CHAPTER 4
RECOMMENDATIONS FOR FUTURE MONITORING

1 INTRODUCTION

1.1 POLICY BACKGROUND

Since the introduction of the first AE schemes under the 1986 Agriculture Act, UK policy for biodiversity and agri-environment measures has evolved, mainly in response to policies initiating from the European Union. A consequence of EU directives is that each nation has to produce its own rural development plan. The England Rural Development Plan was published in 2000, under which AE schemes now reside. The main policy driver for biodiversity is currently the UK Biodiversity Action Plan (BAP) (Anon. 1995a). AE schemes are the main vehicles by which many BAP national objectives and targets are expected to be met and delivered. Equivalent objectives and targets also need to be met and delivered at a local level, including in individual RDR Regions. Individual AE schemes will also have their own objectives. Currently, each ESA has specific objectives related to the local landscape and biodiversity. CSS has overall scheme objectives, with additional ones for specific landscape types and individual counties. Individual sites in CSS and more recent ESA agreements (with management plans) also have specific objectives or targets that might need to be monitored. A full description of the policy background is given in Appendix 2.

At the time of writing, DEFRA is conducting a review of AE schemes. Options under consideration are the continuation or amalgamation of existing schemes, and the introduction of new ‘broad and shallow’ or ‘deep and narrow’ schemes. Irrespective of the structure of the new schemes, the UK BAP will continue to be the driving force for habitat conservation for some time to come. Therefore, the recommendations for future botanical monitoring are structured around BAP objectives for the relevant Priority Habitats. The overall aim of the botanical monitoring programme will be to assess the contribution of AE schemes in meeting objectives and delivering targets for Priority Habitats. This will be aimed primarily across schemes at the country (England) level, although consideration is also given to how the monitoring programme might address these issues at regional and site levels, and within individual schemes.

1.2 APPROACH USED

Recommendations for future botanical monitoring have been made to address the overall monitoring aim, whilst also making optimum use of the existing quantitative samples. The emergence of Rapid Condition Assessment (RCA) methods since the start of the original monitoring programme has also been taken into account. The recommendations include a combination of rapid assessment and quantitative (plot or quadrat based botanical recording) methods. RCA allows individual sites to be sampled and assessed. Quantitative methods are used to sample vegetation types at the scheme or country level. In addition, the use of RCA will allow a large sample of sites to be covered, whilst quantitative methods will maintain the capability for detecting and interpreting vegetation change. Ways of forging links between the two approaches are also suggested.

The review of the previous AE scheme botanical monitoring highlighted the range of habitats being monitored in each scheme. Sampling strategies varied between schemes, but most samples were considered to be representative of the targeted habitat in a particular scheme. Collectively, however, they are not necessarily representative of the range of BAP Priority Habitats under AE scheme agreement across all schemes, so recommendations have been made for restructuring the samples. Recommendations have also been made on ways of using the various existing field methods to ensure, as far as possible, both continuity with the previous monitoring programme, and comparability across all schemes for each habitat. Information from the review on analysis and interpretation methods, and monitoring method development, has also been used.

To make best use of the existing samples each plot or quadrat has been positioned, where possible, within a number of classification frameworks, which has provided an estimate of the size and distribution of the sample between schemes for each habitat. Power analyses have been used to estimate sample sizes required to detect given magnitudes of change. Where data were available, this has also been done against targets representing extremes in condition (pristine or degraded) of the habitat. These results have been used to make recommendations on future sampling strategies.

A considerable pool of expertise and experience on botanical monitoring exists within a range of organisations in the UK. This includes specialist knowledge from different perspectives such as policy, ecology, conservation and field survey. In order to draw on this experience, a workshop was held on 13 May 2002 to which representatives from a range of these organisations were invited. This also ensured that issues relating to botanical monitoring strategies in AE schemes were fully explored, and provided an opportunity for any new issues to be raised. A full report of the workshop is in Appendix 3. Points raised at the workshop have been taken into account in the new recommendations.

The recommendations are for a core monitoring programme of grassland and upland Priority Habitats to be established, with a series of targeted studies in other habitats. The core programme is described in detail, but targeted studies will need to be designed according to their specific objectives, and are outwith the scope of this project. Habitats for targeted study have, however, been identified. Recommendations for the monitoring programme take the following form:

1. A general strategy that outlines the general principles under which the specific recommendations for individual habitats have been drawn up.

2. General recommendations on the application of RCA.

3. A series of habitat schedules. Each habitat or set of habitats targeted for monitoring has its own schedule, which lists the specific objectives and procedures under a standard series of headings.

4. Explanatory notes to accompany the habitat schedules. A set of notes has been compiled to cover all grassland habitats, plus a second set for upland habitats. These notes share the same standard headings as the habitat schedules, and explain the rationale (or methods used) for making decisions on the contents of each schedule.

5. A list of habitats recommended for targeted studies outside the core programme.

6. Some recommendations on practicalities and logistics for the core programme.

1.3 TERMINOLOGY

Terminology relating to the maintenance and enhancement of habitats has, unfortunately, not been standardised within the BAP process. For example, different terminology appears to have been used for grassland and upland Priority Habitats. The Countryside Council for Wales (CCW) is the lead agency for a number of lowland grassland Priority Habitats and has recommended a set of terms that distinguishes re-creation of grassland on arable land from restoration of the biodiversity value of grassland previously subjected to agricultural improvement (see Burke & Critchley 2001). DEFRA currently uses a slightly different set of terms, which are consequently used in this report, as in Table 1.

Table 1. Terminology used for BAP Habitat Action Plan (HAP) objectives, using grassland as examples of management.

Management	**Published grassland HAPs**	**Recommended by CCW**	**DEFRA terminology used in this report**
The re-establishment of grassland of wildlife value, and broadly relating to one or more of the five HAP types, from arable and other non-grassland precursors.	Re-establishment	Re-creation	Re-establishment
The reversion to grassland of wildlife value from improved grassland or semi-improved neutral grassland precursors (usually MG6/7).		Restoration	
The improvement in condition (and maintenance of the extent) of grassland already conforming to one or more of the five HAP types.	Rehabilitation	Rehabilitation	Restoration
The maintenance of the extent and condition of grassland already conforming to one or more of the five HAP types.	Maintenance	Maintenance	Maintenance

2 GENERAL STRATEGY FOR MONITORING

Recommendations for the core monitoring programme of grassland and upland habitats are based on the following general strategy. The monitoring is aimed at BAP Priority Habitats, and vegetation that has potential for re-establishment to Priority Habitat.

2.1 MEASURE STOCK

The statistical population to be monitored is the total resource of the target habitat that is under AE agreement. The first stage is therefore to determine the stock of that habitat and its distribution among the current AE schemes. Ideally this would be done using mapped habitat inventories. Unfortunately such inventories are either not available or incomplete for most habitats (although this situation is likely to improve over time through work by the National Biodiversity Network and English Nature). Alternatively, information on the habitat resource could be collected at the time that agreements are established. Currently, this is not done in a rigorous way, although the management tier or option into which land is entered can often give some information about its habitat type. The collection of such information, including setting of objectives, could be incorporated into the revised AE schemes. This information will need to be updated periodically as the number and location of agreements changes.

Another approach is to estimate the stock by sampling. This has already been done for CSS for 1998-99 (Carey *et al*. 2001a) from a random sample of agreements. However, some estimates for habitats that were poorly represented in the sample might not be reliable. This is also currently being done for ESAs under DEFRA project AE02. It is assumed that results from the latter will be available before the new monitoring programme commences, although in most cases the estimates will be for ESAs collectively rather than for individual ESAs. Another problem with the estimates is that they do not provide information on the distribution of the resource; this will hamper the selection of additional sites for both quantitative monitoring and RCA. It is, however, recommended that the distribution of samples between CSS and individual ESAs should be in proportion to the resource under agreement. If it is not possible to obtain accurate inventories or estimates for individual ESAs, alternatives might be to use tiers (as was used in the stratification for AE02) or other data sources such as land cover maps and perhaps an element of local knowledge.

2.2 MEASURE CONDITION

The condition of the habitat of interest needs to be established so that monitoring can be carried out against condition targets. This would be done using RCA on a sample drawn from CSS and ESAs. The aim would be to allocate each site or feature sampled to a condition category, either as specified in the JNCC Common Standards Monitoring or one of the additional categories as recommended in Section 3 below. The sample of sites drawn for RCA will include all those selected for quantitative monitoring. Methodological development still required for RCA could be carried out in 2003, prior to the start of the new monitoring programme.

2.3 ASSESS CHANGE AGAINST TARGETS

Vegetation change will be measured using quantitative methods, based on botanical (species) data collected by repeated observations from fixed, relocatable plots or quadrats. This will be from a proportionate random sample of sites, according to the stock of the habitat in each AE scheme. The sample will include, as far as possible, existing AE monitoring sites or plots/quadrats. Where the power analyses suggest that the existing sample shows an excess, then a sub-sample will need to be selected. Where the existing sample shows a shortfall, it will need to be topped up. In either case, the existing sample will need to be adjusted to ensure that the correct distribution between schemes is achieved.

In each scheme with an existing sample, the field method in current use will be continued, and any new samples in that scheme will use that same method. This will ensure continuity with previous surveys, and comparability across the whole sample within that scheme. Minor modifications to each field method are recommended that enable comparable data to be collected across all schemes and across all grassland or upland habitats sampled.

To enable vegetation changes to be measured against targets representing condition, it will be necessary to calibrate botanical variables from the quantitative monitoring against attributes or condition categories from RCA. This can be done during the monitoring programme itself, using data from sites used for both quantitative monitoring and RCA. If calibration is not successful, the quantitative samples would need to be regarded as a surveillance programme that is not tied to specific condition targets.

Vegetation change between surveys in the new monitoring programme can be analysed across all schemes. A suggested timetable for surveys is provided in Section 5.1 below. RCA and quantitative monitoring would be done at the same time intervals, although RCA could be done more frequently if resources allow. Change can also be analysed in individual schemes with sufficient samples (which can be determined from the power analysis results) from the baseline year of the previous monitoring programme onwards.

2.4 COMPARE TRENDS IN AE SCHEMES WITH THE WIDER COUNTRYSIDE

In a large-scale monitoring scheme it is not feasible to establish control sites in the same way as would be done in a small-scale manipulative experiment. However, it is possible to establish whether temporal changes in vegetation on land under AE scheme agreement differ from those seen in the wider countryside. Countryside Survey (CS) is the most suitable source of information on botanical changes in the wider countryside. CVS classes or aggregate classes can be used to ensure that comparisons are made between similar vegetation types in AE schemes and in the CS sample. With the recommended modifications to field methods in the AE monitoring programme, the CS and AE samples will be compatible, so allowing quantitative comparisons to be made. Ideally, however, survey dates of CS and AE scheme monitoring would need to coincide. Otherwise, trends can be compared on a qualitative basis. Some interpolation will be possible, once the next CS survey has been done. Since the CS sample includes sites under AE scheme agreement, these should be filtered out of the CS sample before making comparisons. With the increasing area of land coming under AE agreements there may be some scope for CS itself to be used to compare agreement and non-agreement land, though the relatively scarce priority habitats are poorly represented in the sample.

The current lowland grassland BAP monitoring programme (AE08) uses a sample of sites that is stratified by their status as AE agreement or non-agreement. This will enable a comparison to be made between AE sites with those on the wider countryside, although the sample might be biased towards the better quality sites, being based on EN's county inventories.

Other potential data sources for comparing trends in AE schemes with those elsewhere are also recommended.

2.5 ASSESS DRIVERS OF CHANGE

Where changes in vegetation are detected, it is necessary to establish as far as possible what are the likely causes. Changes resulting from management imposed by the AE schemes are of primary interest and are an essential part of the feedback loop of monitoring, evaluating, and improving the effectiveness of the schemes. Therefore, management data should be collected from farmers as part of the monitoring programme.

It is also important to assess whether other factors that are not under the direct influence of AE schemes might also be driving vegetation change. For each habitat, potential environmental drivers will be inferred by analysing indicator variables that are known to show consistent relationships with certain potential drivers of vegetation change. A set of indicator variables is recommended for each habitat. Environmental factors can also be analysed using existing data sets, describing either spatial data (e.g. soil type, estimated deposition of nutrients) or temporal data (e.g. annual vegetation data from Environmental Change Network sites). However, it is important that environmental data are collected for a clear purpose, otherwise large datasets can accumulate that are not utilised efficiently. Therefore, it would be more cost-effective to set up a discrete research or monitoring project (or projects), as an add-on to the core monitoring programme, to consider particular ecological processes. Additional environmental data would be collected, and existing national datasets used, as part of that project.

3 APPLICATION OF RAPID CONDITION ASSESSMENT

3.1 INTRODUCTION

A variety of methods has been devised and published for the botanical condition assessment of designated sites and some AE scheme sites in the lowlands of England (Robertson & Jefferson 2000, SNH 2001, Burch *et al*. 1999, Mitchley *et al*. 2000 and CCW 2002). There is an increasing consensus on appropriate methods for SSSIs in the lowlands of England and final recommendations for RCA (Common Standards Monitoring) of a wide range of habitats are now expected from JNCC in 2002. However, there is a lack of consensus regarding appropriate methods for the more extensive habitats in the uplands (SNH 2001, Jerram *et al*. 2001, CCW 2002, MacDonald 2002).

RCA methods represent the outcome of a good deal of expert opinion and judgement but even for the generally agreed approaches in the lowlands, these are so recent that there has as yet been little testing or validation of the methods and results. Notwithstanding this degree of uncertainty and a need for further work, RCA represents a potentially valuable and powerful approach to assessing the success or otherwise of AE schemes. RCA could therefore become an important means of assessing the increasingly critical ecological and agri-environmental policy objective of assessing whether AE schemes actually deliver environmental gains to the wider countryside.

Ultimately, however, the value of botanical condition assessment as a means of monitoring AE scheme success is determined by two factors:

- Clear and unambiguous objectives for sites or features against which condition can be assessed
- The input (in terms of time and expertise) in determining and validating appropriate attributes and targets.

For the former, we are to a large extent dependent on the work of AES project officers on the ground in determining appropriate site objectives and thus agreements. It is recognised, however, that in the existing AE schemes such objectives are often not set at the level of individual habitats or features and that, even when they are, a rigorous national approach has not been adopted. There is clearly a strong case for the adoption of site objectives for individual habitats in any revised AE Scheme (as for example adopted by Tir Gofal). This would also enable monitoring and/or care and maintenance visits to be more closely tied in with individual agreements.

The latter factor highlights the need for further work (as well as drawing on current agency strategies) a topic covered in Section 3.6.

Given these two provisos however, RCA represents a quick, cost-effective and potentially powerful tool for large-scale botanical monitoring of AE schemes.

3.2 GENERAL STRATEGY

3.2.1 Recommended methods

We recommend that as far as possible, condition assessment of AE scheme sites should be tied into the nationally agreed condition monitoring methodologies for designated sites (e.g. Robertson & Jefferson 2000). This is, in the final analysis, a pragmatic recommendation, to draw benefit from the high degree of expertise and time already expended in developing these methods, and to ensure standardisation and compatibility across the range of sites. For example a proportion of AE scheme sites may also be designated sites (see Chapter 3, Section 2.2.4) and are thus, in principal, already subject to this form of monitoring.

This recommendation may inevitably result in a staggered timetable for monitoring different habitats due to differing level of progress and availability of agreed methods for different habitats. While for some habitats (e.g. woodland) a national methodology is already agreed, or close to agreement (e.g. grasslands), for others (e.g. uplands) a final methodology is still under discussion. We recommend that AE monitoring for these latter habitats should be finalised only once a national strategy has been agreed. For uplands, the final results of the current MAP Project (see also Glaves *et al*. 2001) are likely to be relevant in defining appropriate attributes. Equally, for grasslands, the current English Nature/DEFRA/JNCC BAP reporting project on non-designated grassland sites (AE08) may also yield further guidance on appropriate attributes and targets for non-designated sites which may be fed into final methods for RCA monitoring of AE schemes. Indeed there is considerable scope for future collaboration between DEFRA and English Nature in terms of data exchange for designated sites.

