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Monitoring the condition of lowland grassland SSSIs

Part 1 - English Nature's rapid assessment method

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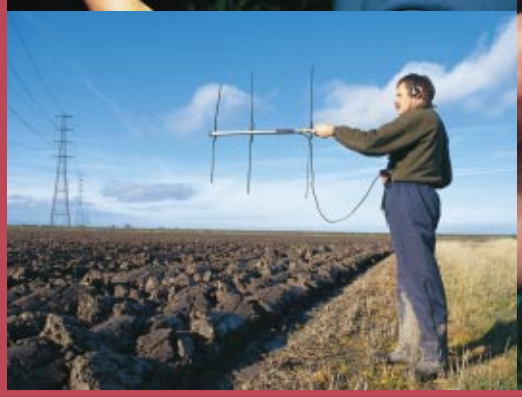

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Monitoring the condition of lowland grassland SSSIs

I English Nature's rapid assessment method

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Summary

English Nature and the other statutory conservation agencies in the UK are monitoring designated sites, including SSSIs, according to an agreed framework of common standards. The aim of the monitoring is to assess whether the nature conservation interest features of these sites are in favourable condition. Attributes of a particular interest feature are used to define favourable condition and targets for each attribute specify the thresholds beyond which change is of concern. English Nature is developing rapid assessment techniques to monitor condition of over 4,000 SSSIs in England, to be supported by detailed monitoring of a small proportion of sites.

A rapid assessment method has been developed for monitoring the condition of lowland grassland SSSIs in England. The project involved English Nature Local and National Team staff and also colleagues from the Countryside Council for Wales, Scottish Natural Heritage and the Environment and Heritage Service (Northern Ireland) and other organisations. The project has produced assessment protocols for all the lowland grassland interest feature types represented in SSSIs and candidate SACs. This report summarizes the rationale behind the method, describes practical ways of making rapid assessments and incorporates field forms for all lowland grassland SSSI and SAC interest feature types.

1. Introduction

1.1 The UK monitoring framework

The statutory nature conservation agencies in the UK, including English Nature, have recently agreed a framework for monitoring designated sites. The framework is outlined in *A Statement on Common Standards Monitoring* (JNCC 1998). The sites covered by these common standards are Sites of Special Scientific Interest (SSSIs), Areas of Special Scientific Interest (ASSIs), Special Protection Areas (SPAs), candidate Special Areas of Conservation (SACs) and Ramsar sites designated under the Convention on Wetlands of International Importance. The first purpose of this monitoring is to determine if the desired condition of the nature conservation feature (or features) of interest for which the site was designated is being achieved. The findings allow judgements to be made about whether the management of the sites is appropriate or if changes are necessary. Secondly, monitoring across the series of designated sites enables managers and policy makers to determine if the series is a whole is achieving the desired condition and whether current legal, administrative and incentive measures are proving effective.

The framework defines seven standard terms for assessing the condition of interest features: Favourable Maintained; Favourable Recovered; Unfavourable Recovering; Unfavourable No Change; Unfavourable Declining; Partially Destroyed; Destroyed. The desired broad category for all interest features is Favourable and this aspiration is translated into Biodiversity Action Plan targets, for instance for key grassland habitats (UK Biodiversity Group 1998), where the target is to achieve favourable condition for all lowland grassland SSSIs wherever feasible by 2010.

The conservation objective for an interest feature will state the need to maintain the interest feature in favourable condition. Favourable condition for the particular interest feature can be defined by attributes of that feature, for example the extent of the feature or its species composition. Some attributes are subject to fluctuations eg vegetation height in grassland can vary year to year dependent on rainfall. Therefore a target is required for the attribute which specifies the thresholds beyond which change is considered to be of concern but which does not trigger action when differences in the observed level of an attribute are likely to be due to natural fluctuations. Remedial action or further investigation can then be set in train where the target for an attribute is not met.

1.2 The need for rapid assessment methods

English Nature has taken a twin-track approach to assessing condition. Given current resource constraints and the size of the designated site series, which exceeds 4,000 SSSIs, covering over one million hectares, the organisation is developing rapid assessment techniques that can be used by conservation officers and others for the bulk of sites. Rapid assessments will be supported by detailed monitoring of a small proportion of sites.

From 1997 onwards, English Nature has been developing a rapid assessment method for monitoring the condition of lowland grassland SSSIs. The sites form a substantial component of the SSSI series and cover a wide variety of grassland types. There have been enormous losses of semi-natural grasslands across lowland England in recent times (Jefferson and Robertson 2000) and to date over 1600 SSSIs have been notified to safeguard their grassland

interest. Lowland grasslands are also included in 80 candidate Special Areas of Conservation (SACs), to be designated under the European Union's Habitats and Species Directive (Council of the European Communities 1992).

1.3 Progress towards a rapid assessment method for lowland grassland SSSIs

Over the last three years a large number of English Nature staff have been involved in the development of the approach and contributions were also made by colleagues from the Countryside Council for Wales, Scottish Natural Heritage and the Environment and Heritage Service in Northern Ireland and by staff from other organisations. The method is referred to as 'English Nature's rapid assessment method' to distinguish it from wider UK guidance that may be produced in future but the contribution of other organisations is recognised and appreciated.

The project has now covered all the semi-natural lowland grassland types found in SSSIs and candidate SACs. A field method has been produced and tested (Robertson et al 2000) and protocols for the assessment of all grassland types disseminated to English Nature Local Team conservation officers. Refinements will no doubt need to be incorporated in the years to come as the method is more generally used for England's designated grassland sites. However, the current report aims to be a convenient summary of the development of the project to date both for users and for a wider audience, who may be interested in similar approaches to the rapid assessment of grasslands outside the SSSI series and in possible methods for use in the monitoring of other habitats.

2. Scope and development of the project

2.1 Interest features covered by the project

The project aim was to produce a rapid assessment method for all lowland grassland 'interest features' on SSSIs in England. An interest feature is the special interest for which an SSSI has been notified. For lowland grasslands these features, or criteria for selection, are defined in terms of NVC (National Vegetation Classification) types in the *Guidelines for selection of biological SSSIs* (Nature Conservancy Council 1989).

The designated site series covers a very wide range of semi-natural grassland types, reflecting the results of traditional management by grazing and cutting interacting with England's varied climate, geology, soils and topography. Lowland grasslands are those that occur in more or less enclosed landscapes, which generally lie below 350 metres in altitude. Upland grasslands above the limit of enclosure are excluded as are coastal grasslands influenced by saline conditions. Examples of the range of lowland grasslands types include the wet purple moor-grass and rush pastures in the Culm area of Devon and Cornwall, dry acid grassland in Breckland, northern hay meadows in the Pennine Dales, flood meadows in the Thames valley and chalk grassland on the South Downs.

Appendix 1 gives the complete list of lowland grassland NVC types which are regarded as SSSI interest features. It also provides the full NVC names of types referred to by standard abbreviations (Rodwell 1991, 1992, 2000) in the text of this report. In addition, the list includes several botanically-diverse, related, sub-types which have been recognised or re-evaluated since the production of the NVC volumes and the SSSI guidelines. Such gaps are currently being examined through a Joint Nature Conservation Committee project reviewing the coverage of the NVC.

The other main set of criteria for selection of designated grassland sites is the European Union's Habitats and Species Directive (Council of the European Communities 1992). Several grassland types are listed on Annex 1 of the Directive as habitats for which Special Areas of Conservation should be selected (Brown et al 1997). All candidate SACs are SSSIs. Each Annex 1 type equates to one or more NVC types with the exception of Calaminarian grassland which covers a slightly wider range of vegetation than the NVC type OV 37 (see Section 5.6 below). Table 1 lists the lowland grassland NVC interest features and their SAC equivalents that have been covered by the rapid assessment project. For convenience, the project also included upland sub-communities of CG9, which have been incorporated into a general CG9 protocol.

Within English Nature's SSSI information system (ENSIS) these SSSI and SAC features are categorised as Level 2 features (English Nature 1997), deriving directly from the criteria for qualification as an SSSI. As well as interest features, ENSIS defines operational features, known as Level 1 features. A Level 1 feature in ENSIS is a practical grouping of the Level 2 features of a site at a level consistent with land management practices, ie it is a useful operational category. For biological sites, Level 1 features equate to Phase 1 habitats (England Field Unit 1990) which incorporate Level 2 interest features. For example, the Phase 1 habitat B3.1, unimproved calcareous grassland, might be the Level 1 feature of a grazed grassland SSSI on the South Downs, incorporating several Level 2 features. These might be a Level 2 grassland feature (CG2 *Festuca ovina-Avenula pratensis* grassland) and

several Level 2 species interest features, eg Early Spider Orchid, *Ophrys sphegodes* (a rare plant on Schedule 8 of the Wildlife and Countryside Act 1981) and Wart-biter Cricket, *Decticus verrucivorus* (a rare invertebrate on Schedule 5 of the Wildlife and Countryside Act 1981).

Table 1 gives all the Level 1 features that relate to Level 2 grassland interest features. It also provides a translation of these into the priority grassland types in the Biodiversity Action Plan (UK Biodiversity Group 1998). These are relevant because the Habitat Action Plans for each of these types includes a target for restoring all lowland grassland SSSIs in unfavourable condition to favourable condition, wherever feasible, by 2010.

The rapid assessment approach developed during the course of the project covers the grassland NVC interest features but does not address Level 2 species interests, which are also present on some sites. Methods to assess sites in relation to their condition for particular species are being developed by species specialists in English Nature. However, it is envisaged that if habitat attributes are used, eg sward height for assessing suitability of CG2 grassland for the Adonis Blue butterfly (*Lysandra bellargus*), these attributes can be built into the grassland interest feature protocols rather than their introduction necessitating a completely separate assessment.

Reporting in ENSIS on grassland NVC interest features will be done at Level 2. For a Level 1 report to be made, condition of all component Level 2 interests will need to be assessed, eg CG2 grassland, Early Spider Orchid and Wart-biter Cricket. If the grassland interest feature is the only Level 2 feature then a report can be made at Level 1 at the same time.

2.2 Development and testing of the method

The process of development began in the summer of 1997 when two workshops were held. They were attended by Local Team staff with grassland expertise, national grassland specialists from Lowlands Team (the authors of the current report) and national monitoring staff. The first workshop took place from 3 to 5 June and was based in Cirencester. It focussed on calcareous grassland SAC types and southern examples of the lowland hay meadow SAC type (MG4). The second workshop (16-18 June) was held in Richmond, North Yorkshire and concentrated on the mountain hay meadow SAC type (MG3) and northern examples of MG4. In 1998 two workshops were organised by English Nature, one in Bromsgrove (19-21 May) to look at MG5 and one in Thetford (2-4 June) to consider species-rich parched grasslands and lichen grassland (U1 and CG7). Colleagues from other organisations including the Countryside Council for Wales and Scottish Natural Heritage attended these workshops in addition to English Nature staff. Overall, representatives from every Local Team in English Nature participated in one or more workshops. In July 1998 the Countryside Council for Wales convened a workshop in Ceredigion, mid-Wales, to develop the approach for *Molinia* grasslands (M24 and M25). This workshop was attended by the Countryside Council for Wales' national grassland specialists and Area staff, English Nature's national grassland specialists and staff from the Environment and Heritage Service in Northern Ireland. All-day discussions and development of the rapid approach during the five workshops took place in the field, with evening discussions on the role of detailed monitoring.

From 1997 onwards, further examples of the types examined in the workshops were looked at in other geographical areas and other grassland types were covered as part of a programme of field visits by English Nature's national grassland specialists and Local Team members, for example visits to Magnesian Limestone grassland (CG8) in County Durham and M22 fen meadow in Cambridgeshire.

The aim of the workshops and visits was to draw on the knowledge and experience of participants to produce a practical, structured way of rapidly assessing grassland condition. The attributes and the targets assigned to them were arrived at by building a consensus view. This was refined in an iterative manner through visiting different sites with known histories to see if the attributes picked up problems and conversely adequately reflected favourable condition. As well as this testing of the adequacy of the method, the robustness and practicalities of measuring attributes was tested by participants dividing into groups and comparing their interpretation and assessment of attributes on the same piece of grassland. Individual Local Team staff also tested draft versions of the protocols in their areas. In addition, other colleagues joined in the testing process, including staff from ADAS Consulting Ltd and the Farming and Rural Conservation Agency. In total, over 100 people contributed to the production of the protocols, as the acknowledgements show (see Section 6 below).

Where relevant research was available this was used to inform the choice of attributes and targets, eg the study of the impact of horse and cattle grazing on MG5 grassland (Gibson 1997). Other important references were those describing ecological attributes of species, such as the work carried out by the Unit of Comparative Plant Ecology at Sheffield University (Grime et al 1988) and the volumes of the NVC (Rodwell 1991, 1992, 2000). Existing NVC survey data held on the national grassland database VEGAN and other survey data were also used to examine the generality of distribution of positive and negative indicator species identified during the field visits and workshops. Grassland data were also contributed by the Countryside Council for Wales.

More formal testing of the approach was undertaken in a validation project begun in 1998. The study aimed to test consistency among observers making rapid assessments and to investigate if the attributes used adequately indicate the condition of an interest feature when compared to the results obtained from more detailed quantitative information. Three National Vegetation Classification (NVC) types of lowland grasslands were examined: MG3 *Anthoxanthum odoratum-Geranium sylvaticum* grassland, CG2 *Festuca ovina-Avenula pratensis* grassland and CG5 *Bromus erectus-Brachypodium pinnatum* grassland. These types were chosen to represent a wider variety of grassland types with similar physiognomy. Fifteen sites in total were recorded, 6 MG3 SSSIs, 6 CG2 SSSIs and 3 CG5 SSSIs. The results are reported in the companion volume to this report; *Monitoring the condition of lowland grassland SSSIs: II A test of the rapid assessment approach* (Robertson et al 2000).

The findings have been incorporated into the rapid method, as described in the next three sections, which cover the rationale behind the choice of attributes and field recording methods. Gaps in knowledge of grassland ecology or of impacts such as atmospheric nitrogen deposition that affect the interpretation of attributes and work required to further refine attributes and targets are outlined in the preambles to individual interest feature protocols (Section 5.6). The field method described in Appendix 2 is intended as a stand-alone summary that can be copied to take out into the field if necessary.

3. Rationale for choice of attributes

3.1 Definitions of attribute and target

The JNCC Common Standards framework defines an attribute as 'a characteristic of a habitat, biotope, community or population of a species which most economically provides an indication of the condition of the interest feature to which it applies'. Attributes for habitats may include items such as area covered (extent), species composition and structure. A 'target' is a range of values for the attribute that can be measured or estimated in some way, eg a range of sward heights. Because attributes are likely to be subject to some degree of variaition eg due to weather effects, the target expresses how much fluctuation is thought to be acceptable while still considering that the interest feature is in favourable condition.

If the feature changes to the degree that the attribute value falls outside its target, this acts as a trigger for remedial action or further investigation. It is by using the attributes and targets for an interest feature that the assignment of the feature to condition categories is made, including the dynamic sub-divisions of recovering and declining, ie Favourable Maintained, Favourable Recovered, Unfavourable Recovering, Unfavourable No Change and Unfavourable Declining. The two other categories, Partially Destroyed and Destroyed, refer to cases where the interest feature itself or the habitat or processes that support it have been removed or irretrievably altered.

3.2 Generic grassland attributes

The process of developing the grassland condition assessment method through workshops and field visits resulted in the identification of three generic attributes that could profitably be applied to any grassland to indicate condition. These were: extent of the interest feature, sward composition and sward structure. Extent is a conceptually simple attribute though it poses some technical challenges in terms of measurement (see Section 4). The other two attributes are made up of several components, one or more of which are usually required to make a reliable assessment of condition. Sward composition can be divided into positive indicator species, negative indicator species and grass/herb ratio while sward structure can be broken down into sward height, cover of litter and bare ground. The general rationale for the choice of these attributes is discussed below together with the constraints on their practical use. The context for attributes relating to individual grassland types is given in Section 5.6.

The general relationship of generic attributes to the detection of impacts is shown on Table 2 and is discussed in more detail below. The impacts themselves can be grouped into categories which reflect major pressures and problems that affect lowland semi-natural grasslands, ie hydrological change, biomass removal (grazing and cutting), eutrophication and disturbance. There is rarely a single, simple, cause and effect relationship, for instance, positive indicator species may decline in the face of a number of impacts. However, examination of the full range of attributes affected and knowledge of the ecology of the species involved can suggest causes. For example, if positive indicators and proportion of herbs fall below target and sward height and litter are above targets in a calcareous grassland, this suggests insufficient removal of biomass (insufficient grazing) leading to less-competitive species being out-competed by a few grasses. Similarly, in a mesotrophic grassland, if positive indicators and sward height fall below target and a negative indicator, *Senecio jacobaea*, and bare ground are above target, this suggests over-grazing.

Through development and testing it became clear that while ranges were appropriate for some attributes, eg 50-90% herb cover, others were better defined by maximum or minimum thresholds. For example, in MG5 grassland, the target for the positive indicator species attribute is at least two species frequent and four species occasional in the sward.

3.3 Significance of attributes: mandatory versus discretionary

Through the development process it became clear that certain attributes had greater significance than others for deciding between the favourable or unfavourable condition of a feature. The more important attributes are called mandatory attributes and have been generally identified as extent and the components of sward composition. The term mandatory is used because estimates for every one of these attributes have to be within targets for a feature to be in favourable condition. If any of these estimates fall outside targets this indicates serious problems.

Sward structure attributes are almost always defined as discretionary attributes, which means that they are recorded as part of every assessment but they do not contribute to the key decision of favourable versus unfavourable condition. This is because sward structure attributes in most cases are relatively easy to alter by management changes, eg by re-instating grazing. Equally, sward structure could be satisfactory but the interest feature could be unfavourable or even lost, for instance a Rye-grass (*Lolium perenne*) re-seed might have sward height, litter and bare ground within the targets set for a semi-natural grassland. Nevertheless, recording sward structure does provide helpful early warning of potential problems ahead which ultimately would lead to loss of species. For example, a sward height above the target and excessive litter build up because of insufficient grazing could lead over time to a lack of regeneration opportunities for seedlings, which in turn could cause a reduction in richness of the flora. These early warnings can be raised with the site manager so that any necessary action can be taken, and can assist in decisions about whether the feature is likely to recover or decline. In a few cases other attributes have been identified as discretionary eg the frequency of rabbit droppings in lichen grasslands. Rabbit grazing plays an important ecological role in the maintenance of the interest of these grasslands (Rodwell 1992).

3.4 General constraints on the practical use of attributes

Two important factors have influenced the identification of usable attributes and the targets set for them. The first is the need for speed, given the large number of sites to cover. For example, except for a small proportion of sites, resources are unavailable for undertaking full plant species recording and analyses using an intensive recording method such as described by the Unit of Comparative Plant Ecology (Hodgson et al 1995) and used in the validation study (Robertson et al 2000). A selection of species has to be made for the purposes of rapid assessment. An important consequence is that while the aim is to make the most informative choice possible within the constraints, the full subtlety and complexity of ecological state and change may not therefore be represented.

Another effect of the need for the assessment to be rapid is that visual estimation has to be the main method of recording. Equally, attributes have to be able to be consistently recognised and estimated. The problems of estimating litter cover and small amounts of bare ground, for instance, affected the definition of attributes and targets. These issues, as they relate to

particular attributes, are discussed in more detail below. The results are unlikely to be as precise as quantitative measurements, eg of sward height. In addition, use of visual estimation limits the area that can feasibly be assessed. An areas of about 15 to 16 ha is probably around the maximum extent across which observers can successfully integrate information visually for one assessment. Evidence suggests that many lowland grassland SSSI interest features are smaller than 10 ha (Jefferson and Robertson 1996), although extensive stands do occur on some sites, eg CG3 on Salisbury Plain. Upland CG9 is covered by a protocol in this report and large stands occur in the Pennines. Subdivision of such areas for recording is then required, followed by assessments of all resultant compartments or a sub-sample of them.

The second important factor affecting the selection of attributes and targets is the likely competency of any users of the method. It is envisaged that the bulk of the monitoring effort is likely to be undertaken by Local Team Conservation Officers in the course of their day to day duties (JNCC 1998). Specialist taxonomic expertise may not be available, nor the time that would be needed to undertake taxonomic determination of difficult groups. Therefore attributes must be able to be estimated without recourse to specialists. The helpful information on condition contained within 'difficult' species has been incorporated to some extent by the construction of simplified taxonomic groups. One example is "small blue-green *Carex* species (leaves less than 5 millimetres wide)". This means *Carex* species with bluish (glaucous) colour on one or both leaf surfaces, characteristic of the small sedges *Carex flacca*, *C. nigra* and *C. panicea*, which are found in low nutrient habitats.

3.5 Extent: loss, damage and natural change

The extent of the interest feature is a critical factor in assessment of condition. Clearly, any loss of grassland to habitats of low or no nature conservation value is undesirable, although very small losses as a consequence of agreed, necessary management, eg the installation of a water trough to enable stock to graze the site, are special cases which should be covered by this agreed management and should not play a part in assessing extent. According to the Common Standards framework, where it is deemed that there is no hope of reinstatement of part or all of an interest feature, then it is categorised as Partially Destroyed or Destroyed, depending on how much of the interest feature is lost. An example would be the loss of an interest feature under the carriageway of a major new road. If the loss is considered to be recoverable then the interest feature is categorised as Unfavourable rather than Destroyed.

Damage is a broad term that requires some analysis in relation to the Common Standards categories. With regard to the recognition of damage, the validation study showed that observers undertaking rapid assessment identified damaged areas that were shown subsequently by detailed quadrat analysis to be demonstrably different in terms of species composition from the interest feature itself. The damaged areas all comprised vegetation of lower conservation interest (Robertson et al 2000). General guidance over the definition of damage is that it should be treated as reduction in extent, as opposed to unfavourable within-sward condition, only if there is an obvious boundary between it and the interest feature vegetation, and the boundary encloses clearly distinctive vegetation or un-vegetated ground.

Examples of distinctive areas might be: 'weed' communities such as OV21 *Poa annua-Plantago major* community or OV25 *Urtica dioica-Cirsium arvense* community, in heavily disturbed, nutrient enriched, areas; MG6 and MG7 grassland, (characteristic of fertilised, or

even re-seeded, grassland); MG1, typically rank, neglected grassland; heavily disturbed bare ground, eg from motorbike scrambling; closed canopy scrub with no grassland plants remaining beneath it. Heavily disturbed ground resulting from the burrowing activities of rabbits is not treated as change in extent in dry acid and calcareous grasslands. Rabbits are often important grazers which affect the ecology of these grasslands. Localized bare ground due to rabbit activity is separated out as an attribute in its own right in these grasslands, or in the case of acid and calcareous lichen grassland, incorporated in the general bare ground attribute. In other grassland types definable areas of bare ground due to rabbit activities are treated as changes in extent. The time constraints imposed by rapid assessment means that such changes in extent can be quite difficult to pick up. Various practical ways of assessing the extent attribute are discussed further in Section 4.

The decision about what is regarded as an irrecoverable reduction in extent (ie Partially Destroyed or Destroyed), rather than recoverable (ie Unfavourable) will need to be a judgement made on an individual site basis, by an on-the-ground assessment of the severity of the damage. Where the interest feature has been removed eg by quarrying or built over by permanent construction such a motorway, loss is almost certainly irrecoverable. In other cases, reinstatement may be possible. Experience suggests that where nutrient levels have been considerably raised, particularly by phosphate addition, recovery is likely to be extremely slow, whereas effects of neglect or erosion of vegetation cover are sometimes quicker to reverse. The continued presence of any positive indicator species (see 3.7 below), even if very sparse, may be a more hopeful sign for quicker recovery than if all positive indicators have been completely eliminated. Reinstatement in these situations is likely to be a difficult, slow and expensive process.

Semi-natural grasslands depend for their survival on low-intensity management and tend to be relatively fixed in spatial extent where this management continues. The processes of natural change have less impact than in some habitats, for example, coastal dunes where bare sand, mobile dunes and stable dunes form part of a dynamic system which is not fixed in the relative proportions and extent of constituent parts. In contrast, unfettered natural change in lowland grasslands would result in them all disappearing under forest. However, there are some circumstances where a degree of natural fluctuation in extent can be expected, for instance where hydrology is an important influence. For example, the boundaries between MG4 and an inundation community like MG13 may change slightly from year to year depending on amounts of rainfall and length of flooding periods. In the few sites with mobile inland dunes, a more dynamic pattern of communities might also be found, as might be the case in river gravel systems which are sites for metallophyte vegetation. In these kinds of situation, judgement is needed on a case by case basis over whether a change in extent is due to a natural process and whether it is acceptable.

Long term climatic change clearly influences habitat distribution, for instance in the Late-Glacial period much of England was in the tundra zone. However, on a human time scale the impact of relatively rapid human-induced climate change is not regarded as a natural process nor are the effects of atmospheric deposition eg of nitrogen, which result from human activities. However, solutions to these wider impacts on site condition are usually beyond local site-based conservation measures.

3.6 Sward composition: grass/herb ratio

This mandatory attribute refers to the proportion, expressed as percent cover, of non-Graminae in the sward. It includes all species, whether or not they appear on indicator lists in other attributes. In some grassland types it is a helpful attribute for identifying a problematic increase in grasses at the expense of other taxa. Competitive grasses respond rapidly to increased nutrient supply eg nitrogen fertiliser (Mountford et al 1993) and other plants decline, notably broad-leaved herbs. In other situations, where management by grazing or cutting is insufficient or has ceased, tall grasses such as *Arrhenatherum elatius* and *Dactylis glomerata* also increase in bulk to the detriment of other species (Rodwell 1992). Wetter conditions can also encourage robust grasses such as *Deschampsia cespitosa* and increase the proportion of grasses overall.

The attribute is of most use in mesotrophic and calcareous grassland where broad-leaved herbs form a significant element in the sward. The targets for the attribute are given an upper limit (90%) as grasses are still an integral part of these communities and should be represented. The ranges are intended to include fluctuations due to weather effects, for instance, after a wet spring the sward may have an increased proportion of grasses compared to a dry year. Grass/herb ratios are harder to estimate and relate to nutrient status in wet grasslands and dry acid grasslands. Rushes (*Juncus* spp) and sedges (*Carex* spp) can be important constituents in wet grasslands and make 'non-Graminae' difficult to estimate. Dry acid grasslands often have a predominance of fine-leaved grasses, while herbs are small and inconspicuous. In addition, moss and lichen cover can also be high which adds to the difficulties of estimating herbs versus grasses. Overall, the attribute is helpful in more than half of the grassland types but in the others more specific negative attributes have been developed to provide signals of undesirable change, eg the cover of coarse grasses, such as *Holcus lanatus* and *Dactylis glomerata* in parched acid grassland (U1). In this grassland type, when conditions are favourable, fine-leaved grasses of small stature predominate (leaves are less than 5 millemetres wide and often less than 1 mm wide). Their physiognomy contrasts with robust or coarse species which generally have wider leaves and thicker flowering stems. The presence of these species in U1 grassland usually indicates greater nutrient availability.

3.7 Sward composition: positive indicator species/taxa

The positive indicator attribute is of key importance in assessing condition. It was originally called 'community character species' but the term positive indicator better reflects its role in showing if ecological conditions are suitable for the survival of particular assemblages of grassland species, in the face of impacts such as eutrophication. The phrase 'community character species' gives the wrong impression that the aim is to manage grasslands towards some ideal phytosociological NVC type. In contrast, the real aim is to assess condition of a range of grasslands that can be broadly described by the relevant NVC type, and in the process to use indicators that take account of the floristic variation in these sites.

The attribute comprises vascular plants in all protocols except the one for lichen grassland (CG7c and U1a), where cover of lichens is used. Targets for vascular plants refer to a minimum number of species at particular level of occurrence, ie frequency, that are required from a given list for the attribute estimate to 'pass'. The summary of the field method in Appendix 2 and the field forms give quantitative definitions of frequency. The attribute is

designed to indicate if the conditions required by the much larger group of species that are not recorded are in fact suitable.

Several criteria were evolved during the project to guide the selection of species for the lists:

- Species should be largely confined to unimproved grassland and not normally found in agriculturally improved or semi-improved grassland. Information sources such as Grime et al (1988), the suited species work developed by ADAS Consulting Ltd for MAFF (Critchley 2000) and the NVC volumes (Rodwell 1991, 1992, 2000), as well as the experience of contributors, guided the selection of suitable species. The use of species normally found in unimproved rather than improved grassland means that declines in these species are likely if the nutrient status of the soil increases, eg through the application of inorganic fertilisers. Such effects are well known and have been demonstrated experimentally (Mountford et al 1993). The selected positive indicators are intended to show if the full range of species needing low nutrient soils are likely to be threatened.

- Where possible, species are characteristic of and reasonably frequent in the grassland type, so that they would indicate if the ecological conditions required for its survival prevail, eg moisture requiring species in MG4 or metallophyte species in Calaminarian grassland.

- Species are relatively easy to identify and are present and obvious in the sward for a reasonable length of time. It was decided not to use scarcer species which are present and visible for short time windows (eg *Orchis morio* and *Ophioglossum vulgatum* in MG5 grassland) as this would make the assessment too variable over time. Instead, the group of indicator species was chosen to ensure that the majority would be present during the recommended visiting period. It was decided to try and avoid the use of grasses and sedges as far as possible as these can pose identification problems for non-specialists. However, a few such species have been included occasionally when not using them would markedly reduce the effectiveness of the assessments.

The overall lists of positive indicator species were also designed to reflect geographical and altitudinal variation in species composition. The need for more local tailoring of lists was explored during the project but testing of protocols in different regions suggested that this was unnecessary, as most suitable species associated with widely distributed grassland types also have wide distributions. More localised species are generally associated with particular grassland types eg CG9, which have their own protocols. In fact, because of the constraint of having to satisfy the selection criteria, the lists that have been produced probably come close to including all suitable species.

In some protocols, particular species have been picked out for separate evaluation. Examples are grasses which play a large role in showing if conditions are suitable in particular grassland types, yet which can have deleterious effects when present in abundance, such as *Molinia caerulea* in M24 and M25. Simple grass/herb ratios are not used in these protocols for the reasons given in 3.6 above. Another category for potential evaluation comprises scarce species. These are actually rarely used because of the difficulties of locating them and being able to specify what abundances are required as populations can vary considerably year to year.

One exception has been made for the occurrence of Snakeshead Fritillary, *Fritillaria meleagris,* in a few MG4 sites, where populations could be affected by spring grazing or harrowing. Extent of the flowering population of *Fritillaria* has been used rather than number or density because extent is thought to be a more robust measure (Ron Porley, English Nature, pers comm). Potentially deleterious spring grazing or harrowing might not be picked up by other attributes such as the group of positive indicator species, which thus does not represent what the full assemblage of species requires. However, as a consequence a separate visit is needed to assess the species, outside the usual visiting period. Other exceptions may be required in future and the population measure for *Fritillaria* may need to be reviewed in the light of experience and comparison with detailed population censuses.

