This report is one of the outputs of the Ecological Factors controlling biodiversity in the British countryside (ECOFACT) research programme and was funded by the Department of the Environment, Transport and the Regions (DETR), Ministry of Agriculture, Fisheries and Food (MAFF) and the Natural Environment Research Council (NERC). DETR funding was provided from the Wildlife and Countryside Research Programme (contract reference: CR0175).

ITE is a component research organisation within the Natural Environment Research Council, and is part of the Centre for Ecology and Hydrology. CEH comprises four Institutes: Institute of Freshwater Ecology, Institute of Hydrology, Institute of Terrestrial Ecology and Institute of Virology and Environmental Microbiology.

For further information please contact:
Bob Bunce
Institute of Terrestrial Ecology
Merlewood Research Station
Grange-over-Sands
Cumbria LA11 6JU
Tel: 015395 32264 Fax: 015395 34705
e-mail: Bob.Bunce@ite.ac.uk

ISBN: 1 870393 47 3

Printed in Great Britain on material containing 100% post-consumer waste (text);
75% post-consumer waste and 25% ECF pulp (cover)
July 1999

Reports in the ECOFACT research report series:
Volume 1: Vegetation of the British countryside;
Volume 2: Measuring change in British vegetation;
Volume 2: Technical Annex – Ellenberg's indicator values for British plants;
Volume 3: Causes of change in British vegetation.

Further copies of reports in this series are available from:

VOLUME 1 (£48)
DETR Publications Sale Centre
Unit 21,
Goldthorpe Industrial Estate
Goldthorpe
Rotherham S63 9BL
Tel: 01709 891318 Fax: 01709 881673

VOLUMES 2 (£10) and Technical Annex (£5)
VOLUME 3 (in prep)
Publication Sales Section
ITE Monks Wood
Abbots Ripton, Huntingdon
Cambs PE17 2LS
Tel: 01487 773381 Fax: 01487 773590

ACKNOWLEDGEMENTS

Full acknowledgements to all people associated with the collection and initial processing of the data are given in the Countryside Survey 1990 Main Report (Barr *et al.* 1993). Dr Nigel Webb and Prof Mike Hornung provided many comments on various drafts and Dr Les Firbank also contributed to the final editing. Peter Wilson, then at the Unit of Comparative Plant Ecology at Sheffield University, carried out the analysis of changes in functional strategies. Dr Andrew Stott, of the Department of the Environment, Transport and the Regions, was involved in the project from the outset and was behind much of the structure and final composition of the document. Diane Whittaker and Dr Tim Moffat worked on many of the drafts and Karen Threlfall was responsible for the preparation of the final document for printing. Last, but most importantly, the authors would like to thank all the landowners and land managers who have given permission for surveyors to visit their property.

The cover photographs are structured to indicate the composition of this document in the series. The main picture is of an upland landscape, which is a representative of the four landscapes used in the analysis – the others being arable, pastural and marginal upland. The top photograph shows hogweed (*Heracleum sphondylium*), a species that is characteristic of the tall grassland/herb aggregate class which has increased in the countryside between 1978 and 1990. The middle photograph is of scentless mayweed (*Tripleurospermum maritimum ssp. inodorum*), an arable weed, which is in decline. The bottom photograph is of cowslip (*Primula veris*), a species that is now rare in fields and could be used as an indicator of quality.

EXECUTIVE SUMMARY

Background

The present document illustrates how statistical analysis of standardised vegetation data can contribute to the assessment of biodiversity in the British countryside. Such tools may contribute to the government's commitments to monitor components of biodiversity and develop indicators of sustainable development.

The botanical data from surveys in 1978 and 1990 provide an important data series for the detection of long-term ecological change in the wider countryside of Great Britain. Such data are particularly valuable because vegetation is not only the essential component of most terrestrial ecosystems, including those important for agriculture or forestry use and conservation of biodiversity, but also because the plant species themselves carry information about the changing environmental conditions in which they grow. In practical terms, plant assemblages are mostly immobile and change relatively slowly – they are, compared to other organisms, straightforward and feasible to survey on a national, synoptic basis.

Countryside Survey 1990 (CS1990) repeated and extended the baseline survey of vegetation established in 1978. Although the results of this survey were published by the Department of the Environment in 1993, (Barr *et al.* 1993) only a preliminary analysis of the botanical data was completed. The work presented here, has extended this analysis and developed a range of indicators of botanical diversity. This is an exploratory study and the results are intended to promote discussion about the validity and application of such indicators. The vegetation survey has been repeated and extended in 1998 and 1999 as part of Countryside Survey 2000 (CS2000). There will be much interest in assessing whether the trends in the indicators reported here for the 1980s have continued or have changed direction during the 1990s.

The work was undertaken within Modules 1 and 2 of the Ecological Factors controlling biodiversity in the British countryside (ECOFACT) research programme. The majority of the results reported here relate to the analysis of vegetation from GB funded by the Department of the Environment, Transport and the Regions (DETR), but some analyses are restricted to agricultural land in England and Wales and are funded by the Ministry of Agriculture, Fisheries and Food (MAFF) and are included for comparison. The Natural Environment Research Council (NERC) also provided financial support from core funding. Modules 1 and 2 aimed to describe, measure and evaluate changes in British vegetation. Work on the causes of change was undertaken in ECOFACT Module 6 and this work is reported separately (Firbank *et al.* in prep).

Approach

The Countryside Survey has established a framework for sampling the vegetation of the wider countryside in GB. The framework involves the repeated survey of vegetation plots in a random stratified sample of 1 km grid squares. In 1990 over 11 000 plots were sampled from 508 km squares. Five main plots were selected at random from the vegetated countryside and up to 17 other plots were randomly located along specified landscape features – field boundaries, hedges, streamsides and roadsides in each square. The random sampling approach enables estimates to be made for the country as a whole. In addition five further plots (termed 'habitat plots') were targeted on patches of vegetation not covered by the random samples. Because these are not random they can only be used for descriptive purposes.

The 1990 survey included over 2500 plots which had been previously surveyed using the same methods in 1978. These *paired* plots are

used in the analysis of change between 1978 and 1990.

Multivariate statistical techniques were used to allocate the vegetation plots into classes with similar botanical composition (vegetation classes) and to identify groups of species with similar ecological affinities (species groups). This exercise has resulted in a new classification of vegetation found in the wider countryside of GB, known as the Countryside Vegetation System (CVS). The CVS contains 100 vegetation classes which describe the floristic character and variation of vegetation. A full description of each vegetation class is given in Volume 1 of this series (Bunce *et al.* 1999).

For statistical tests, and the derivation of summary indicators, the 100 vegetation classes have been statistically grouped into eight major **aggregate classes**.

- ACI – crops/weeds.
- ACII – tall grassland/herb.
- ACIII – fertile grassland.
- ACIV – infertile grassland.
- ACV – lowland wooded.
- ACVI – upland wooded.
- ACVII – moorland grass/mosaic.
- ACVIII – heath/bog.

Zonal patterns in GB were explored using the four major **landscape types** previously defined in CS1990:

- arable;
- pastural;
- marginal upland;
- upland.

Thus, each vegetation plot used in the analysis was stratified by the aggregate classes (such as fertile grassland), the major zonal type (ie landscape type – such as arable) and the particular landscape feature sampled (ie plot type – such as roadsides).

A range of well-established and novel techniques were applied to the vegetation data in order to assess and evaluate the botanical characteristics and dynamics in the British countryside. The work led to the development of indicators of botanical diversity which are used in ECOFACT Module 6 to investigate the ecological factors causing change.

Results: Ecological associations

Ellenberg indicator values

Within the project a method was developed for scoring species according to their environmental status. This method enabled the major underlying ecological dimensions of the CVS to be defined. Thus, the 100 vegetation classes are shown to be distributed along a principal gradient ranging from crops growing on highly fertile soils to heath/bog vegetation in infertile conditions. A secondary gradient ranges from vegetation of crops and grassland growing on open or disturbed soils, to woodland vegetation of shady and undisturbed conditions. The third gradient is related to the degree of moisture in the soil. These relationships provide a framework for understanding changes in habitat quality. A botanical difference between one vegetation plot and another can be explained by reference to the relative prevalence of these three ecological factors of fertility, shading and wetness. The method of assigning indicator values to species for central Europe was adapted for British conditions and are termed Ellenberg values, after their originator. Full details are given in Volume 2 (Technical Annex) of this series (Hill *et al.* in press(b)).

Plant strategy theory

An alternative approach, 'plant strategy theory' has been used to analyse the vegetation classes in terms of the *lifestyles* of the plants. It is possible to classify plants into functional types reflecting productivity and disturbance. The crops/weeds group was dominated by plants with ruderal (R) strategies (ie plants adapted to colonisation of bare ground). The tall grassland/herb group had a high proportion of competitors (C) (ie vigorous growing, tall plants) and competitive ruderals (CR). Fertile/infertile grassland groups were dominated by *generalist* (CSR & CR) plants but the infertile grassland was distinguished by fewer ruderals and more

stress-tolerators (S). The lowland/upland wooded groups comprised plants with varying strategies but with a relatively high proportion of competitive stress-tolerators (SC) (eg woody plants). Moorland grass/mosaic and heath/bog were dominated by stress-tolerant species.

Both the Ellenberg indicator values and plant strategy theory have been used in ECOFACT Module 6 to help interpret the processes of change in vegetation communities, and is reported separately (Firbank *et al.* in prep).

Results: Links

Links between the CVS and other approaches to the classification of vegetation and habitats in GB have been established and demonstrated. These include:

- CORINE Biotopes;
- National Vegetation Classification (NVC);
- Phase I Habitat Survey;
- Biodiversity Action Plan Broad Habitats;
- Northern Ireland Countryside Survey classifications.

Software has been developed for the allocation of vegetation plot data to the CVS and NVC and for analysis of Ellenberg indicator values, plant functional strategies and biogeographical affinities.

Results: Diversity of vegetation at the landscape scale

The distinctive vegetation assemblages and habitat diversity of the four major landscape types of GB were examined. The arable landscape was dominated by crops/weeds with tall grassland/herbs and fertile grassland. The pastural landscape was similar, but was dominated by fertile grassland and had a higher proportion of moorland grass/mosaics. The marginal uplands also had fertile grassland as the most abundant class but had a good representation of all the other aggregate classes, indicating the high diversity of vegetation in the marginal upland landscape. The upland landscape type was dominated by moorland grass/mosaic and heath/bog.

The number of vegetation classes in each landscape type provides a statistical measure of habitat diversity at the broad landscape level. Habitat diversity was found to be similar in arable, pastural and marginal upland landscapes and lower in the uplands. The linear plots (hedges, roadsides boundaries and streamsides) made a major contribution to habitat diversity in all landscapes. The small fragments of vegetation recorded in the habitat plots contained additional diversity and included plant assemblages often unrepresented in the random plots.

Results: Changes in British vegetation 1978–90

Habitat conversion

Net shifts of plots between the eight aggregate classes during 1978 to 1990 indicated two general trends

- a shift from lower to higher fertility
- a shift from lower shade to higher shade.

The results showed that between 1978 and 1990, most major changes in habitat quality were associated with increased fertility and/or more shading. The highest net increase was in the tall grassland/herb habitats which gained 27% plots, mostly by conversion from crops/weeds, fertile and infertile grassland. The reasons for these changes were investigated in ECOFACT Module 6.

Changes in species diversity

As well as the shifts in overall balance between aggregate classes there were also changes in the species diversity of the plots. A simple way of looking at this is to calculate the mean number of species present per plot. In 1990, the mean species number for plots in GB as a whole varied from seven species per plot in crops/weeds to 21 species per plot in moorland grass/mosaic. Species number per plot was generally higher in the linear plots (1 × 10 m) than in the main plots (200 m^2), despite their smaller area.

There were significant changes in mean species number between 1978 and 1990. Considering all plot types together and for GB as a whole,

there were significant decreases in species diversity in infertile grassland (–12%) and upland wooded (–21%) aggegate classes. This is the equivalent of, on average, three fewer species per plot in infertile grassland and four fewer species per plot in upland wooded. There was a small but significant (6%) increase in species number in heath/bog, equivalent to on average one extra species per plot. In the arable landscape there was also a significant 19% reduction in species richness in crops/weed assemblages, on average a loss of one species per plot. Similar results were obtained when the analysis was restricted to agricultural land in England and Wales.

Changes in mean species number were also calculated for each plot type and each landscape type.

- **Main plots** had a significant decline in species diversity (1978–90) in infertile grassland (–13%) and upland wooded (–20%) aggregate classes. A similar pattern was shown on agricultural land in England and Wales, with infertile grassland standing out as having the largest losses.

- **Roadside plots** were dominated by tall grass/herb, fertile grassland and infertile grassland aggregate classes and were mainly restricted to lowland landscapes. For GB overall there was a significant increase in diversity (17%) in tall grass/herb verges between 1978 and 1990. This increase was most marked in pastural landscapes. In the pastural landscape, fertile grassland on roadsides increased in diversity (14%), whereas infertile grasslands on roadsides became slightly less diverse (–6%). On the restricted data set from agricultural land in England and Wales the trends were similar.

- **Hedge plots** were dominated by tall grassland/herb, infertile grassland and lowland wooded aggregate classes. They were mainly restricted to lowland landscape types. For GB as a whole, there was a significant loss of diversity (–14%) in tall grassland/herb hedge plots. The loss occurred in both arable and pastural landscapes and was similar on agricultural land in England and Wales.

- **Streamside plots** were characterised by tall grassland/herb and infertile grassland in the lowlands and by moorland grass/mosaic and heath/bog in the uplands. For GB as a whole, significant loss of diversity occurred between 1978 and 1990 in infertile grassland (–17%), upland wooded (–21%) and moorland grass/mosaic (–13%). The declines were most marked in arable and upland landscapes. The trend was comparable on agricultural land in England and Wales, but since fewer plots were available, fewer significant results were detected.

These figures portray a substantial decline in the diversity of plant species across much of lowland Britain between 1978 and 1990. The widespread vegetation of fields, woods, hedges and streamsides contained fewer species by 1990. However, heath/bog vegetation types in the 'true' uplands experienced a small increase in diversity. Mean species number by major habitat group can be considered a crude indicator of habitat quality, but high species diversity is not a good measure of high quality in all habitats especially in infertile conditions such as heath/bog vegetation.

Changes in plant species composition can provide sophisticated measures of habitat condition and can indicate the ecological processes operating. New techniques were developed to explore whether the changes in vegetation observed were important in relation to the value of habitats for nature conservation in order to assess changes in quality. Although all the techniques are quantitative in application, some rely on expert knowledge about whether certain species, in some situations, can be considered as indicative of high habitat quality.

Changes in frequency of vegetation classes and species groups

In many cases, the types of plants found in plots changed as well as the overall number of species. Changes in species composition were analysed in terms of aggregate classes and species groups. For example, in infertile grassland, the loss of diversity occurred through the decline of plants associated with less fertile soils. The overall loss in diversity in upland wooded vegetation was associated with a decline of woodland streamside plants. The slight increase in diversity in heath/bog vegetation was associated with an increase in moorland grass species, rather than heath plants.

Changes in cover of individual species

For GB as a whole, in all major vegetation classes, more species increased their cover than decreased cover.

- **Fertile grassland**
  The cover of common grassland weeds increased (eg creeping thistle (*Cirsium arvense*)) whilst meadow grasses decreased (eg cock's foot (*Dactylis glomerata*)).

- **Infertile grassland**
  Different trends occurred in different plot types – for example the cover of hawthorn (*Crataegus monogyna*) increased in hedge plots whereas nettles (*Urtica diocia*) increased in streamside plots and rye-grass (*Lolium perenne*) increased in main plots.

- **Lowland wooded**
  In hedges, there was an increase in frequency of weeds such as cleavers (*Galium aparine*) and sterile brome (*Bromus sterilis*).

- **Moorland grass/mosaic**
  Agricultural grasses (eg rye-grass) and sweet vernal grass (*Anthoxanthum odoratum*)), white clover (*Trifolium repens*) and bracken (*Pteridium aquilinum*) increased in cover, at the expense of moorland grasses (eg wavy hair-grass (*Deschampsia flexuosa*)).

- **Heath/bog**
  Vegetation, meadow grasses and mosses increased in cover throughout GB but, more specifically, in the marginal upland landscape, there was a significant decrease in the cover of dwarf shrubs such as heather (*Calluna vulgaris*) and an increase in mat-grass (*Nardus stricta*).

Thus, the vegetation of the wider countryside became increasingly dominated by fewer, widely occurring species.

Habitat indicator species

Changes in species considered to be indicative of unimproved calcareous, neutral and acid grassland habitats were used as a measure of grassland habitat quality. The number of plots in which such species were recorded in 1978 and 1990 was compared. The results showed that in GB the number of plots with at least one indicator species for unimproved neutral grasslands and acid grasslands decreased by 8% and 4%, respectively. For neutral grasslands reductions were marked when only those species most strictly confined to unimproved grasslands were analysed. Results showed a 22% and 15% reduction in frequency in arable and pastural landscapes, respectively. Calcareous grassland indicator species occurred at a lower frequency in the sample – a significant increase in frequency was found in plots close to the coastline only. These analyses should be interpreted with caution because the presence of one or more indicator species does not necessarily imply good habitat condition. However the significant decline in the frequency of unimproved grassland indicator species provides a general indication of a reduction in the extent and/or quality of these habitats.

Rarity indicator species

Data from the survey confirmed the low frequency of rare species in the wider countryside and found no significant changes in the number of plots with rare and scarce species between 1978 and 1990.

NVC diagnostic species

The diagnostic species used in the NVC provide a further benchmark for habitat assessment.

This approach was applied to the Countryside Survey vegetation data set using the NVC category MG5 *Centaurea nigra – Cynosurus cristatus* unimproved grassland. In the entire data set of some 12 500 plots only 73 (0.6%) contained all four species most diagnostic of MG5, thus confirming the rarity of this type of grassland in the wider countryside. Furthermore, these plots were usually in small patches of vegetation and not in fields. Seventeen of these MG5 plots were surveyed in both in 1978 and 1990 and they showed a significant increase in frequency of diagnostic species suggesting an improvement in habitat quality. However, the significance of such results from a small number of plots needs to be treated with caution.

Abundance of preferential species

Lists of indicator, rare and diagnostic species, intended to help assess special sites of conservation interest, were infrequent in the Countryside Survey data set. Most of the vegetation of GB is dominated by widely occurring and relatively common plants. An alternative approach for the identification of indicators was developed using the Countryside Survey data. Firstly, lists of species found to be statistically associated with each aggregate class were derived and then these 'preferential' species were ranked according to their relative abundance. The top third of species within each class were labelled 'abundant', the bottom third 'rare' and those between 'intermediate'. Any losses of preferential species may be regarded as an erosion of distinctiveness and losses of 'rare' and 'intermediate' species would suggest a deterioration in habitat quality.

Between 1978 and 1990 there were significant changes in species composition in each aggregate class with respect to the abundance of preferential species. The changes in vegetation diversity between 1978 and 1990 were generally associated with decreases in abundant and intermediate species, with little significant change in rare species (again, this result reflects the small size of sample of plots with rare species). The results show that the loss of diversity in infertile grassland and upland wooded aggregate classes was associated with a decline in the distinctive plant species of those habitats. The small increase in diversity in heath/bog aggregate class did not involve a significant increase in preferential species – its distinctive botanical character was thus not reinforced.

Habitat quality was not only considered in terms of the diversity and rarity of the plant species present, but also included an assessment of the ability of the vegetation to provide a habitat for animals of conservation interest. This was explored by examining changes in food plants for butterflies and lowland farmland birds.

Food plants for butterfly larvae

Changes between 1978 and 1990 in the frequency of plants which are known to provide food for butterfly lava (caterpillars) were examined. Whilst three butterfly host plants increased in frequency, 19 host plants decreased. The greatest losses of butterfly host plants were in infertile grassland and fertile grassland. Although 23 species of butterfly are associated with these declining host plants, the consequences of these changes for the butterflies are likely to be complex because other factors are also likely to contribute to butterfly population dynamics and distribution.

Food plants for lowland farmland birds

Changes between 1978 and 1990 in the frequency and cover of plants which are known to provide food for 20 lowland farmland bird species were examined. The Countryside Survey data contained 133 such food plant species. Both losses and gains in the frequency and cover of these plants were observed in different aggregate classes and landscape types. However, of the significant changes detected, 17 involved a decline in either frequency or cover of food plants and 13 involved an increase. As might be expected, there is not a simple relationship between changes in food plants and changes in bird populations over the same period. Some declines in bird populations such as tree

sparrow, grey partridge, linnet and dunnock have occurred at the same time as significant decreases in the availability of their food plants. Others, such as bullfinch and song thrush, have declined despite a general increase in availability of their food plants. Some species, such as house sparrow and chaffinch, have actually increased whilst their food plants have generally decreased. However, food plants are only one factor affecting bird populations and much will depend on the availability of food in particular locations, at particular times and the availability of alternative food sources.

Changes in plant strategies

The changes in plant functional strategies observed in plots with similar vegetation and management in 1978 and 1990 provided evidence of:

- less disturbance of tall grassland/herb in roadsides and hedges, in arable landscapes;
- increased eutrophication of infertile grassland in pastural and marginal upland landscapes.

There was also evidence of eutrophication in lowland wooded vegetation in arable landscapes, and upland wooded vegetation in the uplands.

The changes in strategies observed in plots which moved between aggregate classes (1978–90) showed an increase in plants tolerant of less disturbance in tall grassland/herb vegetation in hedges and streamsides (ie increasing woody species). It also showed less disturbance in fertile grassland on roadside and streamside plots (ie increasing tall grassland/herb species). These changes reflect the net shifts between aggregate classes described under *Habitat conversion* (see page 3).

Changes in Ellenberg indicator values

The changes indicated by the conversion of the botanical data into environmental indices (by use of Ellenberg indicator values) showed that there was a general tendency towards an increase in fertility and decrease in acidity in most plot types, except streamsides in tall grassland/herb vegetation. There was no overall pattern of change in moisture and light with some aggregate classes and plot types showing increases and others losses. The significant changes in continentality values were all increases. These could be interpreted in terms of climate change, but it is more likely to be associated with increasing homogeneity involving the loss of oceanic species, rather than gains in more continental taxa.

Ecological factors

The changes observed could be caused by a number of contributory factors, including:

- land use change such as crops/grassland rotation and upland afforestation;
- intensification of crop production;
- spray drift and runoff of pesticides and fertilisers;
- agricultural improvement of grassland;
- reversion of improved grassland;
- reduced management of hedges, ditches and stream banks;
- overgrazing of upland heath;
- tree growth and greater shading in woodland;
- atmospheric deposition of nitrogen and sulphur.

The contribution of the different ecological factors to changes in botanical diversity are the subject of ECOFACT Module 6, which is reported separately (Firbank *et al.* in prep).

The analysis of botanical change between 1978 and 1990 was limited to approximately 2000 plots which had been surveyed in both 1978 and 1990. Most of the larger sample of over 11 000 plots surveyed in 1990 have been re-surveyed in 1998 as part of CS2000. This larger data set will provide a more comprehensive and statistically robust basis for analysis of vegetation change since 1990, than the present analyses.

The botanical indicators identified in this report will form the basis for analysis of changes in vegetation in CS2000. Comments are sought on the validity and application of these indicators for the assessment of botanical diversity and habitat quality. CS2000 will also report using the Broad Habitats framework, which has been developed by the Joint Nature Conservation Committee for the UK Biodiversity Group since this work was commissioned.

INTRODUCTION

The vegetation and land cover of the British countryside was surveyed in 1990, repeating and extending the baseline established by a similar survey of the countryside and its vegetation in 1978. The results of CS1990 were published by the Department of the Environment in 1993 (Barr *et al.* 1993). The work described in this report builds upon these analyses by describing in more detail the botanical characteristics of the British countryside and botanical change between 1978 and 1990.

This work was mainly undertaken within Modules 1 and 2 of the ECOFACT research programme and was funded by DETR. Other components of the ECOFACT programme were funded by MAFF (some of the results of which are incorporated in this document), Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) and NERC.

The objectives of this work were:

- to produce overall indicators of change in botanical characteristics in the British countryside;
- to enable comparison with other systems for the classification and description of British habitats and vegetation, including those used in the European Union, GB and Northern Ireland (NI);
- to describe the botanical characteristics of the countryside and to provide a national context for the more rare and localised elements of biodiversity;
- to develop hypotheses to explain the causes of changes in botanical character;
- to provide readily accessible and understandable results, using the Countryside Information System (CIS), where appropriate.

Work on the explanation of the causes of change are the subject of ECOFACT Module 6 and are reported separately (Firbank *et al.* in prep).

APPROACH
THE RECORDING AND ANALYSIS OF COUNTRYSIDE VEGETATION

Field recording programme

The vegetation of the British countryside was surveyed using a 1 km square as a basic sampling unit. The location of each 1 km square was determined by reference to the ITE Land Classification of GB (Bunce *et al.* 1996). This classification uses environmental parameters, such as altitude and climate, to divide the British landscape into a number of land classes. The 1 km squares to be recorded were distributed in a predetermined way among the different land classes to form a stratified sampling programme. In 1978, 256 1 km squares were recorded throughout GB – the number of squares was increased in 1984 to 384 and to 508 in 1990 (Barr *et al.* 1993). All of the 256 squares recorded in 1978 were re-recorded in 1990. Neither marine nor highly urbanised environments were included in the field survey.

Within each of the 508 1 km squares vegetation (recorded in 1990) was sampled in up to 27 plots. These plots were of three types which differed in size and in the way in which they were distributed within each 1 km square (Table 1). These were:

- Five **main vegetation plots**, which were 200 m^2 and located at random within five equal-sized sectors of the 1 km square. If they fell on a linear feature they were relocated at random.

- Five **habitat vegetation plots**, which were 4 m^2 and placed only within semi-natural habitats not covered by the larger random plots, according to a random allocation procedure.

- Up to 17 10 m^2 (10 × 1 m) linear vegetation plots were placed alongside field boundaries **(boundary plots)**, hedges **(hedge plots)**, watercourses **(streamside plots)**, and roads/tracks **(roadside plots).** Five **boundary plots** were placed at the nearest field boundary to each of the main plots (if within 100 m). Two **hedge plots** were also placed separately at random within each 1 km square. Each of the **streamside plots** were placed at the edge of running water – two of the streamside plots were located at random within the square and three more were placed to sample different sizes of watercourses. **Roadside plots** were placed immediately adjacent to the road edge; two of the roadside plots were located at random and three were placed to sample different road types.

In 1990 a total of 11 246 plots were surveyed and included in the analysis described below – some plots being excluded as they were bare ground or outliers. The share of the these plots between the different plot types is shown in Table 1. Plots totalling 2534 had been recorded in the same location in 1978. but various validation procedures (eg plots on ploughed land in 1978 or 1990 and plots beside hedges that had been removed) reduced the number for paired tests as shown in Annex 1. The random sampling strategy enables estimates to be made of the area and length of the vegetation classes determined by analysis in the main plots and for linear plots respectively. The habitat plots were not located at random, but were targeted at semi-natural habitats and, whilst they can be used to give a measure of the relative diversity and abundance of the habitats concerned, they cannot be used statistically to estimate their area.

In each plot the presence and percentage cover of vascular plants and selected mosses and liverworts (*Bryophytes*) were recorded. The percentage cover was recorded to the nearest five percent. Highly variable and taxonomically-disputed species, such as bramble (*Rubus fruticosus*), were considered as single species,

Table 1. Types and numbers of the vegetation plots surveyed in the 508 1 km squares in CS1990 and included in the anaylsis

Plot	Code letter	Dimensions	Sampling strategy	Max no. per square	Total recorded in 1990
Main plots	X	200 m^2	random	5	2317
Habitat plots	Y	4 m^2	targetted	5	2464
Hedge plots	H	10 m × 1 m	random	2	565
Boundary plots	B	10 m × 1 m	random	5	1797
Roadside plots	R	10 m × 1 m	random	2	783
Additional roadside plots	V	10 m × 1 m	random	3	1164
Streamside plots	S	10 m × 1 m	random	2	879
Additional streamside plots	W	10 m × 1 m	random	3	1277
Total				**27**	**11 246**

except for the analysis of changes in species number, from which they were excluded.

In addition, the mapped land cover and landscape features of the entire 1 km square was described using a predetermined list of codes (Barr *et al.* 1993).

Analysis

The classification of British vegetation

The analysis of vegetation change at the national scale would have been very difficult using existing tools, as no vegetation classification is able to cope equally well with the highly disturbed vegetation found in much of the wider countryside. Furthermore, classifications split according to habitats and landscape elements run into the problem that similar assemblages of species, such as dandelion (*Taraxacum* spp), daisy (*Bellis perennis*) and rye-grass, can grow in a range of situations, such as roadsides, along streamsides, or in fields, and would therefore be double accounted in the analysis of diversity at the landscape scale.

A new classification of British vegetation specifically related to the CS1990 data set was, therefore, constructed in order to provide the basis for the analysis of vegetation change, updating the procedures used previously (Barr *et al.* 1993). This classification of vegetation in the wider countryside is known as the Countryside Vegetation System (CVS).

In summary the procedure involved two steps.

- The vegetation data for each individual sample plot in both 1978 and 1990 that had been validated (see page 11) were separated into 100 vegetation classes (1–100) using a standard statistical method (TWINSPAN, Hill 1979a).

- These classes were arranged statistically using an ordination technique (DECORANA, Hill 1979b) to reveal patterns of similarity among them.

The process of ordination distributed the classes along a primary axis which accounts for the greatest degree of variation among them. The classes were then distributed along a second axis which accounted for the greatest degree of remaining variation, and so on. Those vegetation classes which are close together on the axes are more similar than those which are not. Eight aggregate vegetation classes were then generated by clustering the individual classes according to their relative positions on the first four DECORANA axes. These classes correspond to Broad Habitat groups.

The 100 CVS classes and the eight aggregate classes generated by the TWINSPAN analysis were given names designed to give the reader an understanding of the type of

vegetation and a clear impression of the composition of each class (Annex 2a). The naming could not be entirely consistent because precise ecological terms are not available with adequate definitions; general habitat types were used, qualified by soil types and key species.

Species groups

The species recorded from the plots were also classified into groups (species groups) according to their ecological requirements (Bunce 1977 and Prieto & Sanchez 1992). The vegetation classes vary in their species complexity. The management practised during crop production creates a narrow, uniform range of ecological conditions suitable for only a few species of a restricted ecological range. As a consequence the vegetation classes associated with crops contain few species. In contrast, the woodland classes often contain mixtures of species tolerant of a variety of ecological conditions such as grassland or dense woodland, and plots on the edge of woodlands may contain species from grassland, scrub and tall woodland conditions. Standard phytosociological procedures use this approach and previous work by Bunce (1977) and Barr *et al.* (1993) have shown that species can be grouped in terms of their ecological requirements in order to help interpret the variation within the vegetation classes. For these analyses, the entire 1990 species data set was subjected to ordination and the species were clustered into groups on the basis of their proximity to each other. Each group therefore links species which grow together under similar conditions. The various combinations of the species groups help to provide an ecological explanation of the composition of the aggregate vegetation classes. Furthermore, the analysis of the relative frequencies of species groups provides another tool to help explain differences in the species composition among vegetation classes, and shifts in the vegetation at a location over a period of time.

The species groups were ordered according to the principal gradient of the vegetation classification in the same way as the vegetation classes, and are ranked in this way in the tables describing the classifications.

Detection of vegetation change

By comparing data for the plots sampled in 1978 and 1990, it was possible to determine how the vegetation of individual plots has shifted between classes and to produce, for the first time, a matrix of vegetation change for all plot types together. However, some vegetation classes had too few samples to estimate change reliably. Most of the analyses of change were therefore undertaken at the aggregate class level, for the different plot types and for the four landscape types (Annex 1). Some combinations of plot type, aggregate class and landscape type are absent whilst others are present in low numbers because of their ecological characteristics. In most analyses only those results are presented that have more than 10% of the total number of plots in the aggregate class or over 20 plots, in order to exclude results based on a small sample size. Many of these results provide good measures of botanical change and have, therefore, been selected as Indicators of Botanical Diversity (IBD) for future assessments of change and are listed in Annex 3. For example, some of these indicators have been used by Firbank *et al.* (in prep) to explore the causes of botanical change in British vegetation.

Conclusion

In order to fully assess vegetation character and change in GB, it has been necessary to construct a new, single vegetation classification for all plots surveyed using standard analytical techniques. The results of which was CVS, an integrated system of classifications and supporting analyses. The CVS has 100 vegetation classes representing the botanical variation in the wider countryside. For some analyses and presentation purposes, the 100 classes have been grouped into eight aggregate classes.

RESULTS I
THE COUNTRYSIDE VEGETATION SYSTEM

Description of the classification

A listing of the 100 CVS vegetation classes is provided in Annex 2a. The larger vegetation classes were relatively uniform and clearly defined. For example, vegetation class 10 (tall grassland/herb boundaries) consisted of over 800 plots. However, most of the classes contained only 30–50 plots. The full set of vegetation class summaries has been published separately (Bunce *et al.* 1999) and provides descriptions of each class, depicting:

- its extent in GB;
- its association with the four landscape types in the ITE Land Classification of GB;
- details of the plant species composition
- comparisons with NVC and CORINE biotopes classification;
- characterisation in terms of the CSR functional strategy theory of Grime *et al.* (1988).

The geographical distribution and regional estimates of extent are available as data sets for the CIS.

The 100 vegetation classes are shown plotted on the first two axes of the DECORANA ordination in Figure1. The numbering of classes follows the principal axes of the diagram, increasing from left to right. The grouping of the vegetation classes into the eight aggregate classes is also illustrated. The aggregate classes occupy distinct areas of the diagram because of their relationship with the two axes.

The DECORANA ordination was designed to show the relationships between the vegetation classes purely in terms of their botanical composition, and without additional environmental data. However, the results of the ordination can be interpreted in terms of environmental gradients. On Axis 1 of Figure 1 the vegetation plots show a gradation from arable fields on the left-hand side, through rotational grasslands, fertile grasslands, grass marshes/moorland to heath and bog on the right hand side. The vegetation of arable fields is known to consist of species associated with highly disturbed and nutrient-rich soils, whereas at the opposite extreme (heath and bog) the vegetation is made up of species associated with nutrient-poor peats and podzols. Axis 1 can therefore be interpreted as a gradient of soil nutrient status. Axis 2 is related to another environmental gradient. At the bottom, the vegetation classes contain short-lived herbaceous species tolerant of disturbance. At the other extreme at the top, is woodland vegetation consisting of large long-lived plants associated with much less frequent disturbance. The structure of the vegetation along Axis 2 also affects the light reaching the ground – thus, we may interpret it as representing a gradient of disturbance and shade. Although not shown in Figure 1, there is also a third Axis which separates vegetation classes according to soil moisture characteristics.

The three gradients of nutrient level, shade/disturbance and soil moisture, therefore, dominate the main vegetation analysis, and it is interesting to note their pre-eminence within this random sample of British vegetation.

It is also of interest that changes in land management can also be easily visualised in terms of movement within the ordination diagram (Figure 1). For example, heath and bog vegetation is usually maintained by management (disturbance), and where this management is relaxed, succession typically occurs, with the vegetation moving diagonally higher and to the left towards woodland although some extreme upland classes will never become woodland because of exposure and inappropriate soil type.

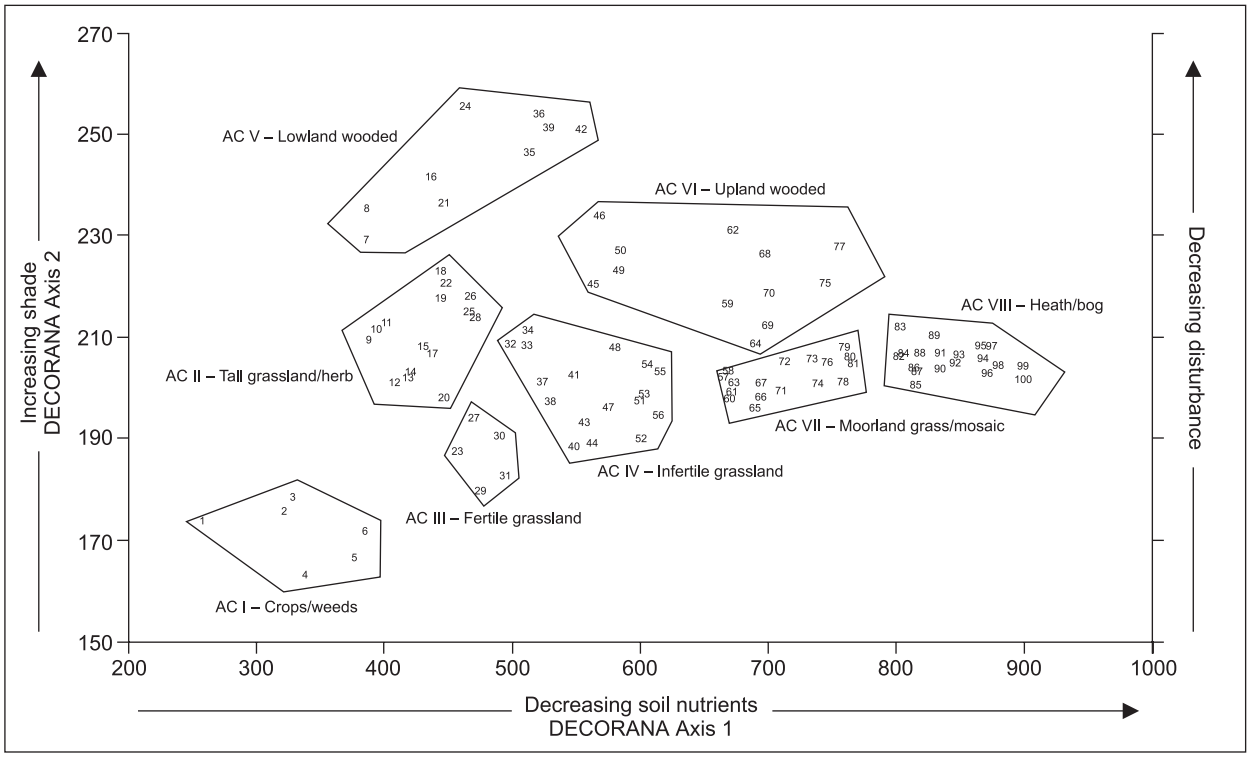


Figure 1. Distribution of the 100 vegetation classes, grouped by aggregate classes, on the first two axes of the CVS ordination. Axis 1 is correlated with a gradient from fertile to infertile soils, and axis 2 with a light gradient and indirectly with disturbance (see Figure 4). The numbers within each polygon refer to each CVS vegetation class

Area estimates for each CVS class were calculated, based on the vegetated area represented by the five main plots in each 1 km square and are given in Annex 2b. The area estimates are summarised for the aggregate classes in Table 2. For linear plots, estimates of abundance were weighted by the length of feature in the 1 km squares rather than area, and these are also given in Annex 2.

Three of the aggregate classes predominate in terms of area: crops/weeds, fertile grassland, and heath/bog. However, some common vegetation classes occupy a negligible area, because they occur mainly by linear features. The area estimated for the aggregate classes is in general agreement with that derived from the land cover measurements given by Barr *et al.* (1993). For example, all woodland was estimated as 24 800 km^2 from the CVS, compared with 26 700 km^2 from land cover estimates, and upland vegetation was estimated to be 58 700 km^2 compared with 51 400 km^2 from land cover. However, as discussed in the *Results II* chapter (pp 29–34), there are greater differences at the scale of individual vegetation classes because land cover definitions apply at a larger scale than the vegetation plots. An exception is calcareous grassland (800 km^2 from CVS as opposed to 600 km^2 from land cover) which shows reasonable correspondence in its overall contribution to British vegetation.

Table 2. The estimated area of eight aggregate vegetation classes in 1990 obtained from cluster analysis of the CVS 100 vegetation classes, derived from the relative coverage of vegetated land. The names are arbitrary especially in class IV which inevitably contains much variation

	Aggregate vegetation class	Area ('000 km^2)	Standard Error ('000 km^2)
I	Crops/weeds	36.0	1.8
II	Tall grassland/herb	4.8	0.5
III	Fertile grassland	34.4	1.6
IV	Infertile grassland	29.1	1.5
V	Lowland wooded	7.2	0.8
VI	Upland wooded	14.4	1.3
VII	Moorland grass/mosaic	19.5	1.3
VIII	Heath/bog	39.2	1.8

The eight aggregate classes form floristically well defined groups which correspond with major habitat types in GB. These classes are summarised below.

Crops/weeds (AC I) encompasses largely lowland vegetation of frequently disturbed ground within arable fields and their boundaries but with a small proportion on roadsides. The most characteristic species of the class include annual weeds such as field pansy (*Viola arvensis*), black bindweed (*Fallopia convolvulus*) and shepherd's purse (*Capsella bursa-pastoris).*

Tall grassland/herb (AC II) is also most common in lowland Britain. It is predominantly made up of vegetation on linear features, for example on roadsides and streamsides, and is characterised by false oat-grass (*Arrhenatherum elatius*), common nettle, cleavers and cow parsley (*Anthriscus sylvestris).*

Fertile grassland (AC III) is characterised by the preferential occurrence of species such as perennial rye-grass, annual meadow grass (*Poa annua*) and curled dock (*Rumex crispus*). The bulk of intensively managed improved and semi-improved grasslands throughout GB are grouped within this aggregate class.

Infertile grassland (AC IV) includes a diverse mix of vegetation classes representing some of the most uncommon and recently declining vegetation types, such as unimproved neutral and calcareous grassland in both dry and wet conditions. Characteristic species include crested dog's-tail (*Cynosurus cristatus*), common mouse-ear (*Cerastium fontanum*), ribwort plantain (*Plantago lanceolata*) and bird's foot trefoil (*Lotus corniculatus*).

Lowland wooded (AC V) encompasses vegetation of both hedgerow and woodland mainly concentrated in lowland Britain, mostly base-rich or neutral. Characteristic species include ash (*Fraxinus excelsior*), hawthorn, bramble and dog's mercury (*Mercurialis perennis*).

Upland wooded (AC VI) covers conifer plantations as well as upland woodlands, and also includes some lowland woodlands on acid soils. Chracateristic species include sessile oak (*Quercus petraea*), birch (*Betula pendula*), rowan (*Sorbus aucuparia*) and wavy hair-grass (*Deschampsia flexuosa*).

Moorland grass/mosaic (AC VII) includes the vegetation of extensive tracts of usually grazed grasslands in the uplands. This aggregate class encompasses both relatively species-poor grassland on acidic bedrocks, and more species-rich and localised upland flushes. The aggregate class is most strongly characterised by species such as mat-grass, tormentil (*Potentilla erecta*), heath bedstraw (*Galium saxatile*) and star sedge (*Carex echinata*).

Heath/bog (AC VIII) is dominated by various dwarf shrub heaths, largely in the uplands but includes some less common lowland samples. This aggregate class is best defined by the wet heathland species cross-leaved heath (*Erica tetralix*) and graminoid dominants such as deer-grass (*Trichophorum cespitosum*), cotton-grass (*Eriophorum vaginatum*) and bog asphodel (*Narthecium ossifragum*).

While the CVS divides the British vegetation into classes and aggregate classes, it should be remembered that this is the result of a statistical division of the continuously variable character of the British vegetation. This is illustrated by Figure 2 which shows the changing abundance of five ecologically important species through the series of 100 CVS vegetation classes.

The aggregate classes of the CVS can be compared to the 'main plot classes' used in the CS1990 Main Report (Barr *et al.* 1993). In broad terms, AC I is comparable with the crops main plot class. AC II is not represented in the CS1990 main plot classes because this classification did not include the linear plots. AC III is comparable to the

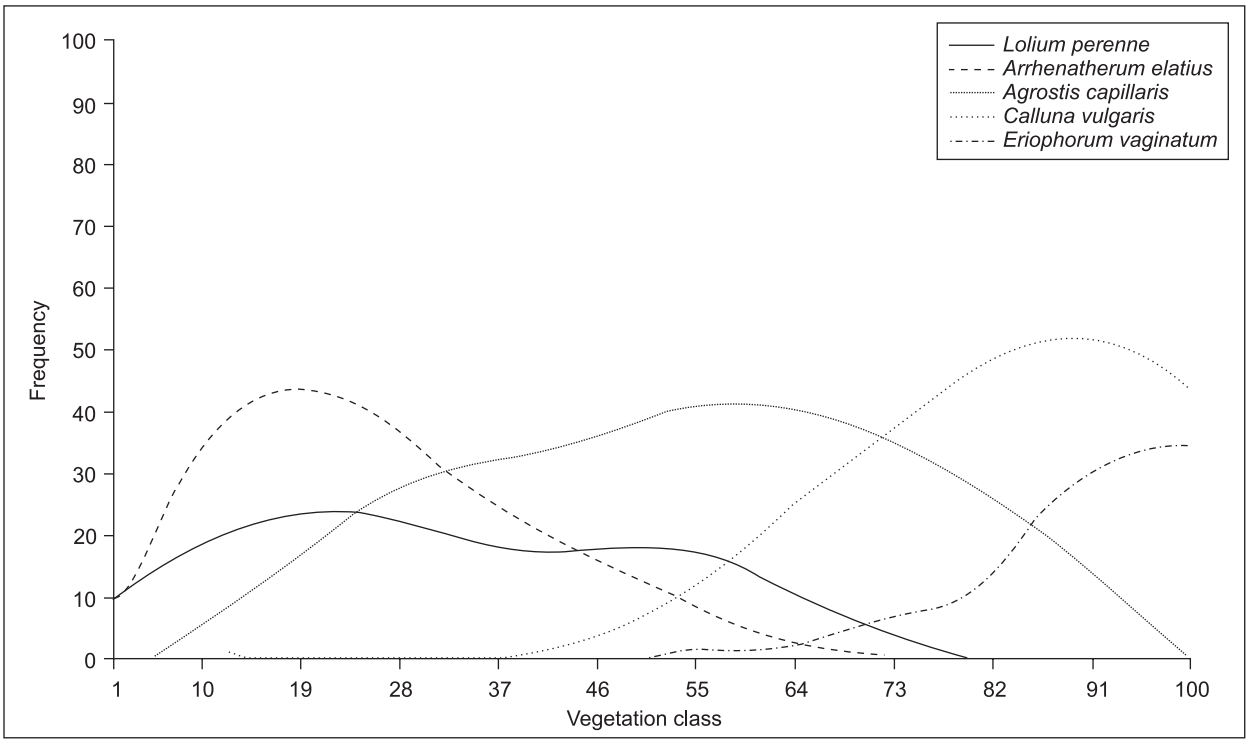


Figure 2. Smoothed distribution of the frequency of five common species in the 100 vegetation classes of the CVS

improved grassland and AC IV to the semi-improved grassland. AC VII to the upland grass mosaics and AC VIII to the heaths and bogs. The single woodland CS1990 main plot class is divided into lowland wooded (AC V) and upland wooded (AC VI) in the CVS.

Relationships between plot types and vegetation classes

The possibility of the size of plots introducing bias into the classification as a whole was tested by correlating the percentage of plot types in the aggregate classes with the first axis DECORANA scores for the constituent plots (described on page 12). Three out of ten possible correlations were not significant and all the remainder showed very weak correlations, with <10% of the variation explained, implying that the use of a single classification across all plot types was justified.

The analysis of the relationship between plot types (eg main plots and habitat plots) and vegetation classes showed distinct patterns, with some vegetation classes more-or-less restricted to some plot types, but other vegetation classes being widely distributed throughout the plots (Figure 3). The crops/weeds classes were dominated by main plots, showing that the vegetation classes are largely restricted to open fields. The tall grassland/herb classes were dominated by linear plots in roughly equal proportions, showing that the vegetation classes are restricted to linear features. The fertile grassland classes had high proportions of main and roadside plots, showing a bimodal distribution between fields and roadsides. The infertile grassland classes contained a mixture of plot types, with equal proportions of main and habitat plots, showing that these classes occur throughout the countryside, but often in small fragments, beside watercourses or on road verges. The lowland wooded classes were dominated by hedge and boundary plots, showing the classes are most common in field boundaries and hedges. The upland wooded classes and moorland grass/mosaic in contrast were dominated by streamside, main and habitat plots, showing a varied distribution of classes between forestry, habitat fragments and watercourses. Over half of the heath/bog classes were main plots, showing the extensive distributuion of these classes in open moorland.