3.2.2 Defining condition

We recommend that condition categories for AE sites should be closely tied into the JNCC categories adopted for designated sites. Thus "favourable" condition should be equivalent across both designated and undesignated AE sites. However, there are problems in adopting the current methodology as it stands, as many sites in restoration or re-establishment tiers will inevitably fall into the "unfavourable" category and there will be little or no likely short-term condition improvement, beyond perhaps unfavourable recovering, under AE schemes. We therefore propose, for discussion, a series of additional condition categories to reflect developing vegetation conditions in the wider countryside and these are discussed in Section 3.4. We emphasise that these additional condition categories represent some first thoughts in this area and will require much wider discussion and refinement before they could be utilised for monitoring of AE sites.

3.2.3 Setting attributes

Attributes chosen should in general follow those developed for the agreed methodologies. However, there are situations where adaptations will be necessary:

- A number of attributes may be irrelevant in the early stages of vegetation development. For example in restoration or re-establishment sites positive indicator species of pristine sites are unlikely to be present.

- Additional or adjusted attributes may be valuable on re-establishment sites, to assess the early success of vegetation establishment. For example, on naturally regenerated sites, the recording of indicator species may be zoned in relation to the colonisation source, while for hay strewn or brush-harvested seed, the establishment of species known from the donor site, can be considered an indicator of re-establishment success. Clearly these attributes must be closely tied to establishment and management information for the site.

- A distinction may be required between broad and shallow and narrow and deep schemes in developing the level of condition assessment required. Thus while the latter, typically priority habitats, merit condition assessment using the full set of attributes and targets, a much more limited set of simple and indicative attributes (probably with less NVC specificity) may be appropriate for the former.

- In a number of sites, site objectives may be unclear in the early stages of development and more broad-brush attributes and targets may be appropriate. This issue is discussed in Section 3.5.4.

- There is also some further development work required to refine field methods for certain attributes, e.g. assessment of litter cover and sward heterogeneity (Kirkham *et al.* 2001).

3.2.4 Setting targets

Targets for favourable condition should be drawn from the agreed national methodologies. For the additional condition categories, however, targets will need to be set to reflect vegetation development. We propose that these are developed following consultation with acknowledged experts. Validation of these targets may be achieved using three approaches: expert opinion, from analysis of existing agri-environment monitoring data and from adoption and piloting in future AE scheme monitoring (see Section 3.6).

3.3 FIELD METHODS

3.3.1 The structured walk

Site condition must be monitored from an assessment of the whole site/feature (though sub-sampling can be used), e.g. during a walk across the site assessing a number of attributes according to predefined targets. There are a number of different published field methods for RCA. For example the English Nature rapid assessment method for lowland grassland is based on a structured walk of the site (Robertson & Jefferson 2000) while the SNH method for uplands employs a random sample of points (MacDonald 2002) and the MAP project uses a grid of sample points (Glaves *et al*. 2001). There is not yet universal agreement on one particular method and there are strengths and weaknesses in each approach. The recommendation is, in general and certainly for lowland sites, to adopt the structured walk for a number of reasons:

- The structured walk is the method currently used in England grassland RCA (Robertson & Jefferson 2000) and there is merit in adopting an existing national method notwithstanding the relatively early stages of use and limited validation (see below)

- The structured walk is a comparatively simple method and generally ensures good coverage of the site

- The route of the structured walk can be determined prior to the site visit and marked on the site map.

On the other hand, the structured walk is not random sampling and resulting data are less amenable to statistical analysis. Robertson & Jefferson (2000) recommend a maximum of 16 ha for visual assessment and therefore that larger sites are subdivided. Also where large sites are being assessed, large areas will be unsampled and so a different method may be required, e.g. for moorland sites. As well as size of sites, the degree of variability or heterogeneity of a site is also an important consideration. In general, the more heterogeneous a site the more samples might be required irrespective of size.

3.3.2 Sampling positions – number and size

For some attributes/habitats the structured site walk noting the existence and condition of the attributes is sufficient without individual sampling positions. However where more quantitative information is required, e.g. on the cover and frequency of indicator species, attributes may be assessed by stopping at a number of sampling positions and assessing the attributes at each position. The recommended number of samples or sampling positions varies considerably in published methods:

- Ten – EN Habitat Restoration Monitoring Project (Burch *et al*. 1999; Mitchley *et al*. 2000), English uplands (Jerram *et al*. 2001)

- Twenty – EN Rapid assessment methods for lowland grassland SSSIs (Robertson & Jefferson 2000)

- Twenty-eight – SNH upland designated site monitoring (MacDonald 2002)

- One hundred – CCW Tir Gofal performance indicator monitoring (CCW 2002).

Clearly the larger the number of samples the more precise the assessment of the attributes but the more time is required in the field. Random and grid samples provide potentially the best representative coverage of a site and the former provides greatest statistical rigour. However stopping at sampling positions during a structured walk of the site has the merit of simplicity as well as being the method in current usage in England, at least for lowland grassland SSSIs. Therefore, the recommendation is to assess attributes at 20 predetermined, more or less equidistant sampling positions during the structured walk. It should be noted again that this approach might not be appropriate for all habitats (e.g. moorland) and all attributes (e.g. some may be better assessed at the site level). Further work may be required to assess the optimal number of samples especially in relation to larger and/or more heterogeneous sites.

Some authors recommend the use of a GPS to record locations of the sample positions. Since the objective of RCA is to provide an assessment of the general condition of the features of a site against objectives, we do not think this additional work is generally necessary or justified. However the approach may have value for monitoring extensive upland habitats for example in the relocation of scarce habitats in a habitat mosaic.

Published RCA methodologies also give varied recommendations for the size of individual sampling positions:

- 3 - 4 m^2 area in front of or around the surveyor - EN Rapid assessment methods for lowland grassland SSSIs (Robertson & Jefferson (2000)

- 1 m semi-circle in front of surveyor - EN Habitat Restoration Monitoring Project (Burch *et al*. 1999; Mitchley *et al*. 2000)

- 1 m around surveyor - CCW Tir Gofal performance indicator monitoring (CCW 2002).

- A hierarchy of scales for different features; 4 m^2 – 1 ha – whole site - SNH upland designated site monitoring (MacDonald 2002).

There is merit in varying the size of sampling position depending upon the nature of the attributes. Following the NVC sampling methodology the recommendation is to adopt a sample size of 1 m around the surveyor (i.e. a circle of 2 m diameter) for grassland attributes and 2 m around the surveyor (i.e. circle of 4 m diameter) for dwarf shrub heath, blanket bog etc.

It should be noted again that not all attributes are amenable to assessment at the relatively small sampling positions. Some attributes should be assessed the whole site/feature level following the structured walk, e.g. landscape features in coastal grazing marsh.

3.4 CONDITION CATEGORIES FOR MONITORING AE SCHEMES IN THE WIDER COUNTRYSIDE

3.4.1 Background

There are strong arguments for adopting the JNCC condition categories to assess habitat condition in AE schemes. The UK BAP targets are framed within these condition categories and the strong linkage of AE objectives to BAP targets suggests that AE monitoring should be linked as closely as possible to the same categorisation system. However there are two significant problems with utilising this system:

1. The existing JNCC categories were set up for established designated sites and thus do not reflect the very different conditions of some AE sites e.g. re-establishment/restoration habitats. For many restoration sites, achievement of favourable condition may only be expected far beyond the ten-year agreement term and the most that may be expected may be a move from unfavourable to unfavourable - recovering (CCW 2002).

2. In an initial baseline survey, a site can only be categorised as “favourable” or “unfavourable”. All other condition categories refer to a change in condition from the

previous recording, "unfavourable recovering" "favourable - recovered" etc. To utilise condition monitoring to provide an assessment of BAP habitat condition as suggested it is desirable to have a set of condition categories that will reflect the ongoing nature of restoration from a low baseline condition.

Robertson *et al.* (2002) have discussed some of these issues in an attempt to develop condition and restoration assessment methodologies for non-statutory grasslands. Their work focused in part on the definition of favourable condition for non-statutory sites. Here we propose, for further discussion, a series of additional condition categories which would work in conjunction with the existing categories but which are tailored to reflect vegetation development on re-establishment/restoration sites. In our view, it is essential that the term "favourable" is equivalent across both designated (e.g. SSSIs) sites and AE restoration sites and thus the additional categories reflect vegetation development towards "favourable" condition. It is likely that for most restoration sites, achieving "developing favourable" condition maybe the most realistic goal in the short- to medium-term.

3.4.2 Proposed additional condition categories

- Potential
- Potential developing
- Developing favourable
- Favourable = existing JNCC condition category

Potential

This refers to site condition at the start of the re-establishment process (typically years 1-2) which provides an indication that it has the potential to develop towards the target vegetation. Thus attributes such as the presence of a least 1 or 2 positive indicator species, which may include "restorability indicators" (Robertson *et al.* 2002), and / or a suitable colonisation source adjacent. For re-establishment from improved grassland, it would be expected that the grass sward was sufficiently open, at least in some parts of the site, to favour colonisation by desirable species.

Potential developing

Site condition indicating that re-establishment management is having a positive effect on vegetation composition (for example years 2 - 5). Here there would be the expectation that a greater number of positive indicator species would be recorded and that some may also have increased in abundance, suggesting increasing colonisation of the site by desirable species. Vegetation height may be closer to the target for favourable condition.

Developing favourable

Site condition that is close to favourable but which still reflects restoration development. Here a greater increase in positive indicators would be expected together with an increase in abundance and a more even distribution of species in the sward across the site, although probably more patchy than an established sward. It would be expected that negative indicators, such as weed species or scrub would be at lower frequency/abundance and close to the targets for favourable condition. Equally sward structure should be close to favourable condition. This category is similar to the existing unfavourable recovering category although that term may not be appropriate for re-establishment sites that may never have been favourable. This example illustrates the difficulty of defining appropriate condition categories for re-establishment sites and emphasises the need for further discussion and elaboration on this issue.

However for illustrative purposes, a proposed range of condition categories, including those reflecting other changes since a previous recording would be:

- Potential
- Potential - no change
- Potential declining
- Potential developing
- Developing favourable
- Favourable = existing JNCC condition category

3.5 SPECIFIC ISSUES

3.5.1 Generic vs. site specific attributes and targets

The adoption of a generic or site-specific approach to attribute and target setting has been a significant issue for discussion (see Chapter 2, Section 9). We again recommend following the agreed national strategy which proposes a series of generic attributes and targets for individual habitat types, but with some scope to adjust target levels by agreement to suit individual site conditions. This is perhaps more likely to be desirable for re-establishment/restoration sites than for existing priority habitats. Only in exceptional circumstances would the attributes themselves need to be adjusted.

3.5.2 Dealing with mosaics

Many upland but also lowland AE sites may not consist of single well-demarcated habitats but fall into the category of habitat mosaics.

In some situations the site AE objective may be to prioritise one habitat type over another e.g. in an upland context the promotion of upland heath and associated reduction of acid grassland. In this case the site objectives and thus condition monitoring is focussed on one target habitat (i.e. upland heath) and habitat (upland heath) condition assessed accordingly. In some such sites there may be a desire to shift the balance of the mosaic (e.g. 20% upland heath 80% acid grassland to 40% : 60%) and thus the ratio of the mosaic as a whole may also be assessed following the methodology set out for large scale mosaics below.

For some sites, the AE objective may be better defined as the maintenance of the mosaic. For the purposes of condition monitoring we can distinguish two scales of mosaic:

1. Fine scale mosaics – For example a lowland calcareous grassland comprising both short-sward CG2 and taller CG4 vegetation. Here the intimate mix of habitats means that the existence of the mosaic and individual habitat condition can be assessed at the sampling position scale. We propose that an additional attribute is included (i.e. existence of a CG2/CG4 mosaic) and the presence of the target habitat types assessed at each sampling position. A range of acceptable proportions can determined for each habitat type and mosaic condition thus assessed. Attributes for each habitat type should also be included and habitat condition assessed at sampling points as appropriate. At some points this may necessitate completing some attributes for both habitat types. The lowland grassland BAP monitoring programme (AE08) is using a single generic grassland card, which enables appropriate data to be collected for more than one habitat type.

2. Large scale mosaics – For example an upland site comprising areas of upland dry heath, acid grassland, bog, bracken and rocky outcrops. In these situations, the quantity and distribution of the mosaic is assessed at the whole site scale. In many upland situations it may be possible to assess this from a number of observation points across the site. We propose that for a number of habitat types (e.g. bracken, rocky outcrops) it is sufficient to record presence and distribution (perhaps using a GPS) of the habitat. For other habitats, such as upland dry heath and blanket bog, an assessment of the condition of each individual feature is also desirable and should be made at representative sampling positions across the site, assessing against the standard attributes and targets.

3.5.3 Dealing with multiple interest features

In some cases AE sites may be managed both for the target habitat type and for individual species, for example a particular butterfly or bird. To an extent condition assessment can be used as a surrogate for species population assessment e.g. by monitoring habitat components such as vegetation structure and the presence of food plants, although Firbank *et al*. (2001) found successful correlation limited to invertebrate groups. It is also possible to devise condition assessment attributes and targets for individual species populations, but elaboration of this approach is beyond the remit of this project. Significant work is underway on condition assessment for major species groups by EN and JNCC, although the approaches are still in development stages. We conclude that methods for the condition assessment of species in AE schemes require further development work.

3.5.4 Sites with no objectives or unknown potential trajectories

In many cases, sites may be under AE management with no clear long-term objectives or unknown trajectories of sward development. This may be particularly relevant to vegetation development from arable reversion or improved grassland. Here for example, the short-term objective may be to develop a more species-rich grassland sward, but the target NVC community may be unclear or there may be several possibilities. In this case the attributes and targets need to be sensitive enough to register condition improvement, yet broad-brush enough to allow for different community development. Thus for an improved grassland site possible attributes could be:

- Grass/herb ratio – set at a fairly low level as far as herb component goes but nevertheless indicating a diversification of the sward.

- Presence/frequency of positive indicator species drawn from a wide list e.g. based on “restorability indicators”, suited species etc.

- Negative indicators e.g. pernicious weeds

- Sward structure.

This type of broad-brush approach may be relevant to many AE sites in the early stages of vegetation development.

3.5.5 The role of quadrat/plot data in the validation of condition assessment

Quadrat data can provide information on site condition attributes, e.g. presence of positive/negative indicators species, grass:herb ratio, bare ground, sward height etc. In such cases it should be possible to determine cross-calibration criteria so that quadrat data can be categorised according to condition. The match between RCA and quadrat data can then be assessed.

This approach does not validate the attributes/targets themselves, i.e. we cannot test the validity of the assumptions using quadrat data alone. Certain attributes and targets may be thought to represent a particular condition category, but often these decisions are the result of expert opinion and there may not be objective data to check this against. The recommendation is for further work examining existing AE quadrat data especially where time-series data are available for individual sites. This analysis would allow some *a-posteriori* testing of attribute targets against actual vegetation development in a variety of agri-environmental settings. In effect the time series data might allow the more objective assessment as to previous judgement of condition targets was correct, given the subsequent development of vegetation.

3.5.6 To what extent could RCA eventually replace quadrat monitoring?

It is not possible to recommend RCA as the sole method of AE scheme monitoring because the methods are not universally agreed and there remain issues of validation to be resolved. In addition, there are fundamental differences in the questions addressed by RCA and quantitative plot or quadrat based methods. RCA is designed to gain coverage of individual sites, while plots or quadrats are used to sample vegetation types across schemes. The methods are complementary, with RCA providing a means of covering a lot of ground rapidly, while quantitative methods provide more precision for detecting vegetation change. Quadrat or plot data also provide a level of detailed information on species composition that can become even more valuable in relation to assessing the impacts of unpredictable events (e.g. climate change) and answers to questions as yet currently unforeseen. It is difficult to devise or envisage RCA methods that would provide this level of flexibility.

The best prospect is to utilise nationally agreed RCA methods as they are developed and to subsequently employ validation approaches from studies of existing time series AE schemes and from results of the next round of AE monitoring. In time RCA methods might be refined into three approaches:

Method 1: A truly rapid method designed to be used by POs as part of the care and maintenance assessment; recording attributes against targets at the whole site/feature level from quick whole-site walks

Method 2: A modified English Nature rapid assessment approach utilising a structured walk with 20 sampling positions and assessing attributes against targets at sampling positions or the whole feature level as appropriate

Method 3: A more detailed (less rapid) method utilising more sampling positions possible randomly selected and employing extended lists of indicator species (positive, negative, suited species etc) to provide more robust information on attributes and targets. This approach might also involve the recording of measurements/estimates for individual attributes from individual sample positions.