Development of attributes for Level 2 plant species interest features may lead to modifications in habitat attributes for sites where they occur. Examples of the specific requirements of particular rare and scarce species in lowland grassland are given in Rich (1997). These have been followed through into modifications of habitat attributes, for instance, for Lizard Orchid (*Himantoglossum hircinium*) on candidate SAC sites.

The constraints imposed on the choice of indicators, coupled with the similarity in composition of certain grassland types, has resulted in the combination of some interest feature types in the protocols. Examples are M24 and M25, M22 and M23 and sub-communities of U1 and CG7. Differences in species composition between the SSSI quality examples of these types which have been scheduled lie in species which are hard to identify, such as sedges and bryophytes. Other types are grouped on the field forms for convenience as they share most attributes eg CG3, 4 and 5. However in these cases there are one or more attributes or targets that differ and these are also given on the forms.

Experience in the field showed that there was another constraint on the use of positive indicator lists. As might be expected, very small occurrences of grassland types (less than 0.25 ha or 50 by 50 metres) invariably had insufficient species, probably for reasons of site size being too small to support viable populations of more than a limited number of vascular plant species. In the SSSI Guidelines (NCC 1989) 0.5 ha is the minimum size for selection of a grassland interest feature, thus this issue of minimum area should not be a problem in the vast majority of cases. However, there may be instances where a combined area of types, say 0.2 ha of CG2 and 0.3 ha of CG3, comprise the 0.5 ha. These cases and 'point' occurrences of types which have been notified as interest features and which total less than 0.25 ha, eg M22 localized around spring lines, will need to be assessed on an individual site basis, perhaps by including more 'difficult' groups such as bryophytes.

3.8 Sward composition: negative indicator species/taxa

A group of species which regularly appear in the protocols, and which came to be described by contributors to the project as the usual suspects, comprises grassland 'weed' species. They are listed as injurious weeds under the Weeds Act 1959 (*Cirsium arvense*, *C. vulgare*, *Rumex obtusifolius*, *R. crispus* and *Senecio jacobaea*). Some other species also appear with some regularity eg *Urtica dioica* and *Anthriscus sylvestris*. An abundance of these species is very often related to problems such as nutrient enrichment and/or disturbance, eg from supplementary feeding or poaching (Crofts and Jefferson 1999). However, each species is not thought to be always completely substitutable for another. For instance, frequent *Anthriscus sylvestris* in mesotrophic grassland can indicate nutrient inputs (Mierlo and

Groenendael 1991), eg from relatively high levels of farmyard manure application and/or reduced intensity of grazing and cutting, while *Senecio jacobaea* responds to overgrazing (Gibson 1997).

Targets refer to occurrences of grassland 'weeds' of more than occasional being of concern, which relates to when individual species are at levels of frequency of occurrence that indicate problems. A composite of several sparsely occurring species reaching more than occasional frequency is not regarded as seriously, for the reason about substitutability. Such a composite may represent small scattered effects from a number of causes. In fact, experience suggests usually only one species is present in abundances of frequent or more than frequent in particular sites. However, a target for combined cover is given as well as one for single species, in order to pick up problems that have gone beyond those suggested by any less alarming, combined, frequency. In addition, use of cover allows patchy occurrences to be registered.

Two species of ragwort, *Senecio jacobaea* and *S. aquaticus* can pose particular management problems because of their toxicity to livestock. They are probably natural components of some grassland types, *S. aquaticus* in wet grasslands and *S. jacobaea* in parched acid grasslands. However, they are included as negative, early warning, discretionary attributes in these grasslands because when abundant they can threaten the continuation of management and thus indirectly threaten the survival of these grasslands.

Some negative indicators have been rejected after trials because of difficulties over identification or uncertainty about the signal that the species might be giving in semi-natural grasslands (Robertson et al 2000). Both reasons for rejection apply to two high-profile species, *Trifolium repens* and *Lolium perenne,* which are the main constituents of agriculturally improved grasslands in England and which initially appeared to be potentially useful indicators. Apart from difficulties of identification, they can occur quite frequently in semi-natural grasslands, though may represented here by different ecotypes to those in heavily fertilised and re-seeded grasslands.

Scrub and tree species are clearly problematic for grassland condition if they become abundant because they shade out grassland plants and eventually change the habitat completely when the canopy closes. However, a modicum of scrub is often associated with grassland managed as grazing land and scrub and scrub edge habitats can be of conservation interest in their own right (Mortimer et al 2000). Where scrub has not been defined as an interest feature with its own attributes for condition assessment, but is present within a grassland interest feature, target thresholds for acceptable amounts of scrub have been developed. After much debate it was decided to include any size of woody individual in the assessment rather than introduce complications of defining age structure, eg seedling/sapling, and to use cover of scrub in the targets rather than frequency.

Bracken (*Pteridium aquilinum*) is another plant that is a component of some grasslands and can have conservation interest in its own right (Pakeman and Marrs 1992). However, like scrub, it can take over entirely so it has also been given cover targets. However, the value of examining frequency of occurrence of scrub and Bracken to assess their potential for rapid spread was recognised. Therefore an early warning reminder was incorporated in the attribute description, ie check management activity with the site manager. If management is in place,

such as scrub control or rolling of Bracken, then the frequent occurrence of scrub or Bracken in the sward is less likely to represent a problem in the making.

The other main group of negative indicators are species which respond to waterlogging (Gowing et al 1997, Cox 1997), and which can show when the hydrological regime is unsuitable for the survival of the grassland interest feature. Large grasses such as *Glyceria maxima* and *Phragmites australis*, large *Carex* species, *Deschampsia cespitosa* and *Juncus* species are used as indicators in several protocols. Lack of management can also exacerbate the spread of these species where sufficiently wet conditions exist for their survival. In addition, *Juncus effusus* can become abundant when poorly drained pastures are heavily poached by livestock (Rodwell 1992). Increased flooding and the creation of bare ground can also increase the abundance of grassland 'weed' species discussed above, especially the *Rumex* species.

3.9 Sward structure: height

Assessed as average height rather than the extreme of flowering spikes of grasses and tall herbs, this discretionary attribute is an early warning signal of conditions that will be deleterious to the plant assemblage of particular grassland types. For example, very short swards produced by continued heavy grazing of MG5 are associated with reductions in species richness (Gibson 1997). Clearly sward height will vary depending on time of year the feature is visited, the nature of the annual grazing/cutting regime and yearly variation due to weather. High rainfall can produce greater herbage mass and height, drought can limit growth. The ranges given in the targets try to take account of all this variation and thus the height should not lie outside this range whatever the timing of the monitoring visit. The ranges in different protocols are based on field experience and available research, eg Gibson (1997). Some grassland communities seem able to persist despite very close grazing, eg CG2, U1, and perhaps more surprisingly, rush pasture and *Molinia* grasslands. Examples seen in the New Forest appear to have historically been grazed very short, yet they have a rich flora and meet the mandatory targets for indicator species.

3.10 Sward structure: litter

The build up of dead plant material can signal problems due to insufficient removal of biomass by grazing or cutting, which would ultimately lead to loss of plant species unable to regenerate in dense litter. Experience has shown that this discretionary attribute is difficult to estimate visually with any consistency, which has led to the development of a simple target of a more or less continuous layer at a 'noticeable' target of 25% or more cover. Only in lichen grasslands has a lower level been used. Here vascular plants are usually very sparse and even limited appearance of dead material in a layer is likely to be noticeable and signal a problem.

3.11 Sward structure: bare ground

An important ecological role of small patches of bare ground distributed through the sward is the provision of regeneration sites for seedlings (Grubb 1976). One important way bare ground can be formed is by the treading action of livestock. There is evidence that mowing alone in the absence of grazing can lead to the reduction of species richness (Smith and Rushton 1994). However, excessive trampling (poaching) and over-grazing can increase bare ground to damaging levels.

Initially, targets were developed which always set lower and upper limits for bare ground. However, the validation study (Robertson et al 2000) showed that it is difficult to visually estimate, or indeed accurately measure, if there is sufficient bare ground present when the threshold is itself very low. In addition, some sites with very high plant species richness had very little bare ground. Surprisingly, quantitative measurements of the generally low amounts of bare ground in the study showed that higher amounts of bare ground were associated with greater amounts of litter, ie a lower intensity of management. In addition, for many species knowledge is lacking as to how much bare ground, if any, is required. Given these problems, the use of very low target thresholds (less than 5%) was abandoned.

The discretionary attribute of localized bare ground refers to the activities of rabbits in dry calcareous and acid grasslands. When rabbits are present in very high numbers they can create heavily churned up ground around their warrens. The target area given for the attribute for particular grassland types is applicable in any size of grassland because it is considered that warrens beyond this size are likely to indicate rabbit numbers that will beginning to deleteriously impact on plant species present in the surrounding vegetation as well as having the effect of removing vegetation from the immediate warren area. Recently, reports of increased rabbit grazing of MG5 grasslands have been received from Conservation Officers. In these grasslands any warren activity is unlikely to be welcome as MG5 grasslands, and probably MG3 and MG4 also, cannot tolerate heavy grazing (Gibson 1997). In such grasslands rabbit problems should be picked up be the extent attribute, sward height and positive and negative indicators. These attributes will also indicate deleterious change in dry acid and calcareous grasslands which have gone beyond the early warning stage of exceeding localized bare ground targets.

3.12 Recommended visiting period

The production of recommended visiting periods for grassland types formed part of the development of the protocols. Drawing on the experience of participants, the maximum window of time was defined when a reliable assessment could be made. Because the presence of particular species forms such a critical part of the assessment, visits have to be made when these species are visible in spring and summer, rather than in autumn/winter. However, supplementary visits made during this latter period can sometimes be helpful in assessing the effects of grazing management on sward structure, particularly the impact of poaching and supplementary feeding.

Grasslands managed as hay meadows must be visited before the hay is cut to make a complete assessment because there is no guarantee that all the indicators will regrow in the aftermath period eg *Rhinanthus minor*, being an annual may not reappear until the following spring. However, Local Team experience in Worcestershire suggests that sometimes a partial, positive, assessment at this time is possible. If sufficient indicators are found, and other attributes meet targets, this shows that the interest feature is in favourable condition, although the grassland cannot be said to be unfavourable if it does not have sufficient indicators.

3.13 Recommended frequency of visits

The question of how often a grassland should be visited was the subject of much vigorous discussion during the development process. The overwhelming consensus was that ideally

grasslands should be visited frequently, every year being a popular choice. However, frequency of visiting has to be considered within the framework of available staff resources and the reporting cycle, which requires a minimum of one visit in a six year period. The priority is to restore grasslands to favourable condition and ensure they are maintained in that condition. Monitoring condition is a tool to achieve those aims, not an end in itself.

Analysis of the reasons for the desire to visit grasslands frequently shows that they relate to the management of the site rather than any inherent ecological characteristic which needs frequent examination. Management is so vital to the conservation of grasslands and the speed at which management can change is so fast that there is often a case for more frequent visits to a grassland than once every six years. These visits might not be to do a condition assessment but to consider grassland management issues with the site manager, eg scrub control. Sites will vary with regard to the stability of management and the degree of stability is unlikely to be related to the ecological type of grassland. The crucial role of management means that contact with site managers is as important as assessment of condition of grassland SSSIs. English Nature has a corporate target of discussing management with SSSI managers at least once every three years (English Nature 2000). Within the six year condition reporting cycle and the three year contact cycle, it is suggested that the frequency with which particular grasslands are visited and management discussed with site managers is decided on site by site basis, ie each are done as often as necessary to secure favourable condition for the grassland.

3.14 Quality versus condition

There is an important distinction between the assessment of nature conservation value or quality of an interest feature and a rapid assessment of its condition. The nature conservation evaluation of a grassland, eg for SSSI selection purposes, takes into account a number of criteria such as the diversity of the plant species, the size of the grassland, the representation of the type in the SSSI series and the scarcity of the type. In contrast, the condition assessment is using attributes to pick up problems on individual sites as a precursor to remedial action. Condition assessment is a diagnostic tool not an evaluation exercise. Two attributes have a close relationship to quality criteria, ie extent and positive indicators, but others such as sward structure are not normally used in quality evaluation. The condition of a site clearly has an impact on its quality but is not the same as its quality. A human analogy would be the high quality music produced by a talented piano player versus the condition of the player's hands, crucial to the musician's ability to play, revealed by a medical examination.

The SSSI grassland condition protocols are designed to diagnose problems in high quality sites. Target numbers and abundances of positive indicators are set at levels that are intended to detect unfavourable conditions, such as elevated soil nutrient status, that will not allow the full richness and abundance of the flora of these high quality sites to be conserved. Lower quality non-statutory sites may not have this diversity or as many indicators. Unfavourable conditions could still be highlighted using lower targets but probably without the same degree of sensitivity.

There remains the question of exceptional quality SSSIs, such as Pixey and Yarnton Meads (MG4) and Wylye Down (CG2). In these sites plant species richness per unit area is extremely high but the reasons for this are not clear. Such sites are managed in a similar way as other sites and superficially at least are influenced by similar environmental factors.

Perhaps an uninterrupted history of low-intensity management over hundreds or even thousands of years is significant. Contributors expressed concern that such sites could lose a high proportion of species before falling below target thresholds for positive indicators. In specific instances there could be a case for introducing stricter targets in an attempt to further increase the sensitivity of the assessment. However, sufficient information about species composition and relative abundances that could be used to justify such targets would have to be available. An alternative, which would be more feasible for immediate practical application, would be to preserve on file all condition assessment estimates from each visit so that trends can be examined within the favourable condition category targets. More detailed monitoring and study might also be considered a high priority for exceptional sites, especially if there are concerns about impacts that could affect the nature conservation interest, eg a change in the management regime. In addition, long term detailed monitoring could provide information on the variability in species frequencies that might be expected from year to year due to seasonal effects, even where management remains stable.

4. Practical methods for rapid assessment of attributes

4.1 Introduction

The discussion of attributes and targets in Section 3 referred to the practical constraints on the choice of attributes and targets that are the inevitable consequence of employing a rapid assessment method. In addition to the importance of using clear definitions of attributes and targets that are feasible to estimate by visual assessment, there are other ways of maximising consistency and accuracy to balance the trade-off between speed and resolution so that reliable results are obtained.

4.2 Assessment of extent

The need to discover if an interest feature has been reduced in extent is one of the most challenging issues for the rapid assessment method to tackle. Clearly the time is not available for detailed re-mapping of interest features. However, there are several ways of making the assessment of the extent attribute a feasible task, first by having a good baseline map and second by using particular recording techniques.

Baseline map and identification of critical boundaries

Changes in extent can only be identified if there is a map showing the pre-existing area of the interest feature (grassland type) and any areas of damage. Usually it is the detection of damage that is of prime concern. The validation study (Robertson et al 2000) showed that observers accurately identified damaged areas which detailed quadrat recording then showed to be distinct from the NVC types of main interest feature types. However, the locations of these areas were mapped somewhat differently by individual observers in the short time available for the task. A good baseline map, which showed existing areas, together with notes and annotations which describe the kind of damage present and comment on the likelihood of any of the areas expanding, would reduce both inconsistency and time on site, because at future dates the recorder would be checking rather than mapping.

Many grassland sites already have a few small areas of low interest at the edges where the interest feature does not extend fully to the field boundaries. These areas have been included because of the practicalities of site boundary definition. In other cases, small areas of damage have resulted from the agreed management of the site eg trampled areas in gateways of grazed grasslands. Such areas are not regarded as reductions in extent in a condition assessment of the interest feature. Nevertheless, the expansion of any of these areas would be unwelcome, particularly given the small overall size of many grassland sites. An example of a likely zone of expansion into an interest feature would be a rank, species poor strip of grassland along the field edge which might be receiving run-off from heavily fertilised fields outside the site. The boundary between such an area and the interest feature would be a critical one to check. Similarly, new areas of damage within the area of the interest, eg from inappropriate installation of a stock feeder, need to be identified.

A particular issue requiring consideration is the assessment of extent among the components of mosaics of interest features. Mosaics are often the result of complex spatial variation in edaphic, topographic or hydrological conditions rather than due to management. Change in edaphically or topographically controlled spatial configuration of types is unlikely to occur as

a result of changes in habitat management. Thus checking of the extent of components of the mosaic is usually unnecessary. Exceptions might need to be made, for example, where liming of one component, eg neutral grassland, could impact another component such as acid grassland. However, other mosaics due to hydrology or management often can be more easily modified, for example floodplain MG4 grassland can be replaced by other grassland types if hydrological conditions change. In these cases it is important to know if the relative extents of different elements of the mosaic are changing. Again, it is important to have a good baseline map to provide a basis for deciding which, if any, are the critical boundaries to check, either in the field or by using photographs.

Photography

Good quality aerial photographs are a very efficient means of checking changes in extent where these are caused by readily recognizable factors such as scrub encroachment, spread of Bracken (as long as the photographs are taken at the right time of year after expansion of Bracken fronds), or construction work. Fixed point photography, even when not precisely located to landmarks, requires more time to be spent in the field and is generally less efficient as it cannot normally be used to measure extent.

Transects

Where a critical boundary has been defined between grassland vegetation types, this is usually hard to spot on aerial photographs. An alternative is to use a transect walk on the ground, across the same line on each visit and use approximate estimates of positions of boundaries, eg from pacing along the transect, to check for change. An example would be across the boundary between species-poor, rank grassland and species-rich CG2. If affordable and sufficiently accurate Global Positioning System equipment becomes available, this could greatly ease the problem of detecting deleterious change in extent within the limited time of a rapid assessment visit.

4.3 Sward composition and structure

Structured walk

The estimation of frequency of positive and negative indicator species is particularly important in the rapid assessment method as it can make the difference between an interest feature being favourable or unfavourable. The validation work (Robertson et al 2000) showed that observers were sometimes inconsistent in estimating frequency when using DAFOR notation and over- or under- estimated compared to quantitative measures of frequency.

A structured walk, where the observer stops at a certain number of points across the site and looks for the indicator species in a relatively small area at each of these points, should improve consistency, especially in pastures where plants may be small and difficult to see. Such semi-quantitative recording would be particularly of benefit where visually the site appears to be borderline or failing. Where high numbers of indicators are all very abundant on a site there is less need for the structured walk approach.

A standardised definition of frequency is also needed. The NVC categories of frequency seem to be reasonable ones to use, and means that a broad relationship between frequencies of species in NVC tables and on sites can be made. An example is 20-41% frequency of occurrence, which is classed as 'occasional' (Rodwell 1992). These quantitative definitions are given in the field method summary in Appendix 2 and are on the field forms.

At each stopping place the indicator species should be looked for in a 'search area', roughly equivalent to a quadrat in character. Quadrat size in the grassland NVC samples varied between 1 x 1 and 2 x 2 metres (ie 4 square metres) with 4 x 4 m sizes only occasionally used where the vegetation had a coarse structure (Rodwell 1992). For recording in a structured walk across calcareous grasslands, approximate areas of 1 m x 1 m size probably do not differ greatly in species composition compared to larger areas. The Nature Conservancy Council chalk grassland survey used 1 m x 1 m quadrats for this reason (M. Wigginton pers comm). Inspection of 14 of the MG3 quadrats in the validation study showed that species number against cell size levelled off by the 0.5 m size with only one or two species generally gained at the 1 m size. However, site visits in 1999 to coarser grasslands and fen meadows suggested that larger areas may be more appropriate for these, such as a 1 m diameter circle around the observer, which gives an area of about 3 square metres. Standardisation on the approximate 3-4 square metre area would therefore seem to be satisfactory. This may be searched as two semi-circles around the observer or a 'quadrat' in front of the observer whichever is quicker. Experience has shown that two to three minutes should be the maximum time required to search at each stopping point because the number of indicators present on any one site is usually limited, especially if it is a borderline case.

When doing a structured walk, it is suggested that 20 stops are made although inspection of the results of the first visit where 20 points are recorded may indicate that fewer would still be satisfactory eg if the frequency of most species derived from 15 stops is the same as for 20 stops. Fewer than 10 stops will probably yield rather too variable results in most cases. Some examples derived from the validation study are given in Appendix 3 to show the differences in frequency recorded from 5, 10, 20 and 40 'stops', ie quadrats. The stops in these examples were a systematic selection from the 40 available quadrats recorded at each site in the study, eg every fifth quadrat on a site was chosen to give a sample of 10 quadrats, to mimic as far as possible a systematic choice of stopping points on a structured walk, say every 20 paces. One exceptionally rich CG2 site, Wylye Down, is included as well as three sites with fewer indicator species, from CG2, CG5 and MG3 grassland types. As might be expected, where there is a difference, frequency from 20 quadrats is usually closer to that from 40 quadrats compared to 10 or 5 quadrats, although 10 quadrats often give a similar result as 20 or 40. Results are more variable if only 5 quadrats are included and in the case of one site, Borrow Beck by river (MG3), would have resulted in a favourable condition being assigned in contrast to unfavourable condition if the assessment was based on 10, 20 or 40 quadrats (see required targets for positive and negative indicator species on the MG3 field form in Section 5.5).

Experience has shown that it is better to pre-determine an approximate stopping distance, say every 20 paces, depending on the dimensions of the route followed, rather than having to 'choose' a place which leads to worries over subjectively picking a 'good bit' or a 'bad bit'. It does not matter if paces are uneven, as the aim is merely to be more objective about where to stop. In a few cases, care with this systematic sampling is needed if there is an underlying, regular, pattern to the vegetation, such as ridge and furrow, which could be sampled in an

unrepresentative way by stopping every 20 paces. For instance, if the ridges were about 20 metres apart, no furrows might be sampled.

Even in instances when a structured walk with semi-quantitative recording is deemed unnecessary, recorders should still deliberately stop along a route that covers the whole area to look for indicator species, as casual observation while walking over the grassland can be unreliable, especially when plants are small, eg in a heavily grazed acid grassland. The route of the walk should cross the entire area to be assessed. It can be a W shape or a squashed, twisted or extended version depending on the shape of the area to be assessed. It is useful to note this route on the map for future comparisons, particularly if a future observer gets a very different result. Then the possible causes can be investigated such as the interest feature not actually extending into an area assessed or that the route missed parts of the interest feature with lower occurrence of indicators. Theoretically, if the interest feature is in favourable condition throughout, any route should give the same answer. In effect, the walk is sampling the interest feature and should represent the whole area, eg it should not miss all indicator-poor areas.

The technique of the structured walk and search areas can also be used to record sward structural attributes and grass/herb ratios. However, the validation results suggest that observers are relatively consistent when making these visual estimates and get similar results to measured values, eg from drop disk measurements. Therefore there is less need to spend time on making semi-quantitative estimates from a structured walk.

Sward height measurement

Despite the findings of the validation study, field visits suggested that it is actually easier to make visual estimates with a centimetre scale to hand, eg as a reminder of what 5 cm looks like, so a ruler has been incorporated into the recording card. If more precise measurements are made using a drop disk or sward stick, then it should be noted that sward sticks tend to give rather higher values than drop disks (Diack et al 2000) and drop disks can be inaccurate on bumpy, short turf (I. Diack pers comm). It is possible that sward height attributes for species interests may have much tighter targets compared to those for grassland types and more quantitative estimates may be required. If this is the case, then the techniques that were used to derive these sward heights should be stated so different measurements equipment can be calibrated.

5. Recording protocols for individual grassland interest feature types and their context

5.1 Context for the attributes that define condition

The individual recording protocols have been produced as forms that can be used in the field. The forms for each type are reproduced in this section together with preambles for individual types or for groups of types. These preambles give the context for the attributes to be assessed and point out where these are affected by gaps in knowledge of grassland ecology or of the impacts of environmental change. For instance, while condition assessment should pick up changes in hydrology of MG4 grasslands that affect species composition as they are happening, hydrological modelling may be necessary in order to predict the likely effects of changes in catchment hydrology caused by actions such as revocation of abstraction licences. In general, novel activities and management regimes are likely to require detailed monitoring, at least to begin with, across a range of sites, so their effects can be fully understood and so they can be related to rapid assessment attributes.

The extent estimates for grassland interest features given in the preambles are the latest made by the authors, based on the most recent information to hand, such as Sanderson (1998b) and Blackstock et al (1999). Summaries of the estimates of extent for interest features and Biodiversity Action Plan priority types are given in Tables 7 and 8 respectively.

The field forms for grassland types are grouped with preambles as follows:

Preamble title	**Interest feature**
Calcareous grasslands and scrub transitions: SAC type, semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)	MG2, CG1-CG9
Lowland dry acid grasslands	U1, U3, U4, U4/U20-related (U1b,c,d,f are on a form with CG7a,b,d,e; U1a is on a form with CG7c)
MG3, *Anthoxanthum odoratum-Geranium sylvaticum* grassland: SAC type, mountain hay meadows (British types with *Geranium sylvaticum*)	MG3 (northern MG8-related and MG3-related types are on a form with M26)
MG4, *Alopecurus pratensis-Sanguisorba officinalis* grassland: SAC type, lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	MG4
MG5, *Centaurea nigra-Cynosurus cristatus* grassland	MG5
Wet grasslands (excluding *Molinia* grassland)	MG8, M22, M23, *Agrostis-Carex*, MG11-related, MG13-related (northern MG8-related and MG3-related types are on a form with M26)
Molinia caerulea grasslands including SAC type *Molinia* meadows on chalk and clay (Eu-Molinion)	M24, M25, M26
Metallophyte vegetation: SAC type Calaminarian grasslands	Calaminarian grassland, OV37

5.2 Recording mosaics and transitions using the field forms

In some SSSIs the grassland interest features comprise a group of co-occurring grassland types. Normally, each type is listed as an interest feature in ENSIS and thus should be assessed separately. However intimate mixtures of types (mosaics) can occur which are easier to assess together in the field. In addition, unusually extensive transitions sometimes occur which require separate assessment. For practical reasons, the rapid assessment method is generally pitched at the level of community rather than sub-community in terms of the NVC, and sometimes is at the level of combinations of NVC types, where attribute definitions and targets are very similar. Therefore mosaics and transitions of these types should not pose a problem. In a few cases, sub-communities have been picked out for assessment where they are very distinctive, eg lichen grassland (CG7c, U1a) and where special attention may be required, for instance in relation to grazing management.

Experience suggests that distinctive transitions that occupy a wider area than a linear band between adjacent types of unimproved grassland which have separate forms, eg MG5 and MG4, are relatively infrequently encountered in grasslands. Careful examination during a baseline survey usually allows a judgement to be made as to the single community label that best fits a particular stand. Transitions between grassland types can be distinguished from grassland communities that occur in positions that are transitional between habitats such as scrub and grassland, where they are often ecologically and floristically more distinctive, and as a consequence have their own forms, eg MG2 tall-herb grassland associated with scrub in the Derbyshire Dales. If other transitional types are found, it is suggested that the stand in question should satisfy all the attributes of the relevant types, eg MG5 and MG4, and generally that where targets for similar attributes differ, eg sward height, then the tighter target should be used, as it is more likely to allow survival of most component species of the transition. However, individual circumstances may suggest the other target is more appropriate. Wider use of the method over time should allow this advice to be refined.

Where different types of grassland co-exist, usually questions of scale and distribution of the types are important in deciding whether to record an area as a mosaic. For instance, ridge and furrow topography, which resulted in MG5 occupying the ridges and MG8 the furrows, might be regarded as a mosaic, in contrast to single occurrences of both communities in a flood plain field, the MG8 area being closer to the river than the MG5. In the latter situation it is more feasible to record the two types separately. The most efficient way to record mixtures of interest features is best decided on a case by case basis, in conjunction with knowledge of the conservation objectives and management of the area.

Conflicts between attribute targets for different species are probably more common than conflicts for grassland types eg Adonis Blue wanting 0.5-2 cm turf height and Duke of Burgundy requiring 5-15 cm (BUTT 1986). However, it also may not be possible to manage two grassland types together in one management unit, eg short CG2 and taller scrub-edge CG6 types. One type may have to be recognised as the priority and management and assessment concentrated on it.

Where it is decided to record an area as a mosaic or a transition, then either all the relevant field forms can be filled in or they can be combined, so that common attributes appear only once. As an aid to combining forms, a set of tables is provided (Tables 3-6) which show the ranges of attributes across grassland types. With regard to the extent attribute, the discussion

in Section 4.2 is relevant in making decisions about whether to record the relative extents of the different components of a mosaic.

5.3 Nomenclature

The nomenclature used for species names on the field forms follows Stace (1997). A few older synonyms are also given for clarity where the new names are not thought to be well known as yet. The English equivalents of all Latin names are given in Appendix 4. The nomenclature of species names in names of NVC communities follows that of the published NVC, which used Clapham et al (1987).

5.4 Reproduction of forms

The forms can be reproduced from the paper report or the electronic versions in WORDPERFECT 7 which are available from the grassland network representative in each Local Team.

5.5 Example of a completed form

As well as a summary of the field method, Appendix 2 gives an example of a completed form and associated maps from a fictitious CG2 grassland.

5.6 Preambles and field forms

Calcareous grasslands and scrub transitions: SAC type, semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)

Context for the attributes that define condition

Habitat type and distribution

The broad SAC habitat type encompasses all the predominantly lowland calcareous grassland NVC communities, ie it covers NVC types CG1 to CG9. Upland SAC and NVC types not included are species-rich *Nardus* grasslands (CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, CG11 *Festuca ovina-Agrostis capillaris-Alchemilla alpina* grass-heath) and Alpine calcareous grasslands (CG12 *Festuca ovina-Alchemilla alpina-Silene acaulis* dwarf-herb community, CG13 *Dryas octopetala-Carex flacca* heath, CG14 *Dryas octapetala-Silene acaulis* ledge community). In addition to CG1 to CG9, the SAC habitat includes scrub transitions that have similarities to NVC communities MG1 and MG2. Calcareous grasslands are widely distributed in the UK, although CG1-CG9, which are mostly lowland and southern in distribution, have not been recorded in Scotland. Most of the resource of these types occurs in England. Candidate SACs have been chosen from England, Wales and Northern Ireland to represent each NVC interest feature type, with the exception of CG4. However CG4 is represented in the list for important orchid sites, along with other examples of lowland calcareous grassland types. As well as lowland sites, the candidate SAC series includes upland CG9 sites in northern England.

The individual NVC types belonging to the broad SAC habitat are Level 2 interest features in ENSIS. The Level 1 feature in each case is unimproved calcareous grassland. The Biodiversity Action Plan priority habitat represented by CG1-CG8 and lowland CG9 is lowland calcareous grassland (UK Biodiversity Group 1998), while upland CG9 falls within the upland calcareous grassland priority habitat (UK Biodiversity Group 1999).

