CENTRE FOR ECOLOGY AND HYDROLOGY

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Countryside Survey 2000

Module 17 - FINDING OUT CAUSES AND UNDERSTANDING SIGNIFICANCE (CS2000 FOCUS)

Final Report
Volume 1: Implications of Findings to Policy

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COUNTRYSIDE SURVEY MODULE 17:
FINDING OUT CAUSES AND UNDERSTANDING SIGNIFICANCE (FOCUS)

EXECUTIVE SUMMARY

1. Following the publication of the Countryside Survey 2000 results a number of questions were raised about the level of confidence in the results and the interpretation of changes reported. In all, 17 specific questions were formulated that were grouped into seven topic areas. The results were re-examined, compared with non-Countryside Survey datasets and the policy relevance of the findings explored.
2. The results are reported in two ways, this report describes the policy relevance of the changes and suggests the implications. A second set of reports, available over the world wide web (http://www.cs2000.org.uk/FOCUS_task1.htm), provide the supporting evidence, showing the scientific detail of the examinations, analyses and interpretations made.
3. The seven topic areas are the six aggregations of Broad Habitats used in the report of Countryside Survey 2000[1]. They are Enclosed farmland; Boundary and linear features; Woodlands; Mountain, moor, heath and down; Rivers, streams and standing waters; and Developed land in rural areas. The seventh topic is more management related and covers Agri-environmental schemes.
4. In general the more detailed analyses confirmed the interpretation made in the original publication although in some cases the extent of change recorded could be recalculated to allow for alternative interpretation, errors in field mapping and data processing.
5. The study has clarified the limits of analysis and interpretation of CS2000 data. CS is a general survey of rural habitats and is not capable of making definitive statements about Priority Habitats or urban areas as the sample has very limited observations in these areas. The data are still valuable in examining questions about these topics as they provide context, describe the background matrix in which change is occurring.
6. The report shows the importance of communication and liaison between different groups generating datasets for monitoring. Following the study, a few changes in the survey methodology are proposed, but these should be made in a conservative way so that they do not invalidate the comparison with data already collected or compromise the links with other groups and their datasets.
7. Additional surveys, sometimes repeating previous work, are proposed to answer questions that CS data is incapable of addressing. The work should be carried out using techniques that will maintain compatibility with CS, but should not be included within the CS structure.
8. The work has generated a list of potential modifications to field recording that should speed up the production of results. The modifications need to be reviewed to guarantee their security, consistency and comprehensiveness.

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[1] R.H. Haines-Young, C.J. Barr, H.I.J. Black, D.J. Briggs, R.G.H. Bunce, R.T. Clarke, A. Cooper, F.H. Dawson, L.G. Firbank, R.M. Fuller, M.T. Furse, M.K. Gillespie, R. Hill, M. Hornung, D.C. Howard, T. McCann, M.D. Morecroft, S. Petit, A.R.J. Sier, S.M. Smart, G.M. Smith, A.P. Stott, R.C. Stuart and J.W. Watkins (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London ISBN 1 85112 460 8

MODULE 17:
FINDING OUT CAUSES AND UNDERSTANDING SIGNIFICANCE (FOCUS)

Background

1. Countryside Survey 2000 was a survey of land cover, landscape features, soils and water character and biodiversity for the rural and peri-urban environment of Great Britain (GB). The majority of the field work was conducted in 1998, with the remainder completed in 1999; it was reported in *Accounting for Nature*, Haines-Young *et al*.(2000). That report presented stock and change on land cover, landscape features and vegetation from the ground survey of sample 1 km squares by Broad Habitat (see Annex 1) and by regions within GB. In general terms, it was reported that changes in stock of habitats and features between 1990 and 1998 seemed to have been less than in the previously reported period (1984 to 1990), but changes in vegetation character had continued.

2. Since the publication of the report, additional information has been made available on the CS2000 website. This includes detailed data that were used to generate the outputs in the Main Report, as well as findings from other elements within CS2000.

3. The findings from CS2000 have potential importance in a wide range of rural policy areas, for example the UK Biodiversity Action Plan (BAP) and the Water Framework Directive (WFD). They also have the potential to inform policy development, for example, in changes in peri-urban areas and agricultural land.

4. There are risks involved with adopting a simplistic translation between published CS2000 findings and policy implications. This is perhaps best demonstrated using an example. One of the findings from CS2000 was that the area of *Fen, Marsh and Swamp* had increased since 1990. Wetland habitats are among the most threatened, so the result appears to be important for the conservation of both this habitat, and the plants and animals that inhabit it. There might have been a significant increase in wetlands across GB but we need to be aware that there are several other possible explanations for this change. For example, it could also have been a change in the occurrence of one or two plant species that led to the Broad Habitats being redefined. It could be explained by a consistent shift in grassland vegetation towards more damp grassland vegetation that is not of great conservation value in its own right.

5. Another issue relates to the turnover of features and habitats. A second important result of CS2000 was that the declines in hedgerow lengths observed between 1984-90 was no longer seen between 1990-98. Yet there was flux: some hedges were lost, while others were gained. This flux may be of concern to rural policy, if new hedges were somehow not equivalent to the ones that had been lost.

6. It was therefore agreed to fund a new project within the CS2000 programme to explore the data in more detail in order to answer specific policy questions. This programme, Module 17 within CS2000, was named "Finding Out Causes and Understanding Significance" (FOCUS), and was funded by range of sponsors, namely Department for Environment, Food & Rural Affairs (Defra), Countryside Council for Wales (CCW), English Nature (EN), Forestry Commission (FC), Joint Nature Conservation Committee (JNCC) and Scottish Natural Heritage (SNH).

7. The research was also co-funded by the Natural Environment Research Council (NERC). These organisations are closely involved in the project specification, provide support and advice to ensure that the research achieves the policy-oriented objectives, and debate the findings with the researchers.

8. The research was constructed around a series of specific research questions, grouped into topics. There are 17 questions reported in seven topic areas.

9. The report is in two sections. This first volume is intended for those with policy-related interests in the research. We present briefly the background for each of the research questions, the approach adopted, the major findings and the implications, both for policy and for possible amendments for future Countryside Surveys. The second volume consists of technical annexes,

where the detailed work programmes for each question is presented. Scientific papers will be submitted to refereed journals as appropriate.

Objectives

1 The formal objectives of the work programme (as defined in the project specification) were:

i. to undertake further critical analysis of the data arising from CS2000 to answer a series of specific questions concerning interpretation and understanding of the results in terms of ecological processes and land management effects;

ii. to acquire and use other contextual data to assist in the analysis, interpretation and assessment;

iii. to recommend improvements to survey protocols;

iv. to establish and consult a steering group and organise workshops as necessary to ensure that user requirements are defined, clearly understood and addressed;

v. to publish the results in technical reports and concise non-technical summaries and to present the results at a seminar; and

vi. to maintain the CS2000 website following completion of the current Module 16 and to facilitate internet publication of the results of ongoing CS2000 projects.

Task, Topics & Questions

2 The objectives have been met through three main areas of work (**tasks**):

i. Answering specific research **questions** arising from published results.

ii. Recommending improvements to survey protocols.

iii. Maintaining the CS2000 Website.

3 It has been agreed that the specific research questions should be aggregated under seven distinct **topics**. Each topic relates to one of the Broad Habitat groups (Chapters) in the CS2000 main report (Haines-Young *et al.*, 2000), with the exception of one (Topic 7) which is of a more over-arching nature.

4 The aggregation of FOCUS questions as shown in Table 1.

5 A number of general points apply to the way this suite of questions were addressed:

i. Where possible, work used external (i.e. to CS2000) research and survey results, including information and expertise held by the funding consortium.

ii. Although this programme of work was been initiated to clarify or expand on some of the results from CS2000, it was been necessary to include an assessment of uncertainty of these further, second-stage results. Statistical significance has been handled in the same way as in the earlier analyses but, in addition, discussion has been held with interested sponsors and other experts about the policy significance and relevance of any results and conclusions.

iii. The work adopted a flexible approach to the use of geographical frameworks according to customer requirements; i.e. Environmental Zones (Annex 3), countries, including the production of separate reports for England and Wales and investigated the appropriateness of using other possible geographical breakdowns – regions, catchments and natural areas.

v. There now follows a report on each of the research questions, structured to review in summary only:

- the background to the research question, including a précis of results from CS2000
- the significant results from the FOCUS work programme
- suggested implications for policy.

The challenge in this Volume I has been to reduce the available information to a concise summary which will be useful to policy customers. There is much greater detail in Volume II, the Technical Annexes.

Table 1. Aggregation of 15 specific research questions under 7 topic headings.

Topic no.	Topic heading	Question no.	Question
T1	Enclosed farmland	1 2 3	Decline in semi-natural grasslands? Newly cultivated land in CS2000? Conservation value of weed species?
T2	Boundary & linear features	4 5 6 7 8	Change in hedges 1990, 1993 and 1998? Plant diversity, hedge characteristics, land use? Value of hedges for birds? Hedges that are being gained/lost? Condition of ancient and/or species-rich hedgerows?
T3	Woodlands	9	Differences in estimates of woodland cover? Correspondence with AWI sites? Woodland changes - where and how?
T4	Mountain, moor, heath & down	10 11 12	Changes in dwarf shrub heath? Increases in fen, marsh & swamp? Bracken invasion?
T5	Rivers, streams & standing waters	13 14	Causes of overgrown streamside vegetation? What and where are the new ponds?
T6	Developed land in rural areas	15 16	Habitat creation on developed land Countryside around towns
T7	Agri-environment schemes	17	Agri-environment schemes?

Reference

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

Acknowledgements

6 The research team is grateful for very significant inputs made by additional staff who have been involved at various stages of the work including Helen Anderson, Cath Barnett, Beverley Dodd, and Claire Wood.

7 We are grateful to the project Steering Group for their the support and input throughout the project. The Steering Group members were: David Allen (CCW), Richard Brand-Hardy (Defra), Simon Gillam (FC), Jane Goodwin (Defra), Debbie Jackson (Defra), Ed Mackey (SNH), Stephen Preston (EN), Andrew Stott (Defra) and Ian Strachan (JNCC).

8 Lastly, we are grateful to a number of people who attended a workshop in May 2002 and who gave helpful advice and guidance to the project at that stage.

Question 1: What are the likely causes of the decline in extent and condition of semi-natural grasslands (acid, neutral and calcareous)? Why was there a high turnover with improved grassland types? To what extent do gains compensate for losses? What are the implications for conservation of biodiversity and agri-environment management prescriptions?