3.6 RECOMMENDED FURTHER WORK

There are a number of issues relating to RCA for AE schemes which are not yet fully resolved or resolvable with the current information available. The need for agreed methods for the uplands is one major issue and this and other issues require additional work before RCA methods can be finalised for England AE schemes monitoring. These issues are outlined below and the relevant issues for individual habitats are indicated under each habitat schedule.

3.6.1 Checking and agreeing attributes.

Key attributes are listed in each priority habitat schedule derived from various published sources including the EN Condition Monitoring approach to grasslands (Robertson & Jefferson 2000). In general these published protocols could be adopted for AE schemes immediately. However because the attributes were selected for the assessment of established, designated sites, there may need to be some modifications for their application to AE schemes, see for example, the case of positive indicator species below. In upland sites for which a large number of quite complex attributes have been developed (e.g. MacDonald 2002) it will be especially necessary to derive a shorter list of attributes relevant to RCA for upland AE schemes. Field methods for some attributes require further development work (Kirkham *et al* 2001).

3.6.2 Selecting appropriate positive indicators.

Positive indicators have been defined for the EN rapid assessment of grassland SSSIs (Robertson & Jefferson 2000) for each priority grassland habitat and could be adopted immediately for AE schemes monitoring. However the lists of positive indicators may need to be modified for use in AE schemes monitoring where some species listed may not be appropriate indicators for AE scheme sites. For example, this will usually be the case for restoration and re-establishment sites which may take many years (if ever) to achieve the full complement of target species.

Attributes could be measured/estimated more precisely, positive and negative indicator species could both be recorded per sampling point thus giving more robust frequency data on all of these.

There may also be a case to provide expanded lists of positive indicators to enable site assessment against performance indicators. For example the list could include indicators of potential changes in the vegetation such as nutrient enrichment or drying or wetting conditions. Indicators of changing environmental conditions could be drawn for example from suited species (Critchley 2000).

Where grassland sites are in AE schemes without objectives or with no definite trajectory of development there is a need to identify indicators of the potential to develop and improve condition. Some work has been done on such "restorability indicators" by EN (Robertson *et al.* 2002) identifying species typical of early stages of successful grassland restoration and re-establishment but there is a need for more work to be done, especially utilising time series data on grassland restoration and re-establishment e.g. from previously collected AE schemes monitoring data.

3.6.3 Selecting and trialling appropriate targets for attributes.

Targets have been set for attributes in grassland RCA for designated sites (Robertson & Jefferson 2000). Since the outcome of RCA depends on meeting targets set in relation to designated features (i.e. site objectives) this issue is critical and central to a workable methodology. AE schemes do include designated sites but in other cases these targets may be inappropriately high. A balance needs to be struck between common standards and generic targets which facilitate comparative assessments countrywide, and site-specific targets reflecting site objectives and conditions, e.g. the starting point of a re-establishment site. Targets for these attributes need to be linked to condition categories but it is difficult to decide where to draw the boundaries. However this could again be determined from analysis of existing AE quadrat data to attempt to define stages of development.

3.6.4 Determining condition category thresholds for targets.

This is the biggest and most complex area of work and will need some major discussion to ensure that thresholds are appropriate - after all if performance indicators are determined by movement between condition categories then these <u>must</u> be as good as they can be. This could be approached in three ways:

- Testing the targets against an existing database and evaluate how the vegetation has developed over time.
- Utilise expert opinion - e.g. circulate suggestions on attributes and targets in a range of scenarios and elicit feedback.
- Use pilot results as a feedback loop - once the method has run for 10-15 years, use the time series data to assess whether targets were realistic.

In particular for non-statutory sites there is a need to develop additional condition categories for non-designated sites and restoration/re-establishment sites of lower quality but with the potential to develop into better condition. It is suggested that existing AE scheme grassland quadrat data could be investigated in further development work to inform key issues such as the selection of appropriate positive indicators. This will be most valuable where time series data are available for individual re-establishment or restoration sites.

4 HABITAT SCHEDULES AND EXPLANATORY NOTES

Explanatory notes should be read in conjunction with the individual habitat monitoring schedules. These are presented in the following order:

1. Grassland monitoring explanatory notes.

2. Grassland habitat monitoring schedules:

   Coastal & Floodplain Grazing Marsh
   Lowland Calcareous Grassland
   Lowland Dry Acid Grassland
   Lowland Meadows
   Purple Moor Grass & Rush Pastures
   Upland Hay Meadows
   Semi-improved Grassland

3. Upland monitoring explanatory notes.

4. Upland habitats monitoring schedule:

   Upland Heathland and Blanket Bog

4.1 GRASSLAND MONITORING EXPLANATORY NOTES

4.1.1 General

1. BAP Habitats

Schedules have been produced for the following grassland habitats:

BAP Priority Habitats

Coastal and floodplain grazing marsh (CFGM)
Lowland calcareous grassland (LCG)
Lowland dry acid grassland (LDAG)
Lowland meadows (LM)
Purple moor-grass and rush pastures (PMRP)
Upland hay meadows (UHM)

Potential BAP Priority Habitats

Semi-improved grassland

The relevant Broad and Priority Habitats and the corresponding NVC communities are listed in individual schedules.

2. Relevant BAP Objectives and Targets

BAP objectives relevant to the schedule are listed.

Re-establishment from arable reversion is not included in the grassland schedules, being recommended as a separate, targeted study.

3. Principle AE Schemes

AE schemes are listed in which the habitat is important in terms of quality and extent. For ESAs, the main source used is Swash (1997). These are the schemes in which most of the monitoring is expected to be targeted, although other schemes with a more limited stock will also need to be included. Schemes that only contain a small area of the habitat are excluded from this table, some of which might have current monitoring samples. Estimated stock for CSS is for the existing Priority Habitat that was under agreement at the end of 1997 (Carey *et al*. 2001a). No estimates are currently available for ESAs. However, the list can be updated when the results of AE02 are available, indicating which schemes have significant stock of the habitat.

4. Proposed Scheme Objectives and Performance Indicators

These are derived from the relevant BAP objectives and targets. It is accepted that these go beyond current scheme objectives though the approach might be adopted for the new schemes. It is suggested that objectives for AE schemes should refer to the majority of sites under agreement even if the national BAP target is only for a percentage of that habitat. This is because AE schemes are one of the main vehicles for achieving national targets, so the majority of agreement sites are expected to be maintained in favourable condition, or to show improvements. For the DEFRA PSA target for SSSIs (95% in favourable condition by 2010) it has been agreed recently with EN that favourable condition will include unfavourable recovering condition. There is therefore an argument for adopting this approach for AE Scheme objectives. It has also been suggested that the AE Scheme objectives may not need to be as specific in identifying targets by dates as the BAP targets and further that agreements that are very recent (e.g. less than 2 years old) at the time the assessment is made might be excluded.

The first part of each performance indicator refers to RCA, which provides assessments of features at the site level. The second part refers to the quantitative monitoring, which assesses vegetation condition and change at a national level, and across individual schemes. Change is measured by indicator variables, which are specified for each habitat (see below). The utility of these variables will be dependent on successful and meaningful calibration against condition categories or attributes. Therefore, the performance indicators refer explicitly to the indicator variables that can be successfully calibrated for the habitat.

The objectives and performance indicators should be viewed as suggestions only, but are an attempt to link AE schemes and their monitoring programme more closely to the national BAP.

5. 2003: RCA Method Development

The English Nature rapid assessment method for monitoring the condition of lowland grassland SSSIs (Robertson & Jefferson 2000) provides RCA protocols for most English grassland habitats. In general the recommendation is to adopt these protocols for priority grassland habitats in AE schemes. Condition assessment should be carried out on all sites/features for which quadrat data are obtained. In this way, after the first monitoring round, an important database will be available with both quantitative and associated RCA data for further evaluation and refinement of some methodological issues.

Despite the availability of RCA methods for English grasslands, there are still a number of issues relating to RCA for grassland sites under AE schemes that are not yet fully resolved. These issues are outlined below and indicated under each habitat schedule and further details are provided in Section 3. Where additional development work is needed before RCA grassland monitoring can commence, the opportunity to progress this should be made in 2003.

Checking and agreeing attributes

Key attributes are listed in each grassland Priority Habitat schedule derived from various published sources including EN rapid assessment methods for grasslands (Robertson & Jefferson 2000). In general these published protocols could be adopted for grassland AE Schemes without modification. However because in these methods attributes were selected for the assessment of established, designated sites, there may need to be some modifications for their application to AE schemes, e.g. defining appropriate attributes, positive indicator species and additional condition categories for restoration/recreation sites (see below).

Selecting appropriate positive indicators

Positive indicators are a key attribute in RCA and these have been defined in the EN rapid assessment methods for each priority grassland habitat (Robertson & Jefferson 2000). These indicator lists could be adopted immediately for grassland AE scheme monitoring. However the lists of positive indicators may need to be modified for use in AE scheme monitoring where certain species may not be appropriate indicators for AE schemes. For example, in the case of restoration and re-establishment sites which may take many years (if ever) to achieve the full complement of target species of the appropriate priority habitat.

It may also be appropriate to provide expanded lists of positive (and possibly negative) indicators to enable site assessment against performance indicators. For example the list of indicators could include species indicative of potential defined changes in the vegetation such as nutrient enrichment or drying conditions. Indicators of changing environmental conditions could be drawn, for example, from the suited species of Critchley (2000).

Where grassland sites are included in AE schemes without objectives or with no defined trajectory of development there is a need to identify indicators of the potential of the grassland to improve in quality. Some work has been done on "restorability indicators" by English Nature (Robertson *et al.* 2002) identifying species typical of early stages of successful grassland restoration and re-establishment. However, there is a need for more work to be done before final methods can be agreed. This work could be carried out in 2003 and should include evaluation analysis of existing time series data on grassland restoration and re-establishment sites from previously collected AE scheme monitoring data.

Selecting appropriate targets for attributes.

Since the outcome of RCA depends on meeting targets set in relation to site objectives, setting appropriate targets is central to a workable RCA methodology. Targets have been defined and published for attributes in grassland RCA defining favourable condition for designated sites (Robertson & Jefferson 2000). These targets could therefore be applied to designated sites and priority habitats in or close to favourable condition in AE schemes. However, for non-designated sites, including restoration or re-establishment sites, these published targets may be inappropriately high. New targets defining additional condition categories (see below) need to be developed for the wider countryside and which are realistic and appropriate to restoration or re-establishment objectives.

Determining condition category thresholds for targets.

For non-designated sites there is a need to develop additional condition categories especially for restoration/re-establishment sites of lower quality but with the potential to develop. It is recommended that existing AE scheme grassland quadrat data (and possibly set-aside and heathland re-establishment data) could be analysed to assist in the selection of appropriate targets. These data will be most valuable where time series is available for individual re-establishment or restoration sites indicating the speed and trajectory of likely vegetation change.

6. Year 1: Sampling

Year 1 refers to the first year of survey in the new monitoring programme. Year 2 *et seq*. refers to the second and subsequent surveys. Recommendations for timing of surveys are given in Section 5.1.

Recommendations are given for drawing a sample of sites for RCA and quantitative monitoring. This should be drawn from the schemes that contain the most important resource of the habitat (see Principle AE Schemes above). Sites might need to be added for schemes for which there is no current sample. RCA will provide information on the condition of individual sites, and collectively for the whole sample; the quantitative methods will be used to measure vegetation change across the whole sample. A large sample is recommended for RCA, the size of which will be determined by available resources. Sample selection requires information on the stock of each habitat under AE scheme agreement. This information is incomplete at present, although there are a number of potential ways of estimating stock (see Section 2.1). A sub-sample of the RCA sites will be used for quantitative monitoring. In both cases, the sample should be proportionate random according to the known stock of the target habitat across existing AE schemes. Consideration should be given to the cost-effectiveness of sampling from schemes with only limited stock of the habitat. As much of the current monitoring sample as possible will be included to make best use of longer-term monitoring data, and of the previous investment of resources. Sites not currently under AE agreement should not be included because the overall aim is to monitor the target habitats under AE agreement. No stratification by agreement tier is recommended because tier structure and management prescriptions evolve over time. However, management tier might in some cases be an aid to identifying the target habitat type, such as semi-improved grasslands with potential to develop into a Priority Habitat type.

Tables in the schedules show current sample sizes for the habitat in each scheme, and required total (national) sample sizes overall to detect specified magnitudes of change. Based on this, a recommended total sample size is given. It is recognised that a final decision will be dependent on resources available and priorities between habitats. Even if the suggested sample sizes cannot be met within the resource available, they can be used as an indication of the relative effort required for each habitat. Whatever final sample size is used, the detectable change for particular indicator variables can be declared by reference to the power analyses (see Chapter 3).

Recommended sample sizes for quantitative monitoring have been calculated using power analysis of the existing monitoring samples (see Chapter 3). Sampling recommendations for individual habitats are made to enable vegetation change of a specified magnitude to be detected at the national (England) scale. If the same magnitude of change needs to be detected at a smaller scale, for example to address similar policy questions within individual RDR regions or AE schemes, then the same sample size as recommended for the national sample would be required for each region or scheme. If designated sites (e.g. SSSIs) need to be assessed specifically, a separate, targeted sample would also be needed.

Power analysis results from the repeat surveys of ESA quadrats and ADAS plots were used to estimate required sample sizes, as these were the most suitable available data. The average standard deviations of difference for species richness, G score and Nu score were used in the calculations (Nu score was highly correlated with Ellenberg N so the latter was not included).

The target for each Priority Habitat will ultimately be favourable condition. However, the indicator variables cannot be calibrated against condition categories or attributes before RCA has been carried out during the monitoring programme (see Analysis and Interpretation below). Therefore, data from sites known to be in pristine condition have been used as far as possible as provisional targets. These data had been obtained previously for some habitats from the conservation agencies (Critchley *et al*. 1999a; Fowbert & Critchley 2000). The distance of the current AE samples from these targets was calculated, and the required sample size to detect 100%, 50%, 20% and 10% progression of the AE samples towards these target values was estimated for each of the three variables. Similarly, sample sizes for detecting specified percentage deterioration of existing Priority Habitats towards MG6 semi-improved grassland were calculated. In this case, the MG6 sample across all schemes was used as the 'target'. Sample sizes in the habitat schedules are those required to detect the specified percentage changes in the variable judged to be the most important for that habitat. Where two or more variables were deemed to be equally important, the largest sample sizes are reported. Existing Priority Habitats in the current sample tend to be fairly close to the provisional targets (pristine habitat), so 20-50% detectable progression is considered to be satisfactory.

Since the current targets are provisional, the percentage progression and deterioration between condition categories detectable in the new samples should be calculated once the calibration has been carried out.

In many cases, the current samples are believed to be representative of the habitat in each scheme (see Chapter 2). In doubtful cases, a recommendation is made to draw a new sample from that scheme.

Some current samples include non-agreement land. The agreement status of all sites should be checked at resurvey because this can change. If a comparison with non-agreement sites is required in a particular scheme, then non-agreement sites can only be used if they are known to be comparable in other respects with agreement sites.

The recommended sample sizes are the number of sites required, with one ADAS or CS plot randomly located in each. For ESA quadrats, it is recommended that a sub-sample of three (from the current five) quadrats per site are selected, this being the optimum number (Fowbert *et al*. 2002). This is because between-field variation tends to be much higher than within-field variation, and the addition of more than three quadrats per field only has a small effect on the sample size required to detect a given magnitude of change. Because the quantitative monitoring is aimed at habitat types (as opposed to entire interest features in individual sites as in RCA), only quadrats representing the required habitat type should be included in the sample. Therefore, sites with fewer than three quadrats of the required type might have to be rejected. However, in marginal cases it might be preferable to include a quadrat or site, since NVC classification is often imprecise. All plots and quadrats are fixed and relocatable.