Extent

Compared to other semi-natural lowland grassland types in the UK, lowland calcareous grassland is relatively extensive. However, the total extent is estimated to be less than 41,000 ha, which is a tiny fraction of the 5 million ha of improved grassland in the UK. The area in England is estimated to be less than 40,000 ha. In the UK as a whole there is less than 25,000 ha of upland calcareous grassland with less than 10,000 ha in England. The approximate areas of the types in the lowlands of England is given below.

Interest feature	Extent (ha)	Interest feature	Extent (ha)
CG1	<300	CG6 and MG1-related	<1,000
CG2	<8,000	CG7	<3,000
CG3	<19,000	CG8	<150
CG4	<3,000	CG9 (lowland)	<1,500
CG5	<2,500	MG2	<100

Landscape structure and dynamics

The habitat is now particularly associated with distinct topographic features such as escarpments or dry valley slopes in the lowlands. However, upland and lowland examples of CG9 occur extensively on level or gently sloping ground and other lowland types also occur on such topography, for instance CG3 grassland on Salisbury Plain. In addition, the habitat occurs on ancient earthworks in chalk landscapes. Where other semi-natural habitats remain along with calcareous grasslands, there can be transitions to more mesotrophic grasslands (eg MG5), or heath where soils are acidic, eg along the top slopes of chalk escarpments. There are also transitions to scrub, where tall-herb communities occur, either in dry situations where the vegetation has similarities to CG6, MG1 and CG2, or damp localities where a scarce community, MG2, is found. The current review of the NVC is considering if these transitions need further description and characterisation.

Physical attributes and function

Soils can range from skeletal substrates over rock or scree to deeper soils at the base of slopes or on plateaux, and in type from protorendzinas to calcareous brown earths. Comparative data (Stevens *et al* 1998, Chambers *et al* 1999) suggest that soils under calcareous grasslands have lower soil nutrient levels than agriculturally improved grassland (MG7 *Lolium perenne* leys and related grasslands). It is unclear if grazing animals bring about a net removal of nutrients from grasslands managed as permanent pasture where no fertilisers are applied, which is the way most calcareous grasslands are managed. Recently, the issue has been examined as part of a review of nutrient relations of pasture habitats (Chalmers *et al* 2000) but this concluded that little information is available on which to base an assessment. The impact of atmospheric nutrient deposition on species composition may be significant, particularly the effect of nitrogen, and needs investigation. Climate change may also have an impact, for instance if temperatures rise in areas with upland CG9 which contain relict Arctic-Alpine species such as *Myosotis alpestris*.

Species composition

The NVC types included in the habitat encompass a range of species assemblages that differ in the representation of particular species or groups of species. However, all types are species-rich and include varied mixes of grasses, dicotyledonous herbs and sedges, usually with non-Gramineous species forming a relatively large proportion. Perennial non-woody species predominate but short-lived plants such as *Linum catharticum* and *Gentianella* species often form a small but important component. Species characteristic of soils unimproved by fertilisers are frequent, including lime-loving species. However, scrub transitions are often marked by species typical of more mesotrophic conditions, including tall herbs, in contrast to most of the dry open grassland types, where low nutrient levels and high base status occur and many species are diminutive in stature.

The habitat is notable for the number of rare and scarce plants found, including important populations of orchids, which have been recognised in a separate list of candidate SACs. Over 70 nationally rare and scarce vascular plant species occur in the NVC types CG1 to CG9. In addition, lower plants can be important, for example the lichens in CG7c (*Ditrichum flexicaule-Diploschistes scruposus* var. *bryophilus* sub-community). Rare and scarce lichens

may be especially vulnerable to the effects of atmospheric deposition but research is required to investigate the issue.

Invasive species

Species that are not present at high frequencies in calcareous grasslands where the nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are characteristic of poorly managed agricultural land in the general countryside and include *Cirsium arvense, C. vulgare, Rumex crispus, R. obtusifolius, Senecio jacobaea* and *Urtica dioica*. In addition, where management does not occur over long periods, scrub species can invade. However, a greater cover of scrub is generally a feature of the scrub transition habitats, and is likely to be the result of intermittent management that also allows tall herbs to flourish. Other invasive species can cause problems in particular grasslands, for example *Brachypodium pinnatum* in CG2 grassland.

Sward structure

The habitat is almost always managed as permanent pasture, although scrub transitions may receive more intermittent management than the purely grassland types. The management regimes that enable scrub transitions to persist are not well understood and require detailed characterisation. The structure of the sward varies widely across types, with parched CG7 grasslands having very short swards while scrub transitions have much taller swards. However, except in the latter types, dead plant material at the base of the sward is not extensive as long as grazing levels are sufficient. Bare ground is distributed through the sward and often includes small scrapes and holes created by rabbits. Rabbit grazing is important in maintaining some grasslands, particularly lichen grassland (CG7c). However, large areas of bare ground around warrens generally indicate that rabbit numbers have reached problem proportions. Although broad targets for sward structure for each type can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Damp tall-herb grassland, damp grassland/scrub transitions, MG2**
Note: Sites with *Polemonium caeruleum* as the main interest feature should be assessed by using attributes relevant to the species, not by the following community attributes.

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

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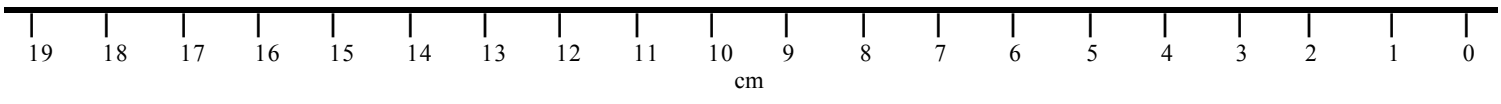
Recommended visiting period: May - July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate	FYM input
Grazing period	Other inputs
Supplementary feeding	Stock type
Burning	Scrub and weed control

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio.	**30-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Alchemilla spp. ( ), Angelica sylvestris ( ), Centaurea nigra ( ), Cirsium heterophyllum ( ),* Fern *spp.* excluding *Pteridium aquilinum ( ), Filipendula ulmaria ( ), Galium verum ( ), Geranium sylvaticum ( ), Geum rivale ( ), Mercurialis perennis ( ), Polemonium caeruleum ( ), Sanguisorba officinalis ( ), Succisa pratensis ( ), Valeriana officinalis ( ).*	At least two species/taxa **frequent** and two species/taxa **occasional** throughout the sward	
*Sward composition: frequency and % cover of negative indicator species/taxa. *Cirsium arvense ( ), Cirsium vulgare ( ), Pteridium aquilinum ( ), Rumex crispus ( ), Rumex obtusifolius ( ), Senecio jacobaea ( ).*	No sp./taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 30% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **30%** cover	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: % cover of *Anthriscus sylvestris* or *Urtica dioica*.	Neither species together or singly more than **25%** cover	
Sward structure: average height of sward.	**5 - 80** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **50%** of the sward	
Sward structure: extent of bare ground (not rock), distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **CG1**

Unit/subdivision reference . . . . . Date. . . . . .

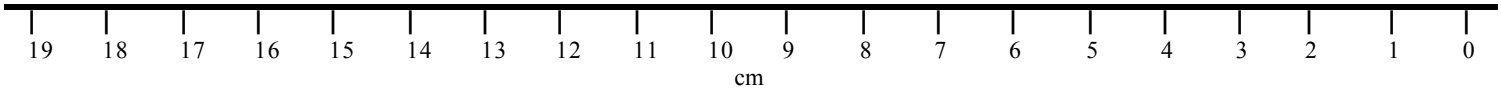
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: May-June
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
	Stock type

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: % cover of lichens.	Cover greater than **5%**	
*Sward composition: frequency of positive indicator species/taxa. *Acinos arvensis (=Clinopodium acinos) ( ), Anthyllis vulneraria ( ), Arenaria serpyllifolia ( ), Carlina vulgaris ( ), Centaurium erythraea ( ), Galium verum ( ), Helianthemum nummularium ( ),* hoary-leaved *Helianthemum* spp. (*H. apenninum or H. canum (=H. oelandicum)*) *( ), Leontodon hispidus/L. saxatilis ( ), Linum catharticum ( ), Lotus corniculatus ( ), Pilosella officinarum (=Hieracium pilosella) ( ), Sanguisorba minor ( ), Scabiosa columbaria ( ), Scilla* spp. *( ), Sedum* spp. *( ), Thymus* spp. *( ), Trinia glauca ( ).*	At least two species/taxa **frequent** and four **occasional** throughout the sward	
*Sward composition: frequency of negative indicator species/taxa. *Cirsium arvense ( ), Cirsium vulgare ( ),* coarse grasses eg *Holcus lanatus ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species including woody climbers, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
Sward composition: frequency of negative indicator species. *Senecio jacobaea ( )*	No more than **occasional** throughout the sward	
Sward structure: average height.	**5** cm or less	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	**5-20%**	
Sward structure: rabbit grazing and disturbance levels, localised bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20 x 20 metres	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **CG2**

Unit/subdivision reference . . . . . Date:. . . . . .

Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

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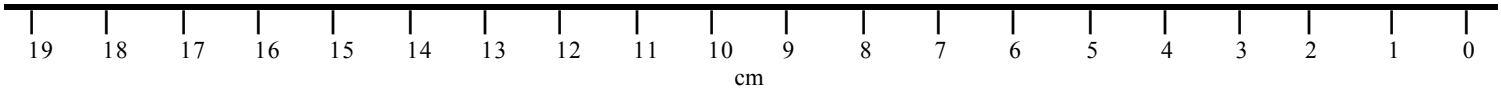
Recommended visiting period: May - July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate	FYM input
Grazing period	Other inputs
Supplementary feeding	Stock type
Scrub and weed control	

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio	**40-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Anthyllis vulneraria* ( ), *Asperula cynanchica* ( ), *Campanula glomerata* ( ), *Cirsium acaule* ( ), *Filipendula vulgaris* ( ), *Gentianella* spp. ( ), *Helianthemum nummularium* ( ), *Hippocrepis comosa* ( ), *Leontodon hispidus/L. saxatilis* ( ), *Leucanthemum vulgare* ( ), *Linum catharticum* ( ), *Lotus corniculatus* ( ), *Pilosella officinarum* (=*Hieracium pilosella*) ( ), *Plantago media* ( ), *Polygala* spp. ( ), *Primula veris* ( ), *Sanguisorba minor* ( ), *Scabiosa columbaria* ( ), *Serratula tinctoria* ( ), *Succisa pratensis* ( ), *Thymus* spp. ( ).	At least four species/taxa **frequent** and three **occasional** throughout the sward	
*Sward composition: cover of *Brachypodium pinnatum* and *Brompsis erecta.*	Neither species at more than **10%** cover	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Sward composition: frequency and % cover of negative indicator species/taxa. *Cirsium arvense ( ), Cirsium vulgare ( ), Rumex crispus ( ), Rumex obtusifolius ( ), Senecio jacobaea ( ), Urtica dioica ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, **excluding** *Juniperus communis*, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
Sward structure: average height	**2-10** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	
Sward structure: rabbit grazing and disturbance levels, localized bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20x20 metres	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **CG3, 4, 5**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

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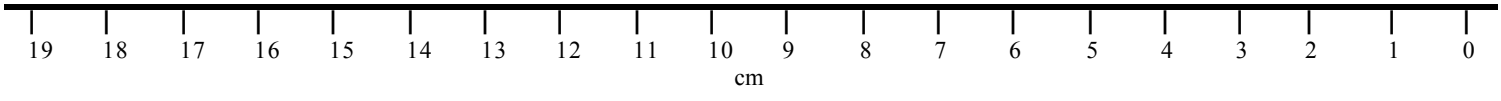
Recommended visiting period: May - July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate	FYM input
Grazing period	Other inputs
Supplementary feeding	Stock type
Burning	Scrub and weed control

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio	**40-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Brachypodium pinnatum* ( ), *Bromopsis erecta* ( ). *Anthyllis vulneraria* ( ), *Asperula cynanchica* ( ), *Campanula glomerata* ( ), *Cirsium acaule* ( ), *Filipendula vulgaris* ( ), *Galium verum* ( ), *Gentianella* spp. ( ) *Helianthemum nummularium* ( ), *Hippocrepis comosa* ( ), *Leontodon hispidus/L. saxatilis* ( ), *Leucanthemum vulgare* ( ), *Linum catharticum* ( ), *Lotus corniculatus* ( ), *Pilosella officinarum (=Hieracium pilosella)* ( ), *Plantago media* ( ), *Polygala* spp ( ), *Primula veris* ( ), *Sanguisorba minor* ( ), *Scabiosa columbaria* ( ), *Succisa pratensis* ( ), *Thymus* spp. ( ).	***Bromopsis erecta*** (if **CG3**) or ***Brachypodium pinnatum*** (if **CG4**), or both (if **CG5**) **frequent** plus at least **two** species/taxa **frequent** and **four occasional** throughout the sward	
*Sward composition: **CG3 only**, cover of *Brachypodium pinnatum*	No more than **10%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, **excluding** *Juniperus communis*, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Sward composition: frequency and % cover of negative indicator species/taxa. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Senecio jacobaea* ( ), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
Sward structure: average height	**2-15** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	
Sward structure: rabbit grazing and disturbance levels, localised bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20 x 20 metres	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Dry tall-herb grassland, dry grassland/scrub transitions, CG6, CG2d-related, MG1-related**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

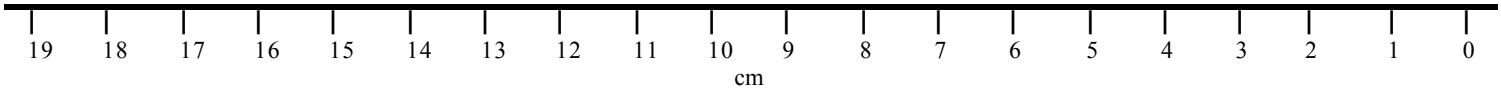
---

Recommended visiting period: May - July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate	FYM input
Grazing period	Other inputs
Supplementary feeding	Stock type
Burning	Scrub and weed control

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio.	**30-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Agrimonia eupatoria* ( ), *Centaurea nigra* ( ), *Centaurea scabiosa* ( ), *Clinopodium vulgare* ( ), *Galium verum* ( ) *Geranium sanguineum* ( ), *Knautia arvensis* ( ), *Lathyrus pratensis* ( ), *Leontodon hispidus* ( ), *Lotus corniculatus* ( ), Orchidaceae spp. ( ), *Origanum vulgare* ( ), *Pimpinella* spp. ( ), *Primula veris* ( ), *Sanguisorba minor* ( ), *Teucrium scorodonia* ( ), *Thymus* spp. ( ), *Tragopogon pratensis* ( ).	At least two species/taxa **frequent** and two species/taxa **occasional** throughout the sward	
*Sward composition: frequency and % cover of negative indicator species/taxa. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Senecio jacobaea* ( ), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, **excluding** *Juniperus communis*, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient if scrub control is not being carried out.	No more than **30%** cover or	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
Sward structure: average height	**5-50** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **50%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	
Sward structure: rabbit grazing and disturbance levels, localised bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20 x 20 metres	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Species-rich parched grassland (CG7a,b,d,e; U1b,c,d,f)**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

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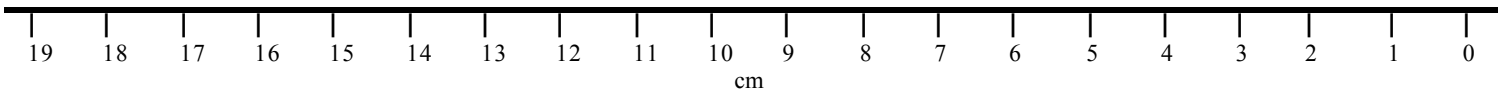
Recommended visiting period: end of April-mid July but periodically visit between end June-end September to assess *Pteridium* cover.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Rolling and chain harrowing	Stock type

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: frequency of positive indicator species/taxa. *Aira* spp. ( ), *Aphanes* spp. ( ), *Astragalus danicus* ( ), *Centaurium erythraea* ( ), *Cladonia* spp ( ), *Dianthus deltoides* ( ), *Erigeron acer* ( ), *Erodium cicutarium* ( ), *Fragaria vesca* ( ), *Galium verum* ( ), *Helianthemum nummularium* ( ), *Leontodon hispidus/L. saxatilis* ( ), *Lotus corniculatus* ( ), *Ornithopus perpusillus* ( ), *Pilosella officinarum* (=*Hieracium pilosella*) ( ), *Plantago coronopus* ( ), *Rumex acetosella* ( ), *Sedum acre* ( ), *Teesdalia nudicaulis* ( ), *Thymus* spp ( ).	At least two species/taxa **frequent** and four **occasional** throughout the sward	
*Sward composition: frequency and % cover of *Pteridium aquilinum*. NB If *Pteridium* is more than occasional throughout the sward but less than 10% cover, it is soon likely to become a problem if no management such as cutting or rolling is being carried out.	No more than **10%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together but **excluding** *Juniperus communis* and *Rhododendron* spp. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
*Sward composition: % cover of *Rhododendron* spp.	No more than **1%** cover	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Sward composition: % cover of coarse grasses eg *Holcus lanatus*, *Dactylis glomerata*.	No more than **10%** cover	
*Sward composition: % cover of *Deschampsia flexuosa*.	No more than **20%** cover	
*Sward composition: frequency of negative indicator species/taxa. *Carduus nutans ( ), Chamerion angustifolium ( ), Cirsium arvense ( ), Cirsium vulgare ( ), Plantago major ( ), Urtica dioica ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
Sward composition: frequency of negative indicator. *Senecio jacobaea*	No more than **occasional** throughout the sward	
Sward structure: average height.	**5** cm or less	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	**CG7a,b,d,e,U1b,d,f** No more than **15%**	
	U1c No more than **30%**	
Sward structure: rabbit grazing and disturbance levels, localised bare ground around rabbit warrens.	No more than **0.25** ha ie approximately 50 x 50 metres	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Lichen grassland (CG7c, U1a)**

Unit/subdivision reference . . . . . Date. . . . . .

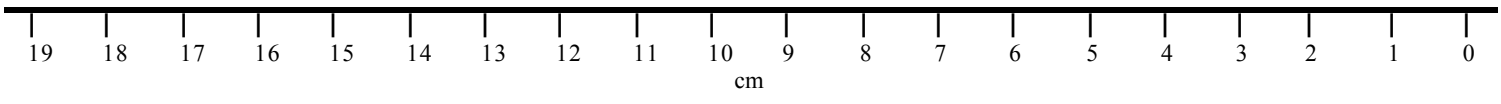
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: end April-August
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Rolling and chain harrowing	Stock type

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: presence, identity and extent (abundance) of rare and scarce lichen species (specific to site).	Continued presence of rare and scarce species and no decline in extent (abundance)	
*Sward composition: % cover of bushy or plate-like lichens, which may encrust the soil surface, rocks, pebbles or acrocarpous (unbranched) bryophytes.	**15-90%**	
*Sward composition: frequency and % cover of negative indicator species/taxa. *Carduus nutans ( ), Chamerion angustifolium ( ), Cirsium arvense ( ), Cirsium vulgare ( ), Plantago major ( ), Pteridium aquilinum ( ), Urtica dioica ( ),* coarse grasses eg *Holcus lanatus ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all tree and scrub species, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 1% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **1%** cover	
*Sward composition: negative indicator, % cover of mat-like, branching (pleurocarpous) bryophytes.	No more than **50%** cover	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
Sward composition: frequency of negative indicator. *Senecio jacobaea*	No more than **occasional** throughout the sward	
Sward structure: average height.	**5** cm or less	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **5%** of the sward	
Sward structure: extent of bare ground distributed through the sward, visible without disturbing the vegetation. Includes flints, pebbles and tiny tufts of acrocarpous (unbranched) bryophytes. Includes disturbance by rabbits.	**10-50%**	
Sward structure: rabbit grazing levels, indicated by frequency of rabbit droppings.	Rabbit droppings **frequent** throughout the sward.	

Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **CG8**

Unit/subdivision reference . . . . . Date. . . . . .

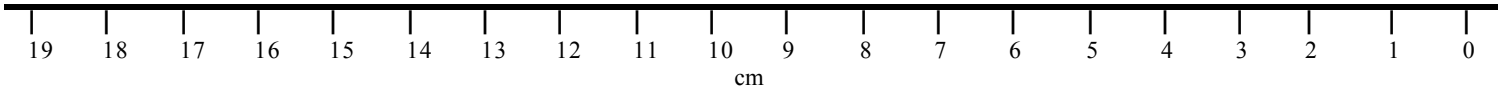
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: mid May-end July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Rolling and chain harrowing	Stock type
Burning	

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio.	**30-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Sesleria caerulea* ( ) *Anthyllis vulneraria* ( ), *Galium verum* ( ), *Gentianella* spp. ( ), *Helianthemum nummularium* ( ), *Hypericum pulchrum* ( ), *Linum catharticum* ( ), *Listera ovata* ( ), *Lotus corniculatus* ( ), *Pimpinella saxifraga* ( ), *Plantago media* ( ), *Polygala* spp. ( ), *Primula veris* ( ), *Sanguisorba minor* ( ), *Scabiosa columbaria* ( ), *Stachys officinalis* ( ), *Succisa pratensis* ( ), *Thymus polytrichus* ( ), *Viola hirta* ( ).	*Sesleria caerulea* **frequent** plus **at least** two species/taxa **frequent** and four **occasional** throughout the sward	
*Sward composition: frequency and % cover of negative indicator species/taxa. *Chamerion angustifolium* ( ), *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Galium aparine* ( ), *Senecio jacobaea* ( ), *Sonchus spp.* ( ), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together**, excluding** *Rosa* species. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: cover of *Rosa* spp..	No more than **10%** cover	
Sward composition: community rare/scarce species **specific to site** (may be none). *Antennaria dioica, Epipactis atrorubens, Linum anglicum (=L. perenne), Hypericum montanum, Parnassia palustris, Pinguicula vulgaris, Plantago maritima, Primula farinosa, Selaginella selaginoides, Trollius europaeus.*	One or more present	
Sward structure: average height.	**2-15** cm	
Sward structure: cover of litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **CG9**

Unit/subdivision reference . . . . . Date. . . . . .

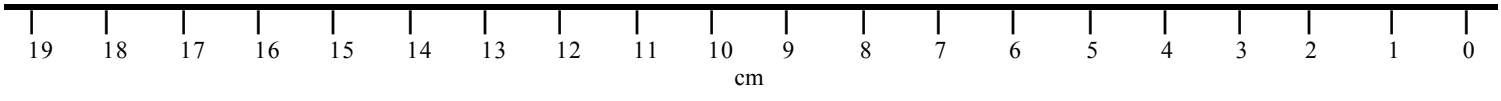
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: mid May-end July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Rolling and chain harrowing	Stock type
Burning	

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio.	**30-90%** herbs	
*Sward composition: frequency of *Sesleria caerulea*.	At least **frequent** throughout the sward	
*Sward composition **CG9c only** (occurs on damp soils): frequency of positive indicator species/taxa. Total meeting target can be added to overall total (see below). *Dryas octopetala ( ), Parnassia palustris ( ), Pinguicula vulgaris ( ), Primula farinosa ( ).*	At least **one** species **occasional** throughout the sward	
*Sward composition **CG9d and CG9e only** (occurs above 500 metres altitude): frequency of positive indicator species/taxa. Total meeting target can be added to overall total (see below). *Antennaria dioica ( ), Armeria maritima ( ), Cochleria pyrenaica ( ), Draba incana ( ), Gentiana verna ( ), Myosotis alpestris ( ), Plantago maritima ( ), Persicaria vivipara ( ), Saxifraga hypnoides ( ), Selaginella selaginoides ( ).*	At least **two** species **occasional** throughout the sward	
*Sward composition: frequency of positive indicator species in **CG9a** and **CG9b,** and a **general list** for **CG9c,d,e**. Species counted in lists for **CG9c, CG9d** and **CG9e** (above) can substitute for these general species (but not vice-versa), these sub-communities are being assessed, ie no more than the overall total is required for any sub-community. *Asperula cynanchica ( ), Carlina vulgaris ( ), Campanula rotundifolia ( ), Euphrasia spp. ( ), Filipendula vulgaris ( ), Galium sterneri ( ), Gentianella* spp. *( ), Helianthemum canum (=H. oelandicum) ( ), Helianthemum nummularium ( ), Hippocrepis comosa ( ), Leontodon hispidus ( ), Lotus corniculatus ( ), Pilosella officinarum (=Hieracium pilosella) ( ), Sanguisorba minor ( ), Scabiosa columbaria ( ), Succisa pratensis ( ), Thymus polytrichus ( ).*	From all relevant lists combined, at least **two** species/taxa **frequent** and **four occasional** throughout the sward if	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: frequency and % cover of negative indicator species. *Cirsium arvense ( ), Cirsium vulgare ( ), Senecio jacobaea ( ), Urtica dioica ( ).*	No species more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together, **excluding** *Juniperus communis*. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
* Sward composition: frequency and % cover of *Pteridium aquilinum*. NB If *Pteridium* is more than occasional throughout the sward but less than 10% cover, it is soon likely to become a problem if no management such as cutting or rolling is being carried out.	No more than **10%** cover	
Sward structure: average height. (Note: Rare species in CG9d/e may be species interest features and require swards taller than the lower target for the community for part of one year in a period of years).	**CG9a,b,c** **2-15** cm	
	CG9d,e **2-10** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation. (Note: Rare species in CG9d/e may be species interest features and occur preferentially on open sugar limestone in swards with greater than 10% bare ground).	No more than **10%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland dry acid grasslands

Context for the attributes that define condition

Habitat type and distribution

This habitat type covers lowland examples of NVC types U1 *Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland, U3 *Agrostis curtisii* grassland, and U4 *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland together with species-rich bracken, a community which is related to U4 and U20 *Pteridium aquilinum-Galium saxatile* community and has similar herbaceous species to U4c *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland, *Lathyrus montanus-Stachys betonica* sub-community .

The species-rich bracken community is not fully described by the NVC but has been described by Sanderson from the New Forest (Sanderson 1998a) and may occur elsewhere. Although considered to be a notifiable community by the 1989 SSSI Guidelines (NCC 1989), U2 *Deschampsia flexuosa* grassland is not included in the protocols as this community is generally not considered to be of high nature conservation value. Current consensus in English Nature is that lowland U2 is a secondary community derived from heathland or U1 as a result of eutrophication, excessive burning or lack of management. It may however, be included within SSSIs, as site fabric where, for example, it may form part of the habitat for associated fauna.

Lowland dry acid grasslands are widely distributed in the UK, although only small areas of lowland acid grassland have been found in Northern Ireland.

Selection of sites has been guided by the 1989 SSSI guidelines (NCC 1989). Upland bracken communities (U20) along with upland acid and calcareous grassland are considered to be of international importance by the SSSI guidelines. However, lowland bracken is not considered by NCC (1989), although there is no doubt that the species-rich bracken/U4-related type described by Sanderson (1998a) has high nature conservation value.

The Level 1 feature in ENSIS is B1.1 unimproved acid grassland. Lowland dry acid grassland embraces three Level 2 features in ENSIS, U1, U3 and U4. The Biodiversity Action Plan priority habitat incorporating U1, U3 and U4 is lowland dry acid grassland.

Extent

The total extent of dry lowland acid grassland in the UK is estimated to be less than 30,000 ha, of which less than 21,250 ha (excluding U2) is in England. The estimated extents of the interest feature types are set out below:

Interest feature	Extent (ha)	Interest feature	Extent (ha)
U1	<12,500	U4 (lowland)	<5,000
U3	<3,000	U4/U20-related	*100-500?

* = Extent not fully known

Landscape structure and dynamics

The habitat occurs in landscapes where the underlying soils are derived from hard acid rocks or acid superficial deposits including sands and gravels. On such soils acid grassland often occurs in association with lowland heathland. It can occur in a wide variety of topographical situations ranging from level plains such as in the East Anglian Breckland to steep valley slopes. In addition, it can occur on coastal cliffs and shingle.

In lowland landscapes that have undergone limited agricultural intensification, transitions to heathland, unimproved grassland (neutral MG5), calcareous and maritime grassland (MC5 *Armeria maritima-Cerastium diffusum* ssp. *diffusum* maritime therophyte community), and wetter fen meadows and mires (eg M21, M23 and M25) are found. Such sequences largely reflect variation in soil type, soil water regime, and maritime influence, particularly soil salt concentration. Sometimes the occurrence of neutral grasslands in sequences with dry acid grasslands derives from the addition of farmyard manure and/or lime to part of a larger pre-existing area of acid grassland.

Physical attributes and function

Soils can range from skeletal brown sands over rock, sands, gravel or shingle to deeper brown podzolic soils on plateaux or moderate slopes. Soils are base-poor with pH ranging between 3.5 and 5.5 and are usually free-draining. The limited soil data available suggests that nutrients levels are low compared to agriculturally improved grassland (Stevens *et al* 1998, Chambers *et al* 1999). This in turn limits the agricultural productivity of this habitat which is only able to sustain low outputs per hectare in terms of livestock performance.

It is unclear if grazing animals bring about a net removal of nutrients from grasslands managed as permanent pasture where no fertilisers are applied, which is the way most acid grasslands are managed. Recently, the issue has been examined as part of a review of nutrient relations of pasture habitats (Chalmers *et al* 2000) but this concluded that little information is available on which to base an assessment. The impact of atmospheric nutrient deposition on nutrient budgets may be significant, particularly the effect of nitrogen, and needs investigation. Climate change may also have an impact. Climate change scenarios, which might include warmer winters and wetter or drier summers, could cause shifts in the range of acid grassland species.

Species composition

The NVC types included in the habitat encompass a range of species assemblages that differ in the representation of particular species or groups of species. They also vary in their species density but, contrary to received wisdom, many types are species-rich (up to 38 species/4m^2 for U1 (Sanderson 1998b)). Parched acid grasslands (U1) are important for short-lived plants of open habitats.

