Summary

Since the introduction of the first Agri-environment (AE) schemes in England in 1987, DEFRA (formerly MAFF) has been committed to monitoring their performance in relation to the scheme objectives. Environmental monitoring programmes, most of which include a major botanical element, have been established in all English AE schemes. However, since 1987, UK policies for biodiversity and rural development have evolved, and there is now a requirement for DEFRA to report on the performance of AE schemes within a wider policy context.

The aim of this project is to make recommendations for the future botanical monitoring programme of AE schemes, scheduled to run from 2003 onwards. The project aims specifically to optimise the use of existing botanical samples and time series data, whilst also taking account of recent developments in botanical monitoring methods. This includes the emergence of Rapid Condition Assessment (RCA) as a means of allocating individual sites or features to a predetermined set of condition categories, using standardised procedures.

At the time of writing, the future strategy for AE schemes in England is under review and the exact structure of the forthcoming schemes is uncertain. Because of this, the assumption has been made here that the maintenance and enhancement of habitats that are of biodiversity value will continue to be one of the main aims of the schemes. In addition, it is assumed that management agreements similar to those currently administered under the CSS and ESAs will continue. Although the recommendations have been formulated within that scenario, the principles should still be applicable even if AE schemes are substantially modified in the future.

The project was carried out in two stages. In the first stage, a review was carried out of botanical monitoring methods in England and the other UK countries. This review covered methods currently in use in AE schemes, ways of analysing and interpreting change in the context of policy objectives, and recent developments in approaches to botanical monitoring. Also in the first stage, botanical data from the previous AE monitoring programmes were classified according to their species composition and geographical location, to assess their continued usefulness in the future programme. Statistical power analysis was then used to estimate the sample sizes required to detect specified magnitudes of change. In the second stage, recommendations for the future botanical monitoring programme were formulated.

Review of Current Methods

In England, grassland botanical monitoring programmes have been established in most Environmentally Sensitive Areas (ESAs), the Countryside Stewardship Scheme (CSS) and the Habitat Scheme (HS). Field methods used for grasslands were mostly based on fixed quadrats or plots. Heathland monitoring in ESAs and the Moorland Scheme (MS) has focussed on grazing of heather, heather abundance and burning practices, and change in species composition. Arable habitats, including field margins, have been monitored in some schemes including the Arable Stewardship Pilot Scheme (ASPS). Other more limited studies have also been done for ditches, banksides, saltmarsh and woodland.

Comparison of monitoring methods between the four UK countries showed that strategies for site selection varied widely, being dictated by the specific objectives of each monitoring programme. There was some consistency between countries in the field methods used for grasslands. On heather moorland, a range of methods has been used to measure grazing intensity, species composition and vegetation structure. Field methods used for other habitats varied according to the monitoring objectives.

Literature searches revealed relatively few examples of research specifically directed at botanical monitoring methods. However, there are clear advantages of using nested systems compared to cover or frequency estimation at single scales. Currently, there does not appear to be a single ideal method for direct measurement of grazing intensity on plants such as heather. Different methods for measuring sward height and structure will be appropriate depending on the objectives of the monitoring. A small number of novel techniques were identified in the review, some of which show promise, although further development is needed.

In England, a range of indicators and methods was used to detect and interpret change, depending on objectives of the monitoring programmes. Quantitative floristic data were reduced to community variables that indicate different attributes (e.g. suited species scores, Ellenberg values, diversity indices, functional groups), and individual species and measures of vegetation structure were used as indicators. Indices of grazing and biomass utilisation were also applied to heather moorland. Plant communities in most samples were classified by National Vegetation Classification (NVC) or the Countryside Vegetation System (CVS). In other UK countries, similar interpretation methods to these were often used.

Suited species scores and Ellenberg values can be related to scheme objectives and management, and indicate the prevailing environmental conditions. The Functional Interpretation of Botanical Surveys (FIBS) approach is potentially powerful but requires expert interpretation and data are lacking for some species. Species richness is widely used but requires careful interpretation. Community variables can potentially be compared with control data, and calibrated with the condition categories developed by the Joint Nature Conservation Committee (JNCC). Current methods for measuring heather condition require further research.