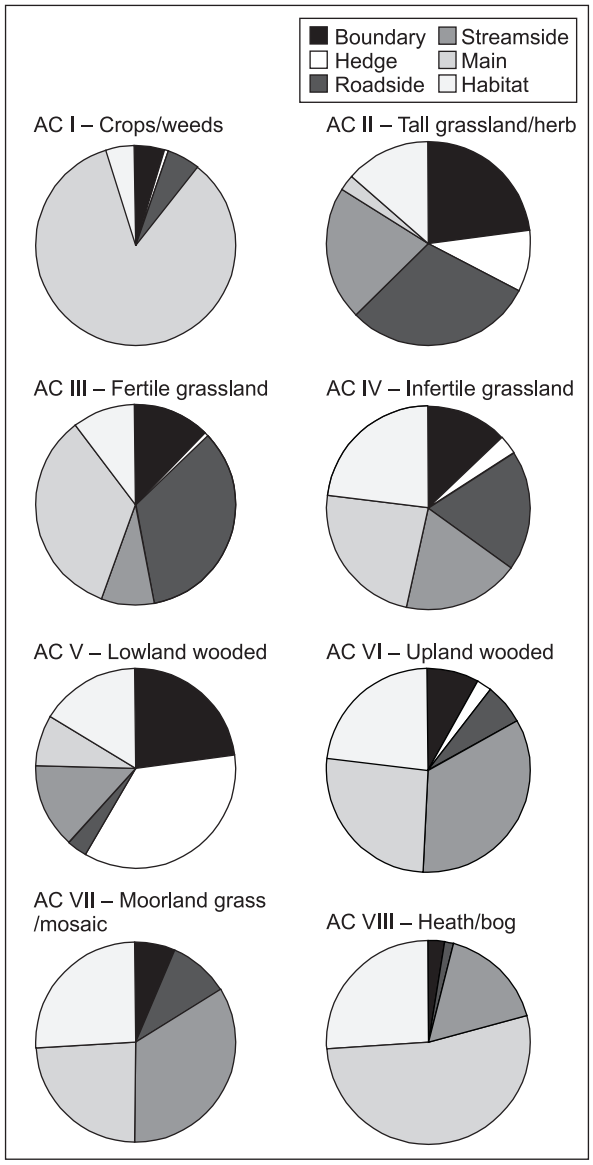


Figure 3. Proportion of the six plot types within each of the eight aggregate classes

Environmental relationship of the CVS

Interpretation of vegetation axes of ordinations is usually carried out using ecological understanding of the species involved. However, it is an important objective of this study to identify the environmental factors which control the vegetation, so that shifts in the composition of the vegetation over periods of time can be interpreted.

In a detailed analysis, Ellenberg (1974) expressed what he called the ecological behaviour of over 2000 species of vascular plants. To each species he assigned scores (indicator values) which represented the behaviour of the species with respect to the main environmental factors. The first three factors were related to climate, namely light, temperature and continentality of the distribution range. For instance, plants which grow in full shade were assigned a score of 1 while plants growing in full light received a score of 9. The next three factors represented soil moisture, soil acidity and fertility. Thus, plants growing only in soils very poor in available nitrogen and fertility were scored 1, and those growing in only soils very rich in available nitrogen were scored 9. Ellenberg pointed out that the ecological behaviour of the plant was different from its environmental demands. For instance, species such as ling heather when cultivated alone grows well in soil with a higher pH than those in which it grows in the wild, where it is confined to the more acid soils through competition with other species. These indicator values have been recalibrated for British conditions by Hill *et al.* (in press(a)) and the full list of values is published in a separate Technical Annex to this Volume (Hill *et al.* in press(b)).

The average Ellenberg indicator values for nitrogen (a measure of soil fertility), light (a measure of disturbance) and moisture were calculated for each of the 100 vegetation classes by weighting the individual species scores according to their cover, so preventing unusual species from biasing the results. These scores were then related to the position of the vegetation class along the first three axes of the DECORANA analysis (Figure 1).

The relationships between Ellenberg indicator values and the scores for the first three axes of the DECORANA ordination support the interpretation of the axes given earlier. The principal axis identified within the CVS shows a highly significant correlation with the weighted Ellenberg scores for nutrients (Figure 4i); low DECORANA scores are associated with crops or grasslands on highly fertile, mineral soils, whereas at the other extreme heath and bog vegetation grows on infertile, organic soils. The second axis is correlated

with the Ellenberg indicator values for light (Figure 4ii), and the third axis is correlated with soil moisture (Figure 4iii). All correlations were significant at $p<0.001$.

This study has demonstrated that the overriding factors which determine the composition of British vegetation are soil fertility, light (disturbance) and soil moisture. This is also evident from the mean Ellenberg indicator values for N – fertility when each of the eight aggregate classes is plotted (see Annex 4). The mean Ellenberg indicator values for N – fertility decrease from 6.3 in crops/weeds to 2.1 in heath/bog. The different plot types within each class exhibit some variability in Ellenberg indicator values, especially in the wooded aggregate classes. Hedge plots have generally higher fertility than other plot types in each class.

These relationships between vegetation classes and environmental variables can be used to help interpret and predict changes in vegetation at a given location. If a plot changes its vegetation class along a particular gradient, then the change is likely to have resulted from the associated environmental change, such as an increase in soil fertility. Equally, ecological impacts of environmental change can be forecast possibly in terms of changes from one plot class to another along the associated gradients.

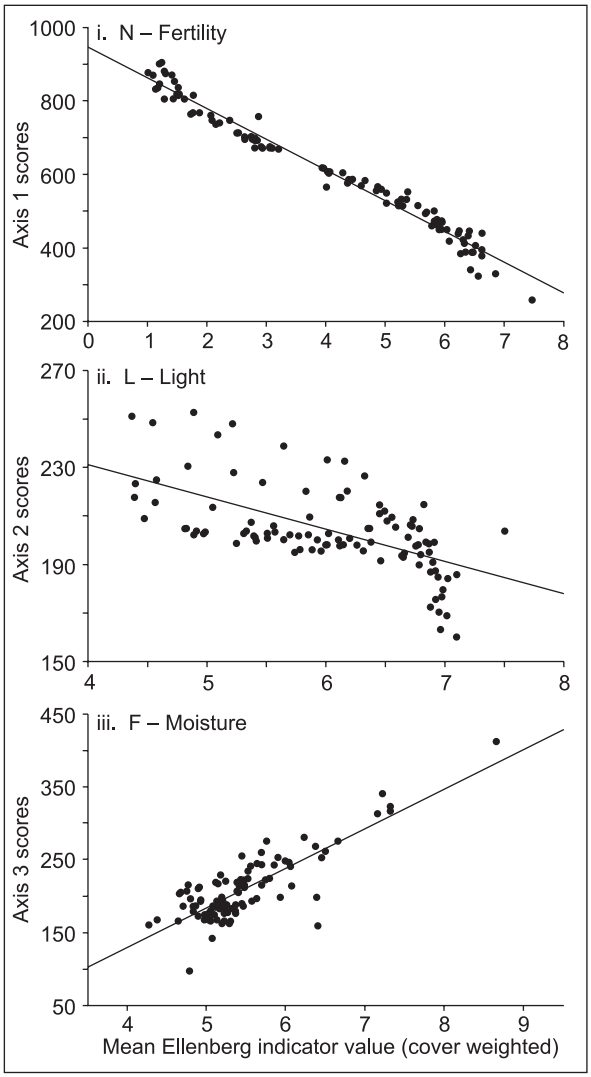


Figure 4. Relationships between the average scores weighted by cover on the first three axes of the DECORANA analysis for each of the 100 CVS vegetation classes and the Ellenberg indicator values

Description of the species groups

The cluster analysis of the species data from all of the plots surveyed in 1990 generated 37 species groups (Table 3). Their full composition is given in Annex 5. The different combinations of species groups help explain ecological differences between vegetation classes and aggregate classes (Table 4) and reveal differences in the inherent diversity of the vegetation. Shifts in the balance in species groups as vegetation changes from one class to another through time can provide insights into the causes of change, and its possible future direction.

The principal ecological characteristics of the aggregate classes are revealed by the species groups they contain, and they may be summarised as follows (with the following section giving the actual dominant species groups):

Crops/weeds (AC I)
Mainly crop and crop edge plants.

Tall grassland/herb (AC II) and Fertile grassland (AC III)
Consists of some crop and crop edge plants, but with more grassland, wood edge and tall grassland plants, usually on brown soils.

Infertile grassland (AC IV)
Dominated by grassland plants on variable soils, but with some plants from wetter conditions.

Lowland wooded (AC V)
Dominated by woodland and wood edge plants, but with some crop edge and tall grassland plants on nutrient rich, calcareous neutral soils.

Upland wooded (AC VI)
Woodland or woodland edge plants but with a strong element of moorland species associated with acidic soils.

Moorland grass/mosaic (AC VII)
Although there is often an element of grassland species from more fertile soils, most plants are moorland or heath species linked to podzolic or peaty gley soils.

Heath/bog (AC VIII)
Dominated by heath or bog plants associated with acidic or peaty soils but with some moorland plants often present.

Tables 3 and 4 show the following.

Crops/weeds (AC I) had a relatively low frequency and narrow range of species groups, mostly species groups 1, 2 and 7, all of which are species typical of crops and crop edges.

Tall grassland/herb (AC II) had a moderate freqency and greater range of species groups (3, 5, 10, 12 and 22), mostly tall grassland, wood edge and scrub plants.

Fertile grassland (AC III) were dominated by species group 12 and 22, the two most widespread groups of grassland and wood edge plants.

Infertile grassland (AC IV) had the greatest range and diversity of species groups (12, 18, 22, 27 and 28).

Lowland wooded (AC V) had a range of woodland and wood edge species groups (3, 5, 8 and 14) with plants typical of more nutrient-rich conditions.

Upland wooded (AC VI) included mainly moorland species groups (22 and 27) with plants typical of woodland and heath on acidic, gley or peaty soils.

Moorland grass/mosaic (AC VII) had a high frequency and moderate range of species groups (22, 28, 29 and 33), with many plants typical of acid grassland, moorland and flushes.

Heath/bog (AC VIII) had a moderate frequency and narrow range of species groups (33, 35 and 37), dominated by plants typical of upland heath, bog and moorland.

An analysis of the occurrence of the species groups in the different plot types and in the different landscape types has also been completed (Annex 6). There are some widespread species groups which are found generally within the major vegetation classes, whilst there are scarcer groups which are found in particular situations resulting from specific local conditions. For example, streamside vegetation is likely to have widespread plants such as stinging nettle from species group 5, but may also have specialist water-loving species such as water cress (*Nasturtium officinale*) from species group 21.

The principal features of the distribution patterns of the species groups may be summarised as follows.

- The most ubiquitous species groups, (18, 22 and 27) mainly consist of grassland species, and they occur throughout all plot types and landscapes.
- Some species groups, (eg 6, 20 and 21) are restricted to particular plot types, usually of limited frequency. They contain specialised species, particularly water loving plants or calcicoles.
- Some species groups, (eg 36) occur only in one landscape type and in the uplands; bog plants are especially restricted.
- In all landscape types the streamside plots are most diverse in their species group composition, reflecting the variety of conditions on river banks at the edge of water.

Table 3. Names of the 37 species groups of the CVS determined by Ward's minimal variance clustering of the first four axes of the species scores from the DECORANA analysis of all plots. Three characteristic species for each species group are given

Species group	Species group name	Characteristic species
1	Crop or crop edge plants on fertile soils	*Bromus sterilis, Convolvulus arvensis, Lamium album*
2	Crops, crop edge or grassland on eutrophic soils	*Elymus repens, Rumex crispus, Sonchus oleraceus*
3	Woods, tall grasslands or wood edge plants on brown earth soils	*Heracleum sphondylium, Anthriscus sylvestris, Hedera helix*
4	Tall grassland plants on calcareous brown earths	*Tragopogon pratensis, Silene latifolia, Carduus nutans*
5	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	*Urtica dioica, Arrhenatherum elatius, Galium aparine*
6	Water edge plants on wet alluvial soils	*Epilobium hirsutum, Polygonum persicaria, Phalaris arundinacea*
7	Crops or crop edge plants on brown earth soils	*Stellaria media, Polygonum aviculare, Veronica arvensis*
8	Woodland edge or scrub plants on brown earth soils	*Crataegus monogyna, Prunus spinosa, Tamus communis*
9	Grassland, tall grassland plants on wood edges on variable soils	*Cirsium arvense, Poa trivialis, Rumex obtusifolius*
10	Maritime saline or fresh water edge plants on gleyed brown earths	*Oenanthe crocata, Phragmites australis, Hordeum secalinum*
11	Water edge plants on saturated gleyed alluvial soils	*Sparganium erectum, Glyceria maxima, Lemna minor*
12	Grassland or tall grassland plants on brown earth soils	*Dactylis glomerata, Lolium perenne, Poa annua*
13	Grassland plants on brown earths, often skeletal and calcareous	*Medicago lupulina, Daucus carota, Leucanthemum vulgare*
14	Wood or wood edge plants on calcareous or neutral brown earths	*Rubus fruticosus, Fraxinus excelsior, Geranium robertianum*
15	Tall grassland plants on damp gleyed brown earths	*Potentilla anserina, Carex hirta, Juncus inflexus*
16	River edge or aquatic plants on wet alluvial soils	*Apium nodiflorum, Nasturtium officinale, Polygonum amphibium*
17	Woodland or wood edge plants on brown earth soils	*Stellaria holostea, Corylus avellana, Hyacinthoides non-scripta*
18	Grassland plants on semi-fertile, sometimes rocky, brown earths	*Taraxacum agg., Poa pratensis, Achillea millefolium*
19	Grassland plants on calcareous brown earths	*Campanula rotundifolia, Galium verum, Heiracium pilosella*
20	Wood or wood edge plants on damp fertile brown earths	*Filipendula ulmaria, Angelica sylvestris, Epilobium montanum*
21	Water edge or aquatic plants on hydromorphic soils	*Glyceria fluitans, Veronic beccabunga, Alopecurus geniculatus*
22	Grassland wood edge or scrub plants on brown earths	*Holcus lanatus, Agrostis stolonifera, Ranunculus repens*
23	Marsh, wood edge or woodland plants on wet gleyed brown earths	*Cardamine pratensis, Stellaria alsine, Lotus uliginosus*
24	Marsh or water edge plants on soil water gleys	*Galium palustre, Juncus bufonius, Caltha palustris*
25	Woodland or woodland edge plants on acid brown earths	*Primula vulgaris, Digitalis purpurea, Oxalis acetosella*
26	Plants of maritime habitats on variable soils	*Plantago maritima, Plantago coronopus, Armeria maritima*
27	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	*Agrostis capillaris, Pteridium aquilinum, Lotus corniculatus*
28	Grassland marsh or water edge plants on moist brown earth or gleyed soils	*Juncus effusus, Ranunculus acris, Deschampsia cespitosa*
29	Grassland or wood edge plants on acid or brown podzolic soils	*Anthoxanthum odoratum, Galium saxatile, Festuca ovina*
30	Water edge or aquatic plants on wet humic soils	*Potamogeton polygonifolius, Carex rostrata, Potentilla palustris*
31	Flush, moorland or water edge plants on soil water gleys	*Juncus articulatus/acutiflorus, J.bulbosus, Ranunculus flammula*
32	Moorland plants on peaty gley soils	*Carex nigra, C.echinata, Viola palustris*
33	Moorland or grassland plants on gley or peaty podzolic soils	*Potentilla erecta, Nardus stricta, Deschampsia flexuosa*
34	Moorland plants on wet peaty gley soils	*Molinia caerulea, Carex panicea, Dactylorhiza maculata agg.*
35	Heath or moorland plants on podzols or brown podzolic soils	*Calluna vulgaris, Juncus squarrosus, Vaccinium myrtillus*
36	Bog, water edge or aquatic plant on peaty soils	*Pedicularis sylvatica, Pinguicula vulgaris, Myrica gale*
37	Bog or heath plants on deep, raw peat soils	*Erica tetralix, Eriophorum angustifolium, Trichophorum cespitosum*

Table 4. Average number of species per plot in each of the 37 species groups within the eight aggregate classes.
1–6 = average no of species per plot (rounded to nearest whole number)
+ = 0.25–0.49 species per plot
• = <0.24 species per plot

Code	Species group name	Aggregate vegetation class I	II	III	IV	V	VI	VII	VIII
1	Crop or crop edge plants on fertile soils	1	+	+	•	+	•	•	•
2	Crops, crop edge or grassland on eutrophic soils	1	+	+	+	+	•	•	
3	Woods, tall grasslands or wood edge plants on brown earth soils	•	1	+	+	2	•	•	•
4	Tall grassland plants on calcareous brown earths	•	•	•	•	•	•		
5	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	2	+	+	2	+	•	•
6	Water edge plants on wet alluvial soils	•	+	•	•	•	•	•	•
7	Crops or crop edge plants on brown earth soils	1	+	+	•	•	•	•	•
8	Woodland edge or scrub plants on brown earth soils	•	+	•	•	1	•	•	•
9	Maritime saline or fresh water edge plants on gleyed brown earths	•	•	•	•	•	•	•	•
10	Grassland, tall grassland plants on wood edges on variable soils	+	1	1	+	+	•	•	•
11	Water edge plants on saturated gleyed alluvial soils	•	•	•	•	•	•	•	
12	Grassland or tall grassland plants on brown earth soils	+	2	3	2	+	+	•	•
13	Grassland plants on brown earths, often skeletal and calcareous	•	•	•	•	•	•	•	
14	Wood or wood edge plants on calcareous or neutral brown earths	•	+	•	+	2	+	•	•
15	Tall grassland plants on damp gleyed brown earths	•	•	•	•	•	•	•	•
16	River edge or aquatic plants on wet alluvial soils	•	•	•	•	•	•	•	•
17	Woodland or wood edge plants on brown earth soils	•	•	•	•	+	+	•	•
18	Grassland plants on semi-fertile, sometimes rocky, brown earths	•	+	1	2	•	+	+	•
19	Grassland plants on calcareous brown earths	•	•	•	+	•	•	•	•
20	Wood or wood edge plants on damp fertile brown earths	•	•	•	+	•	+	•	•
21	Water edge or aquatic plants on hydromorphic soils	•	•	•	+	•	•	•	•
22	Grassland wood edge or scrub plants on brown earths	+	2	4	6	+	2	3	•
23	Marsh, wood edge or woodland plants on wet gleyed brown earths	•	•	•	+	•	+	+	•
24	Woodland or woodland edge plants on acid brown earths	•	•	•	•	+	1	+	•
25	Marsh or water edge plants on soil water gleys		•	•	+	•	•	+	•
26	Plants of maritime habitats on variable soils		•	•	•		•	•	•
27	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	•	•	+	1	+	2	1	+
28	Grassland marsh or water edge plants on moist brown earth or gleyed soils	•	•	+	1	•	1	2	+
29	Grassland or wood edge plants on acid or brown podzolic soils	•	•	•	+	•	1	3	1
30	Water edge or aquatic plants on wet humic soils		•	•	•		•	•	•
31	Flush, moorland or water edge plants on soil water gleys	•	•	•	+	•	•	1	+
32	Moorland plants on peaty gley soils	•	•	•	•	•	•	1	+
33	Moorland or grassland plants on gley or peaty podzolic soils		•	•	•	•	1	3	2
34	Moorland plants on wet peaty gley soils		•	•	•	•	•	+	1
35	Heath or moorland plants on podzols or brown podzolic soils		•		•	•	+	1	3
36	Bog, water edge or aquatic plant on peaty soils			•	•		•	•	+
37	Bog or heath plants on deep, raw peat soils		•		•	•	•	+	3

Arable and upland landscape types have the fewest species groups, as the variation is polarised into crop and grassland species groups on the one hand and moorland and bog species groups on the other. The other two landscapes contain mixtures because they are intermediate in character.

Plant strategy theory and functional analysis

Plant strategy theory (Grime *et al.* 1988) postulates two main determinants of plant distribution in most habitats. The first determinant is stress, which constrains growth (productivity), and the second is disturbance, which destroys biomass. If both

these factors are absent and the conditions become optimal for plant growth, then the composition of a plant community is determined by competition between species. As a consequence, it is possible to classify plant species into functional types based on their responses to gradients of productivity and disturbance – precisely the main gradients of the CVS.

The extremes on the gradients of productivity and disturbance are occupied by:

- competitors (C) (under conditions of high productivity and low disturbance);
- stress-tolerators (S) (plants that can withstand continuously low productivity imposed by light, moisture or nutrient stress);
- ruderals (R) (exploiting severely disturbed, productive habitats).

To represent these functional types, Grime *et al.* (1988) have developed a triangular model (CSR) in which the functional types are represented by the corners of a triangular ordination with intermediate types in-between (19 types in total). Each functional type can be represented within the triangular ordination by a set of C, S and R co-ordinates. The C, S and R co-ordinates, therefore, relate to, and can be defined by a whole set of attributes that contribute to the ability of a species to survive under given conditions of productivity and disturbance (Figure 5).

Functional analyses rely on empirical relationships between measurable plant attributes and ecological processes, such as the relationships described above. For example, plant species which have higher potential relative growth rates are found in sites of higher fertility.

The Ellenberg analysis suggests how the vegetation shifts from one aggregate class to another can be interpreted in terms of environmental factors. The CSR analysis allows these interpretations to be brought to the level of individual species within the assemblages. For example, if a site is subjected to increased nutrient input, then species with certain attributes will increase, whilst others with a different set of attributes will decrease. It follows that some vegetation classes are dominated by plants of particular CSR strategies. The compositions of the eight aggregate vegetation classes in terms of plant strategy (derived by including all plots, both linear as well as main plots, surveyed in 1978 and 1990) bear this out (Figure 5) (Wilson 1999), and the main feature of each aggregate class follows.

Crops/weeds (AC I) is dominated by ruderals and competitive ruderals with no stress-tolerators, reflecting the highly disturbed and productive nature of this vegetation.

Tall grassland/herb (AC II) contains the highest proportion of plants with competitive and competitive/ruderal strategies and indicating a productive and moderately disturbed system.

Fertile grassland (AC III) is similar to tall grassland/herb but has more ruderals and generalists. The virtual absence of stress-tolerators indicates a highly productive habitat.

Infertile grassland (AC IV) contains a more even distribution of strategies reflecting the range of vegetation classes present in this aggregate class. The increasing number of stress-tolerant species suggests lower productivity than aggregate classes I–III.

Lowland wooded (AC V) has a similar general pattern to infertile grassland although it is likely to be less productive as it has more competitors and fewer generalists and includes woody species.

Upland wooded (AC VI) is composed mainly of stress-tolerators, generalists and

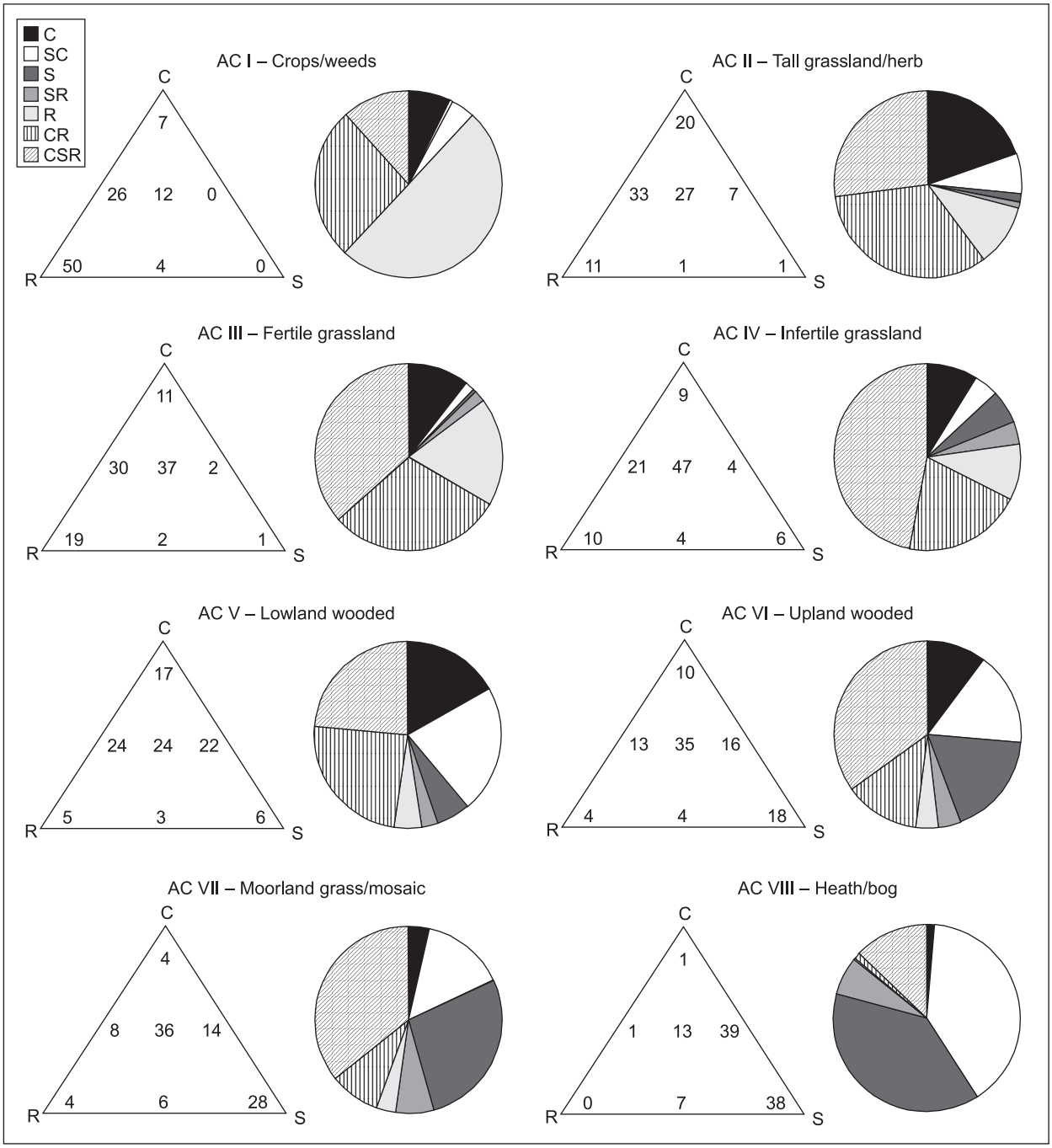


Figure 5. Functional strategy composition (Grime *et al.* 1988) of the eight CVS aggregate classes. The numbers are the percentage of species that were present within each aggregate class both in 1978 and 1990, regardless of shifts between classes

competitors and with few ruderal species, indicating low productivity and low disturbance.

Moorland grass/mosaic (AC VII) has a skewed distribution of strategies towards the stress-tolerant end of the chart but with a strong representation of generalists suggesting less productive systems.

Heath/bog (AC VIII) is mainly composed of stress-tolerators, stress-tolerant competitors and stress-tolerant ruderals with virtually no competitors and ruderals, indicating undisturbed and unproductive systems.

Botanical diversity at the landscape scale

The vegetation classes may be used to define the general patterns of vegetation in the four main landscape types of GB (Figure 6) and provide an indicator of habitat diversity. The arable landscape is dominated by crops/weeds, tall grassland/herb and fertile grassland, but it

has a small element of grass moorland/ mosaic and heath/bog. The pastural landscape is similar, but is dominated by fertile grassland and has a higher proportion of moorland grass/mosaic. The marginal uplands also have fertile grassland as the most abundant aggregate class, but all the other aggregate classes are well represented, indicating the inherent variability of this landscape. The upland landscape is dominated by moorland grass/mosaic and heath/bog.

The average number of vegetation classes in each 1 km square provides a measure of botanical diversity at the landscape scale. Overall, between three and four different vegetation classes were found to be present in the five main plots sampled in each 1 km square. The diversity in main plots was found to be highest in the marginal uplands and lowest in the arable lowlands (Figure 7i). Their relative frequency in the four landscape types and six plot types enables comparisons to be drawn as to the relative diversity of vegetation in the different components of the British countryside. The principal conclusions follow.

- The diversity of vegetation, as represented by the number of vegetation classes, is similar in all four landscape types.

- Linear plots make a major contribution to botanical diversity in all landscapes,

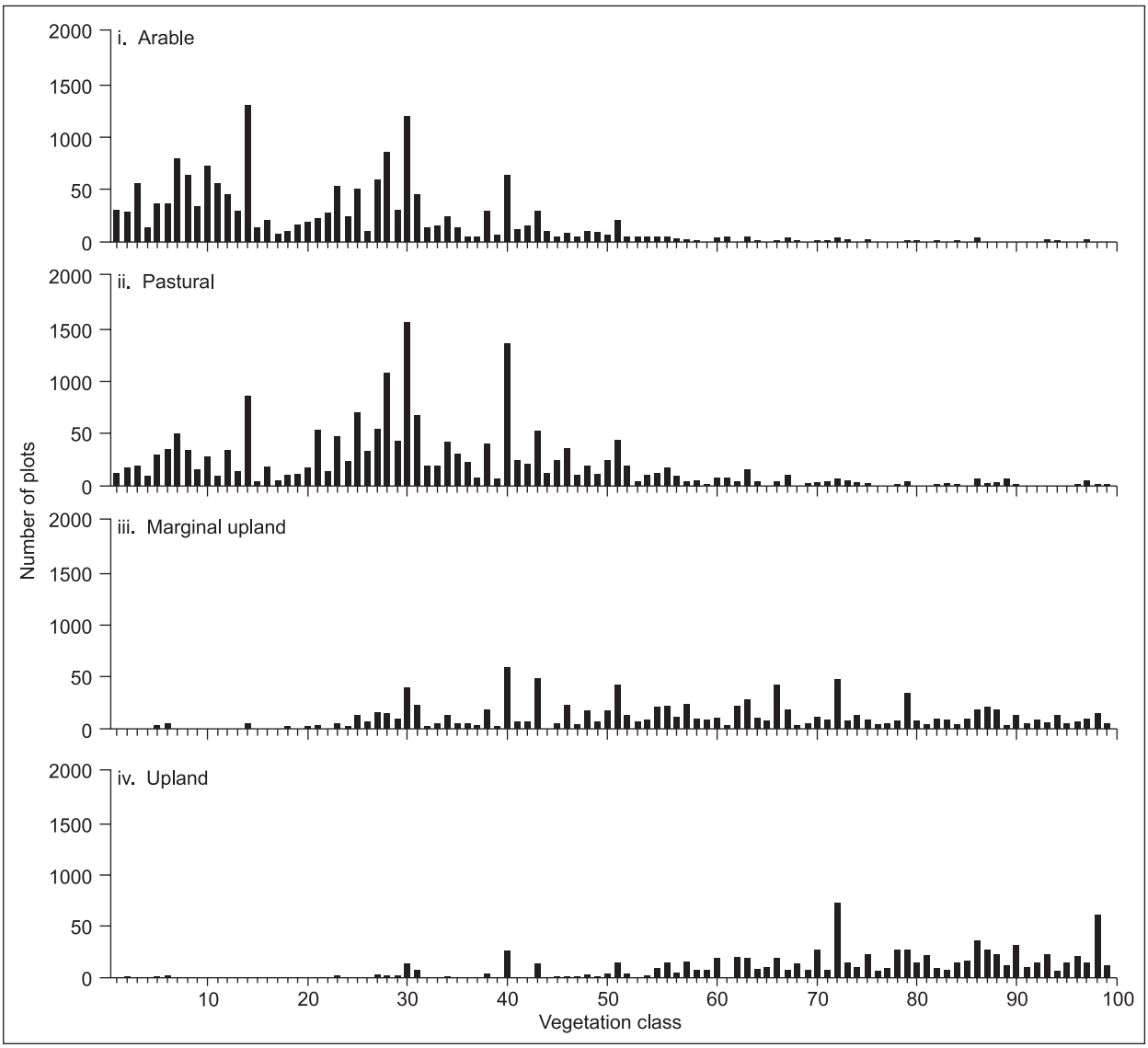


Figure 6. Numbers of vegetation plots per vegetation class of the CVS within the 1 km squares in the four landscape types

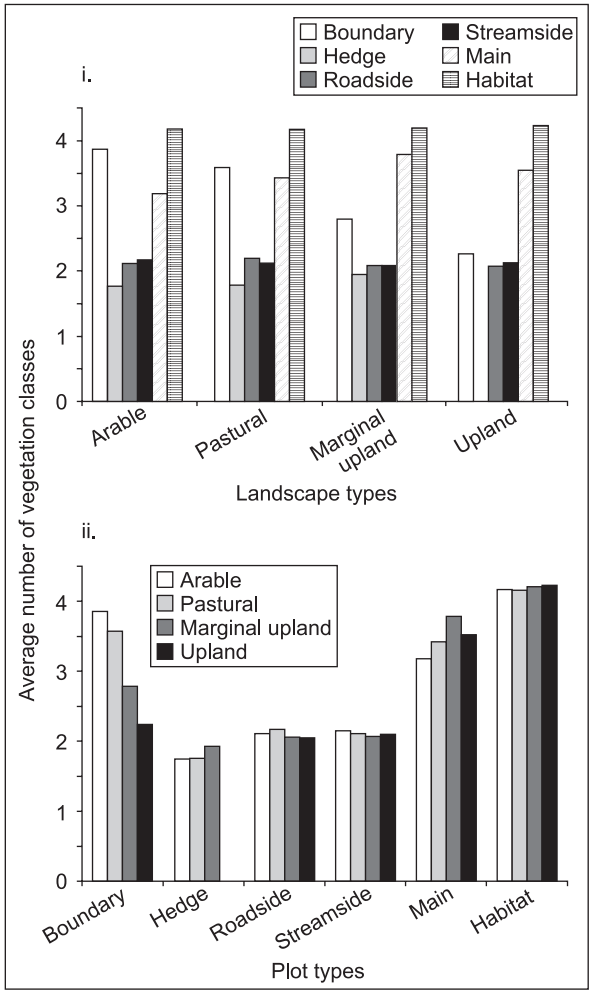


Figure 7. Average number of vegetation classes within the 1 km squares in the four landscape types

but less in the uplands, even allowing for absence of hedgerows.

- The boundary plots decline in diversity through the series of landscape types from arable to upland.

- The targeted habitat plots contain the highest number of vegetation classes – this is not surprising because habitat plots were selected to sample the different vegetation types present in each square.

- Hedges, roadsides and streamsides have similar levels of diversity, but lower than the other plot types.

The average diversity of CVS classes in each plot and landscape type is one aspect of the extent to which landscape elements are associated with different types of plant assemblages. In addition it is possible to determine whether there is any difference in the extent to which a particular plot type samples plant assemblages that do not occur elsewhere in the landscape. This is conveyed by the mean number of CVS classes unique to each plot type over all 1 km squares (Figure 8). A high figure highlights the importance of a plot type as a habitat for plant assemblages unlikely to occur elsewhere in the landscape. To prevent bias due to differences in the numbers of plot types available the analysis was governed by the following constraints. In upland and marginal upland landscapes there were insufficient hedges and roadsides plots available. There was also a difference in the maximum number of plots available as there were only two hedgerow plots per square. This difference biases hedgerow values downwards. The habitat plots were excluded from the statistical analysis as they were not sampled at random but are included in this figure to compare their characteristics with the other plot types.

Figure 8 highlights plot types that are, on average, more likely to contain vegetation classes that do not occur in the other plot types in each sample square. Although no significant differences were found between plot types, the same pattern of variation is found in each landscape type. The boundary plots had the lowest number of unique vegetation classes despite the high diversity shown in Figure 7ii, because many of the vegetation classes occur elsewhere in the landscape. The roadside, streamside and main plots contain very similar numbers of unique vegetation classes, demonstrating that each of these plot types contribute to the overall vegetation diversity in the countryside. Not surprisingly, the targeting of the habitat plots results in these plots having the highest number of unique classes. The habitat fragments represented by these plots, therefore, contribute disproportionately to the overall diversity of each sample square.

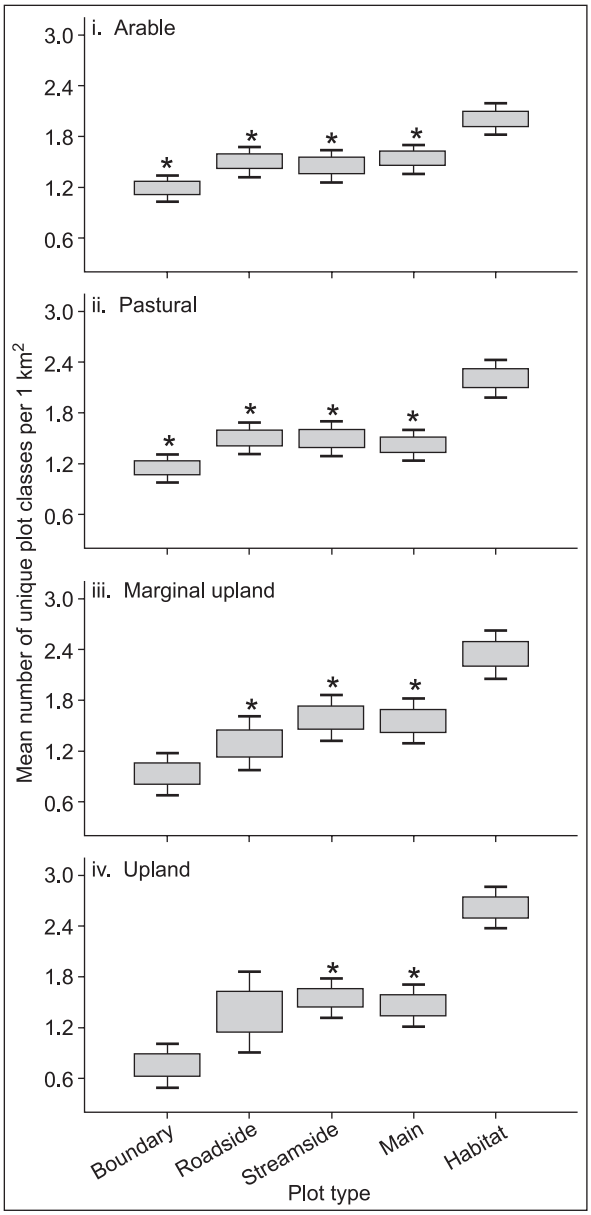


Figure 8. Mean number and range of unique CVS vegetation classes per plot type per 1 km square in each landscape type.
* = plot types analysed by Mann-Whitney and Kruskall-Wallis distribution free tests for differences in the median. No statistical differences were found

Conclusion

CVS provides a statistically valid means of describing vegetation character and its distribution in the wider countryside across GB, both over broad landscape types and among the individual landscape elements within them. It also summarises the vegetation in a manner which is directly interpretable with respect to the key environmental drivers of nutrients, disturbance and water availability. CVS has the potential to assist in the interpretation and forecasting of change of the vegetation as a whole and to the level of individual species using plant strategy theory. The patterns of distribution of botanical diversity vary according to the ecological character of the region concerned. There is a continuum characterised by two extremes.

- The lowlands of the south and southeast of GB vegetation diversity are higher in linear features and scattered, small patches.

- The upland landscapes of the north and west diversity are distributed more evenly across the whole landscape.

The small fragments of vegetation recorded in the habitat plots are often different from the vegetation elsewhere in the landscape, where the other plot types often contain similar vegetation classes. However they do not always contain vegetation of particular nature conservation interest.

RESULTS II
LINKS BETWEEN VEGETATION CLASSIFICATIONS

Introduction

A variety of other classifications of British vegetation and land cover exist for different purposes and this section reports briefly on comparisons between the classes of CVS and these existing classifications. Full tabulations of the comparisons are provided in Annex 7.

Vegetation data are continuously variable (Dale 1988) with no easily recognisable grouping of individuals. It is, therefore, to be expected that, because boundaries between groups (classes) are arbitrary, the divisions used in different classifications will not exactly coincide.

While CVS considers the species composition of the vegetation of the general countryside in GB, other systems erect other divisions first, which are frequently cartographic (geographic). For example, we may consider coastal or mountain vegetation and then develop a classification of the vegetation within each of such locations. These differences make comparisons between various classifications difficult. Further difficulties may arise because of differences in data collection, the structure of the sampling programme, or from analytical procedures.

Figure 9 illustrates some of the difficulties in reconciling two imaginary classifications. A series of classes on two axes of an ordination (such as Figure 1) are illustrated diagrammatically, with two classes from a second classification superimposed. Class A fits within the range of one of the initial classes, (ie it reflects a finer division within the range of that class) and so it would be possible to express the results of the second class in terms of the first. This would not be possible for class B, however, as it overlaps several different classes and therefore is not mutually exclusive to any one class.

Making comparisons

Comparisons between classifications can be made in five principal ways, listed below in ascending order of statistical rigour.

- **Expert judgement**
  Some classifications have been developed based on wide experience of vegetation often by individuals or groups of experts. The classes are qualitative and frequently defined descriptively without statistical data. It is, therefore, impossible to make quantitative comparisons between such classifications.

- **Direct comparison**
  Data may be available from a consistent database that enables two styles of classification to be compared, (eg CVS and the mapped land cover categories from CS1990).

- **Average composition comparison**
  Frequency data and constancy tables from the vegetation classes of different classifications can be compared statistically using a similarity coefficient.

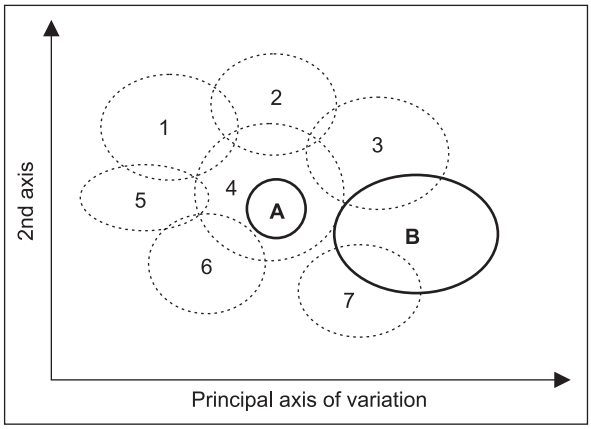


Figure 9. Diagrammatic representation of the relationships between classifications represented on two theoretical axes of variations. The numbers 1–7 refer to one classification, and A and B to the range of two classes of another classification

A number of computer programs are available such as MATCH, TABLEFIT and SIMIL which were developed to assign species lists collected in the field to the classes of the NVC, can be used for this type of comparison.

- **Classification process simulation**
  Exactly the same statistical procedure is followed as was used in the development of the classification. For example, the method developed in the present project for fitting new data into CVS (see below).

- **Integrated analysis**
  Data from different regions can be combined and analysed using standard statistical procedures to assess overlap. In this case the interaction between the data sets determines a new classification. For example, the analysis of NI vegetation in the present project.

The CORINE biotope classification

The CORINE biotope classifaction was developed as a framework for comparing habitats across Europe and was used as the basis for the habitats listed in Annex I of the Habitats Directive. It is not strictly a vegetation classification but a classification of biotopes which are units of land with a recognisable ecological character. However, in many cases it is necessary to use the composition of the vegetation to describe and to compare these units. The CORINE biotope manual (Moss *et al.* 1991) contains 300 pages, has several hundred classes and is an exercise in collating a number of existing classifications. The classes which are distributed between a number of higher categories, some of which are cartographically based, are presented in varying levels of detail. In some cases there are lists of constant and preferential species, whereas in others only a broad description is provided. In most cases, the classes are derived from phytosociological analysis with details being provided of the source publications.

The CORINE biotopes classification, in common with the NVC, concentrates on semi-natural vegetation. In contrast CS1990, which is an impartial, random sample of the countryside only rarely captures scarce and localised assemblages, especially if they cover a small area. In the CVS, such small areas will be incorporated within the vegetation class with which they have most species in common.

Comparisons have been made between the 100 classes of CVS and the 89 major categories of CORINE biotopes (see Annex 7). In conclusion, because the CORINE biotope classification is largely based on vegetation composition, the classes that are in common between GB and Europe have a generally good correspondence with CVS classes, compared with some of the classifications that contain cartographically defined limits.

Phase I – Habitat classification

The former Nature Conservancy Council (NCC) developed a classification of habitats for GB which is widely used by the conservation agencies. This recognises eight major categories of semi-natural vegetation, some of which contain a cartographic element (eg coastal). The ninth category (miscellaneous) contains agricultural habitats. The Phase I categories have been defined qualitatively. Full comparison between the vegetation classes from CVS and the Phase I habitat categories is presented in Annex 7. In general, it was possible to identify reasonable equivalents with most of the categories, although inevitably some vegetation classes needed to be combined. The categories which had no equivalents were either from habitats outside the range of CVS coverage, (eg marine) or those that depended upon cartographic units. In some cases there was a direct correspondence, (eg calcareous grassland) in others, however, vegetation classes had to be assigned arbitrarily between two Phase I categories.

The UK Biodiversity Steering Group report classification of Broad Habitats

A new classification of terrestrial and marine habitats for the UK and the surrounding seas was published in the report of the UK Biodiversity Steering Group (Department of the Environment 1995) as a framework for reporting on biodiversity in the UK. This scheme initially recognised 37 broad habitats which are introduced in Volume 1 of the Steering Group report; each is further described as part of a habitat statement in Volume 2 of the report.

Expert judgement comparisons were made between CVS and the 37 broad habitat types of the Steering Group report (see Annex 7). There is a poor agreement between the two classifications, with only the calcareous grassland and coniferous woodlands showing any direct agreement. It is not possible to compare over one third of the categories since these are defined in geographical terms rather than vegetation (eg islands and archipelagos).

Some CVS classes occur in several of the Broad Habitat types. Predominantly, these are semi-natural habitats of conservational interest which are difficult to place in the CVS scheme since they are composed of vegetation complexes. For example, 'lowland wood pasture and parkland' could contain CVS vegetation classes 42 (woodland on heavy soils), 47 (species-rich neutral grassland) and 52 (neutral grassland).

Other CVS classes are not clearly identifiable among the Broad Habitat definitions and are probably spread between several classes. For example, CVS classes 51 (wet rushy grassland), 55 (wet neutral/acid rush grassland) and 65 (herb-rich acid grassland/heath). The marine broad habitats lie outside the scope of CVS.

The Broad Habitat classification was being revised at the time of writing and it is evident that by definition 'Broad' Habitats will embrace a range of vegetation. However, as the revised Broad Habitats will be mutually exclusive and cover all the land of GB, it will be possible to assess the composition of each Broad Habitat in terms of vegetation classes, thus providing the basis for cross-comparison.

Comparison between the CS1990 land cover reporting categories and CVS

Land cover was mapped as part of CS1990 (Barr *et al.* 1993), and the individual plots were attributed to the land parcel in which they were located or, if the plot was by a linear feature, the land cover of the adjacent parcel. The list of comparisons is presented in Annex 8 . Most of the land cover categories show distinct mixtures of vegetation class but there is no exact correspondence, for the following reasons.

- The plot may fall upon a patch of vegetation below the scale of the land cover mapping. For example, on a nettle clump in a field which is otherwise virtually pure rye-grass.

- CVS is based on analysis of all species and this does not necessarily correspond with land covers determined by single dominant species, (eg wheat or barley).

- The vegetation mosaics and gradients in the uplands are defined in the land cover mapping by the dominant species and these may not coincide with CVS.

- Inevitably there is a degree of background noise in the overlaying process and in observer error in the field mapping, as well as in the vegetation survey.

Nevertheless, some broad generalisations can be made using the more detailed 57 land cover categories of Barr *et al.* (1993) in order to explain the differences.

- Crops, such as wheat, oil seed rape and sugarbeet, which tend not to be in rotation with grassland, are generally related to CVS vegetation classes 1–5 which consist almost entirely of crops and arable weeds.

- Crops such as barley, kale and roots, which are often in rotation, tend to be related with short-term grassland such as CVS vegetation classes 6, 30 and 31.

- The series of lowland grassland categories in the land cover classification were ordered to reflect management intensity. The mixture of CVS vegetation classes present within them reflect this gradient, confirmed by using the Ellenberg values of Figure 4.

- There is reasonable correspondence between CVS vegetation classes and the upland land cover categories of bracken (*Pteridium aquilinum*), upland grass, moorland and bog, but overlaps between them do exist.

- The land cover categories 32 and 33 (dense heath and open-canopy heath) are not differentiated in their CVS class composition, nor are 35 and 36 (drier northern bogs and wet heaths/ saturated bogs). The distinction between these categories has been made on criteria other than the species composition, such as topographic position.

The National Vegetation Classification (NVC)

The programme SIMIL was used to assign the average composition of CVS classes to the NVC communities (eg Rodwell 1992). A summary of these comparisons with the aggregate classes and community groups is given in Table 5. At this level, there is broad agreement with each of the aggregate classes being dominated by one community grouping. In detail, however, comparisons are more difficult to make between CVS classes and NVC associations (as shown in Annex 9) and also in the summary descriptions where almost all the similarity coefficients are below 60%, which is the level generally set as acceptable for good comparisons. This is because the plots in CVS were placed at random within the 1 km squares (except the habitat plots), whereas NVC plots are selectively placed in homogeneous vegetation. NVC is also primarily concerned with semi-natural vegetation, whereas many of the CVS plots, and hence the classes, are in highly disturbed situations. Nevertheless, some direct comparisons can be made, for example, with the NVC calcicolous grassland association (CG 2) and CVS class 44 calcareous grassland. Other comparisons can also be usefully drawn, for example:

- CVS class 40 rye-grass/Yorkshire fog (*Holcus lanatus*) grassland and MG7 rye-grass ley;

- CVS class 26 tall grassland/scrub by roadsides and MG1 false oat-grass grassland;

- CVS class 65 herb-rich acidic grassland/heath and CG10 sheep's fescue (*Festuca ovina*), bent grass (*Agrostis capillaris*) and wild thyme (*Thymus praecox*) grassland.

Annex 9 enables users experienced in the use of the NVC to identify comparable assemblages in CVS classes, further supported by the summaries available for each CVS class (Bunce *et a*l. 1999). Rare associations and those occupying small patches of vegetation may be of conservation importance and are considered separately within the NVC, but they will not correspond to individual CVS classes.