The grasses *Festuca ovina* and *Agrostis capillaris* feature prominently in the three NVC communities which collectively comprise acid grassland. A wide range of other species/taxa, characteristic of semi-natural grasslands unimproved by use of artificial fertilisers or applications of organic manures, are present and can include *Aira* spp., *Anthoxanthum odoratum, Calluna vulgaris, Campanula rotundifolia, Centaurium erythraea , Cladonia* spp ,

Dianthus deltoides, Dicranum scoparium, Erica spp., *Erodium cicutarium, Galium verum, Galium saxatile ,Lathyrus linifolius (=montanus), Leontodon hispidus/L. saxatilis, Lotus corniculatus, Ornithopus perpusillus, Pedicularis sylvatica, Pilosella officinarum, Pleurozium schreberi, Polygala* spp., *Plantago coronopus , Potentilla erecta, Rumex acetosella, Sedum acre, Stachys officinalis, Succisa pratensis, Teesdalia nudicaulis, Teucrium scorodonia, Thymus* spp. *Veronica officinalis, and Viola spp.*

There is considerable overlap between the species composition of U1b, c, d and f and CG7 a, b, d and e and these species-rich grasslands of parched soils sometimes occur together, especially in Breckland. Lower plants can be an important component of the flora of acid grasslands, with parched acid grassland (U1) supporting the richest lichen flora. U1a (*Cornicularia aculeata-Cladonia arbuscula* sub-community) is the richest sub-community for lichens. Lichens may be especially vulnerable to the effects of atmospheric deposition but research is required to investigate the issue. Lowland acid grasslands, in particular U1, harbour a considerable number of rare and scarce vascular plants, including 17 nationally rare and 22 nationally scarce species.

Invasive species

Species that are not present at high frequencies in acid grasslands where the nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. These include *Carduus nutans, Chamerion angustifolium*, *Cirsium arvense, C. palustre, C. vulgare, Plantago major, Pteridium aquilinum, Senecio jacobaea Urtica dioica* and coarse grasses such as *Holcus lanatus* and *Dactylis glomerata*. In addition, where management does not occur over long periods, scrub species can invade. Other species/taxa can cause problems in particular grasslands if they become too abundant include *Deschampsis flexuosa* and, in lichen grassland (U1a), pleurocarpus bryophytes.

Sward structure

The habitat is almost always managed as permanent pasture. The structure of the sward varies widely across types, with parched U1 grasslands having very short swards while some types of acid grassland (U4c) and species-rich bracken have slightly taller swards. However, dead plant material at the base of the sward is not extensive as long as grazing levels are sufficient. Bare ground is distributed through the sward and often includes small scrapes and holes created by rabbits. Some types of parched acid grassland such as U1a and U1c are characterised by high amounts of bare ground. Rabbit grazing is important in maintaining some grasslands, particularly lichen grassland (U1a). However, large areas of bare ground around warrens generally indicate that rabbit numbers have reached problem proportions.

Although broad targets for sward structure for each type can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Lowland acid grassland, U1e, U3, U4a, U4c, U4/U20-related (species-rich bracken)**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained / Favourable recovered / Unfavourable improving / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

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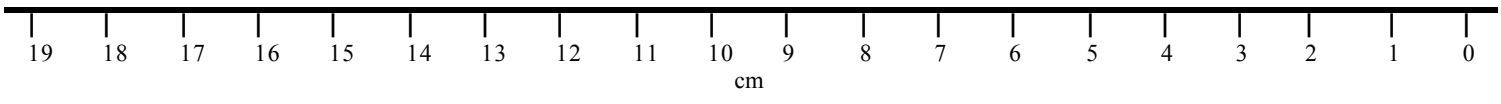
Recommended visiting period: end of April - July but periodically visit between end June-end September to assess *Pteridium* cover.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Grazing intensity/stocking rate	FYM input
Grazing period	Other inputs
Supplementary feeding	Stock type
Scrub and weed control	Rolling and chain harrowing
Burning	Bracken management

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: **U3 only** -frequency and % cover of *Agrostis curtisii.*	At least **frequent** throughout the sward but no more than **80%** cover	
*Sward composition: frequency of positive indicator species/taxa. *Anenome nemorosa ( ),*Calluna vulgaris ( ), Campanula rotundifolia ( ), Cladonia* spp. *( ),*Erica* spp. *( ), Galium saxatile ( ), Galium verum ( ), Lathyrus linifolius (=L. montanus) ( ), Lotus corniculatus ( ), Pedicularis sylvatica ( ), Pilosella officinarum (=Hieracium pilosella) ( ), Polygala* spp. *( ), Potentilla erecta ( ), Rumex acetosella ( ), Serratula tinctoria ( ), Stachys officinalis ( ), Succisa pratensis( ), Teucrium scorodonia ( ), *Vaccinium myrtillus ( ), Veronica officinalis ( ), Viola* spp. *( ).* *Note: If cover of ericaceous species (*Calluna vulgaris, Erica* spp., *Vaccinium myrtillus*) is **greater than 25%**, the habitat is heathland and thus its **condition would be unfavourable if grassland is the conservation interest feature.**	**U1e, U4a, U3** At least 2 species/taxa **frequent** and 2 species/taxa **occasional** throughout the sward [See *species note]	
	U4c, U4/U20-related At least 2 species/taxa **frequent** and 4 species/taxa **occasional** throughout the sward [See*species note]	
* Sward composition: frequency and % cover of *Pteridium aquilinum.* NB If *Pteridium* in U1e, U3 or U4 is more than occasional throughout the sward but less than 20% cover, it is soon likely to become a problem if no management such as cutting or rolling is being carried out.	**U4/U20-related** **50-90%** cover	
	U1e, U3, U4 No more than **20%** cover	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: frequency and % cover of negative indicator species/taxa. *Chamerion angustifolium ( ), Cirsium arvense ( ), Cirsium palustre ( ), Cirsium vulgare ( ), Plantago major ( ), Senecio jacobaea ( ), Urtica dioica ( ).*	No species/taxa more than **occasional** throughout the sward or more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together, including *Rubus fruticosus* agg. but **excluding** *Rhododendron* species, and in **U3 only excluding** *Ulex* species. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
*Sward composition, **U3 only**: % cover of *Ulex* species	No more than **30%** cover	
*Sward composition: % cover of *Rhododendron* species	No more than **1%** cover	
*Sward composition: % cover of coarse grasses eg *Holcus lanatus*, *Dactylis glomerata*.	No more than **10%** cover	
Sward structure: average height, **excluding Pteridium aquilinum**.	**U1e, U3, U4a,** **1-5** cm	
	U4c, **U4/U20-related** **3-10** cm	
Sward structure: cover of litter in a more or less continuous layer, distributed either in patches or in one larger area.	**U1e, U3, U4** Total extent no more than **25%** of the sward	
	U4/U20-related **5-50%**	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	
Sward structure: rabbit grazing and disturbance levels, localized bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20x20 metres	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

MG3, *Anthoxanthum odoratum-Geranium sylvaticum* grassland: SAC type, mountain hay meadows (British types with *Geranium sylvaticum*)

Context for the attributes that define condition

Habitat type and distribution

The SAC habitat type has been interpreted as corresponding to the NVC type MG3, *Anthoxanthum odoratum-Geranium sylvaticum* grassland. The type is largely confined to England although small examples occur along river banks in Scotland. Sites are concentrated in the Pennine and Cumbrian dales in northern England, and comprise isolated or clustered enclosed fields, over 50% of which are 2 ha or less in size. The floristic composition of the meadows in the UK appears to be unique in the European Union. The candidate SAC site series comprises the occurrences of the habitat in the dales of Durham, Northumberland, Cumbria, North Yorkshire and Lancashire.

The SAC type is a Level 2 feature in ENSIS. The Level 1 feature is unimproved neutral grassland. The Biodiversity Action Plan priority habitat represented by this type is upland meadow.

Extent

The habitat is very rare, it is estimated that less than 1,000 ha remain in England and less than 1,100 ha in the UK as a whole.

Landscape structure and dynamics

The habitat occurs on the valley floors and lower slopes of upland areas such as the Pennines. In landscapes that have undergone limited agricultural improvement, transitions to wetter communities such as MG8 and M23 are found on the lowest lying land and there are transitions to flushed communities on slopes (eg M10 *Carex dioica-Pinguicula vulgaris* mire, M26). Vegetation related to MG8 and MG3 can occur in wetter, higher altitude, meadows (Prosser 1990). In areas with limestone outcrops, transitions to dry calcareous grassland occur, while in valleys with more acid substrates, transitions to acid grasslands (eg U4) can be found, particularly towards upper slopes or on banks.

Physical attributes and function

Soils can be relatively free draining or have somewhat impeded drainage leading to gleying. Soil type is usually brown earth or calcareous brown earth. High rainfall (generally over 900mm a year on average) results in leaching of bases from the soil. These losses have been offset on the more acid soils, over the long history of management of the habitat for hay, by applications of farmyard manure and lime. The impact of nutrient inputs from the atmosphere is not well understood and needs further study, but atmospheric deposition might contribute a significant element to the nutrient budgets of the habitat. This proportion might have increased with increasing rates of atmospheric deposition, eg of nitrogen. Comparative data (Stevens *et al* 1998, Chambers *et al* 1999) suggest that soils under MG3 grassland have lower soil nutrient levels than agriculturally improved grassland (MG7 *Lolium perenne* leys and related grasslands). Regular applications of light dressings of farmyard manure supply

nutrients to replace those removed in hay crops but the effect of different amounts of farmyard manure on the species composition of the habitat need further investigation, together with the effects of lime. This topic is the subject of a current research project being undertaken by a consortium led by the Institute of Grassland and Environmental Research and funded by the government agriculture and conservation agencies.

Sites adjacent to rivers and river bank examples of the habitat are potentially vulnerable to river engineering projects.

Species composition

The habitat consists of a varied mixture of dicotyledonous herbs, sedges and grasses, with grasses comprising a relatively small proportion of the sward and herbs being the most abundant component. *Geranium sylvaticum* and *Sanguisorba officinalis* are often prominent in the sward. Constant species in the MG3 NVC table are: *Plantago lanceolata, Rumex acetosa, Ranunculus acris, Geranium sylvaticum, Anthoxanthum odoratum, Conopodium majus, Cerastium fontanum, Dactylis glomerata, Alchemilla glabra, Trifolium repens, Poa trivialis, Festuca rubra, Agrostis capillaris, Holcus lanatus and Sanguisorba officinalis*. A wide range of other species, characteristic of neutral grasslands unimproved by use of artificial fertilisers or heavy applications of organic manures, are present and can include *Rhinanthus minor*, *Centaurea nigra*, and *Cirsium heterophyllum*. *Alchemilla monticola* and *A. subcrenata* are two nationally rare species found in unimproved mountain hay meadows. Two nationally scarce *Alchemilla* species (*A. glomerulans* and *A.wichurae*) can also occur in the habitat as can the nationally scarce species *Euphrasia rostkoviana* subsp. *montana* and *Meum athamanticum*.

Invasive species

Species that are not present at high frequencies in MG3 grasslands where the nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are characteristic of poorly managed agricultural land in the general countryside: *Cirsium arvense, C. vulgare, Rumex crispus, R. obtusifolius, Senecio jacobaea* and *Urtica dioica*. In addition, where management by hay-cutting does not occur over long periods, scrub species can invade. *Anthriscus sylvestris* is another species that appears to indicate unfavourable conditions, such as higher inputs of farmyard manure or insufficient management (Hansson and Persson 1994, Robertson *et al* 2000), when present in abundance, although it can be found in low amounts in species-rich examples of the habitat. There is a need for more detailed investigation of the factors affecting the abundance of *Anthriscus sylvestris*. Some relevant information may result from the farmyard manure research project.

Sward structure

The structure of the vegetation varies over the year according to a regular pattern of management. The sward is cut for hay in the summer, and then aftermath growth is grazed by livestock in late summer and autumn. Sporadic grazing may take place in the winter months, followed by spring sheep grazing on the meadow until it is shut up for hay. Shut up dates vary although usually livestock have been removed by mid-May. It is known that heavy grazing of other types of neutral grasslands can lead to reductions in species diversity and

changes in composition. The effect of length and intensity of the spring grazing period on species composition of MG3 is not well understood and needs investigation. Sward heights are generally at least 5 cms by the end of May and can reach 70 cms or more by hay-cut time. During this period, the sward is dense with little bare ground visible, while the regular removal of biomass by cutting and the subsequent trampling action of livestock results in little dead plant material being present at the base of the sward. Current advice is that to maintain the botanical interest of MG3 meadows they should be cut in July with an occasional late cut in August/September. However, there is need for further research into the effects of timing of cutting on plant communities, particularly the effects of i) adhering to rigid cutting dates and ii) occasional late cutting. During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there will be little poaching amongst the sward and no larger patches of bare ground. Although broad targets for sward structure can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **MG3**

Unit/subdivision reference . . . . . Date. . . . . .

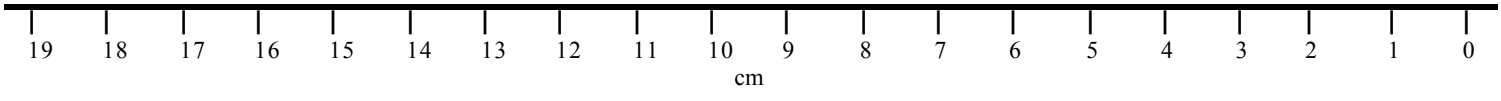
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: Late May - mid July (until hay cut time) with periodic visit in autumn-spring visit to check condition at end of aftermath grazing period.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing
FYM input
Other inputs
Drainage
Scrub and weed control
Grazing intensity/stocking rate
Grazing period
Supplementary feeding
Rolling and chain harrowing

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio	**50-90%** herbs	
*Sward composition: frequency of positive indicator species. *Alchemilla* spp ( ), *Anenome nemorosa* ( ), *Centaurea nigra* ( ), *Cirsium heterophyllum* ( ), *Conopodium majus* ( ), *Euphrasia* spp. ( ), *Filipendula ulmaria* ( ), *Geranium sylvaticum* ( ), *Geum rivale* ( ), *Lathyrus pratensis* ( ), *Leontodon* spp ( ), *Lotus corniculatus* ( ), *Persicaria bistorta* ( ), *Rhinanthus minor* ( ), *Sanguisorba officinalis* ( ), *Succisa pratensis* ( ), *Trollius europaeus* ( ).	At least three species/taxa **frequent** and three **occasional** throughout the sward, **or locally abundant** over more than 10% of the sward	
*Sward composition: frequency and % cover of negative indicator species. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Senecio jacobaea* ( ), *Urtica dioica* ( ).	No species more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all tree and scrub species, considered together.	No more than occasional throughout the sward or more than **1%** cover.	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: frequency of negative indicator species (More than frequent = more than **60%** frequency). *Anthriscus sylvestris ( ).*	*Anthriscus sylvestris* no more than **frequent** throughout the sward or more than **5%** cover	
Sward structure: average height of sward, recorded in summer visit period only. NB If site is permanent pasture in summer period discuss with site manager.	**5** cm or above	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **5%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

MG4, *Alopecurus pratensis-Sanguisorba officinalis* grassland: SAC type, lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)

Context for the attributes that define condition

Habitat type and distribution

The SAC habitat type has been interpreted as corresponding to the NVC type MG4, *Alopecurus pratensis-Sanguisorba officinalis* grassland. The type is almost totally confined to England in the UK and most sites occur south and east of a line between the Tees and the Severn estuaries. The majority are located in the catchments of the Rivers Thames, Yorkshire Ouse, Trent and Severn. Most examples (75%) are less than 10 ha in extent (Jefferson 1997). The sites that have been selected as candidate SACs are those that have the largest surviving areas and the most stable patterns of traditional low-intensity management and so show a high degree of conservation of structure and function. The candidate SAC sites have been selected to encompass the range in ecological variation shown by the habitat type, particularly those variations supporting important populations of rare and scarce meadow species, and also to cover the geographical distribution of the habitat type in the UK.

The SAC type is a Level 2 feature in ENSIS. The Level 1 feature is unimproved neutral grassland. The Biodiversity Action Plan priority habitat represented by this type is lowland meadow.

Extent

The habitat is very rare in the UK, it is estimated that less than 1,500 ha remain.

Landscape structure and dynamics

The habitat occurs on low-lying ground, usually on river flood-plains and occupies a section of the range of habitats that occur in these landscapes, which can include open, flowing fresh water, swamp habitats and drier grassland types on higher ground, as well as MG4. In landscapes that have undergone limited agricultural intensification, transitions to drier unimproved grassland (MG5) and wetter swamp and grassland communities (eg S24, *Phragmites australis-Peucedanum palustre* tall-herb fen and MG13) are found. In response to naturally fluctuating water levels from year to year, the boundary zones between these habitats can drift up and down.

Physical attributes and function

Soils are usually free-draining to moderately permeable, their textural type clay-rich or silty alluvial loams or occasionally peaty mineral soils. Soil reaction is neutral to calcareous, with pHs ranging from pH 5.8 to pH 8.3. Nutrient inputs from flood water are believed to play a significant role in maintaining the nutrient levels in the soils. The habitat may act as a nutrient sink in biogeochemical cycles, although information on nutrient budgets is lacking. However, inputs of nutrients in flood water appear to have allowed the net positive production of biomass over the hundreds or thousands of years that these sites have been managed as hay meadows. In recent times, nutrient levels may have increased if nutrient loading in flood water has risen and this uncertainty illustrates the general need for research

into the nutrient budgets of these meadows. Comparative data (Stevens *et al* 1998, Chambers *et al* 1999) suggest that soils under MG4 grassland have lower soil nutrient levels than agriculturally improved grassland (MG7 *Lolium perenne* leys and related grasslands). The occurrence or impact of heavy metals derived from flood water is unknown but could be significant. In the Netherlands it has been suggested that heavy metals may have deleteriously affected populations of *Fritillaria meleagris* (D. Massen, English Nature, pers comm).

The hydrological regime necessary for the maintenance of the habitat is thought to be relatively narrowly defined. Water tables are at or above the soil surface for limited periods in winter but waterlogging, especially in spring, is of insufficient duration to bring about a shift away from MG4 towards innundation grassland or swamp communities. Conversely, long-term low water tables alter the habitat towards drier grassland types such as MG5.

Critical influences on the habitat are the catchment hydrology and water quality. Natural variation in climate can markedly affect the catchment and thus the habitat, particularly rainfall amounts and evapotranspiration rates. Long term climate change involving these factors also may affect the habitat. Catchment hydrology can also have an impact where, for instance, increase in built land can affect run-off. Other activities such as water abstraction and gravel extraction on nearby land can influence the hydrology of the habitat, as can river channel alteration. The nutrient budget of the catchment can affect the inputs to the site, eg the amount of agricultural fertilisers used. Pollution from catchment releases, eg of heavy metals, may also have an impact. The habitat also plays a role in the wider hydrological regime of the river catchment, by acting as temporary storage capacity for flood water.

There is a clear need for hydrological investigation and modelling in order to understand the hydrology of MG4 hay meadows and predict the likely effects of changes in catchment hydrology.

Species composition

The habitat consists of a varied mixture of dicotyledonous herbs, sedges and grasses, with non-gramineous species attaining a high percentage cover in the sward. Tall, robust perennials such as *Sanguisorba officinalis*, *Filipendula ulmaria* and *Thalictrum flavum* are often characteristically prominent. Constant species in the MG4 NVC community table are: *Festuca rubra, Cynosurus cristatus, Sanguisorba officinalis, Plantago lanceolata, Ranunculus acris, Rumex acetosa, Filipendula ulmaria, Taraxacum officinale agg., Trifolium pratense, Alopecurus pratensis, Cerastium fontanum, Holcus lanatus, Lathyrus pratensis, Leontodon autumnalis, Trifolium repens and Lolium perenne.* A wide range of other species, characteristic of neutral grasslands unimproved by use of fertilisers, are present and can include *Silaum silaus, Lotus corniculatus, Rhinanthus minor* and *Succisa pratensis*. The habitat is species-rich with 28 species per 4 square metres given as an average value in the NVC. Nationally scarce and rare species occur in the habitat, notably *Fritillaria meleagris*, which is largely confined to this habitat and the hydrological regime that influences it (Zhang and Hytteborn 1985, Payne 1998). *Carex filiformis*, nationally rare, and *Oenanthe siliafolia*, nationally scarce, have also been recorded. A rich *Taraxacum* flora is often a feature, including a number of scarce species such as *Taraxacum anglicum, T. tamesense* and *T. subundulatum*.

The relationship of species composition, including rare species, to the habitat factors of water regime and nutrient status needs further study. Currently MAFF are funding Cranfield University to investigate the water regime tolerances of wet grassland communities, including MG4.

Invasive species

Species that are not present at high frequencies in MG4 grasslands where the hydrological, nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are characteristic of poorly managed agricultural land in the general countryside: *Anthriscus sylvestris, Cirsium arvense, C. vulgare, Rumex crispus, R. obtusifolius, Senecio jacobaea* and *Urtica dioica*. In addition, where management by hay-cutting does not occur over long periods, scrub species can invade. *Senecio aquaticus* is a natural component of the sward but may pose a management problem when present in abundance. However there is a need for research into the factors affecting its abundance.

Sward structure

The structure of the vegetation varies over the year according to a regular pattern of management. The sward is cut for hay in the summer, and then aftermath growth is grazed by livestock in late summer and autumn. Spring grazing is damaging to species such as *Fritillaria meleagris,* which flower during this period. Where inappropriate grazing does not occur, sward heights are generally 10 cms by the end of May and can reach 70 cms or more by hay-cut time. During this period, the sward is dense with little bare ground visible, while the regular removal of biomass by cutting and the subsequent trampling action of livestock results in little dead plant material being present at the base of the sward. Current advice is that to maintain the botanical interest of MG4 meadows they should be cut between late-June and the end of July. However, there is need for further research into the effects of timing of cutting on plant communities, particularly the effects of i) adhering to rigid cutting dates and ii) occasional late cutting. During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there will be little poaching amongst the sward and no larger patches of bare ground. Although broad targets for sward structure can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **MG4**

Unit/subdivision reference . . . . . Date. . . . . .

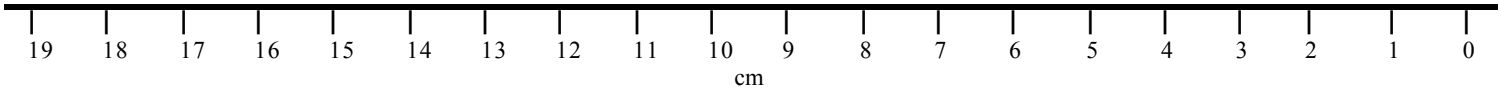
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: Late May - early July (before hay cut time) except for *Fritillaria* attribute, with periodic visit in autumn-winter visit to check condition at end of aftermath grazing period.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing
FYM input
Other inputs
Drainage
Raising water levels
Grazing intensity/stocking rate
Grazing period
Supplementary feeding
Stock type
Rolling and chain harrowing
Weed control

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio	**40-90%** herbs	
*Sward composition: rare species. Extent (not density) of flowering *Fritillaria meleagris* population (specific to certain sites) mid-late April to early May depending on early/late spring. Sample eg by transect if necessary.	Extent not less than **25%** of appropriate reference level	
*Sward composition: frequency of positive indicator species from lists A and B. Species on list A can substitute for species on list B to give an overall total of at least 2 frequent and 3 occasional or locally abundant. **List A** *Filipendula ulmaria ( ), Leontodon autumnalis ( ), Oenanthe silaifolia ( ), Persicaria bistorta ( ), Sanguisorba officinalis ( ), Silaum silaus ( ), Succisa pratensis ( ), Thalictrum flavum ( ).* **List B** *Centaurea nigra ( ), Filipendula vulgaris ( ), Galium verum ( ), Lathyrus pratensis ( ), Leucanthemum vulgare ( ), Lotus corniculatus ( ), Primula veris ( ), Rhinanthus minor ( ), Serratula tinctoria ( ), Stachys officinalis ( ), Tragopogon pratensis ( ).*	Overall total of at least two species **frequent** plus at least three species **occasional** throughout the sward or **locally abundant** in more than 10% of the sward, **including** at least **one** species **frequent** and **one occasional** or **locally abundant** from **list A**	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: frequency and % cover of negative indicator species *Anthriscus sylvestris ( ), Cirsium arvense ( ), Cirsium vulgare ( ), Rumex crispus ( ), Rumex obtusifolius ( ), Senecio jacobaea ( ), Urtica dioica ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: negative indicator species. Frequency and % cover of all tree and scrub species, considered together.	No more than **occasional** throughout the sward or more than **1%** cover	
*Sward composition: % cover of *Juncus* spp, *Deschampsia cespitosa,* large *Carex* spp. (leaves more than 5mm wide) eg *Carex acutiformis*, large grasses (leaves more than 10mm wide, stout stems) ie *Glyceria maxima, Phalaris arundinacea, Phragmites australis*.	No species/taxa together or singly covering more than **10%** of the sward	
Sward composition: frequency of negative indicator species. *Senecio aquaticus ( )*	No more than **occasional** throughout the sward	
Sward structure: average height in summer visit period only. NB If site is permanent pasture in summer period discuss with site manager.	Sward **10** cm or above	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **5%** of the sward	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

MG5, *Centaurea nigra-Cynosurus cristatus* grassland

Context for the attributes that define condition

Habitat type and distribution

The MG5 *Centaurea nigra-Cynosurus cristatus* grassland type occurs on neutral loam and clay soils across the lowlands in the UK, although England has the largest extent of the resource. Sites are widely distributed across England but particularly important concentrations occur in Worcestershire and south-west England (Somerset, Dorset and Wiltshire). The community is highly localised and fragmented. Many sites consist of isolated fields or groups of fields of small size (<5 ha). While the grassland type is notifiable under the SSSI Guidelines (NCC 1989), MG5 is not a SAC type.

The Level 1 feature in ENSIS is B2.1, unimproved neutral grassland. The MG5 grassland type is the Level 2 feature. The Biodiversity Action Plan priority habitat represented by this type is lowland meadow.

Extent

The habitat is rare in England and it is estimated that less than 6,000 ha remain, while less than 13,000 ha are estimated to remain as a whole in England Scotland and Wales.

Landscape structure and dynamics

The habitat occurs in a variety of situations on level to sloping terrain in lowland, enclosed, countryside, where it is managed as hay meadow and pasture. In landscapes that have undergone little agricultural improvement, transitions to wet grassland communities such as MG8, M23 and M24 on the lowest lying land are found. The community can sometimes occur in fields with ancient ridge-and-furrow topography. The furrows may be damper than the ridges and may contain wet grassland communities such as M23 and MG8.

In areas with limestone substrates, transitions to dry calcareous grassland can occur on steeper slopes. Similarly, in areas with more acid substrates, transitions to acid grasslands (eg U1 and U4) and heaths can be found, particularly towards upper slopes or on banks. Transitions to acid grassland are related to edaphic changes but management may sometimes be an influencing factor. For example, changes in the periodicity and rates of farmyard manure and lime use could potentially affect the balance between the more acidic sub-community of MG5 (MG5c) and acid grassland communities.

Physical attributes and function

Soils are usually relatively free draining, or more rarely have somewhat impeded drainage leading to gleying. Soil type is usually brown earth or calcareous brown earth. Most of the floristic variation within the community is related to edaphic differences especially calcium content and the levels of macro-nutrients, particularly nitrogen, phosphorus and potassium. The impact of nutrient inputs from the atmosphere is not well understood and needs further study, but atmospheric deposition might contribute a significant element to the nutrient budgets of the habitat. This proportion might have increased with increasing rates of

atmospheric deposition eg of nitrogen. Comparative data (Stevens *et al* 1998, Chambers *et al* 1999) suggest that soils under MG5 grasslands have lower soil nutrient levels than agriculturally improved grassland (MG7 *Lolium perenne* leys and related grasslands). Regular applications of light dressings of farmyard manure supply nutrients to replace those removed in hay crops but the effect of different amounts of farmyard manure on the species composition of the habitat need further investigation, together with the effects of lime. This topic is the subject of a current research project being undertaken by a consortium led by the Institute of Grassland and Environmental Research and funded by the government agriculture and conservation agencies. The impact of organic manure on lowland pastures including MG5 is the subject of a recently published review (Chalmers *et al* 2000). The review concluded that more data are needed to test the hypothesis that use of manure may be deleterious through increasing nutrient levels that are not then removed, as happens in a hay cropping regime, but in the meantime the precautionary approach of not applying manures to pastures should be continued.

Species composition

The habitat consists of a varied mixture of dicotyledonous herbs, sedges and grasses, with herbaceous plants comprising a relatively high proportion of the sward. Constant species in the MG5 NVC table are: *Festuca rubra, Cynosurus cristatus, Lotus corniculatus, Plantago lanceolata, Holcus lanatus, Dactylis glomerata, Trifolium repens, Centaurea nigra, Agrostis capillaris, Anthoxanthum odoratum and Trifolium pratense*. A wide range of other species, characteristic of neutral grasslands unimproved by use of artificial fertilisers or heavy applications of organic manures, are present and can include *Galium verum, Genista tinctoria, Lathyrus pratensis, Leucanthemum vulgare, Lotus corniculatus, Luzula campestris, Potentilla erecta, Primula veris, Rhinanthus minor, Serratula tinctoria, Silaum silaus, Stachys officinalis, Succisa pratensis and Carex flacca.*

A number of rare and scarce plant species can occur in the habitat including the Red Data book- listed *Cirsium tuberosum* and *Gastridium ventrocosum* and the nationally scarce *Trifolium ochroleucon*. However, the key feature of the community is the abundance of a suite of characteristic species, none of which in themselves is very rare.

Invasive species

Species that are not present at high frequencies in MG5 grasslands where the nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are characteristic of poorly managed agricultural land in the general countryside: *Cirsium arvense, C. vulgare, Galium aparine, Plantago major,Rumex crispus, R. obtusifolius, Senecio jacobaea and Urtica dioica*. On more acidic soils, invasion and increase in bracken *(Pteridium aquilinum),* can become a problem particularly where grazing and cutting management is inadequate to keep this species in check. In addition, where management by hay-cutting does not occur over long periods, scrub species can invade. *Anthriscus sylvestris* is another species that appears to indicate unfavourable conditions when present in abundance, although it can be found in low amounts in species-rich examples of the habitat. There is a need for detailed investigation of the factors affecting the abundance of *Anthriscus sylvestris*. Some relevant information may result from the farmyard manure research project.

Sward structure

The structure of the vegetation varies over the year according to a regular pattern of management.

Hay meadows

The sward is cut for hay in the summer, and then aftermath growth is grazed by livestock in late summer and autumn. Spring grazing prior to hay cutting is not a common feature of the management of MG5 hay meadows in the lowlands. If there has not been a history of spring grazing it is probably best to not to introduce it as it may be potentially detrimental to early-flowering species such as *Orchis morio* and *Narcissus pseudonarcissus*. Where inappropriate grazing does not occur, sward heights are generally at least 10 cms by the end of May and can reach 70 cms or more by hay-cut time. During this period, the sward is dense with little bare ground visible, while the regular removal of biomass by cutting and the subsequent trampling action of livestock results in little dead plant material being present at the base of the sward.

Current advice is that to maintain the botanical interest of MG5 meadows they should be cut between late June and the end of July with an occasional late cut in August/September. However, there is need for further research into the effects of timing of cutting on plant communities particularly the effects of i) adhering to rigid cutting dates and ii) occasional late cutting.

During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there will be little poaching amongst the sward and no larger patches of bare ground.

