*) and the four spotted moth (*Tyta luctuosa*). BAP priority bird species closely associated with chalk grassland include stone curlew (*Burhinus oediconemus*) and skylark (*Alauda arvensis*).

2. CURRENT FACTORS CAUSING LOSS OR DECLINE IN NORFOLK

Both the quality and the extent of calcareous grassland can be affected by the following factors:

- Agricultural intensification by use of fertilisers, herbicides and other pesticides, re-seeding or ploughing for arable crops. Particular problems include pig units and the wind blow of nutrients into chalk grassland banks.
- Farm specialisation towards arable cropping has reduced the availability of livestock in many lowland areas; this is especially true of sheep. The result is the increasing dominance of coarse grasses such as false oat grass (*Arrhenatherum elatius*), cocksfoot (*Dactylis glomerata*) and bush grass (*Calamagrostis epigejos*), followed by the more damaging invasion by scrub and woodland, which leads to losses of calcareous grassland flora and fauna.
- The decline in the availability of grazing stock, especially sheep, is a significant factor in both the decline of existing habitats and the opportunities for managing sites in the future. Over-grazing is less of a problem in Norfolk than in other counties, but is sometimes associated with supplementary feeding, which can also cause localised sward damage, as a result of trampling and long-term nutrient enrichment.
- Development activities such as mineral and rock extraction, road building, housing and landfill.

- Localised afforestation with hardwoods and softwoods; this has been especially evident in the Brecks.
- Recreational pressure bringing about floristic changes associated with soil compaction at some key sites.
- Invasion by non-native plants, including bird-sown *Cotoneaster* species, causes problems by smothering calcareous grassland communities at some sites.
- Atmospheric pollution and climate change, the influence of which are not fully assessed.
- The loss of calcareous grassland in Breckland is linked to the dramatic loss (22,000 ha in the 20th century) of heathland and dry grassland. Many of the surviving areas have declined in quality as sheep grazing has ceased and rabbit populations declined due to myxomatosis.
- Many remaining calcareous grassland sites are small in size and isolated from other sites, exacerbating the problems of management and vulnerability to external threats, such as agricultural spray drift.
- It is possible that in the past chalk grassland sites have not been seen as a priority for conservation in Norfolk, as the county is not, on the whole, as well known for this habitat as other areas are. Furthermore, many calcareous grasslands occur as part of man-made sites and as such are sometimes overlooked.

3. CURRENT ACTION IN NORFOLK

Statutory Designations

- Lowland calcareous grassland features prominently in the SSSI series in England and Wales and the value of the habitat has long been recognised in the NNR series. Statutory calcareous grassland sites of note in Norfolk include the following SSSIs:
 1. Stanford Training Area: 955.56 ha (mosaic including neutral dry grassland)
 2. Barnhamcross Common: 69.07 ha
 3. East Walton & Adcocks Common: 59.71ha
 4. Warham Camp: 19.12 ha
 5. Cockthorpe Common: 7.02 ha
 6. Ringstead Downs: 7.02 ha
 7. Weeting Heath (in part): 141.75 ha
 8. Alderford Common: 17.19 ha
 9. Narborough Railway embankment: 7.94 ha
- Lowland calcareous grassland is included within the *Festuco-brometalia* grassland identified in Annex 1 of the EC Habitats Directive as of Community interest. The habitat is a priority type if important orchid populations are present. Lowland calcareous grassland sites form part of the Natura 2000 network.
- Lowland calcareous grassland is part of the Special Area of Conservation feature for Breckland.

- Several plant, invertebrate and bird species of calcareous grassland are protected under the Schedules of the Wildlife and Countryside Act 1981, including ground pine (*Ajuga chamaepitys*) and spiked speedwell (*Veronica spicata*).