Simon Smart & Sandrine Petit

Background

Losses of species-rich, semi-natural grassland have been taking place for many decades largely as a result of improvement and cultivation. Remaining areas of habitat are therefore of considerable conservation importance. CS2000 reported significant losses of all three grassland Broad Habitats involved in different parts of GB. Moreover, there was considerable turnover with other habitat types. In particular, there were net gains to *Neutral Grassland* in Environmental Zones 1 & 2 (Annex 3). Here, we consider these changes in more detail, determining to what extent they are of significance for nature conservation. We sought to distinguish between changes due to substantial shifts in vegetation and other shifts of less conservation importance. In particular, impacts of the changes were estimated on the five Priority Habitats contained in the Broad Habitat. These are Lowland meadows, Upland hay meadows, Lowland calcareous grassland, Upland calcareous grassland and Lowland dry acid grassland.

Key findings:

What are the likely causes of the decline in extent and condition of semi-natural grasslands (Acid, Neutral and Calcareous)?

- A review of field data broadly confirms the CS2000 estimates of change[2], except for losses from *Calcareous Grassland* to *Improved Grassland* and *Neutral Grassland* to *Arable and Horticultural*, where 50% of the recorded change may have been due to field mapping and data processing errors. Amendments will reduce the estimated 16% loss of Calcareous Grassland and 39% loss of Neutral Grassland both in Environmental Zone 5.
- Changes from semi-natural grasslands to *Improved Grassland* tended to occur in grassland communities that started with higher fertility. Much of the loss involved initial communities more similar to set-aside than to permanent hay meadows and pastures. However, ongoing improvement also affected vegetation referable to the more fertile U4 *Festuca-Agrostis* Acid Grassland type.
- Work carried out under a parallel project indicated that wet and dry deposition of NH_x could account for a small amount of the increase in Ellenberg fertility scores seen in British semi-natural grasslands. However, most of the variation occurred at the sub-km square level implicating local factors such as direct fertiliser application, succession (particularly in the smaller grassland fragments), responsiveness of the initial vegetation and probably small-scale variation in N deposition.
- The *Neutral Grassland* gained from *Improved Grassland* appeared to have more in common with non-rotational set-aside than Priority Habitat grassland types.

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[2] 39% loss of Neutral Grassland in zone 5; 19% loss and 16% loss of Calcareous Grassland in E&W and Scotland respectively; 13% loss and 15% loss of Acid Grassland in zones 3 and 4 respectively (Haines-Young et al 2000).

- In summary, most of the previously presented changes in semi-natural grassland extent were probably attributable to ongoing increases in grassland fertility, and local machair cultivation, with only a minority due to spatial processing and mapping errors.

Why was there a high turnover with improved grassland types?

- High turnover of *Improved Grassland* was a feature of rotation with arable land and, especially, fallow-grasslands, probably related to set-aside uptake. This explains what seemed an unexpectedly high degree of turnover between *Improved Grassland* and *Neutral Grassland*.

To what extent do gains compensate for losses?

- There was no evidence that the real losses of *Acid Grassland*, *Neutral Grassland* and *Calcareous Grassland* were compensated by creation of ecologically equivalent new stock.
- The conservation importance of the turnover detected in the survey did not appear to be high because Priority Habitat types were rarely involved. However this reflects their scarcity in the wider British countryside and is not evidence that fragments of Priority Habitat remained unaffected by land-use change.
- The net increase in 'set-aside type grassland' included in the *Neutral Grassland* Broad Habitat represents a valuable new ecological resource of potential importance to lowland farmland birds as feeding and nesting sites for those species that require mosaics of arable and grassland habitats.

What are the ***implications*** *for conservation of biodiversity and agri-environment management prescriptions?*

- All five Priority Habitats were extremely scarce in Countryside Survey (CS) data. These results therefore highlight the scarcity of Priority Habitats in the wider countryside and the importance of conserving those areas that remain.
- CS can provide a context for ongoing evaluation of local change. This was clearly shown by a comparison of CS plots within the *Neutral Grassland* Broad Habitat against reference data for grassland Priority Habitats within English ESAs. Results showed that ESA *Neutral Grassland* was significantly different in species composition and more species rich than *Neutral Grasslands* sampled in the wider countryside. The CS *Neutral Grassland* sample showed a decline in condition between 1990 and 1998 and therefore moved even further from the ESA reference sample.
- CS2000 provides evidence of an overall shift towards more nutrient-rich, intensively managed grasslands. However there CS provides insufficient data upon which to draw conclusions about losses of BAP Priority Habitats because these habitats are rare and are not well represented in the survey sample. Many of the transfers between improved and semi-natural grassland involved temporarily unmanaged set-aside type grasslands.
- The results do not provide evidence of decline in prime biodiversity habitats because these have mostly not been sampled by the survey. However CS does show a general reduction in botanical diversity (ie wild flowers) across the countryside. These declines are also likely to be significant for other species groups such as invertebrates and farmland birds.
- This general decline in botanical diversity is also significant because the success of entry level agri-environment schemes may well depend on the persistence of species-rich habitat fragments from which species disperse and colonise the wider countryside.

Recommendations for further work

- It is worth considering re-visiting the 'Key Habitat' sample areas (Hornung *et al.*, 1997) alongside the next CS. Since these sample areas were targeted on, among others, Coastal, Lowland Heath, Upland and *Calcareous Grassland* landscapes, a resurvey might provide valuable additional information on wider changes in extent and condition of Priority Habitats included in the *Neutral Grassland* and *Calcareous Grassland* Broad Habitats.
- Further research is required to quantify more accurately the effects of variation in the volumes of fertiliser applied to semi-improved grasslands across Britain. This research is not so much required to quantify the general impact of fertilisers on semi-natural vegetation but rather to assess the importance of this driver at the national scale. Similarly, there is a pressing need for robust but finer-grained modelling of ammonia deposition at the sub-km square level. Only when more detailed deposition data become available will better explanations of the changes in vegetation become testable.
- If entry-level agri-environment schemes are to protect and restore semi-natural grasslands, they will need to benefit those plant species that are already present in the landscape that act as building blocks of species-rich grasslands. An appraisal of the performance of such schemes for generating biodiversity gains might, therefore, come from an assessment of the abundance of residual Priority Habitat assemblages within agreement land.

Reference

Hornung, M., Barr, C.J. and Bunce, R.G.H. (1997) *Current status and prospects for key habitats in England*: *Part 6 summary report*. Report for Department of the Environment, Transport and the Regions ITE Merlewood, Grange-over-Sands.

Question 2: What was the amount and character, in terms of Broad Habitat, parcel size and location of land that was recorded as newly cultivated in CS2000?

Sandrine Petit & Simon Smart

Background

Losses of semi-natural habitats to intensive agriculture (*Arable and Horticultural, Improved Grassland*) have been of major conservation concern during latter half of the 20th century. Between 1990-98 in GB, there had been significant increases in the area of the *Arable and Horticultural* Broad Habitat in Environmental Zones 2 and 4 (Annex 3), but it had declined in the more intensive arable landscapes of the Environmental Zone 1. By contrast, there had been a significant loss of *Improved Grassland* in the Environmental Zone 2, but a significant increase in Environmental Zone 3. CS2000 results indicated that that substantial amounts of semi-natural grasslands, especially *Neutral Grassland*, had been converted to intensive agriculture. This is of concern as *Neutral Grassland* includes ecologically rich habitats, such as species-rich hay meadows.

Key findings:

What was the amount of land reported as newly cultivated in CS2000?

- It was estimated that 396,000 ha of land (SE = 39,000 ha) were converted to intensive agriculture in GB between 1990 and 1998. Conversion occurred mainly in the Environmental Zone 2 (132,000 ha), Environmental Zone 3 (85,000 ha) and Environmental Zone 3 (69,000 ha). In Scotland, around 45,000 ha were converted both in Environmental Zones 4 and 5 while 21,000 ha were converted in the Environmental Zone 6.
- Most of the conversions to cultivated land occurred on previously permanent grassland (as defined in the EIA) , i.e. *Neutral Grassland* (152,000 ha), *Acid Grassland* (131,000 ha) and *Calcareous Grassland* (13, 000 ha).Other conversions to intensive agriculture occurred on previously *Fen Marsh and Swamp* (24,000 ha), and *Bracken* (9,000 ha), mainly in Environmental Zones 2 and 3. These 2 broad habitats are part of the Heathland and moorland category of the EIA.
- Respectively 48% of parcels converted to intensive agriculture in England & Wales and 66% in Scotland were smaller than 0.2 ha (Figure 2.1) although these conversions account for only 4% of the total area converted in England & Wales and 7% in Scotland. These parcels are too small to represent management units and are likely to be strips of land located along existing fields or improved grass or small pieces of land located at the corner of existing management units.
- Respectively 23% of converted parcels in England & Wales and 12% in Scotland were larger than 1 ha – these conversions account for 75% of the area that was converted to intensive agriculture for both countries. Of those, 20% in area were converted to *Arable and Horticultural* in England & Wales while this percentage is higher in Scotland, i.e. 38% in area.

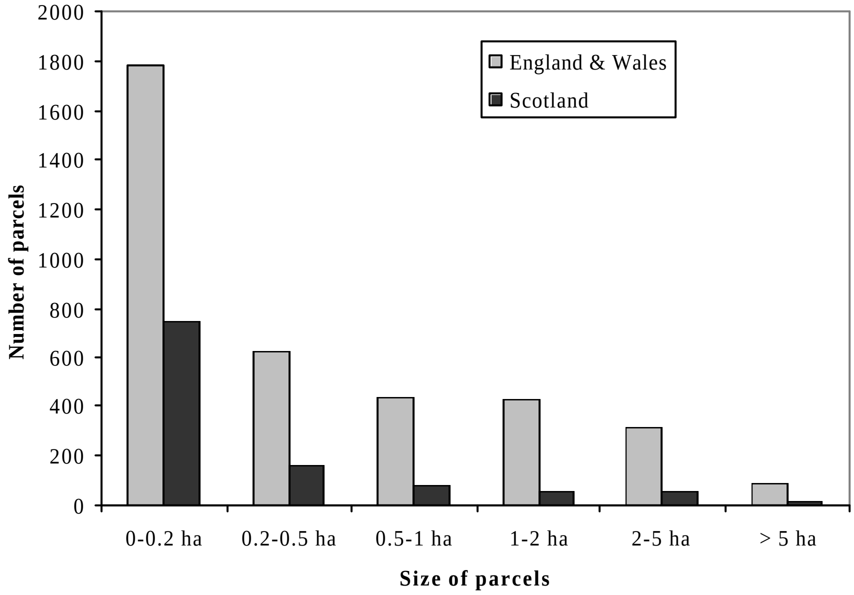


Figure 2.1: Frequency distribution of parcels of land converted to intensive Agriculture in England & Wales and in Scotland between 1990 and 1998 per size of parcels.

What was the character of land lost from Neutral Grassland to intensive agriculture?