Pastures

These are sites managed as permanent pasture for the grazing of cattle, sheep or horses or a combination of livestock types. The sward height through the season should lie within the range 5-15 cms. However, dead plant material at the base of the sward is not extensive as long as grazing levels are sufficient. During the grazing period, there should be little poaching amongst the sward and no larger patches of bare ground.

Some research has been undertaken on the effects of horse and cattle grazing on MG5 grasslands particularly in relation to the intensity of grazing (Gibson 1997). This research indicates that grazing intensity is more important than the type of grazing animal provided that activities such as supplementary feeding are avoided and latrine formation is discouraged, eg by picking up dung. The previous research did not look at sheep-grazed sites and there is anecdotal evidence that sheep grazing of MG5 pastures and the aftermath of meadows is sub-optimal for the maintenance of nature conservation value. This needs further investigation.

Although broad targets for sward structure can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **MG5**

Unit/subdivision reference . . . . . Date. . . . . .

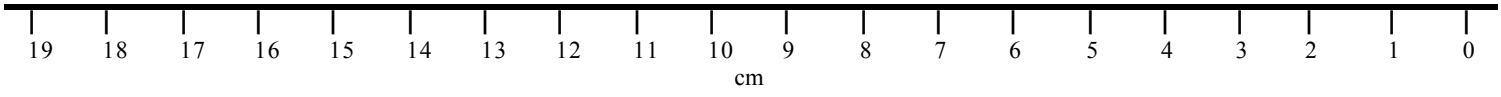
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: mid May-end July (pastures), mid May-hay cut time (meadows) with periodic visit in autumn-winter visit to check condition at end of aftermath grazing period in hay meadows.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing
FYM input
Other inputs
Drainage
Raising water levels
Scrub and weed control
Grazing intensity/stocking rate
Grazing period
Supplementary feeding
Stock type
Rolling and chain harrowing

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: grass/herb (ie non-Graminae) ratio	**40-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Agrimonia eupatoria ( ), Alchemilla spp. ( ), Anenome nemorosa ( ), Centaurea nigra ( ), Euphrasia* spp. *( ), Filipendula ulmaria ( ), Filipendula vulgaris ( ), Galium verum ( ), Genista tinctoria ( ), Lathyrus linifolius (=L. montanus) ( ), Lathyrus pratensis ( ), Leontodon hispidus/L. saxatilis ( ), Leucanthemum vulgare ( ), Lotus corniculatus ( ), Pimpinella saxifraga ( ), Polygala* spp. *( ), Potentilla erecta ( ), Primula veris ( ), Rhinanthus minor ( ), Sanguisorba minor ( ), Sanguisorba officinalis ( ), Serratula tinctoria ( ), Silaum silaus ( ), Stachys officinalis ( ), Succisa pratensis ( ), Tragopogon pratensis ( ),* small blue-green *Carex* spp. (leaves less than 5mm wide) *(=C. flacca, C. nigra, C. panicea) ( ).*	At least two species/taxa **frequent** and four **occasional** throughout the sward	
*Sward composition: frequency of negative indicator species/taxa. *Anthriscus sylvestris ( ), Cirsium arvense ( ), Cirsium vulgare ( ), Galium aparine ( ), Plantago major ( ), Pteridium aquilinum ( ), Rumex crispus ( ) , Rumex obtusifolius ( ), Senecio jacobaea ( ), Urtica dioica ( ).*	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: indicators of waterlogging. Cover % of *Juncus* spp, *Deschampsia cespitosa,* large *Carex* spp. (leaves more than 5mm wide) eg *Carex acutiformis*, large grasses (leaves more than 10mm wide, stout stems) ie *Glyceria maxima, Phalaris arundinacea, Phragmites australis*. **Note**: Care is required on ridge-and-furrow fields where the furrows may support a different interest feature (eg wet grassland).	No species/taxa together or singly covering more than **10%** of the sward	
*Sward composition: frequency and % cover of all scrub and tree species, considered together. NB If scrub/tree species in pastures are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
Sward structure: average height. Upper target refers to pastures only.	**5-15** cm	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **5%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Wet grasslands (excluding *Molinia* grassland)

Context for the attributes that define condition

Habitat type and distribution

This habitat type covers NVC types M22 *Juncus subnodulosus - Cirsium palustre* fen-meadow, M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, and MG8 *Cynosurus cristatus-Caltha palustris* grassland. It also includes communities related to MG8, MG3 *Anthoxanthum odoratum-Geranium sylvaticum* grassland, MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland and MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland.

These related wet grassland communities are not fully described by the NVC but have been described by various authorities as follows:

- MG8 related: southern forms described from the Somerset Levels by Cox 1995, and Prosser & Wallace 1996 and northern forms (also related to the SAC type MG3 *Anthoxanthum odoratum-Geranium sylvaticum* grassland) described from the northern Pennines by Prosser 1990;

- MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* related grassland and MG13 *Agrostis stolonifera-Alopecurus geniculatus* related grassland described from the Somerset Levels by Cox 1995 and Cox & Leach 1996 and from the Yorkshire Derwent Ings (N. Humphries pers comm). This grouping also includes the *Agrostis-Carex* grassland described from the Somerset Levels, and is much richer in species than MG11 and MG13 as described by Rodwell (1992). It also has affinities with MG8.

MG11 and MG13 are considered to be notifiable communities by the 1989 SSSI guidelines (NCC 1989), but the species-poor MG11 and MG13 examples described by Rodwell (1992) are not included in the protocols as they are not generally considered to be of high nature conservation value in their own right. They do, however, often form important habitat or 'site fabric' for species such as breeding and wintering birds. All the other types are notifiable under the Guidelines but none in the wet grassland group are SAC types.

Species-rich inland wet grassland (MG11-related and MG13-related types) are only known from Somerset and Yorkshire but could conceivably occur elsewhere in lowland flood plains. M22 occurs throughout England but the majority of localities are in southern and central areas where the community is highly localised. M23 occurs throughout England but is more abundant in the wetter west. MG8 and related vegetation has a widespread but local distribution throughout England but there are important concentrations in the southern chalkland valleys, the Somerset Levels, the Yorkshire Derwent valley and in enclosed meadows at higher altitudes in the northern Pennines.

The Level 1 features in ENSIS that include wet grassland communities are B5, marshy grassland and B2.1, unimproved neutral grassland and they are represented in the following Level 2 features in ENSIS: MG3, MG8, MG11, MG13, M22 and M23.

The Biodiversity Action Plan priority habitats represented by wet grassland communities are lowland meadow (southern MG8), upland hay meadow (MG3-related, northern MG8-related) and purple moor-grass and rush pastures (M22, M23). The MG11 and 13 related communities and *Agrostis-Carex* can occur in suites of habitats covered by the lowland meadow BAP type, eg with MG8 and MG4, or among more agriculturally improved grassland covered by the coastal and floodplain grazing marsh BAP type.

Extent

All the component grassland types are rare in England as shown in the table below:

Grassland type	Estimated extent (ha)
MG8/ MG8-related north and south, MG3-related	< 900
M22	< 500
M23	<5,000
Inland wet grassland *Agrostis-Carex* grassland MG11 and 13 related.	*<100?

* = Extent not fully known

Landscape structure and dynamics

Wet grassland occurs in a number of different situations. In lowland landscapes, the M22 and M23 fen meadows and rush pastures occur in association with springs, seepage areas and the slopes surrounding waterlogged depressions and hollows. These conditions are typically found on undulating plateaux and hillsides as well as in stream and river valleys. More locally M22 can occur on level terrain river flood plains where base-rich soil water from ground water or periodic surface flooding is present.

Lowland MG8 and related vegetation usually occurs on level terrain in river flood plains. Typically in this situation, the vegetation is subject to periodic inundation usually in autumn and winter. It can also occur as more fragmentary stands below springs, flushes and seepage lines.

Inland wet grassland (MG11-related, MG13-related, *Agrostis-Carex*) occurs on level terrain in flood plains. It occurs in situations where there is prolonged inundation during the period autumn to early spring.

In lowland landscapes that have undergone limited agricultural intensification, transitions from wet grassland to drier unimproved grassland (MG4 and MG5 and calcareous grassland), acid grassland (U4) and wetter tall-herb fens (eg M27 *Filipendula ulmaria-Angelica sylvestris* mire, S24 *Phragmites australis-Peucedanum palustre* tall-herb fen, S25 *Phragmites australis-Eupatorium cannabinum* tall-herb fen), swamps (S2 *Cladium mariscus* swamp and sedge-beds, S5 *Glyceria maxima* swamp, S19 *Eloecharis palustris* swamp, S22 *Glyceria fluitans* water-margin vegetation, S28 *Phalaris arundinacea* tall-herb fen) and small-sedge/*Schoenus* mires (M10 *Carex dioica-Pinguicula vulgaris* mire, M13 *Schoenus nigricans-Juncus subnodulosus* mire) are found. Such sequences reflect variation in topography, management, soil water regime and the base-status of water and surrounding soils. In enclosed upland meadows, transitions from MG8 and related vegetation to MG3 grassland on drier ground and to M23 and M26 in more waterlogged areas are the most usual sequences.

In response to naturally fluctuating water levels from year to year, the boundary zones between these habitats can drift up and down.

Physical attributes and function

The soil types include gleyed brown earths, stagnohumic gleys, stagnogleys, peaty mineral or more rarely shallow peats. Soil pH usually ranges between 4 and 7.5. The soils can range from being damp to the surface for much of the year to having a spring and summer period where the soils dry out, the latter particularly in drier lowland areas.

The limited available data on soil nutrient content for M23 communities indicate that the soils are generally poor in terms of major nutrients (Stevens *et al* 1998, Chambers *et al* 1999). M22 probably also occurs on nutrient poor soils. This in turn limits the agricultural productivity of these habitats which are only able to sustain low outputs per hectare in terms of livestock performance. In contrast, MG8 and MG11 and 13 related communities occurring in lowland flood plains tend to be more productive (Chambers *et al* 1999), probably due to the nature of the soils and the enrichment from silt deposited by floodwaters. The hay and grazing afforded by these types of vegetation can often make a valuable contribution to the feed budgets of commercial livestock enterprises.

The impact of nutrient inputs from the atmosphere is not well understood and needs further study, but atmospheric deposition might contribute a significant element to the nutrient budgets of wet grasslands especially in upland areas. This proportion might have increased with increasing rates of atmospheric deposition, eg of nitrogen.

Critical influences on the habitat are the hydrology and water quality status including base-status. Natural variation in climate may markedly affect the habitat and its catchment (including local ground water regimes), particularly rainfall amounts and evapotranspiration rates. Long term climate change involving these factors also may affect the habitat. Catchment hydrology can also have an impact where, for instance, increase in built land can affect run-off or where drainage may reduce local water tables. Other activities such as water abstraction can influence the hydrology of the habitat. Seasonally flooded types of grassland are particularly sensitive to water tables remaining high from late March onwards. This can result in a shift to inundation grasslands and swamp communities.

There is a clear need for hydrological investigation and modelling in order to understand the hydrology of these wet grassland communities and predict the likely effects of changes in catchment hydrology.

The nutrient budget of the catchment can also affect the inputs to the site eg the amount of agricultural fertilisers used. As far as the lowland MG8 and related communities are concerned, nutrient inputs from flood water are believed to play a significant role in maintaining the nutrient levels in the soils. The habitat may act as a nutrient sink in biogeochemical cycles, although information on nutrient budgets is lacking. However, inputs of nutrients in flood water appear to have allowed the net positive production of biomass over the hundreds or thousands of years that these sites have been managed as hay meadows. In recent times, nutrient levels may have increased if nutrient loading in flood water has risen and this uncertainty illustrates the general need for research into the nutrient budgets of these grasslands.

Species composition

Monocotyledons particularly grasses, sedges and rushes attain a high percentage cover in wet grasslands and are accompanied by a varied mixture of dicotyledonous herbs.

A wide range of species characteristic of unimproved grasslands, fens and mires occur in these wet grasslands and can include *Achillea ptarmica*, *Anthoxanthum odoratum, Briza media, Caltha palustris, Cardamine pratensis, Carex disticha, C. flacca, C. nigra, C. panicea, Eleocharis* spp, *Filipendula ulmaria, Galium palustre, Geum rivale, Juncus acutiflorus, J. subnodulosus, Leontodon* spp, *Lychnis flos-cuculi, Lotus pedunculatus, Mentha aquatica, Oenanthe fistulosa, Ranunculus flammula, Sanguisorba officinalis, Succisa pratensis, Thalictrum flavum, Valeriana dioica* and *Viola palustris*.

The habitat can be variable in terms of species density but unimproved, appropriately-managed stands are generally species-rich, often exceeding 30 species per 4 square metres. Two nationally rare and scarce species occur in these wet grasslands, namely *Lathyrus palustris* and *Peudedanum palustre*. The relationship of species composition, including rare species, to the habitat factors of water regime and nutrient status needs further study. Currently MAFF are funding Cranfield University to investigate the water regime tolerances of wet grassland communities.

Invasive species

Species that are not present at high frequencies in wet grasslands where the hydrological, nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are often characteristic of poorly managed agricultural land in the general countryside: *Anthriscus sylvestris, Cirsium arvense, C. palustre, C. vulgare, Rumex crispus, R. obtusifolius, Senecio jacobaea* and *Urtica dioica*.

Senecio aquaticus, which is toxic to livestock, is a natural component of the sward but may pose a management problem when present in abundance and there is a need for research into the factors affecting its abundance. Species which may be characteristic components of the sward (large *Carex* spp, *Deschampsia cespitosa*, *Juncus* spp and large grasses such as *Phragmites australis*) can increase where inappropriate management or changes in hydrology are occurring, such as decreased intensity or timing of cutting or grazing, nutrient enrichment or waterlogging. In addition, where management by grazing or hay-cutting does not occur over long periods, scrub species can invade. There is a need for further research into the factors affecting the abundance of rushes (*Juncus* species) and the most effective methods of rush control, particularly those which do not involve the use of herbicides.

Sward structure

The structure of the vegetation varies over the year according to a regular pattern of management. The recommended hay cutting dates aim to maintain the botanical interest of these grasslands but there is need for further research into the effects of timing of cutting on plant communities, particularly the effects of i) adhering to rigid cutting dates and ii) occasional late cutting.

Fen meadows & rush pastures (M22 and M23)

The majority of sites are treated as spring and summer pasture particularly for cattle. Typically, stocking rates between 0.2 and 0.5 LU/ha/year are likely to maintain the habitat in favourable condition. Occasionally lowland sites may be managed as hay meadow with a July hay cut followed by late summer/autumn aftermath grazing but this is now quite rare. The regular removal of biomass by grazing and the trampling action of livestock results in only moderate amounts of dead plant material being present at the base of the sward. During the grazing period, there will be some poaching amongst the sward but not such that large areas of bare ground are created.

Lowland MG8 and related vegetation including MG11 and MG13 related and Agrostis-Carex inland wet grassland

These can be managed as hay meadows or as pasture with some alternating from year to year (eg in the Somerset Levels) between both types of management.

For meadows, the sward is cut for hay in the summer, and then aftermath growth is grazed by livestock in late summer and autumn. Where inappropriate grazing does not occur, sward heights are generally 10 cms by the end of May and can reach 70 cms or more by hay-cut time. During this period, the sward is dense with little bare ground visible, although this may be greater during the earlier part of the growing season due to the effects of seasonal flooding. Hay is usually cut between late June and the end of July. The regular removal of biomass by cutting and the subsequent trampling action of livestock results in little dead plant material being present at the base of the sward. During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there should be little poaching amongst the sward and no larger patches of bare ground.

For pastures, the sward height through the season should lie within the range 5-15 cms. However, dead plant material at the base of the sward is not extensive as long as grazing levels are sufficient. During the grazing period, there should be little poaching amongst the sward and no larger patches of bare ground.

Upland wet northern hay meadow (MG8/MG3-related)

In the uplands, sites are mostly managed as hay meadow with livestock grazing during late summer, autumn and spring. The sward is cut for hay in the summer, and then aftermath growth is grazed by livestock in late summer and autumn. Sporadic grazing may take place in the winter months, followed by spring sheep grazing on the meadows until they are shut up for hay. Shut up dates vary although usually livestock have been removed by mid-May. It is known that heavy grazing of other types of neutral grasslands can lead to reductions in species diversity and changes in composition. The effect of length and intensity of the spring grazing period on species composition of wet northern hay meadows is not well understood and needs investigation. Sward heights are generally at least 5 cms by the end of May and can reach 70 cms or more by hay-cut time. During this period, the sward is dense with little bare ground visible, while the regular removal of biomass by cutting and the subsequent trampling action of livestock results in little dead plant material being present at the base of the sward. Hay is usually cut in July with an occasional late cut in August/September. During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there should be little poaching amongst the sward and no larger patches of bare ground.

For pastures, the sward height through the season should lie within the range 5-15 cms. However, dead plant material at the base of the sward is not extensive as long as grazing levels are sufficient. During the grazing period, there should be little poaching amongst the sward and no larger patches of bare ground.

Although broad targets for sward structure can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **MG8, MG8-related (south)**, **M22, M23**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained / Favourable recovered / Unfavourable improving / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

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Recommended visiting period: May-August (before hay-cutting in meadows) with periodic visit in autumn-winter visit to check condition at end of aftermath grazing period in hay meadows.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Drainage and ditch water-levels	Rolling and chain harrowing
Scrub and weed control	Raising water levels

Other useful information from the manager: Timing and duration of natural flooding

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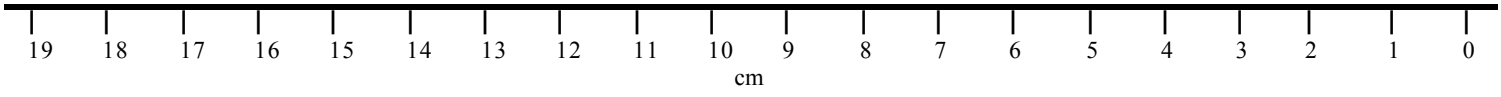
Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: frequency of positive indicator species. *Achillea ptarmica* ( ), *Berula erecta* ( ), *Caltha palustris* ( ), *Cardamine pratensis* ( ), *Cirsium dissectum* ( ), *Eupatorium cannabinum* ( ), *Filipendula ulmaria* ( ), *Galium palustre/G. uliginosum* ( ), *Geum rivale* ( ), *Hydrocotyle vulgaris* ( ), *Lotus pedunculatus* ( ), *Lychnis flos-cuculi* ( ), *Mentha aquatica* ( ), Orchidaceae spp. ( ), *Potentilla palustris* ( ), *Ranunculus flammula* ( ), small blue-green *Carex* spp. (leaves less than 5mm wide) (=*C. flacca, C.nigra, C.panicea*) ( ), *Succisa pratensis* ( ), *Thalictrum flavum* ( ), *Valeriana dioica* ( ), *Viola palustris* ( ).	At least two species/taxa **frequent** and four **occasional** throughout the sward, or **locally abundant** over more than **10%** of the sward:	
*Sward composition: frequency of negative indicator species. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Urtica dioica* ( ).	No species more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together, excluding *Salix repens*. NB If scrub/tree species in pastures are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5 %** cover	
*Sward composition, indicators of waterlogging, **MG8, MG8-related only**: % cover of *Juncus* spp, *Deschampsia cespitosa*, large *Carex* spp. (leaves more than 5mm wide) eg *Carex acutiformis*, large grasses (leaves more than 10mm wide, stout stems) ie *Glyceria maxima, Phalaris arundinacea, Phragmites australis*.	No species/taxa together or singly covering more than **10%** of the sward	



Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Sward composition, **M22, M23 only**: % cover of *Juncus* spp. in Group A and B. **Group A**: jointed rushes (=*Juncus acutiflorus, J. articulatus, J. subnodulosus*) **Group B**: *Juncus conglomeratus, J. effusus and J. inflexus.*	Species from Group A at least **occasional** throughout the sward. All species combined no more than **80%** cover, of which no more than **50%** made up of species from Group B	
*Sward composition, indicators of waterlogging**, M22, M23 only**: % cover of large *Carex* spp. (leaves more than 5mm wide) eg *Carex acutiformis*.	No species/taxa together or singly covering more than **20%** of the sward	
*Sward composition, indicators of waterlogging**, M22, M23 only**: % cover of *Deschampsia cespitosa,* large grasses (leaves more than 10mm wide, stout stems) ie *Glyceria maxima, Phalaris arundinacea, Phragmites australis*.	No species/taxa together or singly covering more than **10%** of the sward	
Sward composition: frequency of negative indicator species. *Senecio aquaticus* ( )	No more than **occasional** throughout the sward or more than **5%** cover	
Sward structure: average height of sward**.** Upper target refers to pastures only.	**MG8,** **MG8-rel.** **5-15** cm	
	M22, M23 Sward **2 cm** or greater (excluding *Juncus* species) but no more than **25%** over **40** cm (including *Juncus* species)	
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation, eg from the seasonal effects of flooding.	**MG8, MG8-related:** No more than **15%** in May-early June <u>or</u> no more than **5%** in mid-June-July	
	M22, M23: No more than **10%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Inland wet grassland, Agrostis-Carex grassland, MG11-related, MG13-related**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained / Favourable recovered / Unfavourable improving / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

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Recommended visiting period: May-July (before hay-cutting in meadows) with periodic visit in autumn-winter visit to check condition at end of aftermath grazing period in hay meadows.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Drainage and ditch water-levels	Rolling and chain harrowing
Scrub and weed control	Raising water levels

Other useful information from the manager: Timing and duration of natural flooding

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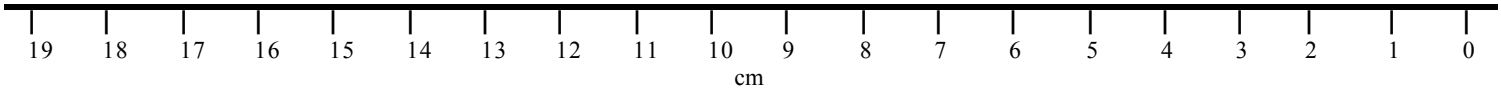
Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: frequency of positive indicator species. *Achillea ptarmica* ( ), *Caltha palustris* ( ), *Cardamine pratensis* ( ), *Eleocharis* spp. ( ), *Filipendula ulmaria* ( ), *Galium palustre / G. uliginosum* ( ), *Juncus acutiflorus / J. articulatus / J. subnodulosus* (=jointed rushes) ( ), *Leontodon autumnalis* ( ), *Lychnis flos-cuculi* ( ), *Lysimachia nummularia* ( ), *Mentha aquatica* ( ), *Myosotis laxa cespitosa / M. scorpioides* ( ), *Oenanthe fistulosa* ( ), *Persicaria amphibia* ( ), *Ranunculus flammula* ( ), small blue-green *Carex* spp. (leaves less than 5mm wide) (=*C. flacca, C.nigra, C.panicea*) ( ), *Thalictrum flavum* ( ).	At least two species/taxa **frequent** and two **occasional** throughout the sward, or **locally abundant** over more than 10% of the sward	
*Sward composition: frequency and % cover of negative indicator species. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Urtica dioica* ( ).	No species more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all scrub and tree species, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: % cover of *Juncus* spp, *Deschampsia cespitosa,* large (leaves more than 5 mm wide) *Carex* spp. (eg *Carex acutiformis*), large grasses (leaves more than 10 mm wide, stout stems) ie *Glyceria maxima, Phalaris arundinacea, Phragmites australis*.	No species/taxa together or singly covering more than **25%** of the sward	
Sward composition: frequency and % cover of negative indicator species. *Senecio aquaticus ( )*	No more than **occasional** throughout the sward or more than **5%** cover	
Sward structure: average height. Upper target refers to pastures only.	**5-15** cm (excluding *Juncus* species)	
Sward structure: cover of litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation, eg from the seasonal effects of flooding.	No more than **15%** in May-early June or no more than **10%** in mid-June-July	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Molinia caerulea grasslands including SAC type *Molinia* meadows on chalk and clay (Eu-Molinion)

Context for the attributes that define condition

Habitat type and distribution

Molinia grasslands encompass three NVC types, M24 *Molinia caerulea-Cirsium dissectum* fen meadow, M25 *Molinia caerulea-Potentilla erecta* mire and M26 *Molinia caerulea - Crepis paludosa* mire. M24 and M26 are SAC types while M25 is an SSSI interest feature.

1. SAC type*: Molinia* meadows on chalk and clay (Eu-Molinion)

This habitat type has been interpreted as corresponding to the NVC types M24 and M26. The former type is found in the lowlands and generally has a southern distribution in Britain. It is most abundant in the wetter west with important concentrations in south-west England western and central Wales. However, distinctive examples also occur in East Anglia. M26 is a rare type restricted to the upland fringes. In England it is confined to the northern Pennines and parts of Cumbria.

The sites that have been selected as candidate SACs encompass the range in floristic variation in the habitat type across the UK. Sites selected to represent each sub-type (NVC community or sub-community) are those that have the largest surviving areas and the most stable patterns of traditional low-intensity management and so show a high degree of conservation of structure and function. Sites selected also often show transitions to other communities such as grassland, fen and mire.

2. M25 *Molinia caerulea-Potentilla erecta* mire

M25 occurs primarily in the western oceanic areas of Britain, from northern Scotland to Cornwall in England. The type occurs mainly in the lowlands but also extends into the fringes of the uplands.

The Level 1 feature for *Molinia* grasslands in ENSIS is B5, marshy grassland. The individual NVC types, M24, M25 and M26 are Level 2 features in ENSIS. The Biodiversity Action Plan priority habitat represented by M24, M25 and M26 is the purple moor-grass (*Molinia caerulea*) and rush pasture type. The Habitat Action Plan Group covering this habitat defined the key habitat as lowland, ie restricted the Plan to stands below the limit of enclosure (D. Stevens, Countryside Council for Wales, pers comm).

Extent

The SAC NVC types are scarce grasslands with most of the resource occurring in England and Wales. It is estimated that less than 2,000 ha of M24 and less than 500 ha of M26 remain in England. M25 is similarly rare in the English lowlands, with less than 2,500 ha estimated as remaining here.

Landscape structure and dynamics

Molinia grasslands occur in a number of different situations. In lowland landscapes, M24 and M25 occur where the water table is near the ground surface, for example springs, seepage areas and the sloping surrounds of waterlogged depressions and hollows. These conditions are typically found on undulating plateaux and hillsides as well as in stream and river valleys. M26 occurs in upland situations associated with flushed slopes in enclosed sub-montane meadows and pastures or as part of the toposequence around open waters and mires.

In lowland landscapes that have undergone limited agricultural intensification, transitions to drier unimproved grassland (MG5) or heath and wetter tall-herb fens (eg S5 *Glyceria maxima* swamp), wet heaths or mires are found. Such sequences reflect variation in the soil water regime and the base-status of water and surrounding soils.

Physical attributes and function

Soils range from moist to fairly dry peaty mineral or peat soils with a pH usually ranging between 5 and 7. M24 usually occurs on more base-rich substrates compared to M25, though both can occur on circumneutral soils and have close floristic affinities in these situations (Rodwell 1991). The soils are usually stagnohumic gleys, stagnogleys or more rarely, peats. The soils are rarely flooded to the surface but can range from being damp to the surface for much of the year to having a summer period where the soils dry out, the latter particularly in drier lowland areas. *Molinia caerulea* is characteristically found on wet but not waterlogged soils, with good aeration throughout most of the year. The hydrological regime necessary for the maintenance of the habitat is thus relatively narrowly defined although better data on this topic are essential.

The limited available data on soil nutrient content indicate that the soils are generally poor in terms of major nutrients (Stevens *et al* 1998, Chambers *et al* 1999). This in turn limits the agricultural productivity of this habitat which is only able to sustain low ouputs per hectare in terms of livestock performance. The impact of nutrient inputs from the atmosphere is not well understood and needs further study, but atmospheric deposition might contribute a significant element to the nutrient budgets of the habitat. This proportion might have increased with increasing rates of atmospheric deposition, eg of nitrogen.

Critical influences on *Molinia* grasslands are the hydrology and water quality status including base-status. Natural variation in climate may markedly affect the habitat and its catchment (including local groundwater regimes), particularly rainfall amounts and evapotranspiration rates. Long term climate change involving these factors also may affect the habitat. Catchment hydrology can also have an impact where, for instance, increase in built land can affect run-off or where drainage may reduce local water tables. Other activities such as water abstraction can influence the hydrology of the habitat. The nutrient budget of the catchment can affect the inputs to sites, eg the amount of agricultural fertilisers used.

There is a clear need for hydrological investigation and modelling in order to understand the hydrology of these *Molinia* communities and predict the likely effects of changes in catchment hydrology.

Species composition

The grassland types consist of a varied mixture of dicotyledonous herbs, sedges, rushes and grasses, with monocotyledons particularly grasses, sedges and rushes attaining a high percentage cover in the sward.

Constant species found in both M24 and M26 (the SAC types) are *Molinia caerulea, Potentilla erecta* and *Succisa pratensis,* whereas only the first two listed species are constant in M25. A wide range of other species characteristic of unimproved grasslands and fens also occur in these *Molinia* grasslands and can include *Angelica sylvestris*, *Anthoxanthum odoratum*, *Briza media, Carex flacca, C. nigra, C. panicea, Cirsium dissectum, Crepis paludosa, Filipendula ulmaria, Galium palustre, Juncus acutiflorus, Lotus uliginosus, Narthecium ossifragum, Sanguisorba officinalis, Serratula tinctoria* and *Viola palustris*. The SAC types are species-rich with overall means of 26 and 31 species per 4 square metres for M24 and M26 respectively. Species-richness varies across the sub-communities of M25. M25b is the richest with similar values to M24. M25 can also result from the degradation of other habitats through burning and drainage, eg fringes of blanket and raised mires (Rodwell 1991). In these situations the community is generally species-poor and of low conservation interest. Nationally rare and scarce species occur in *Molinia* grasslands including *Selinum carvifolia, Hypericum undulatum* and *Scozonera humilis* associated with the SAC habitat and *Erica vagans* and *Lobelia urens* in M25.

The relationship of species composition, including rare species, to the habitat factors of water regime and nutrient status needs further study. Currently MAFF are funding Cranfield University to investigate the water regime tolerances of wet grassland communities, including *Molinia* grasslands.

Invasive species

Species that are not present at high frequencies in *Molinia* grasslands where the hydrological, nutrient and sward structural conditions required for the habitat are found can increase when these conditions are not met. Such species are characteristic of poorly managed agricultural land in the general countryside: *Cirsium arvense, C. palustre, C. vulgare, Rumex crispus, R. obtusifolius, Senecio jacobaea* and *Urtica dioica*.