Other Action

- *A Botanical Survey of East Anglian Calcareous Grassland* (Moore, 1997) and the *Norfolk Grassland Survey* (Roberts and Smyth, 1990) provided studies of key grassland sites, including NVC and rare species information. However, much of the information they contain is now out of date and Natural England is embarking upon an update of grassland information across the eastern region. The lack of current and digitised information on the distribution of the habitat in Norfolk creates a requirement to collect and collate existing data on the extent of both the current and historical resource; this has to some degree been addressed through the Norfolk Grassland Audit (Harris, 2006), but information on current site condition is still lacking for non-statutory sites.
- 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. Non-statutory calcareous grassland sites of note in Norfolk include the following County Wildlife Sites:
 1. Hollow Heath (CWS No. 725): 12.16 ha
 2. Merton Common (CWS No. 731): 11.1 ha
 3. String Drain (CWS No. 308): 8.05 ha
 4. Watton Airfield (CWS No. 2091): 5.07 ha
 5. Castle Acre Castle mound (CWS No. 2056): 3.2 ha
 6. Walsingham disused railway cuttings (CWS No. 1303): 3.08 ha
- A number of chalk quarries in Norfolk are being or will be restored to calcareous grassland. Some river banks in the west of the county and the spoil from the Cut-off Channel also support chalk flora and might be considered for survey and CWS status in the future. Some rides in Thetford Forest also support calcareous flora; these have been identified by the Forestry Commission and managed accordingly.
- The regional under-grazing project (formerly an RDS initiative) attempts to find solutions to some of the problems caused by the decline of grazing stock in East Anglia.
- 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.). These sites can provide a good source of local provenance seed.
- On behalf of the Norfolk Biodiversity Partnership, NWT has recently undertaken an ecological network mapping project for the county (Land, 2006). The report of the project highlights areas where grassland re-creation is desirable to re-connect and buffer fragmented habitats.
- The National Lottery funded Tomorrow's Heathland Heritage project includes a component of chalk grassland where it forms part of a Brecks heath mosaic.

Management, Research and Guidance

- Management agreements to conserve calcareous grassland on SSSIs have been made between owners and occupiers and English Nature (now Natural England). Agri-environment schemes play a major role in providing incentives to encourage the appropriate management of sites, including SSSIs (where a management agreement is not already in place).
- The Breckland ESA contained a significant component of lowland calcareous grassland and the Countryside Stewardship Scheme included calcareous grassland as an eligible habitat for potential re-creation and extensive management elsewhere in the county. The Environmental Stewardship schemes will further promote appropriate grassland management: ELS offers options for low input grassland management, and HLS provides a broad range of grassland maintenance, restoration and re-creation options targeted at SSSIs, BAP habitats and species. Chalk grassland is targeted for the North West Norfolk Joint Character Area (JCA 076) and Breckland (JCA 085).
- The Ministry of Defence is by far the largest landowner (by area) nationally of calcareous grassland with several sites including large areas within the Stanford Training Area, most of which are now notified as SSSI or CWS. The MoD is developing integrated management plans for their properties to take account of nature conservation.
- A major contribution has been made by various non-governmental organisations to the conservation of species-rich calcareous grasslands in parts of the UK through the establishment of nature reserves. In Norfolk, notable nature reserves include NWT Ringstead Downs and NWT Narborough Railway Line
- There is a need across the East Anglian region to ensure that the sustainable, long term management of calcareous grasslands is encompassed in plans to develop grazing networks and projects. This encompasses the need to tackle the poor availability of suitable grazing stock for many grassland sites and the problems of grazing small, fragmented sites.
- Nationally, there is a need to assess the impact of atmospheric nutrient deposition and climate change in this and other types of lowland grassland.

