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to the
Department for Environment, Food and Rural Affairs

Methodology of Countryside Survey 2000 Module 1: Survey of Broad Habitats and Landscape Features

Final Report

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1 INTRODUCTION

1.1 POLICY CONTEXT

1.1.1 History of Countryside Survey

Countryside Survey 2000 has a relatively long pedigree. Its immediate forerunner, Countryside Survey 1990 (CS1990) (Barr *et al.* 1993) was the first in the series of sample-based, field surveys of GB that had been carried out by the former Institute of Terrestrial Ecology to receive funding from a Government Department or Agency. By that time, policy customers had become convinced of the usefulness of the earlier surveys in 1978 (Bunce) and 1984 (Bunce).

CS1990 was reported in 1993 and provided much needed information to Government Departments and their agencies, Non Government Organisations and others involved in the formulation of countryside policy. For example, the Hedgerow Incentive Scheme (which pays farmers to manage hedgerows) was introduced following publication of the survey results. Subsequently, Departments have used Countryside Survey data to help fulfil obligations in relation to:

- UN Rio Declaration and Agenda 21 (UK Sustainable Development Strategy 1994; Indicators of Sustainable Development 1996)
- UN Convention on Biological Diversity (UK Biodiversity Action Plan 1994; Steering Group Report 1995; Species/Habitat Actions Plans)
- EU Habitats and Species Directive (SACs, SSSIs/ASSIs)
- EU Reform of Common Agriculture Policy (Agri-environment schemes, ESAs, Countryside Stewardship)
- UK Environment White Paper 1990
- UK Rural White Paper 1995

In particular, the Rural White paper (England) 1995 includes the following important statement: "The Government will carry out a repeat of Countryside Survey in the year 2000."

Some of the first results from CS1990 generated considerable interest amongst those concerned with countryside policy development. Foremost among these were results which suggested a 23% loss in the lengths of hedgerow in Great Britain between 1984 and 1990. On inspection, much of this '*loss*' was due to hedgerows becoming overgrown through neglect and no longer meeting a relatively strict definition of hedgerow. The subsequent inter-departmental debate on the meaning of the results reinforced the need for careful presentation of scientific results for a policy audience. These results, together with those relating to loss of ponds in the landscape, led to further, targeted surveys of these features in lowland England (Barr *et al.*, 1994, Williams *et al.*, 1998).

Other outputs from CS1990 had policy applications. For example, the hedgerow change data provided underpinning information for the development of the Hedgerow Incentive Scheme (Whelon, 1994). Several of the features recorded as apart of CS1990 have been recommended as indicators of sustainable development and, subsequently, two of these (*plant species-richness* and *landscape features*) have been established as UK Government Quality of Life Counts indicators (Government Statistical Service, 1999).

Additional research programmes such as ECOFACT further explored the policy implications of CS1990 results by attempting to relate observed change in biodiversity with the major human-induced driving forces responsible for these changes (Firbank *et al.*, 2000). There have been substantial changes in the driving forces in the 1990's, particularly with agri-

environmental schemes, new pollution controls and national and regional Biodiversity Action Plans, all expected to enhance biodiversity. Understanding the link between drivers and biodiversity changes is crucial if we are to test whether policies aiming at protecting biodiversity are likely to prove appropriate and effective. The long-term dimension of CS is an obvious asset to improve such understanding and will allow regular updates of findings.

To inform decisions about future countryside surveys, the then Department of the Environment[**] commissioned a 'Policy Review' of CS1990 (Swanwick and Dunn, 1996). Representatives of a wide range of users were consulted and a series of conclusions and recommendations emerged:

1.1.2 Key conclusions from Policy Review of CS1990

CS1990 is:

- An exceptionally comprehensive survey of the British countryside.
- Unique in combining census information on land cover with detailed, sample based field survey information.
- Widely used across a range of central government departments, government agencies, national and local Non-governmental organisations, research institutes, local government and the private sector.
- Used to address a wide range of countryside and environmental policy issues.
- Widely welcomed and praised by users, although areas for improvement are also identified.

1.1.3 Key recommendations from Policy Review of CS1990

1. There should be a commitment to continue the series of Countryside Surveys which should form a significant component of monitoring of the rural environment in the future.
2. The major emphasis should be on providing data which is statistically valid at the national (GB) and individual country levels.
3. Linked and complementary programmes of work should be established to address important topics which are not covered and to tackle questions relating to the causes and processes of change.
4. Countryside Survey should become a ten year event with the actual survey work taking place as near to the end of each decade as possible.
5. Interim five year 'health checks' should also be carried out to address specific concerns or policy needs as they arise.
6. Steps should be taken to ensure quick delivery of outputs and should include:
   - agreement of a reporting framework in advance, based on emerging ideas about indicators and environmental accounts
   - ensuring adequate manpower for the data analysis
7. Future surveys should have clearly stated purposes and scope.
8. Presentation of the findings for non-specialist, non-technical audiences should be improved.
9. Access to data should be carefully considered with core funding from DOE (now DEFRA) supporting use within government departments and agencies.
10. Continuity of time series data is important and should not be prejudiced by changes to the survey specification.
11. Technical issues which need to be reviewed include:
    - number of sample squares

[**] *subsequently the Department of the Environment, Transport and the Regions (DETR) and now the Department of Environment, Food and Rural Affairs (DEFRA)*

- need for more emphasis on landscape, historical and cultural aspects of the countryside
- the range of information to be collected in field surveys
- coverage of issues relating to quality of the countryside
- scope for enhanced census data on land cover
- methods of analysing botanical data

For reasons of scope and remit, compatibility with earlier surveys, and cost, it was not possible to satisfy all of the recommendations in the planning stages of CS2000. Those that were addressed are considered in the following section.

1.1.4 The changing policy agenda

The Haines-Young/Swanwick policy review was published in 1995. In the preparation for CS2000 (during 1997 and 1998), further specific, policy-led prerequisites emerged. These included:

1. The need to base individual country estimates on 'native' squares

There was a strong feeling that the use of the ITE Land Classes as a sampling framework had some negative consequences in policy terms. The GB, national and regional estimates for each recorded attribute were derived from the mean values within a land class. These classes were based on underlying environmental variables and did not respect country borders. Thus, the mean value for the length of hedgerow in Land Class 13 for example, was calculated using the mean value from a sample of 1 km squares which had similar characteristics and lay in both England and Scotland; thus the estimate for Scotland was affected by the presence of hedgerows in England. Despite the scientific rationale of a GB-wide classification providing estimates with more statistical robustness (Howard *et al.*, 1998), the policy imperative was for independent country estimates, based on 'native' squares.

2. The requirement to report land cover by Biodiversity Action Plan (BAP) Broad Habitats

CS2000 was planned, and data collection commenced, at a time when the UK Biodiversity Action Plan (BAP) Broad Habitats were being defined (UK Biodiversity Steering Group, 1995) (Jackson, 2000). The BAP Broad Habitats provided a classification which covered all land types in the UK, with all classes being mutually exclusive. It made sense for the results of CS2000 to be presented in this reporting framework, with results by CS1990 reporting category nested within these where appropriate (e.g. the Arable and Horticulture Broad Habitat being sub-divided by crop type).

3. More robust estimates of stock and change in Broad Habitats

The Countryside Surveys were originally implemented to provide ecological information on widespread and more common features in the broader countryside. The sample-based field surveys are not targeted towards rarer features. The survey and quantification of rarer habitats has been the responsibility of the countryside agencies, and comprehensive census surveys have been possible e.g. lowland mesotrophic grasslands (Blackstock *et al.*, 1999).

Although the CS methodology is more suited to providing data on widespread features, opportunities to increase the number of habitats and features that can be reported with confidence have been requested.

4. Using Countryside Survey as a vehicle for monitoring Biodiversity Action Plan targets

During the planning stages of CS2000, organisations responsible for some of the UK Biodiversity Action Plans recognised an opportunity to use the survey as a way of establishing baselines for monitoring progress towards targets defined within the plans. In

particular, the then Ministry of Agriculture, Fisheries and Food (now part of the Department of the Environment, Food and the Rural Environment – DEFRA) wanted to gather baseline information which would help in the monitoring of species-rich hedgerows and cereal field margins, both of which were recognised as potentially important sources of biodiversity in the wider countryside.

5. Reporting results

CS1990 used aggregations of the ITE Land Classes into four 'landscape types' as a reporting framework. Thus results were presented for 'arable lowlands', 'pastural lowlands', 'marginal uplands' and 'true uplands'. The landscape types extended across GB. With the policy requirement for separate country estimates, based on native squares, there was a concurrent need to redefine the landscape types as the basis for reporting results.

Other aspects of reporting results that needed to be improved were the expression of statistical error and particularly, clearer information about the statistical significance of change statistics.

Lastly, it has been suggested that traditional reporting of research results in contract reports and journal papers should be supplemented by use of the World Wide Web.

Together with the recommendations from the CS1990 Policy Review, these requirements provided the challenge for developing the CS field survey methodology into a more policy-relevant tool.

1.2 SCIENCE CONTEXT

The Countryside Surveys fall directly within the science strategies and mission of both the Centre for Ecology and Hydrology, and its parent organisation, the Natural Environment Research Council.

1.2.1 NERC Mission

The mission of the Natural Environment Research Council is:

- **to promote and support**, by any means, high quality basic, strategic and applied research, **survey**, **long-term environmental monitoring** and related postgraduate training **in terrestrial**, marine and freshwater biology and Earth, atmospheric, hydrological, oceanographic and polar **sciences** and Earth observation;

- to advance knowledge and technology, and to provide services and trained scientists and engineers, which meet the needs of users and beneficiaries (including the agricultural, construction, fishing, forestry, hydrocarbons, minerals, process, remote sensing, water and other industries), thereby contributing to the economic competitiveness of the United Kingdom, the effectiveness of public services and policy and the quality of life;

- to provide advice on, disseminate knowledge and promote public understanding of the fields aforesaid.

Thus, surveys such as Countryside Survey, fall squarely within NERC's region of interest.

1.2.2 CEH Science Mission

The following is extracted from CEH's science strategy:

CEH Mission

- To advance knowledge in ecology, environmental microbiology, hydrology and virology through high quality, interdisciplinary research in support of the NERC Mission and international programmes.

- **To describe and understand the dynamics of terrestrial and freshwater ecosystems through integrated monitoring**, experimentation and modelling.

- To direct research towards predicting human impacts on the environment and generating potential solutions to improve quality of life.

- To enhance the United Kingdom's industrial competitiveness through technology transfer.

- To exploit the Centre's expertise and facilities to enhance research training in the UK and capacity building overseas.

- To secure and manage environmental data, and provide access to academia, governments, industry and the public.

- To promote public awareness and understanding through communication of the Centre's research.

Further, CEH has a Land Use Science Programme which has the following overall programme vision:

The overall, long term objective is to promote an integrated approach to land use science that is applicable to the wide range of user community needs.

The Programme has a number of themes:

- To promote an integrated approach to land use science that is applicable to the wide range of user community needs.

- To improve modelling and forecasting of the environmental impacts of future changes of land use, at a time of possible climatic change and of increasing human pressures.

- To use this information to develop frameworks for human utilisation of water and other natural resources and to ensure ecological sustainability in both industrialised and developing countries.

Specifically:

1 *Long term and large scale monitoring of land use*:
Applying the techniques for the collection, integration and provision of large scale data in order to support the decisions needed to deliver the sustainable use of land.

2 *Land use systems*:

To assess the hydrological, chemical and biological impacts within the aquatic, terrestrial and coastal zone environments of various land use options and changes from one land use type to another. To obtain a better understanding of these impacts on water and other natural resources (quantity and quality), through process and catchment studies.

3 *Management of ecosystems in tropical regions*:
To develop sustainable management strategies for forest and agricultural land in both the moist and dry tropics, through conducting relevant monitoring, experimental, modelling and dissemination programmes.

4 *Landscape function and modelling*:
The mathematical analysis of environmental and socio-economic systems to provide a basis for the integration of environmental and other criteria in land use planning and management.

The Countryside Surveys are seen as important science activities within NERC at all levels of the organisation.

1.3 OBJECTIVES

The field survey had the following objectives:

- to estimate the extent and distribution of widespread habitats in Great Britain;
- to characterise widespread habitats in terms of their land cover and botanical composition and to assess changes in these characteristics over time;
- to derive indicators of sustainable development for the wider countryside including measures relating to biodiversity, land cover/land use and landscape features;
- to provide accessible databases containing information about the state of the British countryside for use in a wide range of policy and scientific applications including the detection and forecasting of long term environmental change;
- to provide ground reference data for the calibration and validation of a satellite-based census of land cover 'Land Cover Map 2000'.

2 METHODS

2.1 Sampling the countryside

During the planning stages of Countryside Survey 2000 (CS2000), there has been consideration of sample numbers in connection with several of the component modules. This has involved re-assessment of the existing (CS1990) sample as well as the need for additional 1 km squares. A number of issues have arisen from an independent appraisal of CS1990 for policy purposes. These include:

- the effects of the changed ITE Land Classification.
- the need to produce separate reliable estimates of surveyed features for Scotland and England with Wales,
- the need to provide statistically reliable estimates of upland habitats in England and Wales.

2.1.1 Development of the ITE Land Classification

The new ITE Land Classification

As discussed above, the application of the new ITE Land Classification has resulted in some classes being under-represented. To correct this imbalance, a number of new squares have been included as part of CS2000; the details of how these are allocated are presented below, under 'Separate country estimates'.

Separate country estimates

In CS1990, 508 1 km squares were sampled in England, Scotland, Wales and the Isle of Man. The sample of squares was drawn at random from a grid of squares in the 32 ITE Land Classes. As described above, these classes were created using underlying environmental attributes and therefore crossed country (E, S & W) boundaries. Country estimates were derived from the mean characteristics of all squares in each class, irrespective of their country location.

A CS2000 Scoping Study[34] recommended that the sampling framework should be modified to enable reporting on 'country units', being (a) England with Wales and (b) Scotland, separately using only squares which lie in the country for which estimates are to be made.

The revised land class maps for England with Wales and for Scotland are shown as Figure 1.

2.1.2 Environmental Zones

In reporting the results of CS1990, it was recognised that presenting results at the level of the sampling strata (ITE Land Classes) was too complex. Accordingly, the ITE land Classes were aggregated into four 'Landscape Types'. In preparation for CS2000, it was no longer possible to retain the Landscape Types because of the new division of land classes at the England/Scotland border. However, potential users (and members of the CS2000 Advisory Group) recommended that any new aggregation should match the earlier structure as closely as possible, as well as having classes of similar size.

A system was devised which started by sub-dividing each of the Landscape Types into its Scottish and English/Welsh components. However, this resulted in some aggregated classes

being too small and so some further aggregation took place. This resulted in six 'Environmental Zones' in Great Britain as shown in Table 1 and Figure 1.

Table 1. The six Environmental Zones in Great Britain.

England & Wales	
EZ1	South & east lowlands
EZ2	North & west lowlands
EZ3	Uplands
Scotland	
EZ4	Lowlands
EZ5	Marginal uplands & islands
EZ6	Uplands

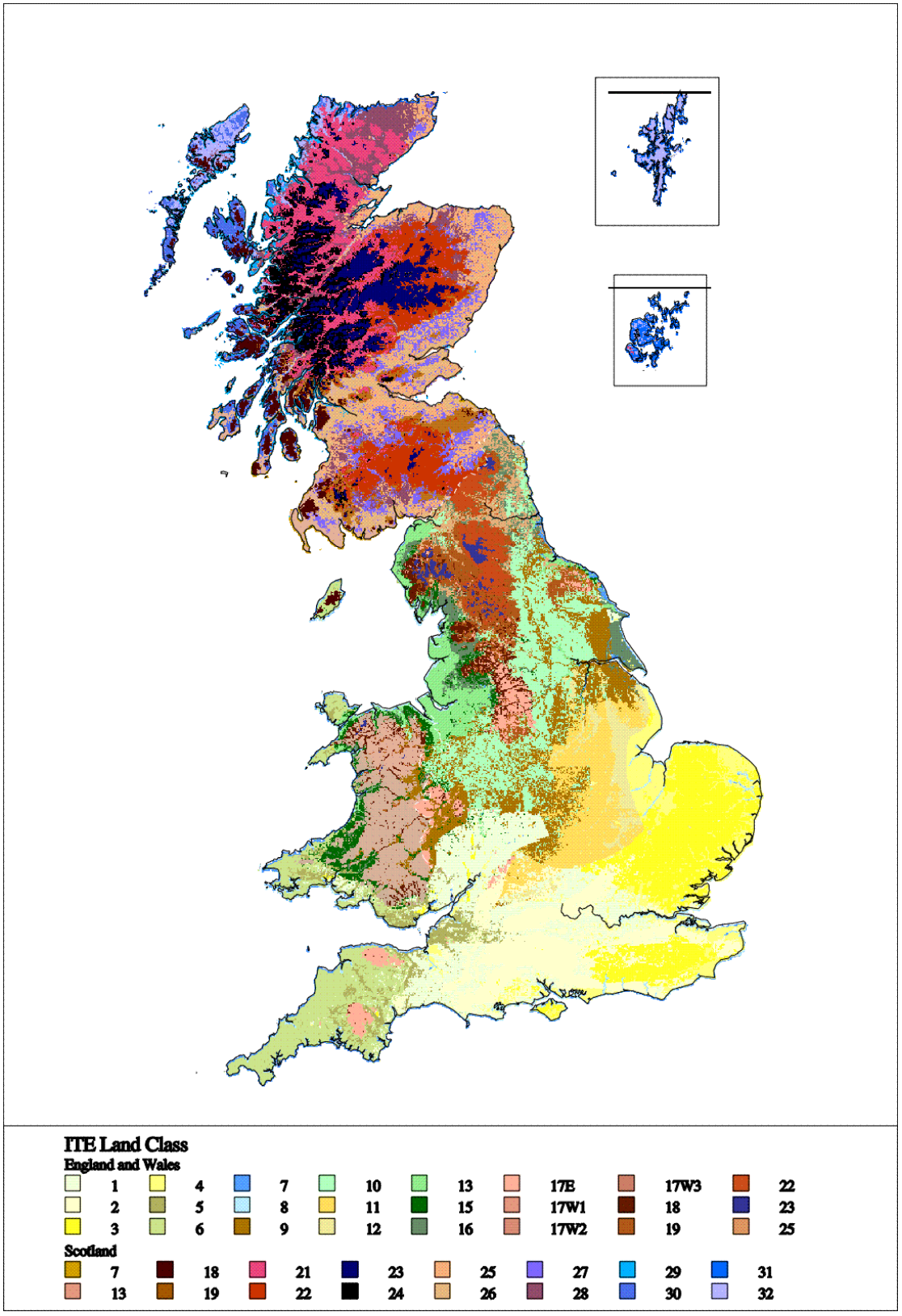
It should be noted that use of names for each zone is a convenient means of reference but can be misleading; thus, for example, not all of Environmental Zone 1 (EZ1) is in the south &and east of England (part of the zone occurs in east Wales), but the zone is predominately in the south and east.

The relationship with the earlier Landscape Types is shown in Table 2.

Table 2. Relationship between (CS2000) Environmental Zones and (CS1990) Landscape Types

	Landscape type (CS1990)			
Environmental zone (CS2000)	**Lowland arable**	**Lowland pastural**	**Marginal uplands**	**True uplands**
England/Wales				
1 (East lowlands)	*			
2 (West lowlands)		*		
3 (Uplands)			*	*
Scotland				
4 (Lowlands)	*	*		
5 (Marginal/islands)			*	
6 (True uplands)				*

Figure 1. ***Map of revised ITE Land Classes in 'England with Wales' and in Scotland – the sampling framework for CS2000***



2.1.3 Increase in sample size

The need for additional squares

The following changes have been made to the sampling framework:

- *class sub-division* - the ITE Land Classes have been sub-divided into the 'country unit' versions of the original classes,
- *class aggregation* - where this has resulted in there being very few squares of any particular class remaining in a country, then this 'rump' has been aggregated with a similar class in that country (the net effect of the class sub-divisions and aggregations is to create 37 strata, instead of the earlier 32),
- *additional squares* - to ensure that there is adequate representation of all new classes in each country unit, 19 additional squares have been allocated and this gives a minimum of 6 squares in each new class. To ensure relatively consistent sampling rates between England and Wales, a further 11 squares (5 in England and 6 in Wales) have been allocated,
- *Land Class 17* - Wales is dominated by Land Class 17 and to help refine the results reported for Wales, a sub-division of Land Class 17 has been carried out in Wales. In the allocation of any new squares in Wales (either detailed above or in any further options), representation of the new sub-classes has been respected.
- *Isle of Man* – the two sample squares in the IOM included in previous surveys so not contribute to estimates for 'country units' and are replaced by two new squares in England.

Survey of uplands in England and Wales

An additional module within CS2000, funded by DETR, MAFF, and WO/CCW, includes surveying an additional 30 squares which have been placed in ITE Land Classes which occur in the uplands and marginal uplands of England and Wales.

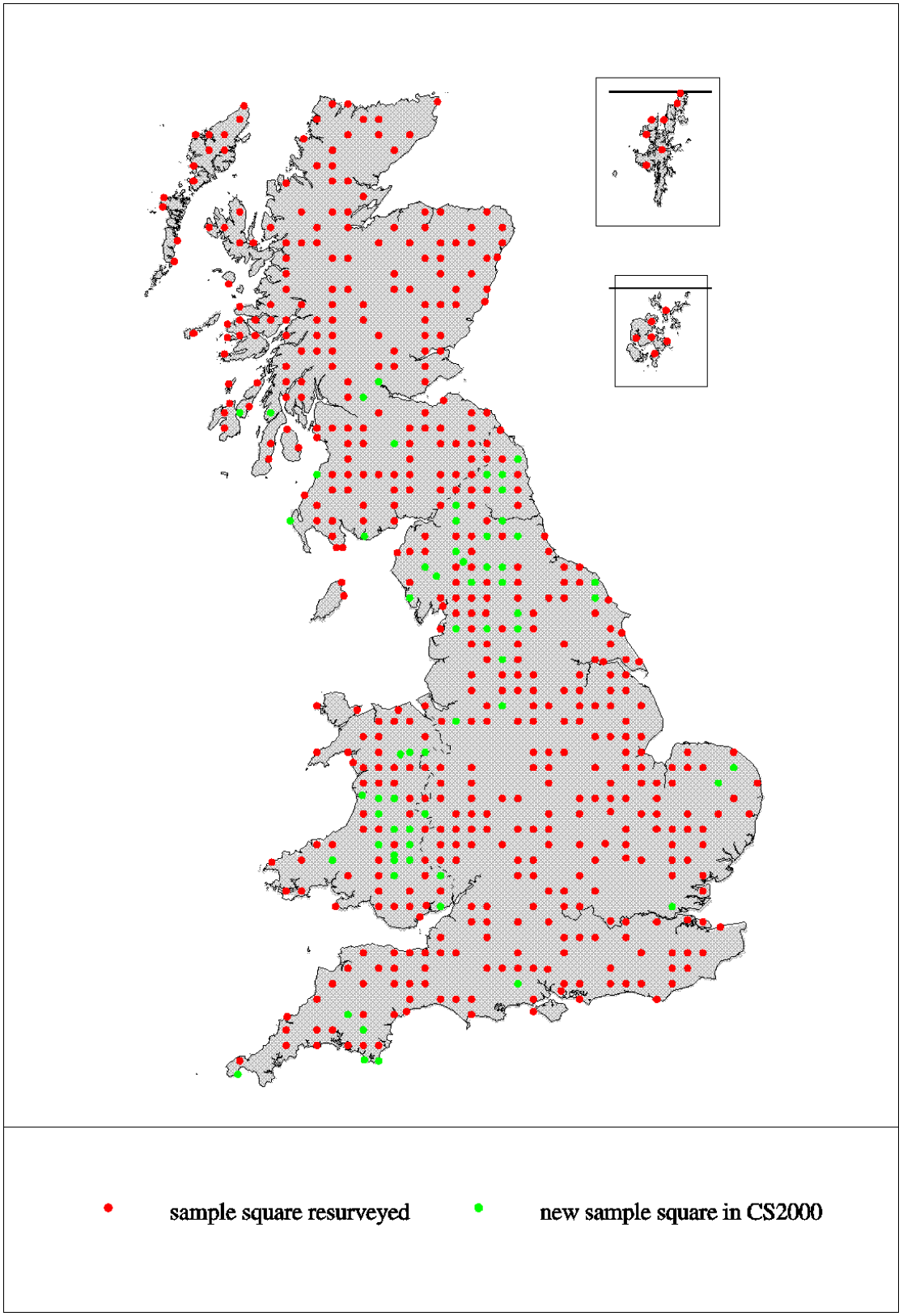
This will give better statistical accuracy to the estimates of habitats in the uplands of England and Wales which, due to the need to provide separate, country-based estimates, would otherwise be under-sampled.

The number of sample squares in CS2000 is shown in Table 3 and is their distribution is shown as a map in Figure 2.

Table 3. Summary of the numbers of squares surveyed as part of CS2000

New LC	No. squares in GB	Sample in 1990	Extra as part of Modules 1 & 4	No. squares in CS2000	Sampling rate (1:x)
England and Wales					
1e	14159	28	2	30	472
2e	14463	24	0	24	603
3e	15452	30	0	30	515
4e	9012	10	4	14	644
5e	3858	6	0	6	643
6e	10011	23	0	23	435
7e	2838	13	3	16	177
8e	4052	11	0	11	368
9e	11728	21	1	22	533
10e	13776	22	0	22	626
11e	8895	22	0	22	404
12e	3542	10	0	10	354
13e	5455	10	0	10	546
15e	3852	9	2	11	350
16e	4273	11	4	15	285
17e	3934	9	4	13	303
17w[1]	1941	3	2	5	388
17w[2]	4978	7	10	17	293
17w[3]	2082	8	0	8	260
18e	3009	8	4	12	251
19e	5677	9	10	19	299
22e	3308	6	5	11	301
23e	1082	5	1	6	180
25e	3205	6	2	8	401
Tot E & W	154582	311	54	365	424
Scotland					
7s	843	7	2	9	94
13s	2267	7	1	8	283
18s	3634	6	2	8	454
19s	3214	3	3	6	536
21s	9708	19	0	19	511
22s	9250	19	0	19	487
23s	6066	12	0	12	506
24s	7010	15	0	15	467
25s	8594	19	0	19	452
26s	5683	14	0	14	406
27s	5697	15	0	15	380
28s	6502	13	0	13	500
29s	5465	11	0	11	497
30s	4254	14	0	14	304
31s	3018	11	0	11	274
32s	3779	10	0	10	378
Tot Scot'	84984	195	8	203	419
Total GB	239566	506	62	568	422

Figure 2. Map of the CS2000 sample squares in England with Wales, and in Scotland



2.2 DATA RECORDING

2.2.1 Quality Control

An important lesson that has been learned from previous surveys is that variation in field recording is a major contributory factor when assessing the statistical accuracy of change data. It was therefore important that every attempt was made to standardise recording between observers and, during CS2000, quality control was undertaken in several ways to maintain consistency of approach. A thorough knowledge of a clear and informative Field Handbook is a vital prerequisite.

The purpose of the Handbook was to define the set of guidelines to be used during survey. Inevitably circumstances will arise which are not fully covered here; it is important that field recording should be as consistent as possible. An accompanying set of definitions is provided but, again, not every interpretation of a data item can be covered. Where atypical or doubtful categories arise, surveyors were instructed to qualify or comment on their choice of recording.

A number of other measures were introduced to ensure quality (Table 4). Although some of these (eg survey newsletter) may seem trivial, collectively these measures were very valuable in ensuring quality control.

Table 4 List of quality control measures implemented for CS2000

Pre-survey

- 1990 surveyors' recommendations
- Consultants' recommendations
- Internal appraisal document
- Qualified survey staff
- Field training course
- Field handbook
- Aerial photographic interpretation

During survey

- Mixing of survey teams
- Permanent plot marking
- Supervision/expertise at each CEH site
- Field supervision
- Desk-checks of recording sheets
- Newsletter

Post-survey

- Co-ordinators' feedback session
- Partial repeat survey
- External checking of data recording forms
- Checking of machine-readable data
- Policy Review

2.2.2 Quality Assurance

A partial re-survey of squares was undertaken to check on field recording accuracy (Prosser and Wallace, 2001 – LINK). The main findings were:

(i) for land cover, where direct comparisons are possible, agreement in recording primary field codes (see below) was about 88% between surveyors and assessors which was very similar to concordance levels found between the CS1990 survey and its QA.

(ii) for vegetation recording, there was an initial recording accuracy of 73%, only slightly lower than that found for the CS1990 survey (estimated at c.78%). The difference of 5% is exactly accounted for by the increase in species mis-matches due to errors in plot location by the surveyors. The circumstances of the 1990 and 1998 surveys were quite different. Plots used in Countryside Surveys prior to 1990 were not permanently marked and hence no estimate for the non-concordance due to errors of plot location could be arrived at in previous surveys. If the change in circumstances is taken into account, then the level of efficiency of species recording in 1998 is the same as that in 1990.

2.2.3 Field survey procedures

Overall management and logistics of the field survey

The field survey was programmed to take place between June and September 1998. The 569 sample squares were split up into six groups and were surveyed by teams from the six (former) ITE Research Stations. Thus, each team had about 95 squares to survey but this number varied from station to station. A coordinator was appointed at each site. Both existing CEH staff and short-term contract staff were used to carry out the survey (see above for details of quality assurance measures).

It was planned that each square would take about take four days to survey, on average, with the more inaccessible sites often being the easiest to record once reached. (This proved to be an under-estimate, especially given the extremely poor weather conditions that prevailed in 1998). The day-to-day working arrangements were in the hands of the Station Co-ordinators

To minimise variation between surveys due to seasonal differences, previously visited squares were surveyed in the same order as was done in 1990. New squares were surveyed at the same time as their nearest neighbours.

General field survey procedures

There were essentially two types of 1 km square to be surveyed in CS2000:
1. 'repeat' squares (that have been visited as part of earlier surveys), and
2. 'new' squares (that have not been visited before).

An important principle of field recording was introduced in CS2000, determined after pre-survey pilot trials. Whereas in earlier surveys, the emphasis had been on making independent records of the stock of features at each survey date, and then computing any changes in these, CS2000 saw a concentration on recording change itself. Thus, when mapping information in 'repeat' squares the emphasis was on recording any changes that surveyors were able to detect through comparison with previous records (1990). In new squares, the recording the stock of everything present within the square, was completed, as in earlier surveys.

In vegetation plots (see 2.2.5), species were recorded 'blind' (ie with no reference to earlier data) in both types of square.

All survey work was carried out with the knowledge and consent of the landowner, farmer, or the agent of one or both (collectively referred to as the landowner hereafter). By way of an introduction, letters were sent to all known landowners saying that the survey was taking place and asking them to expect a visit from CEH surveyors. Letters were also sent to the

Headquarters of all organisations which were likely to have interests in land or landowners interests (eg NFU, CLA, NT, FC, etc). Letters notwithstanding, survey teams were also required to call on the day to confirm that they were in the area and confirm that the arrangements for survey were satisfactory. Copies of a handout, containing a brief explanation of this survey, were available to all survey teams for distribution as appropriate.

A list of known names and addresses from previous surveys, updated using a commercial address package, was available and surveyors were asked to further update and supplement this list.

Where permission to access land was refused, the following procedures were adopted:

a) if access was denied to all parts of a square, then all attempts at field recording were abandoned and reports made to the Station Co-ordinator as soon as possible (a replacement square was then drawn at random).

b) if access was denied to any part of the square, then:

   i. if an 'repeat' square, then the rest of the square was surveyed,

   ii. if a 'new' square, then survey was abandoned as in a) above, unless the area concerned was easily surveyed from neighbouring land.

c) if permission was refused for a vegetation plot then a note was made and the plot repositioned using guidelines given to surveyors.

d) every attempt was made to contact farmers rather than their staff; where appropriate, advice was taken on who else might be informed of the survey as a matter of courtesy, eg anglers, shooting syndicates, grazing clerks.