- Relatively large proportions of the 1990 stock of *Neutral Grassland* had been converted to intensive agriculture between 1990 and 1998. This involved national losses of 2 to 8% (95% confidence interval) to *Arable and Horticultural* in lowland Britain and between 19 and 34% to *Improved Grassland* (occurring in all Environmental Zones but 6).
- *Neutral Grassland* habitats that had been converted to intensive agriculture had similar vegetation and conservation value than parcels that remained *Neutral Grassland* in 1998.
- The spatial context of parcels affected their probability of conversion. In Environmental Zones 2 and 3, parcels that were converted to *Improved Grassland* tended to be larger than those which stayed the same. Across GB, conversions were also more likely in squares where cultivated land was already well represented. However, this trend was not seen in the Environmental Zones 1 and 2, probably because the proportion of intensive agriculture in the squares was already very high and so the potential for expansion was reduced.

What was the character of land lost from Acid Grassland to intensive agriculture?

- Nationally, between 5 and 14% (upper and lower 95% confidence limits) of *Acid Grassland* in 1990 had been converted to *Improved Grassland* by 1998. These conversions occurred mainly in Environmental Zones 2, 3 and 5. The proportion of 1990 *Acid Grassland* lost to *Improved Grassland* was larger in England &Wales (8 to 18%) than in Scotland (2 to 8%).
- Unlike the situation for *Neutral Grassland*, parcels of *Acid Grassland* that were intensified tended to have been atypical in 1990, when they had been more fertile, and less acid, than those parcels that retained *Acid Grassland* status in 1998.
- The spatial context of parcels of *Acid Grassland* affected their probability of conversion. Nationally and in each Environmental Zone, conversions were significantly more likely to occur in squares within which cultivated land was already present.

Implications:

- If the trends observed between 1990 and 1998 continue to prevail, it can be expected that the number of applications for EIA will be especially high in Environmental Zone 2, where it will be mainly related to the conversion of parcels of *Neutral Grassland* (generally larger than average) and the most fertile and least acidic parcels of *Acid grassland*.

- In the same way, one would expect to see a large number of applications for EIA in Environmental Zone 3, mainly related to the conversion of the least acidic and most fertile parcels of *Acid Grassland* (and to a lesser extent *Fen, marsh and swamp*) to *Improved grassland*. Some applications should also be related to the conversion of larger than average parcels *Neutral Grassland* to *Improved Grassland* Applications should be more likely for parcels that are located in landscapes which already contain intensive agriculture.

- The probability of conversion to intensive agriculture was proportional to the area of intensive agriculture in the square, except in areas which have already been intensified to such an extent that this relationship has broken down. Here, increasing habitat diversity (if not quality) is the most likely trend. Perhaps we are seeing a "post-industrial agricultural landscape", in which the processes of habitat change and quality are rather different from those that have been observed in landscapes during intensification.

Question 3: What is the status of, and changes in, the weed flora of dfferent crop types (eg roots and vegetables) as recorded in CS2000 and what is the conservation value of the species concerned?

Les Firbank & Simon Smart

Background

The plants in arable fields are of conservation concern for two reasons. First of all, some species, formerly widespread, have become increasingly localised and scarce, becoming of conservation concern in their own right. Secondly, some other species are of concern because of their importance in the food chains for invertebrates and farmland birds. These changes have been driven largely by changes in farming practice.

In *Accounting for Nature*, Haines-Young *et al*.(2000) reported that plant diversity had increased in the *Arable and Horticultural* Broad Habitat since 1990, especially in field boundaries in England and Wales (albeit on the basis of 22 plots only). It was also reported that two widespread bird food plants, Knotgrass *Polygonum aviculare* and Common Chickweed *Stellaria media*, had become less common.

Key Findings

What is the status of the weed flora in different crop types?

- Species richness was assessed using 552 A plots (Annex 2), that are 100 m x 1 m areas along the edge of the cultivated area of arable fields (the part of the field that tends to have the greatest species diversity). 294 non-crop species were recorded, 110 of which were found in ten or more plots. The most frequent were *Cirsium arvense*, *Galium aparine, Elytrigia repens, Poa annua* and *Urtica dioica*
- Mean species richness per A plot was 13.8, and was greater in the west of England and Wales, and was also greater in root crops and vegetables than in cereals. Set-aside was particularly rich in plants important as a source of food for birds. Analysis of species by soil type in field centres was inconclusive, largely because of small sample size and few samples of sandy soils.

How has the weed flora changed?

- When only plots that were arable in both 1990 and 1998 were considered, it is clear that mean species richness of dicotyledons declined in X plots in Environmental Zone 1 (Annex 3), but not in Zone 2, with corresponding declines for plant species providing forage for birds, bees and butterflies. These declines were less steep between 1990-98 than between 1978-90, and did not affect all species equally.
- A subset of field boundary (B) plots shifted species composition from communities of cultivated ground to those more typical of fallow, set-aside land between 1990-98. This subset of plots saw a significant increase in species richness and contributed to one of the headline results in CS2000. However, in this analysis the total sample size was small (n=22) and 17 plots moved into either tall-herb/grass or fertile grassland communities, and has little relevance to the interpretation of changes in the arable flora.

What is the conservation value of the species concerned?

- No species listed in the UK Biodiversity Action Plan were recorded in A plots, nor were any of the species listed as extinct, rare or scarce by Firbank & Wilson (1995).
- The continued declines of *Polygonum aviculare* and *Stellaria media* are of conservation concern, given their importance as food plants for farmland birds.

Implications

- The continuing loss of forage plants remains a potential barrier to halting the decline in farmland bird numbers. The findings presented here give a worse picture than was reported by Haines-Young *et al.* (2000). In particular, flowering plants that are important sources of food for birds and invertebrates have continued to decline in the arable heartlands of eastern lowland England.
- The increase in species richness in arable field boundaries is based on restricted data. If typical, there may be conservation benefits for animals associated with tall/herb grassland corridors, such as small mammals and some invertebrates.
- The contribution of field centres, as opposed to edges and boundaries, to the conservation of farmland pollinators, is worthy of further investigation, given that forage plants for bees and butterflies had declined, especially in Environmental Zone 1, where other sources of forage may be scarce in the landscape.
- CS is unsuitable for monitoring the status of rare and localised arable plants. Given the dynamic nature of arable rotations, there remains scope for a dedicated national arable plant survey that would complement Countryside Survey.

Reference

Firbank, L.G. & Wilson, P.J. (1995) Arable weeds and set-aside - a cause for conservation or a cause for concern? In: *Insects, plants and Set-aside* ed A. Colston & F. Perring, pp.19-28. Botanical Society of the British Isles, London.

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

Question 4: What evidence is there that length of hedges declined between 1990 and 1993 and increased between 1993 and 1998 in England and Wales?

Rick Stuart & Colin Barr

Background

One of the major findings reported in Haines-Young *et al* 2000 was that the decline in lengths of hedges observed between the Countryside Surveys of 1984-90 had halted between the period 1990-98 – i.e. there was no significant changes in the length of hedges in either Scotland or in England and Wales.

However, there had been an additional survey of hedgerows undertaken in England and Wales in 1993 (Barr *et al.* 1994) that had shown a loss since 1990. This survey had involved surveying a targeted sub-sample of CS squares and the hedgerow lengths were recorded using the CS methodology. These results can be reconciled in one of two ways – either the hedgerow lengths had indeed declined between 1990-93, to recover to the 1990 length by the year 1998, or that the reported decline between 1990-93 was an artefact of survey design or analysis.

Key findings:

Were the field methods and analytical procedures from the three surveys consistent?

- Yes, in general, they were. The field-survey codes, definitions of features and methodology used in all three surveys were consistent. Moreover, the automated allocations of linear features into different categories, including hedges, had been applied consistently across datasets for all three surveys. However, the field surveyors in 1993 did not have access to previous data (from 1990), and although in 1998 the surveyors had access to previous data, this was only from the previous Countryside Survey in 1990. Some of the changes observed between surveys were best explained as a result of inconsistent recording in the field, e.g. changes from 'hedge' to 'no feature' and back to 'hedge' in 1990, 1993 and 1998 respectively.

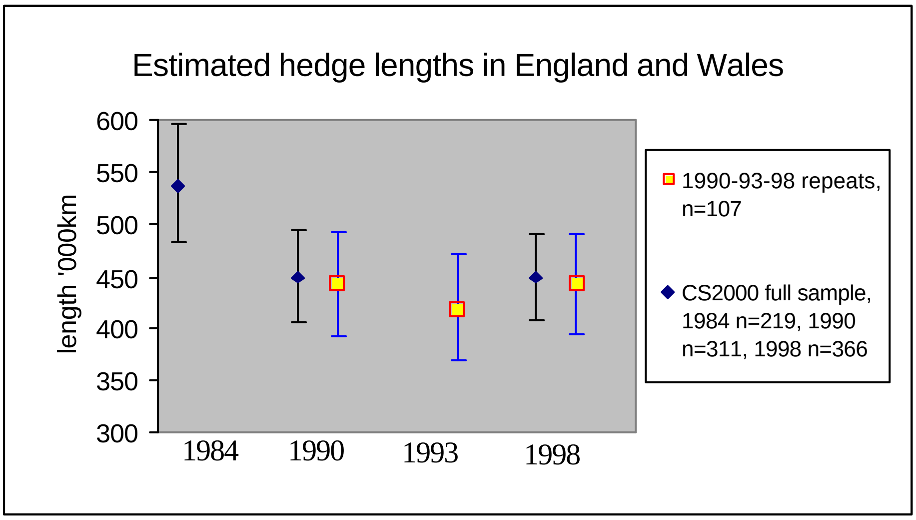
Were the 1993 sub-sample results reported for the 1993 Hedgerow Survey comparable to those reported for CS1990 and CS2000?

- Not directly. This is because the sub-sample of squares used for the 1993 were not a random sample of those used in the full surveys of 1990 and 1998.The 1993 sub-sample could not be used to produce reliable and directly comparable national estimates.

Is it possible to make direct comparisons between the 1993 Hedgerow Survey and CS1990 and CS2000?

- Yes, it is. This is done by using just those 107 1 km sample squares that were used in all three surveys, i.e. 1990, 1993 and 1998, and then seeking significant differences in estimated lengths of hedges. However, using this reduced sample number, the estimates show no statistical difference in estimated lengths between the surveys – the mean estimate was lower in 1993 than in the previous years, but this was well within the margins of error (Figure 4.1: note that, because of the smaller sample sizes, these have larger margins of error than those published for CS1990 and CS2000).

Figure 4.1 Estimates of length of hedge in England and Wales based on stock figures from largest sample of repeatedly-visited 1 km squares available for all years 1990-1993-1998 (n=107) and comparable estimates derived from the full CS2000 sample. Estimates for 1984 from the full sample are shown for context. 95% upper and lower confidence limits are shown for each bootstrapped estimate.



Was the apparent difference between surveys sensitive to inconsistent recording of hedges in the field?

- No. Rules were applied to the data to create a new allocation (to final boundary class) where reported changes were thought to be incorrect. Even then, no significant differences were observed between 1990 – 93 – 98. Although such questionable allocations accounted for 14% of total database length of hedges of the 107 squares analysed there was only a 5% net effect on changes to the total database length, and this was likely to have been outweighed by variation within the sample.