At the time of writing, additional CS plots are being set up in ESAs under project AE02. Potentially, these could incorporated into the new monitoring sample in those ESAs for which there is no current sample of a particular habitat.

The samples should be re-assessed at each re-survey to determine whether there has been sufficient uptake of agreements since the previous survey to justify adding new agreement sites to the sample. However, priority should be given to retaining the existing sample if resources are limited.

Recommended sample sizes for quantitative monitoring of grasslands are as follows:

Grassland	No. of sites
CFGM	200
LCG (existing)	50
LCG (potential)	150
LDAG	50
LM	200
PMRP	50
UHM (potential)	100
UHM (degraded)	100
Semi-improved	100
Total	1000

7. Year 1: Field methods

The recommended period for grassland monitoring is May-July, and before the prescribed cutting date for hay meadows, unless otherwise specified.

RCA

Attributes are assessed from a structured walk of the site, some attributes (e.g. positive indicators) are assessed at 20 predetermined, more or less equidistant sampling positions each comprising an area of 1 m radius around the surveyor.

For some attributes/habitats a structured walk of the site noting the existence and condition of the attributes is sufficient without individual sampling positions.

Quantitative

Most monitoring of grasslands in AE schemes has been carried out to date using one of three methods. These are the Countryside Survey method (used in CSS), the ESA quadrat method (used in ESA monitoring schemes commenced before 1993) and the ADAS plot method (used in ESA monitoring schemes commencing post-1992). The Countryside Survey method is also currently being used in the ESA ecological characterisation project, AE02. These use either frequency or cover estimates of plant species (and other variables), at a range of spatial scales. Although the three methods are not fully cross-compatible, some simple amendments in future surveys will allow data from them to be combined for analysis, without compromising the continuity with previous surveys. Recommended amendments are

1. in the CS method, record presence of species in an additional 1m × 1m central nest and

2. in the ESA quadrat method, record presence of species in a 2m × 2m quadrat surrounding the existing 1m × 1m quadrat (this has already been done in some cases).

These modifications will allow data to be analysed from species presence/absence at both $1m^2$ and $4m^2$ scales (see below). It will also provide compatibility for future comparisons with Countryside Survey data.

In ESA quadrats, it is also recommended that in future, cover is estimated to the nearest 1%, rather than using the Domin scale. This is currently being done in the 2002 Pennine Dales ESA survey of upland hay meadows to enable cross-compatibility between the various recording methods that have been used in that ESA. This will ensure that all quadrat records are now compatible between all ESAs, as well as with previous Domin scale records.

Cell sizes (m) in which data are recorded in each field method – recommended additional sizes in italics; sizes common to all methods in bold:

Method:	ESA quadrat	ADAS plot	CS plot
Sizes:	**1×1**, ***2×2***	point, 0.06×0.06, 0.09×0.09, 0.12×0.12, 0.18×0.18, 0.25×0.25, 0.35×0.35, 0.5×0.5, 0.7×0.7, **1×1**, **2×2**, 4×4	point, ***1×1***, **2×2**, 5×5, 7.07×7.07, 10×10, 14.14×14.14

Existing monitoring data are highly valuable, particularly where the timescales are longer. To preserve and exploit this value, the current method used in each scheme (with the above modifications) can be continued in the future. This will allow changes in individual schemes to be assessed over longer timescales, and using more precise methods (e.g. optimum scale from the ADAS plot method).

There is an opportunity to reduce the resource required for recording from ADAS plots by reducing the plot size by 50% (to 16 nests) with only a slight reduction in power and loss of information (see Chapter 2). This was also confirmed by the power analysis results (Chapter 3). Therefore, it is recommended that in future plot size in grasslands is reduced to a 4×4 grid of 16 nests.

The HFRO sward stick is recommended as the standard method for measuring sward height or structure, as it provides the best compromise in a variety of vegetation types (see Chapter 2).

8. Year 1: Environmental Data

From the results of the review, recommendations can be made on use of environmental data. The quality of management data is dependent on the availability of accurate records from farmers. Although this is usually variable, the information is key to explaining how AE schemes might be influencing vegetation change and condition. Management practices relevant to each habitat are listed. Meteorological data provide contextual background information for interpreting trends that might be attributable to short-term weather effects.

The relationships between vegetation and other environmental factors would be best explored in a discrete project (or projects) that is complementary to the core monitoring programme. Soil properties influence species composition, and can control the rate and direction of vegetation change. Soil analyses should include total nitrogen and sulphur, because atmospheric deposition of both elements might interact in their effects on vegetation. Other environmental data that can be examined in this way are physical, atmospheric deposition and climate change data.

9. Year 1: Analysis and Interpretation

In order to measure vegetation progression towards the BAP targets, it will be necessary to calibrate data from the quantitative monitoring against the condition categories or attributes defined in the RCA. Some calibration has been done previously of community variables against sites of known quality or condition (Critchley *et al.* 1999a; Fowbert & Critchley 2000). This was done for certain NVC communities corresponding to lowland calcareous grassland, lowland meadows, purple moor-grass and rush pastures and upland hay meadows. The calibration was done using reference sites that were either in favourable condition, or degraded by undergrazing, disturbance or eutrophication. However, this has not been done for the range of JNCC condition categories, or the additional categories recommended for the RCA. It is proposed that the calibration will be carried out as part of the monitoring programme. Sites will be allocated to condition categories using RCA, and then community variables derived from quantitative data from the sub-sample of these sites will be calibrated. This will enable quantitative targets to be set for the respective condition categories. The power test results can be used to show how much progression or deterioration between the categories is detectable.

Each AE scheme will need to be analysed separately up to and including Year 1 (using current samples retained in the new sample), because the monitoring timescales and years of survey differ between schemes, as do the field methods used. From Year 1 onwards, schemes can be analysed collectively. Current samples from individual schemes that are retained in the new sample can also be analysed from their baseline year onwards.

Vegetation change can be analysed by both floristics and community variables. Floristic analysis can be used to measure progression towards target community types. This can be done using multivariate analyses and measuring the distance in ordination space from the target communities. Community variables that are most relevant to the objectives for each grassland habitat have been selected from the list identified in the review (Chapter 2). It is recommended that the Ellenberg N (nitrogen) score is used in future in place of the Nu suited species score. The latter was developed for the last round of reporting for ESA monitoring because at that time Ellenberg N values were not available for the full British flora. Although Nu scores are based partly on functional traits of species, which have a more objective theoretical base than Ellenberg values, this had to be supplemented with data on species' habitat preferences due to incomplete functional trait databases. On balance, it is considered that Ellenberg N values have the advantage of simplicity, and can be usefully applied until functional data are more fully expanded. CSR radii can also be useful for assessing change in relation to plant strategy type, although these are more generalised than Ellenberg values and suited species scores. It is suggested that if CSR radii can be successfully calibrated against condition categories or attributes, then they might also be usefully applied in the monitoring programme.

Trends in AE schemes can be put in the context of the wider countryside by comparison with results from Countryside Survey. However, a quantitative comparison is only possible if at least two survey years coincide with those of Countryside Survey. There is an opportunity for AE scheme monitoring and Countryside Survey fieldwork to be synchronised in the future. Currently, however, trends will have to be compared on a qualitative basis. Comparisons will be dependent on an adequate sample being available in CS for each Priority Habitat. The CS samples also include AE agreement sites, which would have to be excluded (e.g. in 1999, 7% of all CS 'X' plots were under ESA and 3% under CSS agreement; 6% of all CS 'Y' plots were under ESA and 3.5% under CSS agreement). The CVS classes or aggregate classes that most closely correspond to each grassland BAP habitat have been identified.

Currently, English Nature/DEFRA/JNCC are carrying out condition assessments of a sample of lowland grassland Priority Habitats from the County Grassland Inventories (project no. AE08), including sites under AE scheme agreement (2002-2003). This will indicate how the condition of AE scheme sites compares with others. Suggestions are made as to which ECN sites are likely to provide information relevant to each habitat. ECN data will be useful for interpreting long-term trends in vegetation that might be attributable to external environmental factors.

10. Year 2 *et seq.*

Recommendations are made for sampling, data collection and analysis in subsequent years.

4.1.2 Notes on Specific Habitats

Coastal and Floodplain Grazing Marsh (CFGM)

CFGM differs from other grassland Priority Habitats in being a physiogeographical landscape type, rather than a particular set of plant communities. CFGM can therefore encompass a range of habitats, including other grassland Priority Habitats, particularly LM and PMRP. Since these Priority Habitats have their own schedules, they are excluded from the CFGM schedule, with only the more species-poor NVC types being included. Semi-improved (MG6) communities could potentially develop into CFGM; these are included in the schedule for semi-improved grassland. Some communities that occur in CFGM are not well described in the NVC, for example transitions between semi-improved grasslands and mires. Sites that fall into this category could be included in the CFGM monitoring sample. AE schemes listed are only those that contain significant areas of CFGM. Although other schemes contain the relevant NVC types in the current samples, these have not been included in the schedule as they are unlikely to be located within CFGM. The current CSS sample will include some not located within CFGM. These will need to be excluded from the new sample by reference to their geographical location; the EN grazing marsh inventory would be a useful information source for this (Dargie 1996).

The BAP objectives and targets for CFGM were set in 1995, and refer to targets for 2000. Suggested objectives and PIs cannot therefore link directly to these, but are consistent with the overall aims for the habitat. Area targets refer to the UK, although most of the CFGM resource is in England.

RCA

RCA methods for CFGM on which the recommendations are based have been published by Burch, *et al*. (1999), Mitchley *et al*. (2000) and CCW (2002).

In most cases these grasslands are not important for their botanical interest *per se*, but as a habitat for breeding waders and wintering wildfowl. Thus, it is the existence and development of attributes such as a varied topography, standing water and a habitat mosaic including areas of short sward and areas of tussocky sward, which determine condition. Many of these attributes are (or could be) recorded during breeding bird monitoring, surveys which include all the major ESAs and other important areas, and so separate RCA may not be necessary for such sites.

In some cases, areas of botanical interest may also be present within the grazing marsh and it is recommended that in these cases, a separate condition assessment for the appropriate NVC community (e.g. MG13) should be undertaken.

The maintenance and restoration of ditches may typically form part of agreements for this habitat type and recommendations for monitoring these would fall under targeted habitats (Section 4.5).

Quantitative

Current sample sizes are for the specified NVC communities only (MG9-13) and so exclude samples located in CFGM but representing other communities. No suitable data of CFGM in pristine condition were available to use as provisional targets. However, this Priority Habitat is primarily of value as habitat for other taxa, and targets relating to high botanical quality are less important than for other grasslands. In contrast, deterioration of CFGM is an issue, and sample sizes for specified percentages to MG6 have therefore been calculated. The Nu score was used for this calculation; species richness tended to be lower in CFGM than in MG6. Although the Ellenberg F (moisture) value is also of direct relevance, it was not included in the power analyses. The sample sizes required are, however, large. Even with the recommended 200 sites, the minimum detectable change is <50% of deterioration to MG6. If the resources that can be allocated to the grassland monitoring programme are insufficient to cover the total sample recommended, it is suggested that quantitative monitoring of CFGM is not carried out, and that RCA alone is used.

The large sample in the Broads ESA was targeted at a small number of holdings and was not considered to be fully representative of CFGM in the scheme. It is recommended that a new sample is drawn from this ESA, which can include some of the existing sample. The samples in the Suffolk River Valleys and Test Valley ESAs were subjectively selected, and the extent to which they are representative of the resource in these schemes needs to be re-assessed once information on the stock of the habitat in these ESAs has been compiled.

Comparison with CS2000 data is recommended at the CVS aggregate class level because CFGM does not correspond exactly to particular CVS classes.

Lowland Calcareous Grassland (LCG)

RCA

RCA methods for LCG on which the recommendations are based have been published by Robertson & Jefferson (2000), Burch *et al*. (1999), Mitchley *et al*. (2000) and CCW (2002).

Quantitative

Provisional targets used for estimating sample sizes were from pristine CG2 on SSSIs provided by English Nature (Critchley *et al*. 1999a). The current sample of LCG in the Cotswold Hills ESA was subjectively selected, and the extent to which it is representative of the resource in that scheme needs to be re-assessed.

For existing LCG, required sample sizes are from power analyses of the Nu score. The recommendation of 50 sites will allow detection of small amounts of deterioration (10% of deterioration to MG6). It will also allow detection of 20-50% progression to the provisional target.

It is assumed that sites with potential for re-establishment of LCG (e.g. those on chalk downland) can be readily identified during scheme operation. This contrasts with other grassland types for which the potential distribution is less easily defined. Sample sizes have therefore been estimated for three potential LCG precursors, namely MG1 (under-grazed), MG6 (semi-improved) and MG7 (improved) grasslands. To estimate required sample sizes for progression to LCG, samples of these communities from the relevant AE schemes only have been used. MG1 and MG7 grasslands occurred mainly in the CSS and South Downs ESA samples. Required sample sizes refer to species richness for MG6 and MG7 because the required sizes for the Nu score are very small, and these two variables were judged to be equally important. For MG1, the G score was used because grazing is likely to be the most important factor in re-establishment of LCG from this grassland type. The recommended sample sizes of 50 sites will enable detection of 20-50% progression towards the provisional target. If the resources that can be allocated to the grassland monitoring programme are insufficient to cover the total sample recommended, it is suggested that the 50 MG7 sites are excluded, as it will be more difficult to re-establish LCG there.

Lowland Dry Acid Grassland (LDAG)

AE schemes listed include those known to have existing LDAG, even if none is represented in the current monitoring sample.

RCA

RCA methods for LDAG on which the recommendations are based have been published by Robertson & Jefferson (2000), SNH (2001), Burch *et al*. (1999), Mitchley *et al*. (2000) and CCW (2002).

Quantitative

The current sample sizes tabulated will include some upland sites (particularly U4), which will need to be removed from the new sample by reference to GIS data. In addition, the extent to which the existing samples are representative of LDAG in the following ESAs will need to be checked: Blackdown Hills, Pennine Dales, Shropshire Hills, Suffolk River Valleys and West Penwith.

No independent data from sites known to be in pristine condition were available, so required sample sizes to detect specified percentage progression to a target could not be calculated. However, required samples for detecting deterioration have been calculated. Power analysis results for the Nu score have been used. The recommended sample size of 50 sites will allow detection of 20% deterioration to MG6.

Comparison with CS2000 data is recommended at the CVS aggregate class level because LDAG does not correspond exactly to particular CVS classes.

Lowland Meadows (LM)

AE schemes listed include those known to have existing LM, even if none is represented in the current monitoring sample.

RCA

RCA methods for LM on which the recommendations are based have been published by Robertson & Jefferson (2000), SNH (2001), Burch *et al*. (1999), Mitchley *et al*. (2000) and CCW (2002).

Quantitative

Provisional targets used for estimating sample sizes were from pristine MG5 on SSSIs provided by English Nature (Critchley *et al*. 1999a).

For LM, required sample sizes refer to power analysis results for the Nu score. The recommendation of 200 sites allows detection of 20% progression to the provisional target and 20% deterioration to MG6. AE schemes known to contain LM but with no current sample will need to be included in the new sample. LM was found in some of the existing AE samples that were targeted at specific grassland types. Because LM can occur over a wide range of environmental conditions, the extent to which the current samples are representative of the whole LM resource in these schemes is uncertain. The schemes in question are the Blackdown Hills, Cotswold Hills, Pennine Dales, Shropshire Hills, South Wessex Downs and Test Valley ESAs.

Sites with potential for re-establishment of LM will be mainly MG6 semi-improved grasslands. These are covered under the improved/semi-improved grassland schedule because it is unlikely that LM (as distinct from other neutral grassland Priority Habitats) can be explicitly identified as a target for these sites.

Comparison with CS2000 data is recommended at the CVS aggregate class level because LM does not correspond exactly to particular CVS classes.

Purple Moor-grass and Rush Pastures (PMRP)

AE schemes listed include those known to have existing PMRP, even if none is represented in the current monitoring sample. A slightly later fieldwork period (June – August) is recommended than for other grasslands.

RCA

RCA methods for PMRP on which the recommendations are based have been published by Robertson & Jefferson (2000) and SNH (2001).