General data recording

The field survey component of Countryside Survey 2000 has four basic elements:

- mapping land cover, landscape features and field boundaries
- recording vegetation.
- collecting freshwater biota samples and carrying out River Habitat Surveys (see CS2000 Module 2 reports - LINK).
- Collecting soil samples (see CS2000 Module 6 reports - LINK).

This report covers the first two of these activities.

All data recording sheets were held in a 'Field Assessment Booklet' or FAB.

2.2.4 Mapping land cover, landscape features and field boundaries

Background to mapping

The most geographically comprehensive element of the survey was basically a mapping exercise. Surveyors were asked to annotate a series of enlarged 6" (1:10,000) maps with a variety of information. Wherever possible, this information was formatted according to the list of options available, but occasionally it was necessary to add other categories to the list.

The objectives of CS2000 required three basic refinements to earlier methodology:

(i) mapping change only
(ii) reporting land cover change by Broad Habitats, as well as by Countryside Survey reporting categories.
(iii) focusing on plot-level information to detail change in those habitats which were characteristic of more upland, unenclosed landscapes

Mapping change only

For the first time in the series of Countryside Surveys, surveyors were provided with data from earlier surveys and instructed to map only change in land cover and landscape features. In previous surveys, independent estimates of what was present were compared to generate change statistics but there has been some difficulty in distinguishing genuine changes and differences between observers.

This means that there were two types of mapping to be done:
(i) mapping *de novo* in new squares (as was done in CS1990), and
(ii) mapping change only in repeat squares.

Descriptions of the methods used for both types of mapping are given below (see ###).

Reporting by 'widespread habitats'

To meet some of the monitoring and reporting requirements of the UK Biodiversity Action Plans, the results from CS2000 were presented according to an agreed framework based on 'Broad Habitats'. Work done with CS1990 data suggest that the reporting framework used to date can be translated to give widespread 'Broad Habitats'. The only exception was the 'montane' category which was not recognised in earlier surveys and which was difficult to translate from earlier land cover codes.

Using more plots in Broad Habitats characteristic of upland, unenclosed landscapes

After examination of the CS1990 and subsequent follow-up pilot studies, CEH reached the conclusion that there were spatial limitations in the mapping of those habitats which were characteristically found in more upland, unenclosed landscapes – they tend not to have regular, easily mapped boundaries, often forming gradients between two or more relatively homogeneous land cover types and often consisting of mosaics. CEH believed that while the mapping done to date gives reasonable estimates of extent of these habitats, the spatial inaccuracies in their recording mean that change is detected less reliably by overlaying independently recorded maps.

In addition, CS2000 used the existing plot information to say something about changes in these habitats, and laid down a baseline of additional plots to allow more comprehensive monitoring of change in future surveys. To this end, up to ten extra plots were placed in unenclosed areas of the square.

Mapping in new squares (CS1990 methodology)

Surveyors were provided with a list of standard codes which were used in combination to describe each feature (area, line or point) in the square. In order to give as much information as possible about each area of land or landscape feature, an alpha code was used on the map to represent a series of numeric codes. This was designed to save space in marking up the map but allow a comprehensive description to be given. To enable this form of coding, boxes were provided on each data recording form, which enable a series of numeric codes to be combined and represented by a single alpha character. For instance a particular length of boundary might be coded with a letter "A". In the boxes at the foot of the recording form "A" might be recorded as being a combination of codes 321, 342, 346, 351, 353, 357, 361, 374, 385 where:

321 = Hawthorn hedge; 342 = 1-2 m high; 346 = Trimmed both sides, 351 = stockproof; 353 = gaps filled along <10% length; 357 = hedge trimmed; 361 = laying, 374 = Box-shaped, 385 = Type C2 (Middle-aged trimmed), 34

There were two types of code: primary and secondary. All features were annotated with at least one primary code. In general, the use of more than one primary code was avoided. However, where more than one primary code had to be used (eg land cover mosaics or multiple land use) then the code reflecting the dominant use was used first.

In some cases, there was no code which adequately describes a feature. In these cases, surveyors used a new code number between 601 and 699 and wrote the new code and a description of the feature on the 'Surveyor-created codes recording sheet'. This 'unique' code only applied to a feature in one particular square so that the number 602 might be used to describe a wind turbine, for example, in one square and might be used to describe a type of quarry in another square. In general, the use of unique codes was discouraged and surveyors were asked to use standard codes wherever possible.

Codes were used in an order which linked the information logically eg a cover code always followed a species code.

Boundaries on the maps were clearly marked, whether actual boundaries such as fences, or interpreted ones, between two moorland vegetation types for instance. Boundaries shown on the OS map which no longer existed on the ground were marked with the universal code 999 (no longer present). When annotating different boundary types then each length was clearly defined at each end with a short line drawn perpendicular to the line of the boundary (except where an obvious boundary junction serves to demarcate the end of a unit).

The minimum mappable area was 1/25th ha (400m2), provided that the feature measured at least 5m in all directions (otherwise it was a length and marked with a line). No vegetation (except Bracken) was mapped as a separate unit unless it comprised this area. The minimum mappable length was 20 m (1/50th km). These units were shown on the data sheets.

Some features which were not on the agricultural/natural vegetation page of the FAB (and bracken) was marked using a cross (X). Such features might include, for example, an isolated tree, a well, or a caravan.

Aerial photographs

For nearly all sites, aerial photographs (APs) were available for use in the field by surveyors. In 1990, a restricted aerial photograph interpretation (API) exercise was undertaken; there was no attempt to interpret the land cover types or to categorise any feature. The work was carried out with the following objectives in mind:

a) to assist in the identification of features which were not generally included on OS maps (such as isolated trees)
b) to indicate 'boundaries' between different semi-natural vegetation types
c) to update OS maps, eg for new buildings, roads etc

The API was found to be helpful in only some circumstances and has not been repeated in CS2000. However, the conventions and symbolic representations that were adopted during the 1990 work were learned and used by CS2000 surveyors for guidance:

a) on copies of maps to be used for annotation by surveyors, all contour lines, place names and other non-essential information were removed from the 1:10,000 maps.
b) any boundary that has been identified through API was marked onto the map using dashed lines - these were for guidance only and were subordinate to the surveyors judgement on the ground.
c) any isolated/individual feature was marked as a cross (these were usually trees)
d) any boundary that was apparently identified as 'no longer present' was marked with a diamond on the line and arrows mark the extent of the feature.

Filling in the FAB

For each square, the data recording forms, together with their enlarged 1:10,000 maps, were combined into a booklet which, for historical reasons, was known as a Field Assessment Booklet (FAB). Field recording in FAB was done on 5 separate thematic sheets (see below). The order of the pages in the booklet was not significant.

There were several general points about filling in the FABs:

1. The square series number was recorded on every page.
2. Where possible, a pencil was used - mistakes could then be erased and waterproofing was enhanced.
3. In recording semi-natural vegetation and certain other complex situations, the surveyor was asked to map recognisably different, yet mappable units. As a rule, an area was mapped separately from another if any descriptive code applies in one case but not in the other. The units were therefore decided by the definitions of the codes which characterise them.
4. This may mean that a mosaic was recorded in a comparatively large unit, the proportions of the components being reflected in the primary 'cover codes'. In these situations, the surveyor used the primary code which most closely fits the majority of the ground cover.
5. Where it was impossible to choose a single primary code, then the dominant one was recorded first in a list of codes. For example an area of *Molinia*/Heather moorland might be recorded as 103/175/163/176/106/175/161/180/189 where:
   103 = Moorland - grass 175 = 25-50% (ie 25-50% of the mapped area was moorland grass) 163 = *Molinia caerulea*; 176 = 50-75% (ie 50-75% of the moorland grass was *Molinia*)
   104 = Moorland - shrub heath 175 = 25-50% (ie 25-50% of the mapped area was moorland shrub heath) 161 = *Calluna vulgaris*; 175 = 25-50% (ie 25-50% of the shrub heath was *Calluna*) 180 = <30cm (ie the *Calluna* was <30cm high on average)
   189 = Sheep (ie the whole area was grazed by sheep)

6. Point information (such as the presence of a hedgerow tree) was marked with an X, distinguishing them from lines (such as a row of trees) and areas, delimited by a boundary.
7. If an area became too complex to record using code numbers (especially in built-up areas) then coloured pens were used, showing which codes were represented by each colour in the boxes.
8. Dotted lines after a category were intended to invite further information e.g. what type of quarry/mine or what sort of race track.

Recorded information

The front cover of the FAB required the surveyors to record: the ITE Series number of the square; the Grid reference; a general location; relevant 1:50,000 Sheet Number; Date surveyed (start); Date surveyed (finish); Total number of days to survey; Surveyors names.

As explained previously, permission were obtained to access all parts of the square. During this exercise, the ownership of all parts of the square was established in detail and marked on the map. All the land units (e.g. fields) belonging to owner number 1 was marked with a "1", those belonging to number 2 with a "2" etc. As far as possible the exact address and telephone number of each owner or tenant was recorded. Expressions of interest by farmers/landowners were noted with a view to sending copies of recorded information in due course.

Physiography/Inland Water/Coastal features

These features were a mix of 'natural' features of the land surface and some human artefacts. The code numbers used, and notes about some of these, are given in Appendix #. The following points should be noted:

- Coastal features were only mapped above Mean High Water Mark in CS1990.
- Inland water features were recorded and mapped whether they were dry at the time of survey or not.
- River/Stream banks - two codes was used for each length of watercourse, one for each side. Record the Right-hand bank first, as seen looking downstream.

Agriculture/Natural vegetation

This includes most of the ground cover types in GB except urban and woodland. The first section, cover types, includes categories which was qualified by the other codes, such as species, use or measurements. The following points should be noted:

- These cover types were not used in built-up areas. Once a curtilage had been recognised, then all land within the curtilage was to be recorded according to the Build up land categories. Hence an orchard in a residential garden was not to be recorded on this sheet.
- Types of grassland were notoriously difficult to distinguish, especially since their species composition and general appearance was decided by management practices, rather than origin, history or use. Hence the primary codes were limited but there were several general descriptive codes, as well as species codes, by which such areas could be described.
- Bracken was treated differently to other categories. Even where bracken occurs in smaller areas than a minimum mappable unit, details was recorded using a cross (X) to mark its location.
- Major agricultural grasses and semi-natural ground cover species (which were listed according to a gradient from rich to poor land) were recorded if they covered 25% or

more of a mapped unit, irrespective of the number of canopies present (ie total cover can reach more than 100%).

- Height class codes were used with Heather (but not with Bracken as was done in 1990) and reflected the average height of the stand being mapped

Forestry/Woodland/Trees

The codes from the woodland sheet was used to describe each 'woodland unit' (ranging from a single sapling to a forestry plantation) and every combination of codes contained at least one primary code. Features from other pages of the FAB were not recorded within woodland, unless they were above a minimum mappable unit in size (ie exceeding 1/25th ha), and excepting bracken. The following points should be noted:

- Trees/scrub was recorded in any situation except inside the curtilages of buildings or communication routes (e.g. roads, railways) or as individuals or lines immediately adjacent to non-agricultural curtilages. Trees was recorded from all recreation land such as golf courses and playing fields (except in urban situations). The double use of land was recorded eg individual trees growing in farmland, or sheep in an abandoned orchard.
- All occurrences of trees were allocated to one of the primary codes (using a specially developed key – see Appendix) and qualified by secondary codes - if any one area of trees included distinct variation in age or species composition, then the unit was sub-divided into blocks and coded separately.
- The species of tree was recorded with one of the cover types if it constituted more than 25% of the canopy. It was not necessary to qualify "unspecified conifer" or "unspecified broadleaf" with a species name. The mixed category codes was used in the same way, ie when >25% of the canopy was mixed.
- The percentage cover of the dominant canopy layer, as if viewed from above. No more than three codes was used to describe any one feature.
- Age was used in conjunction with any of the primary codes (individuals, lines or areas of shrubs or trees) and, in the case of areas and lines, referred to the average age of the species making up the top canopy. Guidance on age recognition was given.
- The use of the tree feature was only used for an area of trees (ie not individuals or lines). It can be extremely difficult to decide the use and many woodlands, especially broadleaved, appear to have no particular use. These were left un-coded in terms of use.

Boundaries

All boundaries were recorded unless they formed part of a curtilage or they were within the canopy of a woodland (except that boundaries of woodlands were recorded). Where several boundary elements ran contiguously (eg hedge with a fence on a bank), then the total boundary feature was coded as a single feature, but using separate codes to describe each element of the boundary. In these cases, the most complete (stockproof) element of the boundary was coded first. The following points should be noted:

- New boundaries was drawn on the map as accurately as possible, using existing features for reference, as well as making full use of measuring tapes and compasses. Bearings were taken from the centre of the plot and, as in previous surveys, bearings were given for magnetic north and not corrected for magnetic deviation.
- A combination of primary codes was used where appropriate. In these cases, the most complete (stockproof) element was recorded first eg:

  C. 313 (fence), 351 (stockproof), 343 (< 1 metre), 321 (hedge), 352 (not stockproof), 341 (> 2 metres), 359 (overgrown), 332 (bank), 343 (< 1 metre).

  or

D. 323 (hedge), 351 (stockproof), 342 (< 2 metres), 357 (trimmed), 362 (flailing), 313 (fence), 352 (not stockproof), 343 (< 1 metre).

- Where there were two or more stockproof elements, the order of elements was not important but each element were coded separately eg:
  E. 301 (wall), 351 (stockproof), 342 (< 2 metres), 321 (hedge), 352 (stockproof), 342 (< 1 metres), 357 (trimmed) etc..
- If none of the individual elements of a boundary was stockproof, but collectively they made a stockproof boundary, then code 351 was placed at the end of the string in brackets (351).
- The condition of walls was recorded using the former Countryside Commission classification (see Annex 1).
- A hedge was defined as a more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape. When hedge management was abandoned and the overall natural shape of the component tree species was regained, or when the bottom 2m (or less) of the feature was not more or less continuous, then the feature was no longer described as a hedge (and was recorded as, for example, a scattered line of shrubs or trees).
- The shape of hedges was coded using a standard classification (see Appendix #). These codes was used where trimming (usually in the past two years) has resulted in a particular shape of hedge. If only one side has been trimmed (ie not the top or the other side) then use code 358 (uncut) but if one side and the top has been trimmed, then use one of the following codes.

Buildings/Structures/Communications

These features comprised built structures and routes of communication. The following points should be noted:

- A curtilage was an area of ground that was associated with a building and which has a use linked with that building eg gardens, 'grounds', forecourts etc.
- Features which were immediately adjacent to a non-agricultural curtilage (except roads) were not be recorded on other FAB pages. Similarly no information from other FAB pages was recorded within a curtilage (except trees).
- Road verges were coded separately for each side of the road so that two numeric codes was used to describe the verges for the length of road concerned (even if they were the same). Verges were mapped adjacent to constructed tracks, as well as tarmac roads.

Recreation

Recreation features were recorded whether they were from formal recreation areas (eg areas of land specifically set aside for recreational purposes, such as football pitches) or more informal, non-designated features (eg denoted by the presence of signs or information boards, such as canal fishing).

Universal codes

Surveyors were also required to code features in relation to their representation on the thematic map provided. Features which were 'new to map' (ie since the map was published) were coded, as were features which were no longer present. In addition, surveyors were asked to validate any change that they recorded by categorising as 'Perceived as genuine change' or 'Probable mis-recording in earlier surveys'.

Mapping change in 'repeat' squares (1998 methods)

As stated above, for the first time in the Countryside Survey series, CS2000 focussed on recording change., Previous surveys had recorded information independently without reference to the earlier data; comparisons between datasets collected in different years were made post-survey. Obviously, this approach was only possible in squares that have been recorded previously.

The rational behind this development in methodology is discussed earlier (see ##). The CS1990 results and subsequent follow-up pilot studies suggest that mapping habitats which were characteristically found in more upland, unenclosed landscapes produces more variable results. To improve the detection of real change, these unenclosed habitats were mapped in a fundamentally different way than those characteristic of enclosed, lowland landscapes. The former were mapped using CS1990 level coding and were known as *Generally enclosed Broad Habitats* whereas the latter were only mapped at the Broad Habitat level and had additional vegetation plots recorded within them – these were known as *Generally unenclosed Broad Habitats*.

The list of *Generally enclosed* and *Generally unenclosed* Broad Habitats was shown in Table 5:

Table 5. List of 'generally enclosed' and generally unenclosed' Broad Habitats.

'Generally enclosed'	'Generally unenclosed'
1 Broadleaved, mixed and yew woodland	
2 Coniferous woodland	
3 Boundary and linear features	
4 Arable and horticulture	
5 Improved grassland	
6 Neutral grassland	
	7 Calcareous grassland
	8 Acid grassland
	9 Bracken
	10 Dwarf shrub heath
	11 Fen, marsh, and swamp
	12 Bog
13 Standing open water and canals	
14 Rivers and streams	
	15 Montane habitats
	18 Supra-littoral rock
	19 Supra-littoral sediment
	26 Inland rock
27 Built up areas and gardens	

Mapping change in Generally Enclosed Broad Habitats which were characteristic of lowland, enclosed landscapes

Generally enclosed Broad Habitats that were characteristic of lowland, enclosed landscapes, were left blank on base map (in contrast to generally unenclosed areas – see below). All land cover recording in these areas related to CS1990 methodology and codes (with translation to Broad Habitat categories being done as part of the subsequent analysis (see 2.4.1).

Each feature described in 1990 was shown on a relevant base map, according to its general theme, and marked with a unique code number. The code number matched those already

printed on a separate data recording form (together with the codes that were used to describe the feature in 1990).

Information for each mapping theme (physiography, agriculture/semi-natural vegetation, forestry/ woodlands and trees, boundaries, buildings/structures and communications) was recorded on a separate Data recording form. Examples of Data recording sheet are presented in section 2.3.2 Map attribute data entry. Each Data recording form has different columns reflecting the types of codes to be used for that theme. However, the first four columns were common to all forms:

- Parcel number: this was the unique number (within each square) which linked the features on the Theme map with the codes printed on the Data recording form.
- New Parcel Number: this column was blank and had two functions:
  (i) where a change had taken place that was so radically different to the previous coded description, this column allowed the surveyor to give a new number to the feature and create a new row of codes at the bottom of the Data recording form. Effectively, it allowed re-numbering of a feature. The convention for re-numbering was to precede the new number with an initial letter indicating the theme in question (P#, A#, F#, B#, S#).
  (ii) where a new feature was to be recorded, then this column allowed the surveyor to give a new number to the feature and create a new row of codes. The convention for re-numbering was as above (P#, A#, F#, B#, S#).
- CS1990 Parcel Code: this column gave an alphabetic code which linked the feature being described on the Data recording form to the photocopied CS1990 recording form (FAB).
- Primary Code: this column gave the CS1990 Primary Code, as held in the database, for the feature.

Other columns included descriptive codes for the feature concerned, together with blank columns to allow changes to be recorded. Surveyors were required to decide if there was any change since 1990, in terms of any of the codes used:

- if there was no change, then the surveyors ticked the box next to each given code on the Data recording form, ticked the relevant polygon on the Theme map (to show that it has been completed) and moved on.
- where the given code was no longer appropriate for the feature, then:
  (i) if a different code was appropriate, then the new code was entered into the box next to the old code.
  (ii) if it was believed that the given code was incorrect (e.g. recorded incorrectly by a 1990 surveyor), then the new code was entered into the box next to the old code and the old, incorrect code was circled.
  (iii) if the code was no longer appropriate and needs to be removed from the Data recording form without being replaced, then a cross (X) was entered in the box next to the old code.
  (iv) if the above (iii) was true but it was believed that the old code was incorrect, then a cross was entered in the adjacent box and the old code was to be circled (see Parcel number 129 in following example).
- where the feature has changed so radically that it was quicker, clearer or otherwise necessary to give a new coded description on a new line, then:
  (i) if the feature being described was still the same in terms of its mapped extent (ie no change in area, length etc), then a new row was completed at the foot of the Data recording form (or on a new, blank Data recording form). First, a cross was entered in the *New Parcel Number* column, next to the parcel number in the original row. Then, the original parcel number was entered into the *Parcel Number*

column in the new row. The remaining columns in the new row was completed with appropriate codes.

(ii) if the feature being described had changed in terms of its mapped extent and had sub-divided (ie become several features), then:
   (a) if one of the new subdivisions can be coded in the same way as in 1990, then the original row on the Data recording form was used to describe that part of the old feature, and one or more new rows were created for the new part(s) of the feature (which also need to be shown on the Theme map).
   (b) if none of the new subdivisions was the same as in 1990, then a cross was entered in the *New Parcel Number* column, next to the parcel number in the original row.
   In both cases, in the new row, a new Parcel number (prefixed by the appropriate alpha code) was entered into the *New Parcel Number* column and the original parcel code entered into the *Parcel Number* column. The rest of the row was then completed with appropriate codes.

(iii) if the feature being described has changed in terms of its mapped extent because several features have become amalgamated, and can be described using the same codes, then a single new code (with alpha prefix) can be placed in the *New Parcel Number* column of each of the old rows, and a new row created to describe the single new parcel code.

- any new feature was marked/drawn (with an identifying number, including alpha prefix) on the Theme map, and it's descriptive codes entered into spare boxes at the bottom of the Data recording form.

The success of this approach depended on surveyors being realistic about whether change had genuinely taken place (or, indeed, whether a mistake was made in the 1990 recording). It was believed that change was most easily detected in the field and not by comparing two independent estimates 'back in the lab'. Good training and quality control were vital in this respect.

Ponds

In those squares that were part of the Lowland Pond Survey 1996, CS2000 surveyors took information on the location of ponds (as determined by the earlier survey) into the field. These squares were those lowland squares in GB which had ponds recorded in 1990 and a handful of 'non-pond' squares. Surveyors checked that all ponds, in upland or lowland Britain were recorded and noted changes from 1990 (using the 1996 map where appropriate). The Lowland Pond Survey definition of ponds was checked carefully as it has changed from that used in 1990.

Mapping *Generally Unenclosed Broad Habitats* in generally upland, unenclosed landscapes

The mapping of Generally Unenclosed Broad Habitats was at the Broad Habitat level (ie at a coarser scale than using CS codes) for the agriculture/ semi natural theme map. Features from all other pages of the FAB were mapped as for Generally Enclosed Broad Habitats. Time saved in this cut-down mapping methodology was used to establish extra vegetation plots (see Section 2.2.5) as a baseline for monitoring more detailed change in future surveys.

Mapping change in areas of Generally Unenclosed Broad Habitats shown on the agriculture page of the FAB

To map area change in Generally Unenclosed Broad Habitats, surveyors were provided with a map of Broad Habitats (translated from 1990 CS codes) and annotated it with their observations in 1998:

- If there was no change, then the surveyor ticked the polygon on the Broad Habitat map to show that the area has been assessed,
- if there was a change, then
  - (i) If the change was from one Generally Unenclosed Broad Habitat type to another Generally Unenclosed Broad Habitat type, and the extent of the feature was unchanged, then the area was marked with the appropriate new Broad Habitat code on the Broad Habitat map only.
  - (ii) If the change was from one Generally Unenclosed Broad Habitat type to another Generally Unenclosed Broad Habitat, and the extent of the feature had changed, then the surveyor allocated a number to the new parcel (unique to the square and prefaced by the theme letter - P, A, F, B or S), marked this on the Broad Habitat map and then completed a new row in the relevant Data recording forms, writing the new Broad Habitat type in the *New Broad Habitat Code* column.
  - (iii) If the change was from a Generally Enclosed Broad Habitat to a Generally Unenclosed Broad Habitat, and the extent remained the same, then this was indicated on the relevant row in the Data Recording Form by putting a cross against the previous parcel code and entering a new Broad Habitat code in the relevant column.
  - (iv) If the change was from a Generally Enclosed Broad Habitat to a Generally Unenclosed Broad Habitat, but the extent has changed, then the surveyor (a) for that part of the original parcel that was still mappable, completed the relevant row in the Data recording form and (b) allocated to the new parcel a number (unique to the square and prefaced by the theme letter - P, A, F, B or S), marked this on the Broad Habitat map and then completed a new row in the Data recording forms, writing the new Broad Habitat type in the *New Broad Habitat Code* column.
  - (v) If the change was from a Generally Unenclosed Broad Habitat to a Generally Enclosed Broad Habitat, then the surveyor (a) marked the appropriate area on the Broad Habitat Map and marked a new code (prefaced by the theme letter - P, A, F, B or S) and (b) created a new line in the relevant Data recording form, using the new identifier code and then a full set of descriptive.
- If there was a change which resulted in a new mosaic, with one component being a Generally Unenclosed Broad Habitat, then this was indicated in the *New Broad Habitat Code* column, using successive rows where two or more code would not fit in a single cell. Where the new feature was a mosaic of Plottable and Generally Enclosed Broad Habitats, then the relevant Broad Habitat code was shown for the Generally Unenclosed Broad Habitat and a primary code was used for the Generally Enclosed Broad Habitat.

The following points should also be noted:

- all mosaics involving a Generally Unenclosed Broad Habitat, were treated as a Generally Unenclosed Broad Habitat and extra U plots (see below) were recorded.
- If there was an additional area of Generally Unenclosed Broad Habitat, then this was drawn on the Broad Habitat map, and then coded in as if a change had taken place (above).

Broad Habitat identification

To identify whether change has taken place, surveyors need to be able to recognise the broad habitats. Guidelines on the identification were provided by JNCC and a key was constructed (see Annex 1) which allowed surveyors to identify Broad Habitats reasonably consistently. (Note: the translation from CS1990 codes to the Montane Broad Habitat was not possible for and so this type was mapped *de novo* in 1998, in all squares in which it occurred.

2.2.5 Recording vegetation

Vegetation recording in plots

In 1977/8, as part of the first ITE national sample survey, detailed information on plant species was collected from c. 2,500 plots and linear plots adjacent to some features (hedges, roads and streams). In 1990, the same plots were resurveyed again (as part of a monitoring programme looking at changes in the quality of land cover types, as well as overall changes taking place) and, additionally, a greatly expanded baseline of new plots was established so that a total of c. 11,500 plots was permanently marked, in 508 squares.

In 1998, the previously established plots were relocated (using metal plate detectors, ground-based photographs and field-plans) and recorded. A further new baseline of plots, in certain situations, was also established. All plots in upland or unenclosed situations were also marked using Geographical Positioning Systems (GPS) for the first time.

Method of recording vegetation

The survey requires recording from different sizes of vegetation plot and fuller descriptions of each are given below. However, the basic recording procedure was the same for all types of plot (except hedgerow diversity plots – see 2.2.5) and a standardised recording sheet has been devised (Figure 3). It has the following sections:

(a) Header - information on the broad environmental and management attributes of the plot was recorded, according to the parameters listed.

b) Listed species - the main part of the form was taken up with a list of 200 common species of plants (herbs, grasses, bryophytes). Where any of these was present, then the species name was ticked and, when appropriate, the number of nested plot recorded. On completion of recording, the estimated cover % was written against each species, using 5% cover categories.

c) Unlisted species - a space remained at the foot of the form in which was recorded the names, nested plot number, and cover %, for any other species which were not listed (using Latin names in general, but English/Common names were used for agricultural crops). (The species list from most plots was largely made up from the species already listed on the recording form with < 10% having to be added.)

In all cases a sketch was included on the back of the recording sheet which showed the position of the plot and all relevant measurements and angles, as described below. All vascular plants were recorded, together with a restricted list of bryophytes and lichens. Species which cannot be easily identified in the field were collected and pressed for later identification. Mosses/lichens growing on rocks/trees were ignored.

Figure 3. ***Standard Recording sheet***

Square

200m2 (large) QUADRAT **X1**

Land use	Physiography	Slope	Aspect	Shade	Grazing
		flat slight moderate steep		none partial full	rabbits stock horses deer

Comments :

	Q	%	%		Q	%	%		Q	%	%		Q	%	%		Q	%	%
Bare ground				153 Erio vag				118 Crat mon				311 Ping vul				446 Trif dub			
213 Barley				228 Junc a/a				121 Crep sp.				315 Plan lan				448 Trif pra			
454 Wheat				230 Junc bul				590 Dact mac				316 Plan maj				449 Trif rep			
GRASSES				231 Junc con				132 Digi pur				324 Poly avi				841 Trip mar			
10 Agro can				232 Junc eff				136 Dros rot				328 Poly per				458 Ulex eur			
8 Agro rep				235 Junc squ				140 Empe nig				833 Poly vul				462 Urti dio			
11 Agro sto				260 Luzu c/m				141 Endy non				336 Pote ans				463 Vacc myr			
12 Agro ten				443 Tric cae				143 Epil hir				337 Pote ere				467 Vero arv			
20 Alop gen				***FERNS etc***				747 Epil mon				339 Pote rep				469 Vero cha			
21 Alop pra				41 Athy fil				144 Epil pal				342 Prim vul				471 Vero off			
28 Anth odo				53 Blec spi				150 Eric cin				343 Prun vul				472 Vero ser			
37 Arrh ela				137 Dryo dil				151 Eric tet				346 Prun spi				477 Vici sep			
562 Aven fat				138 Dryo fil				160 Euph sp.				350 Quer sp.				482 Viol pal			
5o Brac sy				147 Equi arv				168 Fili ulm				351 Ranu acr				849 Viol r/r			
58 Brom mol				348 Pter aqu				170 Frax exc				354 Ranu fic				490 Vero per			
61 Brom ste				***FORBS/WOODY Sp.***				177 Gali apa				355 Ranu fla				***MOSSES/LICHENS***			
123 Cyno cri				2 Acer pse				182 Gali pal				357 Ranu rep				850 Brac sp.			
124 Dact glo				4 Achi mil				183 Gali sax				370 Rosa sp.				512 Clad imp			
129 Desc ces				5 Achi pta				190 Gera mol				373 Rubu fru				106 Clad pyx			
130 Desc fle				18 Alli pet				193 Gera rob				375 Rum a'sa				513 Clad unc			
165 Fest ovi				26 Ange syl				195 Geum urb				376 Rum a'la				519 Dicr het			
166 Fest rub				29 Anth syl				197 Glec hed				837 Rume con				131 Dicr sco			
209 Holc lan				587 Arum mac				204 Hede hel				378 Rume cri				161 Eurh sp.			
210 Holc mol				47 Bell per				206 Hera sph				380 Rume obt				216 Hylo spi			
253 Loli mul				50 Betu sp.				207 Hier pil				381 Sagi sp.				222 Hypn cup			
254 Loli per				64 Call vul				208 Hier sp.				386 Samb nig				530 Loph sp.			
283 Moli cae				68 Camp rot				220 Hype pul				401 Sene jac				280 Mniu hor			
287 Nard str				69 Caps bur				223 Hypo/Leo				402 Sene vul				282 Mniu und			
304 Phle pra				70 Card h/f				238 Lami alb				405 Sile dio				535 Pell sp.			
319 Poa ann				71 Card pra				239 Lami pur				413 Sonc asp				314 Plag und			
321 Poa pra				92 Cent nig				240 Laps com				414 Sonc ole				318 Pleu sch			
847 Poa triv				96 Cera fon				243 Lath pra				415 Sorb auc				331 Poly com			
404 Sieg dec				97 Cham ang				255 Loni per				420 Stac syl				843 Poly jun			
SEDGES/RUSHES				98 Chen alb				256 Lotu cor				421 Stel als				279 Pseu pur			
74 Care bin				101 Chry opp				273 Matr mat				423 Stel hol				543 Rhac lan			
76 Care dem				103 Cirs arv				277 Merc per				424 Stel med				364 Rhyt lor			
78 Care ech				104 Cirs pal				286 Myri gal				427 Succ pra				365 Rhyt squ			
81 Care nig				105 Cirs vul				288 Nart oss				430 Tara agg				558 Spha g/f			
85 Care pan				113 Cono maj				296 Oxal ace				845 Thym dru				559 Spha g/t			
86 Care pil				114 Conv arv				302 Pedi syl				441 Tori jap				561 Spha r/t			
152 Erio ang				117 Cory ave				307 Pice sit				443 Tric cae				439 Thui tam			

OTHER SPECIES	Q	%	%		Q	%	%		Q	%	%

Estimates of vegetation cover were made within 5% categories. It was necessary to constantly check between partners that there was not a tendency to over or under estimate. Cover was over 100% if several layers were present e.g. *Pteridium* (100%) over *Agrostis* (25%). Species with less than 5% cover were given a cover value of '1'.