Species which may be characteristic components of the sward (*Juncus* spp, *Deschampsia cespitosa* and *Phragmites australis*) can increase where inappropriate management or changes in hydrology are occurring, such as decreased intensity or timing of cutting or grazing, nutrient enrichment and waterlogging. In addition, where management by grazing or hay-cutting does not occur over long periods, scrub species can invade. There is a need for further research into the factors affecting the abundance of rushes (*Juncus* species) and into the most effective methods of rush control, particularly those which do not involve the use of herbicides.

Sward structure

The structure of the vegetation varies over the year according to a regular pattern of management. While recommendations can be made as to the timing of hay cutting to maintain the botanical interest of these communities in sites managed as meadows, there is

need for further research into the effects of timing of cutting on plant communities, particularly the effects of i) adhering to rigid cutting dates and ii) occasional late cutting.

Lowland (M24 & M25):

The majority of sites are treated as spring and summer pasture particularly for cattle. Typically, stocking rates between 0.2 and 0.5 LU/ha/year are likely to maintain the habitat in favourable condition. Occasionally lowland sites may be managed as hay meadow with a July hay cut followed by late summer/autumn aftermath grazing but this regime is now quite rare. The regular removal of biomass by grazing and cutting in meadows and pastures and the trampling action of livestock result in only moderate amounts of dead plant material being present at the base of the sward. For sites treated as pasture, and where inappropriate grazing does not occur, sward heights during the period June to August will vary according to the NVC community/sub-community type and the nature of the grazing practised. Where livestock are not inappropriately kept on sites in wet periods there should be little poaching amongst the sward and no larger patches of bare ground. Particular sub-communities, M24a and M25c, seem to be associated with more intermittent management and have taller swards with tall herbs such as *Eupatorium cannabinum* and *Angelica sylvestris*. The management regimes that enable these sub-communities to persist are not well understood and require detailed characterisation.

Upland (M26):

In the uplands, sites may be managed as hay meadow with livestock grazing during late summer, autumn and spring (usually the *Festuca rubra* NVC sub-community of M26) or as pasture with intermittent grazing (*Sanguisorba officinalis* NVC sub-community of M26).

Upland sites which occur in flushed areas within enclosed meadows are subject to the same treatment as the Mountain hay meadows SAC type (MG3) although as the *Molinia* areas are often wetter, they may not get cut with the same degree of regularity as the surrounding neutral meadow community.

During the hay growing season (June and July) the sward height would not be expected to be below 5 cm in early June following removal of grazing animals and may reach 70 cms or more by hay cut time. As with upland MG3 meadows, the current advice is that they should be cut in July with an occasional late cut in August/September. During this period, the sward is quite dense with little bare ground visible, while the regular removal of biomass by cutting and the subsequent action of grazing animals result in little dead plant material being present at the base of the sward. During the aftermath grazing period, where livestock are not inappropriately kept on the site in wet periods, there will be little poaching amongst the sward and no larger patches of bare ground.

Upland sites associated with standing open waters and mires tend to be associated with light, episodic grazing. These stands, which are usually the sub-community M26a, being less intensively managed than those in enclosed meadows, often support a higher cover of the tall herb species such as *Sanguisorba officinalis* and *Angelica sylvestris*. The management regimes that enable this sub-type to persist are not well understood and require detailed characterisation.

Although broad targets for sward structure can be given, to refine these targets detailed investigation would be needed of the relationship of amounts bare ground and litter to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **M24, M25**

Unit/subdivision reference . . . . . Date. . . . . .

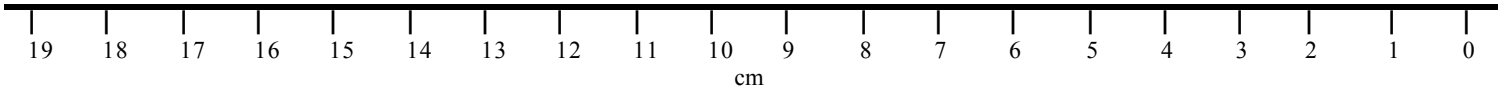
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: Hay meadows: June-July (before hay cut), with periodic visit in autumn-winter visit to check condition at end of aftermath grazing period. Pastures: June-August.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing	Scrub and weed control
FYM input	Grazing intensity/stocking rate
Other inputs	Grazing period
Drainage	Supplementary feeding
Raising water levels	Stock type
Burning	Rolling and chain harrowing

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition: frequency of positive indicator species/taxa. *Anagallis tenella* ( ), *Angelica sylvestris* ( ), *Carum verticillatum* ( ), *Cirsium dissectum* ( ), *Erica tetralix* ( ), *Eupatorium cannabinum* ( ), *Filipendula ulmaria* ( ), *Galium uliginosum*/*Galium palustre* ( ), *Lotus pedunculatus* ( ), *Narthecium ossifragum* ( ), Orchidaceae spp. ( ), *Pedicularis sylvatica* ( ), *Potentilla erecta* ( ), *Serratula tinctoria* ( ), small blue-green *Carex* spp. (leaves less than 5mm wide) (=*C. flacca, C.nigra, C.panicea*) ( ), *Sphagnum* spp. ( ), *Succisa pratensis* ( ), *Valeriana dioica* ( ), *Valeriana officinalis* ( ), *Viola palustris* ( ).	At least two species/taxa **frequent** and three species/taxa **occasional** throughout the sward	
*Sward composition: frequency and % cover of *Molinia caerulea*.	At least **frequent** throughout the sward but no more than **80%** cover	
*Sward composition: frequency and % cover of negative indicator species. *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: % cover of *Juncus* species in Group A and B. **Group A**: jointed rushes (=*Juncus acutiflorus*, *J. articulatus, J. subnodulosus*) **Group B**: *Juncus conglomeratus, J. effusus and J. inflexus*.	All species combined no more than **80%** cover, of which no more than **50%** made up of species from Group B	



Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: % cover of *Cirsium palustre.*	No more than **20%** cover.	
*Sward composition: % cover of *Deschampsia cespitosa.*	No more than **10%** cover.	
*Sward composition: frequency and % cover of all scrub and tree species, considered together**, excluding** *Salix repens* and *Myrica gale*. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
*Sward composition: % cover of *Phragmites australis.*	No more than **10%** cover.	
Sward composition: % cover of *Myrica gale.*	No more than **10%** cover	
Sward composition: frequency and % cover of negative indicator species. *Senecio aquaticus ( )*	No more than **occasional** throughout the sward or more than **5%** cover	
Sward structure: average height. Upper target refers to pastures only.	**M24a**, **M25c** Sward **5** cm or greater (excluding *Juncus* spp.) but no more than **25%** over **60** cm (including *Juncus* species)	
	M24b, M24c, M25a, M25b Sward **2** cm or greater (excluding *Juncus* spp.) but no more than **25%** over **15** cm (including *Juncus* species)	
Sward structure: extent of litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **10%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **M26, MG8-related (north) , MG3-related (wet northern hay meadow)**

Unit/subdivision reference . . . . . Date. . . . . .

Condition: Favourable maintained / Favourable recovered / Unfavourable improving / Unfavourable no change / Unfavourable declining / Partially destroyed / Destroyed

Recommended visiting period: Hay meadows: June-July (before hay cut), with periodic visit in autumn-spring visit to check condition at end of aftermath grazing period. Pastures: June-August.
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Hay+aftermath grazing	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Drainage	Rolling and chain harrowing
Scrub and weed control	Burning

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map)
*Sward composition, **MG8-related** and **MG3-related only:** grass/herb (ie non-Graminae) ratio	**50-90%** herbs	
*Sward composition: frequency of positive indicator species/taxa. *Achillea ptarmica* ( ), *Ajuga reptans* ( ), *Caltha palustris* ( ), *Crepis paludosa* ( ), *Euphrasia* spp. ( ), *Filipendula ulmaria* ( ), *Geum rivale* ( ), *Leontodon* spp ( ), *Lychnis flos-cuculi* ( ), Orchidaceae spp. ( ), *Potentilla erecta* ( ), *Rhinanthus minor* ( ), *Sanguisorba officinalis* ( ), *Serratula tinctoria* ( ), *Succisa pratensis* ( ), *Trollius europaeus* ( ) *Valeriana dioica* ( ), small blue-green *Carex* spp. (leaves less than 5mm wide) (=*C. flacca, C. nigra, C. panicea*) ( ).	At least two species/taxa **frequent** throughout the sward, and four **occasional** throughout the sward, or **locally abundant** over more than 10% of the sward	
*Sward composition, **M26 only**: frequency and % cover of *Molinia caerulea*	At least **frequent** throughout the sward but no more than **80%** cover	
*Sward composition: frequency and % cover of negative indicator species/taxa. *Anthriscus sylvestris* ( ), *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	

19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
cm

Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Sward composition: frequency and % cover of all scrub and tree species, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
*Sward composition: % cover of *Juncus* species in Group A and B. **Group A**: jointed rushes (=*Juncus acutiflorus*, *J. articulatus, J. subnodulosus*) **Group B**: *Juncus conglomeratus, J. effusus and J. inflexus*	**MG8-related, MG3-related** All species combined no more than **50%** cover, of which no more than **25%** made up of species from Group B	
	M26 All species combined no more than **80%** cover, of which no more than **50%** made up of species from Group B	
*Sward composition: % cover of *Deschampsia cespitosa.*	No more than **10%** cover	
*Sward composition, **M26** only: cover of *Phragmites australis.*	No more than **5%** cover	
Sward structure: average height. Upper target applies to pastures only.	**MG8-related, MG3-related** **5** cm (excluding *Juncus* species) to **15** cm (including *Juncus* species)	
	M26 **5 cm** or greater (excluding *Juncus* species) but no more than **25%** of sward over **40** cm (including *Juncus* species)	
Sward structure: cover of litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than **25%** of the sward	
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than **5%**	

Structured walk recording form
Frequencies: **totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

Metallophyte vegetation: SAC type Calaminarian grasslands

Context for the attributes that define condition

Habitat type and distribution

This habitat type consists of vegetation occurring on soils enriched with heavy metals such as lead, zinc and copper in both near-natural and artificial situations. Vegetation of this type is referable to the Violetea calaminareae class of continental phytosociology. This has been divided into three alliances of which the Thlaspion calaminaris is typical of western central Europe. Within the latter alliance, seven associations are recognised in Europe of which the Minuartio-Thlaspietum alpestris represents British metallophyte vegetation. This alliance is equivalent to the NVC type OV37, *Festuca ovina-Minuartia verna* community although the vegetation covered by the NVC type is more narrowly defined than the range of vegetation present in the UK SAC series.

In England, the type is confined to the Northern Pennines, Derbyshire Dales, Cornwall and the Mendips with the majority of sites occurring in areas of former mining activity.

The sites selected as candidate SACs include the best examples of the three main situations where this vegetation has developed. These are:

- Near-natural, open vegetation of serpentine rock outcrops with skeletal soils (Scotland only). Elsewhere natural outcrops of veins containing heavy metals are very rare due to past mining activity
- River gravels and alluvium rich in lead and zinc that are near-natural although the heavy metal content may be partly an artefact of past mining activity in the river catchment
- Artificial mine workings and spoil heaps

The sites that have been selected as SACs are those that have the largest extent of the habitat, the greatest number of metallophyte species and that are considered to be the most structurally-varied.

The SAC type is a Level 2 feature in ENSIS. The Level 1 feature will be determined by Local Teams but is likely to be I2 (artificial) in the case of mine waste sites or J5 (other habitat) for river shingle sites. Currently, metallophyte vegetation is not a Biodiversity Action Plan priority habitat.

Extent

There are no accurate estimates of the extent of the habitat although it is highly localised in the UK. It is estimated that less than 10,000 ha remain. Artificial mine sites are quite numerous but few of these support a wide range of metallophyte species.

Landscape structure and dynamics

In England, the habitat occurs in lowland limestone hills or the northern uplands and their fringes, either in areas of former lead and zinc mining activity or adjacent to rivers on gravel

deposits. Areas of the habitat are often sharply marked off from other vegetation because of the toxicity of the substrate. Upland mine sites are usually juxtaposed with acid grassland/dwarf shrub heath or limestone grassland depending on soils and geology. Metallophyte vegetation on river shingle sites are bounded by riparian vegetation and flowing water on the one hand and tall grassland, scrub and woodland on the landward side. These mosaics of metallophyte vegetation, tall grassland and scrub are often adjacent to more intensively-managed agricultural land particularly improved or semi-improved grassland.

In the absence of management, the pathway and speed of succession will vary according to soil type, levels of heavy metals in the soil, geology, altitude and surrounding land use. Intermediate communities would include calcareous, acid or neutral grassland but ultimately the succession will lead to scrub and woodland communities. The succession is likely to be very slow on sites with high initial heavy metal concentrations in the soil.

Physical attributes and function

Soils are often skeletal and contain high levels of heavy metals. The substrate varies from river gravel, shingle or alluvium to mine waste derived from acid or calcareous sedimentary rocks of Carboniferous age, usually limestone or Millstone Grit. Mine wastes and spoil vary in their composition and can range from rock fragments to finer mineral debris. The conditions of the substrate are extreme for plant growth due to elevated heavy metal status, low nutrient availability and poor water retention.

Most metallophyte species require open ground to persist although *Viola lutea* can occur in closed turf. Further research on the autecological requirements of these species would however, be useful to determine best practice management.

Given the requirement for open ground, the need to arrest succession is a key management issue (Sellars and Baker 1988). Whilst the speed of succession is likely to be very slow due to the extreme environment, particularly on mine spoil, nonetheless over time the physical environment is likely to ameliorate due to the effects of the initial colonising species, and other species will invade. This will reduce the extent of open ground and increase competition. Grazing may help in providing niches for metallophytes in more closed turf situations but it is uncertain whether this is adequate in the long term to maintain populations of the key species.

Consideration may need to be given to the use of rotational disturbance to increase the area of bare ground, although whether this can re-create the original extreme conditions is not known. Further research would be desirable including sampling of heavy metal concentrations in soils of sites in differing conditions.

The other related issue with respect to the river shingle vegetation is whether new metallophyte habitat is being created by erosion and deposition in the river catchments. This is an an important issue as it will influence policy on the management of the existing sites which are threatened by successional change. Another important and related issue is the need to understand the fluvio-geomorphology of existing river shingle sites. Some sites are likely to be fossilised and away from the influence of fluvial erosion processes but this may not be the case for sites closer to the river channel. River shingle sites are potentially vulnerable to

river engineering projects, either directly or because the fluvio-geomorphology of the river channel system is changed.

Species composition

The vegetation usually consists of an open mixture of grasses and dicotyledonous herbs, the latter including the metallophyte species. Some stands contain varied assemblages of lichens and bryophytes.

Various classes of metallophytes have been recognised depending on the degree of restriction to metalliferous soils. Absolute metallopytes are taxa which are found only on contaminated soils over their geographical distribution whereas local metallophytes are found only on heavy metal contaminated soil within a given region but occur on non-contaminated soils in other parts of their range.

There are seven absolute and local vascular plant metallophyte species which can occur in English stands of the vegetation. These are *Armeria maritima, Botrychium lunaria, Cochlearia pyrenaica, Minuartia verna*, *Silene uniflora* (=*Silene vulgaris* ssp *maritima*), *Thlaspi caerulescens* and *Viola lutea*. A range of other non-metallophyte species characteristic of semi-natural grassland and early successional habitats can also occur. These include *Festuca ovina, Achillea millefolium*, *Agrostis capillaris*, *Anthoxanthum odoratum,Thymus polytrichus*, *Campanula rotundifolia*, *Linum catharticum*, *Lotus corniculatus*, *Euphrasia officinalis* agg, *Rumex acetosa*, *Pilosella officinarum* and *Agrostis stolonifera*.

The vegetation varies considerably in its species richness depending on soil type, geology, metal content of the soil, age, management and altitude. The range recorded in Rodwell (2000) for OV37 samples is 9-29 with an average of 16 species per 4 square metres. The more open stands tend to be more species-poor whereas closed turf vegetation on limestone-derived subsrates can be species-rich and approach calcareous grassland in its species composition.

Thlaspi caerulescens, one of the absolute metallophyte species, is nationally scarce and is confined to soils with high heavy metal concentrations. Rare and scarce bryophyte and lichens are also found on metallophyte sites, including the endemic *Ditrichum cornubicum*, which is confined to this habitat. Some of these sites lack vascular plant metallophytes and at present will have site-specific attributes which define condition. Further study of the ecology and distribution of lower plant metallophytes is required to guide management and the identification of more generic attributes.

Invasive species

Species that are not present at high frequencies in Calaminarian vegetation where the required substrate and management conditions are found can increase when these conditions are not met. Such species are characteristic of more nutrient-rich soils with sporadic management and include : *Anthriscus sylvestris, Cirsium arvense, C. vulgare, Heracleum sphondylium, Urtica dioica* and coarse grasses such as *Arrhenatherum elatius* and *Holcus lanatus*. In addition, where management by grazing or disturbance does not occur over long periods, scrub species can invade.

Sward structure

The sward structure is typically open with greater than 20% bare ground and with vegetation height not exceeding 5 cms on average. This is thought to be the ideal structure for maintaining populations of the characteristic vascular plant metallophytes and associated species. Although broad targets for sward structure can be given, to refine these there would be a need to investigate in detail the relationship of amounts bare ground to plant species composition, including the abundance of invasive species.

Lowland grassland SSSI condition assessment (version date 10/10/00)

ENGLISH NATURE

Site Name: . . . . . .

NVC type: **Calaminarian grassland, OV37 (metallophyte vegetation of mine spoil, river gravels, natural heavy metal rock outcrops).**

Unit/subdivision reference . . . . . Date. . . . . .

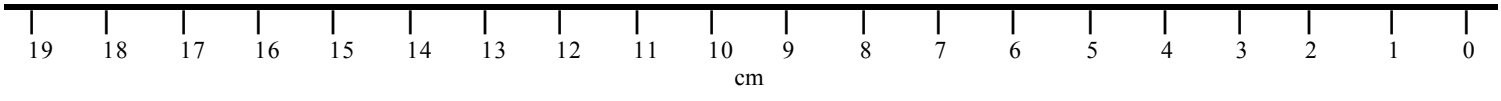
Condition: Favourable maintained/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: mid-May - July
Recommended frequency of visits: Site-specific decision

Key management activities affecting condition to discuss with manager:

Scrub and weed control	Grazing intensity/stocking rate
FYM input	Grazing period
Other inputs	Supplementary feeding
Rolling and chain harrowing	Stock type
Reclamation activities eg tree planting	River management works

Attribute (*= mandatory attribute. One failure among mandatory attributes = unfavourable condition)	***Target***	***Estimate for attribute***
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed). **NB** If erosion of river gravels has occurred review dynamics of river system eg gravel re-deposition downstream.	No loss without prior consent	(Describe and refer to map)
*Sward composition: frequency of metallophyte species , either singly or together. Assemblage ( ) *Armeria maritima* ( ), *Cochleria pyrenaica* ( ), *Minuartia verna* ( ), *Silene uniflora* (= *Silene vulgaris* ssp *maritima*) ( ), *Thlaspi caerulescens* ( ), *Viola lutea* ( ).	Metallophyte species singly or together at least **occasional** throughout the sward	
*Sward composition: frequency and % cover of negative indicator species/taxa. NB Applies within original area of interest, not adjoining areas. *Anthriscus sylvestris* ( ), *Cirsium arvense* ( ), *Cirsium vulgare* ( ), *Heracleum sphondylium* ( ), *Urtica dioica* ( ), coarse grasses eg *Arrhenatherum elatius, Holcus lanatus* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than **5%** cover	
*Sward composition: frequency and % cover of all tree and scrub species, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out.	No more than **5%** cover	
*Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation. Bare ground includes cobbles, gravel and thin crusts of lichens, not foliose or fructose lichens.	**20-90%**	
Sward structure: average height.	**5** cm or less	



Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total

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Tables

Table 1. Terminology used for grassland interest features

Mesotrophic grassland types

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
MG2	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Damp scrub transitions (in limestone landscapes), northern tall herb grassland
MG3	Unimproved neutral grassland	**Mountain hay meadows (British types with *Geranium sylvaticum*)**	Upland hay meadows	Northern hay meadows
MG4	Unimproved neutral grassland	**Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)**	Lowland meadows	Flood plain meadows
MG5	Unimproved neutral grassland	-	Lowland meadows	Old meadows and pastures
MG8, MG8-related (south)	Unimproved neutral grassland, Unimproved marshy grassland	-	Lowland meadows	Flood pasture, water meadow
MG8-related, MG3-related (north)	Unimproved neutral grassland, Unimproved marshy grassland	**Mountain hay meadows (British types with *Geranium sylvaticum*)**	Upland hay meadows	Wet northern hay meadows
Ag-Cx, MG11-related, MG13-related	Unimproved neutral grassland, Unimproved marshy grassland	-	Lowland meadow, coastal and floodplain grazing marsh	Silver meadows, inundation grassland

Calcareous grassland types

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
CG1	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Warm southern temperate limestone grassland, thermophilous limestone grassland
CG2	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Species-rich chalk and limestone grassland
CG3	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Upright Brome grassland
CG4	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Tor-grass grassland
CG5	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Upright Brome - Tor-grass grassland
CG6, CG2d-related, MG1-related (dry scrub edge)	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Downy Oat-grass grassland, dry tall herb grassland, dry grassland/scrub transitions
CG7a,b,d,e	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Species-rich parched grassland
CG7c	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Lichen grassland

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
CG8	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland	Magnesian Limestone grassland
CG9	Unimproved calcareous grassland	**Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).**	Lowland calcareous grassland/ Upland calcareous grassland	Northern Carboniferous Limestone grassland

Calcifugous grassland types

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
U1a	Unimproved acid grassland	-	Lowland dry acid grassland	Lichen grassland
U1b,c,d,f	Unimproved acid grassland	-	Lowland dry acid grassland	Species-rich parched grassland
U1e	Unimproved acid grassland	-	Lowland dry acid grassland	Bent-Fescue - Sheep's Sorrel-Heath Bedstraw grassland
U3	Unimproved acid grassland	-	Lowland dry acid grassland	Bristle Bent grassland
U4a	Unimproved acid grassland	-	Lowland dry acid grassland	Moist acid grassland
U4c	Unimproved acid grassland	-	Lowland dry acid grassland	Herb-rich acid grassland
U4/U20 related	Unimproved acid grassland	-	Lowland dry acid grassland	Species-rich bracken

Mire types

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
M22	Unimproved marshy grassland	-	Purple moor-grass and rush pastures	Fen meadow, Blunt-flowered Rush - Marsh Thistle grassland
M23	Unimproved marshy grassland	-	Purple moor-grass and rush pastures	Rush pasture, Soft Rush - Marsh Bedstraw pasture
M24	Unimproved marshy grassland	***Molinia* meadows on chalk and clay (Eu-Molinion)**	Purple moor-grass and rush pastures	Fen meadow, Purple Moor-grass - Meadow Thistle grassland
M25	Unimproved marshy grassland	-	Purple moor-grass and rush pastures	Purple Moor-grass - Tormentil mire/grassland
M26	Unimproved marshy grassland	***Molinia* meadows on chalk and clay (Eu-Molinion)**	Purple moor-grass and rush pastures	Wet northern hay meadows, Purple Moor-grass - Marsh Hawk's-beard fen/grassland

Open vegetation types

Interest (criteria) feature (ENSIS Level 2)	Operational feature (ENSIS Level 1)	SAC type	HAP type	Other descriptions
OV37, Calaminarian grassland	Other habitat (J5) eg river shingle, artificial habitat (I2) eg mine spoil	**Calaminarian grassland**	-	Metallophyte vegetation

Table 2. General relationships between attributes used to judge favourable condition for grassland types and potential impacts

	Response of attributes							
Impacts	Extent	Sward composition: cover/frequency of positive plant indicator species/taxa	Sward composition: cover/frequency of negative plant indicator species/taxa	Sward composition: cover of plant species/taxa negative indicators of waterlogging	Grass/herb ratio (proportion of non-Graminae)	Sward height	Bare ground	Plant litter
Direct loss (Unrecoverable reduction)	↓							
Adverse change in hydrology: too wet (raised water tables, increased flooding duration and unseasonal timing)		↓	↑	↑	↓		↑	
Adverse change in hydrology: too dry (lowered water tables, reduced flooding duration)		↓						
Adverse grazing/ cutting intensity: too high		↓	↑			↓	↑	
Adverse grazing/ cutting intensity: too low		↓	↑	↑	↓	↑	↓	↑
Adverse eutrophication: too high (fertilisers, stock feeding, atmospheric deposition)		↓	↑		↓		↓	↑
Adverse disturbance: too high (poaching, stock feeding)		↓	↑	↑			↑	

Table 3. Grass/herb ratio attribute in grassland types

Interest feature	Grass/herb ratio (proportion of non-Graminae)
MG2	30-90%
MG3	50-90%
MG4	40-90%
MG5	40-90%
MG8-related, MG3-related (north)	50-90%
CG2	40-90%
CG3	40-90%
CG4	40-90%
CG5	40-90%
CG6, CG2d-related, MG1-related (dry scrub edge)	30-90%
CG8	30-90%
CG9	30-90%

Table 4. Positive indicator species in grassland types

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e /U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c ,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
Achillea ptarmica														O/F	O/F		O/F	
Acinos arvensis (Clinopodium acinos)		O/F																
Agrimonia eupatoria					O/F								O/F					
Agrostis curtisii										F-80% cover (U3)								
Aira spp						O/F												
Ajuga reptans																	O/F	
Alchemilla spp	O/F										O/F		O/F					
Anagallis tenella																O/F		
Anenome nemorosa										O/F	O/F		O/F					
Angelica sylvestris	O/F															O/F		
Antennaria dioica								Present	O/F									
Anthyllis vulneraria		O/F	O/F	O/F				O/F										
Aphanes spp						O/F												
Arenaria serpyllifolia		O/F																
Armeria maritima									O/F									O
Asperula cynanchica			O/F	O/F					O/F									
Astragalus danicus						O/F												
Berula erecta														O/F				
Brachypodium pinnatum				F														
Bromopsis erecta				F														
Calluna vulgaris										O/F								
Caltha palustris														O/F	O/F		O/F	
Campanula glomerata			O/F	O/F														
Campanula rotundifolia									O/F	O/F								
Cardamine pratensis														O/F	O/F			
Carlina vulgaris		O/F							O/F									
Carum verticillatum																O/F		
Centaurea nigra	O/F				O/F						O/F	O/F	O/F					
Centaurea scabiosa					O/F													

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e /U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c ,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
Centaurium erythraea		O/F				O/F												
Cirsium acaule			O/F	O/F														
Cirsium dissectum														O/F		O/F		
Cirsium heterophyllum	O/F										O/F							
Cladonia spp						O/F				O/F								
Clinopodium vulgare					O/F													
Cochlearia pyrenaica									O/F									O
Conopodium majus											O/F							
Crepis paludosa																	O/F	
Dianthus deltoides						O/F												
Draba incana									O/F									
Dryas octopetala									O/F									
Eleocharis spp															O/F			
Epipactis atrorubens								Present										
Erica spp										O/F								
Erica tetralix																O/F		
Erigeron acer						O/F												
Erodium cicutarium						O/F												
Eupatorium cannabinum														O/F		O/F		
Euphrasia spp									O/F		O/F		O/F				O/F	
Fern spp. ex Pteridium	O/F																	
Filipendula ulmaria	O/F										O/F	O/F	O/F	O/F	O/F	O/F	O/F	
Filipendula vulgaris			O/F	O/F					O/F			O/F	O/F					
Fragaria vesca						O/F												
Fritillaria meleagris												Extent within 25%						
Galium palustre/G.uliginosum													O/F	O/F	O/F	O/F		
Galium saxatile										O/F								
Galium sterneri									O/F									
Galium verum	O/F	O/F		O/F	O/F	O/F		O/F		O/F		O/F	O/F					
Genista tinctoria													O/F					

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e /U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c ,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
Gentiana verna									O/F									
Gentianella spp			O/F	O/F				O/F	O/F									
Geranium sanguineum					O/F													
Geranium sylvaticum	O/F										O/F							
Geum rivale	O/F										O/F			O/F			O/F	
Helianthemum canum (H.oelandicum)									O/F									
Helianthemum nummularium		O/F	O/F	O/F		O/F		O/F	O/F									
Hippocrepis comosa			O/F	O/F					O/F									
Hoary leaved Helianthemum (H. appeninum/H. canum)		O/F																
Hydrocotyle vulgaris														O/F				
Hypericum montanum								Present										
Hypericum pulchrum								O/F										
Jointed rushes														O	O/F			
Knautia arvensis					O/F													
Lathyrus linifolius (L.montanus)										O/F			O/F					
Lathyrus pratensis					O/F						O/F	O/F	O/F					
Leontodon autumnalis												O/F			O/F			
Leontodon hispidus					O/F				O/F									
Leontodon hispidus/L.saxatilis		O/F	O/F	O/F		O/F							O/F					
Leontodon spp											O/F		O/F				O/F	
Leucanthemum vulgare			O/F	O/F								O/F	O/F					
Lichen species		Cover >5%					O/F											
Linum anglicum (L. perenne)								Present										
Linum catharticum		O/F	O/F	O/F				O/F										
Listera ovata								O/F										
Lotus corniculatus		O/F	O/F	O/F	O/F	O/F		O/F	O/F	O/F	O/F	O/F	O/F					
Lotus pedunculatus														O/F		O/F		
Lychnis flos-cuculi														O/F	O/F		O/F	
Lysimachia nummularia															O/F			
Mentha aquatica														O/F	O/F			

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e /U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c ,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
Mercurialis perennis	O/F																	
Minuartia verna																		O
Molinia caerulea																F-80% cover	F-80% cover (M26)	
Myosotis alpestris									O/F									
Myosotis laxa/M. scorpioides															O/F			
Narthecium ossifragum																O/F		
Oenanthe fistulosa															O/F			
Oenanthe silaifolia												O/F						
Orchidaceae spp					O/F									O/F		O/F	O/F	
Origanum vulgare					O/F													
Ornithopus perpusillus						O/F												
Parnassia palustris								Present	O/F									
Pedicularis sylvatica										O/F						O/F		
Persicaria amphibia															O/F			
Persicaria bistorta											O/F	O/F						
Persicaria vivipara									O/F									
Pilosella officinarum (Hieracium pilosella)		O/F	O/F	O/F		O/F			O/F	O/F								
Pimpinella saxifraga								O/F					O/F					
Pimpinella spp					O/F													
Pinguicula vulgaris								Present	O/F									
Plantago coronopus						O/F												
Plantago maritima								Present	O/F									
Plantago media			O/F	O/F				O/F										
Polemonium caeruleum	O/F																	
Polygala spp			O/F	O/F				O/F		O/F			O/F					
Potentilla erecta										O/F			O/F			O/F	O/F	
Potentilla palustris														O/F				
Primula farinosa								Present	O/F									
Primula veris			O/F	O/F	O/F			O/F				O/F	O/F					
Pteridium aquilinum										50-90% cover								