Quantitative

Current sample sizes tabulated exclude M25. This community was not included in the classification exercise in Chapter 3 because much of the current sample is from unenclosed upland, and potentially on deep peat (in which case it would be blanket bog Priority Habitat).

No suitable data were available for use as a provisional target. In addition, the PMRP NVC communities differed substantially from one another in their community variable values. Therefore, it was not possible to calculate sample sizes for specified percentages of progression or deterioration. Instead, the magnitudes of change detectable for given sample sizes are presented. The suggested sample size of 50 sites will enable a change of 3.33 species m^{-2}, and of 0.05 and 0.08 in G and Nu score respectively to be detected. The extent to which the existing samples are representative of PMRP in the following ESAs will need to be checked: Broads, Blackdown Hills, Lake District, Test Valley and West Penwith.

Comparison with CS2000 data is recommended at the CVS aggregate class level because PMRP does not correspond exactly to particular CVS classes. It might be possible to identify a subset of the CVS aggregate class that corresponds to PMRP.

Upland Hay Meadows (UHM)

RCA

RCA methods for UHM on which the recommendations are based have been published by Robertson & Jefferson (2000), SNH (2001) and CCW 2002.

Quantitative

Three separate monitoring programmes had been set up previously in the PD ESA, namely the Indicative, Validation and Extension surveys. The samples included potential UHM (MG3a/MG7c), degraded UHM (MG3a) and existing UHM (MG3/MG5). The Indicative survey was designed to be a broad-level survey and to monitor change at a field level, whilst the Validation survey was initiated to target selected grassland communities. Finally, the Extension survey was set-up to investigate the new areas introduced into the ESA in 1992. Methods used were:

<u>Indicative Survey:</u>

Baseline survey in 1987.
Semi-fixed (by bearings only) 1m x 1m quadrats
Five quadrats in a 'W' pattern in a field.
Species recorded using the DAFOR scale

<u>Validation Survey:</u>

Baseline survey in 1987.
Standard ESA quadrat method

<u>Extension Survey:</u>

Baseline survey in 1992.
Fixed 1m x 1m quadrats.
Five quadrats in a transect across a field.
Species recorded using the DAFOR scale

A re-survey of potential, degraded and existing UHM in the PD ESA is being carried out by ADAS in 2002. For this, a separate power analysis had been carried out (Fowbert *et al*. 2002), the results of which have been used here. That analysis used an 80% power level (as opposed to 85% used in the current study). Current sample sizes presented in the table are from the original NVC classification as presented in ADAS (1996d) and used by Fowbert *et al*. (2002). The detectable change for given sample sizes are presented.

To ensure cross-compatibility between the programmes in future, % cover estimates are now being used in quadrats. Attempts had been made in 1995 to permanently fix the location of Indicative quadrats, but feedback from the 2002 survey suggests that this has not been successful. Recommendations will be made in the 2002 survey report on re-recording quadrat locations for future surveys.

Recommendations made here for Year 1 refer to the next survey after 2002. Additional samples from CSS and the LD ESA will probably be required then, using proportionate random sampling as also recommended for other grasslands, and using information on the stock of UHM. The extent to which the existing samples in the Pennine Dales ESA represents its UHM and potential UHM resource will need to be checked.

Semi-improved Grassland

There is a substantial resource of semi-improved grasslands within AE schemes with potential for re-establishment of unimproved grassland, but for which no specific targets can be set in terms of Priority Habitats. This is because the potential trajectory of semi-improved grassland cannot always be predicted accurately. In addition, individual site-specific targets are not always set in AE schemes. Therefore, a separate schedule has been produced for semi-improved grasslands for which no specific habitat has been identified as an end target.

The BAP objectives and targets are from the 'conservation direction' for the Neutral Grassland Broad Habitat (previously called the Unimproved Neutral Grassland Broad Habitat). Priority Habitats that are potential endpoints also have objectives and targets for re-establishment, but these refer specifically to ‘carefully targeted sites’ with only modest area targets, and are more relevant to arable reversion or improved grassland being subjected to interventionist management.

AE schemes listed are those that already contain the Priority Habitats that are the potential endpoints, as listed in the other schedules.

From the current samples, sites will need to be identified that have potential for re-establishment. This should be based on their species composition and NVC classification, and on the current tier of agreement (i.e. including sites under tiers likely to result in enhancement). Soil properties, where data are available, will also be a good indicator. Ultimately, EN’s restorability indicators could be developed and utilised to select appropriate sites. The extent to which these samples are likely to be representative of the potential Priority Habitat resource will need to be reviewed for each scheme. New samples will need to be drawn from schemes if the current sample was targeted at only one existing or potential Priority Habitat. For example, the Suffolk River Valleys ESA sample was targeted at existing and potential LDAG, but there might be potential LM and CFGM in other areas. Also, the Broads ESA was targeted at a small number of holdings and was not considered to be fully representative of CFGM in the scheme.

RCA

RCA methods applicable to semi-improved grassland on which the recommendations are based have been published by Robertson *et al.* (2002), SNH (2001), Burch *et al*. (1999), Mitchley *et al*. (2000) and CCW (2002). These methods do not always deal specifically with semi-improved grasslands and this is a habitat type that requires further work to define appropriate methods.

Quantitative

Sample sizes have been calculated for progression to Priority Habitats for which data were available to use as potential endpoints. For LCG and LM, these were the same as the provisional targets used in the respective schedules. For UHM, data for potential endpoints were from pristine MG3 on SSSIs provided by English Nature (Critchley *et al*. 1999a). No targets were available for LDAG, PMRP or CFGM. Required sample sizes are from power analysis of the Nu score. The recommended sample of 100 sites will enable progression to be detected of <10% towards LCG, 20% towards LM and 20-50% towards UHM.

4.2 GRASSLAND HABITAT MONITORING SCHEDULES

4.2.1 Monitoring Schedule: Coastal & Floodplain Grazing Marsh

1. BAP Habitats

Broad	Neutral grassland
Priority	Coastal & floodplain grazing marsh (CFGM)
NVC Communities	MG9-13

2. Relevant BAP Objectives and Targets

1. Maintain existing habitat extent and quality

2. Rehabilitate 10,000ha of grazing marsh habitat that has become too dry, or is intensively managed, by the year 2000

3. AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	517 ha
Avon Valley ESA	AV	n/k
The Broads ESA	BD	n/k
Essex Coast ESA	EC	n/k
North Kent Marshes ESA	KM	n/k
Somerset Levels & Moors ESA	SL	n/k
Suffolk River Valleys ESA	SR	n/k
Test Valley ESA	TV	n/k
Upper Thames Tributaries ESA	UT	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of coastal and floodplain grazing marsh under AE agreement where condition is currently favourable.

Coastal and floodplain grazing marsh sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of coastal and floodplain grazing marsh under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010.

Coastal and floodplain grazing marsh sites not currently in favourable condition improve by at least one condition category as measured by RCA between Year 1 and

2010. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010.

5. 2003: RCA Method Development

The recommended method is Mitchley *et al*. (2000). However there is scope for further methodological development:

1. Selection and agreement of appropriate attributes.
2. Selection and trialling of appropriate targets for agreed attributes.
3. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing CFGM, including sites selected for quantitative monitoring.

Quantitative

	Scheme	Method	***n*** **(plots or quadrats)**	
Current sample	CSS	CS	53	
	AV	ADAS plot	36	
	BD	ESA quadrat	231	
	KM	ADAS plot	3	
	SL	ESA quadrat/ ADAS plot	233	
	SR	ESA quadrat	2	
	TV	ESA quadrat	99	
	UT	ADAS plot	19	
	all	various	676	
			% deterioration	***n (sites)***
Required sample	all	various	100	100
	all	various	50	>200
	all	various	20	>200
	all	various	10	>200

Recommended national minimum sample = 200 sites

7. Year 1: Field methods

RCA

Structured of the site, noting the existence and condition of the given attributes. With large extensive areas of little botanical interest there is no need for individual sampling positions. Recommended visiting period - before May / June, to assess standing water.

Key attributes
Low hedges - no more than 2m (unless e.g. pollarded willows)
Standing surface water maintained until May / June
Patches of soft mud
Vegetation mosaic of different heights – including frequent tussock forming species
Low infestation of pernicious weed species

Quantitative

Scheme	**Quantitative**
CSS	CS plots plus record species p/a in additional 1m x 1m central nest
BD, SL, SR, TV	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing; water level manipulations.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N & F; G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare trends with ECN site (North Wyke).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq*.: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq*.: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq*.
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare trends with ECN site (North Wyke).

4.2.2 Monitoring Schedule: Lowland Calcareous Grassland

1. BAP Habitats

Broad	Calcareous grassland
Priority	Lowland calcareous grassland (LCG)
NVC Communities	CG1-8, lowland CG9

2. Relevant BAP Objectives and Targets

1. Arrest depletion of unimproved lowland calcareous grassland

2. Within SSSIs, initiate rehabilitation management for all significant stands of unimproved lowland calcareous grassland in unfavourable condition by 2005, with the aim of achieving favourable status wherever feasible by 2010.

3. Secure favourable condition over 30% of the (non-SSSI) resource by 2005 and as near 100% as practicable by 2015

3. AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	3716 ha
Breckland ESA	BK	n/k
Cotswold Hills ESA	CH	n/k
Lake District ESA	LD	n/k
Pennine Dales ESA	PD	n/k
South Downs ESA	SD	n/k
South Wessex Downs ESA	SX	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of lowland calcareous grassland under AE agreement where condition is currently favourable.

Lowland calcareous grassland sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of lowland calcareous grassland in SSSIs under AE agreement is not currently favourable, achieve favourable condition by 2010.

Lowland calcareous grassland sites not currently in favourable condition that are SSSIs achieve favourable condition as measured by RCA by 2010. Improvement in floristics and plant community variables equivalent to favourable condition is detected by 2010.

3. Where the condition of lowland calcareous grassland outside SSSIs under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010 and favourable condition by 2015.

Lowland calcareous grassland sites not currently in favourable condition that are outside SSSIs improve by at least one condition category as measured by RCA between Year 1 and 2010, and achieve favourable condition by 2015. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010, and equivalent to favourable condition by 2015.

4. Semi-improved grassland that has potential for re-establishment to lowland calcareous grassland achieves demonstrable improvements by 2010.

Potential calcareous grassland sites improve by at least one condition category as measured by RCA between Year 1 and 2010. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010.

5. 2003: RCA Method Development

The recommended method is Robertson & Jefferson (2000). This method is appropriate for designated LCG sites and other LCG in or close to favourable condition. For other LCG sites and for restoration and re-establishment sites, method development is required:

Checking and agreeing attributes.

1. Selecting appropriate positive indicators.
2. Identifying species typical of early stages of successful LCG restoration and re-creation for use as potential “restorability indicators”.
3. Selecting and trialling appropriate targets for agreed attributes.
4. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing LCG and potential LCG, including sites selected for quantitative monitoring.

Quantitative

Existing LCG

	Scheme	**Method**	***n* (plots or quadrats)**			
Current sample	CSS	CS	26			
	CH	ADAS plot*	13			
	PD	ESA quadrat	6			
	SD	ESA quadrat	49			
	SX	ADAS plot	39			
	TV	ESA quadrat	3			
	all	various	136			
			% progression	***n* (sites)**	**% deterioration**	***n* (sites)**
Required sample	all	various	100	<10	100	<10
	all	various	50	20	50	<10
	all	various	20	100	20	20
	all	various	10	200	10	50

*4m × 2m

Recommended national minimum sample = 50 sites

Potential LCG

	% progression	**MG1 (under-grazed)**	**MG6 (semi-improved)**	**MG7 (improved)**
Required sample	100	<10	<10	<10
	50	20	20	20
	20	100	100	100
	10	>200	>200	>200

Recommended national minimum sample = 50 each of MG1, MG6 or MG7.

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions

Grassland	Key attributes
Existing LCG	grass:herb ratio positive indicator species (presence & frequency) negative indicator species (presence & frequency): pernicious weeds, scrub & coarse grass species *e.g. Brachypodium pinnatum*, *Bromus erectus* sward structure: height, bare ground, litter cover lichens: % cover (CG1, CG7c)
Potential LCG	positive indicator species (presence) in margin (e.g. 20m closest to adjacent colonising source) & core of site

Quantitative

Scheme	Quantitative
CSS	CS plots plus record species p/a in additional 1m x 1m central nest
SD, PD	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample.

1. Management data: organic & inorganic fertiliser application; stock type, density and timing; weed control; rolling/harrowing.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N & R; C & G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Class 44 (calcareous grassland) in CS2000.
6. Compare condition with EN BAP lowland calcareous grassland samples surveyed in 2002-3.
7. Compare trends with ECN site (Porton Down).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq*.: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq*.: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq*.
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS class 44 (calcareous grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare condition with EN BAP lowland calcareous grassland samples surveyed in 2002-3 (or later surveys if repeated).
7. Compare trends with ECN site (Porton Down).

4.2.3 Monitoring Schedule: Lowland Dry Acid Grassland

1. BAP Habitats

Broad	Acid grassland
Priority	Lowland dry acid grassland (LDAG)
NVC Communities	lowland U1-4, SD10, 11 (inland sub-communities)

2. Relevant BAP Objectives and Targets

1. Arrest depletion of unimproved lowland acid grassland

2. Within SSSIs, initiate rehabilitation management for all significant stands of unimproved lowland acid grassland in unfavourable condition by 2005, with the aim of achieving favourable status wherever feasible by 2010.

3. Secure favourable condition over 30% of the (non-SSSI) resource by 2005 and as near 100% as practicable by 2015

3. AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	2030 ha
Breckland ESA	BK	n/k
Clun ESA	CN	n/k
Dartmoor ESA	DM	n/k
Exmoor ESA	EX	n/k
Shropshire Hills ESA	SH	n/k
Suffolk River Valleys ESA	SR	n/k
West Penwith ESA	WP	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of lowland dry acid grassland under AE agreement where condition is currently favourable.

Lowland dry acid grassland sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of lowland dry acid grassland in SSSIs under AE agreement is not currently favourable, achieve favourable condition by 2010.

Lowland dry acid grassland sites not currently in favourable condition that are SSSIs achieve favourable condition as measured by RCA by 2010. Improvement in floristics and plant community variables equivalent to favourable condition is detected by 2010.

3. Where the condition of lowland dry acid grassland outside SSSIs under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010 and favourable condition by 2015.

Lowland dry acid grassland sites not currently in favourable condition that are outside SSSIs improve by at least one condition category as measured by RCA between Year 1 and 2010, and achieve favourable condition by 2015. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010, and equivalent to favourable condition by 2015.

5. 2003: RCA Method Development

The recommended method is Robertson & Jefferson (2000). This method is appropriate for designated LDAG sites and other LDAG in or close to favourable condition. For other LDAG sites and for restoration and re-establishment sites further method development is required:

1. Checking and agreeing attributes.
2. Selecting appropriate positive indicators.
3. Selecting and trialling appropriate targets for agreed attributes.
4. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing LDAG, including sites selected for quantitative monitoring.

Quantitative

	Scheme	Method	*n* (plots or quadrats)	
Current sample	CSS	CS	11	
	BH	ADAS plot	1	
	CN	ADAS plot	4	
	DM	ADAS plot	17	
	EX	ADAS plot	14	
	PD	ESA quadrat	5	
	SH	ADAS plot	10	
	SP	ADAS plot	11	
	SR	ESA quadrat	10	
	WP	ADAS plot	4	
	all	various	87	
			% deterioration	***n* (sites)**
Required sample	all	various	100	<10
	all	various	50	<10
	all	various	20	50
	all	various	10	200

Recommended national minimum sample = 50 sites

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions.

Key attributes
Positive indicator species (presence and frequency) Frequency and % cover of *Agrostis curtisii* (U3 only) Negative indicator species (presence and frequency) - e.g. pernicious weeds, scrub (including *Ulex* spp. - U3 only, and *Rhododendron* spp.) and coarse grass species, e.g. *Holcus lanatus*, *Dactylis glomerata* Sward structure - sward height, bare ground, litter cover

Quantitative

Scheme	Quantitative
CSS	CS plots plus record species p/a in additional 1m x 1m central nest
PD, SR	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N, F & R; A & G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare condition with EN BAP lowland dry acid grassland samples surveyed in 2002-3.