Cover of tree species, if rooted in the plot, was recorded in the normal way; differences between seedlings and adult trees were not recorded. Tree species which were overhanging the plot were recorded in the second % cover column, in brackets. 'Bare ground' was recorded but also included leaf litter and rock.

Plot types

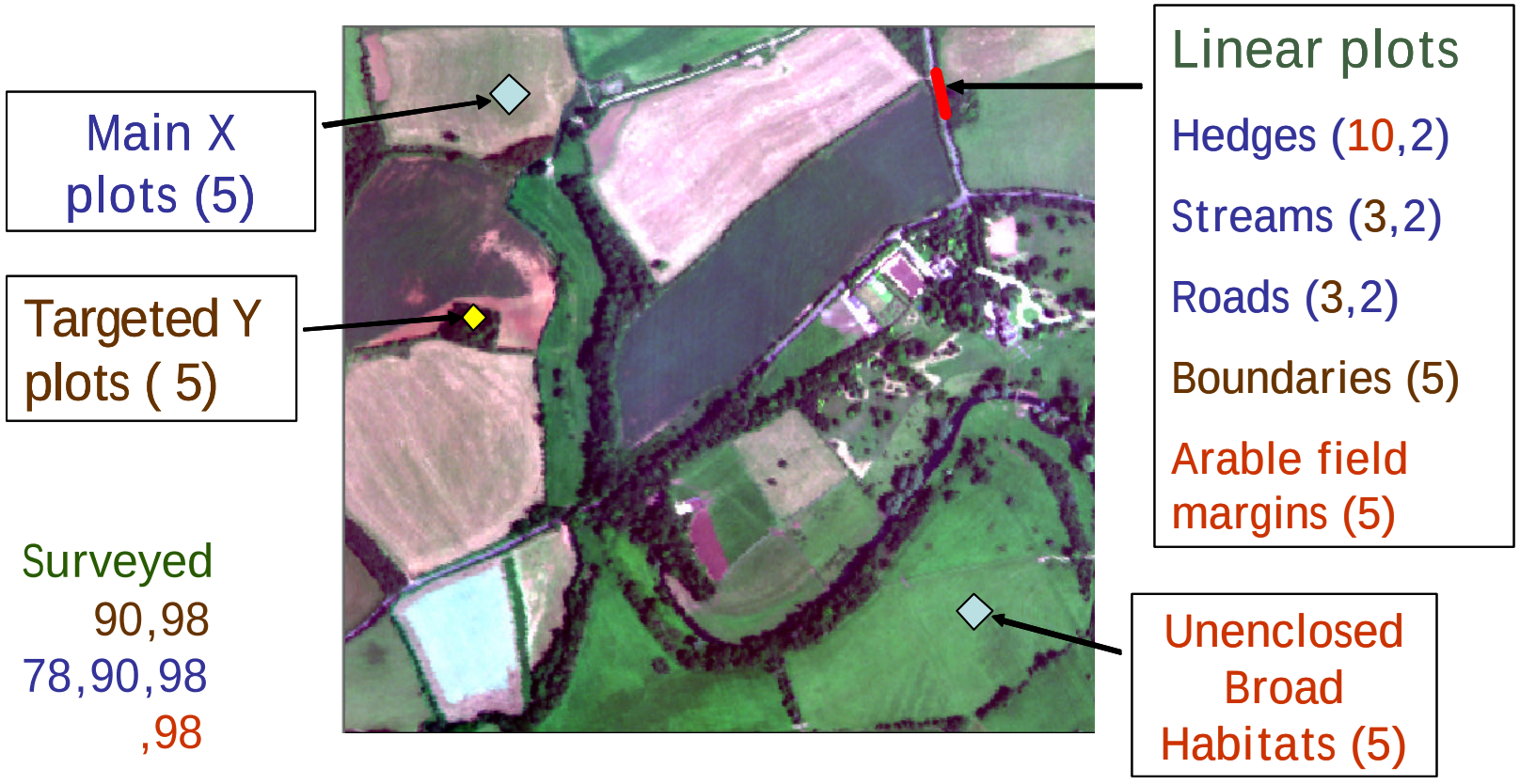
The following types of plot were to recorded in each square (and see Fig 4):

Code	Name	Other names	Where	Size	No. per square
Areal plots					
X[1]	Main	'Wally plot'	Random points in open polygons	200 m^2	5
Y[2]	Targeted	Habitat	Semi-natural vegetation	4 m^2	Up to 5
U[3]	Unenclosed		Unenclosed Broad Habitats	4 m^2	Up to 10
Linear plots					
B[2]	Boundary		Adjacent to main plots (X plots)	10 x 1 m	5
A[3]	Arable		Arable field margins	100 x 1 m	Up to 5
H[1]	Hedgerow		Alongside hedgerows	10 x 1 m	2
D[3]	Hedgerow diversity		Hedgerows	30 x 1 m	Up to 10
S[1]/W[2]	Streamside		Alongside running water courses	10 x 1 m	5
R[1]/V[2]	Roadside		Alongside roads and tracks	10 x 1 m	5
				MAX	52

[1] first recorded in 1978
[2] first recorded in 1990
[3] new in 1998-05-05

Of the 569 squares that were surveyed in 1998/9, 60 were 'new' and therefore some plots had not been marked on maps; the surveyor needed to apply standard rules (given below) to identify the location of these plots within the square. (N.B. no plots were located below the Mean High Water (MHW) mark.)

Figure 4 Types of vegetation recording plots recorded in Countryside Survey sample squares.



X PLOTS - MAIN (LARGE OR RANDOM PLOTS) (X1 - X5)

Locating new plots (in new squares)

These main plots ($200m^2$) were marked on the maps in advance, and was located on the ground as accurately as possible to the position shown on the map. There were instances where the land use had changed between surveys so that a vegetation plot was no longer appropriate eg a field has been developed into a housing estate. Where the new land use was characterised by a vegetation type in which a plot can be placed (eg golf-course) then the original position was re-located and a plot was recorded. Where the new land use clearly precludes the recording of vegetation, a new plot position was selected as follows:

- The boundary between the developed area of land and the nearest vegetated land cover type was located; a position on that boundary which was nearest to the original plot was identified; 20 (twenty) 1 m paces were taken in the opposite direction to the original plot; full details of the changes involved were recorded.

Relocating plots in 'old' squares

In most squares, the X plots had already been marked in 1990 using the following methods:

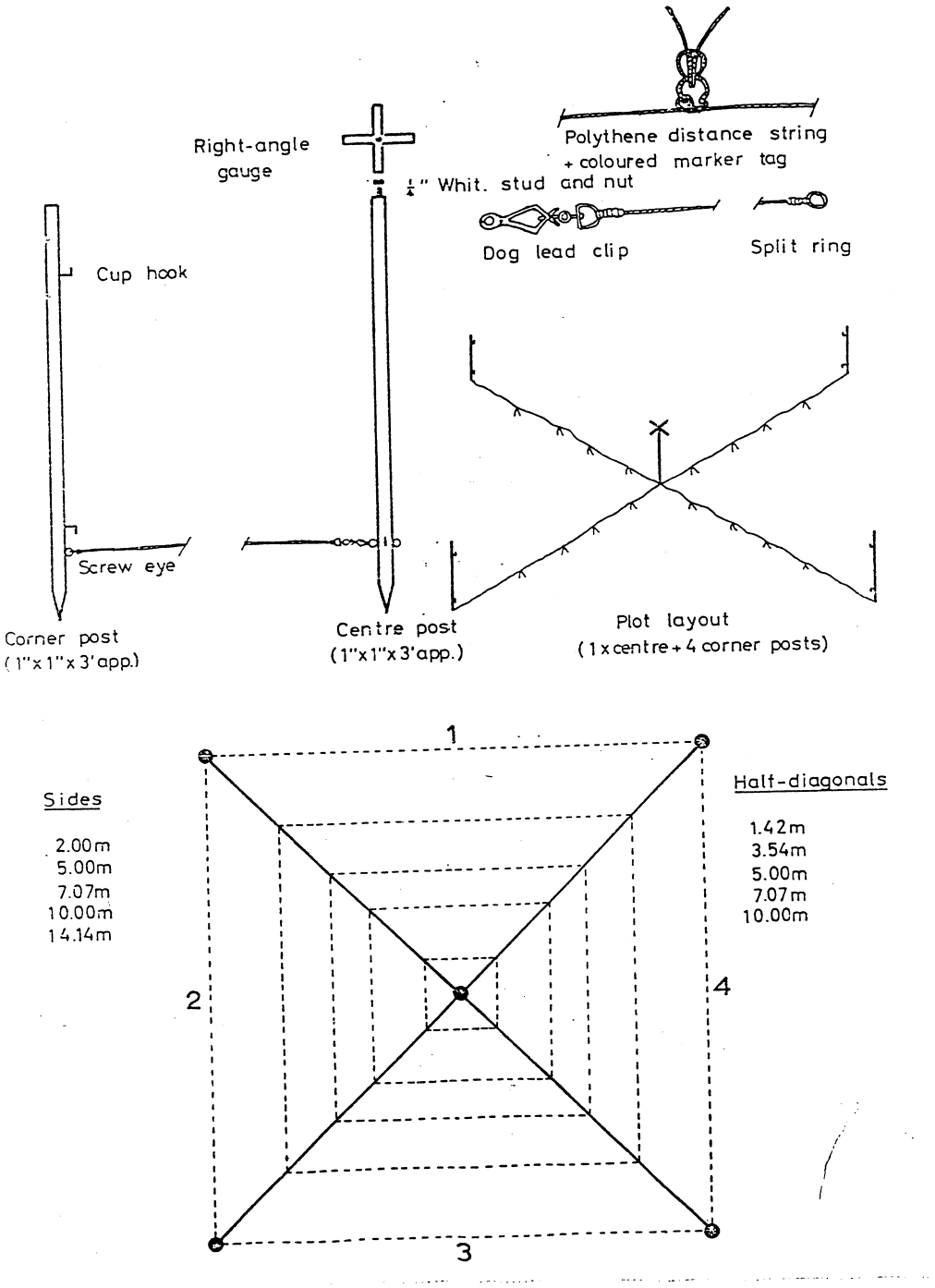
- Plans (including measurements and bearings) drawn on the back of the plot recording sheet
- Ground-based photographs
- Metal plates at the south-most corner of the plot (or in the field boundary)

The metal plate was the proof of relocation. In a pilot study in 1991, 70% of all metal plates were found within five minutes, one year after burial. If the plate could not be detected within 10 minutes of searching (or longer if time permits), then the plot was located as well as possible using the plan and photograph, a new plate was buried and a note was made on the plot recording sheet.

Laying out and recording

The vegetation plot was 200 m^2 and was set up by using the survey poles provided with the strings forming the diagonal of the square (Figure 5). The diagonals were orientated carefully at right angles and the plot was orientated with the strings on the North/South, East/West axes. The different nested plots shown in Figure 5 were marked by different coloured strings on the appropriate position of the diagonal.

Figure 5. *Design of X (Main) Plot*



Details of the plot were entered at the top of the recording form using a standard format. Any additional comments, not covered elsewhere, were entered in the space provided.

On the recording form provided, all species were recorded from the inner nested ($4m^2$) plot first, either by ticking the species names on the "top 200" list or by adding species names at the bottom of the recording form. A "1" was recorded in the column headed "Q" to show that the species was recorded in the first plot. The cover, in 5% bands, was then recorded in the second column (marked "%").

When the inner plot had been completed, the second nested plot was examined and any additional species was recorded using a "2" in the "Q" column. No cover estimate was made at this stage. Each additional nested plot (labelled 3 – 5) was examined in this way until all sizes of plots had been recorded. Only after a final check for any missed recordings was a final overall cover estimate made for all species with a cover of 5% or more in the whole $200m^2$ plot (ie including the inner $4m^2$).

If the plot fell in a field with a growing crop (whether harvested or not) then the plot was moved to the edge of the field nearest to the original position. The new plot was taken as being a 14m square (estimated, not measured), starting 3 metres into the crop (to avoid any edge effect). Access was made using drill lines where possible and causing minimum disturbance to the crop. The species list was compiled from what could be seen in the crop - accuracy was difficult to achieve consistently but data were recorded from all arable crops in whatever way was possible.

Permanent marking

Wherever possible, the plot was marked with a metal plate immediately adjacent to the south corner of the plot (and sloping away from the plot). This was possible in most unenclosed land and in woodlands. The plate was not located within the plot itself; it was driven into the ground at an angle of 45 degrees until the top edge was just below ground level (aligned to give maximum likelihood of easy rebcation with a metal detector). Wooden stakes were used in woodlands and moorland situations where metal plates were especially difficult to re-locate.

Elsewhere, in cultivated land or wet habitats, plots were marked by inserting a plate at the nearest field boundary, along a cardinal bearing line. The distance of the boundary from the plot was measured from the centre of the plot to the centre of the boundary. In semi-enclosed areas where plate burial was inappropriate and where boundaries were more than 100 metres away, an attempt was made to mark the plot by reference to an obvious local feature, such as a boulder or tree where the plate was buried.

In all cases, the position of the plot, and marker plate(s) was sketched on the reverse of the recording sheet, and annotated with distances (measured with a tape) and, if measurements were not possible, compass bearings. All distances and bearings were taken from the centre of the plot to easily recognisable, and permanent, features in the surrounding landscape. Print photographs were taken of every vegetation plot in order to show its general appearance and its position relevant to local landmarks or other reference features.

Y PLOTS – TARGETED (HABITAT PLOTS) (Y1 - Y5)

For the first time in 1990, five plots were established as a baseline for monitoring vegetation change in semi-natural habitats. In 1998, these were re-recorded and, in new squares, baseline plots were also established.

Location in New squares

Five targeted plots (2m x 2m) was placed in natural or semi-natural land cover types in each square. They were placed by the surveyor according to the following guidelines:

1. The five plots were placed in five different land cover types, where these were available, additional to those types that have already been represented by the five main plots.
2. The plot locations were determined after all land cover mapping has been completed and was placed in habitat parcels of any size.
3. During the mapping phase, the presence of small areas of natural or semi-natural vegetation which were below the size of a minimum mappable unit was noted (and mapped, if helpful), to expand the range of possible Y plot locations. Land cover categories which were additional to the mapping codes might have included:
   Strand-line vegetation
   Dune slack
   Dune grassland
   Dune scrub
   Machair
   Inland saltmarsh
   Inundation grassland
   Ultrabasic vegetation
   Calcareous flush
   Acid/neutral flush
   Bryophyte dominated springs
   Montane heath
   Rock ledges
4. If the total number of different semi-natural and natural land cover types exceeded five, then random numbers were used to draw five types for sampling. Where there was more than one area of a type, then the largest area was chosen.
5. If there were fewer than five additional land cover types available in which to place the plots, then the placing of plots was proportional to the size of land cover types available (ie the larger land cover types receive more plots). This was done by dividing the areas of each type into "mappable areas" and comparing sizes.
6. In all cases, a complete record of suitable habitats was recorded, together with the frequency of each.

Relocation in Old squares

The plots had already been marked in earlier surveys using metal plates, ground-based photographs and ground-plans. The plots were re-located as in the case of X plots (above).

Laying out and recording

The plot was in the 'centre of gravity' of the habitat - there was a large element of judgement involved but efforts were made to avoid bias in positioning of the plot. If the centre of gravity was not representative of the habitat type (eg rock boulder in middle of flush), then the plot location was re-randomised.

If the plot was put into a narrow, linear feature within which a 2x2 m plot would not fit then the area was made up to $4m^2$ by extending the length - this was clearly depicted with measurements in the sketch on the back of the recording sheet.

Survey poles were used to mark out the corners of the plot by reference to the first set of marker strings (equivalent to the inner nested plot of the main plots). As with main plots, the

poles were orientated along north/south, east/west axes. However, in a linear feature, this might not have been possible and the alternative main axis of the plot was measured and recorded.

The species present in the square was recorded in the same way as for the inner nested plot of the main plots and a cover estimate made.

Permanent marking

In some cases it was not possible to place the plate immediately adjacent to the survey pole at the south point of the plot, just outside (6") the plot boundary. If the plate has to be placed elsewhere, around the perimeter of the plot, then this was clearly shown on the associated sketch. If it was not possible to place the plate anywhere adjacent to the plot, then it was placed at the nearest possible location and distances and angles measured to show the precise location.

U PLOTS - UNENCLOSED PLOTS (U1 – U10)

These plots were being introduced into the CS methodology for the first time in 1998. Up to 10 plots were established in any Generally Unenclosed Broad Habitats that occur within the square. The plots were 2 x 2 m in all instances, irrespective of the habitat in which they were located.

Location in all squares

It was necessary to have completed the mapping at Broad Habitat level (including any changes in these) before any plots were established (ie. plots were allocated according to the 1998 Broad Habitat map).

The number of plots depended on the proportion of the square that was occupied by Generally Unenclosed Broad Habitats. If the whole square comprised Generally Unenclosed Broad Habitats, then 10 U plots were established; if half the square was made up of these habitats, then 5 U plots were placed. A dot grid was provided to allow estimation of the proportion of the square which was made up of unenclosed habitat types (and thence the number of plots to be established).

Once the number of plots has been determined, then the plots were distributed among the different Broad Habitats, as follows:

- If there were more plots available than there were different Broad Habitats, then:

  (i) At least one plots was placed in each Broad Habitat (to ensure representation of all Generally Unenclosed Broad Habitats present within the square).

  (ii) The remaining plots were then allocated to the habitats in proportion to their area.

- If there were more Broad Habitat types present than there were plots available, then the plots were allocated randomly to the habitat types but, not more than one per type. (All mosaics were treated as one single Broad Habitat category, irrespective of their component parts.)

Once it was known how many plots were to be placed in each Broad Habitat type, then plots were placed at random points, within each habitat, on the overlay grid (chosen using the

random number tables provided). Where a Broad Habitat type was not 'hit' by any grid point, then the plot was located in the centre of gravity of the largest parcel of that Broad Habitat type. (No plot was placed within 10 m of an existing Y plot).

Laying out, marking and recording

The U plots were laid out, permanently marked and recorded in the same way as were Y plots (see above).

LINEAR PLOTS

All linear plots (except Hedgerow Diversity plots – D plots) measured 10 x 1 metres and were all recorded in the same way. The following general rules for applied:

1. No two linear plots of the same type were placed within 10 m of each other on the same linear feature.

2. No two linear plots of different types overlapped.

3. The 1 metre width was measured across the surface of the terrain so that, on a bank, the true horizontal width, as viewed from above, would be less than 1 metre.

B PLOTS - BOUNDARY PLOTS (B1 - B5)

For the first time in 1990, five plots were established as a baseline for monitoring vegetation change in field boundaries. In 1998, these were re-recorded and, in new squares, baseline plots were also established.

Location in New squares

In enclosed land only, a boundary linear plot was to be recorded at the boundary marker of each of the 5 x 200m^2 plots.

In this context, a boundary was taken to be any physical feature that has a length and which was an interface between the land cover of the 200m^2 plot and any other land cover type. This might include a hedge, wall, fence, ditch, embankment etc. It did not include land cover which was associated with the management practice of the field itself eg headlands.

In general the Boundary plot took precedence over other types of linear plot. If two plots would otherwise end up in the same location, then the Boundary plot would be laid out and the other linear feature moved to the nearest permissible length of boundary which was at least 10m away. The exception was where a linear plot had previously been located in the same position as a Boundary plot would fall. In this case the Boundary plot would be moved to the next nearest length of boundary on a different cardinal bearing.

The marker plate for the 200m^2 plot should have been positioned at the boundary nearest to the plot and was lying on one of the cardinal points of the compass, as measured from the centre of the plot.

Relocation in Old squares

The plots had been marked in previous surveys using metal plates, ground-based photographs and ground-plans. The plots were re-located as in the case of X plots (above).

Laying out and recording

The linear plot was laid out with the marker plate on the right side of the plot when faced from the field. In most cases the feature recorded was vertical, ie. a hedge, wall or fence - in these cases the plot occupied the 1m strip going outwards from the centre of the feature (except a wall where the 1m was from the base) . In some cases where there was no vertical feature, but a grass strip, the plate was buried 1m in from the edge of the field (crop), and the linear plot was recorded in the 1m adjacent to the edge.

Where the boundary was composed of several different elements eg hedge with ditch, then the laying out procedure was decided by reference to the dominant vertical feature eg hedges/walls/fences were dominant to ditches which were dominant to grass strips. Once the dominant feature had been identified and the plot laid out accordingly, then recording was carried out in the 1m strip, irrespective of whether it included part of another linear feature. (N.B. different rules apply in the case of H, S/W, R/V plots - see below)

Boundary plots which were adjacent to large ditches or dykes were located at the water's edge, and not at the top of the bank. Where a field was immediately adjacent to a curtilage, then the boundary plot ran from the curtilage into the field.

All species within the plot were recorded using standard recording forms and cover estimates made.

Permanent marking

In some cases, the plate used to mark the Boundary plot may also have served to mark (remotely) the adjacent X plot. In other cases, a separate plate was buried for the Boundary plot.

A PLOTS - ARABLE FIELD MARGIN PLOTS (A1 – A5)

Arable field margin plots were being recorded for the first time in 1998. The purpose of establishing these plots was to record changes in the arable weed population at the edge of cultivated fields. It was reckoned that the non-crop plant diversity increases towards the edge of a field and the field edge may contribute an important source of biodiversity.

Location/Relocation

The A plots will only be located adjacent to those Boundary plots (see above) which border arable fields; thus up to 5 A plots per square were possible. The A plots were 100 x 1 m where the 1 m was the outermost cultivated meter of the field and the 100 m was centred on the B plot. The A plot always extended 50 m outwards from the B plot even if this meant continuing along a second side of the field

Laying out and recording

It was unrealistic to mark out the exact dimensions of A plots. Instead, the 50m tape was run out in each direction (successively) from the centre of the B plot. A plot pole or cane, with a 1 metre mark, should then be used to check the width of the plot as it was walked and recorded.

All species within the plot were recorded using standard recording forms (but cover estimates were not required). There was no need to permanently mark the plot as location was determined by the already marked B plot.

H PLOTS - HEDGEROW PLOTS (H1 - H2)

The two hedgerow plots in each square were first recorded in some squares in 1978 and in others in 1990. Similarly, in new squares in 1998, two hedgerow plots were established if hedgerows were present.

Location in New squares

All linear plots established in the first survey in 1978 (2 each for hedgerows, streamsides and roadsides) were located as close as possible to the two main plots ($200m^2$) which were furthest apart. On reaching the linear feature, from the $200m^2$ plot, the 10m plot was laid out to the left and the 1m width extends out towards the field from the centre of the hedge.

Where the nearest feature was ineligible (because it was not wide enough, or was confused by the presence of a different type of linear within its width) then a new location was chosen at the nearest permissible position. Any changes were noted and clearly marked on sketch maps.

Relocation in Old squares

In the case of already established plots, the original positions were marked on the map - they was relocated as closely as possible. As with other marked plots, if the metal plate could not be found within 10 minutes searching, then the plot was located as closely as possible using the plan and photograph, a new plate was buried and a note was made on the plot recording sheet.

If there was no longer a hedgerow at the position marked, then this was indicated on the map and the plot was moved to the nearest hedgerow - this new plot was renamed (H3, H4 etc) and marked on the map.

If one or both hedges were not marked on the map but hedges exist in the square, they was added using the methodology described above for new squares. However, since two plots should not be nearer than 10m to each other, only one plot was recorded if there was not more than 20m of continuous hedge in the square.

Laying out and recording

The position of the plots was temporarily marked with a survey pole at each end, one metre out from the centre of the hedge. A measuring tape was used to mark the outer edge of the plot. If there was not a clear metre between the centre of the hedge and another linear feature, eg ditch, then the hedge plot was relocated at the nearest permissible location. All species were recorded on the standard recording sheet and cover estimates made. Each plot was permanently marked with a metal plate at the right hand end of the plot when faced from the field - the location of the plate was indicated on a sketch with distances from a marked feature, eg. gate.

D PLOTS - HEDGEROW DIVERSITY PLOTS (D1 – D5)

The hedgerow diversity plots were being recorded for the first time in 1998. The overall purpose was to set up a baseline of plots to monitor woody species diversity and the presence of rarer woody species.

Location

In all squares where hedgerows were present, up to 10 D plots were recorded. Each plot was 30 m long and included the full width of the hedgerow. The position of the D plots was decided once mapping of all hedgerows has been completed (because plot selection depends on knowing where all hedgerows are).

Two of the 10 plots were required to incorporate the existing H plots and comprise the 10 m H plot at the centre with extensions of 10 m at each end. The other 8 plots were located by placing a template over the field boundaries page of the FAB. For each point on the template, the nearest point on a mapped hedgerow formed the centre point of one of the 8 extra plots.

Laying out and recording

The plot length was checked using a measuring tape (15 m in each direction from the centre point).

All woody species present in the hedgerow was recorded on the appropriate plot sheet, together with an estimate of their percentage contribution to the volume of the hedge. Woody species includes rose and climbers such as honeysuckle but not bramble. 'Gaps' were treated as a single species. Recording was carried out from both sides of the hedge where it was tall or wide.

Permanent marking

The 8 extra plots were permanently marked (metal plates, photographs and plot diagrams) at the centre point along the 30 m length. The plate was buried 50 cms out from the centre line of the hedge and the plan indicated clearly on which side the plate was buried and photographs taken.

S & W PLOTS - STREAMSIDE PLOTS (S1 - S2; W1 - W3)

'Streamside plot' was a convenient name given to those linear plots which were placed alongside running water features (mainly rivers and streams but also canals and ditches). The S and W prefixes refer to the different origins of the plots:

S plot — two Streamside plots were established in up to 256 1 km squares in 1978, using a random allocation procedure (and were re-recorded in 1990) – two S plots were also recorded in all new squares in 1990,

W plots — three additional Waterside plots were placed in all squares in 1990 to increase representation of other waterside types.

Location in New squares

S plots

The two linear S plots were located as close as possible to the two main plots ($200m^2$) which were furthest apart. They were then marked on the map provided. On reaching the linear feature, from the $200m^2$ plot, the 10m plot was laid out to the left and the 1m width extended landwards from the point where it appeared that water reached when the watercourse was full (but not flooded). Only permanent water courses were included; ditches were included if they appeared to be normally wet.

W plots

These waterside plots were used to ensure that different types of waterside feature were sampled where they exist. The recognised categories were: River or canalised river; Stream; Canal; Non-roadside ditch; Roadside ditch. If not all types were represented, then samples were allocated according to the total lengths of the different types present (ie the type with the longest length had most plots). Dry ditches were not included.

The first priority was to ensure that there was at least 1 plot in each category existing in the square, including the two original plots. The second priority was to include as much variation as possible so that lengths of stream with species assemblages not covered by the existing plots were sampled.

The plots were located in the centre of that part of the 'waterway' type which lay within the square. If there was only one type of waterway then all 5 plots were placed along its length, providing that it was long enough to put them more than 10m apart. The positions of these plots were marked with plates and sketched as for other plots. The type of ditch/stream/river adjacent to the plot was indicated on the recording sheet.

Relocation in Old squares

In the case of squares recorded in 1990, the original positions of both S and W plots were marked on the map - they was relocated as closely as possible. If the stream or ditch was dry then the plot should still be recorded, but the state of the watercourse should also be noted on the recording sheet. If one or both stream plots were not marked but streams, rivers or ditches exist in the square, they was added using the methodology described above (for New squares).

If the plot coincided with a Boundary plot, then it was moved to the nearest permissible length of stream/river/ditch so that no part of the plot was within 10 metres of the Boundary plot. Streams that had dried out in a temporary/seasonal drought, were sampled if the usual presence of water appeared to have influenced the species composition of the streamside.

Laying out and recording

The position of the plots was marked according to the procedure used with other plots. The waterside edge of the plot was along what appears to be the normal highest point that water reaches (ie excepting flood situations). All species found within a 1 metre width from this edge were recorded and marked on the standard recording form with a "1" in the "Q" column.

In addition to the 10m x 1m plot, a further linear plot of the same size was recorded on the water side, to record species which were rooted or floating in the water (not rooted on the bank of the stream/river) - species in this additional plot was recorded using the standard form but with a "2" in the "Q" column. If the waterway was less than 1m wide then record additional species but also make a note of the average width of the waterway over the ten metres.

R & V PLOTS - ROADSIDE AND VERGE PLOTS (R1 - R2; V1 - V3)

'Roadside plot' was a convenient name given to those linear plots which lie alongside transport routes (mainly roads and tracks). The R and V prefixes refer to the different origins of the plots:

R plots two Roadside plots were established in 256 1 km squares in 1978, using a random allocation procedure (and were re-recorded in 1990)

V plots three additional Verge plots were placed in the 256 1 km squares in 1990 to increase representation of other transport types,

Location in New squares

R plots

The two linear R plots were 10 x 1 m; they was located as close as possible to the two main plots ($200m^2$) which were furthest apart. They must then be marked on the map provided.

On reaching the linear feature, from the $200m^2$ plot, the 10m plot was laid out to the left and the 1m width extends from the road edge, away from the carriageway. Where the nearest feature was ineligible (because it was not wide enough, or was confused by the presence of a different type of linear within its width) then a new location was chosen at the nearest permissible position. Any changes were noted and clearly marked on sketch maps.

V plots

The 'verge' plots were used to ensure that different types of transport route were sampled where they exist. The following categories were recognised : 'A' and 'B' roads including dual carriageways; Yellow roads if tarmac; Constructed tracks and non-tarmac roads. (Motorways were excluded). If not all types were represented, then samples were allocated according to the total lengths of the different types present (ie the type with the longest length had most plots).

The first priority was to ensure that there was at least 1 plot in each category of road present in the square, including the 2 original verge plots R1 & R2. The second priority was to include as much variation as possible so that lengths of verge with species assemblages not covered by the existing plots were sampled. The plots were located in the centre of the verge type. If there was only one type of verge then all 5 plots were placed on that verge, providing that it was long enough to put them more than 10m apart.

The position of these plots were marked with plates and sketched. The type of road or track adjacent to the plot was indicated on the recording sheet.

Relocation in Old squares

In the case of squares recorded in 1990, the original positions of both R and V plots were marked on the map - they was relocated as closely as possible. If the road or track was no longer present, then a new plot was placed using the guidelines used for New squares.

If one or both verges were not marked but road verges exist in the square, they were added using the methodology described above. Verge plots were not located where the verge was less than 1m wide; instead the nearest verge with a 1 metre width was located.

Laying out and recording

The standard procedure was used to lay out the plot. The roadside edge of the plot started at the interface between soil and tarmac, not where overhanging vegetation started.

Where the verge was more than 2m wide (from the edge of the road, to 1m from the centre of the next feature, ie. hedge, wall, fence or ditch) then a supplementary verge plot was recorded adjacent to the first to sample the vegetation between 1m and 2m from the roadside. However, only additional species were recorded and a number '2' recorded in the "Q" column of the standard recording sheet. If there were no additional species, then this was noted accordingly.

SPECIES IDENTIFICATION

Taxonomic nomenclature followed Clapham, Tutin and Warburg to maintain consistency with earlier surveys. Conversion to Stace names were carried out within the database, post-survey, where needed.

Aggregations/Combinations

Surveyors were expected to record to the species level. However, there were certain species which were notoriously difficult to separate out from closely related examples of the same genus. It was therefore necessary, in order to remain consistent with previous surveys, to allow certain combinations to be recorded. The combinations were determined on the basis of experience, where it was considered that it was not possible to identify the species accurately. A number of the species combinations have similar ecological amplitudes e.g. *Cardamine hirsuta/flexuosa*. Where the separate species name was known unequivocally, then it was used; otherwise, the combination name was used. Surveyors were given a list of acceptable combinations:

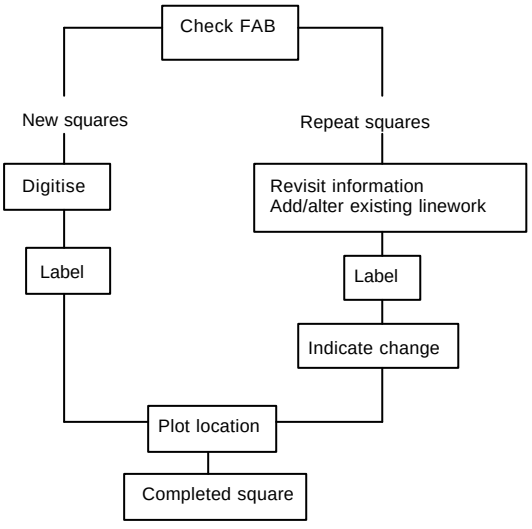
If a plant could not be identified to species level (despite all efforts), then the genus and the epithet, 'spp.', was recorded. Particular care was taken if a taxon was found which was nationally scarce or atypical for the region.