Implications:

- There is no statistically robust evidence that there had been a decline and then an increase in the length of hedges in England and Wales between 1990-93 and then 1993-98 respectively. The sampling rate would have to be increased substantially to detect significant changes in length of less than 10%.
- This analysis shows that the use of surveys using non-random sub-samples of CS squares should not be used to generate national estimates but, rather, as was stated at the time of the 1993 survey, to provide indicative trends only.
- Because surveyors did not have access to previous data, some differences between surveys were more likely to have been due to inconsistent recording rather than genuine change. However, such differences were not sufficiently frequent to affect the overall conclusions.

REFERENCE

Barr C.J., Gillespie M., Howard D. (1994) *Hedgerow Survey 1993 (stock and change estimates of hedgerow lengths in England and Wales, 1990-1993).* Department of the Environment. Published by the DOE.

Question 5: What is the relationship between plant diversity in 10m and 30m hedge plots, hedgerow characteristics/management and adjacent land use?

Sandrine Petit, Rick Stuart & Colin Barr

Background

Hedges have considerable importance for the biodiversity of farmland, acting as potential habitats and refuges for a wide range of plant and animal species. However, the quality of hedges as habitat varies greatly according to their history and management. The UK Habitat Action Plan for Ancient and/or Species-rich hedgerows considers the conservation value of hedges in terms of the number of native woody species in a 30 m length of hedge, and does not account for the vegetation diversity in the hedge bottom, even though that is where many of the plant and animal species associated with hedges are found. If there was no correlation between the diversity of woody and non-woody plant species in hedges, the Habitat Action Plan might be neglecting hedges with potentially high conservation value.

CS2000 involved recording the number of woody species in hedges using 30 m lengths (D plots), and in each 1 km square, up to two such plots were co-registered alongside 10 m plots within which the details (including diversity) of ground vegetation was recorded (H plots). Thus it is possible to relate the numbers of woody and non-woody plant species using a random sample of 450 plots across England and Wales (there were too few such plots in Scotland to be included) – much the most powerful comparison to date. Moreover, the hedge vegetation could also be related to hedge structure, giving some insight about how the hedges have been managed. and adjacent land use.

Key findings

Was there a relationship between the richness of woody species in the hedge and that of the non-woody species in the hedge bottom?

- We found no significant relationship between the diversity of the hedge ground flora in 10 m plots and the woody species diversity recorded in 10 m plot (r = 0.054, n = 440, ns) or the woody species diversity recorded in 30 m plots (r = -0.02, n = 440, ns). This was confirmed by the frequency distribution of plots according to both herbaceous and woody species richness, which did not differ from a distribution expected by chance (Volume II, Table 5.3). This confirms at a national scale the results of the review of Barr *et al* (1995).

Was there a relationship between hedge structure and species richness of the ground flora?

- We detected only a weak effect of hedgerow characteristics and management on the diversity of the ground flora. However, (i) it is questionable that the variables recorded in CS would allow to detect such an effect and (ii) it should be noted that this information was not recorded for a substantial number of hedges. The effect of agri-environmental measures could not be assessed given the small number of H plots located within schemes.

Was there a relationship between the species richness in hedges and surrounding land use?

- There was a significant effect of adjacent land use on hedgerow overall species richness (herbaceous and woody species), whether measured as the land use where the plot was located, land use present on both sides of the hedgerows or the overall Broad Habitat composition of the 1km square. Grassland was consistently positively correlated to species richness and arable land consistently negatively correlated to species richness. This is consistent with the fact that hedges sampled in Environmental Zone 1 (arable landscape –

Annex 3) were poorer in species than hedges sampled in the more pastoral landscapes of Environmental Zones 2 and 3.

- When looking at the combined effect of all variables compiled, it appears that information on hedge characteristics, management and surrounding land use explained typically 17% of the variation of the overall species richness in Environmental Zone 1 and less than 8% in Environmental Zones 2 &3.
- Adjacent land use and landscape context accounted for most of the variation observed, with a notable positive effect of the area of grassland in the 1 km square where the H plot was recorded.
- The ground flora of hedges located in the Easterly lowlands was typically less diverse than the ground flora of hedges located in the Westerly lowlands, itself less diverse than species richness recorded in the Uplands of England & Wales. A comparable trend existed for woody species diversity, although less pronounced.

Implications:

- The lack of relationships between species diversity in the woody and non-woody elements implies that some hedges with species rich ground flora will not be included in the definition of 'important' hedges used in the Hedgerow Regulations and will not be the focus of conservation with the Hedgerow Habitat Action Plan.
- Relationships were found between the number of plant species in hedge bottoms and adjacent land use. In particular, species richness was greater in areas of grassland. However, the single most important variable was area of grassland in the 1 km square as a whole, and not the land use adjacent to the hedge. Perhaps this result indicates an association with farm management practices, e.g. general intensity of farming.
- Relationships between hedge structure and plant species number were weak. However, this may have reflected that low level of management data available within CS, especially in terms of the management of the hedge bottom flora and adjacent land. Moreover, the hedge structure data themselves were collected inconsistently in the field. Hedge survey procedures need to be tightened up in future Countryside Surveys, and consideration should be given to collecting more management data, either directly from landowners / managers or indirectly from other sources.

Question 6: What evidence is there, from the survey of birds in Module 5 and other sources, of the value of different types/patterns of hedges for birds and, by comparison with previous surveys, of changes in the condition of hedges (for birds)?

Sandrine Petit, Rick Stuart, Andy Wilson[3] & Colin Barr

Background

The maintenance of a diversified wildlife in British farmed landscapes is an important issue and studies have reported important declines in the occurrence and abundance of a large number of species. Of particular concern is the general decline of farmland birds since 1970 (Gregory et al., 2002). This situation has been taken seriously by individual government departments, notably through Target 7 of the Public Service Agreement (PSA)[4] which aims at "reversing the long term decline in the number of farmland birds by 2020 …".

In agricultural landscapes, hedges and their associated features are recognised as a key habitat for conservation and many bird species are more or less associated with hedges, at least during part of their life. However, there is so far no evidence that there is an ideal structure or vegetation composition of hedge that would be optimal for birds.

CS2000 involved recording of physical and management data on hedgerows as well as landscape pattern information. Transects were walked in a large proportion of the 1 km sample squares, and birds recorded at different distances from the transect lines. These 2 datasets allow an assessment of the association between different hedge types and bird frequency. Results are presented for three groups of bird species found in the agricultural landscape – generalists, hedgerow specialists and woodland specialists The outcome of the current study is the identification of hedgerow and landscape characteristics that are best suited to particular bird species and to overall avian diversity. This is important in planning new landscapes, through, for example, agri-environment schemes, so that optimal conditions for a range of bird species can be achieved.

Key findings

Part1: What evidence is there of the value of different types/patterns of hedges for birds

We found evidence of the value of different patterns of hedges for birds (Figure 6.1). There was a clear gradient from landscapes that were characterised by no or very few hedges – associated with a poor avian diversity - to landscapes exhibiting a very high density of tall hedges and mature trees, that were associated with a very diverse and abundant avifauna.

Hedge density and the characteristics of hedges were strongly inter-correlated, such that areas with a high density of hedges also tended to hold the tallest and botanically richest hedges. Thus it was difficult to disentangle the effect of particular hedgerow characteristics on bird communities.

Hedges support a wide range of bird species offering different uses and values to species from a variety of niches. We have isolated woodland species from the more generalist farmland species as their use may be more as a corridor and feeding area.

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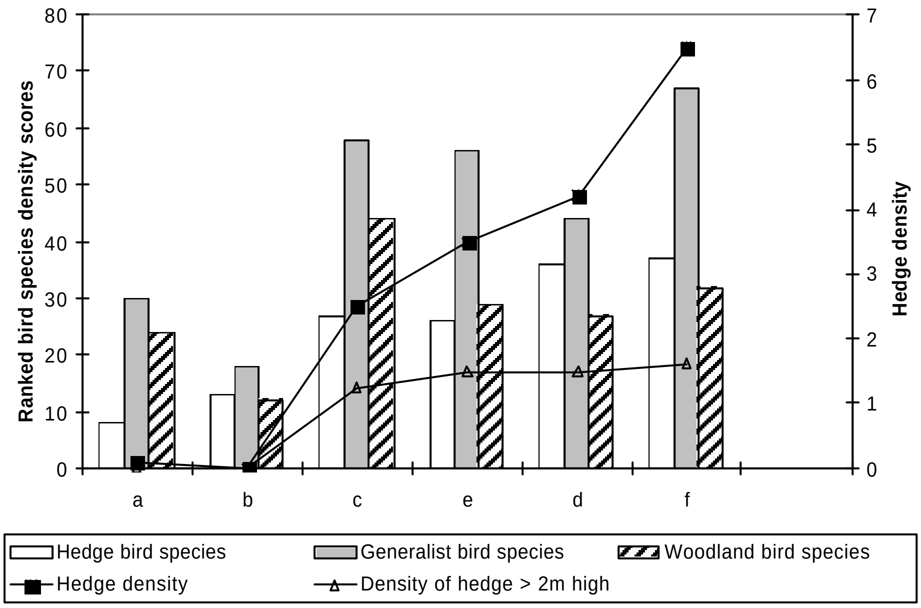
[4] http://www.defra.gov.uk/corporate/busplan/psa2002.htm

Figure 6.1 Bird ranked species scores and hedge characteristics along the gradient of clusters identified in the analysis (from left to right, open to hedged landscapes)



Part 2: What evidence is there, by comparison with previous surveys, of changes in the condition of hedges (for birds)?

Net changes in stock and condition of hedgerows between 1990 and 1998 were modest compared with the large changes in previous decades. However, this modest net change is a result of losses or degeneration of hedgerows balanced by those newly planted or restored. The change in condition or character through these losses and gains will probably have been detrimental to a range of bird species, especially in the area where hedgerow density and avian diversity is at its highest. The loss of traditional hawthorn hedges through the 1990s is identified as a change that may have had a detrimental effect on populations of some species, notably the Lesser Whitethroat and Yellowhammer.

There is insufficient evidence to suggest that generalist and woodland species have been adversely affected by changes in hedgerow stock and characteristics through the 1990s, although undoubtedly deleterious effects will occur on a local scale when hedges are removed or managed inappropriately.

Implications

Our results imply that there is a clear scope for measures that optimise hedge density at the landscape/farm level, in addition to measures that target individual hedges. Such a scheme is likely to contribute to DEFRA's PSA which is aimed at reversing the long-term decline in farmland birds.

The areas which currently hold the highest hedge densities are clearly sheltering a large and abundant bird community, including farmland bird species, and as such should be maintained.

Although we could not disentangle the effect of hedge density and hedge condition, tall and voluminous hedges seemed particularly favourable for diverse and abundant bird communities. To ensure that such hedges are available at the landscape/farm scale at any one time, there should be a rolling programme of management of hedges at this scale.