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq*.
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare condition with EN BAP lowland dry acid grassland samples surveyed in 2002-3 (or later surveys if repeated).

4.2.4 Monitoring Schedule: Lowland Meadows

1. BAP Habitats

Broad	Neutral grassland
Priority	Lowland meadows (LM)
NVC Communities	MG4, MG5, MG8

2. Relevant BAP Objectives and Targets

1. Arrest depletion of unimproved lowland meadow

2. Within SSSIs, initiate rehabilitation management for all significant stands of unimproved lowland meadow in unfavourable condition by 2005, with the aim of achieving favourable status wherever feasible by 2010.

3. Secure favourable condition over 30% of the (non-SSSI) resource by 2005 and as near 100% as practicable by 2015

3. Principle AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	682 ha
Breckland ESA	BK	n/k
Cotswold Hills ESA	CH	n/k
Lake District ESA	LD	n/k
Pennine Dales ESA	PD	n/k
Shropshire Hills ESA	SH	n/k
Somerset Levels & Moors ESA	SL	n/k
South Downs ESA	SD	n/k
South Wessex Downs ESA	SD	n/k
Upper Thames Tributaries ESA	UT	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of lowland meadow under AE agreement where condition is currently favourable.

Lowland meadow sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of lowland meadow in SSSIs under AE agreement is not currently favourable, achieve favourable condition by 2010.

Lowland meadow sites not currently in favourable condition that are SSSIs achieve favourable condition as measured by RCA by 2010. Improvement in floristics and plant community variables equivalent to favourable condition is detected by 2010.

3. Where the condition of lowland meadow outside SSSIs under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010 and favourable condition by 2015.

Lowland meadow sites not currently in favourable condition that are outside SSSIs improve by at least one condition category as measured by RCA between Year 1 and 2010, and achieve favourable condition by 2015. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010, and equivalent to favourable condition by 2015.

5. 2003: RCA Method Development

The recommended method is Robertson & Jefferson (2000). This method is appropriate for designated LM sites and other LM in or close to favourable condition. For other LM sites and for restoration and re-establishment sites, method development is required:

1. Checking and agreeing attributes.
2. Selecting appropriate positive indicators.
3. Selecting and trialling appropriate targets for agreed attributes.
4. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing LM, including sites selected for quantitative monitoring.

Quantitative

	Scheme	Method	*n* (plots or quadrats)			
Current sample	CSS	CS	76			
	AV	ADAS plot	3			
	BH	ADAS plot	10			
	CH	ADAS plot*	9			
	CN	ADAS plot	6			
	DM	ADAS plot	12			
	EX	ADAS plot	2			
	PD	ESA quadrat	4			
	SH	ADAS plot	3			
	SL	ESA quadrat/ ADAS plot	25			
	SP	ADAS plot	4			
	SX	ADAS plot	6			
	TV	ESA quadrat	12			
	UT	ADAS plot	3			
	all	various	175			
			% progression	***n* (sites)**	**% deterioration**	***n* (sites)**
Required sample	all	various	100	20	100	20
	all	various	50	50	50	50
	all	various	20	200	20	200
	all	various	10	>200	10	>200

*4m × 2m

Recommended national minimum sample = 200 sites

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions. Recommended visiting period: May – July, prior to cutting

Key attributes
Grass:herb ratio
Positive indicator species
Negative indicator species
Sward structure - sward height, bare ground, litter cover

Quantitative

Scheme	Quantitative
CSS	CS plots plus record species p/a in additional 1m x 1m central nest
PD, SL, TV	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing; closing & cutting date.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N & F; G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare condition with EN BAP lowland meadow samples surveyed in 2002-3.
7. Compare trends with ECN sites (Drayton, Wytham, North Wyke).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq*.
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq.*
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.

6. Compare condition with EN BAP lowland meadow samples surveyed in 2002-3 (or later surveys if repeated).
7. Compare trends with ECN sites (Drayton, Wytham, North Wyke).

4.2.5 Monitoring Schedule: Purple Moor Grass & Rush Pastures

1. BAP Habitats

Broad	Fen, Marsh and Swamp
Priority	Purple moor grass & rush pastures
NVC Communities	M22-26 (except on deep peat or unenclosed uplands)

2. Relevant BAP Objectives and Targets

1. Secure sympathetic management of at least 5,000 ha (in England) of purple moor grass and rush pasture by 2000

3. AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	n/k
Blackdown Hills ESA	BH	n/k
Broads ESA	BD	n/k
Dartmoor ESA	DM	n/k
Exmoor ESA	EX	n/k
Somerset Levels & Moors ESA	SL	n/k
Suffolk River Valleys ESA	SR	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of purple moor grass and rush pasture under AE agreement where condition is currently favourable.

Purple moor grass and rush pasture sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of purple moor grass and rush pasture under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010.

Purple moor grass and rush pasture sites not currently in favourable condition improve by at least one condition category as measured by RCA between Year 1 and 2010. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010.

5. 2003: RCA Method Development

The recommended method is Robertson & Jefferson (2000). This method is appropriate for designated PMRP sites and other PMRP in or close to favourable condition. For other PMRP sites and for restoration and re-establishment sites, further method development is required:

1. Checking and agreeing attributes.
2. Selecting appropriate positive indicators.
3. Selecting and trialling appropriate targets for agreed attributes.
4. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing PMRP, including sites selected for quantitative monitoring.

Quantitative

	Scheme	Method	*n* (plots or quadrats)
Current sample	CSS	CS	21
	BD	ESA quadrat	2
	BH	ADAS plot	1
	CN	ADAS plot	3
	EX	ADAS plot	9
	LD	ADAS plot	2
	SL	ESA quadrat	11
	SP	ADAS plot	5
	TV	ESA quadrat	1
	WP	ADAS plot	2
	all	various	57

Detectable change in community variables for given sample sizes:

n (sites)	10	20	50	100	200
Species richness	8.21	5.44	3.33	2.33	1.64
G score	0.14	0.09	0.05	0.04	0.03
Nu score	0.21	0.14	0.08	0.06	0.03

Recommended national minimum sample = 50 sites

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions. Recommended visiting period: June – August.

Key attributes
Positive indicator species (presence and frequency) Frequency and cover of *Molinia caerulea* Negative indicator species (presence and frequency) - e.g. pernicious weeds, scrub and trees Percentage cover of *Juncus* species Percentage cover *Cirsium palustre* (M24 and M25 only) Percentage cover *Deschampsia cespitosa* Percentage cover *Phragmites australis* Percentage cover *Myrica gale* (M24 and M25 only) Sward structure - sward height, bare ground, litter cover

Quantitative

Scheme	Quantitative
CSS	CS plots plus record species p/a in additional 1m x 1m central nest
BD, SL, TV	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N & F; G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with a subset of CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare condition with EN BAP purple moor grass & rush pasture samples surveyed in 2002-3.
7. Compare trends with ECN site (North Wyke).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq.*
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with a subset CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare condition with EN BAP purple moor grass & rush pasture samples surveyed in 2002-3 (or later surveys if repeated).
7. Compare trends with ECN site (North Wyke).

4.2.6 Monitoring Schedule: Upland Hay Meadows

1. BAP Habitats

Broad	Neutral grassland
Priority	Upland hay meadows (UHM)
NVC Communities	MG3

2. Relevant BAP Objectives and Targets

1. Arrest depletion of unimproved upland hay meadow

2. Within SSSIs, initiate rehabilitation management for all significant stands of unimproved upland hay meadow in unfavourable condition by 2005, with the aim of achieving favourable status wherever feasible by 2010.

3. Secure favourable condition over 30% of the (non-SSSI) resource by 2005 and as near 100% as practicable by 2015

3. AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	n/k
Lake District ESA	LD	n/k
Pennine Dales ESA	PD	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Maintain the condition of upland hay meadow under AE agreement where condition is currently favourable.

Upland hay meadow sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of upland hay meadow in SSSIs under AE agreement is not currently favourable, achieve favourable condition by 2010.

Upland hay meadow sites not currently in favourable condition that are SSSIs achieve favourable condition as measured by RCA by 2010. Improvement in floristics and plant community variables equivalent to favourable condition is detected by 2010.

3. Where the condition of upland hay meadow outside SSSIs under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010 and favourable condition by 2015.

Upland hay meadow sites not currently in favourable condition that are outside SSSIs improve by at least one condition category as measured by RCA between Year 1 and 2010, and achieve favourable condition by 2015. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010, and equivalent to favourable condition by 2015.

5. 2003: RCA Method Development

The recommended method is Robertson & Jefferson (2000). This method is appropriate for designated UMH sites and other UHM in or close to favourable condition. For other UHM sites and for restoration and re-establishment sites, method development is required:

1. Checking and agreeing attributes.
2. Selecting appropriate positive indicators.
3. Selecting and trialling appropriate targets for agreed attributes.
4. Determining condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of existing UHM, including sites selected for quantitative monitoring.

Quantitative

Current sample: data for Pennine Dales ESA are number of sites (fields) that are predominantly of that grassland type.

Scheme **Method**	***PD*** **ESA quadrat**	***PD*** **'Indicative'**	***PD*** **'Extension'**	**CSS** **CS plot**
Grassland				
Potential UHM	7	28	44	0
Degraded UHM	37	45	50	0
Existing UHM	6	0	1	2

Detectable change in community variables for given sample sizes:

Sample size (sites)	50		100		200	
	Potential UHM	**Degraded UHM**	**Potential UHM**	**Degraded UHM**	**Potential UHM**	**Degraded UHM**
Species richness	≈ 5.5	≈ 5.1	≈ 4.2	≈ 3.7	≈ 2.7	< 2.8
G score	< 0.034	< 0.037	< 0.034	< 0.037	< 0.034	< 0.037
Nu score	> 0.012	≈ 0.039	> 0.012	≈ 0.027	> 0.012	≈ 0.020

Recommended national minimum sample = 100 sites each for potential and degraded UHM. The stock of UHM appears to be low, and it is recommended that as many as possible are sampled, using local grassland inventories to identify suitable sites.

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions. Recommended visiting period: May - July prior to cutting.

Key attributes
Grass herb ratio Positive indicator species (presence and frequency) Negative indicator species (presence and frequency) - e.g. pernicious weeds, trees and scrub Sward structure - sward height, bare ground, litter cover

Quantitative

Scheme	Quantitative
CSS	CSS plots plus record species p/a in additional 1m x 1m central nest
PD	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
LD	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing; closing & cutting date.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N & R; C & G suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare condition with EN BAP upland hay meadow samples surveyed in 2002-3.
7. Compare trends with ECN site (Moor House-Upper Teesdale).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq.*
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare condition with EN BAP upland hay meadow samples surveyed in 2002-3 (or later surveys if repeated).
7. Compare trends with ECN site (Moor House-Upper Teesdale).

4.2.7 Monitoring Schedule: Semi-Improved Grassland

1. BAP Habitats

Broad Neutral grassland

NVC Communities MG6

2. Relevant BAP Objectives and Targets

1. Restore degraded neutral grasslands to buffer sites and restore the range of neutral grasslands

3. Principle AE Schemes

Scheme	Code	Estimated stock
Countryside Stewardship	CSS	682 ha
Avon Valley ESA	AV	n/k
Blackdown Hills ESA	BH	n/k
Breckland ESA	BK	n/k
Broads ESA	BD	n/k
Clun ESA	CN	n/k
Cotswold Hills ESA	CH	n/k
Dartmoor ESA	DM	n/k
Essex Coast ESA	EC	n/k
Exmoor ESA	EX	n/k
Lake District ESA	LD	n/k
North Kent Marshes ESA	KM	n/k
Pennine Dales ESA	PD	n/k
Shropshire Hills ESA	SH	n/k
Somerset Levels & Moors ESA	SL	n/k
South Downs ESA	SD	n/k
South Wessex Downs ESA	SD	n/k
Suffolk River Valleys ESA	SR	n/k
Upper Thames Tributaries ESA	UT	n/k
Test Valley ESA	TV	n/k
West Penwith ESA	WP	n/k

4. Proposed Scheme Objectives and Performance Indicators

1. Semi-improved grassland that has potential for re-establishment to a grassland Priority Habitat or other grassland of wildlife value achieves demonstrable improvements by 2010.

Semi-improved grassland sites with potential for re-establishment improve by at least one condition category as measured by RCA between Year 1 and 2010. Improvement equivalent to at least one higher condition category is detected in floristics and plant community variables between Year 1 and 2010.

5. 2003: RCA Method Development

The recommended method is Mitchley *et al*. (2000). This is a habitat type that requires considerable further work to define appropriate methods:

1. Checking and agreeing appropriate attributes.
2. Selecting appropriate positive indicators including restorability indicators of potential grassland trajectory.
3. Selecting and trialling appropriate targets for the agreed attributes.
4. Determining appropriate condition category thresholds for these targets.

6. Year 1: Sampling

RCA

Large sample (proportionate random according to stock) of MG6 that has potential to progress to one of the lowland grassland Priority Habitats, including sites selected for quantitative monitoring.

Quantitative

	Scheme	Method	*n* (plots or quadrats)			
Current sample	CSS	CS	106			
	AV	ADAS plot	1			
	BD	ESA quadrat	10			
	BH	ADAS plot	9			
	CH	ADAS plot*	18			
	CN	ADAS plot	33			
	DM	ADAS plot	7			
	EX	ADAS plot	7			
	KM	ADAS plot	20			
	PD	ESA quadrat	159			
	SD	ESA quadrat	1			
	SH	ADAS plot	14			
	SL	ESA quadrat/ ADAS plot	51			
	SP	ADAS plot	23			
	SR	ESA quadrat	2			
	SX	ADAS plot	6			
	TV	ESA quadrat	7			
	UT	ADAS plot	4			
	WP	ADAS plot	2			
	all	various	480			
			% progression	**LCG**	**LM**	**UHM**
Required sample (sites)	all	various	100	<10	<10	20
	all	various	50	<10	20	50
	all	various	20	20	100	200
	all	various	10	50	200	>200

*4m × 2m

Recommended national minimum sample = 100 sites

7. Year 1: Field methods

RCA

Structured walk with 20 sampling positions. Recommended visiting period: May – July.

Key attributes
Grass:herb ratio Positive indicator species (presence and frequency) - typically NVC based but could include “restorability indicators” Negative indicator species (presence and frequency) - e.g. pernicious weeds Sward structure - sward height, bare ground, litter cover

Quantitative

Scheme	Quantitative
CSS	CSS plots plus record species p/a in additional 1m x 1m central nest
BD, PD, SD, SL, SR, TV	ESA quadrats with % cover estimate plus record species p/a in surrounding 2m x 2m quadrat
all other ESAs	ADAS plots but reduce to 16 nests

8. Year 1: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data: organic & inorganic fertiliser & lime application; stock type, density and timing; weed control; rolling/harrowing; closing & cutting date.
2. Meteorological data.

9. Year 1: Analysis and Interpretation

1. Calibrate community variables (from quantitative data) against condition categories.
2. Analyse change in floristics and community variables for each scheme separately up to and including Year 1.
3. Community (indicator) variables: Ellenberg N, F & R; G, A & C suited species scores; species richness, individual species.
4. Analyse relationships between vegetation and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in CS2000.
6. Compare trends with ECN sites (Drayton, Wytham, North Wyke, Porton Down).

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

To be collected from quantitative monitoring sample:

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in floristics and community variables for all schemes collectively from Year 1 to Year 2 *et seq.*
2. Analyse change in floristics and community variables for each scheme separately from original baselines up to and including Year 2 *et seq.*
3. Community (indicator) variables: as Year 1.
4. Analyse relationship between vegetation change and management.
5. Compare trends with CVS Aggregate Class IV (infertile grassland) in Countryside Survey if CS is repeated at appropriate interval.
6. Compare trends with ECN sites (Drayton, Wytham, North Wyke, Porton Down).

4.3 UPLAND MONITORING EXPLANATORY NOTES

One of the main causes of deterioration of upland heath and blanket bog is overgrazing by livestock. It is also the key factor controlled by AE schemes, so it is important to monitor the effects of varying grazing intensity. Other practices, such as burning management, also have an impact. The overall approach recommended will address these at three different levels: RCA, measurement of changes in plant species composition, and estimation of heather performance and vegetation condition in relation to grazing.