Bryophytes and Lichens

Only a restricted list of bryophytes and lichens were recorded, with their individual cover values (see Appendix #). No other bryophytes or lichens were recorded, nor any additional cover values, individually or collectively. Sphagnum species were grouped into four types.

2.3 DATA ENTRY

2.3.1 Spatial data entry



Procedure for checking data return

All FABs were checked for correct labelling at each former ITE Station and then returned to Merlewood. They were then checked again for completeness by the digitisers (spatial data entry team) using a prepared check-list, ensuring that all maps and data forms were present. Where any FAB sheets or general information was missing, the Station Co-ordinators responsible for the team who surveyed that particular square were contacted. If, during the digitising process, spatial data was found to be missing, and no further information was available through the co-ordinator, then features were labelled to indicate missing information.

Checked FABs were stored in a fire-resistant storeroom. Information for each sample square was stored in individual folders which included FABs from 1984, 1990 and 1998, plus any aerial photographs and plot location photos. Once the FAB has been checked in by a digitiser, a red dot was placed on the spine of the folder for a quick visual reference. An audit form was developed to track the progress of surveying and digitising (e.g. square survey completed, FAB returned to Merlewood, FAB digitised, FAB scanned etc.).

The 'new' squares, surveyed for the first time in 1998, were all being digitised by staff at CEH Merlewood. Remaining Scottish squares were predominantly allocated to CEH Banchory and CEH Bush, whilst Welsh squares were predominantly allocated to Bangor. The squares were distributed so that each digitiser has a selection of different Land Classes, some of which were easier to edit than others. The audit form recorded which digitiser has digitised which square.

Digitising methodology

All digitisers attended a four-day training course that covered general GIS principles and digitising methodology for CS2000. A handbook for the course, 'GIS: Introduction to Arc/info' (Gillespie, 1998), has been produced, and an adapted version for Scotland has been edited by Geraldine McGowan and Annie Truscott. Further training was given as required. Updates or modifications to the methodology were kept in an open Word document, 'Digitising Updates', which was available to all digitisers.

The digitising was carried out on UNIX Arcinfo software, rather than PC Arcinfo. The software was accessed from UNIX work-stations or through Exceed on PCs. Programmes written to automate procedures in Arc were documented. A paper copy of each programme was kept on file. Details of the programmes and any changes made were documented and dated, as part of the programme.

Editing and digitising 'New' sites

In CS2000, sixty new field sites were surveyed and these had to be digitised from scratch. Field surveyors recorded land cover information for each site onto one or more 'theme' maps (agriculture, physiography, forestry, structures and boundaries). Attribute information was recorded on formatted data sheets for each theme.

All area features from the theme maps were combined onto one map or 'coverage', but line and point features were digitised separately by theme. The area coverage was digitised first, with themes digitised in order of land area, so that the dominant theme was digitised first. Subsequent line coverages were created by transferring any common linework from the area coverage rather than by digitising a line twice. This reduces 'sliver' errors during overlay routines where two lines cross and create small polygons.

Editing and digitising 'Change' sites

Squares surveyed previously ('change' squares) have already been digitised at a previous date, with one area coverage and separate line and point theme coverages. These were copied, to create a backup copy, and new data for 1998 were added. The main digitising effort therefore involved editing to add any new linework or alter existing lines. Lines were not removed: features which were recorded as 'no longer present' by the field surveyors were left intact, so that an historical record of land cover could be maintained.

To simplify the maps given to surveyors, features with an area of $< 400m^2$ (i.e less than the minimum mappable unit) were not shown on the printed maps. Many of these small polygons were 'sliver polygons' that had been created through previous GIS overlay procedures. These features were labelled where possible, using the 1990 attribute columns as a guide to which larger parcel the sliver was associated with.

Labelling 'New' squares

Once all the linework had been digitised and checked for errors, the features were labelled so that spatial information could be related to attribute data. Four data fields were added to the area coverage, one for each of the four area themes (for agriculture, forestry etc.). An additional field was added for attribute data relating to the Broad Habitat information collected by surveyors. The point and line coverages had one field added (e.g. in the physiography line coverage). Each feature was then labelled with a surveyor-created code in the relevant data field. This approach allowed multiple themes to be recorded (e.g. an area of scattered trees over an area of grassland).

For the area coverage, a check was made to confirm that parcels had been recorded in the correct theme data field. The labelling was checked by running a programme to print out a colour map which showed each parcel by theme and indicated whether any parcels have been recorded in more than one theme. Parcels that were recorded in more than one theme were identified and numbered. Parcels with no labels show up as white on the printed map. A separate programme printed out a check-map for correct Broad Habitat labels.

When the area coverage was complete, it was initially built as a polygon coverage. Digitisers use the 'build' command to establish topology rather than the 'clean' command which adjusts topology automatically and can introduce spatial discrepancies. It was then copied and built as a line coverage so that each line could be labelled in order to identify 'real' boundaries (e.g. walls, hedges etc.) as compared to 'soft' boundaries (e.g. the boundary between two vegetation types, streams, the edge of the square). Streams that act as boundaries were given digitiser created codes. Other boundary types (curtilage and square edge) was coded automatically, once attribute data had been entered.

Where a continuous line marked the perimeter of a field, nodes were inserted at field corners to separate field sides. This was to benefit future landscape pattern work examining field or boundary characteristics. The choice of where to place nodes was subjective, based on whether a boundary would appear as one element looking at it from the centre of the field. It may be possible to create field corner positions at a later stage in the analysis using calculations to identify angles and setting a specific angle as the minimum required between two field sides.

Labelling 'change' squares

Attribute data from CS1990 for the 'change' squares was carried over into the copied CS2000 coverage. Four data fields were present in the area coverage, one for each of the four themes,

and these contain the alpha-codes generated by surveyors in 1990. If the square was also surveyed in 1984, four additional fields were also included to include these earlier codes. As with 'new' squares, four data fields were added to the area coverage for 1998, so the coverage therefore had information for all survey years. An additional field was added for attribute data relating to the Broad Habitat information collected by surveyors. Point and line coverages were copied from the 1990 coverages and did not have data for 1984.

The polygons mapped in previous surveys were labelled with a unique code to link to descriptions made in the field. Unique numerical codes were generated for each feature for the field survey and these numbers were printed on the theme maps within or beside the feature. The numbers also link to pre-printed data sheets giving the CS1990 attributes of each feature. It was not possible to automatically link these numbers to the area coverage because they were generated using different coverages, and simplified to aid mapping in the field. The digitisers therefore had to label all features manually. Where new numbers had been added by surveyors (e.g. a new area of woodland might be coded), these were given special numerical codes by digitisers. Broad Habitat mosaic areas were coded separately. A note was put on the comment sheet listing the code and the Broad Habitat combinations.

When the area coverage was complete, it was initially built as a polygon coverage. The coverage was then copied and built as a line coverage in order that each line can be labelled for 'real' and 'soft' boundaries. In order to examine changes in field size and shape, additional data fields were added and all the lines were labelled for 1990, and 1984 where appropriate. As with the 'new' squares, nodes were inserted at field corners to separate field sides.

If new point or line features had been surveyed, and this required a new coverage (e.g. a square with no physiography lines has a new stream mapped in 1998), a new coverage was created. A column was added for 1990 data (parcel) as well as the new 1998 data. If the feature definitely did not exist in 1990, this was coded accordingly.

Indicating spatial change

A field for checking change was included in all coverages. This was for checking where spatial changes have taken place i.e. a boundary position was assumed by the 1998 surveyor to be in the wrong place and has been redrawn, thus affecting the area of a feature within a square. Likewise the position of a tree may have been moved, or a line of trees may have become a belt (area) of trees.

If there was no change whatsoever in the spatial location of a line, point or area then the change value was 0. The characteristics of a feature may have changed (e.g. wall was now a fence) but that change could be calculated from the database and did not have to be recorded as change in the database. The digitisers needed to refer to the data attribute sheets to identify which changes were spatial and which were attribute changes.

If the 1998 surveyor decided that a boundary was incorrectly drawn in 1990, and had redrawn the boundary, thus changing the shape and size of the 1990 field, then the boundaries were labelled with change value 2. The areas affected (on either side of the boundary) were also labelled with change value 2.

Any label changes or additions were noted on a comment sheet for each square, which was kept with the FAB.

Plot location coverage

A new plot location coverage was digitised for each square, with digitisers using the plot location maps for each plot to identify location as accurately as possible within the square. The GIS points were digitised as the position of the metal plate as shown on the plot diagram. Plots were classified as a) exact match (plate found), b) close match (measured) or c) best guess. GPS readings will also be used at a later stage to help verify plot locations. The 1990 plot location coverage was kept as a separate coverage. Digitisers were asked to be especially careful when locating 'U' plots to ensure that they were positioned in the correct Broad Habitat.

Completed squares

A record was kept of which coverages have been digitised for each site. When a square had been completely digitised and labelled, the FAB was returned to the FAB Storeroom and the folder marked with a blue dot for easy visual reference. Digitisers were asked to order the FABs according to the original check-in sheet, and to tag all the sheets for one year together. General maps and work completed by the digitiser were tagged outwith the FAB. The audit form was updated to confirm that digitising was completed, so that the FAB can proceed to the next stages of data entry and scanning.

At the completion of each square, all digitised data was entered into the Countryside Survey 2000 database.

2.3.2 Map attribute data entry

Survey Code Recording for CS2000

To create a baseline database for CS2000 fieldwork, survey codes from the previous 1990 survey were automatically transferred from the survey database into Excel spreadsheets. Each of the five different themes had it's own formatted spreadsheet. An additional sheet was added for recording unique codes created by surveyors. The spreadsheets were then printed out and distributed to the survey teams surveying the squares. The format of the sheets allowed surveyor to record new features, loss of old features and change for individual codes used in the 1990 survey.

Once the survey was complete, the information recorded on the field sheets was entered into the original Excel spreadsheets. This process allowed validation of the surveyor's records and allowed the data to be read back automatically into the database. Once in the database, the information could be used to analyse change between the different surveys, across the whole data set.

Survey Code Sheet Files

Each survey square had an Excel file named after the square series number (e.g. square 1005 has a files named 'SQUARE 1005.xls'. The file contains six formatted sheets, one for each of the themes surveyed and one for unique codes. The information from the field survey sheet was entered into the corresponding spreadsheet. The column names and formats were different for each theme to allow for the different information recorded.

General Format of Sheets

Below is a generalised view of the spreadsheet format for the five survey themes. The column headings indicate the type of code being shown from the 1990 survey. The blank columns are for the 1998 codes to be entered.

Parcel Number	New Parcel Number	CS1990 Parcel Code	Primary Code		Age		Species		Cover Value		Other Codes			Universal Codes
1		A	n		n	*n*	n		n					
2		B	n		n	*n*	n		n	*n*				
							n		n	*n*				
	10001			*n*		*n*		*n*		*n*				

Italics indicate numbers to be entered. 'n' indicates a survey code.

Entering Parcel Numbers

Surveyed features are identified by a unique parcel number. This can be found in the *Parcel Number* column on the field survey code sheet. Parcel numbers apply to linear and point features as well as parcel features.

- Where a new feature or features had been added by a surveyor, a new parcel number was allocated during digitising. This number was entered into the *New Parcel Column*. It was critical that this number was the same as the number allocated for the feature when digitising the feature.
- In the case indicated above, 10001 is a new number allocated during digitising.

Where a parcel has been split into two, both the new parcel numbers need to be recorded against the old parcel.

- Where a feature had been divided into two by a surveyor, two new parcel numbers were allocated during digitising. These numbers were entered into the *New Parcel Column*, with a **new line** added for the second number. In this new line, the original parcel number was copied into the *Parcel Number Column*, and the second new parcel number added to the *New Parcel Column*. It was critical that these numbers were the same as the numbers allocated to the features when digitising.

Indicating change and removal of features (including surveyor error)

Surveyors were asked to compare features in the field with the recorded codes. Where the codes differed from the recorded features they were asked to record the change and indicate if they considered this to be a real change or an error in recording.

Errors in recording were indicated by a circle drawn round the code. A substitute code was placed in the column to the right. Where the 1990 code needed to be removed, an 'x' was placed in the column on the right. The code *702* was also used to indicate a whole parcel as being erroneous. The 999 code was used to indicate the genuine loss of a feature. A possible example is given below:

Parcel Number	New Parcel Number	CS1990 Parcel Code	Primary Code		Age		Species		Cover Value		Other Codes			Universal Codes
1		A	n		(n)	*n*	n		n					
2		B	n		n	*n*	n		n	*n*				
							(n)	*X*	(n)	*X*				
3		C	*n*		*n*		*n*		*n*					*702*
4		D	n		n		n		n					*999*

- When entering this data into the spreadsheet, the circle was indicated by using red. The 'x' was indicated by placing an 'x' or 'X' in the right hand column. If a *702* code was present, the whole line can be coloured red.
- Where *999* has been used to indicate the features has gone, *999* was place in the *Universal Codes* column.

Parcels with missing descriptions or missed in 1990

After the processing of the 1990 data, some parcels indicated on the maps were found to have no matching descriptions. This was indicated by a *777* code. These parcels were included on the field sheets for CS2000 so that surveyors could provide some information on them.

Some parcels may have been included on the field sheets that were either too small to be put on the maps or were illegible due to printing. In these case the surveyors usually indicated either by comment or symbols that they could find the feature. In some cases a whole feature may be indicated as having been missed by surveyors in 1990. In these cases, 1998 surveyors could indicate this only by entering a new line and putting *702* at the end. A similar situation can be implied by use of age codes, but this only applies to the Forestry sheet.

It was also possible that a feature was labelled on the map but had been missed off the code sheet. In this case the surveyor used the original parcel code from the map and entered a new description.

Boundary Sheet *Shape* and *Type* Columns

The *shape* and *type* codes used on the Boundary sheet were introduced in the 1998 survey. Consequently they only have one column each instead of the usual two for 1990 and 1998.

- The new *shape* and *type* codes was place in the headed columns unlike other codes.

Parcel Number	New Parcel	CS1990 Parcel	Primary Code		Height		Shape	Type	Species		Gaps		Management		Stockproof		Features		Other Codes	
1		A	N		n		*n*	*n*	n											
2		B	N		n		*n*	*n*	n											

Italics indicates the inclusion of the new shape and type codes in the description of the boundary.

Stockproof codes 351 and 352 on Boundaries

Though individual elements of a boundary, such as a hedge or a fence, may not be stockproof on their own, they may form a stockproof feature when taken together. To cope with this surveyors were asked to use the non-stockproof code, 352, with individual elements. If the boundary as a whole was stockproof, the 351 code was added to the end of the line with brackets around the elements involved.

To enter this information, the 351 code was moved to the *Other Codes* column and entered for each line involved. If the 352 codes were new for 1998 they were moved to the 1998 column.

Two Codes in One Column

In some cases surveyors entered several codes in one column. This was usually for feature codes where there can be several associated with one feature, or for banks and ditches where there were two sides to be described.

- There was provision in the sheet formats to put additional codes at the end of the line in the *Other Codes* columns. These were empty of any 1990 codes so that any of these columns can be used for 1998 codes.

Code Sequences in the Wrong Columns

Surveyors were asked to create a new line on the sheet if they could not fit new codes into the existing lines. However, there were cases where surveyors entered additional codes into the wrong columns. The codes were moved to their correct columns where possible. This can easily be achieved in *Excel* by creating a new line.

It was not expected that survey codes are examined during data entry to make sure they are all in the appropriate columns. However, where such cases are spotted it will be very useful to have them corrected.

Handling Comments and Unique Codes

When comments had been written on the sheet that describes part of the feature, Standard codes was substituted where possible. Otherwise, an entry was made on the Unique Codes sheet containing the relevant description. This was only done if there was no possible

standard code to cover the description. This and any other new codes entered by the surveyors was entered in red on the Unique Codes sheets:

Where information had been entered that was of more general use to surveyors or for interpreting data from the square, the comment was entered on the FAB Audit form comments section or on the digitiser's notes page.

Interpretation during Data Entry

If interpretation of what the surveyor meant by comments or particular code combinations was required, then as far as possible standard codes were entered but a '?' was placed in the *Universal Codes* column.

Data entry for 'new' squares

A blank set of formatted data sheets was stored as a new XL file. This was copied and given the name of the square e.g. 'Square 002.xls'. As in change squares, the file contains six sheets, one for each theme and one for unique codes.

The information from the field survey was entered into the corresponding spreadsheet, in the blank columns to the right of the '1990' columns. The parcel letter or number given by the surveyor was entered in the 'Parcel number' column.

Where parcels were unlabelled and a 'ZZA' etc code has been created by the digitiser, the ZZA in the 'Parcel number' column and 777 were put in the 'Universal code' column to indicate that the content of the parcel was unknown.

Broad Habitat codes

The recording of vegetation data changed during the survey. Originally, in new Broad Habitat areas, the species information was recorded and then a Broad Habitat code was given. This was amended so that only Broad Habitat information was recorded. The availability of species information was therefore inconsistent through the survey, so only the Broad Habitat code was required. If surveyors have added species codes to an Agricultural/ Natural Vegetation feature and have also given the feature a Broad Habitat code, then the Broad Habitat code alone was entered.

- The *New Parcel Number* was not included, because the spatial data was subsequently labelled with the Broad Habitat code, rather than the *New Parcel Number*.
- Any extra species/cover value information recorded by surveyors was not included.

Where Broad Habitat mosaic codes are given, they were given a *New Parcel Number* value by the digitiser.

- Two lines were added for the one code, to give both Broad Habitat numbers.

2.3.3 Vegetation data entry

Introduction

The 1998 survey recorded information from 569 squares, of which 506 had been surveyed previously in 1990. Each survey square can have a maximum of 52 vegetation plots recorded though in practice the number were considerably less for most squares.

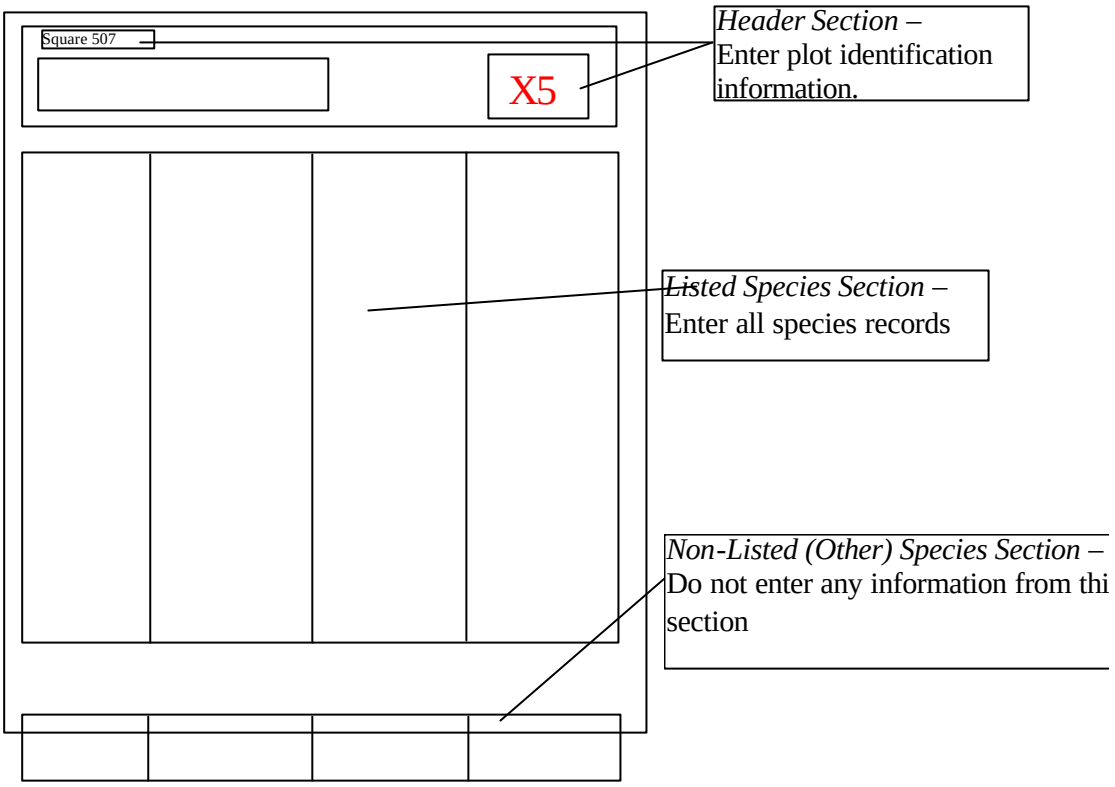
The process of data entry from the vegetation plot information had several stages. These were carried out by different groups inside and outside the former ITE. This document deals with the entry of species records from the list species section of the plot sheet. The layout of the species records and the data entry format required was listed in the following sections.

Vegetation Plot Types

From each survey square there were nine possible type of plot recording sheet from the CS2000 survey. These are summarised below: -

Type	Name	Number per Survey Square
A	Arable Margin Plot	Up to 5
B	Boundary Plot	5
D	Hedge Diversity Plot	Up to 10
H	Hedge Plot	2
R/V	Roadside Plot	5
S/W	Streamside Plot	5
U	Unenclosed Plot	Up to 10
X	Large Random Plot	5
Y	Small Target Plot	Up to 5

All the plot sheets had a similar layout containing different section for different information. The only data to be entered were the plot identity from the header section and the records from the listed species section. The hedge diversity plot sheets (D) had a slightly different format, but the header and listed species formats were the same as for other plot types. The general scheme was as follows: -

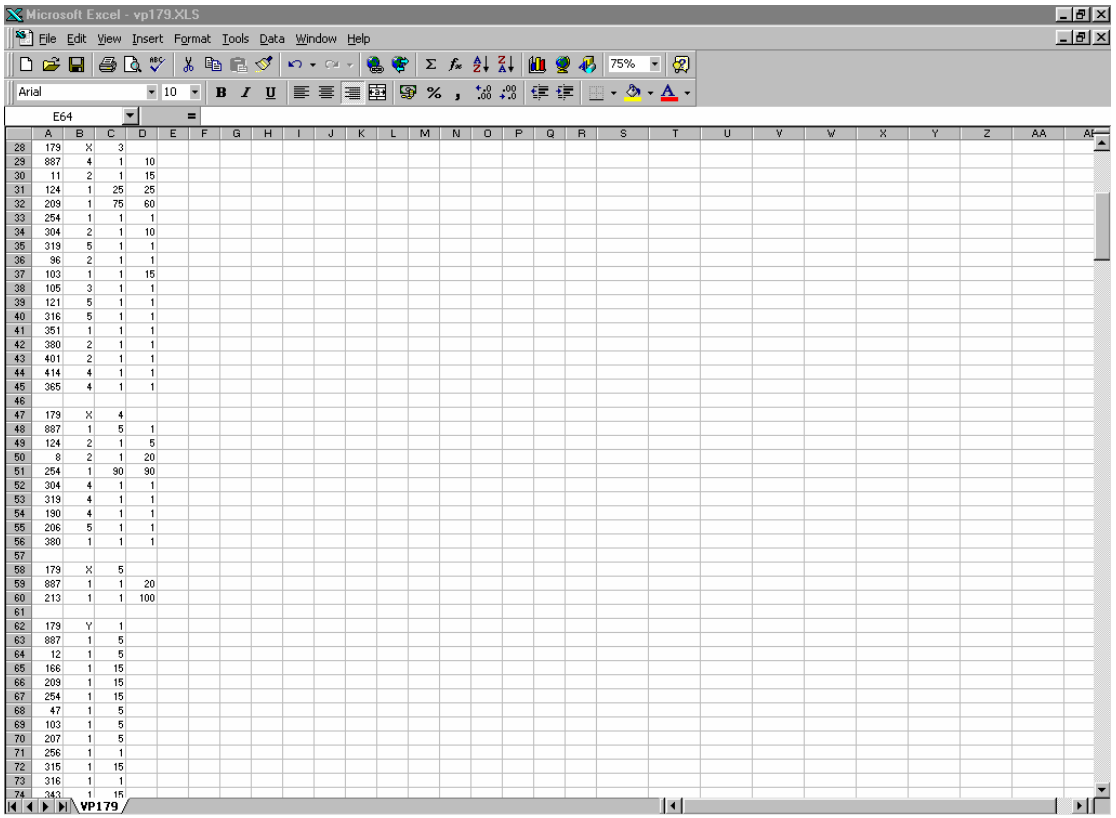


Preparing for Data Entry

No bespoke software was used for entry of listed species. Listed species records were entered in *MS Excel* spreadsheets in column format.

The plots from each square were entered into a different Excel file. The file name included the square number, e.g. plot data from square 179 were in a file named 'VP179.xls'. Within the file all plots were entered into one spreadsheet. The data for each plot were identified by its header record. The plots appeared in the following order: X, Y,U,A,B,H,D,S/W,R/V.

Entries were only made for plots with listed species records. If no D plots were recorded in a square then no D plot entries appeared in the list. The data entered from the plot sheets appeared in a spreadsheet as follows: -



Entering Plot Identification Information

Each plot sheet was uniquely identified by its square number, plot type and replicate number. This information was recorded at the top of each sheet. For example, the plot sheet below can be uniquely identified as 507/X/2.

Square 507 **200m^2 (LARGE) PLOT**

Land Use	Physiography	Slope	Aspect	Shade	Grazing
		flat slight moderate steep		none partial full	rabbits stock horses deer

Comments: X 2

The numbers given to plots may not have been consecutive and may have exceeded the maximum, e.g. a square may have X plots 1, 2, 6, 7, 8. It was important that whatever number had been allocated by the surveyor was the number entered into the spreadsheet. This information was entered at the start of species entry for each plot sheet. All species records in subsequent rows related to this plot. When a new plot was started another plot identifier was entered.

	A	B	C	D	E
	Square or species code	Plot type or nest number	Rep number or cover in first nest	% cover in whole plot	
1	507	X	2		
2	195	2	10	20	

6	507	X	3		
7	454	1	100	100	

13	507	X	4		
14	10	3	10	30	

Listed Species Information

The listed species for most plot sheets started in the format shown below. Surveyors were asked to indicate the presence of a particular species in the *Q* (Quadrat) column and note its percentage cover in the *%* column.

- Although ***Bare Ground*** has no code number indicated, its number was ***887***.
- The percentage covers were in 5% intervals except for covers of less than 5%. In this case the cover was indicated as 1%.
- Sometimes surveyors used a tick as short-hand for '1' and left out the 1% cover. For data entry purposes a tick were substituted with a 1.
- If no cover has been given then a 1 was assumed.

In most cases the *Q* column contained a 1 or a tick. In both cases this was entered as a 1 in the second column. -

Nested Format for X, S/W and R/V Plots

Although the layout of the different plot sheet types was very similar the species recording for the X, S/W and R/V plots was slightly different. This was because they consisted of several nested plots allowing the distribution of the species to be recorded. This was done by recording the number of the nest the species first occurred in. The total cover of the species across all nests was then recorded in the final % column. The result was that different numbers from 1 to 5 occur in the *Q* column and that both *%* columns can have values. To enter these records into the spreadsheet requires four columns instead of the previous two.

Entering Shade Species (Numbers in Brackets)

Where a species was shading a plot but not rooted in it (e.g. covered by tree canopy) the species was recorded with brackets around its cover value. This notation can cause problems in recording and surveyors used variation of the above to indicate different situations. Where the surveyor has put two numbers in the same column (e.g. 5 & 50 for 193) the numbers were put in different columns in the spreadsheet.

Non-standard Notations

Surveyors did come across situations that had not been allowed for on the plot sheet formats. In these cases they may have created notation to try to explain the plot. These were often accompanied by comments somewhere on the sheet. For this stage of data entry, data in the spreadsheet reflected what was on the plot sheets as closely as possible whether standard notation or not. Where this was obviously non-standard it was subsequently spotted during the data validation stage and interpreted by a field botanist. Comments on specific species (e.g. dead, seedling etc.) and additional covers due to shade species were entered in additional

columns. However, trying to interpret what has been recorded into a standard notation was generally avoided.

2.4 DATA ANALYSIS METHODS

2.4.1 Land cover and landscape features

Objectives to be met by spatial data analysis

Spatial data can be divided into three sections using the style of recording and storage of information. The sections are:

1. Area – where information relates to the spatial extent in two dimensions and the data are stored as polygons defined by vectors.
2. Linear – where information describes one dimensional lines with no explicit area and data are stored as vectors.
3. Points – where information is simply locational and has neither length nor area and data are stored as single co-ordinates.

The overall objective of the spatial data analysis is to summarise and present statistics and interpretation at a national and regional scale characterising the British landscape using information from the three sections. The methods applied within the different sections may vary, but there is a strong similarity and cohesion permitting information to be correlated between sections.

Data entry

Mapped information recorded in the field was manually digitised to produce a digital copy. Lines were traced with an electronic puck and vertices inserted wherever there was a bend. Polygons were closed so that they did not 'leak' into neighbouring polygons and did not have short remnants of vectors extending outside them. Lines were simple strings of vertices and points were entered as individual vertices. All information was geo-registered to the Ordnance Survey's National Grid at metre resolution. The potential distortion from mis-registration and directional stretching of paper recording sheets was monitored and used to force re-entry of some information.

Mapped information was recorded under five separate themes, *Physiography, Agriculture and semi-natural vegetation*, *Forestry*, *Buildings and communications* and *Boundaries*. Each individual themes provides comprehensive coverage of its features for the sample square, but is unlikely to describe every square metre within the square. However, by combining the information from all themes coverage is total.

To reduce artificial and extraneous noise being generated form the repeated entry of the same line (e.g. twice as polygon boundaries, once as a linear boundary, etc). Lines were only digitised once and then edited and copied for subsequent use.

Once entered into the GIS, summary information was transferred into the Oracle database so that the feature attributes could be linked to the spatial characteristics.

Data validation

Once entered, it is essential that the quality of information is even. A variety of checks were applied to the data to ensure:

- Completeness of data
- Missing attributes – parcels labelled 'no data'
- Validation of attribute data – code sequences in correct data column etc
- Surveyor/digitiser error in 1998

- Surveyor/digitiser error in 1990
- Handling comments on FABs
- Use of unique codes

One of the goals of data validation is to ensure that interpretation during data entry is reproducible and applied using a standard and documented method. Ideally, interpretation will be perfectly straightforward, but some decisions have to be made if any ambiguity is left after the field recording.

General data issues

Where squares were only part-surveyed squares in one year, the surveyed parts were still used to contribute to the description of the classification. Unsurveyed parts were classed as unknown and will occur in change matrix figures.

It was agreed that although the units of recording were metres (m) for lengths and square metres (m^2) for areas, for presentation of results lengths would be presented in thousands of kilometres (km x 10^3) and areas in thousands of hectares (ha x 10^3 or km x 10). Point features and landscape units such as ponds were presented as simple counts.

The data were collected using a stratification to target the sampling and results for areas, lengths and points were weighted up using standard statistical procedures. The mean extent of a feature was calculated for each land class (or stratum) along with its standard error. The national or regional total was calculated by multiplying the land class sample mean by its full geographic area and then summing all the land class totals.

The parametric statistics produced were presented as national total and standard error (both in agreed units) and the Coefficient of Variation (CV) which is the standard expressed as a percentage of the national total. The latter has the benefit of being unit less and so can be used to compare the variation of features recorded using different units, or of different magnitudes. As a rule of thumb a CV of 40% or less can be considered to be a usable estimate, or a significant change.

Other statistics were also produced, detailing the number and proportion of the sample squares containing a feature, the features occurrence by land class and the proportion of squares containing a feature within the land classes in which it was found.