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e /U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c ,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
										(U4/U20-rel)								
Ranunculus flammula														O/F	O/F			
Rare and scarce lichens							Present & extent											
Rhinanthus minor											O/F	O/F	O/F				O/F	
Rumex acetosella						O/F				O/F								
Sanguisorba minor		O/F	O/F	O/F	O/F			O/F	O/F				O/F					
Sanguisorba officinalis	O/F										O/F	O/F	O/F				O/F	
Saxifraga hypnoides									O/F									
Scabiosa columbaria		O/F	O/F	O/F				O/F	O/F									
Scilla spp.		O/F																
Sedum acre						O/F												
Sedum spp.		O/F																
Selaginella selaginoides								Present	O/F									
Serratula tinctoria			O/F							O/F		O/F	O/F			O/F	O/F	
Sesleria caerulea								F	F									
Silaum silaus												O/F	O/F					
Silene uniflora																		O
Small blue-green Carex spp.													O/F	O/F	O/F	O/F	O/F	
Sphagnum spp																O/F		
Stachys officinalis								O/F		O/F		O/F	O/F					
Succisa pratensis	O/F		O/F	O/F				O/F	O/F	O/F	O/F	O/F	O/F	O/F		O/F	O/F	
Teesdalia nudicaulis						O/F												
Teucrium scorodonia					O/F					O/F								
Thlaspi caerulescens																		O
Thalictrum flavum												O/F		O/F	O/F			
Thymus polytrichus								O/F	O/F									
Thymus spp		O/F	O/F	O/F	O/F	O/F												
Tragopogon pratensis					O/F							O/F	O/F					
Trinia glauca		O/F																
Trollius europaeus								Present			O/F						O/F	
Vaccinium myrtillus										O/F								

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e/U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3,U4a,c,U4/U20-rel	MG3	MG4	MG5	MG8south, M22,M23	Ag-Cx, MG11-MG13-rel	M24,M25	M26,MG8 north,MG 3-rel	OV37
Valeriana dioica														O/F		O/F	O/F	
Valeriana officinalis	O/F																	
Veronica officinalis										O/F						O/F		
Viola hirta								O/F										
Viola lutea																		O
Viola palustris														O/F		O/F		
Viola spp										O/F								
O = Occasional																		
F = Frequent																		

Table 5. Negative indicator species in grassland types

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e/U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3, U4a,c	U4/U20-rel	MG3	MG4	MG5	MG8south, MG8-rel	MG8north, MG3-rel	Ag-Cx, MG11-MG13-rel	M22, M23	M24, M25	M26	OV37
Agrostis curtisii										>80% cover	>80% cover										
Anthriscus sylvestris	<25% cover											<+F/5% cover	<F/5% cover	<F/5% cover		<F/5% cover				<F/5% cover	<F/5% cover
Brachypodium pinnatum			<10% cover	<10% cover (CG3)																	
Bromopsis erecta			<10% cover																		
Carduus nutans						<F/5% cover	<F/5% cover														
Chamerion angustifolium						<F/5% cover	<F/5% cover	<F/5% cover		<F/5% cover	<F/5% cover										
Cirsium arvense	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover
Cirsium palustre										<F/5% cover	<F/5% cover								<20% cover		
Cirsium vulgare	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e/U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3, U4a,c	U4/U20-rel	MG3	MG4	MG5	MG8south, MG8-rel	MG8north, MG3-rel	Ag-Cx, MG11-MG13-rel	M22, M23	M24, M25	M26	OV37
Coarse grasses		<F/5% cover				<10% cover	<F/5% cover			<10% cover	<10% cover										<F/5% cover
Deschampsia cespitosa													<10% cover	<10% cover	<10% cover	<10% cover	<25% cover	<10% cover	<10% cover	<10% cover	
Deschampsia flexuosa						<20% cover															
Galium aparine								<F/5% cover						<F/5% cover							
Heracleum sphondylium																					<F/5% cover
Jointed rushes																<50%		<80% cover	<80% cover	<80% cover	
Juncus conglomeratus/J. effusus/J. inflexus																<25%		<50% cover	<50% cover	<50% cover	
Juncus spp													<10% cover	<10% cover	<10% cover		<25% cover				
Large Carex spp													<10% cover	<10% cover	<10% cover		<25% cover	<20% cover			
Large grasses													<10% cover	<10% cover	<10% cover		<25% cover	<10% cover			
Molinia caerulea																			>80% cover	>80% cover	
Myrica gale																			<10% cover		
Phragmites australis																<5% cover			<10% cover	<5% cover	
Plantago major						<F/5% cover	<F/5% cover			<F/5% cover	<F/5% cover			<F/5% cover							
Pleurocarpous bryophytes							<50% cover														
Pteridium aquilinum	<F/5% cover					<10% cover	<F/5% cover		<10% cover	<20% cover	<50% or >90% cover			<F/5% cover							
Rhododendron spp						<1% cover				<1% cover	<1% cover										

Species	MG2	CG1	CG2	CG3,4,5	CG6, MG1-CG2-rel	CG7a,b,d,e/U1b,c,d,f	Lichen grassland CG7c/U1a	CG8	CG9	U1e,U3, U4a,c	U4/U20-rel	MG3	MG4	MG5	MG8south, MG8-rel	MG8north, MG3-rel	Ag-Cx, MG11-MG13-rel	M22, M23	M24, M25	M26	OV37
Rosa spp								<10% cover													
Rumex crispus	<F/5% cover		<F/5% cover	<F/5% cover	<F/5% cover							<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	
Rumex obtusifolius	<F/5% cover		<F/5% cover	<F/5% cover	<F/5% cover							<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	
Scrub/tree spp	<30% cover	<5% cover	<5% cover	<5% cover	<30% cover	<5% cover	<1% cover	<5% cover	<5% cover	<5% cover	<5% cover	<F/1% cover	<F/1% cover	<5% cover	<5% cover	<5% cover	<5% cover	<5% cover	<5% cover	<5% cover	<5% cover
Senecio aquaticus													<F	<F/5% cover	<F/5% cover		<F/5% cover	<F/5% cover	<F/5% cover		
Senecio jacobaea	<F/5% cover	<F	<F/5% cover	<F/5% cover	<F/5% cover	<F	<F	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover							
Sonchus spp								<F/5% cover													
Ulex spp										<30% cover	<30% cover										
Urtica dioica	<25% cover		<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover	<F/5% cover
F = Frequent																					

NB Some taxa should be considered together with others. See field forms for details

Table 6. Structural attributes of grassland types

Mesotrophic grassland types

Interest feature	Sward height	Litter	Bare ground	Localized bare ground	Other attributes
MG2	5-80 cm	≤ 50%	≤ 10%	-	-
MG3 (hay meadow)	> 5 cm	≤ 25%	≤ 5%	-	-
MG4 (hay meadow)	> 10 cm	≤ 25%	≤ 5%	-	-
MG5	5-15 cm	≤ 25%	≤ 5%	-	-
MG8, MG8-related (south)	5-15 cm	≤ 25%	≤ 15% / ≤ 5%	-	-
MG8-related, MG3-related (north)	5-15 cm	≤ 25%	≤ 5%	-	-
Ag-Cx, MG11-related, MG13-related	5-15 cm	≤ 25%	≤ 15% / ≤ 10%	-	-

Calcareous grassland types

Interest feature	Sward height	Litter	Bare ground	Localized bare ground	Other attributes
CG1	≤ 5 cm	≤ 25%	5-20%	≤ 0.05 ha	-
CG2	2-10 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
CG3	2-15 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
CG4	2-15 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
CG5	2-15 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
CG6, CG2d-related, MG1-related (dry scrub edge)	5-50 cm	≤ 50%	≤ 10%	≤ 0.05 ha	-
CG7a,b,d,e	≤ 5 cm	≤ 25%	≤ 15%	≤ 0.25 ha	-
CG7c	≤ 5 cm	≤ 5%	10-50%	-	Rabbit droppings frequent
CG8	2-15 cm	≤ 25%	≤ 10%	-	-
CG9a,b,c	2-15 cm	≤ 25%	≤ 10%	-	-
CG9d,e	2-10 cm	≤ 25%	≤ 10%	-	-

Calcifugous grassland types

Interest feature	Sward height	Litter	Bare ground	Localized bare ground	Other attributes
U1a	≤ 5 cm	≤ 5%	10-50%	-	Rabbit droppings frequent
U1b,d,f	≤ 5 cm	≤ 25%	≤ 15%	≤ 0.25 ha	-
U1c	≤ 5 cm	≤ 25%	≤ 30%	≤ 0.25 ha	-
U1e	1-5 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
U3	1-5 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
U4a	1-5 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
U4c	3-10 cm	≤ 25%	≤ 10%	≤ 0.05 ha	-
U4/U20-related	3-10 cm	5-50%	≤ 10%	≤ 0.05 ha	-

Mire (rush pasture and fen meadow) types

Interest feature	Sward height	Litter	Bare ground	Localized bare ground	Other attributes
M22	> 2 cm - ≤ 25% > 40 cm	≤ 25%	≤ 10%	-	-
M23	> 2 cm - ≤ 25% > 40 cm	≤ 25%	≤ 10%	-	-
M24a	> 5 cm - ≤ 25% > 60 cm	≤ 25%	≤ 10%	-	-
M24b,c	> 2 cm - ≤ 25% > 15 cm	≤ 25%	≤ 10%	-	-
M25a,b	> 2 cm - ≤ 25% > 15 cm	≤ 25%	≤ 10%	-	-
M25c	> 5 cm - ≤ 25% > 60 cm	≤ 25%	≤ 10%	-	-
M26	> 5 cm - ≤ 25% > 40 cm	≤ 25%	≤ 5%	-	-

Open vegetation types

Interest feature	Sward height	Litter	Bare ground	Localized bare ground	Other attributes
OV37	≤ 5 cm	-	*20-90%	-	-

* = mandatory attribute. All other structural attributes are discretionary

Table 7. Estimated extent of grassland interest features in England

Calcareous grassland

Interest feature	Extent (ha)	Interest feature	Extent (ha)
CG1	<300	CG6 and MG1-related	<1,000
CG2	<8,000	CG7	<3,000
CG3	<19,000	CG8	<150
CG4	<3,000	CG9 (lowland)	<1,500
CG5	<2,500		

Calcifugous grassland

Interest feature	Extent (ha)	Interest feature	Extent (ha)
U1	<12,500	U4 (lowland)	<5,000
U3	<3,000	U4/U20-related	*100-500?

Mesotrophic grassland

Interest feature	Extent (ha)	Interest feature	Extent (ha)
MG2	<100	MG5	<6,000
MG3	<1,000	MG8/ MG8-related north and south, MG3-related	< 900
MG4	<1,500	Inland wet grassland *Agrostis-Carex* grassland MG11& 13 related.	*<100?

Mire types

Interest feature	Extent (ha)	Interest feature	Extent (ha)
M22	<500	M25	<2,500
M23	<5,000	M26	<500
M24	<2,000		

Open vegetation types

Interest feature	Extent (ha)
OV37, Caliminarian grassland	*<10,000?

* = Extent not fully known

Table 8. Estimated extent of priority Biodiversity Action Plan grassland types in England

Biodiversity Action Plan type	Extent (ha)
Lowland calcareous grassland (CG1-8, lowland CG9, MG2)	<40,000
Lowland dry acid grassland (U1-U4, SD10, SD11)	*<26,750
Lowland meadow (MG4, MG5, MG8)	<8,500
Upland meadow (MG3)	<1,000
Purple moor grass and rush pastures (M22-26)	<11,000

* includes <5,500 ha U2 and <750 ha SD10+SD11

Appendices

Appendix 1. Lowland grassland National Vegetation Classification* types occurring in England and their wider distribution in Britain (modified from NCC (1989))

A. Grassland types of high botanical nature conservation value

1. Mesotrophic grasslands

MG1 *Arrhenatherum elatius* grassland: dry tall herb grassland

Some stands of the *Pastinaca, Centaurea nigra* (especially the *Pimpinella saxifraga* variant) and *Filipendula* sub-communities (MG1d, e and c repectively) may be semi-natural and have high botanical nature conservation value. The *Pastinaca* sub-community occurs on calcareous soils in south and east England while the *Centaurea* and *Filipendula* sub-communities are widely distributed on suitable soils in lowland Britain. The *Pimpinella* variant only occurs on limestone in the Mendips and the Pennines. The value of these sub-communities has been recognised since the production of the SSSI Guidelines (NCC 1989).

MG2 *Filipendula ulmaria - Arrhenatherum elatius* grassland: northern tall herb grassland.

A sub-montane community restricted to the Carboniferous limestone in northern England especially in Pennine areas of Derbyshire and North Yorkshire.

MG3 *Anthoxanthum odoratum - Geranium sylvaticum* grassland: northern hay meadow.

Occurs as valley grasslands and on river-banks of northern England and Scotland, often used as hay meadows. There are major concentrations in the Pennine and Cumbrian Dales. The type occurs with related, wetter vegetation which also has some similarities to MG8 and M26, and is as yet undescribed by the NVC.

MG4 *Alopecurus pratensis - Sanguisorba officinalis* grassland: flood meadow.

Found on seasonally-flooded land in lowland river flood plains. Widely scattered but with concentrations in the Thames, Yorkshire Ouse, Seven, Trent, Great Ouse and Nene catchments.

MG5 *Cynosurus cristatus - Centaurea nigra* grassland: lowland hay meadow and pasture.

Widely scattered throughout the British lowlands. The community covers a wide range of soil types and the sub-communities reflect this. The *Galium verum* sub-community shows affinities with some calcareous grasslands and the *Danthonia* sub-community with acid grasslands. Major concentration in Worcestershire.

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* Does not include Northern Ireland

NB: Nomenclature of vascular plants for the NVC follows Clapham, Tutin & Moore (1987)

MG8 *Cynosurus cristatus - Caltha palustris* grassland: flood pasture.

Widespread but rather local distribution throughout England; scarce in Wales and Scotland. Characteristic of land with a seasonally high water table. A related type, which also has similarities to M22, occurs on the Somerset Levels and as yet is undescribed by the NVC.

MG11 *Festuca rubra - Agrostis stolonifera - Potentilla anserina* grassland: inundation grassland.

MG13 *Agrostis stolonifera - Alopecurus geniculatus* grassland: inundation grassland, silver meadows.

MG11 occurs in scattered localities in lowland England characteristic of areas frequently inundated with fresh or brackish water. Also present in Scotland, particularly in the Western Isles. Only one sub-community (*Lolium perenne* sub-community) is found inland, this sub-community has often been agriculturally improved and samples in the NVC are species-poor.

MG13 occurs in scattered localities in lowland areas throughout Great Britain usually in river flood plains. In eastern England it forms mosaics with swamp communities in extensive stands on washlands, but elsewhere it is fragmentary alongside watercourses and on the edges of ponds. Samples in the NVC are species-poor but the type has special value in providing feeding areas for wildfowl.

Botanically diverse vegetation related to MG11 and MG13, including an *Agrostis-Carex* type has been recorded from the Somerset Levels and the Yorkshire Derwent Ings since the production of the SSSI Guidelines (NCC 1989) and as yet is undecsribed by the NVC.

2. Calcareous grasslands

CG1 *Festuca ovina - Carlina vulgaris* grassland: warm southern temperate limestone grassland.

Distribution limited to scattered sites on harder limestones principally around and near to southern and western coasts of England and Wales.

CG2 *Festuca ovina - Avenula pratensis* grassland: species-rich chalk grassland.

Species-rich grassland widely distributed principally over southern lowland calcareous formations, with regional differences showing up as sub-communities.

CG3 *Bromus erectus* grassland

Distribution follows that of the species and so this community is especially frequent over the Chalk, Jurassic Limestone (Oolite) and Magnesian Limestone (Permian).

CG4 *Brachypodium pinnatum* grassland

Frequent on the Cretaceous chalk and Jurassic limestone in England.

CG5 *Bromus erectus - Brachypodium pinnatum* grassland.

Distribution is centred on the Jurassic limestone in central and eastern England.

Major concentration in the Cotswolds (Gloucestershire).

CG6 *Avenula pubescens* grassland.

Occurs in scattered localities over a variety of lowland limestone areas but is nowhere extensive, being a product of little or no grazing of grasslands over moist, mesotrophic calcareous soils on flat or gently-sloping sites. Most of these areas have been converted to arable.

CG7 *Festuca ovina - Hieracium pilosella - Thymus praecox/pulegioides* grassland.

Occurs in scattered localities in Wiltshire, the Yorkshire Wolds, the Carboniferous limestone of Derbyshire and the Mendips, with its greatest concentration and extent in Breckland.

CG8 *Sesleria caerulea- Scabiosa columbaria* grassland: Magnesian limestone grassland.

Distribution is confined to magnesian (Permian) limestone in County Durham.

CG9 *Sesleria caerulea - Galium sterneri* grassland: Northern Carboniferous limestone grassland.

Distribution is confined to the Carboniferous Limestone of northern England, with the sub-communities marking regional differences. The *Helianthemum canum - Asperula cynanchica,* and typical sub-communities occur in lowland situations.

3. Calcifugous grasslands

U1 *Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland.

These very diverse and open swards occur widely on light soils in the drier areas of lowland Britain.

U3 *Agrostis curtisii* grassland.

A community based on the abundance of *Agrostis curtisii* and therefore confined to central, southern and south-west England and south Wales. Frequently occurs in a mosaic with H3/H4 heathland.

U4 *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland.

Principally a community of upland (sub-montane) areas of north and western Britain associated with a range of acidic soils on lime-poor substrates. Examples do occur in lowland situations (<300m). U4c (*Lathyrus montanus-Stachys betonica* sub-community) is more widely distributed in Britain than evident from the NVC. It can be herb-rich and a type related to it and to U20 (*Pteridium aquilinum-Galium saxatile* community) has recently been recognised from the New Forest (Sanderson 1998a).

4. Mire types

M22 *Juncus subnodulosus - Cirsium palustre* fen meadow.

Occurs on wet, base-rich peats and mineral soils in southern lowland Britain with a notable concentration in East Anglia and Anglesey.

M23 *Juncus effusus/acutiflorus - Galium palustre* rush-pasture.

Widespread but local on wet, moderately acid to neutral peaty and mineral soils in the cool and wet lowlands and upland fringes of northern and western Britain.

M24 *Molinia caerulea - Cirsium dissectum* fen meadow.

A widespread but local community characteristic of moist neutral to mildly acidic soils in the lowlands of southern Britain. Particular concentrations occur in north Devon, Wales and East Anglia.

M25 *Molinia caerulea - Potentilla erecta* mire.

This community occurs on moist but well-aerated acid to neutral peats and mineral soils in the western lowlands of Britain. It is particularly frequent in south-west England, Wales and southern Scotland.

M26 *Molinia caerulea - Crepis paludosa* mire.

A very rare community occurring on moist, moderately base-rich peats and peaty mineral soils mainly in the sub-montane northern Pennines. The *Festuca rubra* sub-community often occurs on slopes in enclosed meadows and pastures in association with the MG3 *Anthoxanthum odoratum - Geranium sylvaticum* northern hay meadow. The *Sanguisorba officinalis* sub-community is more usually found in transitional vegetation around open water.

5. Open vegetation types

OV37 *Festuca ovina - Minuartia verna*.

Occurs largely on free-draining calcareous soils and river shingles enriched with heavy metals such as lead and zinc. In England it is most commonly associated with

former metal mining areas in the Pennines, especially in Derbyshire and North Yorkshire. In Scotland it occurs on serpentine soils.

B. Grassland types generally of lower botanical nature conservation value

MG1a,b

Arrhenatherum elatius grassland: Rank grassland.

An unmanaged coarse grassland occurring on neutral soils throughout the British lowlands on road verges and railway embankments and in neglected agricultural and industrial habitats.

MG6 *Lolium perenne - Cynosurus cristatus* grassland: improved permanent grassland.

The major permanent pasture type in lowland Britain, often brought about by the action of fertilisers, herbicides and drainage on many other MG types or by agricultural rundown of MG7. May also be used for silage or hay-making.

MG7 *Lolium perenne*: reseeded grassland.

The major and ubiquitous sown grassland type in Britain.

MG9 *Holcus lanatus - Deschampsia cespitosa* grassland: damp pasture.

This is highly characteristic of permanently moist soils throughout the British lowlands. Often results from invasion of *Deschampsia caespitosa* into MG6 and 7 where drainage has deteriorated.

MG10 *Holcus lanatus - Juncus effusus* rush pasture.

This is ubiquitous throughout the British lowlands, commonly developing by invasion of *Juncus* into MG6 and MG7 where drainage becomes impeded.

U2 *Deschampsia flexuosa* grassland.

These swards are of local distribution on wetter but free-draining, base-poor soils in lowland Britain often associated with heathland. U2 appears to be secondary community derived from U1 or heathland, and has been placed in the group of grasslands of lower botanical value since the production of the SSSI Guidelines (NCC 1989).

Appendix 2 .
Field method and example of a completed form and maps

How to do a rapid assessment of a grassland

Before the visit

Obtain access permission and assemble relevant information:

- SSSI citation and map, showing the location and boundary of the unit to be assessed and its ENSIS reference number.
- Copy of the baseline map showing extent of the interest feature and any areas of existing damage or a modified version showing changes in extent mapped on previous monitoring visits, ie a 'monitoring map'.
- Copy of the previous field form if a previous assessment has been made.
- The relevant blank field forms for the grassland interest feature(s) to be assessed.
- Any relevant points from discussions with the site manager, eg agreed changes made/structures installed since the previous visit.

If necessary, within the unit containing the interest feature, plan the sub-division of large Level 2 interest feature areas (over 15-16 ha) for the purpose of recording in each sub-division or to select a sub-sample of them. Be careful to be objective about choice of areas to be recorded if sub-sampling. An area of 15-16 ha probably represents the maximum area that can be evaluated visually in one assessment. Visually estimating attributes such as average sward height and percentage cover of species becomes increasingly difficult the larger the area. Management units, where these are smaller than 15-16 ha, generally are the most appropriate way of sub-dividing a larger interest feature unit. The minimum area that can be adequately assessed using the protocols is about 0.25 ha.

Recording on site

Time required to do the assessment

The time needed should be around 30-45 minutes if no structured walk is done. If a structured walk is included then an additional 30-60 minutes will usually be required.

Recording attributes

It is important to record actual estimates for mandatory attributes on the field form rather than just 'yes'/'no' type conclusions. These estimates will be needed if trends are to be examined on repeat visits for assigning declining/recovering condition categories. It can be helpful to record estimates for discretionary attributes as well, eg for discussions with the site manager.

Extent

Walk over the area to be assessed and check the extent of the interest feature against the baseline map, or modified monitoring map where relevant, supplemented if required by checking of critical boundaries where change is considered likely, eg by using a transect walk. Identify and map any new areas of damage and describe them. Usually, dated annotations on the monitoring map are most useful. Decide whether changes in extent are recoverable (means unfavourable) or irrecoverable (means partially destroyed). During the walk decide if a structured return walk across the area to assess frequency of positive and negative indicators is required, ie if the grassland seems borderline or failing on these attributes.

Positive and negative indicators

Structured walk: Sketch a return route to follow on the SSSI map to cover the whole area, eg a W shape, and decide the stopping distance for recording, eg every 20 paces. Where there is a systematic pattern in the vegetation, eg ridge and furrow, make sure the chosen distance does not sample one type of vegetation to the exclusion of the other type. Follow the route and at each stopping point search for the indicators in the immediate 3-4 metre area. The easiest way is to search two 1 metre diameter semi-circles around where you are standing. This should take no more than two to three minutes per stopping point. Record species and occurrence in the structured walk table. At the end work out the frequencies of each indicator found and compare them to the targets required. Quantitative definitions of frequency, which are also on the field forms, are as follows:

- Species recorded from up to 20% stops = **rare**
- Species recorded from 21% to 40% of stops = **occasional**
- Species recorded from over 40% of stops = **frequent**
- Species recorded from over 60% of stops = **more than frequent** (only applies to *Anthriscus sylvestris* attribute in MG3 protocol)

The quantitative definition of **locally abundant** is:

- the species occurs as densely packed individuals in patches with clearly defined boundaries, the cover of the species in the patch exceeds 75% and the patches occupy 10% or more of the total extent of the sward.

Visual assessment: Walk across the whole area as for the structured walk, deliberately stopping to look for indicators en route. Visually estimate frequencies of species seen during the walk in relation to the same frequency definitions as those for the structured walk eg species seen up to 20% of the time are rare.

Grass/herb ratio

Visually estimate the proportion (%) of herb cover in the grassland. Herbs include all vascular plants except grasses, ie sedges and rushes are "honorary" herbs. Estimate by looking down on the sward at intervals rather than by looking across the top of it. Patchiness across the unit should be averaged out. Care is required when estimating this parameter in very short swards such as certain types of calcareous grassland (eg CG2) and in hay meadows as it is easy to underestimate the herb cover. For hay meadows, this becomes particularly critical when visits are made late in the season just prior to cutting. In this situation, it is important to look down through the sward to see the herbs below the grass canopy, do not just look across the top of the sward.

Percentage cover of species or groups of species

Assess in the same way as for herbs, by visual assessment, looking down on the sward. Locally abundant means a species occurs as densely packed individuals in patches with clearly defined boundaries, the cover of the species in the patch exceeds 75% and the patches occupy 10% or more of the total extent of the sward. Tall scrub species have to be assessed by looking across the interest feature. Use a vantage point if there is one to assess scrub, or better, use up-to-date aerial photographs back in the office.

Sward height

Visually assess the average height of the sward at intervals during the walk, ie the height of the main mass of herbage, not the tops of scattered flowering spikes of grasses and taller herbs which project above the main sward.

Litter

Visually assess the cover of any litter layer at intervals during the walk. Litter is dead plant material and is of concern where it forms a more or less continuous layer made up of interlocking, 'fallen', stems and leaves. In tall, dense, swards litter may not be immediately obvious so scrabble around at the base of the sward to see if a litter layer is present.

Bare ground

Distributed through the sward: Visually estimate the average amount present at intervals. Bare ground must be visible from above without disturbing the vegetation. It does **not** include rock exposures, stones, pebbles and flints unless otherwise specified on the field form.

Localized bare ground: This occurs around heavily disturbed rabbit warrens where vegetation has been more or less obliterated. Visually estimate the area covered or use an up-to-date aerial photograph. **NB** Collapsing tunnels can be a hazard in warren areas.

Assigning a condition category

This should be done in the field unless aerial photographs are to be consulted after the visit. If the latter is the case check that all field attributes have been assessed before leaving the site.

First assessment using the method

On a first assessment using the relevant protocol only one of four categories can be assigned on the basis of the visit itself, ie Favourable, Unfavourable, Partially Destroyed and Destroyed. All mandatory attributes must be within the targets for the feature to be Favourable. Partially Destroyed or Destroyed mean part or all, respectively, of the interest feature is destroyed with no hope of reinstatement. The dynamic qualifications of recovery, no change and declining should be assigned based on best judgement and site information from previous visits, including condition assessments made before the first assessment made using the rapid assessment method.

Subsequent visits using the method

Where the rapid assessment method is used on a subsequent visit then the dynamic categories can be assigned according to the following scheme, which is provisional at this stage as few sites have yet been recorded more than once using the method.

Favourable maintained: All mandatory attributes are within targets. **NB** If one or more mandatory attribute estimates appear to be decreasing when compared to estimates made on the field form from the previous visit, eg only 5 positive indicators are recorded compared with 10 previously, but the feature still is favourable, **or** if any discretionary attributes are

falling outside targets despite all mandatory attributes being within targets, it is suggested that this situation merits a comment on the form and follow up action.

Favourable recovered*:* All mandatory attributes are now within targets but the feature was unfavourable on the previous visit.

Unfavourable recovering: One or more mandatory attributes are outside targets but there is evidence of recovery, ie one or more attributes are now within targets compared to being outside the targets on the previous visit **or** the estimates are closer to the targets. Evidence of recovery is also provided by discretionary attributes, ie if one or more are within targets compared to being outside them on the previous visit, whether or not mandatory attributes have changed.

Unfavourable no change: The same mandatory attributes are outside targets **and** there is no change in the estimates for these attributes **and** the same discretionary attributes are outside the targets.

Unfavourable declining: More mandatory attributes are outside the targets compared to the previous visit **or** the estimates of any attributes recorded as outside targets on the previous visit are moving further away from these targets **or** discretionary attributes that were within targets on the previous visit are now outside the targets.

After the visit

Management of grasslands is critical to their conservation and aside from the usual contact with site managers it is vital that if the feature is unfavourable or appears to be declining in condition, further investigation is set in train as soon as possible and remedial action taken where necessary. The condition assessment field form, the SSSI map showing the route of the structured walk, if used, and the monitoring map, should all be retained for future reference. The field form is particularly important for judging the dynamic categories of condition on subsequent visits.

ENGLISH NATURE

Lowland grassland SSSI condition assessment (version date 10/10/00)

Site Name: ..White Down and Woods..

NVC type: **CG2**

Unit/subdivision reference 239 ..(Grainger Conservation Trust)..... Date:..23/6/00.....