4. ACTION PLAN OBJECTIVES AND TARGETS

National

- Maintain the current extent of lowland calcareous grassland in the UK. (Target represents no loss of BAP habitat).
- Maintain at least the current condition of lowland calcareous grassland.
- Achieve favourable or recovering condition for 30,421 ha of lowland calcareous grassland by 2010.
- Restore 399 ha of lowland calcareous grassland from semi-improved or neglected grassland, which no longer meets the priority habitat definition by 2010.
- Re-establish 8,424 ha of grassland of wildlife value from arable or improved grassland by 2010.
- 6,320 ha (75%) of re-established area to be adjacent to existing lowland calcareous grassland or other semi-natural habitat by 2010. (Refer to T5)
- 4,200 ha (50%) of re-established area to contribute to resultant habitat patches of two ha or more of lowland calcareous grassland by 2010. (Refer to T5)

Norfolk

- Establish, through audits, desk studies and field work, a more accurate figure for the extent of lowland calcareous grassland in Norfolk by 2008.
- Maintain the existing resource, currently estimated as 182.38 ha (Harris, 2006) through advisory work, protection under the land use planning system and increased publicity about the importance of semi-natural grasslands.
- Wherever biologically feasible, achieve favourable status of all significant stands of unimproved lowland calcareous grasslands 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 being accorded to churchyards and Roadside Nature Reserves.
- Restore 50 ha of lowland calcareous grassland from neglected or improved grassland by 2015.
- Re-establish 30 ha of lowland calcareous grassland from arable or other land by 2015.
- By 2010, 75 per cent (60 ha) of the restored/re-established area should be adjacent to existing lowland calcareous grassland or other semi-natural habitat, and 50 per cent (40 ha) should contribute to resultant habitat patches of 2 ha or more of lowland calcareous grassland.

Notes on Targets:

Restoration and re-establishment work should be carried out at carefully targeted sites, paying particular attention to sites of importance for BAP species, buffering of existing high quality sites and the creation of ecological networks. It is understood that re-creation of calcareous grassland from arable is a difficult and long term process; the re-creation of large areas of calcareous grassland may not, therefore, be realistic, especially in the short-term. Re-establishment of calcareous grassland in Norfolk should be focussed on the establishment of species-rich swards that can be managed as chalk grassland and that have been created using local provenance seed; these should support a range of species typical of calcareous grasslands in Norfolk. The creation of general grassland that is not species-rich is dealt with in the Lowland Meadow BAP. Management work is intrinsically linked to the need to develop sustainable grazing networks across Norfolk.

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.1	Policy and Legislation			
5.1.1	Take account of the conservation requirements of calcareous grassland when developing and adjusting agri-environment schemes. Design measures to suit local needs and in particular target local concentrations of semi-natural calcareous grassland.	Ensure relevant Environmental Stewardship options are promoted and this habitat is addressed in Joint Character Area (JCA) target statements. Accord priority to ecological networks and buffering of existing sites to reduce the negative effects of fragmentation.	NE, NWT, FWAG, NCC NE, NWT, FWAG, NCC	
5.1.2	Develop and implement strategies to restore and expand the cover of unimproved calcareous grassland, taking into account the need to ameliorate the negative effects of isolation, fragmentation, small patch size and scrub encroachment.	Identify potential areas and sites for restoration and re-creation. Priority should be given to expanding and improving sites that are currently scrub covered where reversion to calcareous grassland is possible.	NE, NWT, FWAG, NCC	
5.1.3	Support initiatives to conserve unimproved calcareous grassland within local government development plans and related policy, in forest management and planting schemes and by special projects.	Influence Local Development Frameworks and other strategic plans to recognise and protect calcareous grassland sites.	EA, FC, LAs, NE, NWT	
5.1.4	Consider mechanisms by which lowland calcareous grassland within areas designated as common land can be brought under sympathetic management.	Identify sites and provide advice to landowners, rights holders and local authorities.	NE, NWT FWAG	LAs