Change statistics were produced using two methods. First, using data from re-visited sample squares and identifying the net change by square. As described above, the square values were weighted to produce national estimates. The gross change was calculated as a matrix of change or flow account. This was done by identifying every parcel or line and recording what it had changed from and to. Again, nationally weighted figures were produced.

The parametric statistics require assumptions of statistical normality to be made before significance tests can be applied to determine change. To produce measures of confidence in the statistics without making those assumptions (which were un-testable on a dataset of this size) a method of bootstrapping was used.

Bootstrapping is a repeated random re-sampling of the collected information, each repetition is then used to produce an estimate and together the estimates describe statistical distribution of the values. The mean of the estimates produced matches the figures derived by parametric methods, but improve on those values by providing a description of the level of confidence in the results. Each value shown for each variable is derived from 1,000 bootstrapped calculations. Ranking the values in order of magnitude and reading off the 25th and 975th value produces the 95% confidence intervals and a probability that the value is no different from zero. The probability should only be used for examination of change as it effectively measures the likelihood of no change. If the probability of being zero is > 0.99 you can be reasonably sure that there has been no strong directional change but if the probability is < 0.01 there is a significant change in one direction; $p < 0.01$ is 'three star' significance.

Allocation of Broad Habitat type and Main Land Cover Type to each area feature

Information was collected in more detail than a simple Broad Habitat (BH) or Main Land Cover Type (MLCT). Recording methods were largely the same as used in the Countryside Surveys of 1984 and 1990. To classify the raw field data into BH and MLCT routines were developed. The same method was used to classify the 1990 and 1998 data into BH, but the 1984 data were classified using the 1990 Definition Codes and comparison between 1984 and 1990. The MLCT are subdivisions of BH and therefore smaller generally more consistent categories; they were classified using a simpler procedural key.
In the 1998 data, surveyors had recorded their agreement or concerns over the information collected in 1990. This information was taken into account when producing the 1990 BH definitions. Other landscape features (such as boundaries) were classified using a procedural key.

The allocation procedure
The detailed methods are described in Watkins et al (200#) from which the following is extracted.
To allocate Countryside Survey land parcel polygons to Broad Habitat summary classes for reporting purposes, a matrix was produced giving each field attribute code a score describing its potential occurrence in each of the classes. For example, the code for oak would score highly in broadleaf and mixed woodland but would have no score in conifer wood or calcareous grassland. All polygons can be classified by summing the scores of its attribute codes within each summary class. The polygons are then allocated to the class with the highest score. If several classes tie, the polygon can be left as a mosaic of types or allocated to a particular class using a rule base. The basic procedure for this allocation is illustrated in Table 6.

ATTRIBUTE CODE NUMBER	ATTRIBUTE CODE DESCRIPTIONS	BROADLEAF, MIXED AND YEW	CONIFER	LINEAR	ARABLE	IMPROVED GRASS	NEUTRAL GRASS	CALCARIOUS GRASS	ACID GRASS	BRACKEN	SHRUB HEATH	FEN	BOG	OPEN WATER	RIVER	MONTANE	INLAND ROCK	URBAN	SUPRALITTORAL ROCK	SUPRALITTORAL SEDIMENT	LITTORAL ROCK	LITTORAL SEDIMENT	SEA
2.4.1.1.1 Scoring for parcel in 1990 survey																							
101	Lowland agricultural grass					5	4																
154	*Agrostis capillaris*						1		7														
176	50-75%																						
152	*Cynosurus cristatus*					1	7																
175	25-50%																						
186	Dairy					1																	
194	Hay					2	1																
	Broad Habitat Scores - 1990	**0**	**0**	**0**	**0**	**9**	**13**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Scoring for parcel in 1998 survey																							
101	Lowland agricultural grass					5	4																
154	*Agrostis capillaris*						1		7														
176	50-75%																						
197	No apparent use																						
	Broad Habitat Scores - 1998	**0**	**0**	**0**	**0**	**5**	**5**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 6 Allocation of a single parcel to Broad Habitats using attribute codes

In the example presented in Table 6, two sets of attribute codes describing a parcel in two different years are presented along with their weightings for the 22 Broad Habitats. Summing the weightings for each Broad Habitat and identifying the largest produces an allocation of Neutral Grass for the first year and Acid Grass for the second.

Measuring class affinity and confidence in allocation

In the procedure outlined above, a parcel of land will have attributes that score in several different Broad Habitat classes. This profile of Broad Habitat scores for each land cover element shows whether it has associations with only one class, such as Conifer Woodland, or of several classes, such as the grassland types. Furthermore the magnitude of any one score can be taken as an indicator of the strength of affinity to a class and collectively they describe the diversity present in the polygon. Hence, an element may be said to have a strong or weak affinity to one or several Broad Habitats. Weak affinity may indicate that the characteristics of the land cover element are poorly described by the Broad Habitat classification or may indicate a paucity of information from the survey. The overall polarity of a profile may be used as a measure of confidence in an element's final class allocation. Collecting more

information to strengthen a profile may not give a clear allocation but may broaden the number of classes with which an element shows affinity. Confidence in the classification is therefore a function of the breadth of an element's affinities as well as their strengths.

In order to quantify confidence in the allocation of an element to any one class, the magnitude of all the element's affinities needs to be examined. The greater the dissimilarity in the profile of scores, the greater the confidence in allocating an element to one particular Broad Habitat class.

In the current example of classification of land cover elements into Broad Habitat classes, the highest scoring Broad Habitat in the element's profile determines its allocation. The level of confidence will not alter the allocation of an element to a Broad Habitat. However, a measure of confidence does affect allocation when determining Broad Habitat change.

Comparing class affinities and defining class change

Where elements have been assigned to a set of classes, the measurement of change over time needs to be defined relative to both the individual elements and the overall classification. Where the characteristics of elements have been defined independently of the classification, it is possible to observe changes in the composition of an element that may not affect its class assignment. Measurement of these individual changes can be used to define what is a significant change in class affinity and also give confidence in assigning change to any particular element.

As stated above the confidence in allocation of an element to a class is a function of the strength and breadth of its affinities, as measured in this case by the elements Broad Habitat scores. Comparison of an element's scores at two points in time can be achieved in a variety of ways. One common method is to use a generalised distance measure such as the Minkowski metric (Krzanowski, 1988). Using the Minkowski metric a larger value indicates greater confidence in change in the elements class affinities. If a high value is combined with a change in the highest scoring class between surveys the element can be defined as having changed class allocation. However, if the metric gives a low value, the element will not be assigned change regardless of a change in highest scoring class. This is because the metric value indicates that there is insufficient evidence that a real change has taken place in the elements underlying characteristics. This *override* of the class allocation by the metric value is most likely to take place in borderline cases where confidence in individual class allocations is low at the first, second or both time points. The definition of borderline in this case will be allied to the definition of a sufficiently high metric score to indicate change. By limiting the change to where it is clear-cut, the process is conservative.

Details of how to calibrate the change metric are given in Watkins et al. (200#) but relies on examination of the underlying structure of the code scoring system.

Discussion of the allocation procedure

There are benefits to using a standard statistical method to determine the significance of change, but it also has specific consequences. Three descriptions of a parcel are being made, first its Broad Habitat at time one, then its Broad Habitat at time two and finally the change from one Broad Habitat to another. For estimates of change derived solely from a simple deterministic allocation, the third description can be derived from the other two, but in this case that is not necessarily so. The best estimate for the Broad Habitat at either time point is still that produced by looking at each individual years data, but the additional detailed element data may suggest that no real change has occurred in a parcel classified into different Broad Habitats in the two years. The problem is largely presentational; the Minkowski derived

change statistics are practically useful, as they are conservative estimates of where clear change has occurred.

Ancillary statistics, such as the difference between the best individual time estimates and the correspondence matrix should offer an aid to interpretation. For example, *Calcareous Grass* has a far smaller number of changes rejected than *Improved Grass*. This indicates the quality of change, contrasting dramatic shifts with more subtle evolution and suggests where the edges of the Broad Habitat definitions are less clear.

The clarity or confidence in allocation is available to the GIS through each parcel's Broad Habitat scores. The profile of these scores reflects the underlying heterogeneity indicated by the attribute codes, which is hidden by allocating the parcel to a single Broad Habitat category. This underlying information could be used in graphical presentation of confidence calculated for each parcel using the highest score vs. the total of all scores (c.f. maximum likelihood). Alternatively, a representation of heterogeneity could be presented by allocating areas within each parcel according to its scoring in different Broad Habitats (Aspinall and Pearson, 1995). Information from the scoring profile of each parcel is especially important in scenario testing and permutation methods for predicting change. Use of this information in providing confidence measures for predicted change as well as observed change is the subject of ongoing research.

The analysis of change, especially of repeated measures, needs more careful interpretation than the production of single measures. Where decisions are likely to be made using the results, they need to be conservative and robust. Decisions taken producing the statistics have to be objective and transparent and the final presentation should be qualified by measures of confidence. In this case, a procedure, the Minkowski metric, has been employed that meets those criteria.

Figure 6. Flow diagram for processing of area data

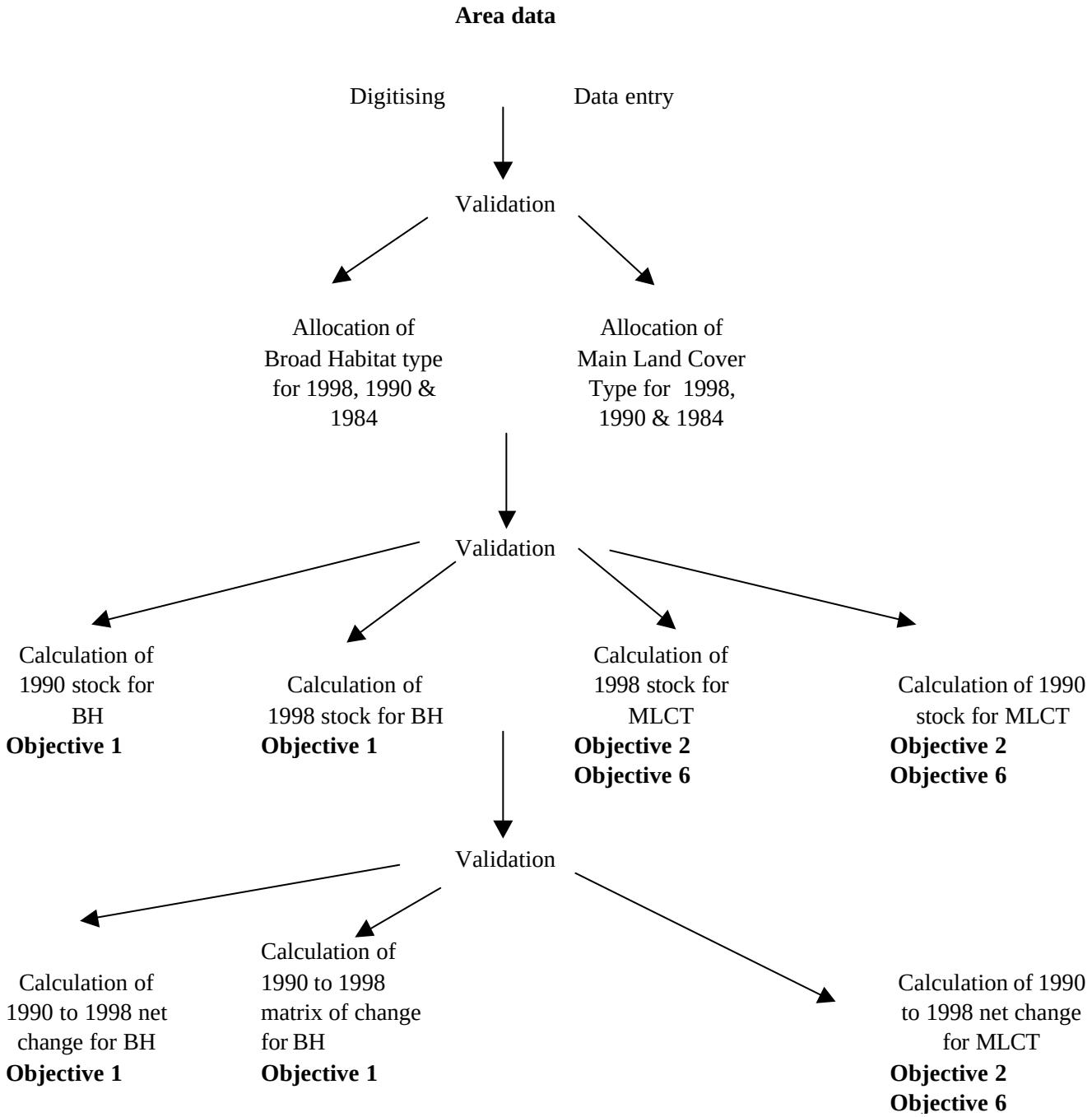
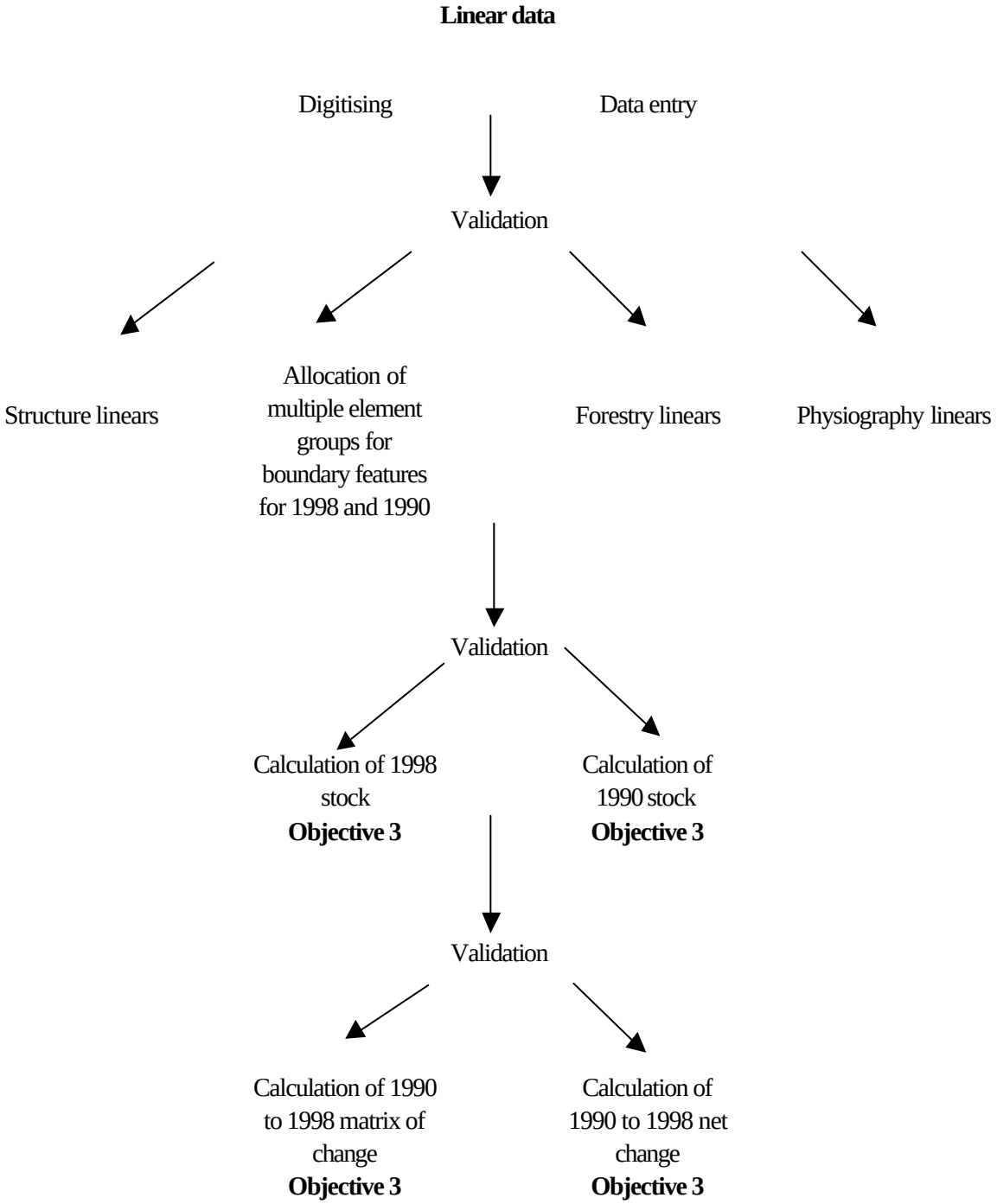


Figure 7. Flow diagram for processing of linear data



2.4.2 Vegetation

The Data Stratification

Country units

These were taken to be England & Wales (together and separated), Scotland and GB; the latter encompassing all three nations. Analysis was undertaken based on each country unit bearing in mind the limitations of the data, as sample size decreases when drilling down to nested combinations of Broad Habitat, Aggregate Class, zone and plot type levels.

Environmental zones

Reflecting devolution in GB, a new series of environmental zones has been derived (see LINK). The new scheme is a development of the original four 'Landscape Types' used for reporting CS1990, comprising aggregation of ITE land classes, but makes a division between Scotland and the rest of GB as follows:

England & Wales	Scotland
1 = South & east lowlands	4 = Lowlands
2 = North & west lowlands	5 = Marginal uplands & islands
3 = Uplands	6 = True uplands

Widespread Habitats

The original research proposal for CS2000 included a requirement to record and quantify 'widespread habitats'. These were taken to be those of the Broad Habitats which were sufficiently extensive in Britain to allow the sampling system used in Countryside Survey to quantify them with reasonable statistical accuracy. Thus, Broad Habitats such as Calcareous grassland and Acid grassland might be excluded from the survey.

Subsequently, it was decided that it would be easier to survey if all Broad Habitats were surveyed and results computed, and only then would decisions be made about which results to advocate as reasonably robust. Thus the concept of 'widespread habitats' was abandoned.

Broad Habitats

It is important to note that the definition of the BAP Broad Habitats had not been fully completed at the time of the field survey, although close contact was maintained with those responsible for drawing up the definitions (JNCC). The relationship between the new Broad Habitats and the field codes used in earlier Countryside Surveys was fairly well understood..

Since the Broad Habitat stratification underpins the entire reporting framework, issues regarding their analytical tractability, the process by which they were defined for survey during CS2000 and the relationships between 1998 definitions and the final definitions were fully aired and discussed. These issues concern all interested parties including the CS2000 Spatial Analysis Group (SAG), DETR and JNCC.

The SAG implemented final Broad Habitat definitions in the 1998 spatial dataset and pinpointed where:

a) Broad Habitats, and therefore plots, stayed the same
b) Broad Habitats and plots changed
c) plots represent the same Broad Habitat in both 1990 and 1998 but comprise those 'lost' from the Broad Habitat in 1990 and 'recruited' to the Broad Habitat in 1998.

Change and turnover *in area* of Broad Habitats was based upon census mapping of the land-cover in each square. Vegetation plot data was then used used to characterise Broad Habitat areas mapped in 1998 and to examine a) compensation related to turnover between Broad Habitats and b) vegetation change in plots that stayed in the same Broad Habitat. In seeking to emphasise that Broad Habitats are defined by Land Cover, the vegetation type (see below) of each plot was determined independently of the Broad Habitat in which the plot was situated.

The Boundary and Linear Features Broad Habitat was characterised using vegetation in linear plots (R/V, S/W, B, H, D). However, these plots also convey intrinsic information about the wider area that a linear feature is associated with. Therefore, the linear plots were used to characterise the vegetation of the nearest adjacent areal Broad Habitat, but kept separate from the plot information in the areal plots to avoid 'double counting' or confusion arising from comparison of different plot areas.

Y plots were separated from other plot types when characterising Broad Habitats. This is because of their different nature of location and placement [LINK].

Relationships to outputs and methodological details are considered later in this report [LINK].

Aggregate classes and CVS classes

The original research specification included the need to "..report vegetation change using the Countryside Vegetation System (CVS) on a country basis." The CVS is a multivariate classification of CS vegetation plot data. The classification consists of 100 minor classes and eight larger units called Aggregate Classes. Full descriptions of each class and the construction of the classification are given in Bunce et al. (1999). Briefly, the classification was constructed as follows. 100 minor units were derived from a TWINSPAN (Hill, 1979a) classification of all plant species by plot data recorded for the survey years of 1990 and 1978, excluding a small number of outlying groups were rejected (vegetation plots located on bare, ploughed soil and in saltmarsh, an under-represented habitat in CS data). These 100 vegetation classes were aggregated into eight Aggregate Classes using Ward's (1963) method of cluster analysis that maximised the ratio of between- to within-class variance of plot scores on the first four rescaled DECORANA axes (Hill, 1979b). These eight Aggregate Classes provided an ecologically meaningful division of the vegetation data, while maximising sample sizes available for analyses of change (Table 9). Environmental interpretations of the major gradients across the classification units were based on correlation between plot scores for ordination axes and mean Ellenberg indicator scores for each plot (see below). Ordination axes 1 and 2 were most strongly correlated with Ellenberg fertility and light scores. Thus changes in plot membership between classes can be interpreted as shifts along these two axes, in turn implicating changes in nutrient availability and disturbance in vegetation change.

Table 9. Descriptions of the eight Aggregate Classes of the Countryside Vegetation System (Bunce et al 1999).

Aggregate Class	Code	Description
Crops/weeds	1	Communities of cultivated and disturbed ground. Includes land under arable cultivation.
Tall grassland and herb	2	Most typical of road verges and infrequently disturbed patches of herbaceous vegetation. Includes 'old field' communities of spontaneous, fallow grassland. Usually dominated by tussock-forming perennial grasses and tall herbs.
Fertile grasslands	3	Improved and semi-improved grasslands very common across Britain. Usually with a long history of high macro-nutrient inputs and cut more than once a year for silage.
Infertile grasslands	4	Unimproved and semi-improved communities in wet or dry and basic to moderately acidic vegetation. Lowland, species-rich mesotrophic grassland is represented here.
Lowland wooded	5	Tree and shrub dominated vegetation of hedges, woodland and scrub in lowland Britain.
Upland wooded	6	Includes upland semi-natural broadleaved woodland and scrub plus conifer plantation. Also includes established stands of Bracken (*Pteridium aquilinum*).
Moorland grass and mosaics	7	Extensive, graminaceous upland vegetation, usually with a long history of sheep grazing.
Heath/bog	8	Ericaceous vegetation of wet or dry ground most extensive in upland areas of Britain. Includes raised and blanket bog vegetation.

Plot types

The different types of vegetation plot used in CS2000, as well as their use in earlier surveys, are shown in the following table and were described earlier.

Plot type	1978	1990	1998
X, field and unenclosed land	X	X	X
B, field boundaries		X	X
H, hedgerows	X	X	X
R, road verges	X	X	X
V, additional road verges		X	X
S, stream/river sides	X	X	X
W, additional stream/river sides		X	X
Y, targeted on atypical vegetation		X	X
U, 'unenclosed' Broad Habitats			X
A, arable field margins			X
D, hedgerow woody species			X

Analyses of A and D plots are not part of the Module 1 work program although they could be used to characterise Broad Habitats in 1998. All other plot types except U plots have been used to stratify data for analyses of change.

U plots were used to characterise the 'unenclosed' Broad Habitats within which they were located, in combination with all other areal plots in that Broad Habitat. Linear plots were used to characterise Broad Habitat of associated areas, but they were kept separate in the reporting, so that double counting did not occur.

For CS2000 analyses, B plots that were recorded next to hedgerows were not included in the analysis of H plots. This was not done during ECOFACT. Also there are subtle differences in the way a B plot as opposed to an H plot would have been recorded next to the same hedge. For example a hedge fronted by a fence would require a B plot to run 1 metre out from the fence base. An H plot in the same situation would run from the centre of the hedge. Joint analyses of these two similar plot types could be undertaken, with care, at a future date.

Change in Y plots does not represent a statistically valid population from which inference can be made to a wider population of vegetation fragments. They have been used to stratify change in Condition Measures but were not mixed with other plot types. Similarly, Y plots were kept separate when characterising Broad Habitats.

Time intervals

The classification of GB into four zones; arable, pastural, marginal uplands and uplands, was used in reporting CS1990 results. A similar analysis of 1990 to 1998 data has provided continuity with earlier work although the current emphasis is on Broad Habitats as the primary reporting framework for Module 1. Since compatible land cover information does not exist for 1978 it is not possible to group 1978 plots by their Broad Habitat in that year. However, even without Broad Habitat stratification, such an analysis provides a link with previously reported changes in species richness. Therefore, replicate data was stratified by the original four zones, by the new country unit and environmental zone classification, by aggregate class and by plot type.

Static and Dynamic strata

An important distinction can be made between strata where plots can change membership in time and those where they cannot. The distinction has important technical consequences since it logically leads to a number of options for partitioning change. It is important operationally as it has implications for the size of the analytical workload.

A division of strata into 'static' and 'dynamic' (Table 8) has been created. Static strata include Country Unit, Environmental Zone and Plot Type where any plot cannot change its membership of a stratum level over time. For example, an X plot is always an X plot and a plot located in the pastural landscape of England and Wales will always be so classified. Dynamic strata are Broad Habitat and Aggregate Class. Membership of dynamic strata can and does change over time with vegetation and land cover change. Membership of these strata is defined by these changeable entities, rather than by landscape location or geography

Thus for dynamic strata three analytical options are available (Figure 8). Each type of change analysis focuses on a different aspect of ecological change. These options were explored to some extent in the ECOFACT 1 project but their potential was not fully exploited.

Table 8. Characteristics of the different types of vegetation analysis

CS strata	Membership change possible	Dynamic or Static
Country Unit	No	Static
Environmental Zone	No	Static
Plot type	No	Static
Broad Habitat	Yes	Dynamic
Aggregate class	Yes	Dynamic

Figure 8. Examples of the types of change analysis, using scenarios of change between 1990 and 1998 for hypothetical strata (such as land cover or aggregate vegetation classes, shown here as classes 1 and 2).

1990 stratum	1998 stratum	1990-based analysis	Stay-same analysis	Turnover analysis
1	1	Yes (1)	Yes	
1	1	Yes (1)	Yes	
1	1	Yes (1)	Yes	
1	2	Yes (1)		Yes
1	2	Yes (1)		Yes
2	2	Yes (2)	Yes	
2	1	Yes (2)		Yes
2	1	Yes (2)		Yes

The 'stay-same' approach is based upon plots whose vegetation or land cover did not change sufficiently to cause a shift in Broad Habitat or Aggregate Class. It therefore focuses on changes within the dynamic stratum that were not large enough to result in a shift in stratum membership.

The '1990-based' analysis looks at plots stratified by their stratum membership in 1990 and analyses their 1998 replicates irrespective of the magnitude of change and their stratum membership in 1998. This approach is the easiest to understand as it simply divides up the data in a baseline year and examines the fate of plots through time but always with reference to the baseline membership of the data. It is also likely to be the most powerful statistically since it will incorporate the largest number of paired samples of all three approaches. However it will be affected by divergent trajectories among plots. For example it could not discriminate between effects on upland grassland plots that became afforested and those where grazing had relaxed. Such interactions will increase within year variance and could lead to lack of significance as happened with the CS1990 amalgamated woodland analysis.

The 'turnover' approach compares plots with the same stratum membership in either year but where each plot either moved into the stratum level in 1998 or was lost from the stratum level in 1990. Change will therefore be based upon unpaired replicates and is also likely to be unbalanced. This approach is useful in that it allows evaluation of the extent to which gains to a stratum level compensate for losses from that level.

Vegetation character

Once subsets of CS data were assembled and appropriately stratified, aspects of stock and change across each were summarised. The range of descriptors and indicator variables that were generated during work on the Causes of Change in Biodiversity between '78 and 1990 carried out under ECOFACT 6 [Ref]. A total of 12 Condition Measures were considered, some of which can imply processes of botanical change whilst others convey aspects of botanical quality.

In Annex 2 the suitability of each Condition Measure is considered in turn, in the light of the Module 1 work program. Analytical methods are discussed in section 4.

In summary vegetation character will be conveyed by the following Condition Measures (Table 9).

Table 9.

Condition Measure	Data type
Aggregate Class change	Count of plots
CSR scores	Weighted proportion per plot
Species richness	Count of category 1 taxa per plot
Ellenberg scores	Weighted proportion per plot
Faunal Food plant Index	Count of species per plot

The Food Plant Index was only computed and analysed for specific subsets of CS data that coincide with those areas in which changes in the abundance of each animal group were known to have occurred. Index scores are also only likely to be appropriate when describing vegetation within the known range of the animal species. In previous work the link between food plants and animal species was drawn out at the species level. However for Module 1 analyses a single index only was used. This conveyed the number of species in each plot known to be food plants for a selected range of butterfly species and a selected number of lowland farmland birds.

Among the original Condition Measures analysed during ECOFACT was a list of species characteristic of unimproved acid, calcareous and neutral grasslands. The list was originally developed by the England Field Unit of the former NCC. Although useful, the list is incomplete from the point of view of a GB-wide analysis of stock and change. This Condition Measure was consequently rejected from Module 1 analysis, however it may still be important to examine the fate of named individual plant species between 1990 and 1998. This may require an analysis of change in plant species particularly characteristic of each Broad Habitat. Such an approach may be necessary to help fulfil the need to describe the general changes in vegetation and botanical diversity occurring in the wider countryside and assess the significance for nature conservation.

ANALYSIS

Change

The Condition Measures selected for computation and analysis in Module 1 comprised two types of data (Table 9). For Aggregate classes, change matrices present a raw count of plots in each class in each year (1990 and 1998) with turnover between (see section 5). Statistical analysis of the significance of these shifts was not carried out under ECOFACT, and therefore were completed in CS2000 for the first time. Chi-square analyses of shifts in plots between aggregate classes (Condition Measure 1) and CVS classes (Condition Measure 2) were carried out. Note that each cell

of an 8 x 8 aggregate class matrix had to be tested, ie reduced to a two-way table, rather than give a much less meaningful significance test for the whole matrix.

For the other Condition Measures the data were analysed using formal statistical techniques. Although paired t-tests have been used extensively in the past, the test does require that certain assumptions are met; ie normality of data distribution as well as independence of plots within a square. Whilst robust to a degree of deviation from these conditions, there is often little guidance on how far the rules can be bent before results become unreliable. The use of non-parametric tests were considered since non-normal data can be analysed and data transformations were not needed.

The Wilcoxon matched-pairs test was considered for analysing change in Condition Measures. However, this test ignores plots whose values in both years were the same. Using this test, it was necessary to convey the proportion of the total sample tested. Where this subset comprised a small part of the total sample then although statistically significant, this change may be ecologically less significant.

T-tests were employed to analyse vegetation change between 1990 and 1998. This decision is based on several considerations:

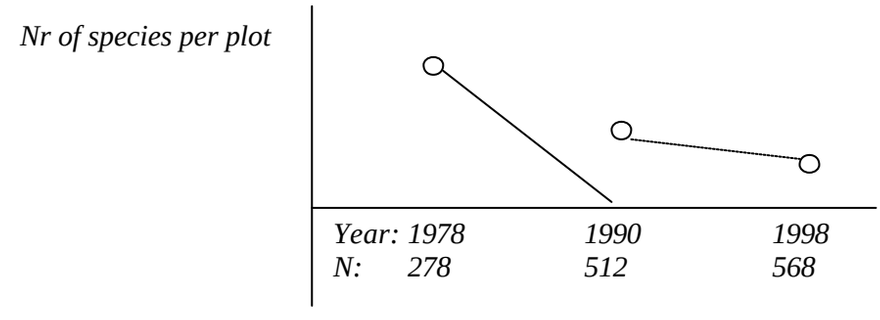
1. First and foremost, using t-tests is in the interests of keeping the analyses as similar as those performed for CS1990

2. It directly addressed the ecologically simple question 'is there significant change' without having to go into matters of extent and severity of change (proportion of plots that change *versus* those that stay the same)

3. To address non-independence between plots estimation of degrees of freedom and variance components for each 1km square were carried out by treating square as a random effect.

4. To answer any problems arising from assumptions of normality of the data, it was suggested that asymmetric confidence intervals are computed for the entire sample of differences. However, results of these calculations could at worst invalidate and confuse test results, without their actually adding information to their interpretation even if they don't. Transformation of Condition Measure data was not considered necessary for expression of means.