Construction of a statistical procedure to assign new vegetation plots to classes within CVS

A part of the work programme of the project was to provide an automated procedure for allocating any new vegetation plots recorded to CVS. Of the statistical methods considered, there is a division between those techniques which allocate plots to a specific class and those which provide a measure of closeness (similarity) to, or probability of membership of all classes. The latter procedure is that used for allocation of data to the NVC by the programs TABLEFIT and

Table 5. Comparison of CVS aggregate vegetation classes with communities of the NVC. Figures give the percentage of all the similarity coefficients (top three for each of the 100 vegetation classes) over each aggregate class that refer to each broad grouping of NVC communities

Community groups of the NVC	Aggregate vegetation class							
	I	II	III	IV	V	VI	VII	VIII
Other Vegetation (OV)	100	22	20					
Mesotrophic Grassland (MG)		61	60	55	19	7		
Swamp and tall-herb fen (S)		2						
Woodland and scrub (W)		14	13	11	48	63		
Calcicolous Grassland (CG)				8		22	23	
Upland and calcifugous grassland (U)				14	26	7	26	7
Mire (M)			6	11	7		37	79
Heath (H)							4	13

MATCH. The following techniques were investigated for the former procedure.

- Classical linear and quadratic discriminant analysis.
- Nearest neighbour discriminant analysis.
- Classification and Regression Trees (CART), a procedure similar in nature to the process used in TWINSPAN to derive the classifications.
- Generalised Canonical Variates Analysis (GCVA).

In addition, the use of the indicators provided by TWINSPAN was considered, but rejected because previous experience had shown that they did not perform satisfactorily when a number of hierarchical levels were involved.

None of the non-hierarchical methods examined performed satisfactorily. Misclassification rates were high (50%–60%), although misclassifications generally fell into neighbouring classes. It, therefore, appears that the hierarchical nature of the classifications themselves necessitates a hierarchical method for allocation of vegetation units to classes. Indeed, it is logical to use this method of allocation as it is based on the methodology originally used to create the classification.

In order to allocate vegetation units to an existing hierarchical classification a binary decision tree was constructed. At each node of the tree a decision method, appropriate to the classification being emulated, is implemented. For classifications strictly constructed using TWINSPAN, the decisions are based on a partition of multidimensional species space. In these cases the resulting decision tree will produce a deterministic result allocating each vegetation unit to a single vegetation class. It should be emphasised that this procedure gives a precise allocation of each individual plot to all the classes of CVS, and it is based on all the information available on the species content of that plot.

The decision tree structure for allocating vegetation units to the CVS has been implemented as a software package running under Microsoft Windows™. So far this package has been made available on request for several applications to test its efficiency, where it has performed well. It has also been incorporated into MAVIS (Modular Analysis of Vegetation and Interpretation System), which is currently being tested and is designed to provide ready access to the vegetation analysis procedures of CVS, NVC, CSR and Ellenberg values. This software allows the user to enter species lists for vegetation units either interactively or in batch mode from a previously constructed file. Once a vegetation unit or units have been allocated to a class or classes the software allows the user to

determine their positions with respect to the three main vegetation gradients in GB, as determined from the Countryside Survey vegetation data. The addition to this software of further deterministic classifications based on the TWINSPAN procedures can also be carried out and has already been implemented in the SOAEFD classification of vegetation within ECOFACT.

Comparisons between land cover and lowland grasslands in GB and NI

Countryside Surveys in NI have followed a similar approach to those in GB, but with different land cover and vegetation classifications. The purpose of this element of the work programme was to compare these different classifications.

The first stage was to compare details of the definitions for land cover, and these were computed and entered into LUCID (Land-use Classification, Information and Documentation), the software package which compares a range of different land cover classifications and which is held within CIS. The second stage was to examine the potential for integration of the botanical data between NI and GB, in order to determine the options for a combined approach.

Botanists have often commented that the lowland grasslands in NI were different from those in GB, even though the two regions are close geographically, the Antrim coast being only 15 km from western Scotland. However, the management of grasslands appears less intense and the extensive drift deposits may be different from western Scotland. Previous work has also suggested that different sampling intensities in the surveys of GB and NI could influence the interpretation of the results. As the first stage of this comparison it was, therefore, decided to:

- compare the lowland grassland vegetation in NI and GB;
- investigate the effect of sampling intensity and Land Classification.

The NI Countryside Survey recorded the land cover composition of 628, 25 ha sample grid squares between 1986 and 1991 (Murray *et al.* 1992). The vegetation sampling programme was based on the NI Land Classification which acted as a sample stratification for field work and defined regional landscape types (Cooper 1989). A subsequent field survey to investigate the botanical composition of NI grasslands was undertaken by recording presence/absence of species in 200 m^2 plots (Cooper and McCann 1994). The vegetation data were classified using similar analytical procedures as for the CVS.

The results confirmed the anecdotal observations of botanists. The NI fertile grasslands differ from the GB grasslands by containing species, such as creeping bent (*Agrostis stolonifera)* and marsh foxtail (*Alopecurus geniculatus),* that are indicative of wetter conditions. There are also differences in the species of grass sown. Cock's foot is less frequent than in southern England where it is often included in seed mixtures as it is drought-resistant. Although some of the differences between these grasslands may be due to climate, other differences may be attributed to management, but these would require further study.

This comparison between the vegetation of NI and GB has also highlighted the desirability that programmes use comparable sampling methods. In particular it is important to ensure that the stratification procedure (both environmental class and land cover), sampling intensity (the number of plots recorded) as well as the proportion of the domain sampled are comparable. Strictly structured sampling is therefore required, otherwise it is misleading to draw comparisons between study areas, other than in a purely descriptive way.

Conclusion

A variety of comparisons were made between CVS and other classifications to aid interpretation of the results. A computer software package (MAVIS) was developed to enable ready access to the classification and to allow vegetation plots to be analysed in a variety of ways.

RESULTS III
CHANGES IN BOTANICAL CHARACTER 1978–90

Introduction

The analysis of change was based on botanical surveys of main, hedge, streamside and roadside plots made at the same locations in 1978 and 1990. Boundary and habitat plots were surveyed for the first time in 1990 and are not included in the analysis of change. Statistical tests of changes in 'paired plots' are more sensitive and require smaller samples to detect significant changes than those relying on separate sets of samples randomly located on each occasion. The sample size of the comparison remains important, in that larger samples can reveal smaller degrees of change, and samples which are too small may not be representative. Therefore, in the results which follow, change data are only presented for analyses in which at least 20 paired plots or more than 10% of all paired plots in the respective landscape type are available (see Annex 1).

One of the objectives of CVS was to enable an integrated assessment of botanical changes in the main component features of the countryside. The different combinations of aggregate classes, plot types and landscape types are analysed separately so that change in different parts of the landscape can be discriminated. The plot types are also combined, irrespective of the size of the plots, to detect changes happening across all plot types.

The change results are generally presented in terms of the aggregate vegetation class recorded in 1978. Therefore, they include plots which may have moved to a different aggregate class in 1990 (see *Changes between aggregate classes* on page 38).

Change in species numbers

Changes in the mean number of species per plot between 1978 and 1990 provide a measure of changes in species diversity. These analyses excluded aggregate species which were not recorded as separate species. Analyses were carried out by CVS aggregate vegetation classes for GB but also using a separate classification of agricultural land in England and Wales. Detailed results are tabulated in Annexes 10 and 11. Although species number has sometimes been considered an over-simple measure, Pielou (1991) emphasises that it is a direct measure and the subsequent analyses described below have shown that it has real ecological meaning.

Main plots

For GB overall there was a significant decline in mean species number between 1978 and 1990 in infertile grassland of –13% and in upland wooded of –20%. In arable landscapes, species number in crops/weeds declined by –24%. Similar changes were noted for agricultural land in England and Wales, with the losses of diversity in crops/weeds being only in arable landscapes.

Roadside plots

Species number per plot was greater in small (10 m^2) linear roadside plots than in the large (200 m^2) main plots. For GB as a whole there was a significant increase in species number (17%) in tall grassland/herb on roadsides between 1978 and 1990. This increase was most marked in pastural landscapes. There were no significant changes in other aggregate classes at the GB level.

In the pastural landscape, fertile grassland on roadsides increased in species number (14%) as did tall grassland/herb (23%). In the marginal upland landscape fertile grassland roadside plots also saw an increase (19%) in species diversity.

Hedge plots

Hedge plots contained fewer species than roadside and streamside plots. For GB as a whole, there was a significant loss of species number (–14%) in tall grassland/ herb in

hedges. Similar losses also occurred in arable, pastural and marginal upland landscapes, in the last two of which, changes were significant but based on few samples for the marginal uplands. A comparable pattern was shown in agricultural land in England and Wales, with an overall trend towards lower species diversity.

Streamside plots

Streamside plots had similar species numbers to roadsides but were more diverse than hedges, and in most cases were more diverse than main plots, even though these were larger. For GB as a whole, significant loss of species number occurred between 1978 and 1990 in infertile grassland (–17%), upland wooded (–21%) and grass moorland/mosaic (–13%). In contrast, tall grassland/herb streamsides in arable landscapes increased in species diversity. In agricultural land, streamsides were generally stable.

All plots

Considering all plots together, for GB as a whole (Annex 10a), there were significant decreases in species number in infertile grassland (–12%), upland wooded (–21%) and moorland grass/mosaic (–6%) vegetation types. That is the equivalent of, on average, three fewer species per plot in infertile grassland, four fewer in upland wooded and one fewer in moorland grass/mosaic. The loss of species richness in these vegetation types was experienced across most of the major elements of the landscape, and was concentrated in the lowlands. There was a small (6%) but significant increase in species number in heath/bog vegetation types, equivalent to on average one extra species per plot. Moorland grass/mosaic showed a significant reduction in species number (–6%). Significant increases were also detected separately in fertile grassland plots in both upland and marginal upland landscapes. Overall, plots in agricultural land showed a significant decline in species with fewer cases of increasing diversity than in the analysis of all GB plots.

Summary

These results are summarised in Table 6 which shows the number of statistical tests for each combination of aggregate class, plot type, landscape type which showed a significant increase or decrease in species diversity between 1978 and 1990 and those comparisons which were not statistically different. The results for all GB plots (Table 6i) and for plots only on agricultural land in England and Wales (Table 6ii) can be compared. For the GB analysis there were more losses than gains in diversity in all plot types except roadside plots. The same general pattern is present on agricultural land in England and Wales, but with regard to main and hedge plots.

Key results

These results portray a substantial decline in the diversity of common plants across much of lowland Britain between 1978 and 1990. The widespread vegetation of fields, woods, hedges and streamsides became simpler in composition and thus more uniform in character. In contrast there was a small increase in diveristy in the heath/bog aggregate class in the 'true' uplands and also fertile grassland on roadsides, in pastural and marginal upland landscapes.

Table 6. Summary of tests of change in species diversity between 1978 and 1990 based upon all viable combinations of aggregate class, plot type, landscape type (see Annex 1)

Plots	Number of comparisons	Increasing diversity	Decreasing diversity	No significant change
i. All plots in GB				
All	28	5	12	11
Main	21	3	7	11
Hedge	10	0	3	7
Verge	13	4	0	9
Streamside	21	1	8	12
ii. Plots only on agricultural land in England and Wales				
All	17	1	7	9
Main	9	0	4	5
Hedge	6	1	4	1
Verge	5	1	0	4
Streamside	8	1	2	5

The analyses that follow look in more detail at the changes in species composition which underly the changes in species numbers. Changes in species composition can help to assess the implications for biodiversity in the wider countryside and can help to indicate the processes operating.

Change in frequency and cover of individual species

Changes in cover and frequency of individual species may contribute to losses or gains in species diversity and may give some insight into the ecological processes operating and the significance of the effects. Generally, given the large number of possible individual species and the noise associated with their observation, including surveyor error, the significant results only apply to widespread and common species. Full tabulations of the changes are given in Annexes 12 and 13.

The principal changes are as follows.

- Reductions in the frequency of arable crops such as oats and potatoes occurred in the arable landscape in crops/weeds, whereas in the pastural landscape rye-grass and white clover have increased.

- In the arable landscape, tall grassland/ herb in hedgerows and on roadsides, there has been an expansion in weeds and grasses such as cleavers, couch grass (*Elymus repens),* Yorkshire fog and sterile brome. In streamsides, within the same landscape and aggregate class, creeping thistle, cleavers and Yorkshire fog all increased.

- In the fertile grassland in main plots, white clover and rye-grass have declined in cover in the arable landscape whilst creeping thistle has increased at the GB scale and in the pastural landscape.

- Other species increasing in cover in fertile grassland include bramble, red fescue *(Festuca rubra)* and creeping bent. The same trends occur on roadsides and main plots.

- The species with increasing frequency across all landscapes were stinging nettle, cleavers, rye-grass, creeping bent and red fescue. There was also an increase in cover in red fescue, creeping bent and Yorkshire fog.

- Stinging nettle has also increased in frequency by streamsides, as well as cleavers, great hairy willow-herb (*Epilobium hirsutum*) and creeping bent.

- In hedges there was an increase in frequency of weeds such as cleavers and sterile brome over the whole of GB and particularly in the arable landscape. Within the pastural landscape creeping bent, rye-grass and bramble have increased in cover.

- Changes in shrub abundance in hedges, show divergent patterns between landscapes within the lowland wooded hedgerow plots. In the arable landscape hazel (*Corylus avellana*), hawthorn, ash, ivy (*Hedera helix),* blackthorn (*Prunus spinosa*) and elder (*Sambucus nigra*) all declined overall, because removed hedges were included in this analysis. In the pastural landscape hazel declined but hawthorn and ivy increased.

- In the upland landscapes Sitka Spruce (*Picea sitchensis*) increased in grass moorland/mosaic and heath/bog.

- Few changes were detected in heath/ bog, however, species such as bent grass, Yorkshire fog and heath bedstraw showed a significant increase in frequency.

- Within the marginal upland and upland heath/bog main plots, however, there was a decline in the frequency of dwarf-shrubs ling and crowberry (*Empetrum nigrum*) and an increase in mat-grass.

Change in species groups

The analyses of changes in cover for species groups did not include records for each species when their cover in a plot was estimated to be less than 5% in both 1978 and 1990. The focus, as with the analysis of individual species, was therefore on changes in cover within plots rather than changes in frequency between plots. Change in species group abundance complements analysis of change in species richness and individual species. This is because species groups comprise taxa with similar ecological requirements and any change in their abundance allows the postulation of links to different types of environmental change as well as intimating change in botanical quality. For example, reductions in a group made up of unimproved wet grassland species has implications for conservation value as well as implying driving forces such as eutrophication and/or drainage. The following are the main changes. The full tabulations are given in Annex 14 and the names of the species groups in Table 5.

Crops/weeds (AC I)
Plants associated with crops decreased whereas grassland plants increased, reflecting a shift towards graminaceous weeds and plots moving from crops to grassland.

Tall grassland/herb (AC II)
Some grassland species were lost and all significant changes in species group numbers were negative.

Fertile grassland (AC III)
The largest decline was in grassland species and there was also an increase in species of plants associated with crops or disturbance, indicating a change in balance of species within fields and conversion of grassland to crops.

Infertile grassland (AC IV)
This class showed the largest change in species groups over all the combinations examined and confirms the decline of species groups representing plants of neutral grasslands. Six groups of grassland plants declined overall and there was also a small increase in plants associated with crops and some wood edge or woodland species.

Lowland wooded (AC V)
A striking decline of woodland and wood edge species, with a corresponding increase in plants associated with crops on fertile soils.

Upland wooded (AC VI)
A significant decline of four species groups all involving woodland species.

Moorland/grass mosaic (AC VII)
Three significant losses affecting mainly grassland species groups.

Heath/bog (AC VIII)
The main changes involved a loss of moorland plants and a gain in grassland plants, reflecting the shift away from ericaceous species to more general grassland plants.

Changes between aggregate classes

The net flows of plots between the aggregate classes from 1978 and 1990 are shown in Figure 10. Complete matrices of change between aggregate classes within the four landscape types are given in Annexes 15 and 16. In general, the overall pattern is that of stability, but with the shifts described below reflecting the changes already described at the species and species group level. Within GB as a whole, there were losses from fertile and infertile grasslands mainly into tall grassland/herb. The other major loss was from heath/bog to moorland grass/mosaic, which in turn has shown shifts into upland wooded, reflecting the planting of new coniferous plantations. There was a small loss from crops/weeds to tall grassland/herb.

Within arable landscapes, the major shift was from fertile grassland into tall grassland/herb indicating that roadsides, streamsides and hedgerows became more overgrown. Within pastural landscapes, the major shift was from

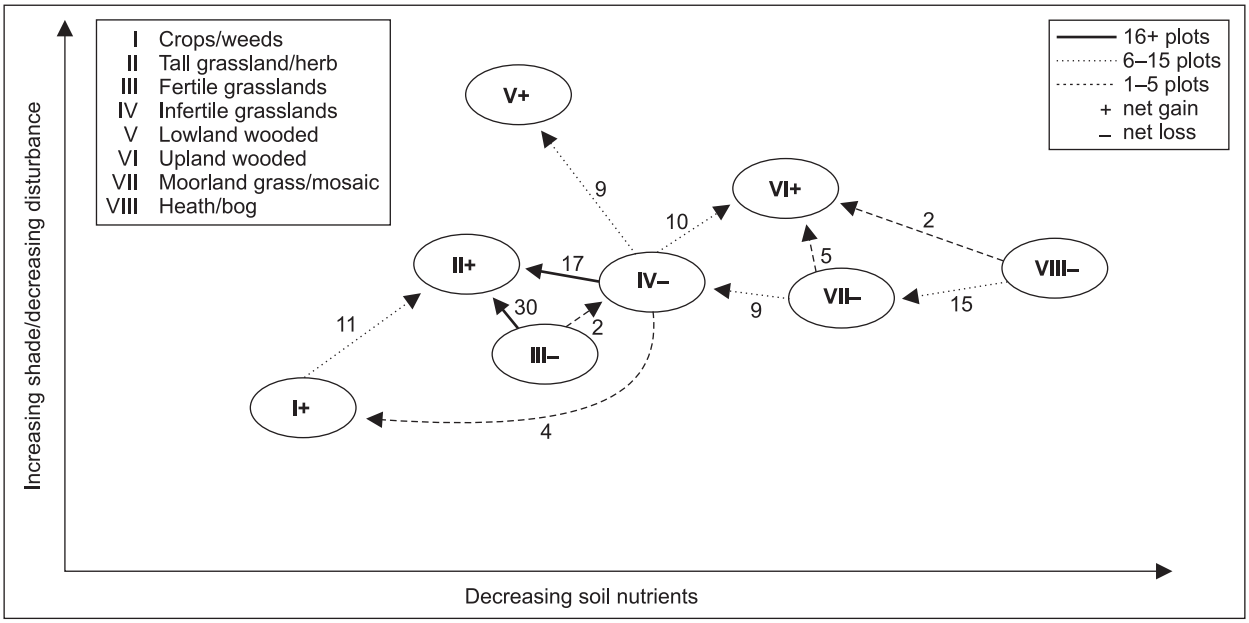


Figure 10. Schematic illustration of net movement of plots between 1978 and 1990 between aggregate vegetation classes plotted against the two principal axes of soil nutrients and shade/disturbance (see Figure 1)

infertile grassland into tall grassland/herb, but this masks a considerable interchange between infertile grassland and fertile grassland. Within marginal upland landscapes lowland wooded and upland wooded increased at the expense of infertile grassland. There were also losses in moorland grass/mosaic and heath/bog mainly into the upland wooded class. Within the uplands, the situation was relatively stable, apart from a loss of heaths/bogs into moorland grass/mosaic corresponding to the losses of ericaceous species.

The overall direction of change can be viewed against the ecological gradients of fertility and shading (Figure 10). There are net movements of plots from right to left (from low to high nutrient status) and from bottom to top (from low to high shading). Thus, at the most general level, the vegetation of GB became more eutrophic and more shaded (or overgrown) between 1978 and 1990.

These shifts in aggregate classes reflect major changes, made up of smaller movements between individual CVS classes. Thus, within infertile grassland there was a major shift from vegetation class 40 (rye-grass/Yorkshire fog grassland) and vegetation class 31 (rye-grass/clover grassland) towards vegetation class 30 (fertile mixed grassland) implying a loss of diversity. CVS class 75 (coniferous plantations) increased at the expense of other vegetation classes in moorland grass/mosaic and heath/bog.

There was also a shift from vegetation class 75 to 77 (mature coniferous plantations) reflecting canopy closure in young plantations between 1978 and 1990. There was a large increase in vegetation class 86 (wet moorland grass/streamside on peaty gley soils) which has acquired plots from a range of different classes reflecting a trend towards increased uniformity in moorland vegetation.

Key results

The decline in the frequency and cover of individual species and species groups adds detail to the changes in species diversity and shows a trend towards simplification of vegetation composition between 1978 and 1990. The species that have increased in cover are generally already widespread, abundant plants. The major shifts in vegetation suggest overall increases in soil fertility and increased shading/less disturbance.

RESULTS IV
ASSESSMENT OF BOTANICAL QUALITY AND CHANGE 1978–90

Introduction

The botanical analyses presented so far are essentially numerical and value-free. However, ecosystems, vegetation and species differ in the values that we attach to them with regard to their contribution to biodiversity and their importance for nature conservation. Procedures are needed to help evaluate the quality aspects of botanical diversity in order to inform policy development and priorities. This is not a new idea, indeed a set of principles for the evaluation of sites using botanical quality was proposed by Usher (1986) over a decade ago and similar approaches have been developed for application with the NVC (Rodwell 1992). More recently the conservation agencies have been working to develop common standards for the assessment of the condition of designated sites.

There is no simple or single measure of quality, and so our approach uses a range of different methods of quality assessment, which relate to different aspects of vegetation as reflected in the botanical composition of vegetation plots. For example, the creeping thistle is normally regarded as of low quality within vegetation as it is widespread, associated within heavily grazed pasture acting as an aggressive weed. However, its flowers and seeds provide important food sources for moths, butterflies and birds, and so this species is an important food plant for the conservation of populations of these taxa. All analyses described below use data on the presence, absence or cover of individual plant species within the particular databases. The approach is comparable with other methods of condition assessment based on indicator species and habitat structure.

The quality measures used can be divided into four broad categories.

- Lists based upon expert judgement (eg English Nature grassland indicator species).
- Published plant community profiles (eg NVC constancy data).
- Statistically derived measures (eg preferential species for aggregate classes).
- Known ecological associations (eg plants that are food for butterfly larvae and lowland farmland birds).

Species associated with vegetation of special importance for nature conservation are known to be relatively localised and therefore uncommon in the countryside as a whole. Such species are relatively infrequent in the data and statistical comparisons of distributions, as used in the Results III chapter (pp 35–39), are inappropriate. Instead, the approach was to examine differences in the proportion of plots of each type (eg hedge plots and field plots) having at least one recorded occurrence for any species in the quality indicator group. Where larger numbers of records were available, differences in the total numbers of quality indicator species within each plot type were analysed. Where possible, analysis of change in abundance between 1978 and 1990 was also carried out, but using only the smaller number of replicate plots recorded in both years.

Habitat indicator species for unimproved grasslands

Approach

Conservation agencies in GB have identified species which they consider on the basis of expert judgement to be indicative of habitats of high conservation status. These lists can be used as a basis for interrogating the CS1990 database in order to determine the representation of these species in the wider countryside. The analysis has been carried

Table 7. Analysis of occurrence of unimproved grassland indicator species by plot type and landscape type, using Countryside Survey data for 1990 only. The χ^2 test was used to test for differences in the distribution of indicator species between plot types (* = p< 0.05, ** = p< 0.01). The data for habitat plots are presented in the table but were not included in the χ^2 test because they were not randomly located

Landscape type	Main	Roadside	Boundary	Hedge	Streamside	Sig	Habitat
i. Calcareous grassland indicators							
Arable							
Total count of species occurrences	128	95	91	11	43	*	79
% of plots with at least 1 present	5.6	8.2	6.4	2.9	5.8		4.6
Pastural							
Total count of species occurrences	117	68	41	1	51	**	214
% of plots with at least 1 present	9.9	8.1	4.8	0.4	6.6		14.6
Coastal							
Total count of species occurrences	155	41	36	0	83	**	136
% of plots with at least 1 present	32.7	16.5	14.7	0	31.2		26.4
ii. Acid grassland indicators							
Arable							
Total count of species occurrences	640	405	451	53	747	**	874
% of plots with at least 1 present	24.6	28.5	28.7	16.2	40.4		38.9
Pastural							
Total count of species occurrences	1268	657	710	154	1429	**	1629
% of plots with at least 1 present	43.8	47.1	46.8	40.3	61.7		62.3
Marginal upland							
Total count of species occurrences	2267	694	612	70	2189	**	1907
% of plots with at least 1 present	86.8	75.2	83.9	73.8	93.9		93.5
Upland							
Total count of species occurrences	5731	937	650	_	5358	**	3684
% of plots with at least 1 present	94.2	88.3	93.3	_	98.9		97.1
Coastal							
Total count of species occurrences	1673	431	332	12	1398	**	1095
% of plots with at least 1 present	66.7	57.5	56	22.6	80.5		72.2
iii. Mesotrophic grassland indicators							
Arable							
Total count of species occurrences	500	485	415	69	772	**	971
% of plots with at least 1 present	22.3	33.5	27.8	20.6	47.5		44.7
Pastural							
Total count of species occurrences	909	660	538	106	1319	**	1565
% of plots with at least 1 present	34.2	44.5	36.9	26.5	65.7		63.7
Marginal upland							
Total count of species occurrences	981	400	272	45	1329	**	1055
% of plots with at least 1 present	70.4	62.2	53.6	50	88.1		79.5
Upland							
Total count of species occurrences	2265	505	314	0	2811	**	1780
% of plots with at least 1 present	84.3	79.8	78.3	0	94.4		81.9
Coastal							
Total count of species occurrences	1010	281	248	9	1007	**	838
% of plots with at least 1 present	60.9	50.9	47.8	22.6	81.8		71.9

out for three types of unimproved grassland using lists of indicator species provided by English Nature. The approach is generic, however, in that a variety of different lists could be used to generate alternative assessments of landscape elements and vegetation types in terms of botanical quality of different habitats.

Three categories of habitat indicator species were considered, which were:

- those regarded as indicators of unimproved calcareous grasslands in England and Wales;
- acidic grassland species in GB;
- mesotrophic grassland species in GB.

Results are expressed as differences between plot types within the four landscape types (arable, pastural, marginal upland and upland) but including an additional overlapping coastal zone comprising all sampled 1 km squares containing maritime fringe features such as sea, estuary, sea cliff, salt marsh and dunes.

Occurrence of habitat indicator species

Calcareous grassland indicators occurred in a significantly greater number of roadside plots than other plot types in the arable landscape, whereas in the pastural and coastal landscapes the indicators occurred most frequently in the main plots (Table 7i). The analysis was not extended to upland or marginal upland plots because northern limestone species are not included in the list.

In all landscape types, acidic and mesotrophic grassland indicator species were recorded from a significantly greater proportion of streamside plots than any other plot type (Table 7ii and iii). Many of these species can occur in species-rich wet grasslands. However, the importance of streamsides as refugia is highlighted in the lowlands where the total number of records of indicator species over all plot types was much lower than the uplands.

Changes between 1978 and 1990

Tests for the significance of changes in presence of indicator species between 1978 and 1990 were undertaken (Table 8). A significant increase in the number of plots containing at least one calcareous grassland indicator was detected in the coastal zone with 55 plots in 1978, 87 and 90. A significant reduction in records for acid grassland indicator species was detected for the whole of GB (–4%) and separately in the upland landscape (–2%). A significant reduction in records for mesotrophic grassland indicators was detected for the whole of GB (–8%) and for the pastural landscape (–11%).

Some indicator species are less strictly confined to unimproved mesotrophic grasslands. These are given a value of 1 in the English Nature grassland indicator list and are described as "..often found in other habitats and including some species able to *hang on* in semi-improved swards...". These were removed and the analysis re-run using only the more strict mesotrophic indicators. As shown in Table 9, the decline becomes even more marked, revealing a 22%

Table 8. Change in numbers of paired plots between 1978 and 1990 that had at least one of the indicators of unimproved grassland for all plot types by landscape type and GB. The χ^2 test was used to test for differences in the distribution of indicator species between the survey dates (ns = *not significant*; * = p< 0.05, ** = p< 0.01)

	Sig	No. of plots in 1978	1990	% change	Chi-square
Calcicoles					
GB	ns	255	276	–	1.4
Arable	ns	54	40	–	3.4
Pastural	ns	56	61	–	0.2
Coastal	**	55	87	58.2	14.6
Mesotrophic species					
GB	**	1156	1068	–7.6	16.4
Arable	ns	226	195	–	1.4
Pastural	**	333	296	–11.1	7.0
Marginal upland	ns	219	214	–	0.3
Upland	ns	378	363	–	3.4
Coastal	ns	166	171	–	0.4
Acidophiles					
GB	**	1243	1189	–4.3	6.9
Arable	ns	201	180	–	2.7
Pastural	ns	370	352	–	1.5
Marginal upland	ns	264	258	–	0.6
Upland	*	408	399	–2.2	4.3
Coastal	ns	173	178	–	0.3

Table 9. Change in numbers of plots that have at least one English Nature indicator for unimproved mesotrophic grassland between 1978 and 1990. Includes only taxa **strictly** confined to unimproved mesotrophic grasslands for all plot types, by landscape type and GB. The χ^2 test was used to test for differences in the distribution of indicator species between the survey dates (ns = *not significant*; *= p< 0.05, ** = p< 0.01)

	Sig	No. of plots in 1978	1990	% change	Chi-square
GB	**	685	624	–8.9	9.5
Arable	*	86	67	–22.1	3.9
Pastural	*	153	130	–15	4.1
Marginal upland	ns	128	122	–	0.4

reduction in the number of records in the arable landscape as well as increasing the percentage decline in GB to 9% and in the pastural landscape to 15%.

Caution is required in the interpretation of these results because the habitat indicator species can occur in other habitats, situations or geographical areas where they would not be regarded as being indicative of high value for nature conservation. For example, acid grassland species would not necessarily be regarded as indicative of high conservation status where they occurred in heathland.

Key results

The analyses provide evidence that overall losses in species diversity observed in grasslands between 1978 and 1990 were associated with a decline in the frequency of species indicative of unimproved mesotrophic and acidic grassland.

Rarity indicator species

Approach

Two groups of rare plant species were considered. The nationally scarce and Red Data Book (RDB) species found in 1–100 hectads (ie 10 × 10 km squares) in GB and rare species found in 101–200 hectads. The number of plots in which these scarce and rare indicator species was compared between landscape types, plot types and between 1978 and 1990.

Occurrence of rare and scarce species

The nationally scarce and RDB species were recorded (Table 10) in only 66 plots in 1990 consisting of:

- 22 in the arable landscape;
- 18 in the pastural landscape;
- 6 in the marginal uplands;
- and 20 in the upland landscape.

However, in a proportion of the total number of plots in each landscape type significantly

Table 10. Analysis of rare and scarce species occurring in 1–100 hectads or 101–200 hectads in GB based on Biological Record Centre (BRC) data, by landscape type and plot type, using Countryside Survey data for 1990 only. The χ^2 test was used to test for differences in the distribution of indicator species between plot types (* = $p < 0.05$, ** = $p < 0.01$). The data for habitat plots are presented in the table but were not included in the χ^2 test because they were not randomly located

i. Landscape type affinity

	Arable	Pastural	Marginal upland	Upland	Significance
1–100 hectads					
Total count of species occurrences	22	18	6	20	**
% of plots with at least 1 present	0.5	0.5	0.4	1	
101–200 hectads					
Total count of species occurrences	38	79	18	39	**
% of plots with at least 1 present	0.9	1.9	1.1	2	

ii. Plot type affinity

	Main	Roadside	Boundary	Hedge	Streamside	Significance	Habitat
1–100 hectads; all GB							
Total count of species occurrences	18	4	4	2	15	*	23
% of plots with at least 1 present	0.7	0.2	0.2	0.4	0.7		0.9
101–200 hectads; all GB							
Total count of species occurrences	43	18	15	3	32	ns	63
% of plots with at least 1 present	1.5	0.9	0.8	0.5	1.4		2.4

more records were found in the uplands. The same preference for the upland landscape was found for the rare species occurring in 101–200 hectads in GB. No significant difference in numbers of records between plot types was detected for species occurring in 101–200 hectads. Nationally scarce and RDB species showed significant differences in plot type preference with records more common in main and streamside plots.

Changes between 1978 and 1990

No change in number of records was detected for either the scarce or rare species. However, the records of rare species are by their nature small in number, unusual and therefore difficult to generalise from, using data from CS1990.

Key results

Rare and scarce species were found in only 66 plots in 1990, a small proportion of the CS1990 plots. Rare and scarce species occurred preferentially in main and streamside plots and in upland landscapes. No changes were detected between 1978 and 1990.

NVC diagnostic species

Approach

The NVC was developed for the mapping, description and assessment of semi-natural vegetation communities (Rodwell 1992). One method of interpreting Countryside Survey vegetation data is to identify core assemblages of species which are typical of a particular NVC community, even though they are likely to be accompanied by species perhaps typical of other community types. This is especially because field sampling for NVC targets homogenous stands of vegetation, while Countryside Survey protocols will encompass gradations of vegetation types.

Within the NVC, there are combinations of widespread species which characterise the less common plant communities, and so it is possible to detect the presence and changes in these communities in a robust statistical manner by analysing those situations where such widespread species occur together. As an example, the plot type and landscape preferences of species that characterise the NVC unimproved grassland community MG5 (Rodwell 1992) were analysed.

Many of the species that *together* typify MG5 grow in abundance in other communities where they exhibit patterns of joint association with other species and may even be used to characterise them. The first step was, therefore, to define a list of species whose joint occurrence is considered characteristic of MG5 vegetation. To do this, all species with constancy of three or more were selected from the floristic table for MG5 published in Rodwell (1992). Species were then excluded if they were also common in other habitat types, as evaluated using Biological Records Centre (BRC) grades, resulting in a list of 21 species (Table 11), here termed MG5 'faithful species'.

Two subsets of plots recorded in 1990 were then defined for analysis using the list of

Table 11. Species faithful to the unimproved neutral grassland type defined as MG5 *Centaurea nigra – Cynosurus cristatus* community within the NVC (Rodwell 1992). * = four species most diagnostic of MG5 from the published key

Species	NVC constancy value
Cynosurus cristatus	5
Festuca rubra agg.	5
Lotus corniculatus	5*
Plantago lanceolata	5
Agrostis capillaris	4*
Anthoxanthum odoratum	4*
Dactylis glomerata	4
Holcus lanatus	4
Trifolium pratense	4*
Trifolium repens	4
Centaurea nigra	4
Achillea millefolium	3
Lolium perenne	3
Prunella vulgaris	3
Ranunculus acris	3
Ranunculus bulbosus	3
Rumex acetosa	3
Trisetum flavescens	3
Luzula campestris	3
Hypochaeris radicata	3
Leontodon autumnalis	3

faithful species. Firstly, a subset of plots was selected such that each contained a minimum identifiable floristic element of MG5. To define this minimum representation, the published key to the grasslands chapter of British Plant Communities (Rodwell 1992) was examined and those species highlighted as being most powerful in distinguishing between MG5 and floristically similar grasslands were used. These were bird's foot trefoil, bent grass, red clover (*Trifolium pratense)* and sweet vernal grass. Out of over 11 000 plots only 73 (0.6%) were selected because they contained all 4 species. Of these 62 (84%) were in infertile grassland, the remainder being in moorland grass/mosaic. The small size of the data set indicates how uncommon the assemblage is in the countryside as a whole. When these plots were grouped by plot type no significant differences in total count of the remaining 19 faithful species were detected, implying that these plots could be regarded as relatively homogeneous. Secondly, joint occurrence patterns of all MG5 faithful species were examined for between plot type and between landscape type differences. For this analysis any plot that contained at least one or more of the faithful species was included.

Frequency distribution of MG5 species among plots

The distribution of MG5 faithful species across the entire CS1990 data set covers extremes which at one end contains many plots that have only one of these species, whilst at the other extreme there are a small number of plots which contain the majority of the species in the list. Examination of the shape of the distribution pattern between these extremes can convey differences in the relative joint abundance of MG5 species for each plot type and each landscape. Figure 11 presents this distribution which describes the increasing numbers of species contributing to a joint association of MG5 species in different plot types, omitting the upland landscape which is outside the expected distribution range of the community.

The degree of the rarity of the community depends upon how many of the MG5 faithful species are judged to be required before the community can be assigned to MG5. Where only one species is present, the community cannot be regarded as MG5, but as the number of faithful species in each plot increases, the greater is the confidence that the plot is best placed in MG5.

In Figure 11, the greater the percentage of plots occupied by high numbers of MG5 species, the more the distribution is skewed to the right of each graph. In practice, there are few plots in the different combinations of landscape and plot type which show more than six MG5 species, and only 25 plots in total have 14 MG5 species or more (Table 12). Main plots in the arable landscape have the lowest representation of MG5 species – they are more abundant in roadsides in all landscapes and in boundary plots in the marginal uplands. The greatest concentration of MG5 plots was in roadside verges in the marginal uplands, although even here only 2.8% of plots had 12 MG5 species growing together.

Changes between 1978 and 1990

For the analysis of change between 1978 and 1990, the variable of interest was the median number of faithful species in each plot which is considered to be MG5, (ie having pre-selected a group of plots possessing a minimum floristic element of MG5 we go on to test whether, between years, there has been any differences in median richness of the remaining MG5 indicators in Table 11, and therefore any increase or decrease in similarity to MG5, which would then change conservation status).

Table 12. Number of plots in the CS1990 database by plot and landscape type that contained over 14 of the faithful species of MG5 within the NVC (Rodwell 1992)

	Landscape type			
Plot type	Arable	Pastural	Marginal upland	Total
Habitat	1	6	–	7
Roadside	–	–	2	2
Streamside	–	–	1	1
Main	–	7	8	15
Total	1	13	11	25

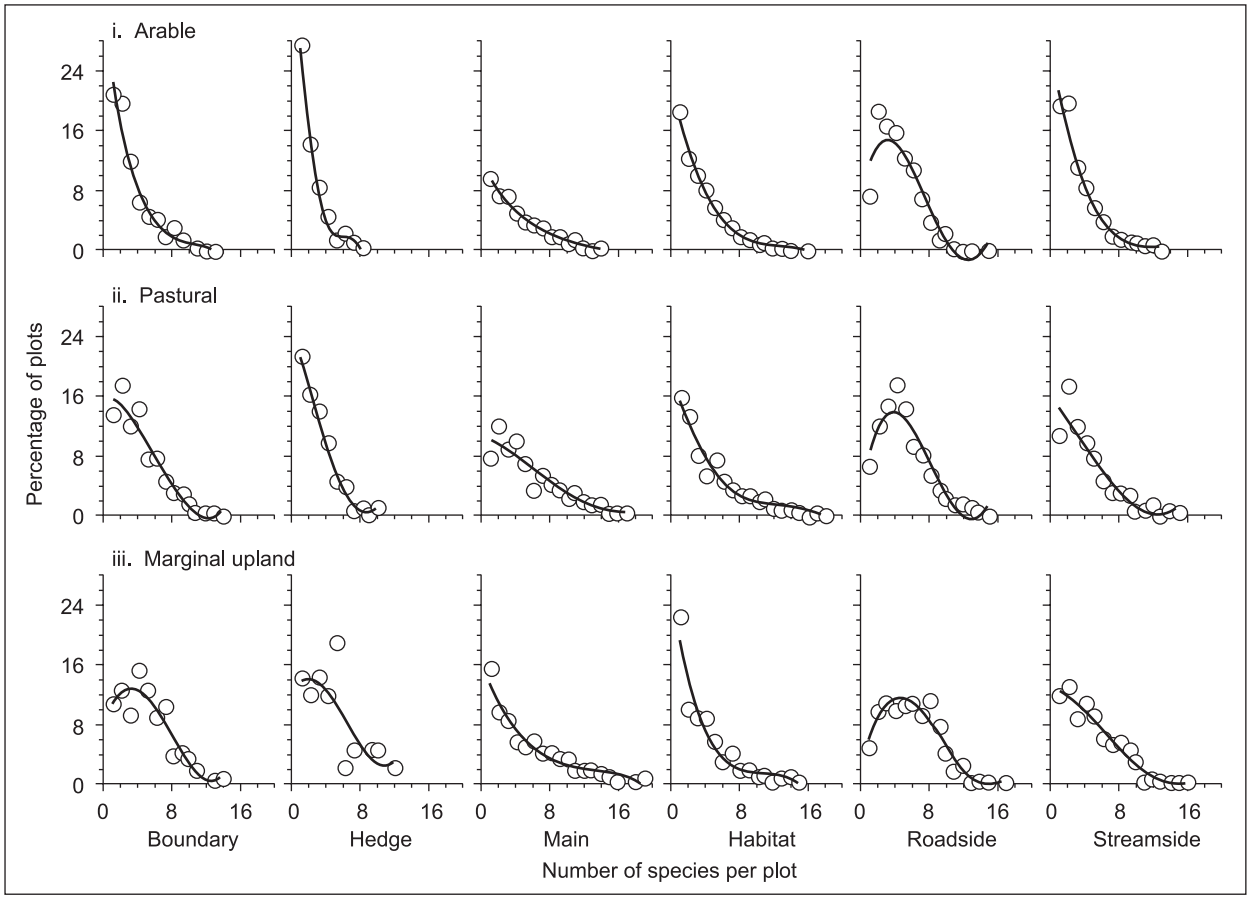


Figure 11. Percentage of plots containing different numbers of unimproved neutral grassland species which together define MG5 within the NVC (Rodwell 1992), by plot types and landscape types (uplands are excluded)

Only 17 plots had all four species recorded together in 1978. Between 1978 and 1990 there was a significant increase in richness of MG5 faithful species in these plots. Their environmental and ecological situations were examined by reference to the original survey records and were shown to be almost entirely in small patches of vegetation, rather than in large management units. They are therefore vulnerable to neglect and land use change.

Key results:

Unimproved neutral grassland (MG5) was chosen as an illustration of the application of NVC quality criteria to the Countryside Survey data. Very few characteristic MG5 plots were found, though many more contained elements of the MG5 community, especially on roadsides. These plots appeared to improve in quality between 1978 and 1990 but were shown to be in small patches and vulnerable to land use change.

Abundance of preferential species

Approach

Preferential species are the species shown to be most strongly associated with each of the eight CVS aggregate classes by a chi-square analysis. These preferential species for each aggregate class were then divided into three groups – abundant, intermediate and rare – based upon their frequency in the Countryside Survey plots (Annex 17).

While the abundant preferental species strongly characterise the vegetation, the intermediate and rare species tend to be more indicative of a high conservation value of the vegetation. However, the interpretation differs between aggregate classes. For example, all abundance categories of infertile grassland could be regarded to be of higher conservation value, since the aggregate class itself represents a diverse range of semi-improved and semi-natural grasslands which are relatively uncommon in

Countryside Survey data. In the lowland wooded class, however, the rare and intermediate species include many ancient woodland indicator species. By analysing plots in terms of the comparative richness of the abundant, intermediate and rare preferential species for each aggregate class, it is possible to make statements about the conservation value of different elements on the landscape and changes in these values between 1978 and 1990.

Occurrence of preferential species

In tall grassland/herb the greatest numbers of preferential species were found in hedge plots in the arable landscape and roadside plots in the pastural landscape. In infertile grassland the greatest numbers of preferential species were found in main and roadside plots. Plots in marginal upland and pastural landscape types were more diverse than arable landscapes. In the upland landscape the greatest numbers of preferential species in moorland grass/mosaic vegetation were associated with streamside plots, whereas species preferential to heath/bog form the richest assemblages in main plots. The full results are presented in Annex 18.

In summary, therefore, hedges and roadsides in the lowlands have the best examples of tall grassland/herb vegetation. The marginal uplands hold the best examples of infertile grassland vegetation. In the uplands, watercourses are associated with the best examples of moorland grass/mosaic but the best examples of heath/bog are found on open moor and mountain.

Changes in preferential species between 1978 and 1990

A measure of changing ecological quality between 1978 and 1990 is provided by analysing changes that occurred in the numbers of preferential species for each aggregate vegetation class divided into the three abundance groups (abundant, intermediate or rare, see Annex 19). The main changes are as follows.

- A decline in the most abundant species in crops/weeds across the whole data set indicating more weed-free crops, since the average cover of weed species was also shown to have declined.
- An increase in the numbers of the most abundant preferential species in tall grassland/herb occurred in the arable and pastural landscapes.
- The number of the preferential species of infertile grassland fell across the whole data set with reductions in the most abundant species in the arable and pastural landscapes. These trends, when considered alongside the overall loss in species diversity and the decline in unimproved grassland indicator species, suggest that the more diverse grassland vegetation in GB experienced a marked decline in conservation value between 1978 and 1990.
- Few changes in intermediate and rare species were found to be significant, reflecting the smaller number of plots containing these species.

Key results

Generally, between 1978 and 1990, declines in species diversity were associated with losses in preferential species. Thus, the distinctiveness of different vegetation types was eroded.

Butterfly larval food plants

Approach

Vegetation forms part of functioning ecosystems and supports other valued elements of biodiversity. One way to assess this aspect of vegetation is to use known dependencies between individual plant species and faunal groups – if the plant species has increased in abundance or cover then that is an indication that the habitat for the animal species concerned has also improved. It is only an indication, since other factors can also be important. For example, adult butterflies require nectar resources and suitable micro-climates as well as larval host plants.

Lists of butterfly species and their larval host plants were obtained from the database of the

BRC. For each landscape type and aggregate class combination, the mean counts of butterfly host plants per plot were generated from 1990 data only. In total 145 butterfly host plants were recorded in Countryside Survey data.

Occurrence of host plant species

In all four landscapes the highest mean counts of host plants were in infertile grasslands, with a maximum value of 9.2 species per plot in the marginal uplands. The lowest numbers of host plants were found in crops/weeds in the arable and pastural and for lowland wooded vegetation in the marginal uplands (Table 13).

Changes between 1978 and 1990

Butterfly host plants for which significant changes in frequency between 1978 and 1990 were detected are listed in Table 14. Host plant

Table 13. Average numbers of butterfly larval food plant species per plot by landscape type and aggregate vegetation class from the CS1990 database

Landscape type	Aggregate vegetation class I	II	III	IV	V	VI	VII	VIII
Arable	2.4	6.0	6.7	8.1	4.5	4.8	7.2	4.6
Pastural	3.1	7.1	7.1	8.8	5.1	5.3	8.1	4.7
Marginal upland	4.1	7.4	7.2	9.2	3.9	5.4	7.5	4.8
Upland	3.3	6.0	6.7	8.5	–	5.1	7.8	5.3

Table 14. Numbers of butterfly larval food plants that have changed frequency between 1978 and 1990. Column labels indicate the combination of aggregate vegetation class (AC I–AC VIII) and the landscape types (A = arable, P = pastural, M = marginal upland, U = upland) in which significant increases and decreases were detected. Non-significant changes are not shown

i. Host plants increasing

Plant species	No. of butterfly species	II P	III P	V A	V P	VIII U
Agrostis capillaris	1					•
Elymus repens	9	•	•	•	•	
Succisa pratensis	1					•

ii. Host plants decreasing

Plant species	No. of butterfly species	I A	III A	III P	IV A	IV M	IV P	V P	VI P	VI U	VII M	VII U	VIII U
Agrostis capillaris	1				•		•		•			•	
Anthoxanthum odoratum	1											•	
Arrhenathrum elatius	1							•					
Calluna vulgaris	1												•
Cynosurus cristatus	1						•						
Dactylis glomerata	7		•										
Digitalis purpurea	1								•				
Elymus repens	9	•											
Festuca ovina	4											•	
Holcus lanatus	5		•				•			•			
Lolium perenne	1		•	•									
Lotus corniculatus	7						•						
Nardus stricta	2										•		
Plantago lanceolata	2				•	•	•					•	
Plantago major	1		•				•						
Poa annua	8	•	•	•									
Rumex acetosa	1						•						
Trifolium pratense	4						•						
Trifolium repens	4		•	•			•						

Table 15. Butterfly species whose larval food plants changed frequency between 1978 and 1990. Column labels indicate the combination of aggregate vegetation class (AC I–AC VIII) and the landscape types (A = arable, P = pastural, M = marginal upland, U = upland) in which significant increases and decreases were detected. Non-significant changes are not shown. Figures are the numbers of larval food plant species

i. Host plants increasing

Butterfly species	II P	III P	V A	V P	VIII U
Ringlet	1	1	1	1	
Marsh fritillary					1
Grayling	1	1	1	1	
Wall	1	1	1	1	
Meadow brown	1	1	1	1	
Marbled white	1	1	1	1	
Large skipper	1	1	1	1	
Speckled wood	1	1	1	1	
Hedge brown	1	1	1	1	1
Essex skipper	1	1	1	1	

ii. Host plants decreasing

Butterfly species	I A	III A	III P	IV A	IV M	IV P	V P	VI P	VI U	VII M	VII U	VIII U
Ringlet	2	2	1									
Green hairstreak						1						
Small heath	1	1	1			1				1	1	
Clouded yellow		1	1			3						
Pale Clouded yellow		1	1			3						
Mountain ringlet										1		
Dingy skipper						1						
Silver-spotted skipper											1	
Grayling	2	1	1								1	
Wall	2	3	1			1			1		1	
Wood white		1	1			3						
Small copper						1						
Meadow brown	2	1	1									
Marbled white	2	3	1			1			1		1	
Glanville fritillary		1		1	1	2					1	
Heath fritillary				1	1	1		1			1	
Large skipper	1	2				1			1			
Speckled wood	2	2	1									
Silver-studded blue						1						1
Common blue	1	1			3							
Hedge brown	2	3	2	1		1		1			1	
Essex skipper	1	2				1	1		1			
Small skipper		1				1			1			

species, totalling 19, showed a significant decline in frequency in one or more of aggregate class/ landscape type combinations. For example, bent grass decreased in abundance in:

- infertile grassland in arable and pastural landscapes;
- upland wooded vegetation in pastural landscapes;
- and in moorland grass/mosaic in upland landscapes.