1. BAP Habitats

A single schedule has been produced for the following upland habitats:

BAP Priority Habitats

Upland heathland (UH)
Blanket bog (BB)

Potential Priority Habitats

Potential upland heathland (acid grassland with dwarf shrubs present but <25% cover)

2. Relevant BAP Objectives

BAP objectives for UH and BB are listed. Area targets refer to the whole of the UK.

Re-establishment of heathland (i.e. on land where upland heathland is unlikely to develop without interventionist management) is not included in the upland schedules, being recommended as a separate, targeted study.

3. AE schemes

AE schemes are listed that include moorland agreements and in which monitoring should be targeted. Estimated stock of moorland under agreement is at 1998, from Cooke (1999). This can be revised as more recent data become available.

4. Proposed Scheme Objectives and Performance Indicators

These are derived from the relevant BAP objectives and targets. Objectives for AE schemes should refer to the majority of sites under agreement even if the national BAP target is only for a percentage of that habitat. This is because AE schemes are one of the main vehicles for achieving national targets, so the majority of agreement sites are expected to be maintained in favourable condition, or to show improvements.

The first part of each performance indicator refers to RCA, which provides assessments at the Management Unit (MU) or sampling unit level. The second part refers to the plant species composition and heather performance, which assesses vegetation condition and change at a national level, and across individual schemes. The performance indicators refer explicitly to the variables that can be successfully calibrated for the habitat. The utility of these variables will be dependent on successful and meaningful calibration against condition categories or attributes.

The objectives and performance indicators should be viewed as suggestions only, but are an attempt to link AE schemes and their monitoring programme more closely to the national BAP.

5. 2003: Method Development

Development work on upland assessment and monitoring methods is currently being carried out by the country agencies and by DEFRA. In particular, a range of RCA methods have been recommended for upland habitats (Jerram *et al.* 2001; CCW 2002; Glaves *et al*. 2001; MacDonald 2002), but a consensus between the country agencies has not yet been obtained. A range of attributes indicative of overgrazing is currently also being tested (Glaves *et al*. 2001). The results of these studies need to be reviewed and evaluated in the context of AE monitoring. There is an opportunity to do this in 2003, if results are available by then.

6. Year 1: Sampling

Year 1 refers to the first year of survey in the new monitoring programme. Year 2 *et seq*. refers to the second and subsequent surveys. Recommendations for timing of surveys are given in Section 5.1.

A Management Unit (MU) is equivalent to a grazing unit, as defined in the current ESA monitoring programmes. The extent of individual MUs will need to be defined clearly for each agreement. The number of MUs sampled in each scheme can be amended as stock data are updated. The sample can include current CSS sites with plots, and sites used for Grazing Index/Biomass Utilisation (GI/BU) assessment in ESAs. This will ensure some continuity with previous assessments or monitoring. In some ESAs, ADAS plots were also set up at rough grazing sites. If these management units contain UH, potential upland heathland or BB, then they can also be included in the sample. Existing plots can be used if they are located in the required vegetation type. Moorland Scheme (MS) sites that subsequently enter CSS (from 2003) can also be included. The current samples of heather moorland and rough grazing sites are representative of the resource in each scheme, although this is not certain for the North Peak ESA and needs to be confirmed. Existing sites or plots for monitoring bracken control, heather restoration or heather burning will not be included in the new sample, as it is more appropriate to include these in separate, targeted studies.

The UH and BB habitats targeted for monitoring are as defined in the UK BAP. Potential upland heathland is defined in the BAP as having potential for restoration to UH, having up to 25% heather cover. However, the spatial scale at which heather cover is measured is not specified in the BAP. Therefore, it is assumed that this applies at all spatial scales at which cover will be measured in the monitoring programme.

In the current sample, relatively few plots were located in UH because the monitoring was focussed mainly on GI/BU assessments. Therefore, power analysis results presented are those from plots classified as Dwarf Shrub Heath Broad Habitat (excluding CSS plots because of their larger size). Although this includes some lowland heathland samples, these were considered to be the best available data. The recommended sample of 100 MUs would allow changes of approximately 0.5 species m^{-2}, and 0.05 in G and Nu scores to be detected in UH, if a there is UH available for establishment of a plot in every MU.

Sampling recommendations are made for BAP habitats at the national (England) scale. If the same questions need to be addressed at smaller scales (e.g. RDR regions, individual AE schemes) then the same sample size as that for the national sample would be required for each region, scheme, etc. If designated sites (e.g. SSSIs) are to be assessed specifically, then the sample would need to be targeted at them. Objectives for individual sites in the sample will be assessed by the RCA. No stratification by tier is recommended because tier structure and management prescriptions evolve over time. Sites not currently under AE agreement should not be included because the overall aim is to monitor the target habitats under AE agreement.

Only MUs that contain at least one of the three target vegetation types will be included in the sample, so that up to three habitats will be sampled in each MU. MUs that do not contain any readily identifiable dwarf shrub cover will be rejected. Habitat maps of MUs are not routinely produced as part of the agreement process. However, there are other maps that can be used to help to focus site selection and to increase the probability of locating plots and RCA sampling locations in the targeted habitats. These include:

1. Land Cover Map 2000 can distinguish between bog, dwarf shrub heath and several categories of grassland. There is a good agreement with ground data from CS2000 (in the order of about 85 %) once differences of scale and timing are taken into account. The 25 m grid underlying the data makes the map less useful for small parcels of land.
2. Soil maps to identify areas of deep peat, and therefore potentially blanket bog.
3. ESA land cover maps, that identify heathland with >25% dwarf shrub cover.

The current agreement tier will also help to screen the suitability of sites. For example, those in a heather restoration tier can be assumed to contain at least some heather cover. Sampling locations within MUs will need to be checked in the field to ensure that they are positioned within the target habitat.

If selected MUs contain other habitats at which targeted studies are aimed (upland calcareous grassland Priority Habitat and other upland features such as flushes and valley mires) then these should be included in the targeted study sample. Logistically, these targeted studies can therefore be combined with the upland monitoring, although strategically they will be part of a separate study.

7. Year 1: Field methods

RCA, species plots and heather performance will be monitored in all MUs in the sample. This will provide an overall assessment of condition with good representation, along with a sensitive method for detecting & exploring change, and links to short-term changes in grazing intensity.

RCA

There are a number of major outstanding issues that need to be resolved before RCA methods are agreed for upland habitats and these are outlined below and elaborated in Section 3.

Area monitored

The uplands often comprise extensive areas typically incorporating a range of habitat types. It is not yet agreed how RCA can be adapted to cope with this, e.g. by monitoring the whole site or MU or by monitoring representative samples of each major habitat.

Sampling method and the number and size of samples

Several contrasting sampling methods have been proposed for the uplands, for example:

Jerram *et al*. (2001): Structured walk covering at least 20% of the site unit - both core and margin. 10 random sampling points selected + 5 for subsidiary habitats (10 if of equivalent area).

MacDonald (2002): Random samples are assessed for condition of attributes; if 6 samples fail the site is recorded as in unfavourable condition, if 28 samples pass the site is recorded as in favourable condition. This approach provides answers at a 90% confidence level and this statistical rigour is important for optimising sampling intensity of condition assessments in common standards reporting. However this approach may be less appropriate for AE scheme monitoring which has rather different objectives.

In addition to the issue of number of samples, different scales of sampling may be required for different attributes, e.g. vegetation composition 4 m^2; ground disturbance 1 ha; disturbance indicators – visual estimate from sample location or while travelling between sample locations (MacDonald 2002).

Mosaics, transitions and multiple interest features

Where the site incorporates a range of different habitat types or interest features, RCA needs to be adapted to cope with this. The structured walk with 20 sampling positions may not provide sufficient coverage for extensive upland mosaics, although the assessment of larger areas at each sampling position would help here. The MAP project deals with mosaics by using a sample grid and classifying each sample point by habitat type and then applying the appropriate attributes. However this is a potentially time-consuming approach and scarce habitats can be missed or under recorded. A further approach is to identify the range of habitats from a map and to sample these individually. However, this approach can also be very time-consuming and result in excessive multiplication of work, although some of this can be reduced by monitoring some habitats/attributes from suitable vantage points. This is one case where it may be helpful to plot the position of key habitats/features using GPS for subsequent relocation.

Setting appropriate attributes and targets, especially for restoration and re-establishment.

The available methodologies for upland RCA include often long lists of attributes, e.g. MacDonald (2002). Not all of these attributes will be appropriate for RCA of upland AE schemes. For the uplands, much more than for the lowlands, selective use of published attributes may need to be considered.

For restoration sites, work is needed to select, for example, the most appropriate indicators of overgrazing. The results of the MAPP work currently in progress, as well as some analysis of appropriate existing AE data, will help here.

Many areas of high mountain heath may be dominated by acid grassland and targets over a 10 year management agreement may do little more than ensuring that frequency and cover of grass species does not increase. PIs and RCA targets for improvement of condition may need to be modest for such sites.

For RCA to work effectively in the uplands (as in the lowlands) site objectives will need to be clear and unambiguous. Objectives will need to deal with issues such as mosaics and transitions. Further, modified wet bogs may support important "secondary" vegetation communities such as marshy grassland and wet woodland which have developed following disturbance and in some cases the maintenance of these habitats may be an acceptable alternative to bog restoration, although currently this is not the case.

Species composition

In earlier reviews of moorland monitoring, recommendations were made for more emphasis to be made on species composition, and for frequency or cover estimates, preferably at different scales, to be used (Gardner *et al*. 1998; 1999). ADAS plots satisfy these requirements, and so appear to be the most appropriate method. Any existing plots in ESAs (and MS) that meet the sampling criteria specified above can be retained for continuity. In CSS, existing CS plots should also be used, again for continuity. The addition of % cover estimates in ADAS plots will ensure better compatibility between the two field methods (presence and % cover within 2m × 2m). It is recommended the existing grid size of ADAS plots (32 nests) is retained (in contrast to the recommendation for grassland of a reduction to 16 nests). This is because in relatively species-poor upland habitats, changes in individual species are often more informative than changes in community variables. Reduction of the grid in ADAS plots would compromise the ability to detect change in individual species (Burke & Critchley 1999).

Plots in UH will be located on the interface with grassland because it is here that temporal responses to grazing in UH are most likely to occur. The intention is to detect changes in species composition within the plant community, not to trace movement of the dwarf shrub/grass interface, which would require a mapping approach. If the MU contains only continuous dwarf shrub cover, then the plot should be located randomly within the UH.

Fixed plots will not be used in BB because of its sensitivity to physical damage and the instability of deep peat. Monitoring of BB will need to be done by RCA alone; it is assumed that the assessments of dwarf shrubs, bog mosses and bare peat cover will provide adequate information.

Heather performance

Previously, heather suppression has been estimated in ESAs using the GI/BU method. However, problems have been identified with this method, which are mainly due to uncertainties and lack of reliable data on the relationship between grazing pressure and heather performance. In a comprehensive review of heather moorland monitoring, Gardner *et al*. (1998) recommended that the BU method should be discontinued. However, the GI component (i.e. the proportion of shoots in a sample that are grazed) is considered to be relatively robust. DEFRA has also continued to use GI for assessing overgrazing in relation to environmental cross-compliance for HLCA/HFA payments (Glaves 2001). The significance of GI for heather performance is dependent on other factors including heather age and condition, but nevertheless is considered to be a useful indicator. This would complement the RCA and species composition monitoring, as it should also be more sensitive to short-term changes in grazing intensity. A protocol for estimating GI and for integrating this information with RCA can be developed in 2003.

8. Year 1: Environmental data

From the results of the review (Chapter 2), recommendations can be made on the use of environmental data.

The quality of management data is dependent on the availability of accurate records from farmers. Although this is usually variable, the information is key to explaining how AE schemes might be influencing vegetation change and condition. Grazing (stock type, intensity, timing), burning and control of weeds such as rushes and bracken, are the most important elements. Ideally, an estimate of the area of different vegetation types within the MU would also be obtained, since this will influence stock grazing behaviour and consequently localised grazing intensity. This would require a vegetation map to be produced by field survey, and would be dependent on a large resource being made available.

Meteorological data provide contextual background information for interpreting trends that might be attributable to short-term weather effects.

The relationships between vegetation and other environmental factors would be best explored in a discrete project (or projects) that is complementary to the core monitoring programme. Environmental data that can be examined in this way are physical, atmospheric deposition and climate change data.

9. Year 1: Analysis and interpretation

Progression towards the BAP targets can be measured by a combination of RCA, heather performance and botanical monitoring. To do this, the relationships between RCA attributes and botanical and heather performance data will need to be explored. This will indicate the extent to which the different variables can be used to measure progression or deterioration against target values. The power test results for the relevant community variables can be used to declare the magnitude of progression or deterioration that is detectable.

Community variables (from plot data) that are most relevant to the objectives for upland habitats have been selected from the list identified in the review (Chapter 2), and from upland assessment methods under development. It is recommended that the Ellenberg N (nitrogen) score is used in future in place of the Nu suited species score. The latter was developed for the last round of reporting for ESA monitoring because at that time Ellenberg N values were not available for the full British flora. Although Nu scores are based partly on functional traits of species, which have a more objective theoretical base than Ellenberg values, this had to be supplemented with data on species' habitat preferences due to incomplete functional trait databases. On balance, it is considered that Ellenberg N values have the advantage of simplicity, and can be usefully applied until functional data are more fully expanded.

10. Year 2 *et seq.*

Recommendations are made for sampling, data collection and analysis in subsequent years.

Trends in AE schemes can be put in the context of the wider countryside by comparison with results from Countryside Survey. However, a quantitative comparison is only possible if at least two survey years coincide with those of Countryside Survey. There is an opportunity for AE scheme monitoring and Countryside Survey fieldwork to be synchronised in the future. Currently, however, trends will have to be compared on a qualitative basis. Comparisons will be dependent on an adequate sample being available in CS for each Priority Habitat. The CS samples also include AE agreement sites, which would have to be excluded (e.g. in 1999, 19% of CS upland Broad Habitat plots were under ESA agreement). The CVS aggregate classes that most closely correspond with the UH and BB Priority Habitats have been identified.

Suggestions are made as to which ECN sites are likely to provide information relevant to upland habitats. ECN data will be useful for interpreting long-term trends in vegetation that might be attributable to external environmental factors.

4.4 UPLAND HABITATS MONITORING SCHEDULE

4.4.1 Monitoring Schedule: Upland Heathland And Blanket Bog

1. BAP Habitats

Broad	Dwarf shrub heath (DSH)
Priority	Upland heathland (UH) Blanket bog (BB)

2. Relevant BAP objectives and targets

UH	1	Maintain the current extent and overall distribution of the upland heathland that is currently in favourable condition
	2	Achieve favourable condition on all upland heathland SSSIs by 2010 and demonstrable improvements in the condition of at least 50% of semi-natural upland heath outside SSSIs by 2010 (compared with their condition in 2000)
	3	Seek to increase dwarf shrubs to at least 25% cover where they have been reduced or eliminated due to inappropriate management. A target for such restoration of between 50,000 and 100,000 ha by 2010 is proposed.
	4	Initiate management to re-create 5,000 ha of upland heath by 2005 where heathland has been lost due to agricultural improvement [or afforestation], with a particular emphasis on reducing fragmentation of existing heathland.
BB	1	Maintain the current extent and overall distribution of blanket mire currently in favourable condition
	2	Improve the condition of those areas of blanket mire that are degraded but readily restored, so that the total area in, or approaching, favourable condition by 2005 is 340,000 ha (i.e. around 30% of the total extent of restorable blanket mire).
	3	Introduce management regimes to improve to, and subsequently maintain in, favourable condition a further 280,000 ha of degraded blanket mire by 2010
	4	Introduce management regimes to improve the condition of a further 225,000 ha of degraded blanket mire by 2015, resulting in a total of 845,000 ha (i.e. around 75% of the total extent of restorable blanket mire) in, or approaching, favourable condition

3. AE Schemes

Scheme	Code	Estimated stock of moorland (ha)
Countryside Stewardship	CSS	15,500
Moorland Scheme	MS	10,300
Exmoor ESA	EX	8,500
Dartmoor ESA	DM	4,900
Lake District ESA	LD	54,200
North Peak ESA	NP	35,600
Shropshire Hills ESA	SH	750
South West Peak ESA	SP	3,700
	Total	133,450

4. Proposed Scheme Objectives and Performance Indicators

UH

1. Maintain the condition of upland heathland under AE agreement where condition is currently favourable.

Upland heathland sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in heather performance, floristics or plant community variables on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of upland heathland SSSIs under AE agreement is not currently favourable, achieve favourable condition by 2010.