The effect of hedge condition on birds could be further investigated by analysing data available at the sub-square level. The exact location of bird transects in CS squares is now digitally available so that bird densities can be related to individual hedges or at least networks of limited size.

Question 7: What were the characteristics and locations of the hedges that were gained as opposed to those that were lost? To what extent do new and restored hedges compensate for hedges that are lost or degenerate into lines of trees?

Colin Barr & Rick Stuart

BACKGROUND

There was a zero net change in estimated length of hedges in Great Britain between 1990 and 1998. However, this reflects a balance of losses and gains.

Using the 501 survey squares repeat sampled in Great Britain in 1990 and 1998 a comparison of characteristics, by the type of gross change that has occurred (e.g. removal, degeneration) allows some general assessments to be made as to the extent to which new and restored hedges compensate for hedges that are lost or degenerate into lines of trees.

Draft guidelines on what constitutes favourable condition of hedgerows formulated by the UK Steering Group for the Ancient and/or Species-rich Hedgerow HAP adds context to the assessment.

Key findings

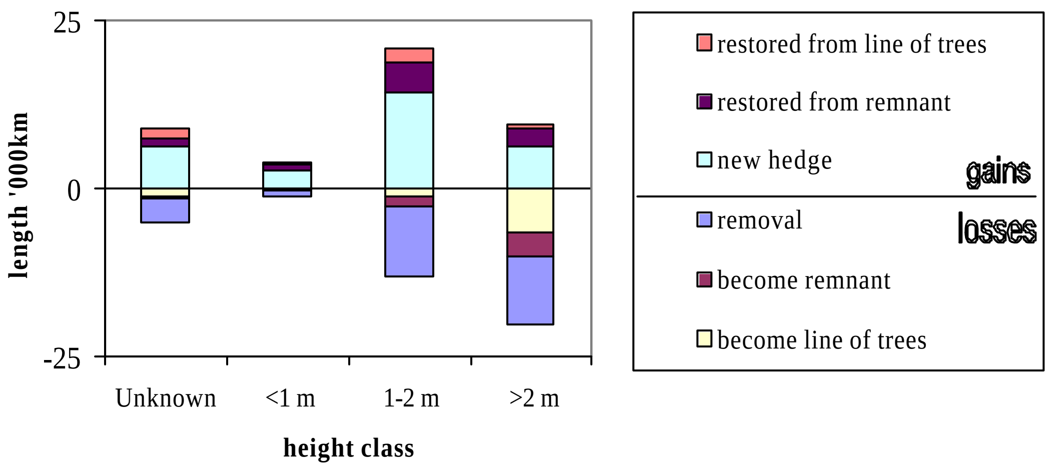
What were the characteristics of the hedges that were gained as opposed to those that were lost?

The characteristics of hedges that were gained or restored as opposed to those that were lost or degenerated were broadly similar at the national level with some exceptions.

<u>Height</u>

The majority of lost hedges in Great Britain tended to be more than 2 m in height and most of those had been removed completely or degenerated to lines of trees, rather than evolving into a different boundary type. Over one quarter of gained hedges were also in the >2m class, and two-thirds of these were recorded where there had been no boundary feature before suggesting, perhaps, that they had not been managed since planting. However, gained or restored hedges were more likely to be between 1 and 2 m in height and of these over two-thirds were new hedges (see Figure 7.1).

Figure 7.1 Estimated length of hedgerow lost/degenerated and gained/restored between 1990 and 1998 in Great Britain, by height class.



Adjacent land
Most hedges gained and lost had grassland on either side (Volume II Figure 7.4) and, as reported in Question 5 of this report, hedges in grassland systems tend to have the highest hedge bottom flora species richness.

Adjacent features
Hedges gained were more likely to be adjacent to a stream or ditch than those lost. Around 20% of hedges gained were adjacent to a stream or ditch in 1998 whereas no hedges adjacent to streams or ditches in 1990 were recorded as lost.

Management

Hedges gained were more likely to be flailed than those lost. It has been estimated elsewhere (Hooper, 1992) that up to 90% of hedgerow management takes place by the use of a flail but surveyors may not have had evidence to use the code more frequently than they did.

More hedges were lost that had been laid within five years of survey than hedges gained. As much as 7% of the total length of lost hedge has been laid in the five years prior to loss. Conversely, and as expected, less than 2% of new hedges had been laid; of this length, a significant proportion was from hedges regained from lines of trees (where laying might form part of a restoration process) and from hedges being newly planted (where normal management cycles would not see hedges laid within seven to ten years of planting).

What was the zonal distribution of the hedges that were gained as opposed to those that were lost?

Most gains and losses occurred in equal proportions in Environmental Zones 1 and 2, the easterly and westerly lowland of England & Wales as shown in Volume II, Figures 7.6 and 7.7. This no doubt reflects the fact that these areas have the highest densities of hedges.

To what extent do new and restored hedges compensate for hedges that are lost or degenerate into lines of trees?

Most hedges lost are tall and overgrown whereas most hedges gained are medium height. Otherwise hedges that have been lost and gained have varied characteristics and broadly compensate each other in the context of the physical and management descriptions available from CS data.

Further assessment of the balance of losses and gains in terms of ecological value is limited as CS data records few attributes used to assess ‘favourable condition’ of hedgerows. Additionally insufficient numbers of associated hedgerow plots were available to assess differences in the characteristics of the vegetation between lost and gained hedges.

Implications

As most hedges lost are in grassland systems, the preservation of these hedges potentially offers higher quality hedges as it is these hedges which tend to have the highest hedge bottom flora species richness. The continuing loss of these hedges is of particular concern as they are associated with the most diverse ground flora.

No statistically significant geographical contransts in gains and losses of hedgerows has been found.

Whilst the lost hedges have been found to be generally compensated by those gained it has become apparent that characteristic attributes recorded in Countryside Survey are limited and do not allow a more comprehensive assessment, especially in terms of ‘favourable condition’. Additional attributes need to be recorded in future Countryside Surveys.

Question 8: How far is it possible to provide an assessment of the condition, and changes in condition, of ancient and/or species-rich hedgerows using CS2000 observations?

Colin Barr & Sandrine Petit

Background

The Habitat Action Plan for Ancient and/or Species-rich Hedgerows includes a target of achieving the *favourable condition* of 25% (c. 47,500 km) of species-rich and ancient hedges by the year 2000, and of 50% (c. 95,000 km) by 2005. The HAP says that the majority of hedges are likely to need some management in the long term and if left for more than about 10 years there is a major risk that they will either change beyond a recoverable state or become so open that they cease to be hedges.

The BAP also includes a number of proposed actions which relate to the *favourable management* of hedgerows.

At the BAP Steering Group meeting on 22 April 1999, members suggested that it would be difficult to obtain a standard definition for the term '*favourable management*' because this could vary according to the function of the hedge, the species in it, and the species for whose benefit it was being managed. Instead, it was concluded that information was needed to assess the conservation status of hedgerows and, especially, to consider the '**favourable condition**' of hedgerows as a precursor to recommending favourable management.

As the definition of favourable condition was a prerequisite to this FOCUS question, CEH took the initiative of organising workshops and consultations with experts.

Key findings

Contribution to the production of a definition of 'favourable condition'

- The recommendations derived from the FOCUS workshop and from a subsequent meeting of the hedgerow condition sub-group (HSG48) were presented at the last meeting of the ASRH SG, on the 20th May 03. It covered attributes for individual hedgerows and network attributes (Table 8.1). The ASRH SG welcomed the work that had been done and agreed that the favourable condition sub-group should further refine and test the attributes presented.
- The process is ongoing. A field testing of the attributes and threshold recommended to the ASRH SG took place at the end of July 03. A de-briefing meeting is planned for early September 03.

Assessment of ASRH condition using CS2000 information

- A positive output is that CS can provide quantitative estimates for most condition attributes (Table 8.1) with the notable exception of width (both woody component and herbaceous layer).
- CS can also provide information about the surrounding network of hedges and their condition allowing interpretation of landscape context.

Implications

- As CS2000 does not record all condition attributes, a statement of favourable condition using the ASHR HAP provisional definition cannot be made at this stage.
- We envisage to continue to work closely and advise the ASRH SG as to addition of attributes that could be included in the next CS survey. This process should ensure that the next CS will report on the favourable condition of hedgerows.
- This implies that the protocols for describing hedgerows in CS will have to be amended in order to provide all the information necessary to assess their condition. It appears already clearly that next CS will include width measurements. These can be recorded consistently.

Table 8.1: Attributes and the availability of data from Countryside Survey and from surveys which will follow the Hedgerow Survey Handbook. In italics, data that could potentially be derived from Countryside Survey.

Attribute	Countryside Survey	Hedgerow Survey Handbook
(i) Agreed		
Width of woody component at ground level	-	Average width at base in 4 classes: 0.1-1m; 1.1-2m; 2.1-4m; >4.1m
Surface area of herbaceous layer	-	Width of verge on each side in 3 classes (< 1m; 1-2 m; > 2m.
Gappiness	Unfilled gaps > or < 10%	Integrity – gaps (Significant or Minor)
Height	4 classes: < 1m; 1-2 m; 2-3 m ; > 3m high	Average height in 4 classes: 0.1-1m; 1.1-2m; 2.1-4m; >4.1m
Number of woody species	30 m plots (D plots) for woody species	Woody species per 30 m
Indicator plant species (nettles, cleavers, …)	10 m plots (H plots) include herbaceous species % cover (5% steps)	Ground flora in 2 quadrats of 1*2m, cover using domin scale.
Bare trampled ground	Bare ground % cover (but no information on the cause)	Bare ground cover in quadrat
(ii) Potential additions		
Connectivity	*Connectedness of network up to 1 km square level*	Number and nature of connection of individual hedgerow
Hedgerow diversity	*Diversity of network up to 1 km square level*	-

Question 9:

a) Why are there differences in estimates of stock of woodland cover and changes in woodland cover obtained from Forestry Commission surveys and CS2000 (including LCM2000)? b) How are Ancient Woodland Inventory sites represented in the CS2000 field survey sample and LCM2000? c) What evidence is there in CS2000 for the location and reasons for changes in woodland cover?

David Howard & Geoff Smith[5]

Background

Woodland is one of the UK's key environmental resources in terms of, for example, biodiversity, carbon sequestration and recreation, and British woodland data contribute to three Quality of Life Counts. Different organisations have interests and generate statistics about woodlands, notably the Forestry Commission, the country conservation agencies, the Council for the Preservation of Rural England and Woodland Trust.