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.2	Site Safeguard and Management			
5.2.1	Keep the extent of SSSI coverage under review and notify further sites as necessary to fill significant gaps in coverage.	Review Norfolk SSSI series as appropriate.	NE	NCC, NE
		Consider suitable sites for County Wildlife Site status.	NWT	
5.2.2	Complete the designation of lowland calcareous grassland SPAs and SACs and prepare and implement management plans by 2004.	No action proposed.		
5.2.3	Secure the uptake of positive management with owners and occupiers of SSSIs where necessary to achieve favourable conservation conditions, and promote the uptake of such agreements on other wildlife sites.	Develop strategies and initiatives to tackle undergrazing, linking to Environmental Stewardship uptake and condition assessment.	NE	NWT, FWAG
5.2.4	Secure the positive management of lowland calcareous grassland sites within the ownership or management of the Ministry of Defence and voluntary conservation bodies, and draw up site management plans with clear targets for this habitat and associated priority species for these sites by 2004.	Provide advice to owners of CWS and other calcareous grassland sites outside SSSIs, including churchyards and road verges.	NE, MoD, NWT, NCC	
		Develop strategies and initiatives to tackle undergrazing.	NE	
		Secure positive management for calcareous grassland on STANTA.	NE, MoD	

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.2.5	Consider the need to manage further key sites as National Nature Reserves and, where appropriate, support acquisition and management by conservation organisations.	Consider this need as appropriate.	NE	
5.2.6	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 will ensure sympathetic management is possible.	<p>Ensure that information on new management techniques is disseminated to BAP partners and land managers.</p> <p>Ensure calcareous grasslands are included in proposed grazing initiatives.</p>	<p>NE, NWT, FWAG</p> <p>NE, NWT</p>	
5.2.7	Contribute to the implementation of relevant species action plans for rare and declining species associated with lowland calcareous grasslands in conjunction with the relevant species steering group.	Incorporate relevant SAPs into all site management advice.	NE, NWT, FWAG, RSPB, BC	
5.3 5.3.1	<p>Advisory</p> <p>Encourage, develop and disseminate best practice for unimproved calcareous grassland management, in particular the integration of conservation management into agricultural practice.</p>	Provide advice to landowners and consider a possible grassland project aimed at increasing the profile of calcareous grasslands, disseminating information and supporting practical management.	NE, LAs, NWT, FWAG	

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.3.2	Produce and disseminate guidelines for appropriate methods and approaches to establish new stands of lowland calcareous grassland of wildlife value.	Identify potential areas for re-creation and ensure use of best practice and local seed. Develop information on species, sources of local seed and potential local donor sites.	NE, FWAG, NWT NWT, FWAG, NFG	
5.3.3	Encourage the use and establishment of private and public demonstration sites, with special linkage to agri-environment schemes.	Ensure calcareous grasslands are incorporated into Norfolk FWAG farm walks and Farming and Biodiversity Practitioners' Forum, where practicable.	FWAG, Farming & Biodiversity Practitioners' Forum	
5.4 5.4.5	International Disseminate information about the UK's experience in conservation of the resource in international literature and conferences and take opportunities to learn from colleagues in Europe and elsewhere.	No action proposed.		
5.5 5.5.1	Future Research and Monitoring Contribute information to a World Wide Web based catalogue of survey information as a means of improving access to information on lowland calcareous grasslands.	No action proposed.		
5.5.2	Undertake vegetation survey and assessment of unimproved calcareous grasslands in parts of UK with poor survey coverage, using standardised and repeatable methodology.	Contribute to update of Norfolk Grassland Survey to look at historical extent of calcareous grasslands. Identify candidate sites for restoration or re-creation, incorporating condition assessments of non-statutory sites.	NE, NWT, FC, FWAG, RSPB, NCC, NBRC NE, NWT, FC, FWAG, RSPB, NCC, NBRC	