The largest number of declines in host plant species was recorded for infertile grassland in the pastural landscape including the prostrate herb of unimproved grasslands bird's foot trefoil (the food-plant for seven butterfly

Table 16. Summary of significant changes in frequency of butterfly host plant species in all replicate plots of the Countryside Survey between 1978 and 1990

	Increasing	Decreasing
Butterfly host plants	3	19
Number of butterfly species for which host plants changed in abundance	10	23

species). It declined along with other typical species of unimproved grassland such as *Cynosurus cristatus,* red clover and *Plantago lanceolata*. In arable landscapes, fertile grasslands, and in upland landscapes, moorland grass/mosaic saw the greatest loss of host plant species.

Only three host plant species showed a significant increase in frequency in one or more of the aggregate class/landscape type combinations. The increase in couch grass in the lowlands occurred at the same time as an expansion of the range of several butterflies in southeast Britain (Pollard *et al.* 1995). The only host plant for which an increase in the uplands was detected was devil's-bit scabious (*Succisa pratensis).* This is the food-plant for the scarce and declining marsh fritillary (*Eurodryas aurinia*). However the butterfly is unlikely to benefit, because increases under sheep grazing are unlikely to result in the greater availability of the preferred larger and leafier individuals of the food-plant typical of 'boggy meadows' (Heath *et al.* 1984, Thomas 1991). This emphasises that direct associations between host plant frequency and butterfly populations are difficult to establish.

Of the remaining 123 host plant species, no change was detected as 15 (10%) and 108 (75%) were too infrequent to detect significant change.

About a third (35%) of the butterflies listed by BRC had host plants that declined (Tables 15 and 16). Differences in the range of each butterfly and its host species plus the presence of more than one host plant for many butterflies suggests that the consequences of these changes are likely to be far from simple.

Key results

Significant reductions in the frequency of 19 widely occurring butterfly larva host plants were detected between 1978 and 1990. Food plants for 23 butterfly species declined in abundance. The greatest reductions occurred in infertile grasslands. Only three host plant species increased in frequency.

Food plants of lowland farmland birds

Approach

Declines in farmland bird populations have been related to the indirect effects of pesticides (Campbell and Cooke 1997). Pesticides can reduce food resources in three ways:

- insecticides can reduce the abundance of invertebrates;
- herbicides may reduce the number of invertebrate host plants thus reducing their abundance;
- and herbicides may reduce the abundance of weeds and seeds directly exploited as food.

A similar approach to the butterfly host plants was used in the analysis in food plants for birds. Plant species were selected from the review of the diet of lowland farmland birds by Wilson *et al.* (1996). Twenty bird species were selected from the list of 24 declining, five stable and 11 increasing bird species in Campbell and Cooke (1997). A total of 133 relevant food plant species were recorded in the Countryside Survey database.

Occurrence of bird food plants

An analysis of the occurrence of bird food plants in the lowland landscapes and aggregate classes is presented for food plants of 12 declining bird species (Table 17). The number of food plants of

Table 17. Percentage of recorded ocurrences of all species which are food plants of 12 declining farmland birds (see Table 19) for aggregate vegetation classes in lowland landscapes in 1990

	Aggregate vegetation class				
Landscape type	I	II	III	IV	V
Arable	45.0	32.2	37.9	31.6	29.5
Pastural	50.2	34.9	41.0	32.2	28.4

Table 18. Average cover per plot (%) of food plants for four severely declining farmland birds (see Table 19). The figure in brackets is the percentage of plots in which total cover was ≥ 10%. Thus, for the tree sparrow the average cover of food plants per plot in crops/weeds in the arable landscape was 13.4%, and 19.6% of plots had over 10% cover of food plant species

Bird species	Landscape type	Aggregate vegetation class I	II	III	IV	V
Tree sparrow	Arable	13.4 (19.6)	1.9 (1.4)	4.1 (4.2)	1.4 (0.8)	2.7 (1.1)
	Pastural	23.2 (34.4)	2.4 (2.0)	2.7 (2.8)	1.6 (1.0)	1.5 (0.4)
Cirl bunting	Arable	10.3 (14.1)	4.6 (10.9)	6.8 (15.5)	5.2 (10.3)	5.2 (5.1)
	Pastural	17.7 (25.6)	5.6 (10.7)	5.8 (14.9)	5.1 (8.1)	4.3 (4.2)
Grey partridge	Arable	15.3 (23.8)	5.0 (13.1)	10.4 (30.1)	7.9 (25.3)	4.6 (5.3)
	Pastural	26.1 (41.9)	6.2 (15.2)	11.9 (37.7)	8.3 (25.3)	3.7 (4.6)
Bullfinch	Arable	4.7 (7.7)	15.4 (35.5)	4.8 (8.8)	5.5 (10.8)	38.3 (74.7)
	Pastural	6.5 (14.4)	18.9 (48.1)	4.9 (10.1)	7.4 (13.3)	32.8 (68.3)

the declining farmland birds is expressed as a percentage of the the total number of species recorded in Countryside Survey plots in the arable and pastural landscape types. Crop and ruderal species such as chickweed, annual meadow grass and especially *Polygonum* spp. feature prominently in the list of food plants, and it is, therefore, not surprising that the highest proportions of food plants were found in crops/weeds in both arable and pastural landscapes, 45% and 50% of species, respectively.

Table 19. List of declining, stable and increasing farmland bird species (after Campbell & Cooke 1997) and changes in their associated food plants by landscape type (A = arable, P = pastural, M = marginal upland) and GB. Figures are the number of food plants with increasing frequency or cover. Thus, for the tree sparrow four food plant species decreased in frequency or cover in arable landscapes, and three in pastural landscapes. No significant increases in frequency or cover of food plant species were detected

Bird	Present status: Declining	Stable	Increasing	Number of food plants with detected range changes: GB +	GB –	Increases A	Increases P	Increases M	Decreases A	Decreases P	Decreases M
Tree sparrow	•				4				4	3	
Cirl bunting	•			1		1	1		1	1	1
Grey partridge	•			1	6	1		1	6	5	1
Bullfinch	•			3	4	2	4		4	4	
Song thrush	•			2		1	1				
Reed bunting	•				2				2	2	
Skylark	•				2				3	1	
Linnet	•			2	8		2		5	5	
Blackbird	•			1		1	2				
Mistle thrush	•			1		1	2				
Dunnock	•				4	2	1	1	6	6	1
Yellowhammer	•			2	1	1	2	2	1	1	1
Meadow pipit		•			2	1			1	1	1
Greenfinch		•		1	5		1		4	4	
Robin		•		2		3	2				
House sparrow			•		5				3	2	
Goldfinch			•	2	4		2		3	3	
Chaffinch			•	1	5		1		4	3	
Woodpigeon			•		2			1	4	3	
Stock dove			•		3				3	2	

Table 20. List of farmland bird food plant species that have changed significantly in frequency between 1978 and 1990 by landscape type (A = arable, P = pastural, M = marginal upland) and for GB (+ = gain in species frequency, – = decline in species frequency)

	GB		Increases			Decreases		
Food plant species	+	–	A	P	M	A	P	M
Festuca ovina		•					•	•
Capsella bursa-pastoris		•						
Cirsium palustre		•						
Cirsium vulgare		•						
Rumex acetosella		•						
Centaurea nigra		•					•	
Taraxacum agg.		•					•	
Holcus mollis							•	
Poa annua		•				•	•	•
Agrostis capillaris		•	•				•	•
Arrhenatherum elatius		•				•	•	
Cerastium fontanum		•				•	•	
Polygonum aviculare		•				•	•	
Stellaria media		•				•	•	
Trifolium pratense		•				•	•	
Polygonum persicaria		•				•		
Poa pratensis		•	•					
Rumex obtusifolius	•					•	•	
Trifolium repens	•				•	•	•	
Holcus lanatus					•	•	•	
Lolium perenne	•			•		•		
Prunus spinosa	•					•		
Rumex acetosa		•		•				
Sambucus nigra			•					
Sonchus oleraceus	•							
Hedera helix	•		•	•				
Potentilla reptans	•		•	•				
Rubus fruticosus	•		•	•				
Agrostis stolonifera	•		•	•	•			
Festuca rubra	•		•	•	•			
Festuca vivipara	•				•			
Cirsium arvense	•			•				
Urtica dioica	•			•				
Potentilla erecta					•			
Crataegus monogyna				•				

Plant cover, rather than simple presence is a better reflection of the abundance of a food source in a particular place. For four of the severely declining farmland bird species (tree sparrow, cirl bunting, grey partridge and bullfinch) food plant abundance is presented in terms of mean cover in plots and the percentage of plots in which total cover equalled or exceeded 10% (Table 18).

The importance of crops/weeds as a source of food plants for grey partridge, tree sparrow and cirl bunting is well illustrated as food plants made up over 10% of the vegetation cover. But in each case, crops/weeds in pastural landscapes had a greater cover than in arable landscapes. Availability of the food plants in the other aggregate classes (AC II–V) was much reduced, especially for tree sparrow and cirl bunting. For the bullfinch, the highest cover of food plants was found in lowland wooded and tall grassland/herb plots. Food plants for the bullfinch include species such as

Table 21. Number of food plants of selected lowland farmland birds that have changed significantly in abundance between 1978 and 1990 by landscape type (A = arable, P = pastural, M = marginal upland)

	Increasing				Decreasing			
	GB	A	P	M	GB	A	P	M
Total	13	8	10	6	17	12	14	3

stinging nettle, hawthorn and elder which are major cover elements of hedges and other linear features.

Changes in frequency and cover of food plants between 1978 and 1990

Changes in the frequency and cover of the food plants of 20 farmland birds were analysed (Table 19). The declining, stable or increasing status of farmland birds followed Campbell and Cooke (1997). A plant species was classified as an increaser or decreaser based upon the difference in number of statistically significant increases or decreases in frequency (between plots) and cover (within plots) in the analysis of 1978 and 1990 paired vegetation plots by aggregate class, landscape and plot type. The number of increasing and decreasing food plants was summed for each bird species in the three landscapes (arable, pastural and marginal uplands) to provide figures for GB (Table 20).

Of all significant food plant frequency changes detected at the GB scale, 17 species decreased in abundance whilst 13 increased (Table 21). Net decreasers included arable crops and weed species particularly important in the diet of severely declined birds such as tree sparrow, cirl bunting, grey partridge and corn bunting.

Changing patterns of food plant abundance however, fail to separate the three groups of stable, increasing and decreasing species. For example, high counts for decreasing food plants are associated with increasing birds such as wood pigeon, house sparrow and stock dove. Factors such as polyphagy, range restriction and nesting habitat specialisation are also likely to be implicated in the cause of decline in different species.

Key results

Significant increases and decreases in frequency and cover of the food plants for farmland birds were detected. More decreases in food plant species were detected than increases, especially in arable landscapes. However, there was no clear relationship between declining food plant availability and population status of farmland birds.

RESULTS V
THE ANALYSIS OF CHANGES IN BOTANICAL COMPOSITION TO INDICATE ENVIRONMENTAL CHANGE

Functional analysis of botanical change (1978–90)

Approach

The application of plant strategy theory and analysis of functional types within the CVS are described on pages 24–25. The data are analysed (Wilson 1999) by plot type, aggregate class and landscape types and by higher level groupings of plots. This overcomes problems associated with the small samples of plots in certain groupings. It also validates some of the observed functional shifts seen at fine divisions by showing the same processes in higher aggregations and provides better evidence of a consistent functional shift in species characteristics**.**

Three types of change analysis were carried out.

- **Type 1 – 'simple' analysis**
  This compares the change in the mean characteristics of plots according to their aggregate classes in 1978 and 1990. This is not therefore an analysis of replicate pairs since, for example, a plot that was in tall grassland/herb in 1978 but moved to fertile grassland in 1990 will contribute to tall grassland/herb data for 1978 but not to fertile grassland data for 1990.

- **Type 2 – 'stay-the-same' analysis**
  This analysis only includes plots which were in the same aggregate class in 1978 and 1990. This is a strict analysis of matched data for the same plots. Because the data set only included plots that remained in the same aggregate class, sample sizes are smaller but the analysis focuses on more subtle changes in species composition of insufficient magnitude to move the vegetation into a different class.

- **Type 3 – '1978-based' analysis**
  This analysis grouped matched pairs of plots by their aggregate class in 1978 irrespective of the class they ended up in in 1990. As a result this analysis followed the divergent fate of plots from a common starting point using the species composition of plots in 1978 as a baseline. This is the main type of analysis of aggregate classes used elsewhere in this report.

Results are summarised in Table 22 which highlights strata in which analyses of the change in representation of different plant functional traits lead to inferences of the processes at work between 1978 and 1990. Plant traits include those derived from plant species distributions (based on surveys of vegetation in central England), through traits of plant morphology derived from floras (eg plant height) to reliable, predictive traits of species ecology (eg leaf mineral nutrient contents). Thus, a large number of correlations with the less reliable distribution data may be less indicative of change than a smaller number of correlations with hard, predictive variables. Furthermore, in situations where processes of change have affected the plots in more than one direction, a confused set of significant correlations may give an apparently self-contradictory picture.

Results of Type 1 'simple' analysis of changes of plots in 1978 and 1990

Crops/weeds (AC I) showed viable groups of plots occurring in arable and pastural landscapes but significant changes in functional strategy were seen only in the arable landscape. The changes indicated increased disturbance in linear as well as main plots. Increases in seed weight and

Table 22. Processes inferred from changes in representation of plant functional traits in CS plot records between 1978 and 1990. (Eu = correlations between species proportional changes and values of species traits consistently indicate eutrophication in those vegetation plots. Di = correlations consistently indicate increased disturbance to the vegetation in plots, De = correlations consistently indicate dereliction, np = inconsistent patterns of correlation, * = too few plots or stratum empty). Results are presented for the three change analysis types

Aggregate vegetation class		Plot type: Hedge	Roadside	Streamside	Main	All
i. Type 1 – 'simple' analysis						
I	Crops/weeds	*	*	*	np	np
II	Tall grassland/herb	np	np	np	*	np
III	Fertile grassland	*	np	*	np	np
IV	Infertile grassland	np	np	np	np	np
V	Lowland wooded	*	np	np	np	
VI	Upland wooded	*	*	np	*De	
VII	Moorland grass/mosaic	*	*	np	np	np
VIII	Heath/bog	*	*	*	np	np
ii. Type 2 – 'stay-the-same' analysis						
I	Crops/weeds	*	*	*	np	Di
II	Tall grassland/herb	np	np	np	*	np
III	Fertile grassland	*	np	*	np	np
IV	Infertile grassland	np	De/Eu	De/Eu	np	np
V	Lowland wooded	np	*	*	*	Eu
VI	Upland wooded	*	*	np	*	np
VII	Moorland grass/mosaic	*	*	np	np	np
VIII	Heath/bog	*	*	*	np	np
iii. Type 3 – '1978-based' analysis						
I	Crops/weeds	*	*	*	De	De
II	Tall grassland/herb	De	np	np	*	np
III	Fertile grassland	*	np	*	np	np
IV	Infertile grassland	np	De	De	np	De
V	Lowland wooded	np	*	*	*	Eu
VI	Upland wooded	*	*	Di	*	np
VII	Moorland grass/mosaic	*	*	np	np	np
VIII	Heath/bog	*	*	*	Eu/Di	Eu/Di

plant canopy height are associated with large-seeded ruderals that germinate in the autumn. The change may be linked to a change from spring to autumn sown crops.

Tall grassland/herb (AC II) showed changes which were again only seen in the arable landscape. Changes were masked by the lack of change or contradictory changes in other landscape types, when all landscape types are analysed together. Changes in both road verges and hedges are quite strongly indicative of dereliction as both plot types became less ruderal and more dominated by competitive species or species with extensive canopies that undergo an extended period of growth before flowering. This pattern was not seen in streamside plots.

Fertile grassland (AC III) showed very little in the way of consistent change probably because this vegetation was already intensively managed in 1978.

Infertile grassland (AC IV) showed many significant changes, particularly in streamside and main plots. The data also provided a good example of the efficacy of using a wide variety of plant traits, as

in several cases subsets of the data indicate the same changes as higher groupings. The changes observed also differed between landscape types. Results from the arable landscape indicated increases in disturbance as they all show increases in species richness and in species of disturbed habitats at the expense of species of more closed habitats. Smaller seeded species also seemed to be increasing. In the marginal upland landscape the changes to streamside and main plots seemed to be in the direction of eutrophication. Both groupings showed correlations that may indicate this process but via different sets of traits. The process is masked at the whole landscape level by many hedge and roadside plots that did not show the same changes. The pastural landscape showed its own processes of change, both streamside and road verge plots having correlations that suggest inconclusively processes of dereliction or eutrophication. Evidence of eutrophication was found in plots throughout the pastural landscape.

Lowland wooded (AC V) showed change which was detectable in the arable landscape and not in the pastural landscape. The correlations for the arable landscape suggested eutrophication.

Upland wooded (AC VI) showed change which was seen in the upland landscape where two reliable correlations indicated increases in species of nutrient rich habitats. When all upland plots were analysed the suggestion of eutrophication was much greater. Large, competitive species of nutrient rich habitats were increasing at the expense of stress tolerant species of diverse habitats. There was also an indication of dereliction, a process indicated for all streamside plots.

Moorland grass/mosaic (AC VII) and heath/bog (AC VIII) showed little change – in contrast to the analysis of change in Ellenberg scores (see below).

Results of Type 2 'stay-the-same' analysis

Crops/weeds (AC I) showed changes in the arable but not in the pastural landscape. Changes suggest an increased disturbance regime, favouring large-seeded tall species adapted to frequent disturbance.

Tall grassland/herb (AC II) showed little evidence of change with the 'stay-the-same' analysis, perhaps because the main changes involved shifts between aggregate classes.

Fertile grassland (AC III) also showed little change except for the main plots in the arable landscape. Here the correlations give quite strong evidence of eutrophication occurring.

Infertile grassland (AC IV) showed changes to roadsides in the pastural and marginal upland landscapes, to streamsides in the pastural landscape. All of these changes involved consistent increases in large, long-lived species able to dominate the vegetation indicating eutrophication or dereliction.

Lowland wooded (AC V) showed increases of large, competitive species despite relatively few plots being available for analysis in the individual landscape types. The results for all plot types in the pastural landscape further indicate eutrophication. Stress tolerant species from species-rich habitats were shown to be decreasing.

Upland wooded (AC VI), moorland grass/mosaic (AC VII) and heath/bog (AC VIII) showed few functional changes in the 'stay-the-same' analysis.

Results of Type 3 '1978-based' analysis

Crops/weeds (AC I) showed distinct patterns of change across landscape types. In arable and pastural landscapes, species of arable habitats with long-lived seed banks decreased at the expense of longer-lived larger species characteristic of

various grassland and derelict habitats. This result is consistent with plots moving from crops/weeds to tall grassland/herb and fertile grassland.

Tall grassland/herb (AC II) showed consistent indications of dereliction, and in some cases eutrophication, across the pastural landscape and throughout roadside and hedge plots. Throughout roadsides the trend was towards large, long-lived competitive species at the expense of smaller, short-lived species (ie dereliction). There was also a hint in the less intensive marginal upland landscape of eutrophication accompanying dereliction, as stress tolerant species of species-rich habitats also decreased.

Fertile grassland (AC III) showed hints of the same processes occurring in road verges in both the arable and pastural landscapes, in arable streamside plots, and in all pastural plot types together. All these groups showed an increase in large, long-lived competitive species at the expense of ruderal species (ie dereliction). In both arable and pastural landscapes many plots moved from fertile grassland to other grassland groups. Dereliction was also indicated in pastural streamsides.

Infertile grassland (AC IV) showed more pronounced changes than the 'stay-the-same' analysis with changes mainly in the marginal upland and pastural landscapes. The same trend (ie eutrophication) is involved.

Lowland wooded (AC V) showed changes involving the loss of species in shady habitats to species of more managed habitats. Several correlations with the 'hard' nutrient concentrations traits suggested increases in species of more nutrient rich habitats (ie eutrophication). This is in agreement with observed shifts of over 25% of plots from lowland wooded to tall grassland/herb between 1978 and 1990.

Upland wooded (AC VI), moorland grass/mosaic (AC VII) and heath/bog (AC VIII) showed no consistent patterns of change.

Key results

The detailed analysis of vegetation change shows contrasting trends and features in different elements of the landscape. Overall, several results indicate widespread effects of eutrophication and dereliction in the already more nutrient rich arable and pastural lowlands. The causes of these changes are the subject of ECOFACT Module 6 (Firbank *et al.* in prep).

Environmental changes indicated by Ellenberg indicator values

Approach

The application of Ellenberg scores to the vegetation data in the CVS is described on pages 19–20. Changes between 1978 and 1990 were based on the Type 3 '1978-based' analysis described above.

Changes in Ellenberg indicator values

A summary table of the significant changes in Ellenberg indicator values are given in Table 23. The full results are presented for all GB plots in Annex 20 and for plots on agricultural land in England and Wales in Annex 21.

Significant increases in Ellenberg fertility scores were detected in main, hedge and roadside plots within fertile grassland and infertile grassland classes. Significant increases were also detected in main and streamside plots within heath/bog. The only significant decrease in fertility score was in streamside plots within tall grassland/herb. Significant increases in Ellenberg pH scores (ie decrease in acidity) were detected in:

- main plots within crops/weeds and infertile grassland;
- hedge plots within tall grassland/herb;
- roadside plots within fertile grassland;
- and in main plots and streamside plots within heath/bog.

The only significant decrease in acidity, as with fertility, was in streamside plots within tall grass/herb.

Table 23. Summary of the significant changes ($p<0.1$) in recalibrated Ellenberg indicator values by plot type for all plots in GB, and for plots on agricultural land in England and Wales – figures are number of changes of aggregate class/landscape type combinations for which sufficient data were available (max = 32, + = number of significant increases in mean Ellenberg indicator values, – = number of significant decreases, ns = number of combinations where no significant change was detected). Full details are given in Annexs 20 and 21

		Fertility			pH			Light			Moisture			Continentality		
Plot types		+	–	ns	+	–	ns	+	–	ns	+	–	ns	+	–	ns
Main	GB	3	0	4	0	0	4	0	3	4	1	3	3	5	0	2
	EW	2	0	2	0	0	1	0	0	4	0	2	2	2	0	2
Roadside	GB	2	0	2	0	0	3	1	1	2	1	1	2	1	0	3
	EW	0	0	2	0	0	1	0	0	2	0	0	2	0	0	2
Streamside	GB	1	1	5	1	1	5	2	2	3	3	1	3	2	2	3
	EW	0	0	5	0	0	5	1	1	3	1	1	3	1	1	3
Hedge	GB	3	0	0	1	0	2	1	1	1	1	0	2	1	0	2
	EW	1	0	1	1	0	1	0	0	2	0	0	2	1	0	1
Total	**GB**	**9**	**1**	**11**	**6**	**1**	**14**	**4**	**7**	**10**	**6**	**5**	**10**	**9**	**2**	**10**
	EW	**3**	**0**	**10**	**5**	**0**	**8**	**1**	**1**	**11**	**1**	**3**	**9**	**4**	**1**	**8**

Significant increases in Ellenberg light scores (ie less shading) were detected in:

- hedge and streamside plots within lowland wooded;
- and in streamside plots within upland wooded.

Significant decreases in light scores (ie more shading) were detected in:

- hedges within tall grassland/herb;
- roadsides, streamsides and main plots within fertile grassland and infertile grassland;
- streamsides and main plots within moorland grass/mosaic and heath/bog.

Significant increases in Ellenberg continentality scores were detected in main plots within crops/weeds, fertile grassland, infertile grassland, lowland wooded and heath/bog.

As all the Ellenberg scores are derived from the same species data there are intercorrelations between the different environmental parameters. For example, a species may have a high nutrient score, a high pH score and a high continentality score. If that species increases because of increased soil fertility it will also have the effect of raising the Ellenberg, pH and continentality scores. Therefore, the interpretation of Ellenberg scores should take into account the other botanical analyses which have been undertaken. In the case of Ellenberg continentality scores it is thought that the increase in continentality may be a consequence of the decline of less competitive, less nutrient demanding species which are also oceanic in distribution.

Key results

The most consistent changes were observed in infertile grassland and heath/bog aggregate classes. In both cases, but probably for different reasons, the Ellenberg indicator values provide evidence of increased levels of fertility, pH and more shading across a range of different plot types. The causes of these changes are investigated in ECOFACT Module 6 (Firbank *et al.* in prep).

SUMMARY AND CONCLUSION

Further botanical analyses have been carried out in response to comments received following publication of the results of Countryside Survey 1990 (Barr *et al.* 1993). The aim of the work reported in this volume was to describe the charactersitics of vegetation in the British countryside and to assess changes in botanical composition between 1978 and 1990.

A new statistical classification of British vegetation was developed based entirely on the species composition of vegetation plots sampled in the wider countryside. This included plots from:

- open fields, woods and moorland;
- linear landscape features such as streamsides, hedges and roadsides;
- and plots from habitat fragments.

The CVS has 100 vegetation classes, ranging from the vegetation of arable fields to blanket bog. A full description of the CVS is already published (Bunce *et al.* 1999). For the purposes of some statistical analyses, the 100 classes were grouped into eight aggregate classes. The major environmental gradients influencing the classification of vegetation were shown to be nutrient status, shading (or disturbance) and moisture. This provides a framework for interpretation of environmental factors affecting vegetation. Comparisons with other existing vegetation classifications were established and software was developed for the allocation of new vegetation plot data to the classification. The CVS provides a comparative framework for vegetation studies and ecological assessment throughout GB. A range of established and novel techniques were used to evaluate the character of British vegetation and the changes occurring between 1978 and 1990.

The results confirmed the principal conclusion of the vegetation analysis from CS1990 reported previously (Barr *et al.* 1993) – that is a decline in botanical diversity in the majority of elements of the wider countryside. However, the single vegetation classification for all plot types enabled comparisons between vegetation in different landscape components and the use of the full range of botanical anlyses was used to evaluate the impacts on conservation interest and to suggest possible ecological factors driving change. The key results of these analyses were as follows.

- There was a substantial decline in the diversity of common plants across much of lowland Britain between 1978 and 1990. The widespread vegetation of fields, woods, hedges and streamsides became simpler in composition and thus more uniform in character. In contrast there was a small increase in diversity in the heath/bog aggregate class in the 'true' uplands and also fertile grasslands on roadside verges, in pastural and marginal upland landscapes.

- Analysis of the decline in the frequency and cover of individual species and species groups added detail to the changes in species diversity and showed a trend towards simplification of vegetation composition. The species that increased were generally already widespread, abundant plants. The major shifts in vegetation suggest overall increases in soil fertility and increased shading.

- The analysis of indicator species provides some evidence that overall losses in species diversity observed in grasslands between 1978 and 1990, were associated with a decline in the frequency of species indicative of unimproved mesotrophic and acidic grassland.

- Rare and scarce species were found in only 66 plots in 1990 – a very small proportion of the plots sampled. The rare and scarce species were significantly associated with main and streamside plots and upland landscapes. No changes were detected between 1978 and 1990.

- Unimproved neutral grassland (MG5) was chosen as an illustration of the application of NVC quality criteria to the Countryside Survey data. Very few characteristic MG5 plots were found, though many more contained elements of the MG5 community, especially in roadside verges. The very few charactersitic MG5 plots appeared to improve in quality between 1978 and 1990.

- Generally, between 1978 and 1990, losses in species diversity were associated with losses in preferential species. Thus, the distinctiveness of different vegetation types was eroded.

- Significant reductions in the frequency of 19 widely occurring butterfly larva host plants, were detected between 1978 and 1990. Food plants for 23 butterfly species became less available. The greatest reductions occurred in infertile grasslands. Only three host plant species increased in frequency.

- Significant increases and decreases in frequency and cover of the food plants for farmland birds were detected. More decreases in food plant species were detected than increases, especially in arable landscapes. However, there was no clear relationship between declining food plant availability and population status of farmland birds.

- Analysis of change in functional strategies of plants showed different trends and features in different elements of the landscape. Overall, several results indicate towards widespread effects of eutrophication and dereliction in the already more nutrient rich vegetation of arable and pastural lowlands.

- The most consistent changes in the environmental variables measured by Ellenberg indicator values were observed in grassland and heath/bog vegetation classes. In both cases, the Ellenberg indicator values provide evidence of increased levels of fertility, pH and more shading across a range of different plot types.

The main directions of botanical changes were towards a loss of species diversity and increasing homogeneity in vegetation. The botanical changes between 1978 and 1990 represent a decline in botanical diversity at both the species and ecosystem levels. There is some evidence that habitat quality, measured in different ways, also deteriorated. The botanical changes are consistent with general trends of eutrophication and dereliction. The measures used in this analysis may be described as Indicators of Botanical Diversity (IBDs) (Annex 3) and they provide a set of tools which can be used to investigate the factors causing botanical change in the British countryside (Firbank *et al.* in prep).

Fieldwork for CS2000 took place in the summers of 1998 and 1999. One aim of this fieldwork was to repeat all the vegetation plots surveyed in 1990. This means that as well as extending the time series from 1978 and 1990 to 1998, there are also about four times as many paired plots now available for analysis of change between 1990 and 1998. All the measures of change or indicators used here could be repeated to assess whether the trends have continued, halted or reversed. The CS2000 field survey included, for the first time, the field mapping and vegetation sampling of 'Broad Habitats' as defined by the UK Biodiversity Group. Thus, CS2000 provides a national survey of the vegetation composition of Broad Habitats. The establishment of the CVS provides a common framework for comparative analysis of additional vegetation data sets collected outside of CS2000.

REFERENCES

Barr, C.J., Bunce, R.G.H., Clarke, R.T., Fuller, R.M., Furse, M.T., Gillespie, M.K., Groom, G.B., Hallam, C.J., Hornung, M., Howard, D.C. & Ness, M.J. 1993. *Countryside Survey 1990: Main Report.* (Countryside 1990 Vol. 2). London: Department of the Environment.

Bunce, R.G.H. 1977. The range of variation within pinewoods. In: *Native Pinewoods of Scotland*, edited by R.G.H. Bunce & J.N.R. Jeffers, 10–25. Cambridge: Institute of Terrestrial Ecology.

Bunce, R.G.H., Barr, C.J., Clarke, R.T., Howard, D.C. & Lane, A.M.J. 1996. Land classification for strategic ecological survey. *Journal of Environmental Management,* **47**, 37–60.

Bunce, R.G.H., Barr, C.J., Gillespie, M.K., Howard, D.C., Scott, W.A., Smart, S.M., van de Poll, H.M. & Watkins, J.W. 1999. *Vegetation of the British countryside – the Countryside Vegetation System.* ECOFACT Volume 1. London: Department of the Environment, Transport and the Regions.

Campbell, L.H., Cooke, A.S. (eds). 1997. *The indirect effects of pesticides on birds.* Peterborough: Joint Nature Conservation Committee.

Cooper, A. 1989. *The Northern Ireland Land Classification.* Colraine: Department of Environmental Studies, University of Ulster.

Cooper, A. & McCann, T. 1994. *Botanical composition of grassland cover types in Northern Ireland.* Coleraine: Department of Environmental Studies, University of Ulster.

Dale, M.B. 1988. Knowing when to stop: the cluster concept. *Coenoses,* **3**, 11–32.

Department of the Environment. 1995. *Biodiversity: the UK Steering Group Report, Volume 2.* London: HMSO.

Ellenberg, H. 1974. Zeigerwerte der Gefasspflanzen Mitteleuropas. *Scripta Geobot*, **9**, 1–97.

Firbank, L.G., Bunce, R.G.H., Smart, S.M., van de Poll, H.M. & Howard, D.C. in prep. *Causes of Change in British Vegetation.* ECOFACT Volume 3. Institute of Terrestrial Ecology.

Grime, J.P., Hodgson, J.G. & Hunt, R. 1988. *Comparative Plant Ecology: a functional approach to common British species.* London: Unwin Hyman.

Heath, J., Pollard, E., Thomas, J.A. 1984. *Atlas of butterflies in Britain and Ireland.* Viking: Harmondsworth.

Hill, M.O. 1979a. *TWINSPAN – A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes.* Ithaca, New York: Cornell University.

Hill, M.O. 1979b. *DECORANA – A FORTRAN program for detrended correspondence analysis and reciprocal averaging.* Ithaca, New York: Cornell University.

Hill, M.O., Mountford, J.O., Roy, D.B. & Bunce, R.G.H. in press(a). Calibration of Ellenberg's indicator values for the British environment. *Journal of Applied Ecology.*

Hill, M.O., Mountford, J.O., Roy, D.B. & Bunce, R.G.H. in press(b). *Ellenberg's indicator values for British plants.* ECOFACT Volume 2, Technical Annex. Huntingdon: Institute of Terrestrial Ecology.

Ivimey-Cook, R.R. & Proctor, M.C.F. 1966. Association analysis and phytosociology. *Journal of Ecology*, **54**, 179–192.

Moss, D., Wyatt, B.K., Cornaert, M.H. & Roekarts, M. 1991. *The design, compilation and use of an inventory of sites of major importance for nature conservation in the European Community.* Luxembourg: Commission of the European Community.

Murray, R., McCann, T. & Cooper, A. 1992. *A land classification and landscape ecological survey of Northern Ireland.* Coleraine: Department of Environmental Studies, University of Ulster.

Pielou, E.C. 1991. The many meanings of diversity. In: *Biological Diversity*, edited by Pineda, F.D., Casado, M.A., de Miguel, J.M. & Montalvo, J, 113–116. Madrid: Fundacion Ramon Aceres.

Pollard, E., Moss, D. & Yates, T.J. 1995. Population trends of common British butterflies at monitored sites. *Journal of Applied Ecology*, **32**, 9–16.

Prieto, J.A.F. & Sanchez, A.B. 1992. A new classification of the forests of the Micelles Biological Reserve in north-west Spain. *Vegetatio,* **102**, 33–46.

Rodwell, J. 1992. *Grasslands and Montane Communities.* British Plant Communities. Vol. 3. Cambridge: Cambridge University Press.

Thomas, J.A. 1991. Rare species conservation: case studies of European butterflies. In: *The Scientific Management of Temperate Communities for Conservation,* edited by Spellerberg, I.F., Goldsmith, F.B., Morris, M.G, 149–197. Oxford: Blackwell Scientific.

Usher, M.B. 1986. *Wildlife Conservation Evaluation.* London: Chapman & Hall.

Wilson, P. J. 1999. The causes and consequences of recent vegetation change in Britain. *PhD Thesis,* University of Sheffield.

Wilson, J.D., Arroyo, B.E. & Clark, S.C. 1996. *The diet of bird species of lowland farmland: a literature review.* A report to the Department of the Environment and English Nature. BBSRC-NERC Ecology & Behaviour Group, Dept. of Zoology, University of Oxford.

ANNEXES

Annex 1. Numbers of replicate plots recorded in both 1978 and 1990. (* = ≥ 10% of the total for each plot type or if not then with 20 or more plots)

Landscape	Aggregate vegetation class	Plot type Hedge	Roadside	Streamside	Main	Total no. of plots
i. Arable	I	0	6	0	124 *	130
	II	38 *	43 *	33 *	4	118
	III	2	60 *	14 *	54 *	130
	IV	6	12 *	21 *	50 *	89
	V	51 *	3	10 *	12	76
	VI	0	0	6	6	12
	VII	0	0	0	5	5
	VIII	0	0	0	8	8
Total		**97**	**124**	**84**	**263**	**568**
ii. Pastural	I	0	1	1	64 *	66
	II	31 *	40 *	20 *	9	100
	III	3	36 *	8	100 *	147
	IV	11	24 *	29 *	101 *	165
	V	43 *	4	14 *	10	71
	VI	1	3	19 *	23 *	46
	VII	0	3	7	17	27
	VIII	0	0	2	16	18
Total		**89**	**111**	**100**	**340**	**640**
iii. Marginal upland	I	0	0	0	4	4
	II	7	1	1	0	9
	III	1	14 *	1	16 *	32
	IV	7	20 *	15 *	54 *	96
	V	2	0	1	0	3
	VI	1	1	10 *	13	25
	VII	0	4	18 *	43 *	65
	VIII	0	0	4	31 *	35
Total		**18**	**40**	**50**	**161**	**269**
iv. Upland	I	0	0	0	2	2
	III	0	2	0	8	10
	VI	0	9 *	6	4	19
	VI	0	1	9 *	31 *	41
	VII	0	16 *	48 *	49 *	113
	VIII	0	1	22	186 *	209
Total		**0**	**29**	**85**	**280**	**394**
v. GB	I	0	7	1	194 *	202
	II	76 *	84 *	54 *	13	227
	III	6	112 *	23 *	178 *	319
	IV	24 *	65 *	71 *	209 *	369
	V	96 *	7	25	22	150
	VI	2	5	44 *	73	124
	VII	0	23 *	73	114 *	210
	VIII	0	1	28 *	241 *	270
GB Total		**204**	**304**	**319**	**1044**	**1871**

Annex 2a. The units of the CVS – aggregate class (AC), vegetation class and names

AC	Vegetation class	Name	AC	Vegetation class	Name
I	1	Almost weed free wheat/other crops	IV	54	Marsh/fen
I	2	Various crops with scattered weeds	IV	55	Wet neutral/acid rush grassland
I	3	Cereal crops with scattered grass weeds	IV	56	Species-rich neutral/acid grassland
I	4	Mixed crops with broadleaved weeds	VII	57	Enriched acid grassland/moorland grass flushes
I	5	Cereal crops with mixed weeds			
I	6	Weedy leys/undersown cereal crops	VII	58	Species-rich moorland grass streamsides/ flushes
V	7	Fertile open hedges/crop boundaries			
V	8	Fertile hedges/boundaries	VI	59	Wooded streamsides
II	9	Fertile tall grassland/open crop hedges	VII	60	Acid grassland/streamsides/flushes
II	10	Tall grassland/herb boundaries	VII	61	Species-rich acid grassland
II	11	Streamsides within crops	VI	62	Woodland on podzolic soils
II	12	Fertile roadsides	VII	63	Herb-rich streamsides/acid grassland
II	13	Lowland neutral roadsides	VI	64	Bracken/acid grassland
II	14	Lowland roadsides/crop boundaries	VII	65	Herb-rich acid grassland/heath
II	15	Lowland streamsides	VII	66	Moorland grass streamsides/flushes
V	16	Moist fertile schrub/woodland	VII	67	Moorland grass
II	17	Lowland wetland/streamsides	VI	68	Oak/birch woodland
II	18	Fertile shaded streamsides	VI	69	Open woodland/heath
II	19	Fertile streamsides/wetland tall herb	VI	70	Wooded acid streamsides
II	20	Grassy roadsides	VII	71	Herb-rich moorland grass/heath
V	21	Species-rich lowland hedges	VII	72	Acid streamsides/flushes
II	22	Fertile wood edges/streamsides	VII	73	Rushy moorland grass/streamsides on peat soils
III	23	Fertile grassland			
V	24	Dry base-rich woodland	VII	74	Inundated streamsides/flushes
II	25	Shaded grassland/hedges	VI	75	Coniferous plantations
II	26	Tall grassland/scrub by roadsides	VII	76	Diverse acid streamsides/flushes
III	27	Rye grass roadsides	VI	77	Mature coniferous plantations
II	28	Fertile tall herb/grassland	VII	78	Speciesh-rich moorland grass/heath
III	29	Rye grass grassland	VII	79	Mountain streamsides/flushes
III	30	Fertile mixed grassland	VII	80	Moorland grass/heath on podzolic soils
III	31	Rye grass/clover grassland	VII	81	Montane heath/acid grassland
IV	32	Gravel reedbeds by streamsides	VIII	82	Wet heath/bog
IV	33	Wet neutral grassland	VIII	83	Young coniferous plantations
IV	34	Mixed grassland/scrub/hedges	VIII	84	Rush heath/moorland grass
V	35	Diverse base-rich woodland/hedges	VIII	85	Streamsides/flushes on peat soils
V	36	Shaded moist streamsides	VIII	86	Wet moorland grass/streamsides on peaty gley soils
IV	37	Neutral grassland/scrub			
IV	38	Fertile/neutral grassland on roadsides	VIII	87	Moorland grass/bog on peaty gley/peat soils
V	39	Fertile wooded streamsides			
IV	40	Rye-grass/Yorkshire fog grassland	VIII	88	Moorland grass/heath/bog
IV	41	Species-rich streamsides/wet grassland	VIII	89	Dry heath on podzolic soils
V	42	Woodland on heavy soils	VIII	90	Wet heath/moorland grass on variable soils
IV	43	Rye-grass/bent grass grassland			
IV	44	Calcareous grassland	VIII	91	Heath/moorland grass
VI	45	Shaded rushy streamsides	VIII	92	Northern moorland grass/bog
VI	46	Species-rich wooded streamsides	VIII	93	Montane heath on podzolic soils
IV	47	Species-rich neutral grassland	VIII	94	Sphagnum bog
IV	48	Marsh/streamsides	VIII	95	Crowberry blanket bog
VI	49	Marsh/streamsides	VIII	96	Wet deer grass bog
VI	50	Neutral/acidic woodland	VIII	97	Northern blanket bog
IV	51	Wet rushy grassland	VIII	98	Cotton grass bog
IV	52	Neutral grassland	VIII	99	Saturated bog
IV	53	Species-rich neutral/acid grassland/scrub	VIII	100	Inundated bog/wetland

Annex 2b. CVS vegetation class, estimates of area, lengths (of boundaries, hedges, roadsides and streamsides) with associated standard errors

CVS vegetation class	Plot types: Main area 1000 km^2	Main SE 1000 km^2	Boundary length 1000 km	Boundary SE 1000 km	Hedge length 1000 km	Hedge SE 1000 km	Roadside length 1000 km	Roadside SE 1000 km	Streamside length 1000 km	Streamside SE 1000 km
1	7.36	0.97	1.09	1.09	0.57	0.57	0.35	0.35	0.00	0.00
2	5.73	0.88	4.53	2.02	0.17	0.17	1.06	0.62	0.00	0.00
3	9.53	1.24	10.71	3.26	0.26	0.26	1.37	0.98	0.00	0.00
4	3.58	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	3.51	0.66	2.34	1.72	0.00	0.00	0.00	0.00	0.36	0.36
6	6.27	0.88	9.76	3.02	0.00	0.00	5.13	1.48	0.00	0.00
7	0.09	0.09	100.11	11.17	122.07	13.58	0.39	0.28	4.75	1.85
8	0.00	0.00	53.57	8.92	79.76	10.89	0.35	0.25	4.84	1.88
9	0.25	0.15	42.35	7.19	20.80	4.94	0.20	0.19	1.18	0.65
10	0.28	0.16	53.41	7.13	8.74	2.97	0.95	0.44	19.24	5.10
11	0.43	0.22	17.98	4.27	0.26	0.26	0.00	0.00	41.17	6.23
12	0.84	0.28	20.50	4.65	5.70	2.54	28.45	3.60	3.05	1.26
13	0.11	0.11	19.84	5.76	3.95	1.91	8.28	1.87	2.92	1.43
14	1.06	0.30	105.48	12.45	17.33	4.82	50.81	4.31	5.58	2.10
15	0.10	0.08	6.17	2.18	0.00	0.00	0.00	0.00	15.02	5.10
16	0.28	0.14	13.49	4.06	15.21	5.19	1.09	0.57	12.58	3.01
17	0.06	0.05	1.45	1.32	0.00	0.00	0.00	0.00	5.54	2.64
18	0.16	0.11	5.98	2.73	0.00	0.00	2.67	0.87	10.22	2.79
19	0.08	0.08	2.77	2.00	0.00	0.00	0.00	0.00	23.89	5.51
20	0.20	0.14	8.76	3.14	0.00	0.00	8.84	1.74	1.30	0.71
21	0.15	0.11	55.15	10.71	104.87	15.17	2.64	0.90	3.54	1.83
22	0.00	0.00	10.80	3.32	0.00	0.00	0.25	0.18	34.27	5.70
23	0.80	0.25	17.22	4.02	0.00	0.00	31.99	5.39	6.21	3.50
24	1.16	0.32	16.26	4.38	1.55	1.34	1.34	0.82	6.51	1.91
25	0.61	0.25	110.38	14.68	58.74	9.72	18.71	2.77	2.76	1.04
26	0.00	0.00	18.74	5.49	3.24	2.10	17.73	2.92	0.36	0.29
27	0.50	0.20	27.53	7.36	0.00	0.00	41.77	4.23	5.30	1.79
28	0.60	0.23	118.42	12.13	22.03	6.24	8.74	1.58	59.98	6.08
29	9.74	1.05	18.57	5.83	0.00	0.00	0.83	0.45	0.00	0.00
30	14.57	1.22	164.12	16.17	3.47	2.36	23.23	2.66	31.91	4.48
31	8.82	0.94	15.11	4.40	0.23	0.19	8.96	1.81	0.39	0.28
32	0.00	0.00	1.37	1.14	0.00	0.00	0.51	0.37	15.39	3.39
33	0.14	0.09	8.26	3.99	1.14	0.87	0.20	0.14	17.29	3.46
34	0.21	0.12	40.62	8.51	17.30	4.56	8.48	1.67	4.92	1.99
35	3.10	0.64	13.80	3.93	24.38	6.07	1.14	0.59	4.70	1.70
36	0.18	0.13	1.36	1.36	0.00	0.00	0.65	0.65	17.18	3.66
37	0.00	0.00	9.65	3.88	0.00	0.00	4.31	1.95	0.53	0.36
38	0.56	0.20	25.82	6.41	6.50	2.83	14.55	2.14	5.69	1.78
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	2.51
40	14.00	1.24	68.43	10.93	0.00	0.00	22.39	2.91	9.75	3.98
41	0.00	0.00	1.65	1.17	0.00	0.00	0.00	0.00	18.57	4.94
42	2.20	0.56	20.55	6.35	8.82	3.78	0.00	0.00	1.03	0.63
43	5.46	0.69	141.82	16.46	8.03	3.18	6.42	1.32	3.02	1.15
44	0.80	0.39	3.01	1.77	0.00	0.00	0.76	0.56	0.00	0.00
45	0.09	0.09	6.29	3.03	0.00	0.00	0.00	0.00	15.03	2.99
46	0.42	0.19	13.49	8.47	0.25	0.25	0.86	0.52	31.18	4.09
47	0.34	0.16	5.05	2.63	0.00	0.00	1.73	0.63	1.06	1.06
48	0.09	0.07	10.62	4.40	0.25	0.25	0.56	0.34	21.79	3.31
49	0.67	0.26	10.32	3.74	0.25	0.16	0.13	0.13	1.90	0.82
50	1.59	0.45	22.40	5.81	13.73	5.10	3.34	1.12	4.95	1.76

continued....