The National Inventory of Woodland and Trees (NIWT) is the most recent woodland inventory taken by the Forestry Commission (FC). Full national statistics are generated every 10 to 15 years; the latest inventory includes the National Inventory of Woodland Digital Map (NIWD) identifying all woodland areas over 2 ha. Annual statistics are produced from Forest Enterprise (FE) administrative records for current woodland area and estimates of non-FE woodland updated from grant scheme data for new planting and FC disposals (sales of woodland). The most recent inventories were in 1980 and 1995-1999. This supplemented by a sample surveys of small woodlands and woodland character and condition to produce full national estimates. The Ancient Woodland Inventory (AWI) describes land that has had continuous woodland cover since 1600 AD (1750 AD for Scotland). The AWI dataset is still provisional and only covers woodland over 2 ha. CS woodland estimates were produced from both satellite (LCM2000) and field survey (CS2000) from land cover characteristics.

Results from CS2000 field survey showed that the woodland area of GB was just over 12% of the land area, with 6.4% of land area under *Broadleaved, Mixed and Yew Woodland* and 5.9% land area under *Coniferous Woodland*. Since 1990, there was substantial turnover into and out of woodland habitats (only 93% of the stock was carried through), with significant net increases in *Broadleaved, Mixed and Yew Woodland* (5% 1990 stock), notably from agricultural land in Environmental Zones 2 and 4 (Annex 3). Here, the differences between the data are explored. Parts a and b involve comparing CS data with datasets used to produce different stock estimates while part c considers change data from CS.

Key findings

Why are there differences in estimates of woodland stock?

- NIWT, LCM2000 and CS2000 produce similar estimates for GB woodland area. Estimates by country show generally greater disparity between all the datasets.
- The similarity in estimates of total area for GB generated by NIWD and LCM2000 are very high when only those polygons greater than 2 ha are included, the minimum mappable area for NIWD.

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- The spatial co-registration of individual woodland parcels is not always good. The lack of correspondence is due to several factors including differences in definitions, differences in timing of observations, differences in mapping technology and resolution, recording and analytical errors, sampling strategy and sample interpretation.

Why are there differences in estimates of woodland change?

- Comparisons with national or regional statistics of change are subject to the same discrepancies noted above for differences in stock estimates. CS2000 showed that woodlands were dynamic, but many of the parcels that changed into and out of woodland were small. 59% of the parcels that showed change were below the minimum size threshold for published NIWT areas (0.1 ha) and 96% below the NIWD minimum mappable unit (2 ha), accounting for 6% and 50% of the total area in the sample that changed respectively.
- CS survey data can be used to estimate change in areas between 1984, 1990 and 1998; the period 1990-98 has a larger sample size than 1984, increasing the precision of the estimates. The vast majority of original allocations of field survey parcels to woodland Broad Habitats were confirmed.
- FC estimates are derived from an amalgamation of inventory figures (1980 and 1995-1999) updated by planting grant, restocking and felling license to produce annual figures. The inventory figures are robust (but may be recorded differently each time), the figures used in the update are weaker (only management where FC or grant/licences used) – not natural small scrubbing up type change estimates are derived from census figures.

How are Ancient Woodland Inventory sites represented in CS2000 and LCM2000?

- 26 % of GB CS2000 squares include Ancient Woodland Inventory (AWI) sites, on the basis of digital maps that generally describe only woodlands over 2 ha. Approximately 3% of GB land cover falls within AWI sites, of which just under half (1.4%) is ancient semi-natural woodland, of particular cultural and conservation value.
- Not surprisingly, the number of CS2000 vegetation plots in AWI parcels is low, with around only 3 % of all main (X) plots – approximately the same as the percent cover. The proportion of targeted habitat plots (Y) is higher in AWI sites than elsewhere at 5%.
- A national estimate of the AWI area generated by sampling the AWI census dataset using CS2000 methodology produced a figure that is lower than the main estimate of area of the same parcels using LCM2000, but is within the confidence intervals of the latter data set.

What evidence is there in CS2000 for the location of changes in woodland cover?

- Change occurs in a number of different ways. If woodland is considered as discrete parcels of land, they can appear or disappear (proliferation and attrition), expand or shrink and coalesce or split (fragment or de-fragment). All six processes commonly occur.
- Between 1984 and 1998 the most dynamic area was Environmental Zone 3 in terms of numbers of different processes described above, while Environmental Zones 5 and 6 were the most stable.
- Between 1990 and 1998, in all Environmental Zones, the area of *Broadleaved, Mixed and Yew Woodland* was estimated to increase and in only three Zones was the estimate not statistically significant. *Coniferous Woodland* showed a much less dramatic change, tending to decline in area.

What evidence is there in CS2000 for the causes of changes in woodland cover?

- The trends across the Zones shows the gain in woodland area in Environmental Zones 1 and 2 were from intensive agriculture. Farm Woodland Grant and similar schemes will have contributed to this. The major net change in the Scottish Zones was from semi-natural vegetation in EZ 5, but similar sizes of shift could be seen in both directions in EZ 6. In

Scotland, commercial, extensive forestry is more common than in England where it is more small scale and for a variety of purposes.

- The flows in Scotland between habitat types suggest that poorer land for silviculture (*Bog* and *Dwarf Shrub Heath*), that is wetter and nutrient poor, was more likely to remain under coniferous cover, while the better, drier land (*Acid Grassland*) was more likely to be replanted with broadleaves.
- Taken together, these changes imply that many woodland changes were the result of local land management decisions, as oppose to natural succession and abandonment.
- In addition, though, CS data suggests that changes often occur as small alterations to existing parcels that may not be detected by grant or licensing statistics.

Implications

- National estimates derived from CS data for woodland stock in 1998 are generally consistent with NIWT, given the methodological differences. These could be reduced further, if woodland polygons recorded by Ordnance Survey and in the NIWT and AWI were used as part of the data entry / interpretation process for a future CS field survey. All four schemes (NIWT, AWI, LCM and CS) would have to start using the same linework. OS MasterMap probably offers the best route
- The exact spatial agreement between LCM2000 and NIWT is weak due, in part, to the pixelated image of the satellite map. LCM should not used directly to answer local questions about woodland cover and location.
- Both LCM2000 and CS2000 FS describe most surrounding habitats, and so can be used to provide contextual information to answer new strategic questions about woodland management, for example in terms of the local landscape and catchment.
- CS datasets provides the best information describing change in environmental quality of woodland land cover. In particular, CS2000 methods can be used to provide estimates of change in extent and condition of AWI sites and set them in context of wider changes in woodland dynamics. FC statistics and AWI data can be used as sources of information to help interpret the causes of change and forecast future changes.
- Woodland dynamics need to differentiate between internal (within woodland blocks) or external (with non-forestry activities) changes.

Question 10: What are the possible causes for change in extent and condition of dwarf shrub heath habitats? Are there geographical variations between Environmental Zones? Is there any evidence for positive effects of conservation measures?

Simon Smart

Background

While the *Dwarf Shrub Heath* Broad Habitat has declined in area across GB in recent decades, Haines-Young et al (2000) reported no significant change in GB since 1990. However, there had been considerable turnover with other habitats. In particular, there had been loss to *Acid Grassland*, *Coniferous Woodland*, *Bracken* and *Bog* but also gains from *Bog*, *Bracken* and *Acid Grassland*. Such changes could have arisen because of changes in land management, and also through more pervasive causes such as the impacts of atmospheric nitrogen deposition. These can be separated to some extent within the CS data by looking at both changes in the Broad Habitat classification of parcels of land, and by changes in the condition of vegetation within plots, in terms of indicators such as Ellenberg nutrient scores. Any effects of problems of classification of data also need to be accounted for. Effects of conservation measures were taken into account by considering changes within agri-environment schemes and within Less Favoured Areas (LFAs).

Key Findings

What were the major causes of change in extent and condition of Dwarf Shrub Heath ?

- There were minor losses of *Dwarf Shrub Heath* habitat to conifer planting (33 ha of surveyed land) and bracken encroachment. However, the majority of habitat changes involving *Dwarf Shrub Heath* were only associated with minor changes in vegetation within the plots. This suggests that much of the turnover reported in Haines-Young et al (2000) was actually an artefact of inconsistencies of the way habitats had been mapped between 1990-98.
- There was no evidence that sheep grazing or atmospheric nitrogen deposition influenced major habitat change. However, the vegetation within *Dwarf Shrub Heath* became more typical of nutrient-rich conditions in areas of high sheep density and/or areas with a high proportion of *Acid Grassland*.
- Lowland areas of *Dwarf Shrub Heath* were rare within the CS database. However, there was evidence of losses, especially as a result of bracken encroachment (6.2 ha lost to Bracken out of a total 70.3 ha of lowland DSH mapped in 1990).

Was there geographic variation between Environmental Zones (Annex 3)?

- Analysis revealed that *Dwarf Shrub Heath* vegetation had become more eutrophic in England and Wales, but not in Scotland. This maybe partly explained by the lower levels of both atmospheric deposition of nitrogen and of sheep density in Scotland.
- The result, reported by Haines-Young et al (2000), that there had been significant losses of *Dwarf Shrub Heath* in Environmental Zone 5 is not fully supported, given the high contribution of mapping discrepancies to the reported changes.

Was there any evidence for positive effects of conservation measures?

- No evidence was found but this partly reflects the difficulty of co-registering the boundaries of designated areas and of assuming that management effects are homogenous across designated areas. The conservation effect is through the management process, not the act of designation and the variation in management both within and between areas marked for conservation (targeting special interests) creates a range of responses that would require a large sample to statistically differentiate from the non-designated. In particular, analyses by Less-Favoured Area (LFA) status was tried but virtually all upland *Dwarf Shrub Heath* was in LFA so no comparisons were possible.

Implications

- The evidence of vegetation changes in response to sheep grazing in England and Wales confirms the importance of conservation schemes that reduce sheep densities, especially where the landscape is already dominated by upland grassland.
- Small, remnant patches of *Dwarf Shrub Heath* were most prone to changes between 1990-98. Such habitat fragments may be the only vestigial sources of habitat and species, especially in lowland areas. They should be conserved to ensure the availability of native genotypes, species and communities to act as foci for future habitat restoration.
- There needs to be a greater recognition of the importance of such small habitat fragments. At the moment, habitat parcels below 0.5ha in size cannot qualify as SSSI or even as County Wildlife Sites, while their small size also means that they may also be easily overlooked in farm management plans and agri-environment scheme applications.
- The problems of mapping *Dwarf Shrub Heath* in unenclosed land was recognised after CS1990 leading to establishment of a new baseline of U plots in the unenclosed upland Broad Habitats. These were introduced in CS2000 to provide a broader baseline of vegetation samples in such areas that will help to quantify change in condition and further validate change in extent after the next Countryside Survey. However, changes in the field recording procedure are also clearly required to improve the estimation of stock and change in area of upland Broad Habitats. Options include electronic mapping, so that mapping code options and error trapping can be rigorously enforced, or even grid sampling of land cover so as to avoid the arbitrariness and error associated with boundary definition. Issues will include consistency with previous surveys and the problems of the retrospective computation of revised figures for stock and change.
- It is problematic to determine causes of change using currently available data, because of the lack of direct land management data and the low resolution of atmospheric deposition maps. There is a need to consider how such data could be obtained in the future.