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.5.3	Formulate quantified and spatially referenced targets to expand the total cover of lowland calcareous grassland of wildlife value across the UK, with particular emphasis on amelioration of habitat fragmentation, by 2005.	Agree revised targets following update of grassland information for Norfolk.	Farmland BAP Topic Group	
5.5.4	Review research needs into the conservation and restoration management of the habitat and the integration of this with agriculture, to identify significant gaps in knowledge. Commission and undertake new research as appropriate.	Disseminate and apply information on restoration and re-creation as appropriate.	NE, FC, NWT, FWAG	
5.5.5	Commission and support research on establishment and expansion of species-rich calcareous grassland, covering methodology and landscape ecological components.	Disseminate information as required. Consider need for a calcareous grassland re-creation project in Norfolk, highlighting potential sites and supporting their reversion to calcareous grassland.	NE, FC, NWT Farmland BAP Topic Group	
5.5.6	Encourage and support conservation studies on scarce animal and plant taxa associated with unimproved calcareous grasslands with particular relevance to amelioration of damaging impacts from habitat depletion and fragmentation.	Support conservation studies on scarce animal and plant taxa associated with unimproved calcareous grasslands.	Farmland BAP Topic Group	

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	NATIONAL ACTION	NORFOLK ACTION	ACTION BY:	PARTNERS
5.5.7	Evaluate the need for impact assessment of the effect of atmospheric nutrient deposition and climate change on community composition, and commission research as appropriate.	Monitor national research and disseminate information locally.	EA, NE	
5.5.8	Develop and implement appropriate surveillance and monitoring programmes to assess progress towards action plan targets.	Monitor condition and progress of existing and re-created sites.	Farmland BAP Topic Group	Landowners
5.5.9	Commission marketing studies into ways to promote agricultural products from lowland calcareous grassland.	Support regional and county-based grazing initiatives.	NE	
5.6	Communications and Publicity			
5.6.1	Seek opportunities to present lowland grassland conservation in the scientific press and the popular media.	Seek opportunities to present lowland grassland conservation in the scientific press and the popular media.	NE, NWT, FWAG, BTO, RSPB, NCC	Landowners
5.6.2	Encourage appropriate public access for observation and enjoyment of lowland calcareous grassland.	Encourage appropriate public access for observation and enjoyment of lowland calcareous grassland.	NE NWT, FWAG BTO, RSPB, NCC	Landowners

Abbreviations

BC	Butterfly Conservation
BTO	British Trust for Ornithology
EA	Environment Agency
FC	Forestry Commission
FWAG	Farming and Wildlife Advisory Group
LA	Local Authority
MoD	Ministry of Defence
NBRC	Norfolk Biological Records Centre
NCC	Norfolk County Council
NE	Natural England
NFG	Norfolk Flora Group
NWT	Norfolk Wildlife Trust
RSPB	Royal Society for the Protection of Birds

NORFOLK DISTRIBUTION

See list of key sites under “Current Action in Norfolk”, pages 3 and 4.

MANAGEMENT GUIDANCE

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

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. For example, lack of grazing on calcareous grassland can lead to the development of more mesotrophic swards.

Lowland calcareous grasslands tend to be very species rich, favouring grasses and especially forbs. Calcareous soils also tend to be nutrient poor, which helps to limit the growth of more competitive and dominant plant species. The existence of unusual species and additional features, such as anthills, should also be accounted for when planning management.

Calcareous grasslands were typically grazed as part of a mixed farming system, although a small number are also cut for hay.

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

Grazing

The best kind of management for grasslands is extensive grazing. 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. Traditionally, dry calcareous grasslands are sheep grazed, whereas damper grasslands (which tend to be used for hay making) are generally cattle grazed. The floras of dry and damp calcareous grasslands are very different and have become adapted to the management they have received for centuries. Attempts to change such management patterns can be disastrous. If a grazing regime is already in place that appears to be maintaining the conservation value of the grassland, it should be continued.

The success of grazing pastures in order to maintain the condition of a site relies on each year's production being removed before the start of the next growing season.

As calcareous grasslands are highly sensitive habitats, grazing regimes and advice must take account of the need for sustainable worming programmes.

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 coarse 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.

Sheep

Sheep grazing is traditionally considered as the best method of managing dry calcareous grassland, creating the tight, species-rich swards associated with the habitats. Sheep were the traditional stock for these thin poor soils

Sheep tend to be most selective when grazing, unless stocking rates are high. They tend to produce a mosaic of short-cropped areas 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.