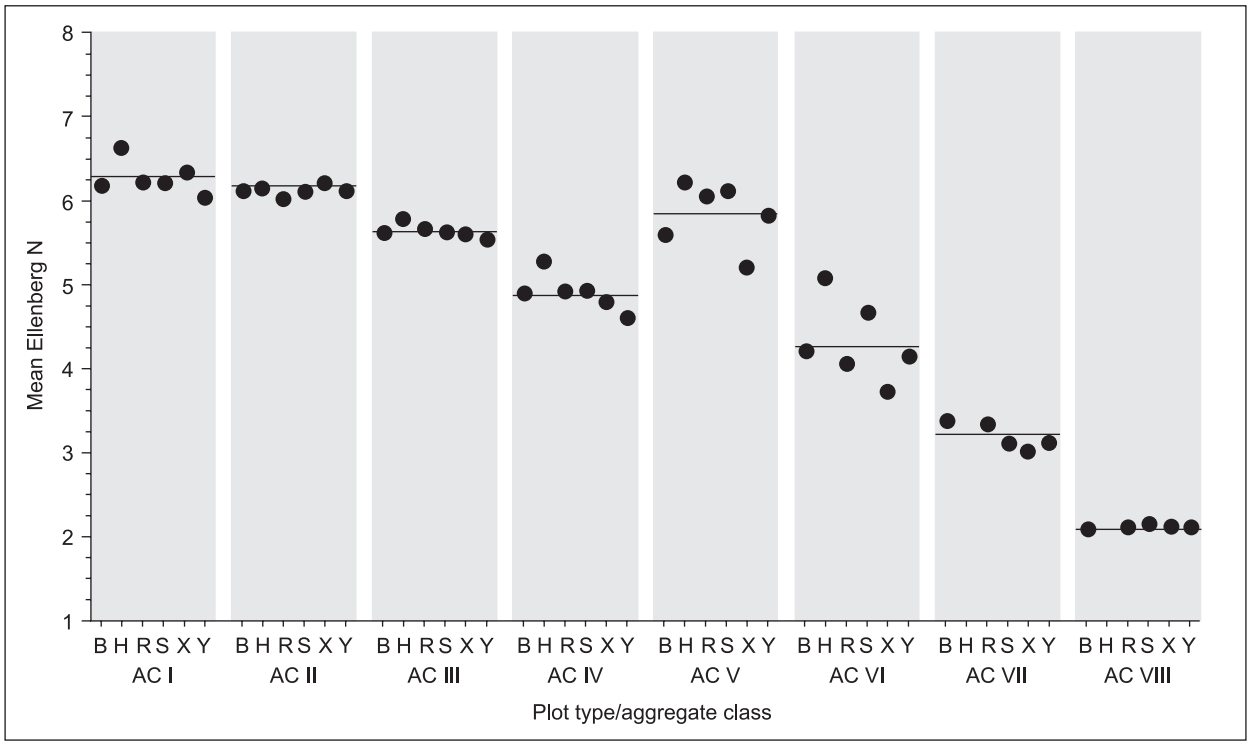
Annex 2b. ....continued

CVS vegetation class	Plot types: Main area 1000 km²	Main SE 1000 km²	Boundary length 1000 km	Boundary SE 1000 km	Hedge length 1000 km	Hedge SE 1000 km	Roadside length 1000 km	Roadside SE 1000 km	Streamside length 1000 km	Streamside SE 1000 km
51	2.05	0.44	16.45	5.27	0.00	0.00	1.63	0.67	48.72	8.05
52	1.48	0.36	5.34	2.75	0.00	0.00	1.29	0.48	0.41	0.41
53	0.24	0.14	4.94	2.90	0.49	0.49	0.75	0.31	0.53	0.38
54	0.12	0.08	3.55	2.17	0.00	0.00	0.00	0.00	4.77	1.78
55	1.14	0.30	45.48	9.29	0.08	0.08	1.66	0.59	7.48	2.23
56	2.42	0.60	22.07	7.01	0.08	0.08	3.86	1.20	1.41	0.83
57	0.61	0.27	5.91	2.80	0.00	0.00	0.00	0.00	3.61	1.27
58	0.97	0.30	6.09	2.78	0.00	0.00	0.13	0.13	24.10	5.02
59	0.50	0.24	1.24	0.85	0.00	0.00	0.30	0.22	9.97	2.60
60	0.14	0.11	3.65	2.30	0.00	0.00	0.21	0.13	9.52	3.70
61	0.86	0.27	9.34	5.58	0.00	0.00	2.11	0.70	0.75	0.75
62	1.32	0.39	3.11	1.57	0.00	0.00	0.00	0.00	1.04	0.57
63	1.13	0.30	6.73	3.45	0.00	0.00	1.31	0.49	23.89	7.34
64	2.69	0.52	31.64	9.10	0.00	0.00	2.70	0.95	1.36	0.67
65	0.33	0.16	2.71	2.09	0.00	0.00	1.01	0.47	3.53	2.83
66	0.11	0.11	2.41	1.73	0.00	0.00	0.03	0.03	4.79	1.50
67	1.96	0.53	40.85	12.09	0.00	0.00	3.59	1.84	2.34	1.03
68	2.09	0.57	9.22	3.78	0.00	0.00	0.01	0.01	4.28	1.74
69	0.19	0.11	0.00	0.00	0.00	0.00	0.00	0.00	6.52	2.19
70	0.75	0.30	0.00	0.00	0.00	0.00	0.00	0.00	9.00	3.96
71	1.25	0.43	7.72	3.12	0.00	0.00	1.75	0.66	12.21	3.02
72	0.14	0.10	0.00	0.00	0.00	0.00	0.00	0.00	5.75	1.87
73	3.83	0.64	23.27	5.56	0.00	0.00	0.61	0.28	47.49	7.13
74	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	10.57	2.76
75	2.44	0.64	2.18	1.84	0.00	0.00	0.50	0.42	1.62	0.83
76	0.79	0.26	5.39	3.56	0.00	0.00	0.05	0.05	21.12	6.76
77	1.64	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	0.52	0.18	0.65	0.65	0.00	0.00	0.09	0.09	4.64	1.72
79	1.64	0.45	1.89	1.69	0.00	0.00	0.28	0.21	14.95	3.38
80	4.18	0.76	14.39	4.94	0.00	0.00	0.50	0.43	1.89	0.85
81	1.05	0.30	2.39	1.41	0.00	0.00	0.08	0.08	0.36	0.36
82	1.20	0.36	0.00	0.00	0.00	0.00	0.00	0.00	2.68	1.19
83	2.36	0.53	0.72	0.72	0.00	0.00	0.00	0.00	0.99	0.81
84	0.51	0.37	0.00	0.00	0.00	0.00	0.03	0.03	5.49	2.49
85	0.01	0.01	1.47	1.47	0.00	0.00	0.00	0.00	15.32	5.67
86	2.44	0.57	1.98	1.48	0.00	0.00	0.00	0.00	12.55	4.40
87	2.17	0.45	6.11	2.34	0.00	0.00	0.15	0.11	16.53	3.54
88	4.00	0.86	1.44	1.44	0.00	0.00	0.01	0.01	3.06	1.12
89	3.05	0.83	1.97	1.17	0.00	0.00	0.08	0.08	0.00	0.00
90	0.77	0.27	2.69	2.14	0.00	0.00	0.09	0.09	0.14	0.14
91	4.51	0.75	2.98	1.88	0.00	0.00	0.08	0.08	2.72	1.02
92	2.09	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93	1.60	0.53	0.64	0.64	0.00	0.00	0.00	0.00	0.40	0.30
94	2.82	0.62	0.66	0.66	0.00	0.00	0.00	0.00	1.89	0.84
95	1.58	0.94	0.83	0.83	0.00	0.00	0.00	0.00	4.95	3.07
96	1.01	0.33	0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.67
97	1.69	0.56	2.04	1.14	0.00	0.00	0.00	0.00	0.92	0.56
98	0.39	0.17	3.31	1.93	0.00	0.00	0.00	0.00	2.40	1.01
99	6.53	1.06	1.27	0.85	0.00	0.00	0.00	0.00	5.72	2.23
100	0.49	0.23	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0.89

Annex 3. List of Indicators of Botanical Diversity (IBDs)

IBD number	Name	Page number
IBD1	Number of CVS aggregate classes by plot type and landscape	18
IBD2	Number of CVS vegetation classes by plot type and landscape	26
IBD3	Plant functional strategy frequencies by CVS aggregate class and landscape	24
IBD4	Number of unique vegetation classes per 1 km square	26
IBD5	Species richness per plot by plot type and landscape	35
IBD6	Average Ellenberg indicator values by CVS aggregate class and landscape	18
IBD7	Frequency of species groups within plot types and landscape	20
IBD8	Frequency of CVS aggregate classes preferential species by plot type and landscape	47
IBD9	Frequency of unimproved grassland indicator species	41
IBD10	Frequency of food plants for animal groups	51 and 52
IBD11	Frequency of scarce species and NVC categories	44 and 45
IBD12	Number of CVS vegetation classes per 1 km square	26

Annex 4. Mean recalibrated Ellenberg indicator values for fertility for each plot type in each aggregate class based on 1990 data. (B = boundary, H = hedge, R = roadside, S = streamside, X = main, Y = habitat)



Annex 5. Species composition of the 37 species groups derived from Ward's Minimal Variance Clustering of the first four DECORANA axes based on 1990 data

Group no.	Species name	Species name
1	*Bromus sterilis*	*Malva sylvestris*
	Convolvulus arvensis	*Alopecurus myosuroides*
	Lamium album	*Urtica urens*
	Capsella bursa-pastoris	*Fumaria officinalis*
	Lamium purpureum	*Aethusa cynapium*
	Artemisia vulgaris	*Carduus acanthoidies*
	Sisymbrium officinale	*Euphorbia helioscopia*
	Viola arvensis	*Veronica polita*
	Fallopia convolvulus	*Bromus commutatus*
	Papaver rhoeas	*Veronica agrestis*
	Sinapis arvensis/alba	
2	*Elymus repens*	*Picris echioides*
	Rumex crispus	*Hordeum murinum*
	Chenopodium album/polyspermum	*Matricaria recutita*
	Sonchus oleraceus	*Coronopus squamatus*
	Sonchus asper	*Raphanus raphanistrum*
	Senecio vulgaris	*Geranium pyrenaicum*
	Geranium dissectum	*Vicia tetrasperma*
	Sonchus arvensis	*Petroselinum segetum*
	Conium maculatum	
3	*Heracleum sphondylium*	*Ulmus minor*
	Anthriscus sylvestris	*Bromus ramosus*
	Hedera helix	*Bryonia cretica*
	Sambucus nigra	*Chaerophyllum temulentum*
	Torilis japonica	*Viola odorata*
	Arum maculatum	*Malus domestica*
	Ballota nigra	
4	*Tragopogon pratensis*	*Pastinaca sativa*
	Silene latifolia	*Reseda lutea*
	Silene vulgaris	*Sherardia arvensis*
	Linaria vulgaris	*Carduus nutans*
5	*Urtica dioica*	*Alliaria petiolata*
	Arrhenathrum elatius	*Arctium spp.*
	Galium aparine	*Elymus caninus*
	Glechoma hederacea	*Rubus caesius*
	Stachys sylvatica	*Humulus lupulus*
	Lapsana communis	
6	*Epilobium hirsutum*	*Polygonum lapathifolium*
	Polygonum persicaria	*Symphytum officinale*
	Phalaris arundinacea	*Myosoton aquaticum*
	Calystegia sepium	*Dipsacus fullonum*
	Scrophularia auriculata	*Barbarea vulgaris*
	Typha latifolia	
7	*Stellaria media*	*Viola tricolor*
	Polygonum aviculare	*Polygonum arenastrum*
	Veronica arvensis	*Chrysanthemum segetum*
	Myosotis arvensis	*Medicago sativa*
	Anagallis arvensis	*Galeopsis speciosa*
	Aphanes spp.	

continued...

Annex 5. ...continued

Group no.	Species name	Species name
8	*Crataegus monogyna*	*Ligustrum vulgare*
	Prunus spinosa	*Clematis vitalba*
	Tamus communis	*Ulmus glabra*
	Acer campestre	*Euonymus europaeus*
	Galium mollugo	*Carpinus betulus*
	Cornus sanguinea	*Ribes uva-crispa*
9	*Cirsium arvense*	*Agrostis gigantea*
	Poa trivialis	*Geranium pratense*
	Rumex obtusifolius	*Petasites hybridus*
	Alopecurus pratensis	*Equisetum telemateia*
	Galeopsis tetrahit	*Rumex longifolius*
	Cruciata laevipes	*Pimpinella major*
10	*Oenanthe crocata*	*Juncus gerardi*
	Phragmites australis	*Lotus tenuis*
	Hordeum secalinum	*Apium graveolens*
	Atriplex patula	*Chenopodium bonus-henricus*
	Atriplex hastata	*Torilis nodosa*
	Carex otrubae	*Honkenya peploides*
	Ranunculus sceleratus	*Samolus valerandi*
	Elymus pycnanthus	*Crepis biennis*
11	*Sparganium erectum*	*Bidens tripartita*
	Glyceria maxima	*Rorippa sylvestris*
	Lemna minor	*Schoenoplectus lacustris*
	Alisma plantago-aquatica	
12	*Dactylis glomerata*	*Bromus hordeaceus*
	Lolium perenne	*Vicia cracca*
	Poa annua	*Geranium molle*
	Plantago major	*Festuca arundinacea*
	Phleum pratense	*Vicia sativa*
	Potentilla reptans	*Vicia hirsuta*
13	*Medicago lupulina*	*Trifolium campestre*
	Daucus carota	*Poa compressa*
	Leucanthemum vulgare	*Erodium cicutarium*
	Phleum bertolonii	*Ononis repens*
	Senecio erucifolius	*Poa subcaerulea*
14	*Rubus fruticosus*	*Asplenium scolopendrium*
	Fraxinus excelsior	*Moehringia trinervia*
	Geranium robertianum	*Melica uniflora*
	Silene dioica	*Milium effusum*
	Geum urbanum	*Galium odoratum*
	Mercurialis perennis	*Viburnum opulus*
	Veronica montana	*Ribes rubrum*
	Lamiastrum galeobdolon	
15	*Potentilla anserina*	*Scrophularia nodosa*
	Juncus inflexus	*Eupatorium cannabinum*
	Festuca gigantea	*Carex pendula*
	Carex hirta	*Salix fragilis*
	Pulicaria dysenterica	*Epilobium roseum*

continued...

Annex 5. ...continued

Group no.	Species name	Species name
16	*Apium nodiflorum*	*Lythrum salicaria*
	Nasturtium officinale	*Carex riparia*
	Polygonum amphibium	*Carex acutiformis*
	Stachys palustris	*Veronica anagallis-aquatica*
	Lycopus europaeus	*Ranunculus aquatilis*
17	*Stellaria holostea*	*Umbilicus rupestris*
	Corylus avellana	*Sanicula europaea*
	Hyacinthoides non-scripta	*Prunus avium*
	Lonicera periclymenum	*Hypericum hirsutum*
	Ilex aquifolium	*Asplenium adiantum-nigrum*
18	*Taraxacum agg.*	*Trifolium dubium*
	Poa pratensis	*Ranunculus bulbosus*
	Achillea millefolium	*Crepis capillaris*
	Veronica chamaedrys	*Hypericum perforatum*
	Senecio jacobaea	*Odontites verna*
	Centaurea nigra	*Geranium sylvaticum*
	Trifolium pratense	*Filago vulgaris*
	Vicia sepium	
19	*Campanula rotundifolia*	*Viola hirta*
	Galium verum	*Avenula pratensis*
	Hieracium pilosella	*Clinopodium vulgare*
	Trisetum flavescens	*Knautia arvensis*
	Briza media	*Brachypodium pinnatum*
	Pimpinella saxifraga	*Helianthemum nummularium*
	Agrimonia eupatoria	*Carex caryophyllea*
	Sanguisorba minor	*Koeleria macrantha*
	Bromus erectus	*Trifolium medium*
	Avenula pubescens	*Scabiosa columbaria*
	Primula veris	*Arenaria serpyllifolia*
	Centaurium erythraea	*Asperula cynanchica*
	Centaurea scabiosa	*Ornithopus perpusillus*
	Cirsium acaule	*Senecio viscosus*
	Plantago media	*Origanum vulgare*
20	*Filipendula ulmaria*	*Ranunculus ficaria*
	Angelica sylvestris	*Carex remota*
	Epilobium montanum	*Allium ursinum*
	Alnus glutinosa	*Salix atrocinerea*
	Circaea lutetiana	
21	*Glyceria fluitans*	*Glyceria declinata*
	Veronica beccabunga	*Gnaphalium uliginosum*
	Alopecurus geniculatus	*Hypericum tetrapterum*
	Myosotis scorpioides	*Glyceria plicata*
	Mentha aquatica	*Cardamine amara*
	Polygonum hydropiper	*Ranunculus hederaceus*
	Senecio aquaticus	*Rumex hydrolapathum*
	Epilobium parviflorum	*Carex disticha*
22	*Holcus lanatus*	*Equisetum arvense*
	Agrostis stolonifera	*Chamaenerion angustifolium*
	Ranunculus repens	*Veronica serpyllifolia*
	Trifolium repens	*Stellaria graminea*
	Festuca rubra	*Festuca pratensis*
	Cerastium fontanum	*Tussilago farfara*
	Plantago lanceolata	*Cerastium glomeratum*
	Rumex acetosa	*Calamagrostis epigejos*

continued...

Annex 5. ...continued

Group no.	Species name	Species name
23	*Cardamine pratensis*	*Geum rivale*
	Stellaria alsine	*Salix caprea*
	Lotus uliginosus	*Crepis paludosa*
	Athyrium filix-femina	*Stellaria palustris*
	Chrysosplenium oppositifolium	*Hypericum maculatum*
	Ajuga reptans	*Polygonum bistorta*
	Valeriana officinalis	*Hypericum androsaemum*
24	*Galium palustre*	*Myosotis laxa*
	Juncus bufonius	*Epilobium obscurum*
	Caltha palustris	*Lysimachia nummularia*
	Equisetum palustre	*Galium uliginosum*
	Epilobium tetragonum	*Isolepis setacea*
	Iris pseudocorus	*Scutellaria galericulata*
	Lychnis flos-cuculi	*Myosotis secunda*
	Salix cinerea	
25	*Viola riviniana/reichenbachiana*	*Primula vulgaris*
	Digitalis purpurea	*Carex sylvatica*
	Oxalis acetosella	*Dryopteris affinis*
	Dryopteris filix-mas	*Hypericum humifusum*
26	*Plantago maritima*	*Anthyllis vulneraria*
	Plantago coronopus	*Carex arenaria*
	Armeria maritima	*Ammophila arenaria*
	Cochlearia officinalis	
27	*Agrostis capillaris*	*Fragaria vesca*
	Pteridium aquilinum	*Polypodium vulgare*
	Lotus corniculatus	*Ulex gallii*
	Rumex acetosella	*Luzula pilosa*
	Hypochoeris radicata	*Stachys officinalis*
	Sorbus aucuparia	*Solidago virgaurea*
	Ulex europaeus	*Agrostis curtisii*
	Veronica officinalis	*Melampyrum pratense*
	Teucrium scorodonia	*Jasione montana*
	Aira praecox	*Vulpia bromoides*
	Potentilla sterilis	*Potentilla anglica*
	Conopodium majus	*Viola canina*
	Rubus idaeus	*Gentianella campestris*
	Linum catharticum	*Corydalis claviculata*
	Lathyrus montanus	*Orchis mascula*
	Cytisus scoparius	
28	*Juncus effusus*	*Juncus conglomeratus*
	Ranunculus acris	*Achillea ptarmica*
	Deschampsia cespitosa	*Montia fontana*
	Prunella vulgaris	*Carex ovalis*
	Cirsium palustre	*Rhinanthus spp.*
	Sagina procumbens	*Equisetum sylvaticum*
	Lysimachia nemorum	
29	*Anthoxanthum odoratum*	*Hypericum pulchrum*
	Galium saxatile	*Carex flacca*
	Festuca ovina	*Luzula sylvatica*
	Agrostis canina	*Anemone nemorosa*
	Luzula multiflora/campestris	*Carex pallescens*
	Euphrasia spp.	*Phegopteris connectilis*

continued...

Annex 5. ...continued

Group no.	Species name	Species name
30	*Equisetum fluviatile*	*Eleocharis palustris*
	Potamogeton polygonifolius	*Potamogeton natans*
	Carex rostrata	*Hypericum elodes*
	Potentilla palustris	
31	*Juncus articulatus/acutiflorus*	*Carex curta*
	Juncus bulbosus	*Scutellaria minor*
	Ranunculus flammula	*Carum verticillatum*
	Epilobium palustre	*Litorella uniflora*
	Anagallis tenella	*Wahlenbergia hederacea*
	Hydrocotyle vulgaris	*Dactylorhiza majalis*
	Pedicularis palustris	*Carex hostiana*
	Triglochin palustris	
32	*Carex nigra*	*Salix aurita*
	Carex echinata	*Parnassia palustris*
	Viola palustris	*Carex lepidocarpa*
	Carex demissa	*Eleocharis quinqueflora*
	Carex pulicaris	
33	*Potentilla erecta*	*Carex pilulifera*
	Nardus stricta	*Oreopteris limbosperma*
	Deschampsia flexuosa	*Trientalis europaea*
	Succisa pratensis	*Salix repens*
	Blechnum spicant	*Polygonum viviparum*
	Carex binervis	*Sedum forsteranum*
	Festuca vivipara	*Gymnocarpium dryopteris*
	Danthonia decumbens	
34	*Molinia caerulea*	*Selaginella selaginoides*
	Carex panicea	*Thalictrum alpinum*
	Dactylorhiza maculata agg.	*Saxifraga stellaris*
35	*Calluna vulgaris*	*Carex bigelowii*
	Juncus squarrosus	*Listera cordata*
	Vaccinium myrtillus	*Antennaria dioica*
	Erica cinerea	*Arctostaphylos uva-ursi*
	Empetrum nigrum	*Diphasiastrum alpinum*
	Polygala vulgaris/serpyllifolia	*Juniperus communis*
	Vaccinium vitis-idaea	*Genista anglica*
	Alchemilla alpina	
36	*Pedicularis sylvatica*	*Carex dioica*
	Pinguicula vulgaris	*Eleocharis uniglumis*
	Myrica gale	*Pinguicula lusitanica*
	Schoenus nigricans	*Carex limosa*
	Menyanthes trifoliata	*Saxifraga aizoides*
37	*Erica tetralix*	*Huperzia selago*
	Eriophorum angustifolium	*Rubus chamaemorus*
	Trichophorum caespitosum	*Drosera anglica*
	Narthecium ossifragum	*Drosera intermedia*
	Eriophorum vaginatum	*Vaccinium oxycoccus*
	Drosera rotundifolia	*Rhynchospora alba*

Annex 6. Mean number of species per species group in the CS1990 database, in GB, in the four landscape types by plot type. (B = boundary, H = hedge, R = roadside, S = streamside, X = main, Y = habitat. Number = rounded mean count, + = 0.5 > mean count ≥0.25, • = 0 < mean count <0.25)

	GB						Arable						Pastural						Marginal upland						Upland				
Species group	B	H	R	S	X	Y	B	H	R	S	X	Y	B	H	R	S	X	Y	B	H	R	S	X	Y	B	R	S	X	Y
1 Crop or crop edge plants on fertile soils	+	+	+	•	+	•	+	+	+	+	+	+	+	+	+	•	+	•	•	•	•	•	•	•		•	•	•	•
2 Crops, crop edge or grassland on eutrophic soils	+	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	•	•	+	•	•	•	•	•	•	•	•
3 Woods, tall grasslands or wood edge plants on brown earth soils	+	1	1	+	•	+	+	2	1	+	•	+	+	1	1	+	•	+	•	+	+	•	•	•	•	•	•	•	•
4 Tall grassland plants on calcareous brown earths	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			•	•				•			
5 Wood edge, tall grassland or grassland plants on brown earths, often humus rich	1	2	1	1.1	•	+	2	2	2	2	+	1	2	2	2	1.4	+	+	+	2	+	+	•	•	•	•	•	•	•
6 Water edge plants on wet alluvial soils	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•	•	•
7 Crops or crop edge plants on brown earth soils	+	•	+	•	+	•	+	•	+	•	+	•	+	•	+	•	+	•	+	+	+	•	+	•	•	•	•	•	•
8 Woodland edge or scrub plants on brown earth soils	+	2	•	•	•	•	+	2	•	•	•	•	+	2	+	•	•	•	•	1	•	•	•	•			•	•	•
9 Maritime saline or fresh water edge plants on gleyed brown earths	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•			•	•	•	•		•	•	•	•
10 Grassland, tall grassland plants on wood edges on variable soils	+	+	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	+	+	+	+	•	+	+	•	•	•
11 Water edge plants on saturated gleyed alluvial soils	•	•		•	•	•	•	•		•	•	•	•			•	•	•	•					•			•	•	•
12 Grassland or tall grassland plants on brown earth soils	1	1	3	+	1	+	1	+	3	+	1	+	2	1	3	+	2	+	1	2	3	+	1	+	+	1	•	•	•
13 Grassland plants on brown earths, often skeletal and calcareous	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•		•		•	•
14 Wood or wood edge plants on calcareous or neutral brown earths	+	1	+	+	•	+	+	+	+	+	+	+	+	1	+	1.2	•	+	•	1	+	+	•	•	•	•	•	•	•
15 Tall grassland plants on damp gleyed brown earths	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•	•	•
16 River edge or aquatic plants on wet alluvial soils	•	•	•	•	•	•	•	•	•	+	•	•	•	•	•	+	•	•	•		•	•	•	•	•	•	•	•	•
17 Woodland or wood edge plants on brown earth soils	•	+	•	•	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	1	•	•	•	•	•	•	•	•	•
18 Grassland plants on semi-fertile, sometimes rocky, brown earths	+	+	2	+	+	+	+	+	2	+	+	+	+	+	2	+	1	+	+	1	2	+	+	+	+	1	+	+	+
19 Grassland plants on calcareous brown earths	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•
20 Wood or wood edge plants on damp fertile brown earths	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	+	•	+	•	+	•	+	•	•	•	•	•	•	•
21 Water edge or aquatic plants on hydromorphic soils	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	+	•	+	•	•	•	+	•	•	•	•	•	•	•
22 Grassland wood edge or scrub plants on brown earths	3	2	4	3.1	3	2	2	1	3	3	2	2	3	2	4	3.4	4	3	4	4	5	4	4	2	4	5	3	1	1
23 Marsh, wood edge or woodland plants on wet gleyed brown earths	•	•	•	+	•	•	•	•	•	+	•	•	•	•	•	+	•	+	•	•	•	+	•	+	•	•	+	•	•
24 Woodland or woodland edge plants on acid brown earths	•	•	•	+	•	•	•	•	•	•	•	•	•	+	•	+	•	•	•	+	+	+	+	•	+	+	+	+	•
25 Marsh or water edge plants on soil water gleys	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•	+	•	•	•	•	•	+	•	+	•	•	+	•	•
26 Plants of maritime habitats on variable soils	•		•	•	•	•	•		•	•	•	•	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•
27 Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	+	+	+	+	+	+	+	•	+	+	+	+	+	+	+	+	+	+	1	1	1	1	1	+	+	2	1	+	+
28 Grassland marsh or water edge plants on moist brown earth or gleyed soils	+	•	+	1.4	+	+	•	•	•	+	+	+	+	•	+	1.2	+	+	+	+	+	2	1	+	1	2	2	+	+
29 Grassland or wood edge plants on acid or brown podzolic soils	+	•	+	1.1	+	+	•	•	•	•	+	+	+	•	+	+	+	+	1	+	1	2	2	1	2	2	3	2	2
30 Water edge or aquatic plants on wet humic soils	•		•	•	•	•	•		•	•	•	•	•		•	•	•	•	•			•	•	•	•	•	•	•	•
31 Flush, moorland or water edge plants on soil water gleys	•	•	•	+	•	+	•	•	•	•	•	•	•		•	+	•	+	•		•	1	+	+	+	+	1	+	+
32 Moorland plants on peaty gley soils	•	•	•	+	+	+	•		•	•	•	•	•	•	•	•	•	•	•		•	+	+	+	+	+	2	+	+
33 Moorland or grassland plants on gley or peaty podzolic soils	+	•	+	1.1	+	+	•	•	•	•	•	•	•	•	•	+	+	+	+	•	+	2	2	1	1	2	3	3	2
34 Moorland plants on wet peaty gley soils	•	•	•	+	+	+	•		•	•	•	•	•	•	•	•	•	•	•		•	+	+	+	+	+	+	1	+
35 Heath or moorland plants on podzols or brown podzolic soils	•	•	•	+	+	+	•		•	•	•	•	•	•	•	•	•	•	+	•	+	+	1	+	+	+	2	3	1
36 Bog, water edge or aquatic plant on peaty soils	•		•	•	•	•			•	•	•	•	•		•	•	•	•	•		•	•	•	•	•	•	+	+	+
37 Bog or heath plants on deep, raw peat soils	•		•	+	+	+	•		•	•	•	•	•		•	•	•	•	•		•	+	+	+	+	•	1	3	1
Mean number of species groups per plot	7	8	8	10	6	7	7	7	8	9	6	6	8	8	9	10	7	7	7	10	8	10	7	6	8	9	9	7	6

Annex 7. Cross-classification table between CVS vegetation classes and CORINE biotope classification, NCC Phase 1 habitats classification and UK Biodiversity Steering Group Report Classification of Broad Habitats.
(ne = non equivalent)

CVS vegetation class	CORINE biotopes	NCC Phase 1 habitats	Broad Habitats	CVS vegetation class	CORINE biotopes	NCC Phase 1 habitats	Broad Habitats
1	82	J1	6	51	1A, 37.2	B5	13
2	82	J1	6	52	1A, 38	B2	8
3	82	J1	6	53	ne	B1	8
4	82	J1	6	54	37.1	ne	13
5	82	J1	6	55	37.2	B5	9
6	81	B4	ne	56	38	B2	8
7	84	J2	5, 7	57	37.2, 54	ne	ne
8	31.8, 84	J2	5	58	37.2, 54	E2	9
9	31.8, 84	C3	5	59	54	B1, C3	1, 19
10	ne	C3	5	60	37.2, 54	B1	9
11	37.1	B4	16	61	ne	B1	9
12	ne	B4	5	62	41.5, 84	A1	1
13	18, 38.2	B4	5	63	54	B1, D2	5
14	38.2	C1, C3	5	64	ne	B1	9
15	37.1	V3	5	65	18, 1A	D6	9
16	31.8, 84	A1	5	66	54	E2	16
17	22.3, 53	F2	ne	67	37.2	ne	19
18	ne	A1	16	68	41.6, 84	ne	1
19	37.1, 53	F1	13	69	41.6, 84	A1	ne
20	ne	B4	5	70	41.6	A1	1
21	31.8, 84	J2	5	71	ne	D6	9
22	ne	C3	16	72	ne	ne	16
23	81	B4	7	73	ne	D2	19
24	41.1, 41.3	A1	1	74	ne	E2	13
25	31.8, 84	C3, J2	4	75	42, 83.3	A1	1
26	31.8	A2	8	76	ne	ne	13
27	81	B4	5	77	42, 83.3	A1	1
28	ne	C3	8	78	35	ne	ne
29	81	B4	7	79	31.1	E2	19
30	81	B4	7	80	31.1	D6	19
31	81	B4	7	81	31.2	D4	9
32	ne	F3	13	82	31.1	D6	19
33	ne	B5	13	83	31.2	D6	19
34	31.8	B6	7	84	31.2	D1	19
35	41.2, 41.3	A1	1	85	51.2, 52.1	E2	19
36	ne	A1	16	86	31.1	E2	19
37	31.8	B6	8	87	51.2, 52.1	D2	19
38	ne	B6	8	88	31.4	D4	18
39	ne	A1	1	89	31.2	D4	18
40	38	B6	7	90	31.1	D6	11
41	53	ne	10, 13	91	31.4	D1	19
42	41.2, 44, 84	A1	1	92	51.1, 52.1	E1	19
43	38	B6	8	93	31.4	D4	18
44	ne	B3	1	94	51.1, 52.1	ne	19
45	41.2, 44, 84	A1	16	95	ne	E1	20
46	41.2, 44, 84	A1	1	96	52.1	E1	19
47	16, 1A	B2	8	97	52.1	E1, E2	20
48	1a, 37.1, 54	F1	13	98	51.1, 52.1	E1	19
49	41.2, 41.5, 44	A1	ne	99	51.1, 52.1	E1	19
50	41.2, 84	A1	1	100	22.3	E1	19

Annex 8. Percentage occurrence of main plots in each CVS class in twelve major land cover types recorded in 1990. (1 = Crops, 2 = Fertile grassland, 3 = Infertile grassland, 4 = Grass mosaic/bracken, 5 = Moorland grass, 6 = Tall grassland/herb, 7 = Bog, 8 = Woodland, 9 = Heath and screes, 10 = Water and wetland, 11 = Maritime, 12 = Urban.) Names and combinations as in Bunce *et al.* (1999)

CVS vegetation class	Land cover category											
	Crops	Fertile grassland	Infertile grassland	Grass mosaic/braken	Moorland grass	Tall grassland/herb	Bog	Woodland	Heath and screes	Water and wetland	Maritime	Urban
1	98	1				1						
2	87	4				5		3			1	
3	96	1				2		1			1	
4	92	4				4						
5	90	8						1				1
6	68	26	1			4				1		1
7	67	21	0	0		4		2		0		5
8	50	20	2			3		21				4
9	63	17	1			11		7		1		1
10	53	8				23		10		3	0	3
11	48	8				23		13		6		4
12	40	26	1			13		10		1	1	8
13	53	14	2			22		5			1	3
14	41	33	1			13		6	0	1		5
15	18	11				44		13		11		2
16	23	28				3		40		3		3
17	3	19	9	3		16		16		31		3
18	16	31				8		29		2		14
19	14	23				19		9		32		3
20	38	20	1			28		5		1		8
21	21	61	2	1		3		9				4
22	35	22	3			20		13		4		3
23	28	32	1	0		15		7		2	5	9
24	5	8						85				2
25	14	65	3	1		3		11		0		4
26	10	71	1			1		13				4
27	23	45	4	1		17		4		2		4
28	19	41	2	1		13		18		2		5
29	4	92		0		1		1				1
30	12	65	3	0		8		4		3	1	4
31	9	79	4	1		1		3	1		0	2
32	9	35				13		15	1	24		2
33	12	32	2			31		6		9	1	6
34	17	42	4	4	1	6		20		1	1	5
35	6	18	2	2		1		66				7
36		21	3			3		74				
37	6	53		15		9		15				3
38	13	40	5	7		18	0	10		1		5
39		10	5	3				79		3		
40	3	64	11	4	0	5	1	5	0	1	2	2
41	2	51	6	3		8		9		21		
42	4	9	1	2		1		81	1			2
43	4	68	5	9	1	4	0	6	0	2	0	1
44	7	12	49	2		12		7	2		9	
45	3	30	2	3	1	10		36		12		1
46	2	18	2	2		4		68		3		1
47	2	32	11	4		17		13		2	11	9
48	1	39	4	4	3	7		28	1	13	1	1
49	3	8	2	9		14		58	2	3		2
50	1	25	3	8		2		55	1	2		3

continued...

Annex 8. ...continued

CVS vegetation class	Land cover category											
	Crops	Fertile grassland	Infertile grassland	Grass mosaic/braken	Moorland grass	Tall grassland/herb	Bog	Woodland	Heath and screes	Water and wetland	Maritime	Urban
51	1	39	11	7	2	8	0	9	1	18	3	1
52	2	41	21	12	1	3	1	5	1		11	2
53	3	38	5	16		5		24	8			
54		17	3	2	2	15	2	10	2	45	3	
55		25	4	21	7	1	2	27	3	7		3
56	1	28	11	32	1	4	1	9	1	7	2	1
57		21	5	10	6	3	3	10	2	40		
58		10		19	16		4	15	4	31		1
59		6	2	2	2	6		70	4	8		2
60		3	3	43	18		5	3	3	25		
61		3	3	45	9	1	7	18	8	7		
62		3		3	3			81	5	3		3
63		4	2	31	9	1	4	25	4	19	2	
64		4	3	37	4	3	1	36	11	1	1	
65		7	9	32	11	4	5	4	14	2	14	
66		7	10	10	2		22			46	2	
67		6	1	29	24	1	3	13	16	3	1	2
68		2		13	1		1	78	4	1		
69		3	3	16	8		11	30	22	8		
70			3	11			6	69	9	3		
71		7	1	29	14	3	20	1	9	12	3	2
72		4		4	13		23	15	2	40		
73		1	0	10	25	0	17	19	14	14		
74		1		17	9	1	26	4	6	33	1	
75		2			8			83	5	2		
76				13	23		22	11	17	13		
77								100				
78		3		16	10	3	16		10	35	6	
79				11	23		24	15	22	5		
80	1	1	1	20	27		8	11	27	3		1
81				16	11		14	9	48	2		
82				8	23		29	5	32	2	2	
83					14	2	10	57	16			
84		3		3	8		17	8	61			
85				6	23		36	2	15	17		
86					16		67		16	2		
87		1		5	18		55	5	7	10		
88			1	3	29		36	10	16	4		
89		1		4	2		10	7	76			
90				10	18		31	6	31	2	2	
91			1	7	20		40	1	28	3		
92					12		74	3	12			
93					38		14		46	2		
94					10		63	8	15	3		
95					7		26	5	60	2		
96					23		57	2	16	2		
97					11		44	9	33	3		
98				3	15		54	14	10	4		
99				2	9		74	3	9	2		
100					8		78		5	8		

Annex 9. Top five percentage similarity coefficients between CVS vegetation classes and the communities and sub-communities of the NVC derived from the SIMIL programme

CVS vegetation class	NVC unit	NVC unit name	% similarity
1	OV24	*Urtica dioica-Galium aparine community*	35.1
1	OV10	*Poa annua-Senecio vulgaris community*	34.9
1	OV22b	*Cirsium vulgare-Cirsium arvense subcommunity*	34.7
1	OV13	*Stellaria media-Capsella bursa-pastoris community*	34.7
1	OV24a	*typical subcommunity*	34.4
2	OV19	*Poa annua-Matricaria maritima community*	47.0
2	OV19b	*Lolium perenne-Capsella bursa-pastoris subcommunity*	45.8
2	OV10	*Poa annua-Senecio vulgaris community*	44.4
2	OV9	*Stellaria media-Polygonum aviculare community*	40.3
2	OV19c	*Atriplex prostrata-Chenopodium album subcommunity*	39.4
3	OV19b	*Lolium perenne-Capsella bursa-pastoris subcommunity*	43.9
3	OV10	*Poa annua-Senecio vulgaris community*	43.2
3	OV19	*Poa annua-Matricaria maritima community*	42.5
3	OV9	*Stellaria media-Polygonum aviculare community*	41.2
3	OV21	*Poa annua-Plantago major community*	39.1
4	OV10	*Poa annua-Senecio vulgaris community*	45.8
4	OV19b	*Lolium perenne-Capsella bursa-pastoris subcommunity*	45.6
4	OV9	*Stellaria media-Polygonum aviculare community*	44.1
4	OV19	*Poa annua-Matricaria maritima community*	43.9
4	OV13	*Stellaria media-Capsella bursa-pastoris community*	41.4
5	OV9	*Stellaria media-Polygonum aviculare community*	47.7
5	OV10	*Poa annua-Senecio vulgaris community*	47.1
5	OV19b	*Lolium perenne-Capsella bursa-pastoris subcommunity*	46.2
5	OV21	*Poa annua-Plantago major community*	46.1
5	OV21c	*Polygonum aviculare-Ranunculus repens subcommunity*	44.4
6	OV19b	*Lolium perenne-Capsella bursa-pastoris subcommunity*	45.0
6	OV19	*Poa annua-Matricaria maritima community*	44.9
6	OV21	*Poa annua-Plantago major community*	41.8
6	OV9	*Stellaria media-Polygonum aviculare community*	41.7
6	OV21c	*Polygonum aviculare-Ranunculus repens subcommunity*	41.3
7	MG1	*Arrhenatherum elatius coarse grassland*	38.7
7	W24	*Rubus fruticosus-Holcus lanatus underscrub*	37.6
7	MG1b	*Urtica dioica subcommunity*	37.6
7	MG1a	*Festuca rubra subcommunity*	36.3
7	MG1c	*Filipendula ulmaria subcommunity*	35.3
8	W21a	*Hedera helix-Urtica dioica subcommunity*	36.4
8	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	36.3
8	W21	*Crataegus monogyna-Hedera helix scrub*	36.2
8	W8e	*Geranium robertianum subcommunity*	35.7
8	W6	*Alnus glutinosa-Urtica dioica woodland*	35.5
9	MG1b	*Urtica dioica subcommunity*	40.5
9	W24	*Rubus fruticosus-Holcus lanatus underscrub*	40.4
9	MG1	*Arrhenatherum elatius coarse grassland*	38.5
9	MG1c	*Filipendula ulmaria subcommunity*	38.4
9	OV25	*Urtica dioica-Cirsium arvense community*	38.3

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
10	MG1b	*Urtica dioica subcommunity*	44.4
10	MG1	*Arrhenatherum elatius coarse grassland*	43.2
10	MG1a	*Festuca rubra subcommunity*	41.7
10	MG1c	*Filipendula ulmaria subcommunity*	40.9
10	OV26d	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	37.2
11	OV26d	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	38.6
11	MG1	*Arrhenatherum elatius coarse grassland*	37.9
11	MG1b	*Urtica dioica subcommunity*	37.3
11	MG1a	*Festuca rubra subcommunity*	36.6
11	W24	*Rubus fruticosus-Holcus lanatus underscrub*	36.4
12	MG1	*Arrhenatherum elatius coarse grassland*	41.3
12	MG1a	*Festuca rubra subcommunity*	39.9
12	W24	*Rubus fruticosus-Holcus lanatus underscrub*	38.3
12	MG1b	*Urtica dioica subcommunity*	37.8
12	OV23	*Lolium perenne-Dactylis glomerata community*	36.4
13	MG1	*Arrhenatherum elatius coarse grassland*	49.1
13	MG1a	*Festuca rubra subcommunity*	48.6
13	MG1b	*Urtica dioica subcommunity*	43.6
13	OV23	*Lolium perenne-Dactylis glomerata community*	42.3
13	MG1c	*Filipendula ulmaria subcommunity*	40.6
14	MG1	*Arrhenatherum elatius coarse grassland*	40.0
14	MG1a	*Festuca rubra subcommunity*	38.6
14	MG1b	*Urtica dioica subcommunity*	36.1
14	OV23	*Lolium perenne-Dactylis glomerata community*	34.4
14	OV19	*Poa annua-Matricaria maritima community*	34.3
15	OV26d	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	42.4
15	MG1c	*Filipendula ulmaria subcommunity*	40.2
15	MG1a	*Festuca rubra subcommunity*	38.3
15	MG1b	*Urtica dioica subcommunity*	37.9
15	MG1	*Arrhenatherum elatius coarse grassland*	37.3
16	W8e	*Geranium robertianum subcommunity*	41.9
16	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	41.3
16	W24	*Rubus fruticosus-Holcus lanatus underscrub*	40.7
16	W8a	*Primula vulgaris-Glechoma hederacea subcommunity*	39.2
16	W8d	*Hedera helix subcommunity*	39.1
17	S26	*Phragmites australis-Urtica dioica fen*	40.0
17	S26d	*Epilobium hirsutum subcommunity*	38.7
17	OV26	*Epilobium hirsutum community*	38.2
17	S5	*Glyceria maxima swamp*	37.7
17	S6	*Carex riparia swamp*	35.9
18	W24	*Rubus fruticosus-Holcus lanatus underscrub*	40.8
18	W24a	*Cirsium arvense-Cirsium vulgare subcommunity*	36.9
18	MG1a	*Festuca rubra subcommunity*	35.8
18	MG1	*Arrhenatherum elatius coarse grassland*	35.7
18	W24b	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	35.4

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
19	OV26	*Epilobium hirsutum community*	42.3
19	OV26d	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	38.3
19	S26	*Phragmites australis-Urtica dioica fen*	36.3
19	OV26b	*Phragmites australis-Eupatorium cannabinum subcommunity*	35.8
19	OV26c	*Filipendula ulmaria-Angelica sylvestris subcommunity*	35.6
20	MG1	*Arrhenatherum elatius coarse grassland*	51.4
20	MG1a	*Festuca rubra subcommunity*	50.6
20	OV23	*Lolium perenne-Dactylis glomerata community*	46.4
20	MG1b	*Urtica dioica subcommunity*	45.5
20	MG1d	*Pastinaca sativa subcommunity*	42.5
21	W24	*Rubus fruticosus-Holcus lanatus underscrub*	42.6
21	MG1	*Arrhenatherum elatius coarse grassland*	40.0
21	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	39.7
21	W8e	*Geranium robertianum subcommunity*	39.4
21	W8d	*Hedera helix subcommunity*	37.9
22	OV26	*Epilobium hirsutum community*	38.3
22	MG1	*Arrhenatherum elatius coarse grassland*	37.4
22	MG1c	*Filipendula ulmaria subcommunity*	36.8
22	OV26d	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	36.4
22	W24	*Rubus fruticosus-Holcus lanatus underscrub*	35.9
23	MG1	*Arrhenatherum elatius coarse grassland*	39.4
23	OV23	*Lolium perenne-Dactylis glomerata community*	39.0
23	MG1a	*Festuca rubra subcommunity*	38.9
23	MG1d	*Pastinaca sativa subcommunity*	33.0
23	OV19	*Poa annua-Matricaria maritima community*	32.8
24	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	49.9
24	W8e	*Geranium robertianum subcommunity*	48.9
24	W8b	*Anemone nemorosa subcommunity*	47.9
24	W8a	*Primula vulgaris-Glechoma hederacea subcommunity*	47.1
24	W8d	*Hedera helix subcommunity*	44.7
25	MG1	*Arrhenatherum elatius coarse grassland*	40.9
25	W24	*Rubus fruticosus-Holcus lanatus underscrub*	39.7
25	MG1a	*Festuca rubra subcommunity*	38.7
25	W24b	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	35.7
25	MG1c	*Filipendula ulmaria subcommunity*	35.4
26	MG1	*Arrhenatherum elatius coarse grassland*	43.2
26	W24b	*Arrhenatherum elatius-Heracleum sphondylium subcommunity*	41.1
26	MG1a	*Festuca rubra subcommunity*	40.7
26	W24	*Rubus fruticosus-Holcus lanatus underscrub*	40.4
26	MG1b	*Urtica dioica subcommunity*	37.3
27	MG1	*Arrhenatherum elatius coarse grassland*	44.0
27	MG1a	*Festuca rubra subcommunity*	41.8
27	MG1e	*Centaurea nigra subcommunity*	36.8
27	MG1b	*Urtica dioica subcommunity*	36.7
27	OV23	*Lolium perenne-Dactylis glomerata community*	36.3

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
28	MG1	*Arrhenatherum elatius coarse grassland*	33.3
28	W24	*Rubus fruticosus-Holcus lanatus underscrub*	32.3
28	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum woodland*	31.2
28	MG1a	*Festuca rubra subcommunity*	31.0
28	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	30.5
29	OV23	*Lolium perenne-Dactylis glomerata community*	48.4
29	OV22b	*Cirsium vulgare-Cirsium arvense subcommunity*	48.0
29	MG7	*Lolium perenne leys and related grasslands*	46.4
29	OV23c	*Plantago major-Trifolium repens subcommunity*	46.1
29	OV22	*Poa annua-Taraxacum officinale community*	45.5
30	MG1	*Arrhenatherum elatius coarse grassland*	30.8
30	MG1a	*Festuca rubra subcommunity*	29.1
30	MG9a	*Poa trivialis subcommunity*	28.4
30	MG9	*Holcus lanatus-Deschampsia cespitosa grassland*	28.3
30	OV23	*Lolium perenne-Dactylis glomerata community*	27.8
31	OV23	*Lolium perenne-Dactylis glomerata community*	42.4
31	OV23c	*Plantago major-Trifolium repens subcommunity*	40.2
31	OV21c	*Polygonum aviculare-Ranunculus repens subcommunity*	39.6
31	OV21	*Poa annua-Plantago major community*	38.4
31	MG1	*Arrhenatherum elatius coarse grassland*	38.3
32	OV26	*Epilobium hirsutum community*	42.6
32	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	41.4
32	OV26a	*Epilobium hirsutum subcommunity*	37.6
32	M27c	*Juncus effusus-Holcus lanatus subcommunity*	36.2
32	OV26b	*Phragmites australis-Eupatorium cannabinum subcommunity*	35.8
33	MG1c	*Filipendula ulmaria subcommunity*	41.5
33	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	41.0
33	MG1	*Arrhenatherum elatius coarse grassland*	40.9
33	MG9	*Holcus lanatus-Deschampsia cespitosa grassland*	40.7
33	OV26	*Epilobium hirsutum community*	40.6
34	MG1	*Arrhenatherum elatius coarse grassland*	43.1
34	MG1a	*Festuca rubra subcommunity*	37.7
34	MG1e	*Centaurea nigra subcommunity*	34.5
34	W24	*Rubus fruticosus-Holcus lanatus underscrub*	34.4
34	MG1d	*Pastinaca sativa subcommunity*	34.4
35	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	50.7
35	W8e	*Geranium robertianum subcommunity*	48.6
35	W8a	*Primula vulgaris-Glechoma hederacea subcommunity*	45.8
35	W10	*Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland*	44.1
35	W8b	*Anemone nemorosa subcommunity*	44.0
36	W8e	*Geranium robertianum subcommunity*	46.2
36	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	45.7
36	W9a	*typical subcommunity*	44.9
36	W9	*Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis woodland*	43.8
36	W8b	*Anemone nemorosa subcommunity*	43.5