Upland heathland sites not currently in favourable condition that are SSSIs achieve favourable condition as measured by RCA by 2010. Improvement in heather performance, floristics and plant community variables equivalent to favourable condition is detected by 2010.

3. Where the condition of upland heathland outside SSSIs under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010.

Upland heathland sites not currently in favourable condition that are outside SSSIs improve by at least one condition category as measured by RCA between Year 1 and 2010. Improvement equivalent to at least one higher condition category is detected in heather performance, floristics and plant community variables between Year 1 and 2010.

4. On potential upland heathland (less than 25% dwarf shrub cover due to inappropriate management) under AE agreement, achieve 25% dwarf shrub cover by 2010.

Potential upland heathland sites achieve at least 25% heather cover at the management unit (or RCA sampling unit) scale by 2010, and their condition improves to at least one higher category as measured by RCA. Improvement equivalent to at *least one higher condition category is detected in heather performance, floristics and plant community variables between Year 1 and 2010.*

BB

1. Maintain the condition of blanket bog under AE agreement where condition is currently favourable.

Blanket bog sites in favourable condition in Year 1 do not show subsequent deterioration to a lower condition category as measured by RCA. No deterioration is detected after Year 1 in heather performance on land under AE agreement or, if there is deterioration, it is within the range of variation of the favourable condition category.

2. Where the condition of blanket bog under AE agreement is not currently favourable, achieve demonstrable improvements in condition by 2010 and favourable condition by 2015.

Blanket bog sites not currently in favourable condition improve by at least one condition category as measured by RCA between Year 1 and 2010, and achieve favourable condition by 2015. Improvement equivalent to at least one higher condition category is detected in heather performance between Year 1 and 2010, and equivalent to favourable condition by 2015.

5. 2003: Method Development

Confirm the most appropriate field method for RCA of AE Schemes in the uplands.

Select appropriate indicators of overgrazing from results of MAP project currently in progress.

6. Year 1: Sampling

Proportionate random sample of Management Units (MUs) according to stock of moorland in each scheme to be drawn. Habitats to be sampled are UH, potential upland heathland (acid grassland with dwarf shrubs present but <25% cover) and BB. MUs with existing CSS or ADAS plots on heathland to be included in sample, along with plots from other habitats that are potential upland heathland.

Distribution of sample between AE schemes for given total sample sizes:

Scheme	**% of total stock**			
CSS	11.6	6	12	23
MS	7.7	4	8	15
EX	6.4	3	6	13
DM	3.7	2	4	7
LD	40.6	20	40	81
NP	26.7	13	26	53
SH	0.6	0	1	2
SP	2.8	2	3	6
	Total *n*	50	100	200

Detectable change in community variables for given sample sizes:

	10	***20***	***50***	***100***	***200***
Species richness	1.91	1.27	0.78	0.54	0.39
G score	0.17	0.11	0.07	0.05	0.03
Nu score	0.16	0.11	0.06	0.05	0.02

Recommended minimum sample size = 100 MUs.

7. Year 1: Field Methods

RCA

Field methods for upland habitats are subject to agreement during 2003 (see explanatory notes).

Habitat	**Key attributes**
UH & BB	Positive indicator species (frequency/cover) Frequency / cover of dwarf shrubs Frequency/cover of graminoids Negative indicator species (frequency/cover) e.g. pernicious weeds, bracken, scrub, trees Grazing impact/index (overgrazing indicators) Dead foliage
UH	Dwarf shrub age structure Bryophyte and lichen abundance Bare ground Indicators of disturbed/undisturbed heath
BB	Position of water table Frequency / cover of *Sphagna* (+ other bryophytes) Extent of bare peat Disturbance indicators (e.g. *Sphagnum* trampling) Indicators of increased drying out of pools, e.g. reduced area of pools and /or *Sphagnum* filled hollows

Species composition

Scheme	**Plot type**
CSS	CSS plots
ESAs & ex-MS	ADAS plots plus record % cover of species in 2m x 2m nest or group of nests if smaller

Habitat	Plot location
UH	one CS or ADAS plot per MU randomly located within RCA sampling areas on the interface with grassland
potential UH	one CS or ADAS plot per MU randomly located within RCA sampling areas within potential UH
BB	no fixed plots

Heather performance

Grazing Index (GI) and other attributes to be recorded according to protocol developed in 2003.

8. Year 1: Environmental Data

1. Management data: stocking density and timing, burning, bracken or rush control.
2. Meteorological data

9. Year 1: Analysis and Interpretation

1. Analyse relationships between RCA attributes, heather performance, floristics and plant community variables for all schemes collectively and for individual schemes with adequate sample sizes.
2. Community (indicator) variables from species plots: Ellenberg N; A & G suited species scores; species richness, dwarf shrubs, dwarf shrub:graminoid ratio, bryophytes as a group.
3. Analyse relationship between vegetation and management.

10. Year 2 *et seq.*: Sampling & Field Methods.

Repeat Year 1 methods.

11. Year 2 *et seq.*: Environmental Data

1. Management data as in Year 1.
2. Meteorological data.

12. Year 2 *et seq.*: Analysis and Interpretation

1. Analyse change in heather performance, floristics and community variables for all schemes collectively from Year 1 onwards, and for individual schemes with adequate sample sizes. Relate changes to site variables from RCA and environmental variables.
2. Community (indicator) variables: as Year 1.
3. Analyse relationship between vegetation change and management.
4. Compare trends with CVS aggregate classes VII (moorland grass/mosaic) and VIII (heath/bog) in Countryside Survey if CS is repeated at appropriate intervals.
5. Compare trends with ECN sites (Moor House-Upper Teesdale, Y Wyddfa/Snowdon, Sourhope).

4.5 TARGETED STUDIES

Habitats are listed below ([1]Broad Habitats, [2]Priority Habitats) for which targeted studies are recommended. In most cases, some monitoring of these habitats has been carried out previously, and existing sites or plots could potentially be used in the future programme. It is recommended that the objectives for each habitat are reviewed separately, and the relative merits assessed of continuing with existing samples or establishing new projects. In some cases, it might be appropriate to use RCA, either alone or in combination with quantitative methods.

Arable[1] (including Cereal Field Margins[2])

A range of habitats to benefit biodiversity can be created on arable land. Examples include overwinter stubble, spring fallow, undersown cereals, grass margins and conservation headlands. Methods for their establishment and management have been relatively well researched. In most cases, these were successfully established under the ASPS. Some of these management methods have now been introduced at a national level under CSS. These arable habitats are expected to be most beneficial at higher trophic levels, for example to invertebrates and farmland birds. Therefore, it would be more appropriate for monitoring to be focussed on habitat structure rather than detailed botanical composition. RCA could be used to check that the desired habitat structure is being achieved.

More detailed botanical monitoring might be justified in those arable habitats that remain in the same location for more than one season. Where perennial vegetation is established (e.g. grass margins) the establishment and spread of grassland or woodland species might be of interest. In uncropped wildlife strips, the maintenance of annual dicotyledonous plant communities is the main aim. Sites surveyed in the ASPS assessment might provide a suitable sample for longer-term monitoring.

Also in the ASPS, populations of rare annual arable plants were identified, particularly in the East Anglia Pilot Area. It would be important to establish whether these are being maintained under AE scheme agreements. This might also apply to populations elsewhere that are the target of CSS agreements.

Arable Reversion

Arable reversion to grassland has been monitored or assessed in a sample of sites in the South Downs ESAs. Similarly, arable reversion to lowland heathland has been assessed in Breckland ESA, both as part of the botanical monitoring programme, and within a separate research project (Fowbert *et al*. 2000). Given that individual arable reversion sites would normally be expected to have clear objectives, RCA might be a suitable method for monitoring their progress towards targets. RCA methods for arable reversion are relatively well developed.

Ditches

Ditch monitoring has been carried out in the Broads and North Kent Marshes ESAs, and on more limited samples in the Somerset Levels and Moors ESA and South Downs ESA. The value of ditches is influenced primarily by water quality and by ditch management. In areas where ditches are of high biodiversity value, a monitoring or assessment programme might be justified. However, it might be preferable to focus on aspects such as the relationships between ditch management, vegetation structure and invertebrate communities as well as botanical composition.

Fen, Marsh & Swamp[1]

This Broad Habitat includes the Reedbeds and Fens Priority Habitats that are of local importance and can be incorporated in AE scheme agreements. Because of the relatively small area of these habitats, any botanical monitoring would probably be best focussed on objectives for individual sites. Purple moor-grass and rush pastures is also included in this Broad Habitat, but has its own monitoring schedule.

Saltmarsh[2]

A number of saltmarsh sites, formerly under the Habitat Scheme, have been the focus of specific studies. These could be continued using the same methods as previously. Alternatively, it might be worth developing an RCA method for this habitat.

Former Set-aside

Sites previously managed as non-rotational set-aside were included in the Habitat Scheme monitoring programme. Some sites from this sample are now in the CSS. This presents a good opportunity to monitor the development of set-aside in the longer term, with sites now being up to fourteen years old. This also has relevance for arable reversion to habitats such as grassland, heathland or scrub. Botanical monitoring could be continued at the remaining sites in the sample.

Water Fringe

Sites formerly in the Habitat Scheme were monitored between 1995 and 1997. These included land withdrawn from agricultural production, and sites formerly under arable cropping. Along with the Former Set-aside sample, continued monitoring of these sites would provide an opportunity to assess habitat development over the longer-term.

Lowland Heathland[2]

Lowland heathland samples have been monitored in the Breckland, West Penwith and Blackdown Hills ESAs and in CSS. Lowland heathland is an important habitat in AE schemes, and is expected to benefit from management agreements, especially where grazing and burning regimes are controlled. It is recommended that high priority is given to monitoring this habitat in future. However, the objectives of the current monitoring programmes have varied, for example being focussed on the effects of grazing in Breckland and West Penwith, and recovery after burning in a second West Penwith sample. Monitoring methods have also varied between the schemes. It is suggested that the objectives of lowland heathland monitoring should be reviewed, and consideration given as to whether studies should focus in future on specific aspects of management (as in Breckland and West Penwith) or more generally on heathland condition and change (as in the Blackdown Hills and CSS). Lowland dry acid grassland often occurs as part of the habitat mosaic of lowland heathland sites, although it also exists elsewhere as a discrete grassland type. At sites where they coincide, the monitoring programmes for lowland dry acid grassland and lowland heathland could be linked.

Upland Calcareous Grassland[2]

Upland calcareous grassland is an important habitat in CSS and the Pennine Dales and Lake District ESAs. However, it has not been included in the upland monitoring schedule because its relative scarcity means that it is unlikely to be well represented in the main upland sample that is aimed at upland heathland and blanket bog. Instead, it is suggested that a targeted sample of upland calcareous grassland is selected. As noted in the upland schedule, calcareous grassland could be surveyed at the same time as the main upland sites, where it is present. For logistical reasons, the targeted study of this habitat could be timed to coincide with the main upland surveys.

Upland Flushes and Valley Mires

Upland management units often contain flushes and valley mires that are important components in the overall mosaic of habitats. They are vulnerable to inappropriate levels of grazing, and are sensitive to damage by burning, and merit consideration for inclusion in the monitoring programme. However, flushes occupy a relatively small area in comparison with the main upland heath and blanket bog habitats, while valley mires are also relatively scarce. Small examples can also be more difficult to identify without detailed searching in the field. As with upland calcareous grassland, a targeted study of flushes and valley mires would be appropriate, with fieldwork timed to coincide with the main upland surveys.

Upland Management (Bracken Control, Heather Burning, Heather Restoration)

A number of studies have been carried in ESAs focussing on specific components of the management prescriptions. It might be of value to continue some of these studies in the longer term. It is recommended that they should be reviewed collectively with a view to integrating them within a small programme of upland management studies.

Broadleaved Woodland[1]

The only woodland assessments carried out to date in English AE schemes is of a limited sample within the FWS/FWPS. Consideration could be given to extending this study to national sample, with repeated surveys to monitor development of new woodland. RCA methods for woodland are well developed and could be readily applied here.

Ancient and/or Species-Rich Hedges[2]

Hedge monitoring has not been addressed specifically in this study, being the subject of another project (AE05: ‘Study of hedgerow maintenance and restoration under the Environmentally Sensitive Areas and Countryside Stewardship Schemes in England’).

However, this is clearly a major habitat within AE schemes that merits consideration for a monitoring programme.

5 LOGISTICS

5.1 TIMETABLE

It is anticipated that the new monitoring programme will not start until after 2003. This provides an opportunity to carry out methodological development work that is still needed before the recommended programme can be fully implemented. Outstanding requirements are specified for each habitat. Site selection can also be started in 2003.

To spread the resource evenly between years, fieldwork could be carried out on only a selection of habitats in each year. A suggested roster is shown below. It is important to allow sufficient time between field data collection and reporting, so that a thorough analysis can be carried out. A period of 12 months between the end of fieldwork and reporting is suggested. Resurvey intervals will be determined mainly by the perceived need to detect any early signs of deterioration in Priority Habitats, and by resource availability. An interval of 5-9 years between quantitative surveys is suggested. This will provide a long-term monitoring programme that can feed into policy reviews as they arise. RCA should be done at the same time at each site, with the option also of RCA surveys being done at more frequent intervals.

Suggested roster for field data collection:

1st year	Lowland calcareous grassland	High botanical value
	Lowland dry acid grassland	High botanical value
	Lowland meadows	High botanical value
	Purple moor grass & rush pasture	High botanical value
2nd year	Upland heathland & blanket bog	Allows additional time for method development
	Semi-improved grassland	Deterioration less important; re-establishment probably slow
3rd year	Upland hay meadows	Last surveyed in 2002
	Coastal & floodplain grazing marsh	Botanical value less important

5.2 FIXED UNIT RELOCATION

Existing quadrats and plots are fixed and potentially relocatable. Many of these have already been relocated (some more than once) since their first establishment. However, buried plot/quadrat markers can deteriorate over time, and some landmarks used as reference points for bearings and measurements can change over the longer term. Recent experience in the Pennine Dales ESA has shown that the accuracy of instructions and measurements for relocating fixed positions sometimes varies depending on the quality of supervision of the original field teams. It is recommended that in 2003, the opportunity is taken to evaluate a sample of plots or quadrats from each scheme for ease relocation. Where there are shortcomings, the continued usefulness of a sample might need to be re-assessed. In all future surveys, GPS readings should be taken for all fixed units to assist their subsequent relocation.

5.3 Links with other Programmes

The main purpose of the AE scheme botanical monitoring programme will be to assess the contribution of AE schemes to achieving BAP targets for specific habitats. The monitoring results should also provide feedback, by helping to identify strengths and weaknesses in the way that the schemes operate. At the whole-scheme level, this would allow improvements to be made to help the schemes to meet their objectives. It would also be advantageous if the resource allocated to monitoring could be used to improve the effectiveness of the day to day running of schemes. This could be achieved by using, for example, results of RCA at individual sites to influence the way that each site is managed. However, unless RCA was carried out at all agreement sites, this could bias the monitoring sample in the longer term, and the monitoring programme would no longer be fit for its main purpose. Nevertheless, RCA could be a useful tool for Project Officers to use themselves, as it could help them to make judgements about the condition of particular sites/features in a standardised way. This would need to be done independently of the monitoring programme.

There are also opportunities to link the AE botanical monitoring more closely to other monitoring programmes. These include CS, and EN's programme of BAP grassland condition assessment on designated and non-designated sites. In addition, there will be opportunities to make links with the validation network being developed by EN, for which quantitative data will be collected from a series of designated sites. If the timetables for these national monitoring schemes coincided, then trends in AE schemes and elsewhere could be compared more readily. It would be of great benefit if DEFRA could ensure that, as far as possible, these programmes are co-ordinated and data exchange is facilitated.