Figure 9. Calculation of difference in species number between 1978, 1990 and 1998. No assumptions are made about the actual shape of the curve



Test of change: ([mean 1998 – mean 1990; N = 512] – [mean 1990 – 1978; N = 278] against 0)

The meaning of zero values

It is important to recognise that zero values for Ellenberg scores can result because no species in a particular plot had a value. In other words no score is possible for the plot and on this basis zero

cannot be compared with an Ellenberg score of 1 which is in fact, the lowest value possible. In this instance the zero means null rather than a low score. The same applies to CSR scores since the denominator comprises only cover or presence of species that have CSR data. For other Condition Measure variables in which the score is a proportion of all species present, zero is the lowest possible value. For example the proposed Faunal Food-plant Index conveys the proportion of cover of species in a plot that are known to provide food for each animal group. If a plot has 6 species none of which are food plants then the score is zero which can be meaningfully compared to a score of 0.5 or 1.

These issues required careful consideration, especially regarding the communication of total sample numbers used in each analyses and why numbers may potentially differ. For example plots that contained species with no Ellenberg values were excluded from any analysis of Ellenberg scores. To ensure that this happened as little as possible, species newly recorded in 1998 had scores attached to them from the larger British Flora database (ref – Hill). Bryophyte-dominated plots lacked Ellenberg values.

Replicate datasets

In line with the ECOFACT 1 and 6 modules, minimal sample size was defined without exploring further options such as power analysis. This ruled out reporting the likelihood of 'missed change' for analyses based on low number of samples.

The minimal sample was defined as the number of plots when n is >20 or n is >=10% of plots in the higher level stratum. Replicate plots were those that were recorded in the same location in both years without having been subject to ploughing, or other destructive agricultural management practices, in either year.

STOCK

The only element of vegetation analysis relating to stock was the characterisation of Broad Habitats.

To clarify what was possible in terms of Broad Habitat characterisation, it was assumed that all Broad Habitats are defined by 1990 reporting code. Logically therefore, plots could not be used to search for Broad Habitat fragments smaller than a Minimal Mapping Unit based on the species composition of the plot. Thus Y plots cannot, for example, be used to identify small fragments of a calcareous Broad Habitat although calcareous grassland CVS classes may be represented by plots in an area otherwise mapped as Improved Grassland.

In order to use plot data to search for unmapped fragments of Broad Habitats, a link was needed between CVS classes and Broad Habitats. This was not practicable since on that basis an 'unenclosed' Broad Habitat exhibiting some diversity of CVS class composition could then be said to be a mixture of Broad Habitats, rather than any single one..

Broad Habitats were characterised using all the random plot types available plus the U plots for 'unenclosed' Broad Habitats. Y plots were used separately to convey the character of vegetation not typical of the Broad Habitat (although some less extensive Broad Habitats could only be characterised in this way). Linear plots were used primarily to characterise the linear Broad Habitats. They were used additionally to characterise the wider Broad Habitat by which they were surrounded, but for this purpose were always kept separate from the area plots to prevent confusion. A (arable field margin) and D (hedgerow diversity) plots were separated out from the other plot types and used to characterise Broad Habitats in terms of species frequency and mean richness (A&D) and CVS class frequency (A).

Since the location of an A plot, by definition, occurred where arable land was present, these were only used to characterise the Arable Broad Habitat. They were not used for characterising the Boundary & Linear feature Broad Habitat (except where this is explicitly restricted to that fraction of the Boundary and Linear feature Broad Habitat associated with it).

CODING AND DATA MANIPULATION

The use of MAVIS

The software package, MAVIS, developed under ECOFACT (available free at www.ceh.ac.uk/products_services/software/mavis.htm) offered the facility to produce both CSR radius scores and Ellenberg scores for vegetation sample data. However since MAVIS was never rigorously and formally tested, it was necessary to check that the MAVIS output was consistent with scores generated previously for ECOFACT outwith the MAVIS environment. Testing was carried out to ensure that MAVIS could be used to generate reliable Condition Measure data.

The MAVIS software was also used to allocated botanical data for each vegetation plot to the CVS and therefore to one of the eight aggregate classes. This allocation works by applying the weightings of every species in the original TWINSPAN classification of CS data for 1978 and 1990.

Species names

Representing the current standard, Stace species names were used in Module 1 reporting and a migration was also made to the numeric codes used by the Biological Records Centre at CEH Monks Wood..

Handling data for species overhanging but not rooted in vegetation plots

To ensure consistency with CS1990 and ECOFACT analyses, the same approach to these species was adopted. Hence, species not rooted in the plot but overhanging and therefore casting shade were incorporated in the calculation of condition measures.

OUTPUTS

The range of outputs stated in the Module 1 specification are summarised in Table 10. Stratification of the vegetation data and the definition of 'vegetation character' are common to all outputs. Issues and recommendations have therefore been discussed separately in sections 2 and 3 in this report.

An important aspect of the proposed outputs is worth highlighting: Because of the need to stratify CS plot data by country unit, Environmental Zone, plot type and Broad Habitat, a huge number of analyses were potentially possible. Many analyses within particular cells of the stratification were rejected at an early stage because of small sample size. The approach was then to analyse data at the highest levels of the hierarchy of strata, and then to drill down to smaller data subsets.
Consideration of the flow of results in terms of ecological meaning and statistical robustness limited analyses to those combinations of strata that provided the most information on stock and change in CS plot data.
The higher level results have been reported in *Accounting for nature: assessing habitats in the UK countryside* (Haines-Young *et al.* 2000) while the results of more detailed analyses appear on the Countryside Survey web site (www.CS2000.org.uk).

Table 10. A summary of CS2000 Module 1 outputs relevant to analyses of stock and change based upon vegetation samples

Output required; listed as in section 4.1.4 of Module 1 proposal	Stratification	Stock/ Change	Analysis
A) "Summaries of the *stock* and *change* in *area* of *each widespread habitat* by *country*, by *Environmental Zone* and *GB*."	1. For each Broad Habitat 1…n; 1.1 Within each Country 1.2 Within each Zone within each Country	STOCK 1998	1. Characterise Broad Habitats in 1998 only (see 2.4.3a in Mod 1 proposal). For each Broad Habitat; 1.1 Frequency tables of species and selected CVS classes 1.2 Mean Condition Measures +-inter-quartile range 1.3 AC and CSR % composition
B) "Summaries of the *change* in …*vegetation character* of *selected widespread habitats* by *country*, by *Environmental Zone* and *GB*."	2. For each Broad Habitat 1…n; 2.1 Within each Country 2.2 Within each Zone within each Country	CHANGE '90 – '98	2. For each Broad Habitat; 2.1 Change in mean Condition Measures including matrices of shift in AC and selected CVS classes 2.2 Broad Habitat is a dynamic stratum so '1990-based', 'stay-same' and 'turnover' analyses are possible
D) "Summaries of the *change* in *species diversity* by *vegetation class*, by *plot type*, by *country*, by *Environmental Zone* and *GB*."….and by the original 4-zone classification of GB.	3. For each Aggregate Class; 3.1 Within each Country 3.2 Within each Zone within each Country 3.3 Within each Plot Type within each Country	CHANGE 1978 – '90 – '98	3 For each AC; 3.1 Change in mean category 1 species richness 3.2 AC is a dynamic stratum so '78-based', 'stay-same' and 'turnover' analyses are possible
E) "Summaries of the *types* of *botanical changes* occurring *within* each *vegetation class*, by *plot type*, by *country*, by *Environmental Zone* and *GB*." Broad Habitats also mentioned in minuted additions by CJB on 26/11/98.	Prescribes a stratification the same as D) but Broad Habitats are included (see CJB's meeting notes of 26/11/98).	CHANGE '90 – '98	4. For each Broad Habitat and each AC; 4.1 Change in mean Condition Measures 4.2 'stay-same' and 'turnover' analyses are specified here although already included in 2 and 3.

2.5 PRESENTATION OF RESULTS

The results from Module 1 of Countryside Survey 2000 are presented as a comprehensive series of tables elsewhere on the CS2000 website [LINK]. Each table is accompanied by some explanatory comment and guidance on interpretation of the results.

Analysis of the results, and their significance, is becoming available in a number of reports. Examples include:

- UK (main) report [Link]
- England report [Link]
- Scotland report [Link]
- Wales report [Link]

3 AVAILABILITY AND USE OF DATA

There are a number of ways in which data from CS2000 Module 1 may be obtained of which the following are promoted by the CEH data policy:

i. At the most general - from the CS2000 Web Site [Link]

ii. In more detail via the Countryside Information System (CIS) [Ref]

iii. In a 'customised' form through the CS2000 Scientific Support Service [link to contact]

The guiding principle of the CEH data policy is that cost should not prohibit use although, inevitably, there are charges where staff time is involved.

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6 ANNEX 1 . FIELD SURVEY CODES AND DEFINITIONS

Physiography/Inland Water/Coastal

[N.B. after each primary code name, the permitted recording unit ie Area, Line or Point is indicate by the letters, A, L and P]

These features are a mix of 'natural' features of the land surface and some human artefacts.

Inland physiographic features

1 **Cliff >30m high (A, L)**: a vertical or near-vertical face of rock
2 **Cliff 5-30m high (A, L)**:
3 **Rock outcrop & cliff <5m (A, L, P)**: areas of bare rock should be included here together with a % cover category (12-14)
4 **Scree (A)**: more or less unstable loose or shattered rock on slopes
5 **Surface boulders (A, P)**: boulders are defined as >50 cms in any direction and should be mapped as an area with a % cover code (12-14)
6 **Limestone pavement (A)**:
7 **Peat hags (A)**: includes any bare or eroding peat which is not vegetated and should be qualified by a % cover code (15-17)
8 **Current peat workings (A)**: where peat has obviously been extracted in the current or previous season - should be qualified by a % cover code (15-17)
9 **Old peat workings (A)**: and may be qualified by a % cover code (15-17)
10 **Soil erosion (A, L, P)**: includes both human and natural erosion in any situation
11 **Ground levelling (A)**: includes any formerly raised area that has been reduced to the level of the surrounding terrain (eg for development)

Codes 12 to 17 should be used in conjunction with primary codes above and should relate to the percent of the area as seen from above (this excludes many cliffs, for example).

12 **95 - 100% rock**:
13 **>50% rock**:
14 **10-50% rock**:
15 **95 - 100% peat**:
16 **>50% peat**:
17 **10-50% peat**:

Coastal features

Coastal features should only be mapped above Mean High Water Mark.

31 **Cliff > 30m high (A, L)**:
32 **Cliff 5-30m high (A, L)**:
33 **Rock outcrop & cliff <5m (A, L, P)**: to be used when the rock is outcropping base-rock, as opposed to ...
34 **Rocky/Boulder shore (A, L)**: used when the shore is of shattered rocks or boulders >10cm diam (ie grapefruit-size)
35 **Pebble/Gravel shore (A, L)**:
36 **Sandy shore (or un-vegetated dune) (A)**:
37 **Bare mud (A)**:
38 **Sea (A)**: this may seem obvious but is helpful in estuarine and coastal marsh situations - always record.

Inland water features

These features should be recorded and mapped whether they are dry at the time of survey or not.

50 **Pond (A, P)**: –a body of standing water 25m^2 - 2 ha in area which usually holds water for at least 4 months of the year (this definition was used in the Lowland Pond Survey 1996 and may be difficult to apply in a one-off visit – particular attention should be paid to the type of vegetation associated with the feature)

51 **Lake - natural (A, P)**: any inland water body bigger than a pond, should be mapped using this code.

52 **Lake - artificial (A, P)**: usually distinguished by the presence of a dam or embankment.

53 **River (A, L)**: defined as being more than 2.5m wide; a stream is less than 2.5m. (2.5 m would be a very brave leap).

54 **Canalised river (A, L)**: rivers which have been modified (eg sections straightened, banks smoothed), but which still follow the same basic direction as the natural watercourse.

55 **Canal (A, L)**: constructed where no watercourse existed previously.

56 **Stream (L)**: defined as being less than 2.5m wide (see River)

57 **Roadside ditch (L)**: linear excavations with the purpose of drainage; should be recorded even if dry at the time of survey.

58 **Other ditch (A, L)**: (see Roadside ditch)

59 **Spring (P)** usually marked on the map but implies evidence of a continual supply of water at ground surface.

60 **Well (A, L, P)**

61 **Signs of drainage (A)**: includes evidence of tile-drains or mole-drains ie lines of disturbance across a field.

63 **Gorge (P)**:

64 **Levee (A, L)**: artificial raised banks at the sides of rivers, characteristic of canalised rivers.

Banks - two codes should be used for each length of watercourse, one for each side. Record the Right-hand bank first, as seen looking downstream.

65 **Bank <1m**: to describe the bank intimately associated with, or effected by, a watercourse ie river, stream, ditch, canal etc.; the bank would run from the 'normal' water's edge to a boundary, or change in land cover type. The height is a vertical height, not the distance across the ground.

66 **Bank <5m**: (vertical height)

67 **Bank >5m**: (vertical height)

Agriculture/Natural vegetation etc

This sheet includes most of the ground cover types in GB except urban and woodland. The first section, cover types, includes categories which may be qualified by the other codes, such as species, use or measurements.

It is important to note that these cover types should **not** be used in a **built-up** area. Once a **curtilage** has been recognised, as defined in Section viii, then all land within the curtilage is to be recorded according to the Section viii categories. Hence an orchard in a residential garden is not to be recorded on this sheet.

Cover types

Cover types - many of these categories need defining in the context of this survey and the definitions given may not be those with which the surveyors are familiar.

Types of grassland are notoriously difficult to distinguish, especially since their current species composition and general appearance is decided by management practices, rather than origin, history or use. Hence the primary codes are limited but there are several general descriptive codes, as well as species codes, by which such areas can be described.

Bracken is to be treated differently to other categories. Even where bracken occurs in smaller areas than a minimum mappable unit, details should be recorded using a cross (X) to mark its location.

Some of the semi-natural land cover types, characteristic of open, unenclosed landscapes, are difficult to record consistently. The following key helps in this process:

KEY TO VEGETATION & LAND COVER CODES

This key is not absolutely definitive - it has been drawn up with the key to *Euphrasia* species in CTW as a template ie. in some cases there is no simple way to determine with 100% certainty which dichotomy should be followed. The full descriptions given in the field handbook should always be consulted in any borderline cases.

Only those Broad Habitat codes recorded in generally unenclosed situations are included in this key:

1a	Vegetation consisting of over 75% herbaceous species	2
1b	Vegetation with over 25% cover of dwarf shrubs, less than 1m	8
1c	Non-coastal vegetation cover less than 50% with residual cover being rock.	19
1d	Vegetation with over 25% cover of woody species	Refer to woodland key on page xx
2a	Vegetation consisting entirely of Bracken. There is no primary code for Bracken – a relevant primary code (e.g. acid grassland) should be used in conjunction with a bracken secondary code.	Relevant primary code with *Pter. aqu.* (156) and 95-100% (178) (BH 9)
2b	Vegetation with Bracken cover between 25 and 95% cover	Relevant primary code with *Pter. aqu.* (156) and (175, 176 or 177)
2b	Vegetation with Bracken present but less than 25% cover	Relevant primary code with Scattered Bracken (157)
2d	Vegetation not as above	3
3a	Vegetation containing halophytic species	4
3b	Vegetation not as above	5
4a	Vegetation consisting virtually entirely of halophytes, usually on mud often much bare ground.	116 Saltmarsh (BH 19)
4b	Vegetation with some halophytes present usually on sea cliffs	106 Maritime (BH 18)
4c	Vegetation growing on sand dunes including yellow dunes, grey dunes and slacks[1].	172 Sand dune (BH 19)
4d	Generally linear vegetation, just above the high-tide mark, consisting of a few specialised species such as *Cakile maritima*, *Agropyron junciforme* and *Elymus arenarius*	173 Strandline (BH 19)
5a	Tall vegetation with no evidence of recent management and usually more than 25cm in height.	6
5b	Vegetation cut, grazed or with evidence of management usually less than 25cm in height.	10

[1] Machair should be coded according to the floristic composition of constituent parcels - this allows variation from place to place within a Machair landscape to be reflected in the land cover map and acknowledges that Machair has cultural and geographical, as well as floristic, connotations.

6a	Terrestrial vegetation growing on lowland peat soils often with or without scattered Alder or Willow. Species include *Carex paniculata, C. acutiformis, Iris pseudacorus, Phragmites australis, Eupatorium cannabinum, Lythrum salicaria*, *Scutelaria galericulata*.	113 Fen (BH 11)
6b	Aquatic vegetation where macrophytes persist as emergents within standing water . Species include *Typha* spp., *Ranunculus fluitans, Phragmites australis.*	Aquatic macrophytes 108
6c	Vegetation fringing open water often developed as a narrow part of a hydrosere between standing water and upslope vegetation. Species include *Valeriana officinalis, Epilobium hirsutum, Filipendula ulmaria, Oenanthe crocata*.	Aquatic marginal vegetation 109
6d	Not as above	7
7a	Mature vegetation consisting entirely of long-lived perennials with little or no open ground	8
7b	Seral vegetation containing arable weeds with some long-lived perennial species usually with some open ground present	9
8a	Vegetation with over 50% grass cover usually *Arrhenatherum, Dactylis* and *Elymus repens*.	Unmanaged Grass 133
8b	Vegetation with less than 50% grass cover with species such as *Epilobium hirsutum, Urtica dioica* and *Filipendula ulmaria*.	Tall herb 134 (BH 11)
9a	Vegetation consisting mainly of annual weeds. Open ground usually conspicuously present. Actual species composition dependent upon starting point.	Neglected 141
9b	Vegetation containing some annual weeds but consisting mainly of long lived perennials including some grasses. Some shrubby species maybe present as infrequent juveniles.	Abandoned 142
10a	Vegetation well dominated by palatable grasses with a rich or poor suite of accompanying herbs on fertile, neutral soils. Calcareous grassland species absent. Indicators include *Trifolium repens, Stellaria media, Cerastium fontanum, Rumex acetosa, Ranunculus repens*.	11
10b	Calcareous indicators present	12
10c	Calcifugous indicators present	13
11a	Palatable grasses predominate mainly *Lolium, Phleum, Dactylis, Cynosurus* and the larger *Festuca* spp. *Agrostis capillaris* and *Anthoxanthum odoratum* maybe present at the less fertile end of the gradient. Varies from pure grass to moderately species rich grassland but herb-rich grassland indicators are always infrequent or absent.	Fertile grassland (101)

11b	Cover of grass species usually less than 50% with a high proportion of high quality grassland indicators such as *Lathyrus pratensis, Alchemilla glabra, Trifolium pratense, Geranium sylvaticum, Leucanthemum vulgare, Galium verum, Primula veris, Conopodium majus* and *Centaurea nigra.*	Herb-rich grassland (169)
12a	Vegetation with scattered sedges, many calcicoles present in often species rich turf on calcareous soils usually rendzinas on chalk or limestone. Examples include *Lotus corniculatus, Linum catharticum, Sanguisorba minor, Carlina vulgaris, Sesleria albicans, Cirsium acaule.*	Calcareous grassland 105
12b	Localised, narrow areas of vegetation, usually with several sedge species and species of wet soils. Includes *Briza media, Parnassia palustris, Carex hostiana, Carex dioica.*	Flush 115 (BH 11)
13a	Vegetation with many wetland species on nutrient rich, mainly inorganic soils. Some species maybe over 25cm in height however the sward will be dominated by a shorter turf of grazing tolerant species[2].	Marsh 114 (BH 11)
13b	Not as above	14
14a	Localised narrow wet areas of vegetation or obvious flushing. Vegetation usually dominated by acidophilous species e.g.. *Sphagnum, Juncus effusus/articulatus/acutiflorus, Carex echinata, Ranunculus flammula, Stellaria alsine.*	Flush 115 (BH 11)
14b	Vegetation with many acid indicators but not in linear features	Go to 15
15a	Cover of peat land species over 25% eg. *Tricophorum, Molinia, Sphagnum* and *Myrica* usually on deep-peats or wet peaty rankers	Go to 16
15b	Peat land species under 25% on variable soil types	Go to 17
16a	Vegetation dominated by *Eriophorum vaginatum* often including *Rubus chamaemorus*	Blanket bog (111) (BH 12)
16b	Vegetation dominated by other peatland species eg. *Tricophorum, Molinia, Sphagnum* and *Myrica*	Bog (112) BH 12
17a	Fine grasses predominate in generally in dry situations eg. *Agrostis, Festuca, Anthoxanthum* usually brown podzolic soils. Acid indicators present eg. *Galium saxatile, Potentilla erecta, Pleurozium schreberi* and *Rumex acetosella*	Acid grassland (102) BH 8

[2] *Molinia caerulea* maybe present sometimes at high cover but species poor, acidophilous vegetation well dominated by *Molinia* should be included under 103 Moorland grass.

17b	Coarse grasses predominate generally in wet situations eg. *Nardus, Molinia, Deschampsia flexuosa* usually on peaty-gley soils	Moorland grass (**103**) BH 8
18a	Peat land species predominate eg. *Tricophorum, Molinia, Sphagnum* and *Myrica* usually on deep-peat soils or wet peaty rankers	Bog (**112**) BH 12
18b	Wetland indicators present eg. *Pedicularis/Narthecium* Peat land species not dominant eg. *Calluna, Vaccinium, Empetrum* and *Erica* predominate.	Go to 18
19a	Sub-arctic indicators present eg. *J. trifidus, C. bigelowii, Racomitrium* usually on rankers or distinctive arctic-type soils	Sub-arctic (Montane) (**174**) (BH 15)
19b	Sub-arctic indicators not present dominated by dwarf shrubs usually on podzolic soils but also on brown podzolics, shallow peats, rankers and gleys	Dwarf shrub heath (**104**) (BH 10)
19c	Saxicolous (on rock) and chasmophytic (in crevices), non-coastal vegetation cover less than 50% with residual cover being rock. Includes species such as *Cryptogamma crispa, Cystopteris fragilis* and *Asplenium trichomanes.*	Rock vegetation (**135**) (BH 26)

Codes

101 **Fertile agricultural grass (A)**: includes any grass crop or pasture in a generally lowland, or enclosed, situation. Palatable grasses predominate mainly *Lolium, Phleum, Dactylis, Holcus lanatus, Agrostis stolonifera,* and *Cynosurus. Agrostis capillaris* and *Anthoxanthum odoratum* maybe present at the less fertile end of the gradient. Varies from pure grass to moderately species rich grassland but herb-rich grassland indicators are always infrequent or absent. Other species such as *Trifolium repens, Taraxicum officianale, Ranunculus repens* and *Stellaria media* may also be present. Uncommon planted species may also occur eg. *Festuca arundinacea*. *Lolium multiflorum* may be present which has colonised from plants which have been introduced during re-seeding. Also note that there are many cultivars of *Lolium perenne* which have large leaves comparable to *Lolium multiflorum.* Some broadleaved species indicative of lower fertility such as *Plantago lanceolata, Ranunculus acris* and *Rumex acetosa* may also be present but quality indicators included under 171 (below) are absent.

171 **Herb-rich grassland (A):** Cover of grass species usually less than 50% with species such as *Festuca pratensis*, *Trisetum flavescens* and *Alopecurus pratensis.* There is a high proportion of quality grassland indicators such as *Lathyrus pratensis, Alchemilla glabra, Trifolium pratense, Geranium sylvaticum, Leucanthemum vulgare, Galium verum, Sanguisorba officinalis, Conopodium majus* and *Centaurea nigra.* This category is usually found on brown earth soils.

102 **Acid grassland (A)**: grassland usually in an upland situation but also on appropriate soils in the lowlands. There is a high proportion of palatable grasses and including, individually or in combination, *Festuca ovina, Agrostis tenuis*, and *Anthoxanthum odoratum*. Usually on unenclosed land but some enclosed land on the margin between fertile grassland and open hillsides may have this vegetation. Other species which are present include *Galium saxatile, Potentilla erecta* and *Polygala serpyllifolia* and *Pleurozium schreberi*. Scattered *Pteridium aquilinum* may also be present but dense *Pteridium* should be included under code 156. This vegetation is usually on brown podzolic or mineral soils.

103 **Moorland - grass (A)**: Coarse grass, usually occurring in a moorland setting but is also present within lowland heath landscapes in southern Britain and in the Scottish lowlands. Usually dominated by *Nardus* or *Molinia* but often with significant amounts of *Deschampsia flexuosa* and *Juncus squarrosus*. *Sphagnum* species may be present but if so, associated with *Anthoxanthum odoratum* and/or *Juncus* species. Dwarf shrubs and peatland species may be frequent but are usually less than 25% cover and are never dominant. Usually on peaty gley soils but also on some peats.

104 **Dwarf shrub heath (A)**: cover of dwarf shrub/ericaceous species over 25% and usually much higher. *Calluna, Vaccinium myrtilus, Erica cinerea, Arctostaphylos uva-ursi* and *Empetrum nigrum* are species which have significant cover, individually or in combination. Peat land species of bogs, codes 111 and 112, are usually scarce or absent. *Deschampsia flexuosa, Festuca ovina* and *Nardus stricta* may be present but rarely form significant cover. Herb-rich variants of this category include species such as *Thymus praecox, Viola riviniana* and *Hypericum pulchrum*. This vegetation is usually found on podzolic soils but may also be on peats, peaty gleys or rankers.

174 **Sub-arctic (montane) (A)**: Mainly confined to exposed mountain summits in Scotland. The vegetation has at least 25% cover of *Calluna* and/or *Racomitrium lanuginosum*, together with much bare rock, often sorted into polygons or with exposed mineral/peat soil. Often the vegetation is in stripes with evidence of wind pruning and will usually contain one ore more of the following species: *Salix herbacea, Juncus trifidus, Carex bigelowii, Loiseleuria procumbens, Cladonia* spp. and *Cetraria* spp. Small patches of snow bed vegetation are likely to be less than an MMU. Usually on sub-arctic or skeletal soils.

135 **Rock vegetation (A)**: Saxicolous (on rock) and chasmophytic (in crevices), non-coastal vegetation cover less than 50% with residual cover being rock. Includes species such as *Cryptogamma crispa, Cystopteris fragilis* and *Asplenium trichomanes*. Not including vegetation with sub-arctic species (see 174, above). This code may need to be used in a mosaic (ie with another primary code).

105 **Calcareous grassland (A)**: found on calcareous soils with a high proportion of calcicole species usually on limestone or chalk but occasionally on shell sand or other calcareous substrate. Characteristic grasses forming significant cover, individually or in combination, include *Festuca ovina, Briza media, Koeleria cristata, Avenula pratensis, Bromus erectus* and *Sesleria caerulia*. Typical calcicole species include *Circium acaule, Sanguisorba minor, Helianthemum nummularium* and *Carlina vulgaris*. Usually growing on rendzinas.

106 **Maritime vegetation (A)**: found on sea cliffs or other coastal situations and usually herb-rich due to salt spray. Some halophytes always present eg *Plantago maritima, Plantago coronopus, Armeria maritima* and *Tripleurospermum maritium.*

~~107~~ **~~Lowland heath:~~** code no longer used – refer to 104.

108 **Aquatic macrophytes (A)**: aquatic vegetation where macrophytes persist as emergents within standing water . Species include *Typha* spp., *Ranunculus fluitans, Phragmites australis.*

109 **Aquatic marginal veg (A)**: vegetation fringing open water often developed as a narrow part of a hydrosere between standing water and upslope vegetation. Species include *Valeriana officinalis, Epilobium hirsutum, Filipendula ulmaria, Oenanthe crocata*.

110 **~~Raised bog~~**: code no longer used – see 112.

111 **Blanket bog (A)**: Ombrogenous bog, common in the Pennines, Wales and northern and western Scotland. May occur on moderate slopes, as well as flatter ground. *Eriophorum vaginatum*, or *Sphagnum* (usually hummocks) occur individually at over 25% cover. Often with some *Calluna*, and with or without *Erica tetralix*. *Molinia* is frequent but rarely over 25% (see 103 - Moorland grass). Sphagnum rarely forms carpets as in 112.

112 **Other bog (A)**: This broad category includes all vegetation (other than blanket bog) that is dominated by peatland species and should be identified by the plants present and not by topographic position since across the whole of Britain there is no consistency in the position of bogs within the landscape. The category therefore includes wet heaths, raised bogs and valley bogs but note that the soligenous mires dominated purely by *Molinia* and *Juncus* species would be included under 103 as no other peatland species are present. *Calluna* may be up to 50% cover but usually less. *Molinia* and *Sphagnum* species are usually present, often over 25%. *Tricophorum* is also often present as a significant cover species. Other species which may be locally dominant include *Myrica gale, Eriophorum angustifolium, Nardus stricta* and *Eriophorum vaginatum.* The latter species will always have less than 25% cover, otherwise it would fall in category 111. Indicative species include *Narthecium ossifragum, Drosera* spp., and *Pedicularis ssp*.

113 **Fen (A)**: Lowland peat-forming sites, usually dominated by sedges or rushes often with alder or willow. Common species include *Carex rostrata, Filipendula ulmaria, Equisetum fluviatile, Carex paniculata* and *Iris pseudocorus*. On wet, peaty soils.

114 **Marsh (A)**: Nutrient-rich wetland on predominantly inorganic soil dominated by rushes or sedges. Commonly found indicative species are *Juncus artic./acutiflorus* and *J. effusus. Carex panicea, C. demissa, C. nigra, C. flacca* and *C. hostiana; Iris pseudacorus* frequently present, particularly in west. Found on wet, mineral soils. Does not include 101, fertile grassland, with *Juncus effusus* and no wetland indicators (= 101 + 158).

115 **Flush (A)**: Localised, usually narrow areas (which may coalesce where adjacent) with evidence of the influence of water which tend to have species which are different from surrounding vegetation. Calcareous flushes are dominated by species such as *Linum catharticum, Carex hostiana and C. dioica, Campyllium stellatum* and *Parnassia palustris*. Non-calcareous flushes are usually dominated by *Juncus effusus, J articulatus/acutiflorus* and *Carex echinata,* often with *Sphagnum.* Usually found on peaty gley soils.

116 **Saltmarsh (A)**: Should only be recorded where the area is vegetated, otherwise bare mud (Physiography section) is appropriate. In complex situations which cannot be mapped, the proportions of 'bare mud' and vegetated ground in a polygon should be indicated by as % cover code following the primary code on their respective pages. Typical species include *Salicornia, Puccinellia, Triglochin maritima* and *Aster tripolium.*

172 **Sand dune (vegetated) (A)**: Should only be recorded where the area is vegetated at 25% or greater, otherwise sandy shore (36). Typical species include *Ammophila arenaria, Viola tricolor,* and *Euphorbia portlandica*. Dune slacks should also be included with typical species such as *Salix repens.*

173 **Strandline vegetation (A)**: generally linear, just above the high-tide mark, consisting of a few specialised species such as *Cakile maritima, Agropyron junciforme* and *Elymus arenarius.*

117-132 These categories are straightforward - young crops may be difficult to recognise (the notes following each code may help):

117 **Wheat (A)**: - wheat plants have broad, glaucous blades with auricles.
118 **Barley (A)**: - barley has dull green leaves and auricles.
119 **Oats (A)**: - oat plants have broad soft glaucous leaves with no auricles.
120 **Sugar beet (A)**:
121 **Turnips/Swedes/Roots (A)**:
122 **Kale (A)**:
123 **Potatoes (A)**:
124 **Field Beans (A)**:
125 **Peas (A)**:
126 **Maize (A)**:
127 **Rye (A)**:
128 **Oilseed rape (A)**:
129 **Other crop (A)** .... (please use English/Common name)
130 **Flowers (A)**:
131 **Commercial horticulture (A)**: to include strawberries, salad crops, cabbages and onions etc.

170 **Perennial crops (A)**: to include raspberries, currents and vineyards
132 **Orchard (A)**: commercial enterprises only – not to include, for example a few fruit trees in a back garden (see curtilage – 402, 434).
133 **Unmanaged grass (A)**: this is grassland that has no obvious use (agricultural, amenity etc) but which cannot be called an abandoned land use. (Wide roadside verges, only cut once/twice per year, may be coded as unmanaged grass - or tall herb vegetation, as appropriate).
134 **Tall herb vegetation (A)**: semi-natural vegetation, often in wet or disturbed positions; dominated by tall herbs but with grasses present.
135 **Rock vegetation (A)**: (see before 105)

136 **Ley**: a short-term grassland, re-seeded less than five years previously. Characterised by evidence of ploughing, bare soil between grass plants, scarcity of broadleaf species and is often dominated by a single grass species eg *Lolium.* This code should only be used if there is absolutely no doubt about these factors (eg from landowner information or recent sowing). Any field with more than 10% Lolium multiflorum (a short-lived ley species) would be included here.