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
37	MG5a	*Lathyrus pratensis subcommunity*	47.6
37	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	46.1
37	MG1	*Arrhenatherum elatius coarse grassland*	45.5
37	MG1e	*Centaurea nigra subcommunity*	44.7
37	MG9	*Holcus lanatus-Deschampsia cespitosa grassland*	44.6
38	MG1	*Arrhenatherum elatius coarse grassland*	45.5
38	MG1e	*Centaurea nigra subcommunity*	42.5
38	MG5a	*Lathyrus pratensis subcommunity*	41.0
38	MG1a	*Festuca rubra subcommunity*	40.8
38	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	40.4
39	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	47.9
39	W8e	*Geranium robertianum subcommunity*	47.7
39	W9a	*typical subcommunity*	47.7
39	W9	*Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis woodland*	47.2
39	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum woodland*	45.3
40	MG1	*Arrhenatherum elatius coarse grassland*	35.8
40	MG5a	*Lathyrus pratensis subcommunity*	35.1
40	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	34.3
40	MG5b	*Galium verum subcommunity*	33.6
40	SD8	*Festuca rubra-Galium verum fixed dune community*	33.0
41	MG10	*Holcus lanatus-Juncus effusus rush-pasture*	38.0
41	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	37.8
41	MG9a	*Poa trivialis subcommunity*	36.5
41	MG9	*Holcus lanatus-Deschampsia cespitosa grassland*	36.3
41	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	35.8
42	W10	*Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland*	51.9
42	W10c	*Hedera helix subcommunity*	50.9
42	W10a	*typical subcommunity*	49.1
42	W10d	*Holcus lanatus subcommunity*	47.8
42	W10e	*Acer pseudoplatanus-Oxalis acetosella subcommunity*	45.1
43	MG5a	*Lathyrus pratensis subcommunity*	39.5
43	U4b	*Holcus lanatus-Trifolium repens subcommunity*	39.3
43	MG6b	*Anthoxanthum odoratum subcommunity*	39.2
43	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	38.8
43	MG6	*Lolium perenne-Cynosurus cristatus grassland*	38.6
44	CG2c	*Holcus lanatus-Trifolium repens subcommunity*	58.3
44	CG3	*Bromus erectus grassland*	56.5
44	CG2	*Festuca ovina-Avenula pratensis grassland*	56.0
44	CG3c	*Knautia arvensis-Bellis perennis subcommunity*	55.8
44	CG2a	*Cirsium acaule-Asperula cynanchica subcommunity*	53.2
45	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	43.5
45	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum woodland*	41.0
45	M27c	*Juncus effusus-Holcus lanatus subcommunity*	39.2
45	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	37.6
45	W7b	*Carex remota subcommunity*	37.1

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
46	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum woodland*	41.3
46	W9a	*typical subcommunity*	41.2
46	W9	*Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis woodland*	41.1
46	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	38.2
46	W8e	*Geranium robertianum subcommunity*	37.2
47	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	50.2
47	MG5a	*Lathyrus pratensis subcommunity*	49.5
47	MG5b	*Galium verum subcommunity*	48.7
47	MG1	*Arrhenatherum elatius coarse grassland*	46.9
47	SD8	*Festuca rubra-Galium verum fixed dune community*	46.5
48	MG9	*Holcus lanatus-Deschampsia cespitosa grassland*	40.2
48	MG9a	*Poa trivialis subcommunity*	39.9
48	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	39.7
48	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	38.0
48	W7	*Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum woodland*	37.3
49	OV27	*Epilobium angustifolium community*	39.4
49	W10d	*Holcus lanatus subcommunity*	39.2
49	W10	*Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland*	38.9
49	W10c	*Hedera helix subcommunity*	38.7
49	W10a	*typical subcommunity*	36.6
50	W10	*Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland*	39.8
50	W9	*Fraxinus excelsior-Sorbus aucuparia-Mercurialis perennis woodland*	37.3
50	W10c	*Hedera helix subcommunity*	37.2
50	W9a	*typical subcommunity*	37.2
50	W8	*Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland*	36.6
51	M22b	*Briza media-Trifolium spp. subcommunity*	34.0
51	M22	*Juncus subnodulosus-Cirsium palustre fen-meadow*	33.4
51	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	32.9
51	MG8	*Cynosurus cristatus-Caltha palustris flood-pasture*	32.2
51	U4b	*Holcus lanatus-Trifolium repens subcommunity*	32.1
52	MG5a	*Lathyrus pratensis subcommunity*	48.4
52	MG5b	*Galium verum subcommunity*	48.1
52	MG5	*Cynosurus cristatus-Centaurea nigra grassland*	47.8
52	SD8	*Festuca rubra-Galium verum fixed dune community*	46.5
52	U4b	*Holcus lanatus-Trifolium repens subcommunity*	44.6
53	U4b	*Holcus lanatus-Trifolium repens subcommunity*	46.3
53	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	41.8
53	U4a	*typical subcommunity*	39.9
53	MG6b	*Anthoxanthum odoratum subcommunity*	39.9
53	MG6a	*typical subcommunity*	39.6
54	M27	*Filipendula ulmaria-Angelica sylvestris tall-herb fen*	51.8
54	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	49.1
54	M23a	*Juncus acutiflorus subcommunity*	48.0
54	M27c	*Juncus effusus-Holcus lanatus subcommunity*	45.9
54	M23b	*Juncus effusus subcommunity*	45.2

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
55	U4b	*Holcus lanatus-Trifolium repens subcommunity*	41.2
55	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	39.9
55	U4a	*typical subcommunity*	38.3
55	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	36.3
55	U20a	*Anthoxanthum odoratum subcommunity*	35.4
56	U4b	*Holcus lanatus-Trifolium repens subcommunity*	47.6
56	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	44.2
56	MG5a	*Lathyrus pratensis subcommunity*	41.2
56	U4a	*typical subcommunity*	41.0
56	CG10a	*Trifolium repens-Luzula campestris subcommunity*	41.0
57	M23a	*Juncus acutiflorus subcommunity*	51.0
57	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	48.3
57	M23b	*Juncus effusus subcommunity*	44.6
57	M22b	*Briza media-Trifolium spp. subcommunity*	42.3
57	M22	*Juncus subnodulosus-Cirsium palustre fen-meadow*	41.5
58	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	43.1
58	M23a	*Juncus acutiflorus subcommunity*	41.0
58	M23b	*Juncus effusus subcommunity*	40.6
58	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	39.0
58	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	38.3
59	W11	*Quercus petraea-Betula pubescens-Oxalis acetosella woodland*	40.4
59	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	39.7
59	W11c	*Anemone nemorosa subcommunity*	39.3
59	W11d	*Stellaria holostea subcommunity*	39.0
59	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	38.9
60	U4b	*Holcus lanatus-Trifolium repens subcommunity*	46.2
60	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	44.1
60	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	43.8
60	CG10a	*Trifolium repens-Luzula campestris subcommunity*	42.9
60	M23a	*Juncus acutiflorus subcommunity*	42.8
61	CG10a	*Trifolium repens-Luzula campestris subcommunity*	51.3
61	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	49.3
61	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	49.2
61	U4a	*typical subcommunity*	49.1
61	U4b	*Holcus lanatus-Trifolium repens subcommunity*	48.0
62	W16a	*Quercus robur subcommunity*	43.3
62	W16	*Quercus spp.-Betula spp.-Deschampsia flexuosa woodland*	40.2
62	W10d	*Holcus lanatus subcommunity*	38.1
62	W17d	*Rhytidiadelphus triquetrus subcommunity*	37.4
62	W15	*Fagus sylvatica-Deschampsia flexuosa woodland*	36.9
63	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	46.6
63	CG10a	*Trifolium repens-Luzula campestris subcommunity*	46.3
63	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	44.9
63	CG10b	*Carex pulicaris-Carex panicea subcommunity*	44.8
63	U4b	*Holcus lanatus-Trifolium repens subcommunity*	44.1

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
64	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	46.8
64	U4a	*typical subcommunity*	45.7
64	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	43.8
64	W11	*Quercus petraea-Betula pubescens-Oxalis acetosella woodland*	42.6
64	CG10a	*Trifolium repens-Luzula campestris subcommunity*	42.5
65	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	53.2
65	CG10b	*Carex pulicaris-Carex panicea subcommunity*	52.1
65	CG10a	*Trifolium repens-Luzula campestris subcommunity*	50.5
65	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	48.6
65	U4b	*Holcus lanatus-Trifolium repens subcommunity*	46.3
66	U4b	*Holcus lanatus-Trifolium repens subcommunity*	41.2
66	M23a	*Juncus acutiflorus subcommunity*	39.5
66	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	38.2
66	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	38.1
66	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	37.3
67	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	51.4
67	U4a	*typical subcommunity*	49.6
67	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	47.9
67	U4b	*Holcus lanatus-Trifolium repens subcommunity*	44.8
67	U5	*Nardus stricta-Galium saxatile grassland*	44.4
68	W11	*Quercus petraea-Betula pubescens-Oxalis acetosella woodland*	47.4
68	W11a	*Dryopteris dilatata subcommunity*	47.2
68	W17c	*Anthoxanthum odoratum-Agrostis capillaris subcommunity*	46.4
68	W11c	*Anemone nemorosa subcommunity*	44.7
68	W17	*Quercus petraea-Betula pubescens-Dicranum majus woodland*	43.9
69	CG10b	*Carex pulicaris-Carex panicea subcommunity*	49.1
69	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	48.1
69	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	47.4
69	U4a	*typical subcommunity*	46.0
69	CG10a	*Trifolium repens-Luzula campestris subcommunity*	45.6
70	W11	*Quercus petraea-Betula pubescens-Oxalis acetosella woodland*	48.1
70	W11c	*Anemone nemorosa subcommunity*	47.0
70	W11b	*Blechnum spicant subcommunity*	45.1
70	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	43.5
70	W11d	*Stellaria holostea subcommunity*	42.8
71	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	47.9
71	CG10a	*Trifolium repens-Luzula campestris subcommunity*	47.3
71	CG10b	*Carex pulicaris-Carex panicea subcommunity*	46.7
71	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	44.0
71	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	43.1
72	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	51.0
72	M23a	*Juncus acutiflorus subcommunity*	50.5
72	M23b	*Juncus effusus subcommunity*	48.2
72	M25	*Molinia caerulea-Potentilla erecta mire*	47.7
72	M6	*Carex echinata-Sphagnum recurvum/auriculatum mire*	43.4

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
73	U5	*Nardus stricta-Galium saxatile grassland*	41.2
73	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	41.1
73	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	40.2
73	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	40.0
73	CG10a	*Trifolium repens-Luzula campestris subcommunity*	39.8
74	M23a	*Juncus acutiflorus subcommunity*	43.4
74	M15	*Scirpus cespitosus-Erica tetralix wet heath*	42.0
74	M15a	*Carex panicea subcommunity*	41.6
74	M23	*Juncus effusus/acutiflorus-Galium palustre rush-pasture*	41.5
74	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	41.2
75	U16	*Luzula sylvatica-Vaccinium myrtillus tall-herb community*	44.4
75	U16b	*Anthoxanthum odoratum-Festuca ovina subcommunity*	43.0
75	U20b	*Vaccinium myrtillus-Dicranum scoparium subcommunity*	41.3
75	U2	*Deschampsia flexuosa grassland*	40.9
75	U4e	*Vaccinium myrtillus-Deschampsia flexuosa subcommunity*	40.8
76	CG10b	*Carex pulicaris-Carex panicea subcommunity*	49.0
76	CG11b	*Carex pulicaris-Carex panicea subcommunity*	48.5
76	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	48.0
76	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	47.9
76	CG10a	*Trifolium repens-Luzula campestris subcommunity*	44.9
77	U6b	*Carex nigra-Calypogeia trichomanis subcommunity*	25.5
77	U16c	*species-poor subcommunity*	24.7
77	U2b	*Vaccinium myrtillus subcommunity*	24.4
77	U20b	*Vaccinium myrtillus-Dicranum scoparium subcommunity*	22.8
77	U6	*Juncus squarrosus-Festuca ovina grassland*	22.6
78	CG11b	*Carex pulicaris-Carex panicea subcommunity*	48.7
78	CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	47.0
78	CG10b	*Carex pulicaris-Carex panicea subcommunity*	46.9
78	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	46.0
78	CG10a	*Trifolium repens-Luzula campestris subcommunity*	45.5
79	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	50.4
79	CG11b	*Carex pulicaris-Carex panicea subcommunity*	48.3
79	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	48.1
79	CG11a	*typical subcommunity*	46.6
79	U5	*Nardus stricta-Galium saxatile grassland*	46.1
80	U5	*Nardus stricta-Galium saxatile grassland*	54.8
80	U5a	*species-poor subcommunity*	53.8
80	U5d	*Calluna vulgaris-Danthonia decumbens subcommunity*	52.1
80	U5b	*Agrostis canina-Polytrichum commune subcommunity*	51.5
80	U4a	*typical subcommunity*	50.4
81	U4a	*typical subcommunity*	56.5
81	U4	*Festuca ovina-Agrostis capillaris-Galium saxatile grassland*	56.0
81	H10c	*Festuca ovina-Anthoxanthum odoratum subcommunity*	55.8
81	H10	*Calluna vulgaris-Erica cinerea heath*	55.0
81	U4d	*Luzula multiflora-Rhytidiadelphus loreus subcommunity*	54.3

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
82	M15	*Scirpus cespitosus-Erica tetralix wet heath*	48.1
82	M15b	*typical subcommunity*	47.1
82	M15d	*Vaccinium myrtillus subcommunity*	46.7
82	H10c	*Festuca ovina-Anthoxanthum odoratum subcommunity*	46.7
82	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	46.7
83	M15d	*Vaccinium myrtillus subcommunity*	55.7
83	H10a	*typical subcommunity*	51.2
83	H10	*Calluna vulgaris-Erica cinerea heath*	50.0
83	H12	*Calluna vulgaris-Vaccinium myrtillus heath*	49.6
83	H12a	*Calluna subcommunity*	49.4
84	M15d	*Vaccinium myrtillus subcommunity*	49.8
84	M15c	*Cladonia subcommunity*	47.2
84	M15	*Scirpus cespitosus-Erica tetralix wet heath*	46.4
84	M15b	*typical subcommunity*	46.1
84	U5d	*Calluna vulgaris-Danthonia decumbens subcommunity*	45.5
85	M15a	*Carex panicea subcommunity*	57.7
85	M15	*Scirpus cespitosus-Erica tetralix wet heath*	54.6
85	M15b	*typical subcommunity*	54.0
85	M10a	*Carex demissa-Juncus bulbosus subcommunity*	49.2
85	M15d	*Vaccinium myrtillus subcommunity*	46.6
86	M15a	*Carex panicea subcommunity*	50.3
86	M15	*Scirpus cespitosus-Erica tetralix wet heath*	49.6
86	M15b	*typical subcommunity*	49.0
86	CG11	*Festuca ovina-Agrostis capillaris-Alchemilla alpina grassland*	47.2
86	M15d	*Vaccinium myrtillus subcommunity*	46.7
87	M15	*Scirpus cespitosus-Erica tetralix wet heath*	52.3
87	M15b	*typical subcommunity*	50.7
87	M15a	*Carex panicea subcommunity*	50.0
87	M15d	*Vaccinium myrtillus subcommunity*	48.1
87	M15c	*Cladonia subcommunity*	41.4
88	M15d	*Vaccinium myrtillus subcommunity*	56.9
88	U5b	*Agrostis canina-Polytrichum commune subcommunity*	50.3
88	U5d	*Calluna vulgaris-Danthonia decumbens subcommunity*	50.2
88	M15	*Scirpus cespitosus-Erica tetralix wet heath*	49.7
88	U5	*Nardus stricta-Galium saxatile grassland*	49.5
89	H12	*Calluna vulgaris-Vaccinium myrtillus heath*	55.5
89	H12a	*Calluna subcommunity*	53.2
89	H12b	*Vaccinium vitis-idaea-Cladonia impexa subcommunity*	50.8
89	H10a	*typical subcommunity*	50.0
89	H10	*Calluna vulgaris-Erica cinerea heath*	49.6
90	M15c	*Cladonia subcommunity*	60.8
90	M15b	*typical subcommunity*	57.4
90	M15	*Scirpus cespitosus-Erica tetralix wet heath*	56.7
90	H10b	*Racomitrium lanuginosum subcommunity*	56.4
90	M15d	*Vaccinium myrtillus subcommunity*	56.3

continued...

Annex 9. ...continued

CVS vegetation class	NVC unit	NVC unit name	% similarity
91	M15d	*Vaccinium myrtillus subcommunity*	50.8
91	U5	*Nardus stricta-Galium saxatile grassland*	49.6
91	H18	*Vaccinium myrtillus-Deschampsia flexuosa heath*	49.5
91	H10	*Calluna vulgaris-Erica cinerea heath*	49.0
91	U5a	*species-poor subcommunity*	49.0
92	M15	*Scirpus cespitosus-Erica tetralix wet heath*	53.6
92	M15b	*typical subcommunity*	53.5
92	M15d	*Vaccinium myrtillus subcommunity*	53.2
92	M15a	*Carex panicea subcommunity*	51.1
92	M15c	*Cladonia subcommunity*	49.4
93	U7	*Nardus stricta-Carex bigelowii grass-heath*	58.0
93	H18c	*Empetrum nigrum-Racomitrium lanuginosum subcommunity*	57.9
93	U7b	*typical subcommunity*	56.9
93	U5a	*species-poor subcommunity*	56.7
93	U7c	*Alchemilla alpina-Festuca ovina subcommunity*	56.4
94	M15	*Scirpus cespitosus-Erica tetralix wet heath*	61.3
94	M15b	*typical subcommunity*	60.7
94	M15d	*Vaccinium myrtillus subcommunity*	55.6
94	M17	*Scirpus cespitosus-Eriophorum vaginatum blanket mire*	54.7
94	M15c	*Cladonia subcommunity*	53.7
95	M19a	*Erica tetralix subcommunity*	43.8
95	M19	*Calluna vulgaris-Eriophorum vaginatum blanket mire*	41.4
95	U2b	*Vaccinium myrtillus subcommunity*	40.9
95	M17c	*Juncus squarrosus subcommunity*	40.6
95	M15d	*Vaccinium myrtillus subcommunity*	39.0
96	M15b	*typical subcommunity*	59.0
96	M15a	*Carex panicea subcommunity*	58.9
96	M15	*Scirpus cespitosus-Erica tetralix wet heath*	58.4
96	M15c	*Cladonia subcommunity*	54.2
96	M17b	*Cladonia subcommunity*	54.1
97	M19a	*Erica tetralix subcommunity*	60.2
97	M19	*Calluna vulgaris-Eriophorum vaginatum blanket mire*	58.9
97	M19b	*Empetrum nigrum subcommunity*	55.1
97	M17c	*Juncus squarrosus subcommunity*	54.5
97	M15d	*Vaccinium myrtillus subcommunity*	53.5
98	M15b	*typical subcommunity*	56.0
98	M15	*Scirpus cespitosus-Erica tetralix wet heath*	55.4
98	M17	*Scirpus cespitosus-Eriophorum vaginatum blanket mire*	53.0
98	M15c	*Cladonia subcommunity*	51.4
98	M15d	*Vaccinium myrtillus subcommunity*	50.8
99	M15	*Scirpus cespitosus-Erica tetralix wet heath*	57.8
99	M15b	*typical subcommunity*	57.7
99	M15c	*Cladonia subcommunity*	54.3
99	M17	*Scirpus cespitosus-Eriophorum vaginatum blanket mire*	54.0
99	M17b	*Cladonia subcommunity*	53.5
100	M15a	*Carex panicea subcommunity*	55.4
100	M15	*Scirpus cespitosus-Erica tetralix wet heath*	53.2
100	M15b	*typical subcommunity*	53.0
100	M17a	*Drosera rotundifolia-Sphagnum spp. subcommunity*	52.8
100	M17	*Scirpus cespitosus-Eriophorum vaginatum blanket mire*	50.0

Annex 10a. Changes in mean species number per plot between 1978 and 1990 over all plot types reported in the four landscape types and the eight aggregate classes of the CVS. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Plot type	Aggregate vegetation class	No. of plots	No. of species 1978	No. of species 1990	Change in mean number	% Change	T value
Arable	I	130	6.71	5.43	–1.28	–19.0	–2.25*
	II	118	12.07	12.67	0.60	5.0	1.08
	III	130	13.26	11.61	–1.65	–12.5	–2.72**
	IV	89	20.28	17.10	–3.18	–15.7	–3.95***
	V	76	10.76	12.92	2.16	20.1	2.53*
	VI	12	25.08	20.58	–4.50	–17.9	–0.83
	VII	5	29.60	23.20	–6.40	–21.6	–1.88
	VIII	8	11.25	15.50	4.25	37.8	3.28*
Pastural	I	66	7.59	8.30	0.71	9.4	0.96
	II	100	14.39	15.04	0.65	4.5	0.83
	III	147	11.89	12.71	0.82	6.9	1.41
	IV	165	21.01	17.56	–3.44	–16.4	–5.22***
	V	71	14.34	12.45	–1.89	–13.2	–2.29*
	VI	46	16.48	12.70	–3.78	–23.0	–3.27**
	VII	27	24.26	19.96	–4.30	–17.7	–2.76*
	VIII	18	16.50	13.06	–3.44	–20.9	–2.42*
Marginal upland	I	4	7.50	14.25	6.75	90.0	2.45
	II	9	17.89	15.56	–2.33	–13.0	–1.84*
	III	32	13.13	15.34	2.22	16.9	1.47
	IV	96	22.11	21.11	–1.00	–4.5	–1.07
	V	3	14.33	17.33	3.00	20.9	1.41
	VI	25	20.80	13.84	–6.96	–33.5	–3.85**
	VII	65	17.77	20.37	2.60	14.6	2.26*
	VIII	35	12.06	14.29	2.23	18.5	1.99*
Upland	I	2	5.00	7.00	2.00	40.0	2.00
	III	10	9.60	11.80	2.20	22.9	1.66
	IV	19	22.32	21.00	–1.32	–5.9	–0.63
	VI	41	23.44	20.41	–3.02	–12.9	–1.54
	VII	113	23.74	21.03	–2.72	–11.4	–2.53*
	VIII	209	18.90	19.98	1.08	5.7	1.92*
Great Britain	I	202	7.00	6.56	–0.44	–6.2	–0.97
	II	227	13.32	13.83	0.51	3.8	1.12
	III	319	12.50	12.50	0.00	–0.0	–0.01
	IV	369	21.19	18.55	–2.63	–12.4	–5.93***
	V	150	12.53	12.79	0.26	2.1	0.43
	VI	124	20.48	16.24	–4.24	–20.7	–4.20***
	VII	210	22.10	20.74	–1.36	–6.2	–1.85*
	VIII	270	17.63	18.65	1.02	5.8	2.14*

Annex 10b. Changes in mean species number per plot between 1978 and 1990 by plot types by the eight aggregate classes of the CVS for GB as a whole. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Plot type	Aggregate vegetation class	No. of plots	No. of species 1978	No. of species 1990	Change in mean number	% Change	T value
Main	I	194	6.97	6.27	–0.71	–10.1	–1.55
	II	13	11.77	14.46	2.69	22.9	0.91
	III	178	10.69	10.62	–0.06	–0.6	–0.12
	IV	209	21.65	18.79	–2.86	–13.2	–4.69***
	V	22	13.45	16.86	3.41	25.3	1.55
	VI	73	19.47	15.75	–3.99	–20.2	–3.05**
	VII	114	22.06	21.67	–0.39	–1.8	–0.37
	VIII	241	17.39	18.24	0.85	4.9	1.74
Roadside	I	7	7.43	13.43	6.00	80.8	3.23*
	II	84	13.46	15.73	2.26	16.8	3.24**
	III	112	14.62	14.87	0.25	1.7	0.36
	IV	65	19.48	18.85	–0.63	–3.2	–0.71
	V	7	15.00	18.43	3.43	22.9	0.88
	VI	5	20.80	16.80	–4.00	–19.2	–1.35
	VII	23	21.00	20.04	–0.96	–4.6	–0.52
	VIII	1	21.00	24.00	3.00	14.3	0.00
Hedge	II	76	13.34	11.46	–1.88	–14.1	–2.85**
	III	6	12.50	8.83	–3.67	–29.3	–1.82
	IV	24	16.58	14.42	–2.17	–13.1	–1.54
	V	96	11.48	11.40	–0.08	–0.7	–0.13
	VI	2	29.50	18.00	–11.50	–40.0	–1.35
Streamside	I	1	8.00	15.00	7.00	87.5	1.00
	II	54	13.44	14.06	0.61	4.6	0.65
	III	23	16.26	16.43	0.17	1.1	0.09
	IV	71	22.96	18.99	–3.97	–17.3	–3.66***
	V	25	15.04	12.96	–2.08	–13.8	–1.49
	VI	44	21.27	16.91	–4.36	–20.5	–2.42*
	VII	73	22.51	19.51	–3.00	–13.3	–2.59*
	VIII	28	19.61	22.00	2.39	12.2	1.30

Annex 10c. Changes in mean species number per plot between 1978 and 1990 by plot type by the eight aggregate classes of the CVS and the four landscape types. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Plot type	Landscape type	Aggregate vegetation class	No. of plots	No. of species in 1978	No. of species in 1990	Change in mean number	% Change	T value
Main	Arable	I	124	6.69	5.08	–1.61	–24.1	–2.82**
		II	4	16.50	12.75	–3.75	–22.7	–2.02
		III	54	10.02	8.76	–1.26	–12.6	–1.74*
		IV	50	20.94	17.90	–3.04	–14.5	–2.53*
		V	12	12.92	20.83	7.92	61.3	2.38*
		VI	6	17.67	18.67	1.00	5.7	0.13
		VII	5	29.60	23.20	–6.40	–21.6	–1.88
		VIII	8	11.25	15.50	4.25	37.8	3.28*
	Pastural	I	64	7.55	8.05	0.50	6.6	0.67
		II	9	9.67	15.22	5.56	57.5	1.41
		III	100	10.92	11.23	0.31	2.8	0.43
		IV	101	21.65	17.45	–4.21	–19.4	–4.91**
		V	10	14.10	12.10	–2.00	–14.2	–1.14
		VI	23	15.04	11.00	–4.04	–26.9	–4.11**
		VII	17	25.71	22.35	–3.35	–13.0	–1.70
		VIII	16	15.63	12.25	–3.38	–21.6	–2.16*
	Marginal upland	I	4	7.50	14.25	6.75	90.0	2.45
		III	16	12.31	13.06	0.75	6.1	0.30
		IV	54	22.22	21.61	–0.61	–2.8	–0.49
		VI	13	21.23	11.77	–9.46	–44.6	–2.96**
		VII	43	17.60	20.35	2.74	15.6	1.87*
		VIII	31	12.16	14.55	2.39	19.6	1.89*
	Upland	I	2	5.00	7.00	2.00	40.0	2.00
		III	8	9.00	10.75	1.75	19.4	1.15
		IV	4	22.50	25.75	3.25	14.4	1.25
		VI	31	23.00	20.39	–2.61	–11.4	–1.17
		VII	49	23.94	22.43	–1.51	–6.3	–0.79
		VIII	186	18.67	19.48	0.81	4.4	1.42
Streamside	Arable	II	33	10.61	13.27	2.67	25.1	2.53*
		III	14	16.93	13.86	–3.07	–18.1	–1.45
		IV	21	20.90	17.76	–3.14	–15.0	–2.62**
		V	10	12.90	12.50	–0.40	–3.1	–0.23
		VI	6	32.50	22.50	–10.00	–30.8	–1.27
	Pastural	I	1	8.00	15.00	7.00	87.5	1.00
		II	20	17.85	15.30	–2.55	–14.3	–1.59
		III	8	16.00	19.38	3.38	21.1	1.09
		IV	29	20.45	17.38	–3.07	–15.0	–1.74*
		V	14	16.36	12.86	–3.50	–21.4	–1.64
		VI	19	16.63	14.05	–2.58	–15.5	–1.07
		VII	7	21.71	16.14	–5.57	–25.7	–1.41
		VIII	2	23.50	19.50	–4.00	–17.0	–1.00
	Marginal upland	II	1	19.00	15.00	–4.00	–21.1	–1.00
		III	1	9.00	29.00	20.00	222.2	1.00
		IV	15	28.67	23.33	–5.33	–18.6	–1.75*
		V	1	18.00	19.00	1.00	5.6	1.00
		VI	10	18.70	15.20	–3.50	–18.7	–1.55
		VII	18	18.11	20.89	2.78	15.3	1.35
		VIII	4	11.25	12.25	1.00	8.9	1.21
	Upland	IV	6	28.00	20.17	–7.83	–28.0	–1.62
		VI	9	26.44	21.11	–5.33	–20.2	–1.13
		VII	48	24.27	19.48	–4.79	–19.7	–3.46**

continued...

Annex 10c. ...continued

Plot type	Landscape type	Aggregate vegetation class	No. of plots	No. of species in 1978	No. of species in 1990	Change in mean number	% Change	T value
Roadside	Arable	I	6	7.00	12.67	5.67	81.0	2.67*
		II	43	13.21	14.60	1.40	10.6	1.66
		III	60	15.30	13.85	–1.45	–9.5	–1.41
		IV	12	19.33	16.92	–2.42	–12.5	–1.00
		V	3	11.67	20.00	8.33	71.4	1.00
	Pastural	I	1	10.00	18.00	8.00	80.0	1.00
		II	40	13.90	17.05	3.15	22.7	2.75**
		III	36	13.61	15.50	1.89	13.9	1.79*
		IV	24	20.88	19.63	–1.25	–6.0	–0.81
		V	4	17.50	17.25	–0.25	–1.4	–0.09
		VI	3	21.67	17.67	–4.00	–18.5	–2.32
		VII	3	22.00	15.33	–6.67	–30.3	–1.71
	Marginal upland	II	1	7.00	11.00	4.00	57.1	1.00
		III	14	14.64	17.43	2.79	19.0	1.79*
		IV	20	18.35	18.80	0.45	2.5	0.32
		VI	1	29.00	16.00	–13.00	–44.8	–1.00
		VII	4	18.00	18.25	0.25	1.4	0.06
	Upland	III	2	12.00	16.00	4.00	33.3	1.22
		IV	9	18.44	19.44	1.00	5.4	0.44
		VI	1	10.00	15.00	5.00	50.0	1.00
		VII	16	21.56	21.38	–0.19	–0.9	–0.08
		VIII	1	21.00	24.00	3.00	14.3	0.00
Hedge	Arable	II	38	11.58	9.95	–1.63	–14.1	–1.64
		III	2	14.00	5.50	–8.50	–60.7	–1.78
		IV	6	14.50	8.50	–6.00	–41.4	–2.81*
		V	51	9.78	10.73	0.94	9.6	1.29
	Pastural	II	31	14.16	12.23	–1.94	–13.7	–1.85*
		III	3	12.67	11.00	–1.67	–13.2	–0.78
		IV	11	16.82	14.64	–2.18	–13.0	–1.23
		V	43	13.44	11.95	–1.49	–11.1	–1.37
		VI	1	31.00	11.00	–20.00	–64.5	0.00
	Marginal upland	II	7	19.29	16.29	–3.00	–15.6	–2.29*
		III	1	9.00	9.00	0.00	0.0	0.00
		IV	7	18.00	19.14	1.14	6.4	0.35
		V	2	12.50	16.50	4.00	32.0	1.22
		VI	1	28.00	25.00	–3.00	–10.7	–1.00

Annex 11a. Cross-tabulation between aggregate classes derived from data on agricultural land in England and Wales (A–H) and the aggregate classes of the CVS for all land in GB (I–VIII). Values in the table are the percentage of England and Wales plots in each combination of classes, rounded to the nearest integer

CVS aggregate class	Agricultural land in England and Wales aggregate classes								% of England and Wales agricultural plots in each GB aggregate class	Number of England and Wales agricultural plots as % of GB total
	A	B	C	D	E	F	G	H		
I	3	6							8	80
II	1	1	11	1	14				28	60
III		5			10				15	51
IV					15	2	1		20	45
V			12	3					15	71
VI			1	1		1	1		5	34
VII							4		5	20
VIII								2	3	14

Annex 11b. Relationship of the eight aggregate classes for GB with their counterparts for agricultural land in England and Wales. (* = Note that the GB upland wooded (AC VI) does not correspond with any unit of the agricultural classification for England and Wales)

	Agricultural land (England & Wales)		GB*
A	Sparse weeds/crops	I	Crops/weeds
B	Mixed weeds/crops		
C	Open wooded	V	Lowland wooded
D	Dense wooded		
E	Mixed grassland herb	II	Tall grassland/herb
		III	Fertile grassland
		IV	Infertile grassland (part)
F	Wet grassland	IV	Infertile grassland (part)
G	Acid grassland/moorland	VII	Moorland grass/mosaic
H	Heath/bog	VIII	Heath/bog

Annex 11c. Changes in mean species number per plot over all plot types reported in the four landscape types and the eight aggregate classes of the CVS between 1978 and 1990 on agricultural land in England and Wales. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Landscape type	Aggregate vegetation class	No. of plots	Mean no. of species 1978	Mean no. of species 1990	Change in mean number	% Change	T value
Arable	I	24	6.00	5.29	–0.71	–11.8	–0.82
	II	110	7.17	5.38	–1.79	–25.0	–3.10**
	III	83	10.87	12.19	1.33	12.2	1.69*
	IV	8	11.88	21.63	9.75	82.1	2.50*
	V	71	16.39	13.45	–2.94	–18.0	–4.26***
Pastural	I	2	5.00	11.50	6.50	130.0	1.86
	II	90	8.16	9.11	0.96	11.7	1.53
	III	67	15.27	13.15	–2.12	–13.7	–2.59*
	IV	21	20.33	15.71	–4.62	–22.7	–2.43***
	V	176	17.41	15.57	–1.84	–10.5	–2.94**
	VI	15	17.00	20.47	3.47	20.4	1.88*
	VII	9	21.78	16.22	–5.56	–25.5	–2.61*
	VIII	5	9.80	8.40	–1.40	–14.3	1.23*
Marginal upland	II	2	7.00	10.00	3.00	42.9	1.31
	III	8	21.50	19.88	–1.63	–7.6	–0.66
	IV	3	20.33	19.67	–0.67	–3.3	–0.58
	V	54	21.76	19.28	–2.48	–11.4	–1.94*
	VI	2	20.50	19.50	–1.00	–4.9	–0.55
	VII	26	16.81	18.35	1.54	9.2	1.37
	VIII	16	6.94	6.25	–0.69	–9.9	–0.56
Upland	V	2	19.50	16.00	–3.50	–17.9	–1.61
	VII	16	15.13	15.75	0.63	4.1	0.46
	VIII	7	10.86	11.71	0.86	7.9	0.71
England and Wales	I	26	5.92	5.77	–0.15	–2.6	–0.17
	II	202	7.61	7.09	–0.52	–6.8	–1.21
	III	158	13.27	12.99	–0.28	–2.1	–0.50
	IV	32	18.22	17.56	–0.66	–3.6	–0.35
	V	303	17.96	15.74	–2.22	–12.4	–4.86***
	VI	17	17.41	20.35	2.94	16.9	1.76*
	VII	51	17.16	17.16	0.00	0.0	0.00
	VIII	28	8.43	8.00	–0.43	–5.1	–0.55

Annex 11d. Changes in mean species number per plot over all plot types reported in the eight aggregate classes of the CVS between 1978 and 1990 on agricultural land in England and Wales. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Plot type	Aggregate vegetation class	No. of plots	Mean no. of species 1978	Mean no. of species 1990	Change in mean number	% Change	T value
Main	I	18	5.17	3.50	–1.67	–32.3	–1.75*
	II	187	7.34	6.64	–0.71	–9.6	–1.57
	III	3	38.67	19.00	–19.67	–50.9	–1.85
	IV	10	18.70	23.60	4.90	26.2	1.18
	V	206	18.32	16.04	–2.28	–12.5	–4.00*'
	VI	4	19.75	26.50	6.75	34.2	2.25
	VII	38	18.00	17.89	–0.11	–0.6	–0.10
	VIII	24	8.46	7.96	–0.50	–5.9	–0.55
Roadside	I	1	9.00	17.00	8.00	88.9	1.00
	II	11	10.55	13.45	2.91	27.6	1.96*
	III	7	19.00	22.57	3.57	18.8	0.91
	V	29	17.97	17.59	–0.38	–0.26	–0.26
Hedge	I	4	7.50	9.50	2.00	26.7	1.06
	II	1	17.00	17.00	0.00	0.0	0.00
	III	112	12.16	12.10	–0.06	–0.5	–0.11
	IV	3	14.67	14.67	0.00	0.0	0.00
	V	43	15.58	11.05	–4.53	–29.1	–4.51*'
Streamside	I	3	7.33	10.67	3.33	45.5	1.35
	II	3	10.33	8.67	–1.67	–16.1	–0.40
	III	36	13.50	13.39	–0.11	–0.8	–0.10
	IV	19	18.53	14.84	–3.68	–19.9	–1.82*
	V	25	19.08	19.20	0.12	0.6	0.08
	VI	13	16.69	18.46	1.77	10.6	0.90
	VII	13	14.69	15.00	0.31	2.1	0.18
	VIII	4	8.25	8.25	0.00	0.0	0.00

Annex 11e. Changes in mean species number per plot over all plot types reported in the eight aggregate classes of the CVS on agricultural land in England and Wales and the four landscape types between 1978 and 1990. (* = p≤0.1, ** = p≤0.01, *** = p≤0.0001)

Plot type	Landscape type	Aggregate vegetation class	No. of plots	No. of species in 1978	No. of species in 1990	Change in mean number	% Change	T value
Main	Arable	I	17	5.41	3.35	–2.06	–38.0	–2.23*
		II	102	6.81	4.94	–1.87	–27.5	–3.09**
		III	1	51.00	14.00	–37.00	–72.5	–1.00
		IV	5	13.80	28.20	14.40	104.3	2.72
		V	38	17.74	15.39	–2.34	–13.2	–3.06**
	Pastural	I	1	1.00	6.00	5.00	500.0	1.00
		II	83	8.00	8.64	0.64	8.0	0.97
		III	2	32.50	21.50	–11.00	–33.8	–1.81
		IV	5	23.60	19.00	–4.60	–19.5	–1.35
		V	125	17.66	15.30	–2.37	–13.4	–3.11**
		VI	4	19.75	26.50	6.75	34.2	2.25
		VII	8	21.88	17.13	–4.75	–21.7	–2.16*
		VIII	4	8.50	6.75	–1.75	–20.6	–1.25
	Marginal upland	II	2	7.00	10.00	3.00	42.9	1.31
		V	41	20.80	18.90	–1.90	–9.1	–1.23
		VII	18	17.39	18.83	1.44	8.3	1.05
		VIII	14	7.36	6.43	–0.93	–12.6	–0.67
	Upland	V	2	19.50	16.00	–3.50	–17.9	–1.61
		VII	12	16.33	17.00	0.67	4.1	0.38
		VIII	6	11.00	12.33	1.33	12.1	1.02
Streamside	Arable	I	3	7.33	10.67	3.33	45.5	1.35
		II	2	11.50	5.50	–6.00	–52.2	–1.92
		III	23	11.35	13.43	2.09	18.4	1.72*
		IV	2	11.00	10.50	–0.50	–4.5	–0.13
		V	6	15.83	15.33	–0.50	–3.2	–0.25
	Pastural	II	1	8.00	15.00	7.00	87.5	1.00
		III	11	16.36	13.27	–3.09	–18.9	–1.52
		IV	15	19.80	15.13	–4.67	–23.6	–1.88*
		V	14	17.50	20.21	2.71	15.5	1.36
		VI	11	16.00	18.27	2.27	14.2	1.00
		VII	1	21.00	9.00	–12.00	–57.1	–1.00
		VIII	1	15.00	15.00	0.00	0.0	0.00
	Marginal upland	II	2	22.50	13.50	–9.00	–40.0	–1.44
		IV	2	16.50	17.00	0.50	3.0	1.00
		V	5	27.40	21.00	–6.40	–23.4	–1.79
		VI	2	20.50	19.50	–1.00	–4.9	–0.55
		VII	8	15.50	17.25	1.75	11.3	0.85
		VIII	2	4.00	5.00	1.00	25.0	2.00
	Upland	VII	4	11.50	12.00	0.50	4.3	0.25
		VIII	1	10.00	8.00	–2.00	–20.0	0.00

continued...

Annex 11e. ...continued

Plot type	Landscape type	Aggregate vegetation class	No. of plots	No. of species in 1978	No. of species in 1990	Change in mean number	% Change	T value
Roadside	Arable	II	5	10.80	12.00	1.20	11.1	0.47
		III	2	12.00	27.00	15.00	125.0	1.47
		V	11	15.18	15.09	–0.09	–0.6	–0.04
	Patural	I	1	9.00	17.00	8.00	88.9	1.00
		II	6	10.33	14.67	4.33	41.9	2.52*
		III	5	21.80	20.80	–1.00	–4.6	–0.37
		V	15	18.07	18.00	–0.07	–0.4	–0.03
	Marginal upland	V	3	27.67	24.67	–3.00	–10.8	–0.55
Hedge	Arable	I	4	7.50	9.50	2.00	26.7	1.06
		II	1	17.00	17.00	0.00	0.0	0.00
		III	57	9.93	11.14	1.21	12.2	1.80*
		IV	1	4.00	11.00	7.00	175.0	1.00
		V	16	14.25	7.00	–7.25	–50.9	–5.96***
	Pastural	III	49	13.65	12.00	–1.65	–12.1	–1.72*
		IV	1	12.00	8.00	–4.00	–33.3	–1.00
		V	22	15.45	12.55	–2.91	–18.8	–1.89*
	Marginal upland	III	6	21.17	22.00	0.83	3.9	0.38
		IV	1	28.00	25.00	–3.00	–10.7	–1.00
		V	5	20.40	17.40	–3.00	–14.7	–0.88

Annex 12a. Changes in species frequency between 1978 and 1990 within CVS aggregate classes for all plots in GB. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01)

Aggregate vegetation class	Species name	Direction	Significance
I Crops/weeds	*Agrostis stolonifera*	+	**
	Avena fatua	–	**
	Capsella bursa-pastoris	–	**
	Convolvulus arvensis	–	*
	Elymus repens	+	*
	Fallopia convolvulus	–	**
	Galium aparine	+	**
	Hordeum vulgare	–	**
	Lamium purpureum	–	**
	Matricaria matricarioides	–	**
	Myosotis spp.	–	**
	Poa annua	–	**
	Polygonum aviculare	–	**
	Polygonum persicaria	–	**
	Ranunculus repens	+	*
	Senecio vulgaris	–	**
	Stellaria media	–	**
	Veronica arvensis	–	**
	Veronica persica	–	**
	Viola arvensis	–	*
II Tall grassland/ herb	*Alliaria petiolata*	–	**
	Anthriscus sylvestris	–	**
	Arrhenathrum elatius	–	**
	Bromus sterilis	+	**
	Cirsium vulgare	–	**
	Crataegus monogyna	–	**
	Dactylis glomerata	–	**
	Epilobium hirsutum	–	*
	Festuca rubra	+	*
	Filipendula ulmaria	–	**
	Galium aparine	–	**
	Glechoma hederacea	–	**
	Heracleum sphondylium	–	**
	Holcus lanatus	–	**
	Holcus mollis	–	**
	Lamium album	–	**
	Poa pratensis	–	*
	Polygonum aviculare	+	**
	Rosa spp.	–	**
	Rumex obtusifolius	–	**
	Silene dioica	–	*
	Stellaria media	–	*
	Urtica dioica	–	**
III Fertile grassland	*Achillea millefolium*	–	**
	Anthriscus sylvestris	+	**
	Arrhenathrum elatius	+	**
	Bellis perennis	–	**
	Cerastium fontanum	–	**
	Cirsium vulgare	–	**
	Dactylis glomerata	–	**
	Elymus repens	+	**
	Lolium multiflorum	–	**
	Lolium perenne	–	**
	Matricaria matricarioides	–	**
	Phleum pratense	–	**
	Plantago lanceolata	–	**
	Plantago major	–	**
	Poa annua	–	**
	Poa pratensis	–	**
	Polygonum aviculare	–	**
	Potentilla reptans	–	**
	Ranunculus repens	–	**
	Rumex acetosa	+	**
	Rumex crispus	–	**
	Rumex obtusifolius	–	**
	Stellaria media	–	**
	Taraxacum agg.	–	**
	Trifolium pratense	–	**
	Trifolium repens	–	**
	Urtica dioica	+	**
IV Infertile grassland	*Achillea millefolium*	–	**
	Agrostis capillaris	–	**
	Agrostis stolonifera	+	**
	Anthoxanthum odoratum	–	**
	Bellis perennis	–	**
	Cardamine pratensis	–	**
	Centaurea nigra	–	**
	Cerastium fontanum	–	**
	Cirsium palustre	–	**
	Cirsium vulgare	–	**
	Cynosurus cristatus	–	**
	Dactylis glomerata	–	**
	Festuca ovina	–	**
	Festuca rubra	–	*
	Galium saxatile	+	*
	Holcus lanatus	–	**
	Holcus mollis	–	**
	Lathyrus pratensis	–	**
	Lolium perenne	–	**
	Lotus corniculatus	–	**
	Phleum pratense	–	**
	Plantago lanceolata	–	**
	Plantago major	–	**
	Poa annua	–	**
	Prunella vulgaris	–	**
	Ranunculus acris	–	**
	Ranunculus repens	–	**
	Rubus fruticosus	+	**
	Rumex acetosa	–	**
	Rumex acetosella	–	**
	Rumex crispus	–	*
	Senecio jacobaea	–	**
	Stellaria media	+	**
	Taraxacum agg.	–	**
	Trifolium pratense	–	**
	Trifolium repens	–	**
	Urtica dioica	+	**
	Veronica chamaedrys	–	**
	Veronica serpyllifolia	–	**
V Lowland wooded	*Acer pseudoplatanus*	–	**
	Agrostis stolonifera	+	**
	Alliaria petiolata	–	*
	Arrhenathrum elatius	–	**
	Arum maculatum	–	**

continued...

Annex 12a. ...continued

Aggregate vegetation class	Species name	Direction	Significance
	Brachypodium sylvaticum	–	**
	Bromus sterilis	+	*
	Cirsium arvense	+	**
	Corylus avellana	–	**
	Crataegus monogyna	–	**
	Dactylis glomerata	+	**
	Dryopteris filix-mas	–	**
	Elymus repens	+	**
	Fraxinus excelsior	–	**
	Galium aparine	–	**
	Geranium robertianum	–	*
	Geum urbanum	–	**
	Glechoma hederacea	–	**
	Hedera helix	–	**
	Heracleum sphondylium	–	**
	Holcus lanatus	+	**
	Holcus mollis	–	**
	Hyacinthoides non-scripta	–	**
	Ilex aquifolium	–	**
	Lonicera periclymenum	–	**
	Mercurialis perennis	–	**
	Prunus spinosa	–	**
	Rosa spp.	–	**
	Rubus fruticosus	–	**
	Sambucus nigra	–	**
	Silene dioica	–	**
	Tamus communis	–	**
	Urtica dioica	–	**
VI Upland wooded	*Acer pseudoplatanus*	–	*
	Agrostis canina	–	**
	Agrostis capillaris	–	**
	Agrostis stolonifera	+	**
	Athyrium filix-femina	–	**
	Betula spp.	–	**
	Blechnum spicant	–	**
	Calluna vulgaris	–	*
	Chrysosplenium oppositifolium	–	**
	Cirsium palustre	–	*
	Dactylis glomerata	+	**
	Deschampsia cespitosa	–	*
	Deschampsia flexuosa	–	**
	Digitalis purpurea	–	**
	Dryopteris filix-mas	–	**
	Epilobium spp.	–	**
	Erica cinerea	–	**
	Festuca ovina	–	**
	Filipendula ulmaria	–	**
	Galium saxatile	–	**
	Holcus lanatus	–	*
	Holcus mollis	–	*
	Hyacinthoides non-scripta	–	**
	Hypericum pulchrum	–	**
	Lysimachia nemorum	–	**
	Molinia caerulea	–	*
	Oxalis acetosella	–	**
	Picea sitchensis	–	*
	Primula vulgaris	–	**
	Quercus spp.	–	*
	Rubus fruticosus	–	*
	Rumex acetosella	–	*
	Sorbus aucuparia	–	**
	Succisa pratensis	–	*
	Teucrium scorodonia	–	**
VII Moorland grass/mosaic	*Achillea millefolium*	–	**
	Agrostis canina	–	**
	Agrostis capillaris	–	**
	Agrostis stolonifera	+	**
	Agrostis vinealis	+	**
	Anthoxanthum odoratum	–	**
	Blechnum spicant	–	**
	Calluna vulgaris	–	**
	Carex binervis	+	**
	Carex demissa	+	*
	Cirsium palustre	–	*
	Danthonia decumbens	–	**
	Erica tetralix	+	**
	Eriophorum angustifolium	+	**
	Festuca ovina	–	**
	Galium saxatile	–	**
	Juncus effusus	–	**
	Juncus squarrosus	–	**
	Lotus corniculatus	–	**
	Molinia caerulea	–	**
	Nardus stricta	–	**
	Plantago lanceolata	–	**
	Potentilla erecta	–	**
	Prunella vulgaris	–	*
	Ranunculus acris	–	**
	Rumex acetosella	–	**
	Veronica officinalis	–	**
VIII Heath/bog	*Agrostis canina*	–	**
	Agrostis capillaris	+	**
	Anthoxanthum odoratum	+	**
	Calluna vulgaris	–	**
	Carex binervis	+	**
	Carex nigra	+	*
	Carex panicea	+	*
	Dactylorhiza maculata	–	**
	Drosera rotundifolia	–	**
	Empetrum nigrum	–	*
	Erica cinerea	–	**
	Erica tetralix	–	**
	Eriophorum angustifolium	–	**
	Festuca vivipara	+	*
	Galium saxatile	+	*
	Juncus effusus	+	**
	Juncus squarrosus	–	*
	Myrica gale	–	**
	Narthecium ossifragum	–	**
	Pinguicula vulgaris	–	*
	Succisa pratensis	+	**
	Trichophorum caespitosum	–	**
	Vaccinium myrtillus	–	**
	Viola palustris	+	**

Annex 12b. Changes in species frequency between 1978 and 1990 by landscape type and by CVS aggregate class for all plot types. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01)

Landscape	Aggregate class	Species name	Direction	Significance
Arable	I	*Convolvulus arvensis*	–	**
	I	*Elymus repens*	–	*
	I	*Hordeum vulgare*	–	**
	I	*Matricaria matricarioides*	–	**
	I	*Poa annua*	–	**
	I	*Polygonum aviculare*	–	**
	I	*Polygonum persicaria*	–	**
	I	*Stellaria media*	–	**
	I	*Veronica persica*	–	**
	II	*Festuca rubra*	+	*
	III	*Cerastium fontanum*	–	**
	III	*Dactylis glomerata*	–	*
	III	*Holcus lanatus*	–	*
	III	*Lolium perenne*	–	**
	III	*Phleum pratense*	–	*
	III	*PlantAo major*	–	*
	III	*Poa annua*	–	**
	III	*Ranunculus repens*	–	**
	III	*Rumex obtusifolius*	–	*
	III	*Trifolium repens*	–	**
	IV	*Agrostis capillaris*	–	*
	IV	*Cerastium fontanum*	–	**
	IV	*Plantago lanceolata*	–	*
	V	*Bromus sterilis*	+	**
	V	*Elymus repens*	+	**
Pastural	I	*Hordeum vulgare*	–	**
	I	*Matricaria matricarioides*	–	**
	I	*Polygonum aviculare*	–	**
	I	*Stellaria media*	–	**
	II	*Elymus repens*	+	*
	II	*Heracleum sphondylium*	–	*
	II	*Rumex obtusifolius*	–	*
	III	*Agrostis stolonifera*	+	**
	III	*Elymus repens*	+	*
	III	*Lolium perenne*	–	**
	III	*Poa annua*	–	**
	III	*Stellaria media*	–	*
	III	*Trifolium repens*	–	**
	IV	*Achillea millefolium*	–	*
	IV	*Agrostis capillaris*	–	**
	IV	*Bellis perennis*	–	**
	IV	*Centaurea nigra*	–	**
	IV	*Cerastium fontanum*	–	**
	IV	*Cynosurus cristatus*	–	**
	IV	*Holcus lanatus*	–	**
	IV	*Lotus corniculatus*	–	**
	IV	*Phleum pratense*	–	**
	IV	*Plantago lanceolata*	–	**
	IV	*Plantago major*	–	*

continued...