'Control' datasets can be used to compare vegetation condition and trends in AE schemes with those in the wider countryside. Sources of control data that have been used for comparisons with AE scheme botanical data include Countryside Survey (CS), survey datasets from English Nature (EN), the Countryside Council for Wales (CCW) and Scottish Natural Heritage (SNH), non-agreement land within ESAs, and results from other independent research.

Environmental data have been collected to assist in interpreting the results of vegetation monitoring. These include data on soil properties, management, climate and topography. Quantitative analyses were not always possible and these environmental data were often used as background information. Climate change and atmospheric deposition of pollutants are also potentially important drivers of vegetation change that are outwith the influence of AE schemes.

Rapid methods of condition assessment are currently being developed, mainly by the statutory conservation agencies. These are working towards common standards of

assessment, within the existing JNCC framework. Several studies in various stages of development were identified in this review, covering a wide range of habitats. A common model has been adopted, using both generic attributes and site-specific targets. In this review these methods have been evaluated and their applicability to AE schemes has been explored.

Data Classification and Power Analysis

Plot data from CSS had been classified according to the NVC and CVS using standard software, as part of the monitoring programme. The main grassland and upland datasets from ESAs were re-classified using the same method to ensure standardisation across schemes. Samples from CSS and ESAs were then allocated as far as possible to BAP Broad Habitats and Priority Habitats by cross-referencing to NVC communities.

The AE data were classified into 93 NVC communities, of which 76% were mesotrophic grasslands. Of the mesotrophic grasslands, 42% were agriculturally improved or semi-improved communities. Similarly, 86% of the whole sample was classified as Fertile Grassland or Infertile Grassland in the CVS. In the CSS dataset 66% of the plots were classified into fourteen BAP Broad Habitats, with 34% unclassifiable. ESA quadrats and plots classified into six and nine Broad Habitats respectively, with 18% and 30% respectively being unclassified. In total, seven Priority Habitats were identified within the samples, being 22%, 15% and 30% of the CSS, ESA quadrat and ESA plot samples respectively. BAP classifications of CSS plots did not match well with habitat classifications done in the field as part of the monitoring programme, due to variations in scale.

The location of samples in relation to Government Office Regions and sites with statutory nature conservation designations was also ascertained. The South West had the greatest concentration of botanical monitoring sites (27%) and East Midlands the least (3%). In total, 36% of plots and quadrats for which grid references were available coincided with designated sites.

Power analysis was carried out on CSS, ESA quadrat and ESA plot samples. A range of variables was tested, including species richness, Ellenberg values and suited species scores. Analyses were done on subsets of the data representing the various classifications from NVC, CVS, Broad Habitats and Priority Habitats. A power of 85% was used, i.e. when true differences occur between samples, there is an 85% probability of detecting them. Calculations were done using the variation within a single year's worth of data, and the variation of differences from repeated surveys.

Power analysis results were used to calculate the sample sizes recommended for the future monitoring programme. For some habitats, data were available that represented sites in favourable condition, and these were used as provisional targets for restoration of Priority Habitats. Power analysis output tables are provided to enable detectable change for given sample sizes to be declared in the future monitoring programme.

Recommendations for Future Monitoring

The main policy driver for biodiversity is currently the UK Biodiversity Action Plan (BAP). AE schemes, which now reside under the England Rural Development Plan (ERDP), are the main vehicles by which BAP national objectives and targets are expected to be met and delivered. Although DEFRA is currently conducting a review of AE 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 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, with consideration also given to monitoring within regions, individual schemes and individual sites.

Recommendations are based on the results of the first stage of the project. A workshop was also held to draw on the experience from a range of organisations. A core monitoring programme for grassland and upland Priority Habitats, and for vegetation with potential to re-establish as Priority Habitat, is recommended. A list of habitats in which targeted studies are more suitable is also given.

The general approach will require data from other completed or current projects on the *stock* (inventory) of the target habitats under AE agreement. The *condition* of habitats will be measured using RCA on a sample of AE agreement sites. Vegetation *change* will be measured against targets of condition using quantitative species composition data collected from fixed plots or quadrats. Trends in AE schemes will be compared with those in the *wider countryside* by reference to CS and other programmes. Probable *drivers* of change will be determined by analysing appropriate indicator variables and environmental data.