~~**137** **Unimproved grass**~~: code no longer in use

~~**138** **Forbs >10%**~~: code no longer used.

~~**139** **Forbs >25%**~~: code no longer used.

~~**140** **Forbs >50%**~~: code no longer used.

141 **Neglected land (A)**: agricultural land for which there is no obvious intended change of use, but where the former use has been temporarily neglected (for up to 3 years). **Fallow** land (which has been unused as part of an agricultural rotation) should be recorded here and most Set aside land should be recorded here with 198 (if identified without doubt). Vegetation consisting mainly of annual weeds. Open ground usually conspicuously present. Actual species composition dependent upon previous management.

142 **Abandoned land (A)**: agricultural land which has been neglected for more than 3 years and in which long-lived perennials and shrubby species are becoming established. Vegetation containing some annual weeds but consisting mainly of long lived perennials including some grasses. Some shrubby species maybe present as infrequent juveniles.

143 **Ploughed**: the crop harvested before ploughing should be identified (from fragments that remain) and this code used as an extra description after the crop primary code.

144 **Burnt (moorland)**: land which has been burned deliberately as a management practice e.g. for grouse (muirburn) within the last 12 months.

145 **Mown:** to be used for any grassland type that has been mown such that the 'normal' vegetative structure of grasses is not present and therefore hinders species identification.

Species (if >25% cover)

The following major agricultural grasses and semi-natural ground cover species (which are listed according to a gradient from rich to poor land) are recorded if they cover 25% or more of a mapped unit, irrespective of the number of canopies present (ie total cover can reach more than 100%). For any species which is not listed here and which reaches 25% cover, one of the blank code numbers should be used**:**

146 ***Lolium multiflorum***
147 ***Lolium perenne***
148 ***Trifolium repens***
149 ***Dactylis glomerata***
150 ***Anthoxanthum odoratum***
151 ***Phleum pratense***

152 ***Cynosurus cristatus***
153 ***Holcus lanatus***
154 ***Agrostis tenuis***
155 ***Festuca ovina***
156 ***Pteridium aquilinum* –** should follow a primary code (e.g. 102) and should also be used with a cover code
157 ***Pteridium aquilinum* – scattered –** to be used as a secondary code on its own to indicate presence of bracken at less than 25% cover
158 ***Juncus effusus***
159 ***Deschampsia flexuosa***
160 ***Nardus stricta***
161 ***Calluna vulgaris***
162 ***Vaccinium myrtillus***
163 ***Molinia caerulea***
164 ***Eriophorum angustifolium***
165 ***Eriophorum vaginatum***
166 ***Tricophorum cespitosum***
167 ***Sphagnum*** spp
168 ***Juncus squarrosus***

See above for these new land cover codes in CS2000

170 **Perennial crops** (after 131)
171 **Herb-rich grassland** (after 101)
172 **Sand dune** (after 116)
173 **Strandline vegetation** (after 116)
174 **Sub-arctic (Montane)** (after 104)

Cover

175-178 These cover % codes should be used with the species codes 146-168 and, where a mosaic of vegetation categories exists, with land cover types. Usually, no more than three cover codes may be used to describe any area.

175 **25-50%**:
176 **50-75%**:
177 **75-95%**:
178 **95-100%**:

Heights (*Calluna* only)

179-182 These height class codes should only be used with Heather (but not with Bracken as was done in 1990) and should reflect the average height of the stand being mapped

179 **<10cms** :
180 **<30cms** :
181 **<50cms** :
182 **>50cms** :
~~**183** **<1.5m:** no longer used~~
~~**184** **>1.5m:** no longer used~~

Uses etc

185-198 These codes should be used to qualify the cover types where known. Stock type can be told from recent dung as well as actual presence of animals.

185 **Beef**: cattle which tend to be of stocky build and do not have udders - should also include 'sucklers' (0-6 mths) and 'rearers' (6 mths onwards)

186 **Dairy**: cattle which have udders – especially Fresians –
(N.B. mixed herds of beef cattle and dairy cattle should be coded 185/186)

187 **Cattle (unspecified)**: only to be used if it is not possible to determine whether the cattle are dairy, beef or dual purpose (**note**: this code was used for 'breeder' cattle in 1990).

188 **Dual purpose**: applies to the few remaining cattle breeds which are bred for beef and milk production e.g. Simmentals, South Devons, some Shorthorns and some Friesians.

189 **Sheep**:

190 **Goats (with no.)**: the numbers of goats and horses in fields should be recorded where possible, including those animals in a field, only part of which is in the square. Numbers should follow the code (in parentheses).

191 **Horses (with no.)**: (as with goats)

192 **Pigs**:

193 **Silage**: Silage fields can be distinguished from hay fields only after cutting (silage-cut stems are fresh, bright green: hayfields usually produce dried grass remnants), or by asking the farmer.

194 **Hay**: should only be used if there is firm evidence eg wisps of dry grass after harvesting. If there it is impossible to tell whether a field has been left for hay or silage, then both codes should be used, rather than not using a code.

195 **Deer:** only to be used if there is firm evidence including presence of animals or dung, artificial feeds, estate information

196 **Grouse:** as for deer

197 **No apparent use (A):** should be used if the primary use of the land cannot be identified.

198 **Setaside:** To be used with a primary code such as 141 and 142. Set-aside is arable land which has been temporarily removed from production to allow the farmer to qualify for Arable Area Payments. While there are various technical kinds of set-aside, the main points to note that:

- it can be whole or part of a field; if the latter, it must be at least 20 m wide;
- most set-aside is first-year, which comprises a mixture of crop volunteers and arable weeds (this is characteristic); much will already have been sprayed with non-selective herbicides to give a dead, yellow cover, which can hide populations of seedlings;
- older set-aside is more grassy, and more difficult to identify with confidence; if the cover is patchy, with cereals and arable plants among grasses, it is likely to be set-aside;
- there are a range of covers in set-aside (grass, crop mixtures, industrial crops) which cannot be identified as set-aside from the field evidence alone - only the farmer will know.

Forestry/Woodland/Trees

The codes from the woodland sheet should be used to describe each 'woodland unit' (ranging from a single sapling to a forestry plantation) and every combination of codes must contain at least one primary code. Features from other pages of the FAB should not be recorded within woodland, unless they are above a minimum mappable unit in size (ie exceeding 1/25th ha), and excepting bracken.

Trees/scrub should be recorded in any situation except inside the curtilages of buildings or communication routes (e.g. roads, railways) or as individuals or lines immediately adjacent to non-agricultural curtilages.

Trees should be recorded from all recreation land such as golf courses and playing fields (except in urban situations). It is important that the double use of land is recorded eg individual trees growing in farmland, or sheep in an abandoned orchard.

Tree species (with apical dominance leading to the formation of recognised trunks) of all sizes should be recorded, as should shrubby species (comprising scrub).

Cover types - all occurrences of trees should be allocated to one of the primary codes and qualified by secondary codes - if any one area of trees includes distinct variation in age or species composition, then the unit should be sub-divided into blocks and coded separately.

The following key should allow any feature to be placed in one of the primary code definitions:

KEY TO WOODLAND TYPES

1. Dominant canopy is a mix of trees and vegetation in shrubby form?	YES .. Step 2	NO .. Step 3
2. Consider the two components separately in this key and use 2 primary codes as a mosaic.		
3. Canopy composed of trees (not shrubby form)?	YES .. Step 4	NO .. Step 10
Trees		
4. Less than 6 individual trees?	YES .. Code 201	NO .. Step 5
5. Less than 0.25 ha with canopy >25% area?	YES .. Code 205	NO .. Step 6
6. Linear feature (area ratio <1:5 and <4 trees wide)?	YES .. Step 7	NO .. Step 8
7. Single tree width?	YES .. Code 203	NO .. Code 204
8. Canopy cover less than 25%?	YES .. Step 9	NO .. Code 206
9. Trees less than 50 m apart (on average)	YES .. Code 202	NO .. Code 201*
Shrubby form		
10. Less than 6 individuals?	YES .. Code 207	NO .. Step 11
11. At least 20m line of single specimen width?	YES .. Code 209	NO .. Step 12
12. Canopy covers more than 25% of area?	YES .. Code 210	NO .. Step 13
13. Individuals less than 50 m apart (on average)?	YES .. Code 208	NO .. Code 207*

* because the individuals are (on average) more than 50 m apart, then they should be coded separately and not as part of an area feature

201 **Individual trees (P)**: should be marked with a cross. Groups of less than 6 trees should be recorded as individuals as should lines of trees of less than 20 m in length. A coppice stool is recorded as a single tree. Where loose groups of trees are each more than 50 m apart, they should all be marked as individuals.

202 **Scattered trees (A, P)**: 6 or more trees which do not make a wood or clump (see definitions) because their crowns are not contributing 25% cover of the mapped unit and the trees are not more than 50 m from other trees (in which case they are mapped as individuals).

203 **Line of trees (L)**: must be single tree width and be at least 20 m long with or without crown contact (215, 216). They should be marked with a line.

204 **Belt of trees (A, L)**: 2 or more trees wide with a width to length ratio of at least 1:5, parallel-sided and with a maximum width of 50m.

205 **Clump of trees (A, P)**: a small woodland or group of trees (6 or more) and of less than 0.25 ha.

206 **Woodland/Forest (A)**: an area of trees of more than 0.25 ha (but see Belt) and a crown cover of more than 25% (see 285 for areas fenced and ploughed ready for afforestation).

207 **Individual scrub (P)**: an individual of a shrubby species or a tree in shrubby form.

208 **Scattered scrub (A, P)**: scattered as for trees.

209 **Line of scrub (L)**: line as for trees.

210 **Patch of scrub (A, P)**: an area of continuous scrub (canopy >25%) of any size consisting exclusively of shrubby species or trees in shrubby form, often with tree regeneration. Individual trees of more than twice the average height of the scrub should be separately marked as individuals or scattered.

215 **Closed canopy**: canopies touching or overlapping

216 **Canopies not touching**: to be used for linear features, if the gap between two canopies does not exceed the average canopy width of the two individuals on either side.

217 **Hedgerow tree(s)**: trees in a hedgerow which are twice the average height of the hedge, or where the hedge has been trimmed to favour the growth of a young tree. They should be marked with an X or as a line.

218 **Parkland**: a series of isolated mature trees over usually grazed grassland, often associated with large country houses or recreational areas.

Species (if >25%) - should be recorded with one of the cover types if they constitute more than 25% of the canopy. It is not necessary to qualify "unspecified conifer" or "unspecified broadleaf" with a species name. The mixed category codes should be used in the same way ie when >25%.

221 **Fir - Douglas**
222 **Larch**
223 **Pine - Corsican**
224 **Pine - Lodgepole**
225 **Pine - Scots**
226 **Spruce - Norway**
227 **Spruce - Sitka**
228 **Unspecified conifer (do NOT give species).**
231 **Alder**
232 **Ash**
233 **Beech**
234 **Birch**
235 **Bramble**
236 **Elder**

237 **Elm**
238 **Field maple**
239 **Gorse**
240 **Hawthorn**
241 **Hornbeam**
242 **Lime**
243 **Oak**
244 **Poplar**
245 **Rowan**
246 **Sweet Chestnut**
247 **Sycamore**
248 **Willow**

250 **Mixed broadleaved**: ie to be used as if it were a separate species code and can be used on its own or in combination with other species codes where a proportion of the canopy is composed of a mixture of species, none of which comprises 25% (do NOT give species).
251 **Mixed conifers:** as above (do NOT give species).
252 **Unspecified broadleaf** (do NOT give species).

Proportions - these are for use with the tree species codes and should refer to the percentage cover of the dominant canopy layer, as if viewed from above. No more than three codes should be used to describe any one feature.

256 **25-50%**
257 **50-75%**
258 **75-95%**
259 **95-100%**

Age - should be used in conjunction with any of the primary codes (individuals, lines or areas of shrubs or trees) and, in the case of areas and lines, refers to the average age of the species making up the top canopy.

To help with age category recognition the following table may be of use. These figures are a guideline and individuals will vary according to species, vigour, climate and other environmental factors, particularly fast-growing species of exotic origin. Further information is available in "Trees of Britain and Europe" by Mitchell.

Age (yrs.)	Diam. at breast height
5	3-4 cm
20	18-20 cm
50	45-50 cm
100	70-75 cm

261 **1-4 yrs**
262 **5-20 yrs**
263 **20-50 yrs**
264 **> 100 yrs**
265 **50-100 yrs** (note code number order!)
264 **> 100 yrs**

Use - To be used for an area of trees (ie not individuals or lines). It can be extremely difficult to decide the use and many woodlands, especially broadleaved, appear to have no particular use. These should be left uncoded in terms of use.

266 **Timber production**: most coniferous forest and highly managed broadleaved woodland is likely to be included here.

267 **Landscape**: usually covering trees planted to improve the amenity of a site (usually visual amenity), or to fringe and 'hide' commercial plantations.

268 **Sporting/Game**: to be used if there is clear evidence that the wood is used to rear pheasants or other game birds.

269 **Public recreation**: where there is active encouragement for the public to use the area for recreation eg car parks, forest walks, arboreta etc.

270 **Nature conservation**: only to be used if there is clear evidence that the feature is being managed for nature conservation purposes.

271 **Shelter**: includes signs of wintering livestock as well as windbreaks etc.

Condition (NO LONGER USED)

~~**275 Managed:**~~

~~**276 Unmanaged - thriving:**~~

~~**277 Unmanaged - improvable:**~~

~~**278 Declining:**~~

Descriptions/Features

281 **Felling/Stumps**:

282 **Natural regeneration**: to be used only where tree species <1.3m high, which have grown naturally from seed (or suckers) are outside the canopy of a dominant woodland feature.

283 **Underplanting**: where semi-natural woodland has been under-planted with standard exotic or native species.

284 **Planted**: Planted may be used with any of the cover types where it is obvious that planting has taken place, rather than self-seeding.

285 **Ploughed land (A)**: to be used where land has been ploughed (or scarified) and fenced in advance of forestry planting. Should not be used once planting has taken place.

286 **Staked trees**: to be used for isolated trees only and not where 288 applies.

287 **Tree protectors**: light-weight plastic tubes (about 1 m high) which provide protection as well as a favourable micro-climate for planted trees.

288 **Fenced (single trees)**:

289 **Windblow**: can be used to qualify an area of forest or a single individual which has clearly been blown over, or had the top blown out, by wind.

290 **Dead standing tree(s) (A, L, P)**: recorded either singly or as a description for an area of woodland.

291 **Regrowth - cut stump**: applies to isolated regenerating trees

292 **Grazing (stock)**: to be used if there is any evidence of agricultural stock using the feature for grazing, intentionally or otherwise.

293 **Ride/Firebreak (A, L)**:

294 **Bracken dense**: closed canopy or canopy likely to close during growing season - any bracken in a woodland area must be recorded as for codes 156 and 157.

295 **Bracken scattered**:

Boundaries

All boundaries should be recorded unless they form part of a curtilage or they are within the canopy of a woodland (except that boundaries of woodlands must be recorded). It is important that the boundary between urban and rural is marked, but it need not be coded if a curtilage is involved.

It is the total boundary feature which is to be coded, using a codes to describe each element of the boundary (e.g. fence with hedge). In these cases, the most complete (stockproof) element of the boundary should be coded first.

New boundaries should be drawn on the map as accurately as possible, using existing features for reference, as well as making full use of measuring tapes and compasses. Bearings should be taken from the centre of the plot and, as in previous surveys, bearings should be given for magnetic north and not corrected for magnetic deviation. If recent change is obvious then please make use of codes where possible to show this, or else make a note on the sheet concerned. Part of the purpose of this project is to record reasons for hedgerow change. Use codes 999 for boundaries that have been removed and add code 888 to new boundaries. If possible annotate the map or add comments on the page to give reasons for removal or addition of hedges.

Where the boundary includes a hedge, the total boundary feature must be recorded in detail, using CS1990 codes. A combination of primary codes may be used if appropriate. In these cases, the most complete (stockproof) element should be recorded first.

eg: C. 313 (fence), 351 (stockproof), 343 (< 1 metre), 321 (hedge), 352 (not stockproof), 341 (> 2 metres), 359 (overgrown), 332 (bank), 343 (< 1 metre).
or
D. 323 (hedge), 351 (stockproof), 342 (< 2metres), 357 (trimmed), 362 (flailing), 313 (fence), 352 (not stockproof), 343 (< 1 metre).

If there are two or more stockproof elements, the order of elements is not important but each element must be coded separately.

eg: E. 301 (wall), 351 (stockproof), 342 (< 2 metres), 321 (hedge), 352 (stockproof), 342 (< 1 metres), 357 (trimmed) etc..

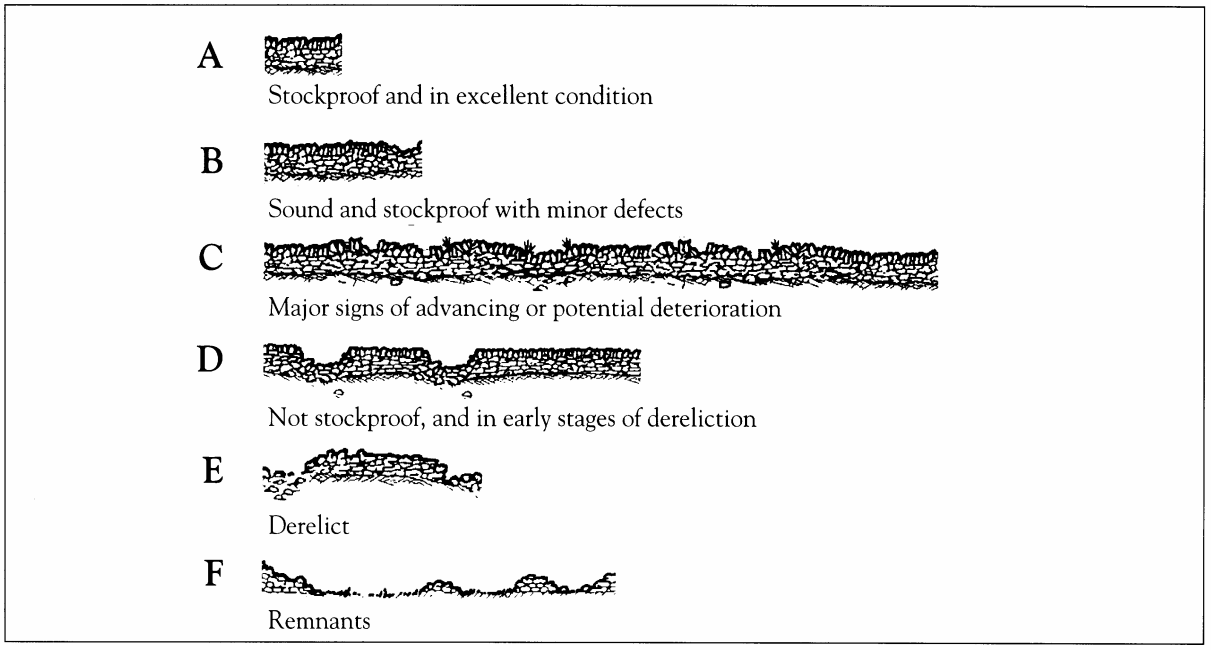
If none of the individual elements of a boundary is stockproof, but collectively they make a stockproof boundary, then code 351 should be placed at the end of the string in brackets (351).

Walls

301 **Dry-stone (L)**:
302 **Mortared (L)**: includes dry-stone walls which have been capped with mortared stone.
303 **Other (L)**: ... (include a description)

Wall condition codes (after ADAS report to Countryside Commission) – see Figure 10.

Figure 10. ***Condition of dry stone walls (from Countryside Commission leaflet CCP 482)***



305 A - Stockproof and in excellent condition
306 B - Sound and stockproof with minor defects
307 C - Major signs of advancing or potential deterioration
308 D - Not stockproof and in early stages of dereliction
309 E - Derelict
310 F - Remnants

Fences

311 **Wood only (L)**:
312 **Iron only (L)**:
313 **Wire on posts (L)**:
314 **Other (L):** ... (include a description)

Hedges

A hedge is defined as a more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape. When hedge management is abandoned and the overall natural shape of the component tree species is regained, or when the bottom 2m (or less) of the feature is not more or less continuous, then the feature can no longer be described as a hedge (and might be considered as, for example, a scattered line of shrubs or trees).

321 **>50% Hawthorn (L)**: only to be used if Hawthorn constitutes more than half of the length of hedge under consideration.
322 **>50% Other (L):** . (add extra code e.g. 601 and specify species type)
323 **Mixed hedge (L)**: should be used for any length of hedge where no single species has >50% cover.

Other

331 **Stone bank (L)**:
332 **Earth bank (L)**:
333 **Grass strip (L)**: to be used where a grass strip separates two fields with no vertical boundary.
334 **Stone and earth bank (L)**:

Descriptions

340 **>3m high**: if different heights apply on either side of the boundary, then the height should apply to the side on which stock are kept; otherwise, the lowest height category should be used.
341 **2-3 m high**
342 **1-2m high**:
343 **<1m high**:

351 **Stockproof**: where possible, this should apply to the stock that would normally use the surrounding fields; if in doubt, assume sheep. The code should be applied to each separate element of the length of boundary under consideration, not necessarily to the whole side of a field. However, if none of the individual elements of a boundary is stockproof, but collectively they make a stockproof boundary, then this code should be placed at the end of the string in brackets.

352 **Not stockproof**: This code should be used when gaps of more than 1 metre but less than 20 metres are present but, together, constitute less than 50% of the total length. If unfilled gaps constitute more than 50% of the boundary length, but the gaps are less than 20 metres in length, then the boundary should be coded as a line of scattered shrubs or trees, for example. If gaps are greater than 20 metres, then the gap should be coded as boundary no longer present on map (999).

353 **Filled gaps <10%**: should be used to show that the boundary has had gaps which have been filled in an attempt to make it stockproof. The %s refer to the gaps as a % of the boundary unit being coded.

354 **Filled gaps >10%**:

355 **Signs of replacement**: (of one boundary type by another)

356 **Signs of removal**:

When is a linear feature described as a hedge?

It can be difficult to distinguish between 'mature' hedges and lines of trees or lines of scattered shrubs. Some illustrations follow:

A. Management

The definition of a hedge (above) includes " ... woody vegetation that has been subject to a regime of cutting in order to maintain a linear shape. When hedge management is abandoned and the overall natural shape of the component tree species is regained ... then the feature can no longer be described as a hedge"

This is a hedge:

This is not a hedge

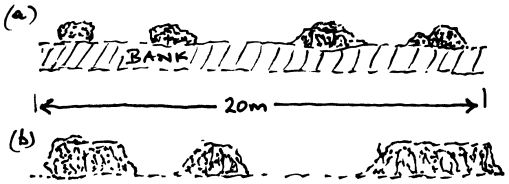
Because lack of hedge management means that the woody components have regained their natural shape. This should be coded as a line of trees.

B. Continuity of length

The definition of a hedge includes " ... as a more or less continuous line of woody vegetation ... "

This is a hedge:

These are not hedges



Because they cannot be described as 'more or less continuous' in the context of a 'minimum mappable length' (20m). They may be coded as shrubs (line or individuals)

C. Vertical continuity

The definition of a hedge (above) includes "...or when the bottom 2m (or less) of the feature is not more or less continuous, then the feature can no longer be described as a hedge"

This is a hedge:

This is not a hedge

Because the bottom 2m is no longer a vegetated part of the feature – this is a row of trees.

Hedge codes 345, 346 and 357 - 360 represent points on a transition from a well managed, trimmed hedge, to a relict line of shrubs.

357 **Recently planted**: to be used if it is estimated that a the hedge has been planted in the previous 5 years. (N.B. code was used for 'Trimmed' in 1990).

358 **Uncut**: has had recent management but has been 'let go' over one or more seasons. Also includes hedges where only one side has been trimmed (ie not the top or the other side.).

359 **Derelict**: still obviously a hedge but all attempts at management having been abolished.

360 **Line of relict hedge**: usually a line of shrubs showing where a hedge has once been (see definition of hedge; should be used in addition to codes on the forestry page)

361 **Laying (recent)**: to be used if it appears likely that the hedge has been laid in the last five years.

362 **Flailing**: to be used if flailed in the last year; recognisable by smashed and shattered ends to cut branches.

363 **Re-growth from stumps**: this applies to hedges that have been cut to ground level but have sprouted again, often at intervals along the old boundary.

364 **Bracken present**: to be used if <u>any</u> bracken is present in the boundary.

371 **Unfilled gaps <10%**: to be used where gaps (of less than 20m each) constitute less than 10% of the unit being described.

372 **Unfilled gaps >10%**: to be used where gaps (of less than 20m each) constitute more than 10% of the unit being described.

<u>Hedge shapes (cross section view)</u>

These codes should be used where trimming (usually in the past two years) has resulted in a particular shape of hedge. If only one side has been trimmed (ie not the top or the other side) then use code 358 (uncut) but if one side and the top has been trimmed, then use one of the following codes.

374 **Box-shaped hedge**: (see examples below):

375 **Pointed box-shaped hedge**:

376 **Chamfered hedge**:

377 **A-shaped hedge**:

378 **Topped A-shaped hedge**:

379 **Round topped hedge**: (rare as requires hand-cutting)

380 **Untopped hedge**: trimmed sides only

Buildings/Structures/Communications

This sheet covers features associated with built structures and routes of communication. Note that features which are immediately adjacent to a non-agricultural curtilage (except roads) need not be recorded on other FAB pages. Similarly no information from other FAB pages need to be recorded within a curtilage (except trees - see 402 below)

Colour Coding - we would rather that colouring was not used but, where colours do have to be used because numbering is too complex, then please use the following choice of colours wherever possible:

Grey = Residential Building Yellow = Agricultural curtilage (+ green dots with trees >10% cover) Green-solid = other curtilage without trees Green-dots = other curtilage with trees Orange = Commercial Buildings Dark Blue = Public Service Buildings Purple = Religious Buildings Pink = Road (tarmac) Red = New development

Other buildings and grounds should be number-coded, most being large enough to accommodate a written code.

Cover types

Built-cover types - these categories should cover the majority of "urban" land and built features in the countryside but special codes may be needed on rare occasions. Where possible they should be qualified by use and description codes.

A curtilage is an area of ground that is associated with a building and which has a use linked with that building eg gardens, 'grounds', forecourts etc. Apart from the presence of trees (cf. code 402), it is not necessary to record any features within curtilages. If in doubt about whether a feature is a curtilage, then only treat it as such in an urban situation (eg land around a rural reservoir is not curtilage).

401 **Building (A, P)**: usually present on the map - the exceptions will be new buildings which must be coded or coloured with code 441.

Gardens/Grounds apply to curtilages associated with residential or other buildings. Gardens/Grounds may be mapped and coded in groups if they are all alike.

402 **Garden/grounds with trees (A)**: Gardens/Grounds with trees includes those curtilages or mapped group of curtilages, which have a cover of 10% or more.

403 **Garden/grounds without trees (A)**:

434 **Agricultural curtilage (A)**: generally enclosed areas around agricultural buildings eg farm yards, pens etc. – does not include residential farmhouse gardens (=402 or 403).

404 **Public open space (A)**: includes Parks, Ornamental Gardens and Accessible Common Land, especially near large conurbations.

405 **Amenity grass >1ha (A)**: non-agricultural grass which is clearly being used for amenity purposes (not recreation); to be recorded in units of 1ha or more eg parks, large lawns etc (but see 404). Use code 503 for all land on golf courses.

406 **Allotments (A)**:

407 **Car park (A)**:

408 **Glasshouse (A)**: refers to commercial, large-scale enterprises, not greenhouses at the bottom of gardens.

409 **Garden Centre/Nursery (A)**:

410 **Embankment (A)**: to be used for any constructed embankment in any situation eg motorway, reservoir etc.

411 **Other land (A, L, P)**:....: for use in exceptional circumstances; try and use other primary codes first. Always qualify.

Use - these categories should be used to describe the cover type.

421 **Residential**: covers all domestic living area (except farm houses – see 428).

422 **Commercial**: includes all buildings devoted to selling things, including shops, garages, hotels, pubs, commercial offices etc.

423 **Industrial**: those used for the manufacture of goods and include workshops, warehouses and associated buildings such as stores.

424 **Public Service & facilities**: Public Services and facilities are those buildings which are associated with services available to the public, such as Police Stations, Hospitals, Libraries and facilities associated with electricity, gas and telephone.

425 **Institutional**: includes all buildings belonging to forms of public or private institutions, such as old peoples homes, local government and central government buildings, MOD buildings, Crown land, Remand homes, Prisons and even Research Stations.

426 **Educational/Cultural**: includes schools, establishments of further education, museums, theatres and cinemas.

427 **Religious**: confined to places of worship including Churches, Mosques and Synagogues, and their curtilages eg graveyards, cemeteries etc.

428 **Agricultural**: covers all buildings used for agricultural purposes including the farmhouse if occupied by a framer or farm-worker.

429 **Sporting/Recreational**:

430 **Waste - domestic (A, P)**:

431 **Waste - industrial (A, P)**: and to include agricultural

432 **Quarry/Mine (A, P)**...:

433 **Gravel pit (A, P)**:

434 **(Agricultural curtilage) – see above**

Description

441 **New**: those developments which are not shown on the OS Map. Boundaries of associated Gardens or Grounds should also be drawn.

442 **Vacant**: building land which is temporarily out of use; often has sign posted and is adjacent to building land.

443 **Derelict**: buildings or land that have been abandoned or neglected such that they are beyond ordinary repair.

Communications

451 **Railway track/land (A, L)**: to include tracks, yards, sidings and their associated curtilages (e.g. banks and ‘verges’).

452 **Road (tarmac) (A, L)**: includes any road, whether private or not, which is totally tarmac across its width.

453-455 Verges should be coded separately for each side of the road so that two numeric codes should be used to describe the verges for the length of road concerned (even if they are the same). Record the 'north-most' verge first. If road runs north-south, then record 'east-most' first. If there is no verge (eg tarmac up to a

wall, or in a moorland) then do not use a code at all. Verges should be mapped adjacent to constructed tracks, as well as tarmac roads.

453 **Verge <1m**: this refers to the width of the verge across the ground surface.
454 **Verge <5m**:
455 **Verge >5m**:
456 **Constructed track (L)**: includes any track which has been manufactured using stone or hard material.
457 **Unconstructed track (L)**: those tracks which are not defined as above ie no construction has been involved along their length.
458 **Footpath (exclusive) (L)**: a path which uses land area for the purposes of a footpath only - often walled or fenced.
459 **Footpath (other) (L)**: those which are shared with some other land use, such as a path across a grazed field.

Surface: (these codes should be used as qualifiers for public footpaths, bridleways, and 'roads used as public paths')

460 **satisfactory throughout:**
461 **parts in poor condition:**
462 **impassable/difficult:**

Barriers: (to be used as descriptions of Rights of Way as above)

463 **difficult stile/gate:**
464 **difficult bridge:**
465 **difficult fence/wall:**
466 **ploughed/crops:**
467 **natural vegetation:**
468 **muddy/flooded:**
469 **fallen trees/rock:**
470 **bull(s):**
471 **other ....:**

Recreation

Designated

These are generally areas deliberately set aside for recreational purposes; examples other than those given, may be entered using new codes.

501 **School playing fields (A)**:
502 **Other playing fields (A)**:
503 **Golf course (A)**:
504 **Race track .... (A)**:
505 **Tennis courts (A, P)**:
506 **Boating area (A, P)**:
507 **Static caravan(s) (A, P)**:
508 **Touring caravan park (A)**:
509 **Camp site (A)**:
510 **Launch site .... (A, P)**:
511 **Other designated area ... (A, L, P)**:

Non-designated

Information or signs - where land normally given to some other use, has been used for recreation, often on a very ad hoc basis.