Annex 12b. ...continued

Landscape	Aggregate class	Species name	Direction	Significance
	IV	*Prunella vulgaris*	–	**
	IV	*Ranunculus repens*	–	**
	IV	*Taraxacum agg.*	–	*
	IV	*Trifolium pratense*	–	**
	IV	*Trifolium repens*	–	**
	V	*Arrhenathrum elatius*	–	*
	V	*Elymus repens*	+	**
	VI	*Agrostis capillaris*	–	**
	VI	*Agrostis stolonifera*	+	*
	VI	*Athyrium filix-femina*	–	*
	VI	*Digitalis purpurea*	–	*
Marginal upland	IV	*Bellis perennis*	–	*
	IV	*Festuca rubra*	+	*
	IV	*Plantago lanceolata*	–	**
	IV	*Ranunculus repens*	–	**
	VII	*Nardus stricta*	–	*
Upland	VI	*Holcus lanatus*	–	*
	VII	*Agrostis capillaris*	–	**
	VII	*Anthoxanthum odoratum*	–	**
	VII	*Carex binervis*	+	*
	VII	*Eriophorum angustifolium*	+	*
	VII	*Festuca ovina*	–	**
	VII	*Galium saxatile*	–	**
	VII	*Juncus squarrosus*	–	*
	VII	*Plantago lanceolata*	–	**
	VIII	*Agrostis canina*	–	*
	VIII	*Agrostis capillaris*	+	**
	VIII	*Calluna vulgaris*	–	**
	VIII	*Carex binervis*	+	**
	VIII	*Carex panicea*	+	*
	VIII	*Dactylorhiza maculata agg.*	–	*
	VIII	*Erica tetralix*	–	**
	VIII	*Eriophorum angustifolium*	–	*
	VIII	*Juncus bulbosus*	+	**
	VIII	*Succisa pratensis*	+	*
	VIII	*Trichophorum caespitosum*	–	*

Annex 13a. Changes in species cover between 1978 and 1990 by landscape type and by CVS aggregate class for all plot types where cover was ≥5% in either year. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, ***= p<0.001)

Landscape	Aggregate class	Species name	Direction	Significance
Arable	I	*Agrostis stolonifera*	+	*
	I	*Avena sativa*	–	**
	I	*Hordeum vulgare*	–	***
	I	*Matricaria matricarioides*	–	*
	I	*Solanum tuberosum*	–	*
	II	*Agrostis stolonifera*	+	*
	II	*Arrhenathrum elatius*	–	**
	II	*Elymus repens*	+	*
	II	*Festuca rubra*	+	**
	II	*Galium aparine*	+	***
	II	*Hedera helix*	+	**
	II	*Poa pratensis*	+	*
	II	*Potentilla reptans*	+	*
	II	*Sambucus nigra*	+	**
	III	*Alopecurus geniculatus*	–	**
	III	*Dactylis glomerata*	–	*
	III	*Festuca rubra*	+	*
	III	*Lolium perenne*	–	***
	III	*Rubus fruticosus*	+	*
	III	*Trifolium pratense*	–	*
	III	*Trifolium repens*	–	**
	IV	*Alopecurus pratensis*	–	*
	IV	*Galium aparine*	+	**
	IV	*Ranunculus repens*	+	**
	IV	*Urtica dioica*	+	**
	V	*Agrostis stolonifera*	+	**
	V	*Dactylis glomerata*	+	*
	V	*Elymus repens*	+	**
	V	*Galium aparine*	+	**
	V	*Hedera helix*	+	**
Pastural	I	*Hordeum vulgare*	–	***
	I	*Lolium perenne*	+	**
	I	*Poa annua*	+	*
	I	*Trifolium repens*	+	**
	II	*Arrhenathrum elatius*	–	***
	II	*Bromus sterilis*	+	**
	II	*Galium aparine*	+	*
	II	*Hedera helix*	+	***
	II	*Mercurialis perennis*	+	*
	II	*Rubus fruticosus*	+	*
	II	*Urtica dioica*	+	*
	III	*Agrostis stolonifera*	+	*
	III	*Cirsium arvense*	+	*
	III	*Festuca rubra*	+	**
	III	*Phleum pratense*	–	***
	III	*Poa annua*	–	***

continued...

Annex 13a. ...continued

Landscape	Aggregate class	Species name	Direction	Significance
	IV	*Crataegus monogyna*	+	*
	IV	*Festuca ovina*	–	*
	IV	*Lolium perenne*	+	*
	IV	*Phleum pratense*	–	*
	IV	*Rumex acetosa*	+	*
	IV	*Urtica dioica*	+	*
	V	*Agrostis stolonifera*	+	*
	V	*Crataegus monogyna*	+	*
	V	*Hedera helix*	+	**
	V	*Holcus mollis*	–	*
	V	*Lolium perenne*	+	*
	V	*Rubus fruticosus*	+	*
	VI	*Agrostis capillaris*	–	*
	VI	*Agrostis stolonifera*	+	*
	VI	*Festuca ovina*	–	*
	VI	*Quercus spp.*	+	*
	VI	*Rubus fruticosus*	+	*
Marginal upland	IV	*Agrostis stolonifera*	+	***
	IV	*Dactylis glomerata*	–	*
	IV	*Festuca ovina*	–	**
	IV	*Festuca rubra*	+	*
	IV	*Holcus lanatus*	+	**
	VII	*Agrostis capillaris*	–	**
	VII	*Festuca vivipara*	+	*
	VII	*Trifolium repens*	+	*
	VIII	*Calluna vulgaris*	–	*
	VIII	*Trichophorum caespitosum*	–	*
Upland	VI	*Galium saxatile*	+	*
	VI	*Pteridium aquilinum*	–	*
	VII	*Agrostis capillaris*	–	**
	VII	*Danthonia decumbens*	–	*
	VII	*Eriophorum angustifolium*	+	*
	VII	*Festuca ovina*	–	*
	VII	*Picea sitchensis*	+	**
	VIII	*Agrostis capillaris*	+	**
	VIII	*Agrostis vinealis*	+	**
	VIII	*Carex echinata*	+	*
	VIII	*Carex panicea*	+	*
	VIII	*Molinia caerulea*	–	*
	VIII	*Picea sitchensis*	+	**

Annex 13b. Changes in species cover between 1978 and 1990 by landscape type and by CVS aggregate class and by plot type where cover was ≥5% in either year. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Landscape	Aggregate class	Plot type	Species name	Direction	Significance
Arable	I	Main	*Agrostis stolonifera*	+	*
	I	Main	*Lolium perenne*	+	**
	II	Hedge	*Arrhenathrum elatius*	–	*
	II	Hedge	*Galium aparine*	+	***
	II	Hedge	*Sambucus nigra*	+	*
	II	Roadside	*Anthriscus sylvestris*	–	**
	II	Roadside	*Arrhenathrum elatius*	–	*
	II	Roadside	*Festuca rubra*	+	**
	II	Streamside	*Galium aparine*	+	*
	III	Roadside	*Ranunculus repens*	+	*
	III	Main	*Alopecurus geniculatus*	–	*
	III	Main	*Dactylis glomerata*	–	**
	III	Main	*Lolium perenne*	–	***
	III	Main	*Trifolium repens*	–	*
	IV	Streamside	*Galium aparine*	+	*
	IV	Main	*Alopecurus pratensis*	–	*
	IV	Main	*Trifolium repens*	–	*
	V	Hedge	*Arrhenathrum elatius*	–	***
	V	Hedge	*Corylus avellana*	–	**
	V	Hedge	*Crataegus monogyna*	–	***
	V	Hedge	*Fraxinus excelsior*	–	*
	V	Hedge	*Hedera helix*	–	**
	V	Hedge	*Prunus spinosa*	–	***
	V	Hedge	*Sambucus nigra*	–	**
	V	Hedge	*Urtica dioica*	–	***
Pastural	I	Main	*Lolium perenne*	+	***
	I	Main	*Poa annua*	+	*
	II	Hedge	*Agrostis stolonifera*	+	*
	II	Hedge	*Galium aparine*	+	**
	II	Hedge	*Hedera helix*	+	**
	II	Hedge	*Urtica dioica*	+	*
	II	Roadside	*Arrhenathrum elatius*	–	***
	II	Roadside	*Bromus sterilis*	+	**
	III	Roadside	*Festuca rubra*	+	*
	III	Roadside	*Potentilla reptans*	+	*
	III	Main	*Agrostis stolonifera*	+	*
	III	Main	*Cirsium arvense*	+	**
	III	Main	*Cynosurus cristatus*	+	*
	III	Main	*Poa annua*	–	**
	IV	Roadside	*Agrostis stolonifera*	+	*
	IV	Roadside	*Festuca rubra*	+	*
	IV	Streamside	*Dactylis glomerata*	+	*
	IV	Streamside	*Juncus effusus*	–	**
	IV	Main	*Agrostis stolonifera*	+	*
	IV	Main	*Lolium perenne*	+	**
	IV	Main	*Rumex acetosa*	+	*

continued...

Annex 13b. ...continued

Landscape	Aggregate class	Plot type	Species name	Direction	Significance
Pastural cont...	V	Hedge	*Cirsium arvense*	+	*
	V	Hedge	*Corylus avellana*	–	*
	V	Hedge	*Crataegus monogyna*	+	*
	V	Hedge	*Hedera helix*	+	***
	VI	Streamside	*Juncus effusus*	–	*
Marginal upland	III	Roadside	*Festuca rubra*	+	*
	III	Roadside	*Poa annua*	–	*
	IV	Roadside	*Agrostis stolonifera*	+	**
	IV	Streamside	*Agrostis stolonifera*	+	*
	IV	Main	*Dactylis glomerata*	–	**
	IV	Main	*Festuca ovina*	–	**
	IV	Main	*Festuca rubra*	+	**
	IV	Main	*Ranunculus acris*	+	*
	IV	Main	*Trifolium repens*	+	*
	VII	Main	*Agrostis capillaris*	–	**
	VII	Main	*Holcus lanatus*	+	**
	VIII	Main	*Calluna vulgaris*	–	*
	VIII	Main	*Empetrum nigrum*	–	**
	VIII	Main	*Nardus stricta*	+	*
Upland	VI	Main	*Festuca ovina*	–	*
	VII	Streamside	*Agrostis capillaris*	–	*
	VII	Main	*Danthonia decumbens*	–	*
	VII	Main	*Juncus effusus*	–	*
	VII	Main	*Potentilla erecta*	+	*
	VIII	Main	*Agrostis capillaris*	+	***
	VIII	Main	*Molinia caerulea*	–	*

Annex 13c. Changes in species cover between 1978 and 1990 by CVS aggregate class and by plot type for GB as a whole where cover was ≥5% in either year. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class	Plot type	Species name	Direction	Significance
I Crops/weeds	Main	*Agrostis stolonifera*	+	***
		Lolium perenne	+	***
		Matricaria matricarioides	–	**
		Trifolium repens	+	**
II Tall grassland/herb	Hedge	*Agrostis stolonifera*	+	**
		Arrhenathrum elatius	–	*
		Bromus sterilis	+	*
		Festuca rubra	+	*
		Galium aparine	+	***
		Hedera helix	+	***
	Roadside	*Anthriscus sylvestris*	–	*
		Arrhenathrum elatius	–	***
		Festuca rubra	+	*
		Holcus lanatus	–	*
	Streamside	*Cirsium arvense*	+	*
		Galium aparine	+	**
		Holcus lanatus	+	*
III Fertile grassland	Roadside	*Agrostis stolonifera*	+	*
		Festuca rubra	+	***
		Lolium perenne	–	*
		Potentilla reptans	+	**
		Ranunculus repens	+	**
	Main	*Agrostis capillaris*	+	*
		Agrostis stolonifera	+	*
		Alopecurus geniculatus	–	**
		Cirsium arvense	+	***
		Dactylis glomerata	–	**
		Lolium perenne	–	***
		Poa annua	–	*
IV Infertile grassland	Hedge	*Agrostis stolonifera*	+	*
		Crataegus monogyna	+	*
	Roadside	*Agrostis stolonifera*	+	***
		Festuca ovina	–	*
		Festuca rubra	+	**
	Streamside	*Galium aparine*	+	*
		Urtica dioica	+	*
	Main	*Agrostis stolonifera*	+	**
		Festuca ovina	–	**
		Lolium perenne	+	**

continued...

Annex 13c. ...comtinued

Aggregate vegetation class	Plot type	Species name	Direction	Significance
V Lowland wooded	Hedge	*Bromus sterilis*	+	*
		Cirsium arvense	+	*
		Corylus avellana	–	**
		Dactylis glomerata	+	*
		Festuca rubra	+	**
		Galium aparine	+	***
		Glechoma hederacea	+	*
		Hedera helix	+	***
		Lolium perenne	+	*
		Prunus spinosa	+	*
VI Upland wooded	Streamside	*Agrostis stolonifera*	+	*
		Festuca rubra	+	*
		Juncus effusus	–	*
VII Moorland grass/mosaic	Streamside	*Agrostis capillaris*	–	**
	Main	*Agrostis capillaris*	–	*
		Anthoxanthum odoratum	+	*
		Carex panicea	+	*
		Danthonia decumbens	–	*
		Deschampsia flexuosa	–	*
		Festuca vivipara	+	*
		Holcus lanatus	+	***
		Lolium perenne	+	*
		Pteridium aquilinum	+	*
		Trifolium repens	+	*
VIII Heath/bog	Main	*Agrostis capillaris*	+	**
		Carex panicea	+	*
		Galium saxatile	+	*
		Holcus lanatus	+	*
		Molinia caerulea	–	**

Annex 13d. Changes in species cover between 1978 and 1990 by CVS aggregate class and by plot type for GB as a whole where cover was ≥5% in either year and where plots remained in the same aggregate class between years. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	Species	Change	Significance
I	Crops/weeds	Main	*Matricaria matricarioides*	–	*
II	Tall grassland/herb	Streamside	*Epilobium hirsutum*	+	**
		Streamside	*Galium aparine*	+	*
		Roadside	*Anthriscus sylvestris*	–	*
		Roadside	*Arrhenathrum elatius*	–	**
		Roadside	*Festuca rubra*	+	*
		Roadside	*Hedera helix*	+	*
		Roadside	*Holcus lanatus*	–	*
III	Fertile grassland	Roadside	*Agrostis capillaris*	–	*
		Roadside	*Festuca rubra*	+	**
		Roadside	*Plantago major*	+	*
		Roadside	*Potentilla reptans*	+	*
		Roadside	*Ranunculus repens*	+	*
		Main	*Cirsium arvense*	+	*
IV	Infertile grassland	Roadside	*Festuca rubra*	+	**
		Main	*Agrostis stolonifera*	+	**
		Main	*Festuca ovina*	–	*
		Main	*Festuca rubra*	+	*
		Main	*Lolium perenne*	+	*
		Main	*Ranunculus acris*	+	*
V	Lowland wooded	Hedge	*Bromus sterilis*	+	**
		Hedge	*Galium aparine*	+	***
		Hedge	*Hedera helix*	+	***
		Hedge	*Prunus spinosa*	+	***
VII	Upland wooded	Main	*Agrostis capillaris*	–	*
		Main	*Anthoxanthum odoratum*	+	*
		Main	*Holcus lanatus*	+	**
		Main	*Potentilla erecta*	+	*
VIII	Heath/bog	Main	*Hylocomium splendens*	+	***
		Main	*Pleurozium schreberi*	+	**
		Main	*Racomitrium lanuginosum*	+	*
		Main	*Rhytidiadelphus loreus*	+	***

Annex 13e. Changes in species cover between 1978 and 1990 by landscape type, by CVS aggregate class and by plot type where cover was ≥5% in either year and where plots remained in the same aggregate class between years. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Landscape	Aggregate vegetation class	Plot type	Species	Direction	Significance
Arable	II	Hedge	*Galium aparine*	+	*
	II	Roadside	*Anthriscus sylvestris*	–	*
	II	Roadside	*Festuca rubra*	+	*
	IV	Main	*Agrostis stolonifera*	+	*
	IV	Main	*Trifolium repens*	–	*
	V	Hedge	*Bromus sterilis*	+	*
	V	Hedge	*Galium aparine*	+	**
	V	Hedge	*Hedera helix*	+	*
Pastural	III	Main	*Poa annua*	–	**
	IV	Main	*Agrostis stolonifera*	+	*
	IV	Main	*Lolium perenne*	+	*
	IV	Main	*Rumex acetosa*	+	**
Marginal upland	IV	Roadside	*Festuca rubra*	+	*
	IV	Roadside	*Holcus lanatus*	+	*
	IV	Main	*Dactylis glomerata*	–	*
	IV	Main	*Festuca ovina*	–	**
	IV	Main	*Festuca rubra*	+	**
	IV	Main	*Holcus lanatus*	+	*
	IV	Main	*Poa pratensis*	–	*
	IV	Main	*Ranunculus acris*	+	*
	IV	Main	*Trifolium repens*	+	**
	VII	Main	*Agrostis capillaris*	–	*
	VII	Main	*Holcus lanatus*	+	**
Upland	VII	Main	*Agrostis capillaris*	–	*
	VII	Main	*Holcus lanatus*	+	**

Annex 14a. Changes in species group richness between 1978 and 1990 by CVS aggregate class and by plot type for GB as a whole. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class	Plot type	Species group	Change	Significance
I Crops/weeds	Main	Crops or crop edge plants on brown earth soils	–	***
	Main	Grassland wood edge or scrub plants on brown earths	+	**
	Main	Water edge plants on wet alluvial soils	–	***
II Tall grassland/herb	Hedge	Grassland or tall grassland plants on brown earth soils	–	**
	Hedge	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	**
	Hedge	Grassland, tall grassland plants on wood edges on variable soils	–	*
	Streamside	Grassland wood edge or scrub plants on brown earths	+	*
	Roadside	Crops, crop edge or grassland on eutrophic soils	+	*
	Roadside	Grassland or tall grassland plants on brown earth soils	+	*
	Roadside	Grassland wood edge or scrub plants on brown earths	+	**
	Roadside	Wood or wood edge plants on damp fertile brown earths	–	*
III Fertile grassland	Roadside	Tall grassland plants on damp gleyed brown earths	–	*
	Roadside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	***
	Roadside	Woods, tall grasslands or wood edge plants on brown earth soils	+	*
	Main	Crop or crop edge plants on fertile soils	+	***
	Main	Grassland or tall grassland plants on brown earth soils	–	***
	Main	Grassland or wood edge plants on acid or brown podzolic soils	+	*
	Main	Water edge or aquatic plants on hydromorphic soils	–	*
	Main	Wood or wood edge plants on calcareous or neutral brown earths	+	*
IV Infertile grassland	Roadside	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	*
	Roadside	Wood or wood edge plants on damp fertile brown earths	+	*
	Main	Crop or crop edge plants on fertile soils	+	**
	Main	Crops or crop edge plants on brown earth soils	+	*
	Main	Grassland or tall grassland plants on brown earth soils	–	**
	Main	Grassland or wood edge plants on acid or brown podzolic soils	–	*
	Main	Grassland plants on brown earths, often skeletal and calcareous	–	*
	Main	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	***
	Main	Grassland wood edge or scrub plants on brown earths	–	***
	Main	Moorland plants on wet peaty gley soils	+	*
	Main	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	–	***

continued...

Annex 14a. ...continued

Aggregate vegetation class	Plot type	Species group	Change	Significance
IV Infertile grassland continued...	Streamside	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	*
	Streamside	Grassland wood edge or scrub plants on brown earths	–	***
	Streamside	Marsh, wood edge or woodland plants on wet gleyed brown earths	–	*
	Streamside	Water edge or aquatic plants on hydromorphic soils	–	*
	Streamside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	**
	Streamside	Wood or wood edge plants on calcareous or neutral brown earths	+	**
	Streamside	Woodland or wood edge plants on brown earth soils	+	*
	Streamside	Woods, tall grasslands or wood edge plants on brown earth soils	+	**
	Hedge	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	*
	Hedge	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	–	*
	Hedge	Woodland or wood edge plants on brown earth soils	+	*
V Lowland wooded	Hedge	Crop or crop edge plants on fertile soils	+	*
	Hedge	Woodland or wood edge plants on brown earth soils	–	*
	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils	–	*
VI Upland wooded	Streamside	Marsh, wood edge or woodland plants on wet gleyed brown earths	–	**
	Streamside	Wood or wood edge plants on damp fertile brown earths	–	*
	Streamside	Woodland or wood edge plants on brown earth soils	–	*
	Streamside	Woodland or woodland edge plants on acid brown earths	–	**
VII Heath/bog	Streamside	Bog, water edge or aquatic plant on peaty soils	–	**
	Streamside	Grassland marsh or water edge plants on moist brown earth or gleyed soils	–	**
	Streamside	Grassland or wood edge plants on acid or brown podzolic soils	–	**
	Streamside	Moorland or grassland plants on gley or peaty podzolic soils	–	*
	Streamside	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	–	***
	Main	Bog or heath plants on deep, raw peat soils	+	**
	Main	Bog, water edge or aquatic plant on peaty soils	+	*
	Main	Grassland or wood edge plants on acid or brown podzolic soils	–	*
	Main	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	**
	Main	Grassland plants on calcareous brown earths	–	***
	Main	Grassland wood edge or scrub plants on brown earths	+	***
	Main	Heath or moorland plants on podzols or brown podzolic soils	–	***
	Main	Moorland or grassland plants on gley or peaty podzolic soils	+	*
	Main	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	*

Annex 14b. Changes in total cover per species group between 1978 and 1990 by CVS aggregate class and by plot type for GB as a whole where cover was ≥5% in either year. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class	Plot type	Species group	Change	Significance
I Crops/weeds	Main	Grassland or tall grassland plants on brown earth soils	+	***
	Main	Grassland plants on semi-fertile, sometimes rocky, brown earths[2]	+	*
	Main	Grassland wood edge or scrub plants on brown earths	+	***
	Main	Grassland, tall grassland plants on wood edges on variable soils[2]	+	*
II Tall grassland/herb	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils	+	***
	Roadside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	–	***
	Streamside	Woods, tall grasslands or wood edge plants on brown earth soils[2]	+	*
III Fertile grassland	Roadside	Grassland or tall grassland plants on brown earth soils	–	**
	Main	Grassland or tall grassland plants on brown earth soils	–	***
	Main	Grassland, tall grassland plants on wood edges on variable soils[2]	+	*
	Main	Water edge or aquatic plants on hydromorphic soils	–	**
	Main	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths[2]	+	*
IV Infertile grassland	Roadside	Grassland wood edge or scrub plants on brown earths[2]	+	*
	Streamside	Water edge or aquatic plants on hydromorphic soils	–	**
	Streamside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	**
	Streamside	Woods, tall grasslands or wood edge plants on brown earth soils	+	**
	Main	Grassland or wood edge plants on acid or brown podzolic soils	–	**
	Main	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	**
	Main	Grassland wood edge or scrub plants on brown earths	–	***
V Lowland wooded	Hedge	Crop or crop edge plants on fertile soils	+	**
	Hedge	Grassland or tall grassland plants on brown earth soils[2]	+	**
	Hedge	Grassland, tall grassland plants on wood edges on variable soils[2]	+	*
	Hedge	Woodland edge or scrub plants on brown earth soils[2]	+	**
	Hedge	Woodland or wood edge plants on brown earth soils	–	*
	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils[1]	+	***
VI Upland wooded	Streamside	Grassland marsh or water edge plants on moist brown earth or gleyed soils	–	*
VII Moorland grass/mosaic	Streamside	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	–	**
	Main	Grassland or tall grassland plants on brown earth soils[2]	+	**
	Main	Moorland or grassland plants on gley or peaty podzolic soils[2]	–	**

continued...

Annex 14b. ...continued

Aggregate vegetation class	Plot type	Species group	Change	Significance
VIII Heath/bog	Main	Bog or heath plants on deep, raw peat soils[2]	–	**
	Main	Grassland wood edge or scrub plants on brown earths	+	*
	Main	Heath or moorland plants on podzols or brown podzolic soils	–	***
	Main	Moorland plants on wet peaty gley soils	–	*
	Main	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths[2]	+	**

[1] Reduced species group count but increased species group cover

[2] Species group changes not detected by analysis of change in species group count

Annex 14c. Changes in total cover per species group between 1978 and 1990 by landscape type, by CVS aggregate class and by plot type where cover was ≥5% in either year. Only significant changes are shown. (+ = increase, – = decrease, * = p<0.05, ** = p<0.01, *** = p<0.001)

Landscape	Aggregate class	Plot type	Species group	Change	Significance
Arable	I	Main	Grassland or tall grassland plants on brown earth soils	+	**
	I	Main	Grassland wood edge or scrub plants on brown earths	+	**
	II	Roadside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	–	**
	II	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils	+	*
	II	Streamside	Grassland wood edge or scrub plants on brown earths[1]	+	**
	II	Streamside	Woods, tall grasslands or wood edge plants on brown earth soils	+	*
	III	Main	Grassland or tall grassland plants on brown earth soils	–	***
	III	Main	Water edge or aquatic plants on hydromorphic soils	–	*
	IV	Streamside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	+	*
	IV	Main	Grassland or wood edge plants on acid or brown podzolic soils	–	*
	V	Hedge	Crop or crop edge plants on fertile soils	+	**
	V	Hedge	Grassland or tall grassland plants on brown earth soils	+	*
Pastural	I	Main	Grassland or tall grassland plants on brown earth soils	+	***
	I	Main	Grassland wood edge or scrub plants on brown earths	+	***
	II	Hedge	Wood edge, tall grassland or grassland plants on brown earths, often humus rich[1]	+	*
	II	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils	+	**
	II	Roadside	Crop or crop edge plants on fertile soils[1]	+	**
	II	Roadside	Wood edge, tall grassland or grassland plants on brown earths, often humus rich	–	**
	II	Roadside	Wood or wood edge plants on calcareous or neutral brown earths[1]	+	*
	III	Main	Grassland or tall grassland plants on brown earth soils	–	*
	III	Main	Grassland wood edge or scrub plants on brown earths[1]	+	***
	III	Main	Grassland, tall grassland plants on wood edges on variable soils	+	*
	VI	Streamside	Grassland marsh or water edge plants on moist brown earth or gleyed soils	–	**
	IV	Roadside	Grassland wood edge or scrub plants on brown earths	+	**
	IV	Roadside	Woods, tall grasslands or wood edge plants on brown earth soils[1]	–	**
	IV	Streamside	Water edge or aquatic plants on hydromorphic soils	–	*
	IV	Main	Grassland or tall grassland plants on brown earth soils[1]	+	*
	V	Hedge	Grassland or tall grassland plants on brown earth soils	+	*
	V	Hedge	Grassland, tall grassland plants on wood edges on variable soils	+	*
	V	Hedge	Woodland edge or scrub plants on brown earth soils	+	**
	V	Hedge	Woods, tall grasslands or wood edge plants on brown earth soils	+	***

continued...

Annex 14c. ...continued

Landscape	Aggregate class	Plot type	Species group	Change	Significance
Marginal upland	IV	Roadside	Grassland wood edge or scrub plants on brown earths	+	*
	IV	Main	Grassland plants on semi-fertile, sometimes rocky, brown earths	–	*
	VII	Streamside	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	–	*
	VII	Main	Grassland wood edge or scrub plants on brown earths[1]	+	*
	VIII	Main	Heath or moorland plants on podzols or brown podzolic soils	–	**
Upland	VIII	Main	Wood, wood edge, scrub, grassland or heath plants on acid or neutral brown earths	+	**
	VII	Main	Moorland or grassland plants on gley or peaty podzolic soils	–	*

[1] Species group changes detected after stratifying by landscape and not detected at the GB scale

Annex 15a. Matrices showing movement of replicate plots between aggregate vegetation classes between 1978 and 1990. Matrices are given for the whole of GB and for each landscape type

Arable landscape – matrix of change between aggregate classes

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	101	13	15	1					130
II	2	79	11	6	19	1			118
III	18	34	57	18	3				130
IV	2	12	18	50	6	1			89
V		18		1	55	2			76
VI			1	4	1	6			12
VII				2		1	1	1	5
VIII			1				2	5	8
Total	123	156	103	82	84	11	3	6	568

Change 1978–90

	1978	1990	1978–90
I	130	123	–7
II	118	156	38
III	130	103	–27
IV	89	82	–7
V	76	84	8
VI	12	11	–1
VII	5	3	–2
VIII	8	6	–2

Gross movement of fertile grassland to tall grassland

Shift from crops to tall grassland

Pastural landscape – matrix of change between aggregate classes

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	42	1	20	3					66
II	1	56	10	9	22	2			100
III	14	16	84	32	1				147
IV	7	21	34	87	3	8	5		165
V	1	20		2	38	10			71
VI		2	1	6	6	29	1	1	46
VII				4		6	14	3	27
VIII				1		1	2	14	18
Total	65	116	149	144	70	56	22	18	640

Change 1978–90

	1978	1990	1978–90
I	66	65	–1
II	100	116	16
III	147	149	2
IV	165	144	–21
V	71	70	–1
VI	46	56	10
VII	27	22	–5
VIII	18	18	0

Infertile grassland to tall grassland

Smaller shift from moorland/grass mosaic to upland wooded

Marginal upland landscape – matrix of change between aggregate classes

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	1		2	1					4
II		4	1	3	1				9
III	1	2	15	13		1			32
IV		2	11	65	3	9	6		96
V					2	1			3
VI					6	18		1	25
VII				9		5	44	7	65
VIII				1		1	8	25	35
Total	2	8	29	92	12	35	58	33	269

Change 1978–90

	1978	1990	1978–90
I	4	2	–2
II	9	8	–1
III	32	29	–3
IV	96	92	–4
V	3	12	9
VI	25	35	10
VII	65	58	–7
VIII	35	33	–2

Increase in lowland and upland wooded

Losses from moorland/grass mosaic to upland wooded

continued...

Upland landscape – matrix of change between aggregate classes

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I			2						2
II									0
III	2		5	3					10
IV			1	10		3	5		19
V									0
VI				1		19	17	4	41
VII				10		11	71	21	113
VIII				1		6	35	167	209
Total	2		8	25		39	128	192	394

Change 1978–90

	1978	1990	1978–90
I	2	2	0
II	0	0	0
III	10	8	–2
IV	19	25	6
V	0	0	0
VI	41	39	–2
VII	113	128	15
VIII	209	192	–17

Loss of heath/bog to moorland/grass mosaic

Whole of GB – matrix of change between aggregate classes

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	144	14	39	5					202
II	3	139	22	18	42	3			227
III	35	52	161	66	4	1			319
IV	9	35	64	212	12	21	16		369
V	1	38		3	95	13			150
VI		2	2	11	13	72	18	6	124
VII				25		23	130	32	210
VIII			1	3		8	47	211	270
Total	192	280	289	343	166	141	211	249	1871

Change 1978–90

	1978	1990	1978–90
I	202	192	–10
II	227	280	53
III	319	289	–30
IV	369	343	–26
V	150	166	16
VI	124	141	17
VII	210	211	1
VIII	270	249	–21

Increase in tall grassland and losses from fertile and infertile grassland

Losses from heath/bog to upland wooded and moorland/grass mosaic

Losses from tall grassland and infertile grassland to lowland wooded

Annex 15b. Matrices showing movement of replicate plots between aggregate vegetation classes between 1978 and 1990. Matrices are given for the whole of GB by plot type

Hedgerows

1978 \ 1990	I	II	III	IV	V	VI	Total
I							0
II		41		4	31		76
III		4			1	1	6
IV		7		8	7	2	24
V	1	24		2	67	2	96
VI						2	2
Total	1	76	0	14	106	7	204

Change 1978–90

	1978	1990	1978–90
I	0	1	1
II	76	76	0
III	6	0	–6
IV	24	14	–10
V	96	106	10
VI	2	7	5

Loss from infertile grassland

Gains to lowland and upland wooded

Streams

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I		1							1
II		32	4	9	6	3			54
III		6	8	8	1				23
IV		16	2	33	2	13	5		71
V		8			11	6			25
VI		2	1	8	5	23	3	2	44
VII				10		9	44	10	73
VIII							12	16	28
Total	0	65	15	68	25	54	64	28	319

Change 1978–90

	1978	1990	1978–90
I	1	0	–1
II	54	65	11
III	23	15	–8
IV	71	68	–3
V	25	25	0
VI	44	54	10
VII	73	64	–9
VIII	28	28	0

Gains to tall grassland/herb and upland wooded

Losses from moorland grass/mosaic and fertile grassland

Road verges

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	1	4	2						7
II	1	62	14	3	4				84
III	5	35	54	18					112
IV		8	14	36		2	5		65
V		5			2				7
VI				1		3	1		5
VII				5		2	15	1	23
VIII							1		1
Total	7	114	84	63	6	7	22	1	304

Change 1978–90

	1978	1990	1978–90
I	7	7	0
II	84	114	30
III	112	84	–28
IV	65	63	–2
V	7	6	–1
VI	5	7	2
VII	23	22	–1
VIII	1	1	0

Large loss from fertile grassland to tall grassland/herb

continued...

Annex 15b. ...continued

Main

1978 \ 1990	I	II	III	IV	V	VI	VII	VIII	Total
I	143	9	37	5					194
II	2	4	4	2	1				13
III	30	7	99	40	2				178
IV	9	4	48	135	3	4	6		209
V		1		1	15	5			22
VI			1	2	8	44	14	4	73
VII				10		12	71	21	114
VIII			1	3		8	34	195	241
Total	184	25	190	198	29	73	125	220	1044

Change 1978–90

	1978	1990	1978–90
I	194	184	–10
II	13	25	12
III	178	190	12
IV	209	198	–11
V	22	29	7
VI	73	73	0
VII	114	125	11
VIII	241	220	–21

Loss from heath/bog to moorland grass/mosaic

Loss from crops/weeds and infertile grassland

Gains to tall grassland/herb and fertile grassland

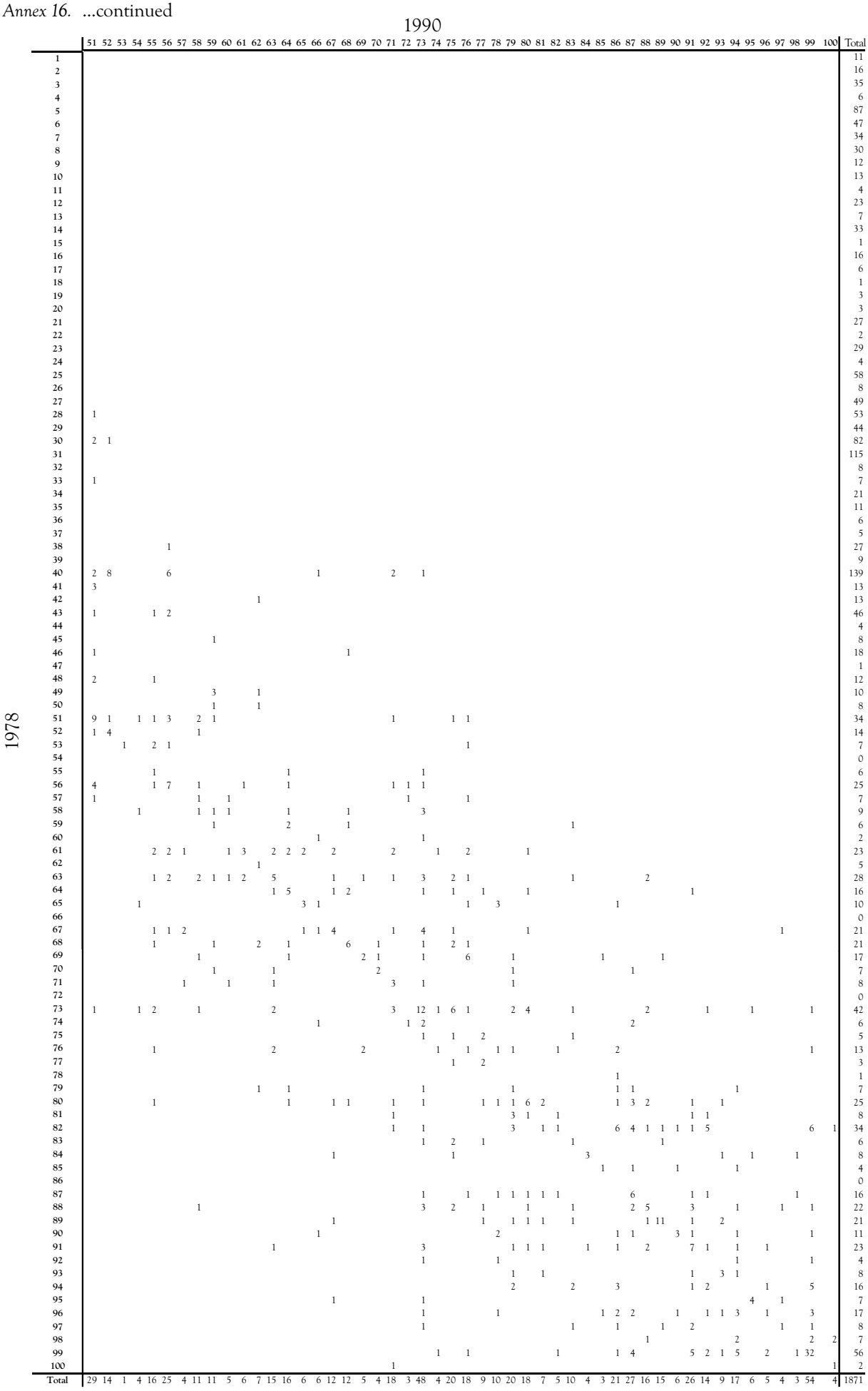
Annex 16. Matrix of change between CVS plot classes for the whole of GB for 1978 to 1990. Numbers in the table give the total number of plots that were members of a particular CVS class in 1978 (row) and the same or a different CVS class in 1990 (column). The final column and row give total membership in either year.
CVS classes are ordered numerically and thus according to the mean DECORANA axis 1 score of each class

1990

1978	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total
1	6	1	2	1	1																																														38
2	2	3	2	2	2	2						2		1																																				20
3	8	4	14	1	1	2				1													1					1	1	1																					54
4	1	1		1	1	2																																												17
5	10	3	21	5	5	12								4	1								2					8	8	5										2		1								21
6	5	2	5	5	6	5				1				2						1							1	1	6	3	2									1			1							42
7			1				13	4	2	6			1	2							4				1																											42
8							6	12	1	1	1	1		1							2				2	1		1																							34
9							2		1	1	1	3	1	1					1						1																										14
10							2	1	2	1	1	1			1				1								1		1		1																			19
11										1												1	1				1																							4
12								4			1	5	2	3		1				1			2		1	1				1			1																	27
13								1				1	2	2						1																														8
14		1					1	1	2		1	5	2	8						1			2		3		2	1		3																				30
15														1																																			1
16							4	2								1					6							2							1														16
17								1		1						1	1											1		1																			17
18																				1																														1
19																			1			1																			1									4
20												1	1	1																																			6
21							3	1						2		4					3				5	2		1						2	4														36
22																			1		1																													3
23		1								1		1	2	3						1		11					3			2	1										3								23
24								1													1			1										1															7
25							7	3	3	3		2		3		1				1	3		1		9	5	2	4		3				3	1			1			1		1	1						54
26																		1							5									2															9
27				1	1	1		1				2	2	6									3		4	10	2	1	3	1	1		3				4		2							1			52
28	1			1		2	1			1	1			5	1				2		2	3		1	5		11		2		1	1	1		2	1	2	1	1		2						5	112
29	2	3	1	1	2	2								2														10	8	7										5		1						17
30			2			1			2			3		5	2				1				2	1	2	1	4	1	8	18	4		1			1	1		15	1	2				1				54
31	2	1	3	1	1	10				1	1		1	3				1				7	1	1		6		11	25	16			1					10		12								9
32										1	1								1		1							1			1	1																21
33																			1									3				1																	4
34							1	1						1											1	1		3		1				2	2		1			2	2	1						11
35																					1	1						1							3					1	1							3
36																		1																		1					1		3						5
37																																		1		1		2		1								5
38																				2	1				1	1	4	2		1	2		1	2			4		3		2							21
39											1																								1	2			3									5
40	1		2			5								1									3				1	3	6	17	10			1				5		45		13	3		1	1	1		112
41										1									1									1		2		2	1							1				1				5
42																					1							1							2							5						1	2	17
43			1					1				1													3			2		13	1									5	1	11		1	1		1	54
44																																									1			3						9
45																																									1	1			1	3	1				9
46																											1								1	2	2								5			4	21
47																																								1									4
48																																3						1					1	2	2			11
49																												2												1	2					1			7
50																																		1						1							4		20
51																												1		2			1		1	1				1			1	2	1	1		1	115
52																																						3		2				1	2				52
53																																	1	1															5
54																																																	11
55																																										1	1			1				18
56																														1										2		3		1						23
57																																								1					1				7
58																																																	4
59																																												1					21
60																																																	4
61																																																	11
62																							1													1						1						1		7
63																																								1		1								4
64																																												1					21
65																																																		11
66																																																		7
67																																												2			1			9
68																																										4					1			9
69																																													1		1		21
70																																													1				4
71																																																		11
72																																																		7
73																																																		20
74																																																		
75																																																	
76																																																	
77																																																	
78																																																	
79																																																	
80																																																	
81																																																	
82																																								1										2
83																																																		3
84																																																		1
85																																																		1
86																																																		1
87																																																		1
88																																																		1
89																																																		1
90																																																		1
91																														1										1									4
92																																																			1
93																																								1										2
94																																																			1
95																																																			1
96																																																			1
97																																																			1
98																																																			1
99																																																			1
100																																																			1
Total	38	20	54	17	21	42	42	34	14	19	10	29	14	57	5	8	1	3	10	9	26	7	36	4	39	17	35	46	51	115	52	5	11	18	23	7	4	21	5	112	5	17	54	9	9	21	4	11	7	20	

continued...

Annex 16. ...continued



Annex 17. List of plant species preferential to each aggregate class (I–VIII). Species were selected by chi-square analysis of their association with each class. Qualifying species exhibited a significant association at $p<0.5$. They were then ordered by preference value computed as (o–e)*abs(o–e)/e, where o = observed frequency and e = expected frequency. Species were then allocated an abundance category. (A = abundant species with ≥66% tile frequency in aggregate class samples, I = intermediate, 66% tile > frequency ≥33% tile, R = rare, frequency <33% tile)

Aggregate class	Species name	Abundance category
I	*Stellaria media*	A
I	*Polygonum aviculare*	A
I	*Capsella bursa-pastoris*	A
I	*Senecio vulgaris*	A
I	*Polygonum persicaria*	A
I	*Veronica persica*	A
I	*Avena fatua*	A
I	*Veronica arvensis*	A
I	*Lamium purpureum*	A
I	*Galeopsis tetrahit*	A
I	*Viola arvensis*	A
I	*Anagallis arvensis*	A
I	*Fallopia convolvulus*	A
I	*Papaver rhoeas*	A
I	*Alopecurus myosuroides*	I
I	*Matricaria recutita*	I
I	*Viola tricolor*	I
I	*Urtica urens*	I
I	*Fumaria officinalis*	I
I	*Polygonum lapathifolium*	I
I	*Aethusa cynapium*	I
I	*Coronopus squamatus*	I
I	*Reseda lutea*	I
I	*Sherardia arvensis*	I
I	*Veronica polita*	I
I	*Bromus commutatus*	I
I	*Carduus nutans*	I
I	*Erodium cicutarium*	I
I	*Chrysanthemum segetum*	R
I	*Veronica agrestis*	R
I	*Papaver dubium*	R
I	*Thlaspi arvense*	R
I	*Hordelymus europaeus*	R
I	*Lamium amplexicaule*	R
I	*Stachys arvensis*	R
I	*Veronica hederifolia*	R
I	*Anthriscus caucaulis*	R
I	*Lamium hybridum*	R
I	*Echium vulgare*	R
I	*Anchusa arvensis*	R
I	*Kickxia elantine*	R
II	*Dactylis glomerata*	A
II	*Urtica dioica*	A
II	*Arrhenathrum elatius*	A
II	*Cirsium arvense*	A
II	*Galium aparine*	A
II	*Heracleum sphondylium*	A
II	*Anthriscus sylvestris*	A
II	*Bromus sterilis*	A
II	*Convolvulus arvensis*	A
II	*Stachys sylvatica*	A
II	*Potentilla reptans*	A
II	*Epilobium hirsutum*	A
II	*Lamium album*	A
II	*Sonchus oleraceus*	A
II	*Lapsana communis*	A
II	*Torilis japonica*	A
II	*Phalaris arundinacea*	A
II	*Apium nodiflorum*	A
II	*Calystegia sepium*	A
II	*Galium mollugo*	A
II	*Oenanthe crocata*	I
II	*Phragmites australis*	I
II	*Artemisia vulgaris*	I
II	*Sisymbrium officinale*	I
II	*Scrophularia auriculata*	I
II	*Sonchus arvensis*	I
II	*Conium maculatum*	I
II	*Sparganium erectum*	I
II	*Glyceria maxima*	I
II	*Malva sylvestris*	I
II	*Lemna minor*	I
II	*Agrostis gigantea*	I
II	*Silene latifolia*	I
II	*Polygonum amphibium*	I
II	*Silene vulgaris*	I
II	*Lycopus europaeus*	I
II	*Eupatorium cannabinum*	I
II	*Typha latifolia*	I
II	*Linaria vulgaris*	I
II	*Alisma plantago-aquatica*	I
II	*Geranium pratense*	R
II	*Chaerophyllum temulentum*	R
II	*Calamagrostis epigejos*	R
II	*Petasites hybridus*	R
II	*Symphytum officinale*	R
II	*Carduus acanthoidies*	R
II	*Carex riparia*	R
II	*Knautia arvensis*	R
II	*Brachypodium pinnatum*	R
II	*Myosoton aquaticum*	R
II	*Dipsacus fullonum*	R
II	*Barbarea vulgaris*	R
II	*Bidens tripartita*	R
II	*Equisetum telemateia*	R
II	*Humulus lupulus*	R
II	*Geranium columbinium*	R
II	*Allium vineale*	R
II	*Rorippa amphibia*	R

continued...