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 generally considered to be more suitable in the management of damper calcareous grassland.

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. However, horses can be useful if stocking rates are carefully managed.

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. Areas 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

The majority of calcareous grasslands are managed by grazing, usually with sheep. Management by cutting presents some difficulties, as the grass growth on calcareous grasslands is poor and rarely sufficient for a hay crop. Furthermore, cutting will not create the variation in sward associated with grazing; coarser species, especially grasses, may come to dominate in time, resulting in less species-rich communities.

However, when grazing is not an option, cutting or mowing the grassland is the best possible alternative and should follow similar guidelines to the cutting of neutral hay meadows, although, as grass growth may be slow, cutting may not be required every year. Cutting/mowing usually occurs in late summer, followed by a period of aftermath grazing (if possible) to control vegetation re-growth after the hay cut. Aftermath grazing can control competitive coarse grasses and will encourage the germination of seedlings in the bare patches created by trampling.

Inorganic fertilisers should not be used and any cut material should generally 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. 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.
- Hay bales should be removed from site within three to four weeks to reduce sward damage. Small bales and light machinery are preferable.
- Sustained early hay cuts should be avoided, as 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 (reliant on seed production for regeneration) have set seed.
- Where grasslands support breeding birds, cutting on or after 1 July is preferable in order to reduce disturbance and possible mortality.
- 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.
- In some instances, especially grasslands 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 or bird species in a grassland 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; 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; with some animals being 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 that vitally important habitat and food source for birds.

Reversion to Grassland from Arable or Improved Grassland

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

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 chalk 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 or green hay.

REFERENCES

- Beckett, G., Bull, A. and Stevenson, R. (1999). *A Flora of Norfolk*. Privately published.
- Crofts, A. and Jefferson, R.G. (Eds). (1999). *The Lowland Grassland Management Handbook (2nd edition)*. English Nature/The Wildlife Trusts.
- Harris, E. (2006) *The Norfolk Grassland Audit*. Norfolk Wildlife Trust.
- Land, R. (2006). Report of Ecological Network Mapping Project for Norfolk. Presentation of Methodology and Draft Maps for Consultation. Norfolk Wildlife Trust, for the Norfolk Biodiversity Partnership.
- Moore, L. (1997). *A Botanical Survey of East Anglian Calcareous Grassland*.
- Roberts, N. and Smyth, W. (1990). *Norfolk Grassland Survey*. Nature Conservancy Council.
- Rodwell, J.S. (Ed). (1992). *British Plant Communities, Volume 3: Grassland and Montane Communities*. Cambridge: Cambridge University Press.

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APPENDIX 1: SPECIES LISTS

NVC CG2 – *Festuca ovina*-*Avenula pratensis* grassland including relevent sub-communities

Latin Name	Common Name	Status in Norfolk
<i>Asperula cynanchica</i>	Squinancywort	Confined chiefly to the south-west of the county.
<i>Avenula pratensis</i>	Meadow oat-grass	
<i>Briza media</i>	Quaking grass	
<i>Carex caryophyllea</i>	Spring sedge	Much decreased since 1968.
<i>Carex flacca</i>	Glaucous sedge	
<i>Cirsium acaule</i>	Dwarf thistle	Occasional.
<i>Dactylis glomerata</i>	Cocksfoot-grass	
<i>Galium verum</i>	Lady's bedstraw	
<i>Festuca ovina</i>	Sheep's fescue	
<i>Helianthemum nummularium</i>	Rock rose	Confined chiefly to west Norfolk.
<i>Trifolium repens</i>	White clover	
<i>Filipendula vulgaris</i>	Dropwort	
<i>Holcus lanatus</i>	Yorkshire fog	
<i>Hieracium pilosella</i>	Mouse-ear hawkweed	
<i>Koeleria macrantha</i>	Crested hair-grass	
<i>Leontodon hispidus</i>	Rough hawkbit	
<i>Linum catharticum</i>	Fairy flax	
<i>Lotus corniculatus</i>	Common birdsfoot trefoil	
<i>Plantago lanceolata</i>	Ribwort plantain	
<i>Plantago media</i>	Hoary plantain	Typical of long established chalk grassland.
<i>Prunella vulgaris</i>	Selfheal	
<i>Pseudoscleropodium purum</i>	Bryophyte	
<i>Sanguisorba minor</i>	Salad burnet	
<i>Scabiosa columbaria</i>	Small scabious	
<i>Trifolium pratense</i>	Red clover	
<i>Thymus praecox</i>	Wild thyme	Confined to the south of the county.