Reference

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

Question 11: Where did increases in Fen, Marsh and Swamp occur? What are the possible causes? What are the botanical characteristics of these new areas? What are the wider implications for biodiversity?

Simon Smart & Beverley Dodd

Background

Haines-Young et al (2000) reported substantial changes in the area of *Fen, Marsh and Swamp* between 1990-98, with a 27% increase in England with Wales, an 19% increase in Scotland and a 19% decrease in Northern Ireland. As with *Dwarf Shrub Heath*, it is possible that some of these changes may have been due to changes in mapping procedures; alternatively they could have arisen, for example through changes in land management. The conservation importance of these changes also requires investigation. Taken at face value, these changes could be very positive for the Biodiversity Action Plans for three Priority Habitats within this Broad Habitat, namely purple moor grass and rush pastures, reed beds and fens. However, a major criterion for classifying land as *Fen, Marsh and Swamp* is the presence of sp. *Juncus effusus*, typical of waterlogged grasslands. In other words, the area of habitat may have increased in GB largely as a result of an increase in this species, that would not (on its own) indicate high conservation value.

Key findings

Where did increases in Fen, Marsh and Swamp occur?

- Detailed manual checks of field survey data indicated that the actual areas of habitat gained and lost were much smaller than reported previously (Haines-Young et al 2000). Discrepancies were greater concerning land in the unenclosed uplands than in the lowlands, and affected losses from *Fen, Marsh and Swamp* more than gains. The verified increases were highest in Environmental Zones 1 and 4 (Annex 3), at 123% and 33% respectively: the largest loss was in Environmental Zone 1 at 130% (the figures for this Zone actually refer to small absolute values, because of the small areas of this Broad Habitat present), followed by 20% in Environmental Zone 4 and less than 9% in all other Zones .
- The observed increases occurred mainly at the expense of *Improved Grassland* in lowland GB.

What are the botanical characteristics of new areas of Fen, Marsh and Swamp, and what were the possible causes of change?

- The most important factor in changes to and from *Fen, Marsh and Swamp* was changes in the presence and cover of *J. effusus* in *Improved Grassland.* The increase in this species indicates a reduction in the intensity of grassland management. *J. effusus* can expand rapidly in damper conditions as grazing shifts to sheep, and drains are less well maintained, whether for conservation reasons or not. It is also possible that some of the increases were triggered by wet weather and even flooding in the years prior to CS2000 field survey. More localised increases in Environmental Zone 2 were attributed to the managed increase in abundance of wetland monocotyledons such as *Glyceria maxima* on land primarily managed for conservation in both 1990 and 1998.
- Few plots referable to Priority Habitat communities were found within either new or pre-existing habitat parcels.

- Losses of *Fen, Marsh and Swamp* took place mostly in parcels less than 0.5 ha in area, especially along watercourses, implicating channel modification as a possible cause of change. There were more localised losses due to bracken encroachment, succession, forestry, agricultural intensification and quarrying.

Implications

What are the wider implications for biodiversity policy?

- The value of the newly gained areas of *J. effusus* pasture depend very much on the biodiversity of the pre-existing vegetation and of the surrounding landscape. Although of inherently low conservation importance, new *J.effusus* pasture is a valuable addition to mosaics of largely species-poor, agricultural habitats.
- Although the new areas of *Fen, Marsh & Swamp* did not represent increases in Priority Habitat area they certainly constitute gains in habitat suitable for wading birds that nest in damp grassland, especially in lowland Britain. Some of the gains appear to have been the deliberate result of land management for conservation, but by no means all.
- There has been a continued attrition of small fragments of wetland, particularly in lowland Britain. The loss of small and often species-rich wetland fragments within wider lowland landscapes could become an important constraint on habitat restoration measures that rely on remnant habitat fragments and species populations as foci for expansion and reintroduction.

Lessons for Countryside Survey:

- Because of the sampling strategy, Countryside Survey is more capable of detecting the gains and losses of frequent but small fragments of habitat than those of fewer, but larger areas. This means that there may be a bias in assessing habitat change if losses are most likely in widely dispersed, small patches and gains are most likely as a result of more localised restoration of larger areas. The future use of a map that integrates field and remotely sensed data will reduce this problem for at least some habitats.
- As is the case for *Dwarf Shrub Heath*, there have been problems resulting from the field mapping and coding systems used. These issues need to be addressed before the next Countryside Survey.

Reference

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

Question 12: What were the environmental and management circumstances under which bracken invaded acid grassland, heath and bog habitats? Is the expansion likely to continue and what are the implications for agriculture and conservation of heaths and bogs?

Simon Smart & Beverley Dodd

Background

Bracken (*Pteridium aquilinum*) encroachment is considered a serious threat to the conservation of Priority Habitats such as lowland and upland heath; habitat restoration after bracken has established is a difficult process. The net area of *Bracken* fell between 1984-90 but Haines-Young et al (2000) reported no net change, although there was considerable uncertainty in the estimates. There was evidence of considerable turnover, especially with *Dwarf Shrub Heath*, *Acid Grassland* and *Broadleaved, Mixed and Yew Woodland*. Therefore, even if bracken is no longer expanding nationally, bracken encroachment appears to be an issue of at least local importance for conservation.

Key findings

What were the environmental and management circumstances under which bracken invaded Acid Grassland, Dwarf Shrub Heath and Bog habitats?

- The majority of increases in mapped *Bracken* were supported by reconsideration of the field data. The largest increase in surveyed area affected Environmental Zone 3 (Annex 3): 49% of the gain was at the expense of *Acid Grassland* and 26% at the expense of *Bog*.
- Plots in parcels that changed from *Dwarf Shrub Heath* in 1990 to *Bracken* in 1998 already had higher mean fertility scores in 1990 than stable DSH, and bracken was already present in at least some cases. It seems that conversion to the *Bracken* Broad Habitat resulted more from the expansion of populations already present, rather than dramatic invasion and colonisation events.
- Significant increases in mean *Bracken* cover occurred in England in Y plots (small fragments of semi-natural habitat), in Scotland on streamside plots and in field boundaries across GB. In general, increased bracken cover in plots was more a feature of the linear network and small habitat fragments than of larger areas of habitat.
- Change in *Bracken* area and cover were correlated with sheep density and the presence of common land, but no significant relationships were found.
- While the majority of increases in bracken extent were judged to be real based on a parcel by parcel review of the evidence, increases in bracken abundance are likely to have been played out in parcels with bracken already present or adjacent by 1990. This is consistent with the rarity of new colonisation from spores and the fact that the vast majority of increases in bracken occur as a result of rhizome penetration from nearby stands

Is the expansion likely to continue?

- Future change in *Bracken* extent will reflect land-use, climate and the limits of the species' edaphic tolerances. In particular, a widespread downturn in farming intensity in upland and marginal upland areas could easily see bracken encroachment into the deeper, well-drained soils, especially where bracken is already present at low levels. Encroachment might also take place in Scottish montane regions if the climate was to warm.

What are the implications for agriculture and conservation?

- The losses from *Acid Grassland* to *Bracken* in Environmental Zone 3 represent a reduction in the quality of the invaded areas of upland grassland. However, the threats posed by bracken expansion in land entered for agri-environment measures are well recognised since funding is widely available in areas where encroachment is a problem. If funding remains available to meet the proposed increase in area of agri-environment land then this mechanism should increase the likelihood of successful prevention and restoration across vulnerable habitats.
- In terms of the conservation status of Priority Habitats, the most significant change was the apparent increase in bracken at the expense of DSH in Environmental Zone 2 (already highlighted in the Topic 4 report on DSH) and at the expense of Bog in Environmental Zone 3. The losses from Bog is not easily explained by a process of succession and were not supported by analysis of vegetation change in repeat plots, albeit that sample size was very small.
- Increased bracken abundance affected the linear network and small fragments of semi-natural habitat more than larger areas of habitat in fields and unenclosed land. This implies an expansion along and within the less-disturbed interstices of lowland landscapes, perhaps because of reduced disturbance. The role of bracken as an increasing dominant on linear features is consistent with the strong signals of increased shade and reduced species richness seen in mid-successional communities on road verges, field boundaries and streamsides in the eight year interval. Past and future bracken expansion is therefore likely to reduce the residual value of the linear landscape network as a significant reservoir of botanical diversity.
- This positive response to reduced disturbance also lies behind the bracken encroachment known to have occurred on many lowland commons since the 1950s, though not well supported by CS2000 (perhaps because of small sample sizes). These increases reflect difficulties in negotiating and funding the fencing and grazing of these fragmented stretches of marginal agricultural land.

Reference

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

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Question 13: What are the possible causes of more overgrown streamside vegetation? What are the implications for other species groups and associated freshwater habitats?

Lisa Norton & Lindsay Maskell

Background

CS2000 results revealed that whilst there were significant improvements in the biological condition of rivers and streams between 1990 and 1998 (Furse *et al.* 2002), there had been a marked decline in the ecological quality of streamside vegetation. Species richness had declined, while both the proportion of competitive species and the fertility level of the vegetation had increased. Moreover, there had been losses of some species that had also become uncommon in the wider countryside, and for which streamsides had become a refuge by the time of the 1990 survey. While these changes are negative in terms of the conservation of plant species, they may have other implications for animals that use streamsides (notably otters, water voles, birds and invertebrates).

Declines in vegetation condition are associated with lower habitat quality which can result from habitat modification as recorded within the River Habitat Survey (RHS) in 1998. CS2000 Module 2 revealed negative correlations between the *Arable and Horticultural* Broad Habitat and both habitat and stream condition and positive correlations between the woodland Broad Habitats and habitat and stream conditions. Moreover, habitat modification was positively correlated with the extent of *Arable and Horticultural*, *Improved Grassland* and *Built-up and Gardens* Broad Habitats and negatively correlated with *Acid Grassland*, *Bog*, *Woodland*, *Fen, Marsh and Swamp* and *Dwarf Shrub Heath.*

Key findings

What were the possible causes of more overgrown streamside vegetation?

- More detailed analysis confirmed the CS2000 results that streamside vegetation had become increasingly rank and overgrown. Woody and late-successional species (e.g. Hawthorn - *Crataegus monogyna*, Bramble - *Rubus fruticosus* agg., Common nettle - *Urtica dioica*) had increased in both cover and frequency since 1990.
- The precise causes of vegetation change could not be determined from CS.
- Species richness in streamside vegetation was lower within *Improved Grassland* areas than within upland semi-natural habitats. The only significant difference between Broad Habitats in terms of change was that species richness increased in *Dwarf Shrub Heath* habitats as compared to decreases in *Arable and Horticultural*, *Improved Grassland*, *Coniferous Woodland* and *Bog.* These changes are consistent with both a signal of broad-scale eutrophication of streamside vegetation and of changes in management.
- Fencing off of streamsides had been proposed as a potential reason for changes in the vegetation associated with streamside plots. However, only around 3 % of streamside plots had a fence within 5 m – far too low for fencing to have been a major cause of change.
- It has been argued that the creation of buffer strips may have caused the changes in vegetation. However, the locations of such strips can only be determined on the basis of management information, that was lacking in CS2000. CS results suggest that where the vegetation was more eutrophic water quality was low (using indices based on macro-invertebrate fauna) and conversely water quality was high where streamside plant species richness was high. Whilst it may be possible that the creation of buffer strips is the cause of more eutrophic vegetation, if it is the case, they do not appear to be associated with higher water quality in the adjacent section of stream. However, given the importance of catchment-scale processes on water quality this is hardly surprising.