Condition: (Favourable maintained)/Favourable recovered /Unfavourable improving/
Unfavourable no change/Unfavourable declining/Partially destroyed/Destroyed

Recommended visiting period: May - July
Recommended frequency of visits: Site-specific decision 1999-2001, annual - review 2001. (April 1999 change from sheep+cattle to sheep only, manager concern over Bromopsis spread

Key management activities affecting condition to discuss with manager: - see file note (24/3/00)

Grazing intensity/stocking rate	FYM input	N.B. Manager phoned 22/6/00, neighbour complaints about rabbits.
Grazing period	Other inputs	
Supplementary feeding	Stock type	
Scrub and weed control		

Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*
*Extent of community (recoverable reduction = unfavourable; non-recoverable reduction = partially destroyed).	No loss without prior consent	(Describe and refer to map) No change in extent ✓
*Sward composition: grass/herb (ie non-Graminae) ratio	**40-90%** herbs	- 60% ✓
*Sward composition: frequency of positive indicator species/taxa. - see structured walk Summary of results: *Anthyllis vulneraria ( ), Asperula cynanchica (O), Campanula glomerata ( ), Cirsium acaule (R), Filipendula vulgaris (R), Gentianella spp. (R), Helianthemum nummularium ( ), Hippocrepis comosa ( ), Leontodon hispidus/L. saxatilis (O), Leucanthemum vulgare ( ), Linum catharticum (F), Lotus corniculatus (F), Pilosella officinarum (=Hieracium pilosella) (R), Plantago media ( ), Polygala* spp. ( ), *Primula veris ( ), Sanguisorba minor (F), Scabiosa columbaria (F), Serratula tinctoria ( ), Succisa pratensis ( ), Thymus* spp. *(F).*	At least four species/taxa **frequent** and three **occasional** throughout the sward	5 F 2 O Same as 1999 ✓
*Sward composition: cover of *Brachypodium pinnatum* and *Bromopsis erecta.*	Neither species at more than **10%** cover	No Brachypod. seen Bromopsis < 5% cover ✓ Same as 1999 No problem

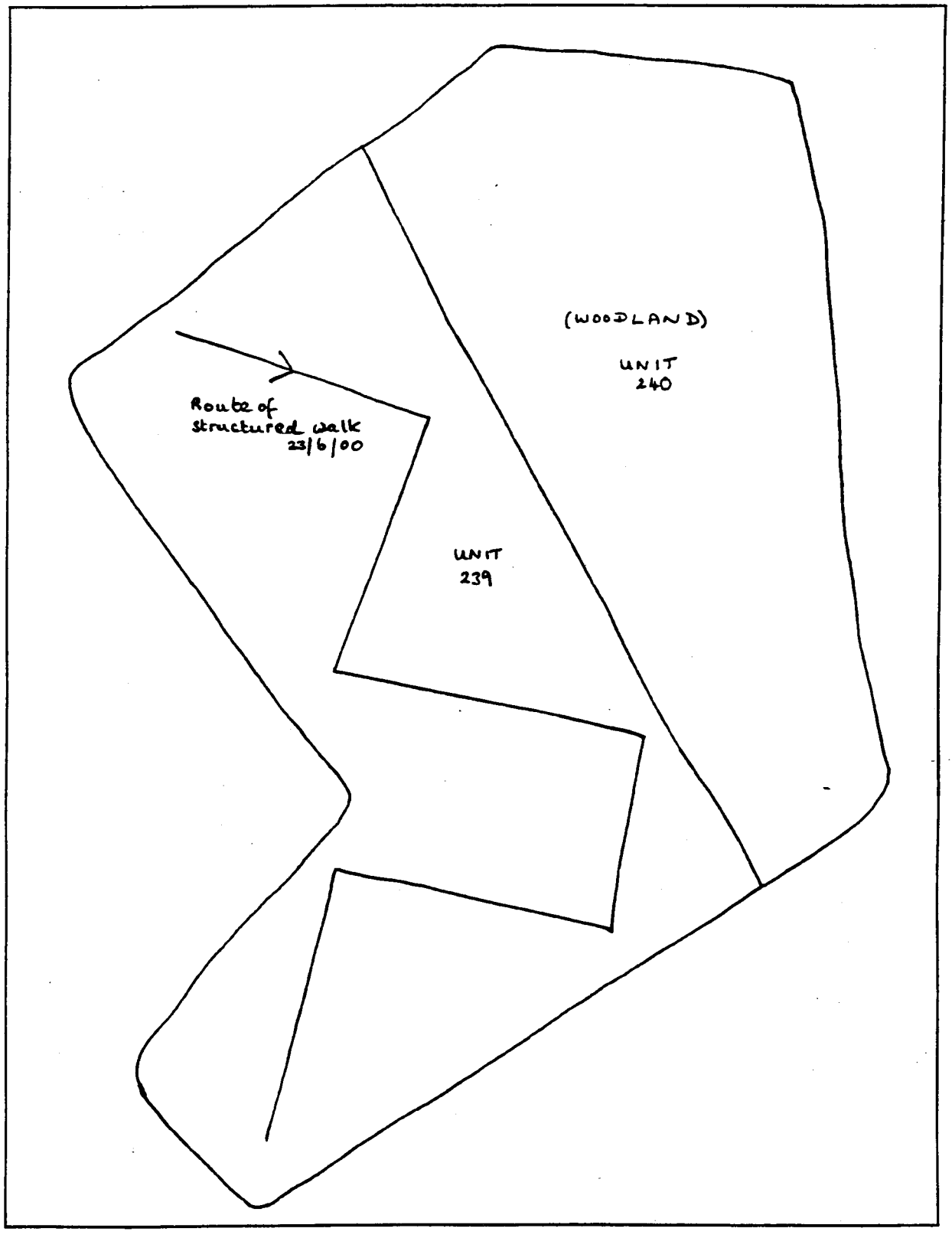
Attribute (= mandatory attribute. One failure among mandatory attributes = unfavourable condition)*	*Target*	*Estimate for attribute*	
*Sward composition: frequency and % cover of negative indicator species/taxa. see structured walk summary of results: *Cirsium arvense* (R), *Cirsium vulgare* ( ), *Rumex crispus* ( ), *Rumex obtusifolius* ( ), *Senecio jacobaea* (R), *Urtica dioica* ( ).	No species/taxa more than **occasional** throughout the sward or singly or together more than 5% cover	None > occ. Cover < 1 %	✓
*Sward composition: frequency and % cover of all scrub and tree species, **excluding** *Juniperus communis*, considered together. NB If scrub/tree species are more than occasional throughout the sward but less than 5% cover, they are soon likely to become a problem if grazing levels are not sufficient or if scrub control is not being carried out. see structured walk	No more than 5% cover	2% cover Scrub spp. rare	✓
Sward structure: average height	2-10 cm	5cm	✓
Sward structure: litter in a more or less continuous layer, distributed either in patches or in one larger area.	Total extent no more than 25% of the sward	< 25%	✓
Sward structure: extent of bare ground (not rock) distributed through the sward, visible without disturbing the vegetation.	No more than 10%	< 10%	✓
Sward structure: rabbit grazing and disturbance levels, localized bare ground around rabbit warrens.	No more than **0.05** ha ie approximately 20x20 metres	1 warren 30x30m	X

Hmm... 36x bigger than 1997, 4x bigger than 1999
Talk to manager a.s.a.p.

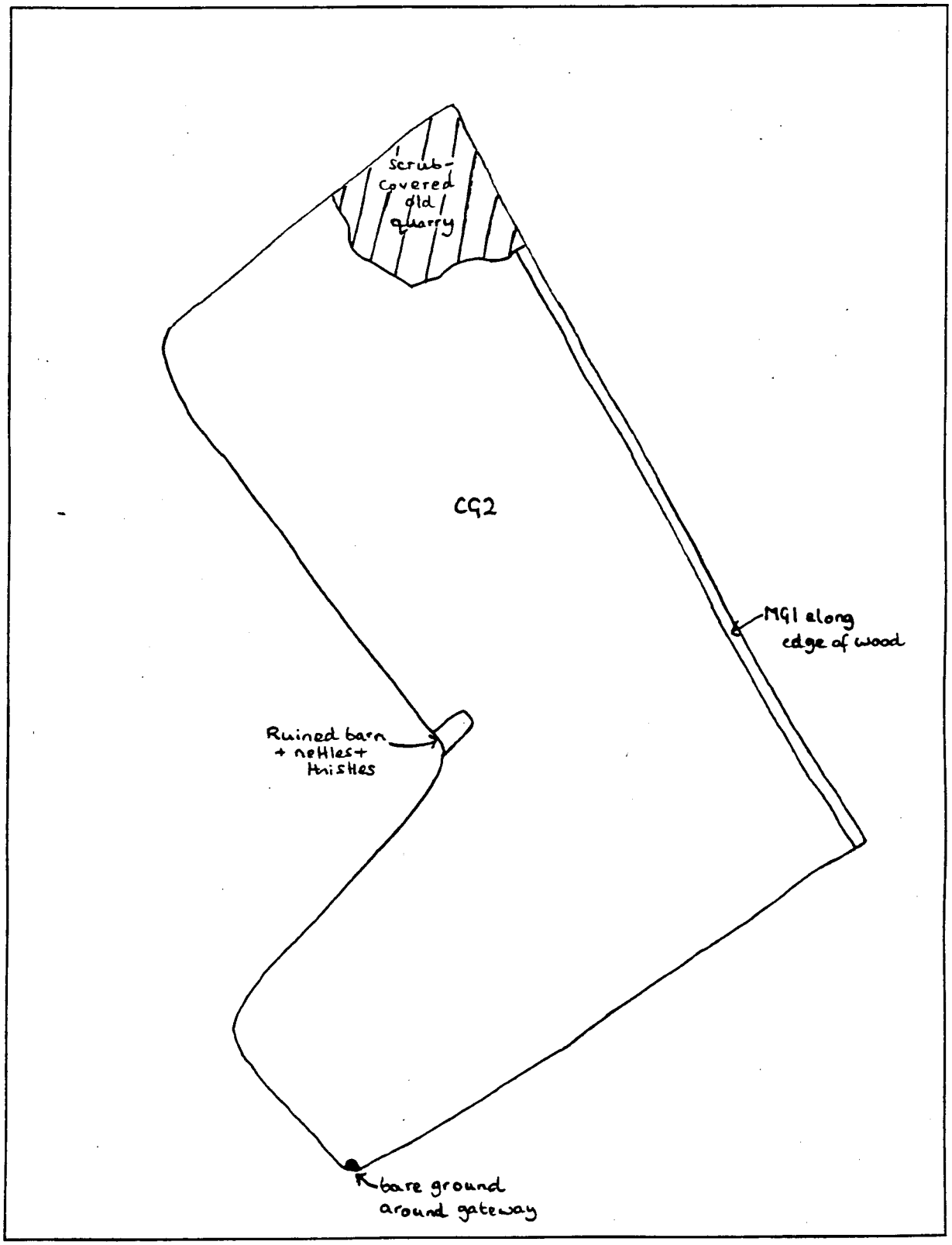
Structured walk recording form
Frequencies: totals out of 20 stops. 1-4 = rare, 5-8 = occasional, 9+ = frequent or more

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Asperula cynanchica	✓	✓			✓		✓					✓			✓		✓	✓			8
Leontodon hispidus	✓					✓		✓					✓		✓			✓			6
Sanguisorba minor	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	16
Linum catharticum	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	15
Thymus spp.	✓	✓		✓	✓	✓				✓	✓		✓	✓	✓		✓				11
-ve Senecio jacobaea		✓				✓				✓	✓										4
Cirsium acaule		✓					✓										✓				3
Filipendula vulgaris			✓								✓										2
Scabiosa columbaria			✓		✓			✓	✓	✓		✓					✓		✓	✓	9
Lotus corniculatus			✓		✓			✓	✓		✓		✓				✓		✓	✓	9
-ve Cirsium arvense				✓							✓							✓			3
Gentianella spp.					✓																1
Pilosella officinarum											✓						✓				2
-ve Scrub spp									✓						✓						2

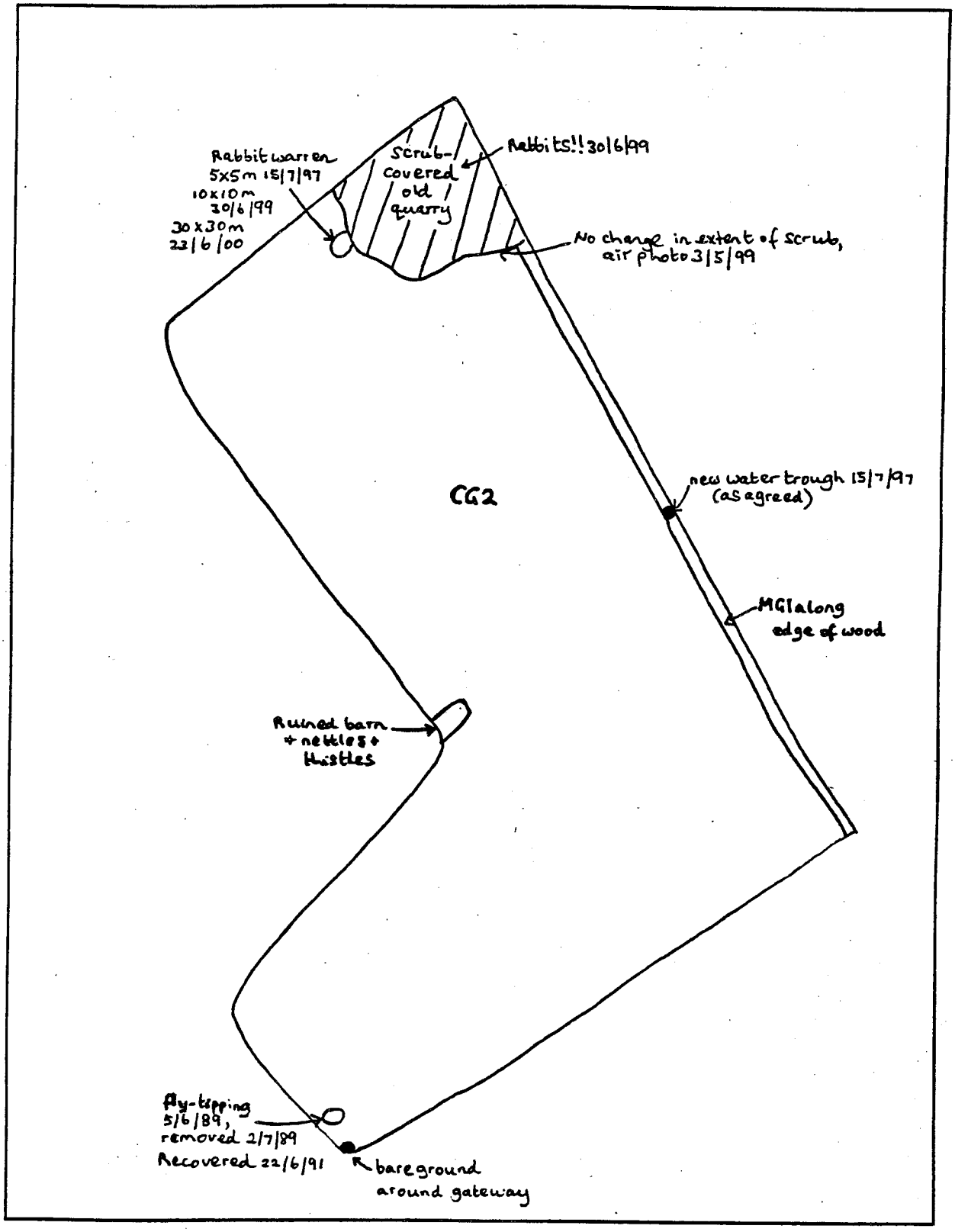
White Down and Woods SSSI map and unit numbers



White Down and Woods SSSI: baseline map of grassland interest feature



White Down and Woods SSSI: monitoring map for grassland interest feature



Appendix 3.
Variation in frequency of indicator species with number of quadrats sampled

CG2: Wylye Down (site 1)

Species/No of quadrats	5 quads	FOR	10 quads	FOR	20 quads	FOR	40 quads	FOR
Anthyllis vulneraria	0.0		10.0	R	35.0	O	40.0	O
Asperula cynanchica	100.0	F	100.0	F	100.0	F	100.0	F
Campanula glomerata	80.0	F	60.0	F	70.0	F	70.0	F
Cirsium acaule	100.0	F	100.0	F	100.0	F	100.0	F
Filipendula vulgaris	40.0	O	40.0	O	40.0	O	40.0	O
Gentianella amarella	40.0	O	30.0	O	50.0	F	55.0	F
Helianthemum nummularium	100.0	F	70.0	F	85.0	F	90.0	F
Hippocrepis comosa	20.0	R	50.0	F	50.0	F	52.5	F
Leontodon hispidus	100.0	F	80.0	F	85.0	F	90.0	F
Leucanthemum vulgare	40.0	O	70.0	F	60.0	F	65.0	F
Linum catharticum	80.0	F	80.0	F	90.0	F	90.0	F
Lotus corniculatus	100.0	F	100.0	F	95.0	F	97.5	F
Pilosella officinarum	60.0	F	80.0	F	80.0	F	72.5	F
Plantago media	80.0	F	100.0	F	90.0	F	90.0	F
Polygala calcarea	0.0		40.0	O	45.0	F	35.0	O
Primula veris	20.0	R	30.0	O	25.0	O	25.0	O
Sanguisorba minor	100.0	F	100.0	F	100.0	F	100.0	F
Scabiosa columbaria	80.0	F	100.0	F	100.0	F	92.5	F
Senecio jacobaea	40.0	O	20.0	R	20.0	R	25.0	O
Serratula tinctoria	80.0	F	30.0	O	55.0	F	70.0	F
Succisa pratensis	100.0	F	100.0	F	100.0	F	97.5	F
Thymus polytrichus	100.0	F	100.0	F	100.0	F	97.5	F
No positive indics Freq		14		15		18		17
No positive indics Occ		3		5		3		4
No of negative indics >Occ		0		0		0		0

CG2: Knighton, Middleton Bank (site 6)

Species/ No of quadrats	5 quads	FOR	10 quads	FOR	20 quads	FOR	40 quads	FOR
Anthyllis vulneraria	0.0		10.0	R	10.0	R	10.0	R
Campanula glomerata	20.0	R	10.0	R	5.0	R	7.5	R
Cirsium acaule	20.0	R	20.0	R	30.0	O	35.0	O
Filipendula vulgaris	80.0	F	70.0	F	60.0	F	60.0	F
Gentianella amarella	80.0	F	50.0	F	60.0	F	62.5	F
Helianthemum nummularium	0.0		0.0		0.0		2.5	R
Hippocrepis comosa	0.0		10.0	R	15.0	R	17.5	R
Leontodon hispidus	100.0	F	100.0	F	100.0	F	100.0	F
Leucanthemum vulgare	0.0		0.0		10.0	R	5.0	R
Linum catharticum	80.0	F	80.0	F	85.0	F	87.5	F
Lotus corniculatus	100.0	F	100.0	F	100.0	F	100.0	F
Pilosella officinarum	20.0	R	20.0	R	20.0	R	12.5	R
Plantago media	80.0	F	100.0	F	95.0	F	92.5	F
Polygala vulgaris	80.0	F	80.0	F	65.0	F	65.0	F
Primula veris	80.0	F	50.0	F	35.0	O	55.0	F
Sanguisorba minor	100.0	F	100.0	F	100.0	F	100.0	F
Scabiosa columbaria	100.0	F	100.0	F	95.0	F	97.5	F
Senecio jacobaea	20.0	R	40.0	O	30.0	O	27.5	O
Succisa pratensis	80.0	F	70.0	F	70.0	F	72.5	F
Thymus polytrichus	0.0		20.0	R	10.0	R	5.0	R
No positive indics Freq		11		11		10		11
No positive indics Occ		0		0		2		1
No of negative indics >Occ		0		0		0		0

CG5: Edge Common (site 10)

Species/Quadrat	5 quads	FOR	10 quads	FOR	20 quads	FOR	40 quads	FOR
Anthyllis vulneraria	20.0	R	30.0	O	30.0	O	27.5	O
Brachypodium pinnatum	100.0	F	100.0	F	100.0	F	100.0	F
Bromopsis erecta	80.0	F	100.0	F	100.0	F	92.5	F
Cirsium acaule	60.0	F	50.0	F	45.0	F	47.5	F
Galium verum	60.0	F	40.0	O	30.0	O	37.5	O
Gentianella amarella	0.0		40.0	O	40.0	O	27.5	O
Helianthemum nummularium	20.0	R	20.0	R	25.0	O	17.5	R
Hippocrepis comosa	20.0	R	10.0	R	5.0	R	2.5	R
Leontodon hispidus	60.0	F	70.0	F	60.0	F	62.5	F
Leucanthemum vulgare	40.0	O	30.0	O	35.0	O	27.5	O
Linum catharticum	80.0	F	70.0	F	50.0	F	55.0	F
Lotus corniculatus	100.0	F	100.0	F	100.0	F	97.5	F
Pilosella officinarum	20.0	R	20.0	R	15.0	R	10.0	R
Plantago media	0.0		20.0	R	30.0	O	25.0	O
Polygala vulgaris	0.0		0.0		5.0	R	2.5	R
Primula veris	40.0	O	20.0	R	25.0	O	27.5	O
Sanguisorba minor	100.0	F	90.0	F	95.0	F	90.0	F
Scabiosa columbaria	40.0	O	30.0	O	45.0	F	45.0	F
Senecio jacobaea	20.0	R	10.0	R	5.0	R	2.5	R
Thymus polytrichus	60.0	F	50.0	F	50.0	F	40.0	O
Brachypodium/Bromopsis >Occ		2		2		2		2
No other positive indics Freq		7		6		7		6
No other positive indics Occ		3		5		7		7
No of negative indics >Occ		0		0		0		0

MG3: Borrow Beck:, by river (site 3)

Species/No of quadrats	5 quads	FOR	10 quads	FOR	20 quads	FOR	40 quads	FOR
Alchemilla spp.	80.0	F	20.0	R	20.0	R	20.0	R
Anemone nemorosa	0.0		10.0	R	5.0	R	5.0	R
Anthriscus sylvestris	60.0	F	90.0	>F	90.0	>F	75.0	>F
Centaurea nigra	60.0	F	40.0	O	40.0	O	35.0	O
Conopodium majus	40.0	O	70.0	F	70.0	F	65.0	F
Filipendula ulmaria	0.0		0.0		0.0		2.5	R
Geranium sylvaticum	0.0		0.0		5.0	R	2.5	R
Lathyrus pratensis	40.0	O	40.0	O	40.0	O	37.5	O
Leontodon spp.	100.0	F	80.0	F	90.0	F	92.5	F
Persicaria (Polygonum) bistorta	0.0		10.0	R	5.0	R	2.5	R
Rhinanthus minor	40.0	O	80.0	F	65.0	F	67.5	F
Rumex obtusifolius	0.0		0.0		0.0		2.5	R
Sanguisorba officinalis	0.0		10.0	R	20.0	R	15.0	R
No positive indics Freq		3		3		3		3
No positive indics Occ		3		2		2		2
No of negative indics >Occ		0		0		0		0
No of negative indics >Freq		0		1		1		1

F = Frequent or more than frequent ie present in 41%+ of quadrats
O = Occasional ie present in 21-40% of quadrats
R = Rare ie present in 1-20% of quadrats
>F = More than frequent ie present in 61%+ of quadrats
Note: Site numbers refer to numbers in the validation project

Appendix 4. English names of indicator species

Latin name	English name
Achillea ptarmica	Sneezewort
Acinos arvensis (Clinopodium acinos)	Basil Thyme
Agrimonia eupatoria	Agrimony
Agrostis curtisii	Bristle Bent
Aira spp	Hair-grass
Ajuga reptans	Bugle
Alchemilla spp.	Lady's Mantles
Anagallis tenella	Bog Pimpernel
Anenome nemorosa	Wood Anenome
Angelica sylvestris	Wild Angelica
Antennaria dioica	Mountain Everlasting
Anthriscus sylvestris	Cow Parsley
Anthyllis vulneraria	Kidney Vetch
Aphanes spp	Parsley-piert
Arenaria serpyllifolia	Thyme-leaved Sandwort
Armeria maritima	Thrift
Arrhenatherum elatius	False Oat-grass
Asperula cynanchica	Squinancywort
Astragalus danicus	Purple Milk-vetch
Berula erecta	Lesser Water-parsnip
Brachypodium pinnatum	Tor-grass
Bromopsis erecta	Upright Brome
Calluna vulgaris	Heather
Caltha palustris	Marsh-marigold
Campanula glomerata	Clustered Bellflower
Campanula rotundifolia	Harebell
Cardamine pratensis	Cuckooflower
Carduus nutans	Musk Thistle
Carex acutiformis	Lesser Pond-sedge
Carex flacca	Glaucous Sedge
Carex nigra	Common sedge
Carex panicea	Carnation Sedge
Carex spp	Sedges
Carlina vulgaris	Carline Thistle
Carum verticillatum	Whorled Caraway
Centaurea nigra	Common Knapweed; Hardheads
Centaurea scabiosa	Greater Knapweed
Centaurium erythraea	Common Centaury
Chamerion angustifolium	Rosebay Willowherb
Cirsium acaule	DwarfThistle; Stemless Thistle
Cirsium arvense	Creeping Thistle

Latin name	English name
Cirsium dissectum	Meadow Thistle
Cirsium heterophyllum	Melancholy Thistle
Cirsium palustre	Marsh Thistle
Cirsium vulgare	Spear Thistle
Cladonia spp	
Clinopodium vulgare	Wild Basil
Cochlearia pyrenaica	Pyrenean Scurvygrass
Conopodium majus	Pignut
Crepis paludosa	Marsh Hawk's-beard
Dactylis glomerata	Cock's-foot
Deschampsia cespitosa	Tufted Hair-grass
Deschampsia flexuosa	Wavy Hair-grass
Dianthus deltoides	Maiden Pink
Draba incana	Hoary Whitlowgrass
Dryas octopetala	Mountain Avens
Eleocharis spp.	Spike-rushes
Epipactis atrorubens	Dark-red Helleborine
Erica spp	Heaths eg Cross-leaved Heath
Erica tetralix	Cross-leaved Heath
Erigeron acer	Blue Fleabane
Erodium cicutarium	Common Stork's-bill
Eupatorium cannabinum	Hemp-agrimony
Euphrasia spp.	Eyebrights
Filipendula ulmaria	Meadowsweet
Filipendula vulgaris	Dropwort
Fragaria vesca	Wild Strawberry
Fritillaria meleagris	Fritillary; Snakeshead Fritillary
Galium aparine	Cleavers; Goosegrass
Galium palustre	Common Marsh-bedstraw
Galium saxatile	Heath Bedstraw
Galium sterneri	Limestone Bedstraw
Galium uliginosum	Fen Bedstraw
Galium verum	Lady's Bedstraw
Genista tinctoria	Dyer's Greenweed
Gentiana verna	Spring Gentian
Gentianella spp	Gentians eg Autumn Gentian
Geranium sanguineum	Bloody Crane's-bill
Geranium sylvaticum	Wood Crane's-bill
Geum rivale	Water Avens
Glyceria maxima	Reed Sweet-grass
Helianthemum appeninum	White Rock-rose

Latin name	English name
Helianthemum canum (H. oelandicum)	Hoary Rock-rose

Helianthemum nummularium	Common Rock-rose
Heracleum sphondylium	Hogweed
Hippocrepis comosa	Horseshoe Vetch
Holcus lanatus	Yorkshire-fog
Hydrocotyle vulgaris	Marsh Pennywort
Hypericum montanum	Pale St John's-wort
Hypericum pulchrum	Slender St John's-wort
Juncus acutiflorus	Sharp-flowered Rush
Juncus articulatus	Jointed Rush
Juncus conglomeratus	Compact Rush
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Juncus spp	Rushes
Juncus subnodulosus	Blunt-flowered Rush
Juniperus communis	Juniper
Knautia arvensis	Field Scabious
Lathyrus linifolius (L. montanus)	Bitter-vetch
Lathyrus pratensis	Meadow Vetchling
Leontodon autumnalis	Autumn Hawkbit
Leontodon hispidus	Rough Hawkbit
Leontodon saxatilis	Lesser Hawkbit
Leontodon spp.	Hawkbits
Leucanthemum vulgare	Oxeye Daisy
Linum anglicum (L. perenne)	Perennial Flax
Linum catharticum	Fairy Flax
Listera ovata	Common Twayblade
Lotus corniculatus	Common Bird's-foot-trefoil
Lotus pedunculatus	Greater Bird's-foot-trefoil
Lychnis flos-cuculi	Ragged-Robin
Lysimachia nummularia	Creeping-Jenny
Mentha aquatica	Water Mint
Mercurialis perennis	Dog's Mercury
Minuartia verna	Spring Sandwort
Molinia caerulea	Purple Moor-grass
Myosotis alpestris	Alpine Forget-me-not
Myosotis laxa	Tufted Forget-me-not
Myosotis scorpioides	Water Mint
Myrica gale	Bog-myrtle
Narthecium ossifragum	Bog Asphodel
Oenanthe fistulosa	Tubular Water-dropwort
Oenanthe silaifolia	Narrow-leaved Water-dropwort
Orchidaceae spp	Orchids

Latin name	**English name**
Origanum vulgare	Wild Marjoram
Ornithopus perpusillus	Bird's-foot
Parnassia palustris	Grass-of-Parnassus
Pedicularis sylvatica	Lousewort
Persicaria amphibia	Amphibious Bistort
Persicaria bistorta	Common Bistort; Easter-ledges
Persicaria vivipara	Alpine Bistort
Phalaris arundinacea	Reed Canary-grass
Phragmites australis	Common Reed
Pilosella officinarum	Mouse-ear-hawkweed
Pimpinella saxifraga	Burnet-saxifrage
Pimpinella spp	Burnet-saxifrages
Pinguicula vulgaris	Common Butterwort
Plantago coronopus	Buck's-horn Plantain
Plantago major	Greater Plantain
Plantago maritima	Sea Plantain
Plantago media	Hoary Plantain
Polemonium caeruleum	Jacob's-ladder
Polygala spp.	Milkworts
Potentilla erecta	Tormentil
Potentilla palustris	Marsh Cinquefoil
Primula farinosa	Bird's-eye Primrose
Primula veris	Cowslip
Pteridium aquilinum	Bracken
Ranunculus flammula	Lesser Spearwort
Rhinanthus minor	Yellow-rattle
Rhododendron spp	Rhododendrons
Rosa spp	Wild Roses
Rumex acetosella	Sheep's Sorrel
Rumex crispus	Curled Dock
Rumex obtusifolius	Broad-leaved Dock
Salix repens	Creeping Willow
Sanguisorba minor	Salad Burnet
Sanguisorba officinalis	Great Burnet
Saxifraga hypnoides	Mossy Saxifrage
Scabiosa columbaria	Small Scabious
Scilla spp.	Squills
Sedum acre	Biting Stonecrop
Sedum spp.	Stonecrops
Selaginella selaginoides	Lesser Clubmoss
Senecio aquaticus	Marsh Ragwort
Senecio jacobaea	Common Ragwort
Serratula tinctoria	Saw-wort
Sesleria caerulea	Blue Moor-grass

Latin name	**English name**
Silaum silaus	Pepper-saxifrage

Silene uniflora	Sea Campion
Sonchus spp	Sow-thistles
Sphagnum spp	Bog Mosses
Stachys officinalis	Betony
Succisa pratensis	Devil's-bit Scabious
Teesdalia nudicaulis	Shepherd's Cress
Teucrium scorodonia	Wood Sage
Thlaspi caerulescens	Alpine Penny-cress
Thalictrum flavum	Common Meadow-rue
Thymus polytrichus	Wild Thyme
Thymus spp	Thymes
Tragopogon pratensis	Goat's-beard
Trinia glauca	Honewort
Trollius europaeus	Globeflower
Ulex spp	Gorse
Urtica dioica	Common Nettle
Vaccinium myrtillus	Bilberry
Valeriana dioica	Marsh Valerian
Valeriana officinalis	Common Valerian
Veronica officinalis	Heath Speedwell
Viola hirta	Hairy Violet
Viola lutea	Mountain Pansy
Viola palustris	Marsh Violet
Viola spp	Violets

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