NVC CG6 – *Avenula pubescens* grassland including relevent sub-communities

Latin Name	Common Name	Status in Norfolk
<i>Avenula pratensis</i>	Meadow oat-grass	
<i>Avenula pubescens</i>	Downy oat-grass	
<i>Briza media</i>	Quaking grass	
<i>Carex flacca</i>	Glaucous sedge	
<i>Cirsium acaule</i>	Dwarf thistle	
<i>Dactylis glomerata</i>	Cocksfoot grass	
<i>Danthonia decumbens</i>	Heath grass	Scarce.
<i>Festuca rubra</i>	Red fescue	
<i>Holcus lanatus</i>	Yorkshire fog	
<i>Koeleria macrantha</i>	Crested hair-grass	
<i>Leontodon hispidus</i>	Rough hawkbit	
<i>Linum catharticum</i>	Fairy flax	

<i>Lotus corniculatus</i>	Common birdsfoot trefoil	
<i>Plantago lanceolata</i>	Ribwort plantain	
<i>Psuedoscleropodium purum</i>	Bryophyte	
<i>Sanguisorba minor</i>	Salad burnet	
<i>Succisa pratensis</i>	Devil's-bit scabious	
<i>Taraxacum officinale</i> agg	Dandelion	

NVC CG7 - *Festuca ovina*-*Hieracium pilosella*-*Thymus pulegioides* grassland

Latin Name	Common Name	Status in Norfolk
<i>Avenula pratensis</i>	Meadow oat-grass	
<i>Campanula rotundifolia</i>	Harebell	
<i>Cirsium acaule</i>	Dwarf thistle	
<i>Galium verum</i>	Lady's bedstraw	
<i>Festuca ovina</i>	Sheep's fescue	
<i>Hieracium pilosella</i>	Mouse-ear hawkweed	
<i>Homalothecium lutescens</i>	Bryophyte	
<i>Hypnum cupressiforme</i>	Bryophyte	
<i>Koeleria macrantha</i>	Crested hair-grass	
<i>Leontodon hispidus</i>	Rough hawkbit	
<i>Linum catharticum</i>	Fairy flax	
<i>Lotus corniculatus</i>	Common birdsfoot trefoil	
<i>Plantago lanceolata</i>	Ribwort plantain	
<i>Prunella vulgaris</i>	Selfheal	
<i>Pseudoscleropodium purum</i>	Bryophyte	
<i>Sanguisorba minor</i>	Salad burnet	
<i>Senecio jacobaea</i>	Ragwort	
<i>Taraxacum officinale</i> agg.	Dandelion	
<i>Thymus pulegioides</i>	Greater wild thyme	

Additional Rare Species associated with CG2, CG6 & CG7

Latin Name	Common Name	Status in Norfolk
<i>Aceras anthropophorum</i>	Man orchid	Found on two dry grassland sites; nationally scarce.
<i>Ajuga chamaepitys</i>	Ground pine	Native to south Britain. Recorded in 1993 as casual at East Tuddenham.
<i>Anacamptis pyramidalis</i>	Pyramidal orchid	Locally frequent perennial of chalk grassland.
<i>Artemisia campestris</i>	Breckland mugwort	Native plant only at Thetford, with a few introductions around Breckland.
<i>Astragalus danicus</i>	Purple milk-vetch	Confined to well-drained, chalky soils.
<i>Campanula rotundifolia</i>	Clustered harebell	Confined to a few areas of calcareous grassland; markedly absent from many apparently suitable sites.
<i>Carex ericetorum</i>	Breckland sedge/rare spring sedge	Five sites in 1999; confined to Breckland on undisturbed, calcareous,