A variety of methods have been developed by the UK agencies for RCA of designated sites (SSSIs) and AE schemes (e.g. Tir Gofal). The Common Standards Monitoring (CSM) approach of JNCC defines favourable condition of designated site features in terms of features, conservation objectives, attributes and targets. RCA is a general approach for assessing habitat condition against predetermined targets and so clear site objectives are a critical prerequisite. Nationally agreed methods of RCA for lowland habitats should be published by JNCC in 2002. The adoption of these agreed methods for agri-environment scheme monitoring is recommended in this report although some further work is identified that is needed to validate the methods and the targets. There is no currently agreed method of RCA for upland habitats and further work is needed to define sampling methods, attributes and targets for monitoring the condition of upland habitats in agri-environment schemes. For re-establishment sites RCA methods are not well developed and further work is recommended to define additional condition categories together with appropriate attributes and associated targets. It is suggested that RCA be carried out alongside quadrat or plot monitoring of AE scheme sites to provide a database for the validation and future refinement of the RCA methodologies.

Specific recommendations are made for grassland and upland Priority Habitats. A detailed monitoring schedule for each habitat has been drawn up, with the rationale explained in sets of accompanying notes. Scheme objectives and performance indicators have been suggested for each habitat, which are linked to BAP objectives and targets. Some further development work is still required before RCA can be used in AE schemes; this is specified and could be carried out in 2003 in advance of the new monitoring programme. For each habitat, a stratified random sample of sites according to the stock of that habitat in each scheme is recommended. This will include, as far as possible, sites in the current monitoring sample. Vegetation change can be analysed by floristics (species composition) and community variables; a set of the latter is recommended for each habitat. The use of CVS classes for comparing CS data is also recommended.

Schedules have been produced that detail recommended procedures for future monitoring for seven grassland habitats. These are 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) and semi-improved grassland that has re-establishment potential. Sample sizes required to detect specified magnitudes of change in fixed plots or quadrats are given. Required sample sizes range from 50-200 for different habitats. For habitats with available data, provisional targets are specified, which are represented by sites known to be in favourable condition. Semi-improved grassland is used to represent a potential endpoint of deterioration of Priority Habitats. RCA should be carried out on a large sample of sites, which will include those in the quantitative sample. In each scheme, the field method in current use will be continued to ensure linkage with previous surveys, but minor adaptations are recommended that will enable analyses to be done across all schemes. Quantitative data from plots or quadrats should be calibrated as far as possible against attributes or condition categories from the RCA.

A single schedule has been produced for upland habitats, which are Upland Heathland (UH), Blanket Bog (BB) and potential upland heathland (i.e. degraded upland heathland with potential for restoration). Final recommendations on the application of RCA cannot be made until current development work by the statutory conservation agencies and DEFRA is completed. A sample of 100 management units (MUs) (areas of upland managed as autonomous units) is recommended. UH, BB and potential upland heathland will be monitored in each MU if available. RCA and heather performance will be measured in each habitat, and a single fixed plot established in UH and potential upland heathland. Relationships between RCA, heather performance and botanical data will need to be established to enable progression against targets to be measured.

Recommended sample sizes for quantitative monitoring are as follows:

	Priority Habitat	**No. of sites**
Grassland	CFGM	200
	LCG (existing)	50
	LCG (potential)	150
	LDAG	50
	LM	200
	PMRP	50
	UHM (potential)	100
	UHM (degraded)	100
	Semi-improved	100
Upland	UH, BB & potential UH	100
	Total	1100

A monitoring timetable is provided that indicates which habitats could be surveyed each year over a three year period. Some recommendations are also made regarding plot or quadrat relocation.

RCA could also be used by Project Officers to make judgements about individual sites. However, this would need to be done independently of the monitoring programme to avoid biasing the monitoring sample. AE botanical monitoring could be linked to other monitoring programmes including CS and EN's programme of BAP grassland monitoring.

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