521 **Horsiculture (A, P)**: any signs of horses used for recreational purposes eg jumps, schooling rings etc
522 **Angling (A, P)**: any signs of angling eg notices, platforms etc.
523 **Boat - inland water (A, P)**: any evidence that a boat is used on a piece of water, eg boathouse, moorings etc.
524 **Other .... (A, L, P)**:

7 ANNEX 2.

The Condition Measures developed under ECOFACT and their potential contribution to vegetation character measurements

Condition Measure 1 – Changes in Aggregate Class membership

As a result of ECOFACT work, this indicator has proven ecological meaning. Shifts between aggregate classes can be interpreted in terms of key environmental gradients whilst shifts at this coarse level are also likely to reflect well marked changes in species composition.

Change matrices have been produced according to each specified stratification. Change matrices by plot type are particularly important in discriminating between change in areal versus linear features.

The simple characterisation of Broad Habitats has been achieved by computing the percentage of plots in each aggregate class in each Broad Habitat in 1998.

Condition Measure 2 – CVS class membership

We recognise the need to characterise Broad Habitats in terms of CVS class composition. Since each plot can be allocated to a CVS class, it has been possible to characterise each Broad Habitat as a frequency table of CVS classes by Broad Habitat, analogous to a sub-community-by-species table for an NVC community.

Since CVS classes are by definition non-changeable units, it is not recommended that change matrices are produced at this level.

Condition Measure 3 – Functional attributes

As part of ECOFACT 1, the change in representation of selected plant traits was analysed between 1978 and 1990. As a result of this, processes of eutrophication, dereliction and disturbance were inferred. The database used to do this was lodged at UCPE, Sheffield, whilst interpretation depended to a large extent on their knowledge of the significance of individual traits. Within Module 1 it has not been possible to repeat this analysis but strata in 1998, and change between 1990 and 1998, have been analysed using weighted CSR radius scores. These are based upon values given to a subset of the British Flora which locates a plant species within the UCPE triangle (ref) and denotes the extent to which a species demonstrates a ruderal, stress-tolerant or competitive life strategy. The facility to produce cover-weighted C, S and R scores is available in MAVIS (see section 4).

Given the process-linked nature of the UCPE approach, it has been possible to analyse change in CSR scores and the strategic composition of Broad Habitats has been described for 1998 data.

Condition Measure 4 – CVS classes unique to 1 plot type per 1 km square

Following the interpretation of this Condition Measure in the ECOFACT 6 module, it was decided to omit this measure from the analyses.

Condition Measure 5 – Species richness per plot

Species richness is clearly a fundamental measure of botanical diversity which, coupled with a stratification by vegetation type, can convey change in quality in a simple way. Thus, mean species richness in specified strata has been analysed.

Condition Measure 6 – Ellenberg scores

Work carried out in ECOFACT 1 and 6 proved the usefulness of these process linked scores. As for CSR scores, MAVIS can be used to generate Ellenberg scores from plot data.

Change in the suite of Ellenberg indicators by specified strata has been analysed.

Condition Measure 7 – Frequency of species groups

Although useful in the ECOFACT 6 project on Causes of Change in Biodiversity, results are not easy to digest and summarise. This is partly because of their sheer volume and partly because interpretation is best undertaken with a specific scenario in mind. They are less useful as a summary surveillance measure of change. The potential use for this Condition Measure lies with scenario analysis as part of a further 'Causes of Change' project, rather than as part of the routine CS2000 analysis.

Condition Measure 8 - Frequency of Aggregate Class preferentials

For the same reasons as Condition Measure 7, this Condition Measure was not used in CS2000 analyses.

Condition Measure 9 - Frequency of EN grassland indicator species

Analysis of change in frequency of these species proved to be a compelling way of showing change in botanical quality in ECOFACT 1. Since the species lists were drawn up specifically to include taxa characteristic of vulnerable, high conservation value communities, change in their abundance has a direct link to vegetation quality. However the problem here is one of completeness. The lists were originally drawn up by the England Field Unit so that Welsh and Scottish communities were not considered. Even though the lists purport to cover England, northern limestone grassland species are also absent.

The incompleteness of the lists has meant that this Condition Measure could not be used as part of the CS2000 Module 1 analyses.

Condition Measure 10 – Frequency of food plants for animal groups

The importance of this work in ECOFACT 1 has been recognised. However results were originally derived by matching up animal species with changes in each food plant, thus a synthesis depended upon the existence of a database of individual species changes. The workload required in carrying out these analyses and in the post-analysis interpretation would be huge and, we believe, not possible in the time frame.

Instead of using exactly the same approach, an amalgamated Faunal Food Plant Index has been used. This was done separately for birds and butterflies giving one cover weighted index per plot per animal group for change analyses between 1990 and 1998.

Condition Measure 11 - Frequency of scarce species and NVC categories

The range of exploratory analyses carried out under this heading demand more development time and a separate forum for their presentation. Rather than present an incomplete and unsatisfactory treatment, these have been left out at this stage.

Regarding NVC allocation of plots as a characterisation measure, MAVIS again provides a facility for rapid production of matching coefficients. This maybe seen as desirable for U and Y plots.

Condition Measure12 - Mean number of CVS classes per 1km square

For the same reasons as given under Condition Measure 4, this Condition Measure has been omitted from the suite of CS2000 analyses.

8 GLOSSARY

CS2000 GLOSSARY and ACRONYMS

1990 River Quality Survey: chemical and biological survey of the quality of watercourses in 1990, undertaken by the Institute of Freshwater Ecology (IFE) and commissioned by the National Rivers Authority (England and Wales), the River Purification Boards (Scotland) and the Department of Economic Development (N. Ireland).

AC: see Aggregate class (I-VIII)

Accuracy: term used (incorrectly) in the past to indicate the degree of correspondence between LCM data/results and field survey data/results.

Aerial photographic interpretation (API): the use of aerial photographs to update and enhance base maps prior to field survey.

Aggregate class (AC) I-VIII: the eight aggregate classes derived from aggregation of the 100 CVS vegetation classes by cluster analysis and used to stratify data for analyses of change (see Bunce *et al.* 1999a,b).

AONB: see Area of Outstanding Natural Beauty

API: see Aerial Photographic Interpretation

Aquatic macrophytes: higher plants which are growing in, or on, water.

Arable Landscape Types: one of the four Landscape Types into which ITE Land Classes have been aggregated to present results from CS1990.

ARC/INFO: proprietary Geographical Information System (GIS) written by the Environmental Systems Research Institute, Redlands, California, and used at both the CEH Monks Wood and Merlewood sites.

Area of Outstanding Natural Beauty (AONB):

ASPT: see Average Score Per Taxon

Average Score Per Taxon (ASPT): the total site score divided by the number of taxa contributing to that score.

BAP: see Biodiversity Action Plan

Biodiversity Action Plan (BAP): refers to the UK plan, published in 19##.

Biological Monitoring Working Party (BMWP): responsible for devising a scoring system relating freshwater biota to their tolerance of organic pollution (Armitage *et al.* 1983).

Biotic index values: simple numeric representations of complex biological information, normally used to indicate some aspect of environmental quality (see BMWP score, number of scoring taxa and ASPT).

BMWP: see Biological Monitoring Working Party

BNG: see British National Grid

BNSC: see British National Space Centre

Bootstrapping: method of calculating Confidence Intervals around an estimated mean, using repeat partial sampling of the original data (eg 1,000 times).

Boundary plots: one of the linear plot types recorded during the field survey, placed alongside field boundaries and being 10 m x 1 m in size.

British National Grid (BNG): as shown, for example, on Ordnance Survey maps.

British National Space Centre (BNSC): based in London, the BNSC was formed in 1985 as a partnership between UK Government departments and the research councils (eg NERC) to form the focus for Britain's non-military space interests. A contributor of funding to CS1990.

Broad Habitats: a classification of the British countryside which is the framework used in the UK Biodiversity Action Plan to describe the full range of habitats represented in the UK (cf Priority Habitats)

Buffer zone: used in classification of satellite imagery to define an area of user-selected width surrounding features of a defined type.

CA: see Countryside Agency

Calibrate: to compare quantitatively the LCM with field survey data

CAP: see Common Agricultural Policy

CASI: see Compact Airborne Spectrographic Imager

Category 1 species: plant species which were used in the analysis of botanical data, having few taxonomic or identification difficulties and which were consistently recorded by field surveyors.

CCW: see Countryside Council for Wales

Census data: data collected from every unit/member of a population, eg a complete inventory of land use information (cf sample data).

Centre for Ecology and Hydrology (CEH): part of the Natural Environment Research Council and a funding partner in CS2000.

Changes in Key Habitats: a DOE-funded project to collect data from specific habitats which have a limited representation in CS1990 and to examine the effects of designations on these.

CIS: see Countryside Information System

CLEVER-mapping: a procedure developed for the construction of the Land Cover Map 2000 which segments Britain using the spectral data from satellite images. The resulting classification gives a field-based pattern of land use which is similar to that recorded in the field survey.

Common Agricultural Policy (CAP): .

Compact Airborne Spectrographic Imager (CASI):

Confidence Intervals:

Contextual correction: re-labelling of polygons, using external context (e.g. elevation) or internal context (e.g. surrounding classes) to correct segments believed to be erroneously classified.

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 phyto-sociological units themselves based upon the joint occurrence of characteristic plant species.

CORINE: Co-ordinated Information on the European Environment**:** a joint European initiative which includes the aim of mapping the land cover of all CEC countries using satellite imagery.

CORINE: see Co-ordinated Information on the European Environment

Correspondence: (a) measure(s) derived by comparison of field and LCM data.

Countryside Agency (CA): formed in 199# from the former Countryside Commission and the Rural Development Agency, the CA has responsibility for #

Countryside Council for Wales (CCW):

Countryside Information System (CIS): a computer-based system to display and integrate CS1990 data and other environmental information.

Countryside Information System (CIS): A software mapping package developed to deliver rural information using a one kilometre square grid of Great Britain.

Countryside Survey 1990 (CS1990): The Countryside Survey which took place in 1990, but also repeating those carried out in 1978 & 1984. Results were reported in Barr *et al.* (1993).

Countryside Vegetation System (CVS) Classes: The 100 classes produced from the classification of all CS1990 vegetation data (Bunce *et al.* 1999a,b).

Countryside Vegetation System (CVS): The integrated system developed during ECOFACT for classifying vegetation of the wider countryside. Built from all Countryside Survey plot data recorded in 1978 and 1990 (see Bunce *et al.* 1999a,b).

CS1990: see Countryside Survey 1990

CSR model: Refers to the model developed by Grime (1979) which recognises three primary strategies of plant species; Competitors, Stress-tolerators and Ruderals. Plant species can be assigned to one of these functional groups or an intermediate category depending upon the value of a series of attributes e.g. canopy height and relative growth rate (see Grime *et al.* 1988).

CSR: see Competitors, Stress-tolerators and Ruderals

CVS: see Countryside Vegetation System

DAFS: see Department of Agriculture and Fisheries for Scotland (now SOAFD)

Detrended Correspondence Analysis (DECORANA): a FORTRAN computer program which produces an ordination (gradient) of species and plots, using an improved version of Correspondence Analysis (Hill & Gauch 1980).

DECORANA: see Detrended Correspondence Analysis

Department of the Environment (DOE): one of the principal funders of CS1990 and the commissioners of this report.

Department of Trade and Industry (DTI): one of the principal funders of CS1990, especially in relation to the land cover map.

DETR: see Department of the Environment, Transport and the Regions

Digital data base: usually referring to a data base comprised of digitised map co-ordinates (see Digitising).

Digitising: the process of capturing information from maps in the form of points, lines or areas, and converting these into computer-readable co-ordinates (grid references).

Directorate of Rural Affairs (DRA): division of DOE responsible for CS1990.

DOE: see Department of the Environment (now DETR)

DRA: see Directorate of Rural Affairs

Driving force – State – Response model: A framework used in this report for understanding causes of change in vegetation biodiversity. The 'driving forces' are those human-induced drivers of vegetation change, which operate in different areas of the landscape, and which arise from different sectors of human activity. The 'states' are those measures of botanical diversity, which include species number and vegetation character in different locations of the landscape. The 'response' is the human response to the changes in state, for example appropriate changes in policy or land management practices. The model is also used as a basis for reporting UK Indicators for Sustainable Development.

DTI: see Department of Trade and Industry

EA: see Environment Agency

ECN: see Environmental Change Network

ECOFACT: see Ecological Factors Controlling Biodiversity in the British Countryside

Ecological Consequences of Land Use Change (ECOLUC): ITE research project, completed in 1989 and funded by DOE (see Bunce et al. 1993).

Ecological Factors Controlling Biodiversity in the British Countryside (ECOFACT): The title of a research programme of which this report forms part.

ECOLUC: see Ecological Consequences of Land Use Change

Ellenberg Scores: Scores attributed to species, which define their ecological range in terms of fertility, pH, light, and moisture (Ellenberg 1991). These were re-calibrated for the British situation and subsequently used in the ECOFACT program to interpret the CVS and to explore causes of change.

Environment Agency (EA): formed in 19## from the former National Rivers Authority and the #, EA has responsibility for # in England and Wales; the Scottish Environment Protection Agency (SEPA).

Environmental Change Network (ECN): The Environmental Change Network is a multi-agency organisation (co-ordinated by CEH on behalf of NERC and fourteen other sponsors) which has established and maintains a selected network of sites within the UK from which to obtain comparable long-term datasets through the monitoring of a range of variables identified as being of major environmental importance (see http://www.nmw.ac.uk/ecn/).

Environmental Quality Index (EQI): an expression of the extent to which the freshwater fauna of a site matches that to be expected in the absence of environmental stress.

Environmental Zone: one of six divisions of GB based on aggregations of ITE Land Classes to report CS2000 results (and broadly analogous to the four Landscape Types used to report CS1990). The 6 EZs can be described broadly as 1. arable, 2. pastural and 3. marginal/upland in England and Wales, and 4. arable/pastural, 5. marginal and 6. upland in Scotland

Environmentally Sensitive Area (ESA): Designation of land areas where additional fiscal support is available to farmers and landowners.

EQI: see Environmental Quality Index

Error terms: (eg standard error) measures of the reliability of an estimate which has been based on a sample (eg when extrapolating from a sample of 1 km squares to a national or regional estimate).

ESA: see Environmentally Sensitive Areas

EZ: see Environmental Zone

Field reconnaissance data: data collected by the LCM team, in the field, by annotating hard copy images with cover information at the 'variant' level.

Field survey data: vector data (and summary statistics) generated from the CS2000 Field Survey.

Geographical Information System (GIS): a computer package which handles spatial information (usually as computerised maps) and which allows analysis of, for example, area, length and overlay.

GIS: see Geographical Information System

Habitat plots: 4 m^2 plot recorded within areas of semi-natural vegetation during the field survey element of CS1990. Up to five were recorded in each 1 km square.

Condition Measure : identified as appropriate for measuring changes in biodiversity in GB. Some are more appropriate for measuring botanical quality. Others can be used to infer processes of change

IFE: see Institute of Freshwater Ecology

IIS: see International Imaging Systems (also I^2S)

Indicator Species Analysis (ISA): a computer program from which TWINSPAN was developed.

Infra-red (IR): wavelength used in satellite imagery.

Institute of Freshwater Ecology (IFE): one of the former research institutes of the Natural Environment Research Council, now part of CEH.

Institute of Terrestrial Ecology (ITE): one of the former research institutes of the Natural Environment Research Council, now part of CEH.

International Imaging Systems (IIS also I^2S): image analysis software/hardware for processing satellite images.

IR: see Infra-red

ISA: see Indicator Species Analysis

ITE Land Classification: the system developed by ITE to classify each of the c 240 000 1 km squares in Great Britain into one of 32 Land Classes, depending on its environmental affinities. Used to stratify the CS1990 field survey.

ITE: see Institute of Terrestrial Ecology

JNCC: see Joint Nature Conservation Committee

Joint Nature Conservation Committee (JNCC):

Knowledge-based correction: contextual correction and, locally, direct manual re-labelling where class labels are believed or known to be erroneous.

Land Class: one of 32 environmental regions based on physical characteristics, usually called 'ITE Land Classes' which were defined as the basis for stratifying the Countryside Surveys.

Land Classes: 32 strata produced by the ITE Land Classification.

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 (Bunce *et al.* 1996).

Land cover map: map of GB showing the principal land cover classes and derived from interpretation of satellite imagery by staff at CEH Monks Wood, as part of CS1990.

Land cover: the composition of the land surface, being described in terms of land cover classes (eg arable crops, trees, buildings, bare rock).

Land Use Allocation Model (LUAM): the product of research project carried out by the Centre of Agricultural Strategy, Reading University (with input by ITE), which links national agricultural statistics to the ITE Land Classes.

Land Use Research Coordination Committee (LURCC): a national committee under the auspices of NERC, with membership from Departments, Agencies and academia, and a remit to encourage collaboration and dissemination of land use research.

Landscape type: one of the four aggregations of the ITE Land Classes (into arable, pastural, marginal upland and upland types) (see Appendix 1). The 32 ITE Land Classes generated by the land classification were aggregated at a higher level into four Landscape Types (arable lowlands, pastural lowlands, marginal upland and upland) based on joint similarity in shared geological, climatic and topographic attributes (Barr *et al.* 1993). For many of the analyses in this report Countryside Survey data was stratified by these four Landscape Types.

Landscape type: The 32 ITE Land Classes generated by the land classification were aggregated at a higher level into four Landscape Types based on joint similarity in shared geological, climatic and topographic attributes. For many of the analyses in this report Countryside Survey data was stratified by these four Landscape Types.

Land-use Classification, Information and Documentation (LUCID): Software that provides a comparison of land cover definitions between different classifications.

Laser Induced Direction And Range (LIDAR) instrument:

Laserscan GIS: proprietary Geographical Information System, developed by Laser-Scan Laboratories Ltd, Cambridge.

LCM (eg LCM1990 and LCM2000): see Land Cover Map

LCM: Land Cover Map UK 2000

LIDAR: see Laser Induced Direction And Range instrument.

Linear plots: 10 m x 1 m plots placed alongside field boundaries, streamsides and road verges in the 1 km field survey sites from which vegetation data were recorded.

LUAM: see Land Use Allocation Model

LUCID: see Land-use Classification, Information and Documentation

LURCC: see Land Use Research Coordination Committee

Macaulay Land Use Research Institute (MLURI): based in Aberdeen, MLURI was subcontracted to carry out the soil survey element of CS1990 in Scotland.

MAFF: see Ministry of Agriculture, Fisheries and Food

Main Plot Classes: outputs from TWINSPAN classification of all Main (vegetation) plots (29 in number).

Main plots: 200 m^2 plots placed at random in each 1 km field sample square (5 in each) from which vegetation data were recorded.

Majority filter: filtering procedure, used to smooth out 'noise' in classification of satellite data, to produce generalised images.

Marginal upland landscape: one of the four Landscape Types into which ITE Land Classes have been aggregated to present results from CS1990.

Mask: a region defined manually, or by attribute rules based on segment attribute, or by recourse to

MAVIS: see Modular Analysis of Vegetation and Interpretation System

Maximum likelihood classification (MLC): allocation of labels, here to image vector segments, using a spectral comparison against training areas and the calculation of a distance weighting (Mela nhobis distance) in the 6-dimensional image feature-space, based on the 6 bands of image data (summer and winter red, NIR and MIR); probabilities reflect the relative distance in spectral feature-space of the segment from all the options set in training: and the maximum likelihood class is that initially ascribed to the segment.

Millennium Report on Biodiversity:

Minimum mappable area (0.04 ha): smallest area of land to be mapped as a homogeneous unit (using a consistent coded description) within the field survey part of CS1990.

Minimum mappable length (20 m): shortest length of any linear feature to be mapped as a homogeneous unit (using a consistent coded description) within the field survey part of CS1990.

Ministry of Agriculture, Fisheries and Food (MAFF): responsible for administering Government policy for agriculture, horticulture and fisheries in England.

MLC[1]: see Maximum Likelihood Classifier

MLC[2]: see Monitoring Landscape Change (project)

MLURI: see Macaulay Land Use Research Institute

MMA: see Minimum mappable area (004 ha)

MML: see Minimum mappable length (20 m)

Modular Analysis of Vegetation and Interpretation System (MAVIS): a software package being developed to link NVC, CVS, CSR and Ellenberg scores for analysis of vegetation samples.

Monitoring Landscape Change (project) (MLC): 1984 sample survey of the countryside of England and Wales carried out by Huntings Technical Services on behalf of the DOE and the Countryside Commission.

MSS: see Multispectral Scanner

Multiple-element category: used in describing physical boundaries which have more than one element (eg wall with a wire fence).

Multispectral Scanner (MSS): instrument carried on all Landsat satellites, offering an 80 m spatial resolution and four wavebands.

Multivariate statistical technique: statistical analysis using more than one variable (characteristic) at a time to classify members of a statistical population.

National Biodiversity Network (NBN):

National Countryside Monitoring Scheme (NCMS): developed by the former Nature Conservancy Council (NCC) to record changes in GB using aerial photography on a county-by-county basis. Currently being used in Scotland.

National Remote Sensing Centre (NRSC): (now National Remote Sensing Centre Limited)**:** home of the Earth Observation Data Centre and British agents for the supply of Landsat data.

National Rivers Authority (NRA): formed in 1989 as an independent body with statutory responsibilities for the management of such things as water resources, flood defence, fisheries and pollution control for all inland waters, estuaries, coastal waters and natural underground water in England and Wales.

National Vegetation Classification (NVC): The classification system developed at Lancaster University for describing British vegetation (Rodwell 1991).

Natural Environment Research Council (NERC): responsible for planning, support and encouragement of research in those sciences that relate to man's natural environment and its resources.

Nature Conservancy Council (NCC): until 1992, the Government agency with responsibility for nature conservation in Britain, now undertaken by the Countryside Council for Wales, English Nature, the Joint Nature Conservation Committee and Scottish Natural Heritage. A contributor of funding to CS1990.

NBN: see National Biodiversity Network

NCC: see Nature Conservancy Council

NCMS: see National Countryside Monitoring Scheme

NERC: see Natural Environment Research Council

NICS: see Northern Ireland Countryside Survey

Northern Ireland Countryside Survey (NICS): field survey adopting similar approach to CS1990, funded by the Department of the Environment for Northern Ireland, carried out between 1986 and 1991.

NRA: see National Rivers Authority

NRSC: see National Remote Sensing Centre (now National Remote Sensing Centre Limited)

NVC: see National Vegetation Classification

ORACLE: data base management system, widely used in CS1990.

Ordination Axis: The gradient along which vegetation samples are ordered, according to their ecological affinities.

Ordnance Survey (OS): based in Southampton and responsible for the official survey and mapping of Great Britain.

OS: see Ordnance Survey

Parcel: here used to describe the field survey land unit (e.g. a field, a wood, a lake), based on OS maps but with editing of linework as appropriate.

Pastural landscape: one of the four Landscape Types into which ITE Land Classes have been aggregated to present results from CS1990.

Patch size: used in landscape ecology and pattern analysis as a measure of the area of a unit of vegetation, habitat or land cover type.

Pattern analysis: general term to describe the measurement of elements in the landscape, such as area of fields, lengths of boundaries and edges, and the relationships between them.

Pixel: area of ground surface which is the unit of classification used in satellite image interpretation (eg 25 m x 25 m in CS1990).

Plot classes: outputs from classification of vegetation plots and determined by the plant species present in the plot**:** plots in the same class will generally have the same species present.

Plot Types: The 6 types of sample vegetation plots placed in different landscape elements in the Countryside Survey (main, streamside, roadside, hedge, boundary and habitat) (Barr *et al.* 1993, Bunce *et al.* 1999b).

Plot Types: The 6 types of sample vegetation plots placed in different landscape elements in the Countryside Survey (main, streamside, roadside, hedge, boundary and habitat).

Plots: Defined areas of vegetation, usually by quadrats, within which species are recorded.

Polygon data: data derived from multi-sided figures representing distinct areas on a field survey map or satellite image.

Polygon: a vector GIS areal object representing a field survey parcel or LCM image segment.

Polynomial model: mathematical expression which, in this report, expresses how the geometry of the original satellite image relates to that of the earth's surface and which is used to alter the image geometrically to match the desired map scale and projection.

Primary codes: used in the field mapping part of CS1990 to define the general nature of a feature (eg woodland, lake, field of grass) (cf secondary codes which describe the feature in more detail).

Principal vegetation gradient: name given to the first axis resulting from a TWINSPAN analysis of the vegetation data**:** generally interpreted as being from plots which are characteristic of highly managed lowland vegetation, often with high levels of nutrients, to those of unmanaged upland vegetation with low nutrient levels.

Priority Habitats:

Proximity analysis: measurement of the closeness of one land cover type to another.

Quality assessment: means of measuring the quality of work, eg by repeat sampling of vegetation plots.

Quality Assurance Exercise: partial re-survey carried out in 1990 and 1991 to assess consistency and reliability of CS1990 field survey, and repeated in 1998 as quality assurance for CS2000.

Raster data: data which relate to areas rather than lines (vector data)**:** raster maps may be made up of a grid of cells, each having a separate value.

Reflectances: light values reflected from the earth's surface and recorded by satellites.

Relict hedges: boundaries recorded in the field survey which at some point in the past have been hedges but are something else at the time of survey (eg line of trees).

Remote sensing: a general term to include observation of the land surface from a distance, usually applied to aerial photography and satellite imagery.

River Invertebrate Prediction and Classification System (RIVPACS): a software package devised by IFE for assessing the biological quality of rivers.

River Purification Boards (RPB): have similar responsibilities in Scotland as the National Rivers Authority in England and Wales.

RIVPACS: see River Invertebrate Prediction and Classification System

RMSE: root mean square error of spatial displacement of a series of points (here control points used in geo-registration of the satellite images to an OS base map.

Roll-over: a process whereby classified segments of one scene are used to label equivalent segments of an overlapping unclassified scene using spatial correspondence >90% and probability of classification >90% to ensure that only the most reliable are transferred.

RPB: see River Purification Boards

SAC: see Special Area of Conservation

Sample data: data which have been collected from only some members of a statistical population and which are usually assumed to be representative of the whole population.

Satellite image: general term used to refer to data acquired by remote sensing; also used to refer to the visual display of such data on a screen or as printed paper products.

Satellite imagery: process of collecting satellite images.

Satellite scene : here used to refer to a summer-winter composite of two scenes or part-scenes.

Scottish Environment Protection Agency (SEPA):

Scottish Executive (Rural Affairs Division):

Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD): now part of the Scottish Executive, formed in 1999.

SE: see Standard Error

Secondary codes: used in the field mapping part of CS1990 to define the characteristics of mapped features in detail (eg tree species in woodland, size of lake, species present in grass field) (cf primary codes).

Segmentation: the process which identifies spectrally similar pixels of the satellite scene and groups them into raster segments; the process uses 3 image bands (winter NIR and summer MIR and red) with a threshold .....

Segments: spatially coherent clusters of pixels with similar spectral signatures; they start as raster segments but are converted to vector segments for classification; later in ARC/Info they may be used as vector objects or as 'raster polygons'.

Semi-natural vegetation: generally, vegetation which has not been created by human activity (management) although it may have been influenced by it.

SEPA: see Scottish Environment Protection Agency

SERAD: see Scottish Executive, Rural Affairs Division

Site of Special Scientific Interest (SSSI):.

SOAEFD: see Scottish Office Agriculture, Environment and Fisheries Department

Soil group: division of soils into one of ten major groups, eg podzolic soils.

Soil Prediction and Classification System (SOILPACS): Similar to RIVPACS but for terrestrial systems, SOILPACS will predict the health and quality of soils from the micro-fauna present.

Soil subgroups: division of major soil group into more detailed classes, as supplied by SSLRC and MLURI for CS1990.

Soil Survey and Land Research Centre (SSLRC): based at Silsoe, Bedfordshire, SSLRC was subcontracted to carry out the soil survey element of CS1990 in England and Wales.

SOILPACS: see Soil Prediction and Classification System

Spatial recording: recording the position of features (eg fields, trees) using a co-ordinate (grid reference) system.

Spatial scales: data recorded at one scale applied at national, regional or local levels.

Special Area of Conservation (SAC): These will be designated under the EC Habitats Directive and will contribute to the Natura 2000 series of pan-european sites along with Special Protection Areas.

Species cover values: estimates of the ground area covered by a plant species.

Species Groups: (not used in CS2000 analysis) Groups of species with relatively similar environmental affinities generated by minimum variance cluster analysis of ordination scores for each species (Bunce *et al.* 1999b).

Spectral characteristics: reflectances in different wavebands, from different surfaces on the ground, measured at sensor, and peculiar to a particular cover type.

SSLRC: see Soil Survey and Land Research Centre

SSSI: see Site of Special Scientific Interest

Standard Error (SE): estimated standard deviation of an estimate of a parameter.

Stock: the amount of any feature present at a point in time (cf change).

Stratified random sample: sample drawn at random from within each of the different strata of a data set (eg the CS1990 1 km field sample squares were drawn at random from each of the 32 ITE Land Classes (strata)).

Stratified sample: sample drawn from different divisions (strata) of the whole data set**:** intended to increase the chances of the sample being truly representative of the whole population.

Stream order: classification of streams/rivers where a first-order stream is one which runs from a source to the first confluence; second-order streams run from the confluence of two first-order streams to a confluence with another second-order stream, and so on.

Streamside plots: one of the linear plot types, placed alongside flowing watercourses (see section 2.3.11).

Student's t-test: statistical procedure to test for significant differences between two sets of data.

Subclasses: thematic subdivisions of target classes where these fail to match the widespread Broad Habitat subdivisions; also, to meet wider needs such as matching 1990 cover types; the attempt is to map these consistently across the UK but with the admission that 90% 'accuracy' may not be achieved.

Suburban: land cover class shown on the land cover map.

Target cover classes: those widespread Broad Habitats, or very close equivalents, which can be separated spectrally.

Target land cover classes: one of the classifications of land cover data produced from the land cover map (being 25 in number).

Taxa: any group of organisms that is sufficiently distinct from any other group to be distinguished by name at one or other level of classification.

Thematic Mapper (TM): scanner on board the Landsat satellite, which provided the reflectance data used in mapping land cover**:** the scanner offers seven wavebands of data for reflectances from 30 m ground cells.

TM: see Thematic Mapper

TWINSPAN: see Two-way Indicator Species Analysis

Two-way Indicator Species Analysis (TWINSPAN): a FORTRAN program used in CS1990 to classify plot data into vegetation classes (see Hill 1979).

Unsurveyed urban land: a census estimate of urban land from all 1 km squares not surveyed.

Upland landscape: one of the four Landscape Types into which ITE Land Classes have been aggregated to present results from CS1990.

Validate: here a misnomer, used to describe the process of calibrating LCM data against field reconnaissance and/or filed survey data.

Variants: subdivisions of Target classes and Subclasses where these offer potential to meet wider user needs; the variants may not be mapped consistently across the UK (e.g. specific arable crops will only be mapped where image-dates permit).

Vascular plants: all plants excluding mosses, liverworts and algae (ie ferns, conifers and flowering plants).

Vector-digitising: entering the spatial co-ordinates of features (eg fields, lines of trees) from a map to a GIS using continuous lines in order to represent the feature as exactly as possible (cf raster data).

Vegetation gradient: see principal vegetation gradient.

Vegetation plots: three types of plot, Main, Habitat and linear, recorded in each 1 km field survey square for vegetation analysis.

Verge plots: one of the linear plot types, placed alongside roads/tracks.

Ward's minimum variance clustering: statistical technique to group species which have similar distributions.

Welsh Office (WO):

WES: see Wildlife Enhancement Scheme

Wider countryside: term used to distinguish the majority of the 'ordinary' countryside from special, designated areas (usually in relation to wildlife designation). The field survey component of CS2000 provides information on the wider countryside (and Broad Habitats), rather than the smaller, rarer designated areas (eg SSSIs, ESAs etc).

Widespread Broad Habitat: those Broad Habitats, as defined under the Biodiversity Action Plan, which tend to be larger in extent and for which more accurate estimates of extent are likely from the field survey component of CS2000.

Wildlife Enhancement Scheme (WES):

WO: see Welsh Office