		sharply drained soils. Nationally scarce.
<i>Euphrasia pseudokernerii</i>	Eyebright sp	Scarce species of calcareous grassland; found at four sites.
<i>Galium parisiense</i>	Wall bedstraw	Once more widespread and still surviving on old, mortared walls. Nationally scarce.
<i>Gentianella amarella</i>	Autumn gentian	Much reduced since 1968, probably due to increasing rankness of calcareous grassland especially after myxomatosis.
<i>Herminium monorchis</i>	Musk orchid	Rare orchid, recorded as native from three stations in 1914, all on chalk.
<i>Himantoglossum hircinum</i>	Lizard orchid	Most recent record at Long Stratton in 1956.
<i>Hippocrepis comosa</i>	Horse-shoe vetch	Restricted to undisturbed calcareous grassland. A nationally scarce species.
<i>Hypochoeris maculata</i>	Spotted cat's-ear	Two uncertain records before 1914.
<i>Iberis amara</i>	Wild candytuft	Last recorded at Thetford in 1943.
<i>Linum perenne ssp anglicum</i>	Perennial flax	Last recorded at Aylmerton in 1920. Nationally scarce.
<i>Medicago sativa ssp falcata</i>	Sickle medick	Chiefly found on calcareous soils in Breckland. Becoming much less frequent because hybridises with lucerne. Nationally scarce.
<i>Medicago x varia</i>	Sand lucerne	Perennial hybrid; occurs spontaneously, but also introduced from Germany.
<i>Minuartia hybrida</i>	Fine-leaved sandwort	Native to dry grass heaths, mainly Breckland, nowhere frequent. Nationally scarce.
<i>Orchis ustulata</i>	Burnt-tip orchid	Presumed extinct.
<i>Origanum vulgare</i>	Marjoram	Lost from many former roadside verge sites. Stems are leafy and repeated cutting weakens the plant. Abundant in some forest rides.
<i>Phleum phleoides</i>	Purple-stemmed cat's-tail	Confined to permanent grassland on base rich soils, now only Breckland. Red Data Book Species.
<i>Pleurochaeta squarrosa</i>	Bryophyte	Very rare; only two recent records.
<i>Potentilla tabernaemontani</i>	Spring cinquefoil	Two records from 1955 (Garboldisham and Santon Downham).
<i>Pulsatilla vulgaris</i>	Pasque flower	Extinct.
<i>Salvia pratensis</i>	Meadow clary	Not considered native in Norfolk; five old records.
<i>Silene conica</i>	Sand catchfly	Typical of sandy Breckland soils, but much reduced recently. Needs bare open ground. Nationally scarce.
<i>Silene otites</i>	Spanish catchfly	Typical of and confined to Breckland. Found at four sites. Red Data Book Species.
<i>Spiranthes spiralis</i>	Autumn lady's-tresses	Recorded at two sites around Holt, north Norfolk.
<i>Thesium humifusum</i>	Bastard toadflax	Survived in Norfolk until 1965.

		Nationally scarce.
<i>Thymus serpyllum</i>	Breckland thyme	Now only known in Santon and Thetford. Red Data Book Species.
<i>Verbena officinalis</i>	Vervain	Scattered on roadside verges and permanent grassland; usually base rich soils.
<i>Veronica spicata</i>	Spiked speedwell	Confined to Norfolk, Suffolk and Cambridgeshire. Good native colonies on Weeting Heath. Red Data Book Species.
<i>Veronica verna</i>	Spring speedwell	Introduced at Weeting and still survives at its native site at Thetford. Red Data Book Species.