Annex 17. ...continued

Aggregate class	Species name	Abundance category
III	*Agrostis stolonifera*	A
III	*Lolium perenne*	A
III	*Poa annua*	A
III	*Rumex obtusifolius*	A
III	*Plantago major*	A
III	*Cirsium vulgare*	A
III	*Matricaria matricarioides*	A
III	*Rumex crispus*	A
III	*Alopecurus pratensis*	A
III	*Sonchus asper*	A
III	*Bromus hordeaceus*	A
III	*Geranium molle*	A
III	*Alopecurus geniculatus*	A
III	*Geranium dissectum*	I
III	*Festuca arundinacea*	I
III	*Vicia sativa*	I
III	*Festuca pratensis*	I
III	*Picris echioides*	I
III	*Hordeum murinum*	I
III	*Hordeum secalinum*	I
III	*Tragopogon pratensis*	I
III	*Carex otrubae*	I
III	*Ranunculus sceleratus*	I
III	*Gnaphalium uliginosum*	I
III	*Pastinaca sativa*	I
III	*Trifolium campestre*	I
III	*Polygonum arenastrum*	R
III	*Rorippa sylvestris*	R
III	*Elymus pycnanthus*	R
III	*Juncus gerardi*	R
III	*Pimpinella major*	R
III	*Galeopsis speciosa*	R
III	*Petroselinum segetum*	R
III	*Samolus valerandi*	R
III	*Crepis biennis*	R
III	*Spergularia marina*	R
IV	*Holcus lanatus*	A
IV	*Ranunculus repens*	A
IV	*Trifolium repens*	A
IV	*Festuca rubra*	A
IV	*Cerastium fontanum*	A
IV	*Plantago lanceolata*	A
IV	*Rumex acetosa*	A
IV	*Poa pratensis*	A
IV	*Achillea millefolium*	A
IV	*Ranunculus acris*	A
IV	*Cynosurus cristatus*	A
IV	*Deschampsia cespitosa*	A
IV	*Prunella vulgaris*	A
IV	*Bellis perennis*	A
IV	*Veronica chamaedrys*	A
IV	*Filipendula ulmaria*	A
IV	*Senecio jacobaea*	A
IV	*Centaurea nigra*	A
IV	*Lotus corniculatus*	A
IV	*Trifolium pratense*	A
IV	*Lathyrus pratensis*	A
IV	*Cardamine pratensis*	A
IV	*Equisetum arvense*	A
IV	*Stellaria alsine*	A
IV	*Rumex acetosella*	A
IV	*Potentilla anserina*	A
IV	*Vicia sepium*	A
IV	*Lotus uliginosus*	A
IV	*Veronica serpyllifolia*	A
IV	*Vicia cracca*	A
IV	*Glyceria fluitans*	A
IV	*Stellaria graminea*	A
IV	*Veronica beccabunga*	A
IV	*Ulex europaeus*	A
IV	*Campanula rotundifolia*	A
IV	*Galium verum*	A
IV	*Nasturtium officinale*	I
IV	*Trifolium dubium*	I
IV	*Conopodium majus*	I
IV	*Juncus inflexus*	I
IV	*Juncus bufonius*	I
IV	*Tussilago farfara*	I
IV	*Ranunculus bulbosus*	I
IV	*Hieracium pilosella*	I
IV	*Medicago lupulina*	I
IV	*Carex ovalis*	I
IV	*Polygonum hydropiper*	I
IV	*Cruciata laevipes*	I
IV	*Carex hirta*	I
IV	*Daucus carota*	I
IV	*Iris pseudocorus*	I
IV	*Trisetum flavescens*	I
IV	*Crepis capillaris*	I
IV	*Lychnis flos-cuculi*	I
IV	*Cytisus scoparius*	I
IV	*Hypericum perforatum*	I
IV	*Leucanthemum vulgare*	I
IV	*Pulicaria dysenterica*	I
IV	*Odontites verna*	I
IV	*Briza media*	I
IV	*Pimpinella saxifraga*	I
IV	*Cerastium glomeratum*	I
IV	*Agrimonia eupatoria*	I
IV	*Senecio aquaticus*	I
IV	*Sanguisorba minor*	I
IV	*Bromus erectus*	I
IV	*Stachys officinalis*	I
IV	*Stachys palustris*	I
IV	*Avenula pubescens*	I
IV	*Glyceria declinata*	I
IV	*Primula veris*	I
IV	*Centaurium erythraea*	I
IV	*Hypericum tetrapterum*	R

Annex 17. ...continued

Aggregate class	Species name	Abundance category
IV	*Centaurea scabiosa*	R
IV	*Vicia hirsuta*	R
IV	*Cirsium acaule*	R
IV	*Plantago media*	R
IV	*Glyceria plicata*	R
IV	*Viola hirta*	R
IV	*Avenula pratensis*	R
IV	*Clinopodium vulgare*	R
IV	*Lythrum salicaria*	R
IV	*Senecio erucifolius*	R
IV	*Stellaria palustris*	R
IV	*Helianthemum nummularium*	R
IV	*Carex caryophyllea*	R
IV	*Koeleria macrantha*	R
IV	*Trifolium medium*	R
IV	*Raphanus raphanistrum*	R
IV	*Vulpia bromoides*	R
IV	*Sanguisorba officinalis*	R
IV	*Anthyllis vulneraria*	R
IV	*Carex arenaria*	R
IV	*Scabiosa columbaria*	R
IV	*Ammophila arenaria*	R
IV	*Asperula cynanchica*	R
IV	*Carex disticha*	R
IV	*Tanacetum vulgare*	R
IV	*Ornithopus perpusillus*	R
IV	*Ononis repens*	R
IV	*Origanum vulgare*	R
IV	*Honkenya peploides*	R
IV	*Glaux maritima*	R
IV	*Trifolium fragiferum*	R
IV	*Phyteuma orbiculare*	R
IV	*Ranunculus omiophyllus*	R
IV	*Campanula glomerata*	R
V	*Crataegus monogyna*	A
V	*Hedera helix*	A
V	*Glechoma hederacea*	A
V	*Prunus spinosa*	A
V	*Fraxinus excelsior*	A
V	*Geranium robertianum*	A
V	*Silene dioica*	A
V	*Sambucus nigra*	A
V	*Brachypodium sylvaticum*	A
V	*Stellaria holostea*	A
V	*Geum urbanum*	A
V	*Corylus avellana*	A
V	*Mercurialis perennis*	A
V	*Alliaria petiolata*	A
V	*Hyacinthoides non-scripta*	A
V	*Lonicera periclymenum*	A
V	*Ilex aquifolium*	A
V	*Tamus communis*	A
V	*Veronica montana*	A
V	*Acer campestre*	A
V	*Circaea lutetiana*	I
V	*Arum maculatum*	I
V	*Festuca gigantea*	I
V	*Lamiastrum galeobdolon*	I
V	*Ballota nigra*	I
V	*Asplenium scolopendrium*	I
V	*Cornus sanguinea*	I
V	*Bromus ramosus*	I
V	*Ligustrum vulgare*	I
V	*Carex sylvatica*	I
V	*Clematis vitalba*	I
V	*Bryonia cretica*	I
V	*Moehringia trinervia*	I
V	*Carex pendula*	I
V	*Umbilicus rupestris*	I
V	*Sanicula europaea*	I
V	*Malus sylvestris*	I
V	*Melica uniflora*	I
V	*Allium ursinum*	I
V	*Euonymus europaeus*	R
V	*Viola odorata*	R
V	*Carpinus betulus*	R
V	*Prunus avium*	R
V	*Rubus caesius*	R
V	*Hypericum hirsutum*	R
V	*Milium effusum*	R
V	*Galium odoratum*	R
V	*Asplenium adiantum-nigrum*	R
V	*Taxus baccata*	R
V	*Viburnum opulus*	R
V	*Euphorbia amygdaloides*	R
V	*Iris foetidissima*	R
V	*Adoxa moschatellina*	R
V	*Listera ovata*	R
V	*Rhamnus catharticus*	R
V	*Populus tremula*	R
V	*Campanula trachelium*	R
V	*Epipactis helleborine*	R
VI	*Holcus mollis*	A
VI	*Pteridium aquilinum*	A
VI	*Mnium hornum*	A
VI	*Thuidium tamariscinum*	A
VI	*Digitalis purpurea*	A
VI	*Oxalis acetosella*	A
VI	*Angelica sylvestris*	A
VI	*Plagiomnium undulatum*	A
VI	*Chamaenerion angustifolium*	A
VI	*Athyrium filix-femina*	A
VI	*Sorbus aucuparia*	A
VI	*Primula vulgaris*	A
VI	*Chrysosplenium oppositifolium*	A
VI	*Lysimachia nemorum*	A

continued...

Annex 17. ...continued

Aggregate class	Species name	Abundance category
VI	*Teucrium scorodonia*	A
VI	*Dicranella heteromalla*	A
VI	*Ajuga reptans*	I
VI	*Luzula sylvatica*	I
VI	*Alnus glutinosa*	I
VI	*Potentilla sterilis*	I
VI	*Atrichum undulatum*	I
VI	*Rubus idaeus*	I
VI	*Ranunculus ficaria*	I
VI	*Anemone nemorosa*	I
VI	*Carex remota*	I
VI	*Valeriana officinalis*	I
VI	*Fragaria vesca*	I
VI	*Geum rivale*	I
VI	*Dicranum majus*	I
VI	*Polypodium vulgare*	I
VI	*Scrophularia nodosa*	I
VI	*Luzula pilosa*	I
VI	*Solidago virgaurea*	I
VI	*Crepis paludosa*	R
VI	*Hypericum humifusum*	R
VI	*Plagiothecium denticulatum*	R
VI	*Jasione montana*	R
VI	*Carex pallescens*	R
VI	*Galium uliginosum*	R
VI	*Polygonum bistorta*	R
VI	*Corydalis claviculata*	R
VI	*Hypericum androsaemum*	R
VI	*Filago vulgaris*	R
VI	*Gymnocarpium dryopteris*	R
VI	*Carex paniculata*	R
VI	*Senecio sylvaticus*	R
VI	*Cystopteris fragilis*	R
VI	*Carex diandra*	R
VII	*Agrostis capillaris*	A
VII	*Anthoxanthum odoratum*	A
VII	*Potentilla erecta*	A
VII	*Juncus effusus*	A
VII	*Rhytidiadelphus squarrosus*	A
VII	*Galium saxatile*	A
VII	*Festuca ovina*	A
VII	*Nardus stricta*	A
VII	*Deschampsia flexuosa*	A
VII	*Cirsium palustre*	A
VII	*Hylocomium splendens*	A
VII	*Carex nigra*	A
VII	*Carex echinata*	A
VII	*Succisa pratensis*	A
VII	*Juncus bulbosus*	A
VII	*Viola palustris*	A
VII	*Blechnum spicant*	A
VII	*Galium palustre*	A
VII	*Ranunculus flammula*	A
VII	*Pseudoscleropodium purum*	A
VII	*Carex binervis*	A
VII	*Carex demissa*	A
VII	*Festuca vivipara*	A
VII	*Epilobium palustre*	A
VII	*Danthonia decumbens*	I
VII	*Hypericum pulchrum*	I
VII	*Carex pilulifera*	I
VII	*Juncus conglomeratus*	I
VII	*Carex flacca*	I
VII	*Veronica officinalis*	I
VII	*Achillea ptarmica*	I
VII	*Aira praecox*	I
VII	*Plantago maritima*	I
VII	*Caltha palustris*	I
VII	*Montia fontana*	I
VII	*Oreopteris limbosperma*	I
VII	*Equisetum palustre*	I
VII	*Rhizomnium punctatum*	I
VII	*Anagallis tenella*	I
VII	*Rhytidiadelphus triquetrus*	I
VII	*Linum catharticum*	I
VII	*Hydrocotyle vulgaris*	I
VII	*Peltigera canina*	I
VII	*Lathyrus montanus*	I
VII	*Equisetum fluviatile*	I
VII	*Plantago coronopus*	I
VII	*Potamogeton polygonifolius*	I
VII	*Pedicularis palustris*	I
VII	*Alchemilla alpina*	I
VII	*Trientalis europaea*	R
VII	*Potentilla palustris*	R
VII	*Armeria maritima*	R
VII	*Carex curta*	R
VII	*Scutellaria minor*	R
VII	*Cochlearia officinalis*	R
VII	*Isolepis setacea*	R
VII	*Parnassia palustris*	R
VII	*Phegopteris connectilis*	R
VII	*Carum verticillatum*	R
VII	*Litorella uniflora*	R
VII	*Wahlenbergia hederacea*	R
VII	*Viola canina*	R
VII	*Gentianella campestris*	R
VII	*Eleocharis quinqueflora*	R
VII	*Hypericum elodes*	R
VII	*Carex hostiana*	R
VII	*Sedum forsteranum*	R
VII	*Eleogiton fluitans*	R
VII	*Lycopodium clavatum*	R
VII	*Sesleria albicans*	R
VII	*Ophioglossum vulgatum*	R
VII	*Botrychium lunaria*	R

continued...

Annex 17. ...continued

Aggregate class	Species name	Abundance category
VIII	*Calluna vulgaris*	A
VIII	*Molinia caerulea*	A
VIII	*Juncus squarrosus*	A
VIII	*Vaccinium myrtillus*	A
VIII	*Pleurozium schreberi*	A
VIII	*Carex panicea*	A
VIII	*Erica tetralix*	A
VIII	*Eriophorum angustifolium*	A
VIII	*Trichophorum caespitosum*	A
VIII	*Dicranum scoparium*	A
VIII	*Narthecium ossifragum*	A
VIII	*Cladonia impexa*	A
VIII	*Eriophorum vaginatum*	A
VIII	*Erica cinerea*	A
VIII	*Racomitrium lanuginosum*	A
VIII	*Rhytidiadelphus loreus*	A
VIII	*Plagiothecium undulatum*	A
VIII	*Empetrum nigrum*	A
VIII	*Cladonia uncialis*	I
VIII	*Drosera rotundifolia*	I
VIII	*Pedicularis sylvatica*	I
VIII	*Pinguicula vulgaris*	I
VIII	*Myrica gale*	I
VIII	*Vaccinium vitis-idaea*	I
VIII	*Aulacomnium palustre*	I
VIII	*Selaginella selaginoides*	I
VIII	*Cladonia arbuscula*	I
VIII	*Breutelia chrysocoma*	I
VIII	*Huperzia selago*	I
VIII	*Rubus chamaemorus*	I
VIII	*Leucobryum glaucum*	I
VIII	*Triglochin palustris*	I
VIII	*Carex rostrata*	I
VIII	*Eleocharis palustris*	I
VIII	*Drosera anglica*	I
VIII	*Carex bigelowii*	I
VIII	*Menyanthes trifoliata*	I
VIII	*Listera cordata*	R
VIII	*Carex dioica*	R
VIII	*Drosera intermedia*	R
VIII	*Vaccinium oxycoccus*	R
VIII	*Antennaria dioica*	R
VIII	*Agrostis curtisii*	R
VIII	*Eleocharis uniglumis*	R
VIII	*Cladonia furcata*	R
VIII	*Melampyrum pratense*	R
VIII	*Arctostaphylos uva-ursi*	R
VIII	*Diphasiastrum alpinum*	R
VIII	*Carex lepidocarpa*	R
VIII	*Carex limosa*	R
VIII	*Juniperus communis*	R
VIII	*Genista anglica*	R
VIII	*Juncus trifidus*	R
VIII	*Utricularia intermedia*	R

Annex 18. Differences in median counts of aggregate class preferential species, ranked in terms of their abundance, between five plot types and four landscape types. Highest and lowest median counts are shown in bold italics. (* = p<0.05, ** = p<0.01, *** = p<0.001, A = abundant species with ≥66% tile frequency in aggregate class samples, I = intermediate 66% tile > frequency ≥33% tile; R = rare, frequency <33% tile)

Arable landscape

Aggregate class	Abundance	Plot type: Boundary	Hedge	Roadside	Streamside	Main	Significance
I	A	1.6	***1.3***	1.5	***1.3***	***2.1***	***
II	A	4.3	***4.9***	4.8	4.6	***2.0***	***
III	A	2.2	***1.7***	***3.4***	2.0	2.5	***
IV	A	3.5	***2.4***	4.5	4.4	***4.5***	***
IV	R	1.5	1.2	1.4	***1.1***	***2.3***	**
V	A	2.5	2.9	***1.9***	2.3	***3.2***	***
V	I	1.3	***1.2***	***1.2***	1.3	***1.8***	*

Marginal upland landscape

Aggregate class	Abundance	Plot type: Boundary	Hedge	Roadside	Streamside	Main	Significance
III	A	2.2	2.1	***3.1***	***1.7***	2.6	***
IV	A	5.2	***4.4***	6.5	6.1	***6.6***	***
VI	A	***1.8***	2.6	***1.8***	***3.0***	2.2	***
VII	A	3.8	***2.1***	3.7	6.5	***5.6***	***
VIII	A	3.0	–	***2.2***	3.3	***5.5***	***

Upland landscape

Aggregate class	Abundance	Plot type: Boundary	Hedge	Roadside	Streamside	Main	Significance
VI	A	1.8	–	***1.5***	***2.4***	2.0	***
VII	A	5.8	–	***5.6***	***8.5***	6.5	***
VII	I	***1.5***	–	1.7	2.0	***2.1***	*
VIII	A	4.2	–	***2.8***	5.0	***8.5***	***
VIII	I	1.8	–	***1.3***	2.0	***2.5***	***

Pastural landscape

Aggregate class	Abundance	Plot type: Boundary	Hedge	Roadside	Streamside	Main	Significance
I	A	1.5	***1.2***	1.5	1.3	***2.1***	***
II	A	3.5	3.8	***4.5***	3.6	***2.0***	***
II	I	***1.4***	***1.2***	***1.2***	***1.4***	***1.2***	**
III	A	2.5	***1.8***	***3.4***	2.3	3.1	***

Annex 19. Change in mean number of aggregate class preferentials per plot by abundance class and landscape type. The direction of change is shown as an increase, decrease or no change in number of species. (ns = not significant, * = p<0.05, ** = p<0.01, *** = p<0.001, A = abundant species with ≥66% tile frequency in aggregate class samples, I = intermediate, 66% tile > frequency ≥33% tile; R = rare, frequency <33% tile)

Landscape type	Aggregate vegetation class		Abundance	Change	Significance
Arable	I	Crops/weeds	A	–	***
	II	Tall grassland/herb	A	+	***
	III	Fertile grasslands	A	–	***
	IV	Infertile grasslands	A	–	**
	V	Lowland wooded	A	.	ns
	I	Crops/weeds	I	.	ns
	II	Tall grassland/herb	I	.	ns
	III	Fertile grasslands	I	+	**
	IV	Infertile grasslands	I	.	ns
	V	Lowland wooded	I	.	ns
	I	Crops/weeds	R	.	ns
	II	Tall grassland/herb	R	.	ns
	III	Fertile grasslands	R	.	ns
	IV	Infertile grasslands	R	.	ns
	V	Lowland wooded	R	+	*
Pastural	I	Crops/weeds	A	.	ns
	II	Tall grassland/herb	A	+	**
	III	Fertile grasslands	A	.	ns
	IV	Infertile grasslands	A	–	***
	V	Lowland wooded	A	.	ns
	I	Crops/weeds	I	.	ns
	II	Tall grassland/herb	I	–	*
	III	Fertile grasslands	I	.	ns
	IV	Infertile grasslands	I	.	ns
	V	Lowland wooded	I	–	**
	I	Crops/weeds	R	.	ns
	II	Tall grassland/herb	R	.	ns
	III	Fertile grasslands	R	.	ns
	IV	Infertile grasslands	R	.	ns
	V	Lowland wooded	R	.	ns
Marginal upland	III	Fertile grasslands	A	.	ns
	IV	Infertile grasslands	A	.	ns
	VI	Upland wooded	A	.	ns
	VII	Moorland/grass mosaic	A	.	ns
	VIII	Heath/bog	A	.	ns
	III	Fertile grasslands	I	.	ns
	IV	Infertile grasslands	I	.	ns
	VI	Upland wooded	I	.	ns
	VII	Moorland/grass mosaic	I	.	ns
	VIII	Heath/bog	I	+	*
	IV	Infertile grasslands	R	.	ns
	VI	Upland wooded	R	.	ns
	VII	Moorland/grass mosaic	R	.	ns
	VIII	Heath/bog	R	.	ns
Upland	II	Tall grassland/herb	A	.	ns
	VI	Upland wooded	A	.	ns
	VII	Moorland/grass mosaic	A	.	ns
	VIII	Heath/bog	A	.	ns
	II	Tall grassland/herb	I	.	ns
	VI	Upland wooded	I	–	**
	VII	Moorland/grass mosaic	I	–	**
	VIII	Heath/bog	I	.	ns
	VI	Upland wooded	R	–	**

continued...

Annex 19. ...continued

Landscape type	Aggregate vegetation class		Abundance	Change	Significance
Upland continued..	VII	Moorland/grass mosaic	R	+	**
	VIII	Heath/bog	R	.	ns
GB	I	Crops/weeds	A	–	***
	II	Tall grassland/herb	A	+	***
	III	Fertile grasslands	A	–	*
	IV	Infertile grasslands	A	–	***
	V	Lowland wooded	A	.	ns
	VI	Upland wooded	A	.	ns
	VII	Moorland/grass mosaic	A	.	ns
	VIII	Heath/bog	A	.	ns
	I	Crops/weeds	I	.	ns
	II	Tall grassland/herb	I	.	ns
	III	Fertile grasslands	I	+	**
	IV	Infertile grasslands	I	–	*
	V	Lowland wooded	I	–	**
	VI	Upland wooded	I	–	***
	VII	Moorland/grass mosaic	I	–	***
	VIII	Heath/bog	I	.	ns
	I	Crops/weeds	R	.	ns
	II	Tall grassland/herb	R	.	ns
	III	Fertile grasslands	R	.	ns
	IV	Infertile grasslands	R	.	ns
	V	Lowland wooded	R	.	ns
	VI	Upland wooded	R	–	***
	VII	Moorland/grass mosaic	R	.	ns
	VIII	Heath/bog	R	.	ns

Annex 20a. Mean change in recalibrated Ellenberg K – continentality indicator values by CVS aggregate class and plot type. Emboldened rows indicate n ≥20 or n ≥10% of total number of plots of each type. Results based on GB classification of Countryside Survey plots. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	Roadside	7	3.86	3.89	0.33	ns	
		Main	**194**	**3.86**	**4.04**	**37.47**	***	+
		Streamside	1	–	–	–	–	
II	Tall grassland/herb	**Hedge**	**76**	**3.65**	**3.63**	**0.68**	**ns**	
		Roadside	**84**	**3.72**	**3.75**	**2.59**	**ns**	
		Streamside	**54**	**3.63**	**3.58**	**2.85**	*	–
		Main	13	3.69	3.68	0.03	ns	
III	Fertile grassland	Hedge	6	3.66	3.77	3.45	ns	
		Roadside	**112**	**3.72**	**3.75**	**2.27**	**ns**	
		Streamside	**23**	**3.67**	**3.56**	**9.94**	**	–
		Main	**178**	**3.64**	**3.73**	**15**	***	+
IV	Infertile grassland	**Hedge**	**24**	**3.39**	**3.39**	**0**	**ns**	
		Roadside	**65**	**3.45**	**3.50**	**10.43**	**	+
		Streamside	**71**	**3.42**	**3.40**	**1.66**	**ns**	
		Main	**209**	**3.42**	**3.48**	**23.69**	***	+
V	Lowland wooded	**Hedge**	**96**	**3.55**	**3.63**	**14.56**	***	+
		Roadside	7	3.53	3.60	1.83	ns	
		Streamside	**25**	**3.24**	**3.33**	**6.94**	*	+
		Main	**22**	**3.16**	**3.25**	**6.27**	*	+
VI	Upland wooded	Hedge	2	3.19	3.17	0.07	ns	
		Roadside	5	3.10	3.06	0.39	ns	
		Streamside	**44**	**3.16**	**3.22**	**3.42**	*	+
		Main	**73**	**3.07**	**3.11**	**1.53**	**ns**	
VII	Moorland grass/mosaic	**Roadside**	**23**	**3.12**	**3.15**	**0.54**	**ns**	
		Streamside	**73**	**3.02**	**3.05**	**0.84**	**ns**	
		Main	**114**	**3.04**	**3.03**	**0.44**	**ns**	
VIII	Heath/bog	Roadside	1	–	–	–	–	
		Streamside	**28**	**2.74**	**2.81**	**2.11**	**ns**	
		Main	**241**	**2.80**	**2.82**	**2.82**	*	+

Annex 20b. Mean change in recalibrated Ellenberg F – moisture indicator values. Emboldened rows indicate n ≥20 or n ≥10% of total number of plots of each type. Results based on GB classification of Countryside Survey plots. (* = p≤0.1, ** = p≤0.01, *** = p≤0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	Roadside	7	4.99	5.12	6.63	*	+
		Main	**194**	**4.99**	**4.88**	**17.11**	***	–
		Streamside	1	–	–	–	–	
II	Tallgrassland/herb	**Hedge**	**76**	**5.33**	**5.33**	**0**	**Ns**	
		Roadside	**84**	**5.31**	**5.24**	**7.78**	**	–
		Streamside	**54**	**6.28**	**6.15**	**1.08**	**Ns**	
		Main	13	5.81	6.11	0.34	Ns	
III	Fertile grassland	Hedge	6	5.37	5.35	0.06	Ns	
		Roadside	**112**	**5.21**	**5.23**	**1.08**	**Ns**	
		Streamside	**23**	**5.87**	**6.16**	**5.83**	*	+
		Main	**178**	**5.30**	**5.25**	**5.16**	*	–
IV	Infertile grassland	**Hedge**	**24**	**5.41**	**5.49**	**3.3**	*	+
		Roadside	**65**	**5.36**	**5.45**	**9.2**	**	+
		Streamside	**71**	**6.37**	**6.37**	**0**	**ns**	
		Main	**209**	**5.38**	**5.41**	**1.35**	**ns**	
V	Lowland wooded	**Hedge**	**96**	**5.32**	**5.28**	**2.23**	**ns**	
		Roadside	7	5.34	5.36	0.12	ns	
		Streamside	**25**	**5.81**	**6.12**	**13.56**	**	+
		Main	**22**	**5.48**	**5.54**	**0.65**	**ns**	
VI	Upland wooded	Hedge	2	5.68	5.65	0.34	ns	
		Roadside	5	5.91	5.90	0.01	ns	
		Streamside	**44**	**6.30**	**6.33**	**0.07**	**ns**	
		Main	**73**	**6.04**	**6.14**	**3.68**	*	+
VII	Moorland grass/mosaic	**Roadside**	**23**	**6.04**	**6.12**	**1.02**	**ns**	
		Streamside	**73**	**6.63**	**6.74**	**3.83**	*	+
		Main	**114**	**6.42**	**6.51**	**3.33**	*	+
VIII	Heath/bog	Roadside	1	–	–	–	–	
		Streamside	**28**	**7.35**	**7.11**	**4.56**	*	–
		Main	**241**	**7.22**	**7.15**	**7.08**	**	–

Annex 20c. Mean change in recalibrated Ellenberg L – light indicator values. Emboldened rows indicate n ≥20 or n ≥10% of total number of plots of each type. Results based on GB classification of Countryside Survey plots. (* = p≤0.1, ** = p≤0.01, *** = p≤0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	Roadside	7	6.99	6.97	0.23	ns	
		Main	**194**	**6.93**	**6.95**	**1.65**	**ns**	
		Streamside	1	–	–	–	–	
II	Tall grassland/herb	**Hedge**	**76**	**6.58**	**6.47**	**9.6**	**	–
		Roadside	**84**	**6.70**	**6.73**	**1.11**	**ns**	
		Streamside	**54**	**6.67**	**6.62**	**0.74**	**ns**	
		Main	13	6.73	6.96	15.21	**	+
III	Fertile grassland	Hedge	6	6.81	6.72	4.13	*	–
		Roadside	**112**	**6.95**	**6.91**	**4.67**	*	–
		Streamside	**23**	**6.99**	**6.91**	**1.88**	**ns**	
		Main	**178**	**7.05**	**7.02**	**3.06**	*	–
IV	Infertile grassland	**Hedge**	**24**	**6.58**	**6.47**	**2.65**	**ns**	
		Roadside	**65**	**6.94**	**6.89**	**5.33**	*	–
		Streamside	**71**	**6.76**	**6.62**	**6.53**	*	–
		Main	**209**	**7.01**	**6.99**	**1.17**	**ns**	
V	Lowland wooded	**Hedge**	**96**	**6.28**	**6.35**	**6.43**	*	+
		Roadside	7	6.14	6.29	3.52	ns	
		Streamside	**25**	**5.59**	**5.87**	**11.66**	**	+
		Main	**22**	**5.45**	**5.64**	**2.68**	**ns**	
VI	Upland wooded	Hedge	2	6.12	6.18	0.08	ns	
		Roadside	5	6.49	6.54	0.04	ns	
		Streamside	**44**	**6.02**	**6.23**	**6.59**	*	+
		Main	**73**	**6.11**	**6.04**	**1.99**	**ns**	
VII	Moorland grass/mosaic	**Roadside**	**23**	**6.98**	**6.98**	**0**	**ns**	
		Streamside	**73**	**6.93**	**6.90**	**0.73**	**ns**	
		Main	**114**	**6.96**	**6.88**	**3.56**	*	–
VIII	Heath/bog	Roadside	1	–	–	–	–	
		Streamside	**28**	**7.32**	**7.20**	**3.07**	*	–
		Main	**241**	**7.28**	**7.18**	**15.76**	***	–

Annex 20d. Mean change in recalibrated Ellenberg R – soil reaction indicator values. Emboldened rows indicate n ≥20 or n ≥10% of total number of plots of each type. Results based on GB classification of Countryside Survey plots. (* = p≤0.1, ** = p≤0.01, *** = p≤0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	Roadside	7	6.34	6.55	7.14	*	+
		Main	**194**	**6.41**	**6.54**	**25.07**	***	+
		Streamside	1	–	–	–	–	
II	Tall grassland/herb	**Hedge**	**76**	**6.47**	**6.56**	**6.5**	*	+
		Roadside	**84**	**6.48**	**6.51**	**1.13**	**ns**	
		Streamside	**54**	**6.47**	**6.40**	**3**	*	–
		Main	13	6.35	6.42	0.27	ns	
III	Fertile grassland	Hedge	6	6.16	6.51	6.72	*	+
		Roadside	**112**	**6.21**	**6.30**	**8.35**	**	+
		Streamside	**23**	**6.14**	**6.20**	**0.44**	**ns**	
		Main	**178**	**6.08**	**6.12**	**2.29**	**ns**	
IV	Infertile grassland	**Hedge**	**24**	**5.71**	**5.83**	**2.26**	**ns**	
		Roadside	**65**	**5.73**	**5.76**	**0.13**	**ns**	
		Streamside	**71**	**5.67**	**5.73**	**0.63**	**ns**	
		Main	**209**	**5.62**	**5.70**	**5.42**	*	+
V	Lowland wooded	**Hedge**	**96**	**6.66**	**6.69**	**1.51**	**ns**	
		Roadside	7	6.63	6.66	0.22	ns	
		Streamside	**25**	**6.24**	**6.18**	**0.88**	**ns**	
		Main	**22**	**5.70**	**5.69**	**0.02**	**ns**	
VI	Upland wooded	Hedge	2	5.44	5.33	2.24	ns	
		Roadside	5	4.66	4.56	0.26	ns	
		Streamside	**44**	**5.12**	**5.09**	**0.48**	**ns**	
		Main	**73**	**4.12**	**4.04**	**2.04**	**ns**	
VII	Moorland grass/mosaic	**Roadside**	**23**	**4.38**	**4.45**	**0**	**ns**	
		Streamside	**73**	**4.04**	**4.03**	**0.42**	**ns**	
		Main	**114**	**3.79**	**3.77**	**0.67**	**ns**	
VIII	Heath/bog	Roadside	1	–	–	–	–	
		Streamside	**28**	**3.03**	**3.38**	**7.51**	*	+
		Main	**241**	**2.62**	**2.79**	**21.11**	***	+

Annex 20e. Mean change in recalibrated Ellenberg N – fertility indicator values. Emboldened rows indicate n ≥20 or n ≥10% of total number of plots of each type. Results based on GB classification of Countryside Survey plots. (* = p≤0.1, ** = p≤0.01, *** = p≤0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	Roadside	7	6.05	6.27	1.64	ns	
		Main	**194**	**6.29**	**6.37**	**1.63**	**ns**	
		Streamside	1	–	–	–	–	
II	Tall grassland/herb	**Hedge**	**76**	**6.15**	**6.28**	**7.3**	**	+
		Roadside	**84**	**6.20**	**6.17**	**0.53**	**ns**	
		Streamside	**54**	**6.31**	**6.14**	**6.61**	*	–
		Main	13	6.16	5.96	1.46	ns	
III	Fertile grassland	Hedge	6	5.70	6.22	19.2	**	+
		Roadside	**112**	**5.72**	**5.82**	**3.92**	*	+
		Streamside	**23**	**5.71**	**5.76**	**0.11**	**ns**	
		Main	**178**	**5.62**	**5.70**	**2.85**	*	+
IV	Infetile grassland	**Hedge**	**24**	**5.17**	**5.48**	**5.53**	*	+
		Roadside	**65**	**4.98**	**5.11**	**2.85**	*	+
		Streamside	**71**	**5.06**	**5.22**	**2.69**	**ns**	
		Main	**209**	**4.81**	**4.99**	**14.87**	***	+
V	Lowland wooded	**Hedge**	**96**	**6.37**	**6.40**	**0.56**	**ns**	
		Roadside	7	6.41	6.37	0.08	ns	
		Streamside	**25**	**6.06**	**5.98**	**0.87**	**ns**	
		Main	**22**	**5.45**	**5.30**	**1.28**	**ns**	
VI	Upland wooded	Hedge	2	5.03	5.01	0	ns	
		Roadside	5	4.11	3.91	0.81	ns	
		Streamside	**44**	**4.70**	**4.63**	**1.12**	**ns**	
		Main	**73**	**3.73**	**3.69**	**0.88**	**ns**	
VII	Moorland grass/mosaic	**Roadside**	**23**	**3.53**	**3.62**	**0.05**	**ns**	
		Streamside	**73**	**3.19**	**3.26**	**0.04**	**ns**	
		Main	**114**	**3.04**	**3.05**	**0.13**	**ns**	
VIII	Heath/bog	Roadside	1	–	–	–	–	
		Streamside	**28**	**2.22**	**2.51**	**5.94**	*	+
		Main	**241**	**2.05**	**2.20**	**25.17**	***	+

Annex 21a. Changes in Ellenberg scores in CS1990 data stratified by a classification of vegetation on agricultural land in England and Wales. Mean change in recalibrated Ellenberg K – continentality indicator values. Emboldened rows indicate n≥20 or n ≥10% of total number of plots of each type. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	**Hedge**	**4**	**4.11**	**3.83**	**2.52**	**ns**	
		Roadside	1	–	–	–	–	
		Streamside	**3**	**3.87**	**3.82**	**0.15**	**ns**	
		Main	**18**	**4.19**	**4.24**	**0.23**	**ns**	
II	Tall grassland/herb	Hedge	1	–	–	–	–	
		Roadside	11	3.84	3.87	0.1	ns	
		Streamside	3	3.75	3.66	0.95	ns	
		Main	**179**	**3.81**	**4.01**	**45.73**	***	+
III	Fertile grassland	**Hedge**	**112**	**3.57**	**3.60**	**2.59**	**ns**	
		Roadside	7	3.43	3.50	1.04	ns	
		Streamside	**40**	**3.52**	**3.57**	**4.34**	*	+
		Main	3	3.25	3.18	0.71	ns	
IV	Infertile grassland	Hedge	3	3.26	3.45	1.55	ns	
		Streamside	**21**	**3.24**	**3.21**	**0.35**	**ns**	
		Main	**11**	**3.23**	**3.28**	**0.54**	**ns**	
V	Lowland woodd	**Hedge**	**43**	**3.55**	**3.61**	**4.21**	*	+
		Roadside	**29**	**3.65**	**3.69**	**1.23**	**ns**	
		Streamside	**25**	**3.55**	**3.45**	**8.53**	**	–
		Main	**206**	**3.50**	**3.57**	**26.34**	***	+
VI	Upland wooded	**Streamside**	**14**	**3.41**	**3.38**	**0.26**	**ns**	
		Main	**4**	**3.23**	**3.38**	**1.14**	**ns**	
VII	Moorland grass/mosaic	**Streamside**	**13**	**3.03**	**3.09**	**0.75**	**ns**	
		Main	**38**	**3.09**	**3.11**	**0.23**	**ns**	
VIII	Heath/bog	**Streamside**	**4**	**2.86**	**2.99**	**0.76**	**ns**	
		Main	**24**	**2.92**	**2.98**	**2.27**	**ns**	

Annex 21b. Changes in Ellenberg scores in CS1990 data stratified by a classification of vegetation on agricultural land in England and Wales. Mean change in recalibrated Ellenberg F – moisture indicator values. Emboldened rows indicate n≥20 or n ≥10% of total number of plots of each type. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	**Hedge**	**4**	**4.86**	**5.02**	**4.9**	**ns**	
		Roadside	1	–	–	–	–	
		Streamside	**3**	**5.53**	**5.47**	**0.17**	**ns**	
		Main	**18**	**4.84**	**4.70**	**1.19**	**ns**	
II	Tall grassland/herb	Hedge	1	–	–	–	–	
		Roadside	11	5.09	5.16	1.74	ns	
		Streamside	3	5.65	6.16	0.64	ns	
		Main	**179**	**5.06**	**4.93**	**26.96**	***	–
III	Fertile grassland	**Hedge**	**112**	**5.33**	**5.32**	**0.42**	**ns**	
		Roadside	7	5.41	5.41	0	ns	
		Streamside	**40**	**6.07**	**6.27**	**2.76**	**ns**	
		Main	3	5.17	5.35	3.98	ns	
IV	Infertile grassland	Hedge	3	5.52	5.56	0.28	ns	
		Streamside	**21**	**6.28**	**6.16**	**0.24**	**ns**	
		Main	**11**	**5.99**	**5.56**	**3.74**	**ns**	
V	Lowland wooded	**Hedge**	**43**	**5.41**	**5.37**	**1.65**	**ns**	
		Roadside	**29**	**5.23**	**5.24**	**0.12**	**ns**	
		Streamside	**25**	**6.00**	**6.22**	**4.16**	*	+
		Main	**206**	**5.32**	**5.34**	**0.24**	**ns**	
VI	Upland wooded	**Streamside**	**14**	**6.86**	**6.61**	**3.46**	*	–
		Main	**4**	**6.21**	**5.89**	**3.34**	**ns**	
VII	Moorland grass/mosaic	**Streamside**	**13**	**6.70**	**6.80**	**0.37**	**ns**	
		Main	**38**	**6.27**	**6.32**	**0.23**	**ns**	
VIII	Heath/bog	**Streamside**	**4**	**7.09**	**6.85**	**2.41**	**ns**	
		Main	**24**	**7.06**	**6.82**	**8.17**	**	–

Annex 21c. Changes in Ellenberg scores in CS1990 data stratified by a classification of vegetation on agricultural land in England and Wales. Mean change in recalibrated Ellenberg L – light indicator values. Emboldened rows indicate n ≥ 20 or n ≥ 10% of total number of plots of each type. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	**Hedge**	**4**	**7.02**	**6.57**	**20.46**	**ns**	
		Roadside	1	–	–	–	–	
		Streamside	**3**	**7.02**	**6.97**	**0.51**	**ns**	
		Main	**18**	**6.90**	**6.89**	**0.03**	**ns**	
II	Tall grassland/herb	Hedge	1	–	–	–	–	
		Roadside	11	7.02	6.99	0.35	ns	
		Streamside	3	7.12	6.75	5.97	ns	
		Main	**179**	**6.95**	**6.97**	**1.25**	**ns**	
III	Fertile grassland	**Hedge**	**112**	**6.34**	**6.36**	**0.6**	**ns**	
		Roadside	7	6.15	6.33	0.69	ns	
		Streamside	**40**	**6.43**	**6.59**	**8.76**	**	+
		Main	3	6.21	6.14	0.02	ns	
IV	Infertile grassland	Hedge	3	5.94	6.10	1.16	ns	
		Streamside	**21**	**5.71**	**5.71**	**0**	**ns**	
		Main	**11**	**5.61**	**5.89**	**2.29**	**ns**	
V	Lowland wooded	**Hedge**	**43**	**6.59**	**6.54**	**2.08**	**ns**	
		Roadside	**29**	**6.84**	**6.83**	**0.2**	**ns**	
		Streamside	**25**	**6.92**	**6.63**	**12.14**	**	–
		Main	**206**	**7.02**	**7.02**	**0**	**ns**	
VI	Upland wooded	**Streamside**	**14**	**6.58**	**6.44**	**1.08**	**ns**	
		Main	**4**	**6.52**	**6.78**	**4.57**	**ns**	
VII	Moorland grass/mosaic	**Streamside**	**13**	**6.85**	**6.91**	**0.27**	**ns**	
		Main	**38**	**6.86**	**6.92**	**1.98**	**ns**	
VIII	Heath/bog	**Streamside**	**4**	**7.24**	**7.21**	**0.09**	**ns**	
		Main	**24**	**7.11**	**7.08**	**0.09**	**ns**	

Annex 21d. Changes in Ellenberg scores in CS1990 data stratified by a classification of vegetation on agricultural land in England and Wales. Mean change in recalibrated Ellenberg R – soil reaction indicator values. Emboldened rows indicate n≥20 or n ≥10% of total number of plots of each type. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	**Hedge**	**4**	**6.80**	**7.04**	**3.78**	**ns**	
		Roadside	1	–	–	–	–	
		Streamside	**3**	**6.84**	**6.84**	**0**	**ns**	
		Main	**18**	**6.70**	**6.83**	**3.88**	**ns**	
II	Tall grasslands/herb	Hedge	1	–	–	–	–	
		Roadside	11	6.31	6.50	6.61	*	+
		Streamside	3	6.39	6.38	0.01	ns	
		Main	**179**	**6.35**	**6.50**	**34.78**	***	+
III	Fertile grassland	**Hedge**	**112**	**6.59**	**6.62**	**1.34**	**ns**	
		Roadside	7	6.31	6.39	0.62	ns	
		Streamside	**40**	**6.42**	**6.48**	**0.91**	**ns**	
		Main	3	5.85	5.89	0.04	ns	
IV	Infertile grassland	Hedge	3	6.29	6.37	0.22	ns	
		Streamside	**21**	**6.02**	**5.90**	**2.45**	**ns**	
		Main	**11**	**5.68**	**5.78**	**1.55**	**ns**	
V	Lowland wooded	**Hedge**	**43**	**6.14**	**6.36**	**15.81**	***	+
		Roadside	**29**	**6.23**	**6.31**	**2.62**	**ns**	
		Streamside	**25**	**5.87**	**5.95**	**0.98**	**ns**	
		Main	**206**	**5.81**	**5.87**	**6.37**	*	+
VI	Upland wooded	**Streamside**	**14**	**5.56**	**5.61**	**0.02**	**ns**	
		Main	**4**	**4.76**	**5.33**	**2.15**	**ns**	
VII	Moorland grass/mosaic	**Streamside**	**13**	**3.99**	**4.03**	**0**	**ns**	
		Main	**38**	**3.83**	**3.84**	**0.13**	**ns**	
VII	Heath/bog	**Streamside**	**4**	**2.54**	**3.04**	**1.86**	**ns**	
		Main	**24**	**2.36**	**2.58**	**5.66**	*	+

Annex 21e. Changes in Ellenberg scores in CS1990 data stratified by a classification of vegetation on agricultural land in England and Wales. Mean change in recalibrated Ellenberg N – fertility indicator values. Emboldened rows indicate n≥20 or n ≥10% of total number of plots of each type. (* = p<0.01, ** = p<0.01, *** = p<0.001)

Aggregate vegetation class		Plot type	No. of replicate plots	Mean score 1978	Mean score 1990	F ratio	p value	Direction of change
I	Crops/weeds	**Hedge**	**4**	**6.42**	**6.80**	**4.34**	**ns**	
		Roadside	1	–	–	–	–	
		Streamside	**3**	**6.60**	**6.34**	**1.34**	**ns**	
		Main	**18**	**6.88**	**6.91**	**0.02**	**ns**	
II	Tall grassland/herb	Hedge	1	–	–	–	–	
		Roadside	11	5.88	6.07	1.78	ns	
		Streamside	3	6.15	6.21	0.01	ns	
		Main	**179**	**6.15**	**6.30**	**10.67**	**	+
III	Fertile grassland	**Hedge**	**112**	**6.28**	**6.34**	**2.35**	**ns**	
		Roadside	7	6.01	6.00	0.02	ns	
		Streamside	**40**	**6.23**	**6.24**	**0**	**ns**	
		Main	3	4.80	5.30	1.82	ns	
IV	Infertile grassland	Hedge	3	6.17	6.15	0.1	ns	
		Streamside	**21**	**5.86**	**5.73**	**2.09**	**ns**	
		Main	**11**	**5.41**	**5.15**	**0.88**	**ns**	
V	Lowland wooded	**Hedge**	**43**	**5.73**	**6.07**	**22.57**	***	+
		Roadside	**29**	**5.65**	**5.76**	**2.31**	**ns**	
		Streamside	**25**	**5.30**	**5.47**	**2.84**	**ns**	
		Main	**206**	**5.10**	**5.23**	**9.68**	**	+
VI	Upland wooded	**Streamside**	**14**	**5.07**	**5.22**	**0.88**	**ns**	
		Main	**4**	**4.16**	**4.66**	**1.35**	**ns**	
VII	Moorland grass/mosaic	**Streamside**	**13**	**3.22**	**3.30**	**0.02**	**ns**	
		Main	**38**	**3.17**	**3.19**	**0.15**	**ns**	
VIII	Heath/bog	**Streamside**	**4**	**1.93**	**2.32**	**1.74**	**ns**	
		Main	**24**	**2.03**	**2.14**	**2.33**	**ns**	

GLOSSARY

Aggregate classes (AC I–VIII)	The eight aggregate classes derived from the 100 CVS vegetation classes, by cluster analysis and used to stratify data for analyses of change. These correspond to major habitats
BRC	Biological Records Centre
CART	Classification and Regression Trees
Countryside Information System (CIS)	Spatial information software developed to deliver rural information using a one kilometre square grid of GB
CS1990	The Countryside Survey which took place in 1990, but also repeating that carried out in 1984 and the original Ecological Survey of GB of 1978
CS2000	Countryside Survey 2000
CORINE biotopes	A classification of European habitat types used to identify Special Areas of Conservation (SAC) under the EC Habitats Directive (92/43/EEC). The biotopes were defined by grouping phytosociological units, themselves based upon the joint occurrence of characteristic plant species
(CVS) Countryside Vegetation System	The integrated system developed during ECOFACT for classifying vegetation of the wider countryside
CSR	The functional traits (Competitors, Stress tolerators and Ruderals) of the approach developed by the Unit of Comparative Plant Ecology (UCPE) at Sheffield University to analyse vegetation (see Grime *et al.* 1988)
CVS classes	The 100 classes produced from the classification procedure, TWINSPAN, (Hill 1979a) of all CS1990 vegetation data, Bunce *et al.* (1999)
DECORANA (ordination)	The statistical procedure used to derive the principal gradients within vegetation (Hill 1979b)
DETR	Department of the Environment, Transport and the Regions
DOE	Department of the Environment, the former name for DETR
ECOFACT	Ecological Factors controlling biodiversity in the British countryside. The title of the research programme of which this report forms part.
Ellenberg indicator values	Values attributed to species, which define their ecological range in terms of fertility, acidity, light, and moisture (Ellenberg 1974).
GCVA	Generalised Canocial Variates Analysis
IBDs	Indicators of Botanical Diverity. The indicators identified as appropriate for measuring changes in biodiversity in GB
ITE	Institute of Terrestrial Ecology
JNCC	Joint Nature Conservation Committee

Land Classification	A multivariate classification of all 1 kilometre squares in GB based on geology, climate and topography and thus independent of the biota of the land surface
Landscape type	The 32 ITE Land Classes generated by the land classification were aggregated at a higher level into four landscape types (arable, pastural, marginal upland and upland). For many of the analyses in this report Countryside Survey data were stratified by these four landscape types. These will be replaced in CS2000 by environmental zones for England, Wales and Scotland separately
LUCID	Land-use Classification, Information and Documentation. Software that provides a comparison of land cover definitions between different classifications
MAFF	Ministry of Agriculture, Fisheries and Food
MATCH	An algorithm developed by Andrew Malloch at Lancaster University for assigning vegetation units to NVC
MAVIS	Modular Analysis of Vegetation and Interpretation System: a software package being developed to link NVC, CVS, CSR and Ellenberg values for analysis of vegetation samples
MG5	Unimproved neutral grassland in NVC
National Vegetation Classification (NVC)	The classification system developed at Lancaster University for describing British vegetation
NERC	Natural Environment Research Council
NCC	Nature Conservancy Council now divided into national agencies
NI	Northern Ireland
Ordination Axis	The gradient along which vegetation samples are ordered, according to their ecological affinities
Plant strategy theory	See CSR
Plots	Defined areas of vegetation, usually by quadrats, within which plant species are recorded
Plot Types	The six types of vegetation plots placed in different landscape elements in the Countryside Survey (main, streamside, roadside, hedge, boundary and habitat)
RDB	Red Data Book
SAC	Special Areas of Conservation
SIMIL	An algorithm developed at Lancaster University for assigning vegetation units to NVC
SOAEFD	Scottish Office Agriculture, Environment and Fisheries Department
Species groups	Groups of species with relatively constant ecological affinities classified by a minimum variance cluster analysis of ordination scores for each species
TABLEFIT	An algorithm developed by Mark Hill at ITE Monks Wood for assigning vegetation units to NVS
TWINSPAN (classification)	The statistical procedure used for classification of vegetation into classes (Hill 1979a)
UCPE	Unit of Comparative Plant Ecology at Sheffield University