What are the implications of vegetation changes for individual plant species?

- Streamsides are important habitats for both grassland and wetland species. Mesotrophic and acidic grassland indicator species decreased in the countryside as a whole at a higher rate between 1990-98 than 1978-90. They were found in greater proportions in streamside plots than other plot types. A number of wetland species were found predominantly in streamside plots as opposed to all other plot types. However, although they were found more frequently in streamside plots than other plot types, both grassland and wetland species also showed decreases in streamside plots which were comparable and in some cases greater than losses in other plot types. This suggests that while streamsides may be playing an increasingly important role as refuges for plant species which are representative of particular communities, this role may be under threat.

What are the implications for other species groups?

- Overall, the improvement in water quality observed in Countryside Survey is beneficial to all species using the river, streams and streamside habitats. However, management of streams to enhance water quality may be in conflict with habitat creation objectives for particular species. The impacts of the changes in vegetation observed in CS on species other than plants are difficult to determine, as they differ between species and sites. For example, an increase in rankness of streamside vegetation may be good for water voles and some invertebrate species, while bird abundance and diversity may be greater in more shrubby, wooded riparian strips (see technical annexe 'Watercourse Management').
- Decreases in species richness in streamside plots were significantly related to increases in the number of taxa in the adjacent watercourse. This may have resulted from increasing rankness of vegetation providing shadier conditions for a larger range of stream invertebrates.

Implications

- Improvements in water quality are positive for many species associated with streamside habitats. However, a number of wetland and grassland species which are indicative of good condition have decreased in occurrence throughout the countryside, including within streamside plots that are acting as refugia. There is a need for more pro-active management of streamsides for their associated communities if these losses are to be reversed and the refuges retained.

- The Water Framework Directive (WFD) requires all inland and coastal waters to reach good status by 2015. Legislation will require solutions at a catchment scale, affecting both the management and monitoring of riparian habitats. Currently, the management of land adjacent to watercourses is primarily the responsibility of the landowner, although the EA In England and Wales and SEERAD in Scotland are responsible for fresh water quality. Advice to land managers is largely targeted at improving water quality (DEFRA, FWAG), though may in some cases be targeted at enhancing watersides for particular species (EA) (see technical annexe, 'Policy context statement'). If the Water Framework Directive is able to achieve strategic catchment level management of watercourses, taking into account both water quality and the quality of the waterside habitats themselves for both the flora and fauna which inhabit them, it will provide a more comprehensive approach than currently exists.

- There is a need for funding of further work in this area (see technical annexe).

Reference

Furse, M.T. , Davy-Bowker, J., Dawson, F.H., Gunn, R.J.M., Blackburn, J.H., Gunn, I.M., Winder, J.M., Scarlett, P.M., Gravelle, M., Kneebone, N., Nesbitt, I., Amarillo, M., Brereton, C., Cannan, C.,Collett, G., Collier, D., Cooper, G., Dent, M., Fairfax, C.M., Hardie, D., Henville, P., Hilton, C., James, B., Moorhouse, C., Randle, Z., Shirley, C., Small, S.R., Vowles, K.E., Clarke, R.T., Watkins, J.W. (2002) Countryside Survey 2000. Module 2: Freshwater studies. R&D Technical Report EY XXX/TRI.

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Question 14 What were the characteristics and locations of the new ponds recorded in 1998? How do the 1996 figures on pond numbers and condition relate to changes in 1998?

Rick Stuart & John Watkins

Background:

Ponds are an important landscape element as recognised by their inclusion in the S5 *Quality of Life Counts* indicator. Though there are no specific targets for ponds with the UK BAP they can play an important role in biodiversity as '*ponds collectively support at least two-thirds of Britain's freshwater plants and animal species*' as stated in the indicator description. Protection, restoration and creation of ponds is specifically encouraged to under the *Countryside Stewardship Scheme*. CS2000 reported an increase in the number of ponds, especially of water bodies of less than 20 x 20 m in the westerly lowlands of England and Wales, reversing the losses that had occurred reported between CS1990 and the Lowland Pond Survey (LPS) of 1996. This survey had used a restricted sub-sample of 150 of the 1 km x 1 km CS2000 sample squares, using the 'standard definition' of a pond: 'a body of standing water 0.25 ha to 2 ha in area, which usually holds water for at least four months of the year'.

This question therefore involves looking at the relationship between pond records in CS1990, LPS and CS2000 more closely. It also involves elucidating the type and location of new ponds, and whether they are of different ecological character than older ones.

Key Findings:

What were the characteristics of new ponds?

- Ponds that were gained between 1990 and 1998 were mostly small in size (<0.04 ha), as were ponds that were lost, reflecting the abundance of such small ponds in the CS database.

Where were new ponds located?

- Ponds gained between 1990-96 were mostly in the ITE 'pastural' landscape type, contrasting markedly with the period 1996-98, when ponds were gained in the ITE 'arable' landscape type, or easterly lowlands (N.B. it is not possible to report by Environmental Zones).
- Most new ponds were created within grassland landscapes, and most ponds were surrounded by a single Broad Habitat, of either grasslands, *Broadleaved, Mixed and Yew Woodland*, *Bog* or *Arable and Horticultural.* Transfers from the Open Water Broad Habitat were probably artefacts from the recording systems at the time of the different surveys.
- Ponds lost between 1990 and 1998 were replaced by four main Broad Habitats: *Broadleaved, Mixed and Yew Woodland* (suggesting succession from overgrown vegetation), grasslands (including *Improved*, *Neutral*, *Calcareous* and *Acid Grassland*), Urban (included examples of ponds filled-in with concrete) and Open Water (mainly where areas recorded as 'dried-up' ponds).
- Gains and losses to grassland and *Broadleaved, Mixed and Yew Woodland* habitats were roughly equal. More ponds were gained from arable land than were lost to it, while more ponds were lost to urban than came from urban.

Categories of change

- Just over half of the ponds gained were from features that had not been previously described as a dried-out pond or other wet feature. Nearly half of the new ponds were from features that may have been either dry depressions or wet features that may have increased in water volume. These are not ponds that are 'seasonally-dry pond' but may fluctuate over a longer time span and are best described as 'temporary ponds'. Similarly, while the majority of ponds lost had been infilled, over one third had become features that may, at some point in time, return to a pond. Ponds are highly dynamic features and are difficult to define and record over time(especially when only visited once in a field season, as in Countryside Survey).

How do 1996 figures on pond numbers and condition relate to 1998 data?

- Gains and losses in ponds numbers within the smallest size group showed little net change between 1990 and 1996 but a large increase in 1996-1998. This may have been due to 1998 being a wetter summer than 1996.
- Statistical testing of pond condition data was invalid due to the small sample size (9) of lost ponds from 1996 to 1998. Moreover, detailed data on the physiological and biological condition of ponds was collected only in 1996.

Implications:

- The transient nature of small ponds make recording and reporting change difficult. Many reported gains and losses of ponds involved exchange with features that may well contain water at intervals, and can be best described as 'temporary ponds,' as opposed to 'seasonal ponds'.
- It has not been possible to comment on whether creation of new ponds can compensate for earlier losses in ponds in terms of pond quality.
- The information collected as part of the LPS was more detailed than that collected by CS surveys, but being base on a limited sample size figures generated had large statistical error margins. An LPS-level of detail could be achieved within a future CS, but only by using teams of specialist surveyors.
- Repeated surveys containing the level of detailed information recorded from the LPS are require to inform policy on the relative compensation of newly created ponds against the loss of older ponds.

References

Williams P.J., Briggs, J., Barr, C.J., Cummins, C.P., Gillespie, M.K., Rich, T.C.G., Baker, A., Beaseley, J., Corfield, A., Dobson, D., Collin, A.S., Fox, G., Howard, D.C., Luursema, K., Rich, M., M., Samson, D., Scott, W.A., White, R. and Whitfield, M. (1998) Lowland Pond Survey 1996: Final Report, DETR, London

Question 15: Under what circumstances are habitats created on previously developed land? How do the newly created habitats compare with habitats that were lost to development?

Lisa Norton, Lindsay Maskell, Sandrine Petit, Rick Stuart & David Howard

Background

The CS in 1998 showed that the *Built up and Gardens* Broad Habitat accounted for around 6% of rural land, while transport features made up a further 2%; these Broad Habitats were particularly concentrated in the lowlands of England and Wales. The area of previously developed land which was converted to other Broad Habitats was very limited, but may have compensated for some of the losses to development, in particular of *Neutral Grassland* and *Broadleaved Woodland*. In contrast, the area of developed land in rural areas increased by about 58,000ha in Great Britain with biggest increases in the areas which already contained a concentration of the *Built up and Gardens* Broad Habitat. The growth in the area of the *Built up and Gardens* Broad Habitat reflects the continued pressures for urban development particularly in the south and east of England. Analyses of the patterns of transfer between other Broad Habitats and developed land since 1990 show that development in rural areas has largely been at the expense of agricultural land. This question seeks to discover whether further analysis of CS data can provide more information on the detailed changes between developed and undeveloped land between 1990 and 1998, i.e. what kind and quality of land is moving in and out of development.

Key Findings

- The findings from this question confirm that Countryside Survey is essentially a survey of rural land. The area of land moving into and out of development covered by CS squares is small.
- Less than 0.1% (48 ha) of land within survey squares was converted from developed land to other Broad Habitats between 1990 and 1998. The majority of this land was converted to intensive agriculture from developed land described as Gardens & Grounds with or without trees. Artefacts of the way in which spatial data is entered resulted in apparent changes from developed to undeveloped land in some cases.
- Approximately 0.4% (207 ha) of land within survey squares was converted from undeveloped to developed land between 1990 and 1998. The majority of land lost was from intensive agriculture followed by semi-natural grassland and a small amount of woodland.
- Land tended to be developed from intensive agriculture and semi-natural grasslands to Buildings, Grounds and Gardens, whereas losses of woodland were to changes in tracks and roads. The scale of these changes was very small with extensions to buildings of 9ha in one square making up over 20% of all development in semi-natural grasslands.
- The scale of the changes recorded in CS squares is such that analysis on the ecological quality of land lost to development must be viewed cautiously. However, there are indications that land which gets developed is of poorer ecological quality than comparable land in the wider countryside.

Implications

- The limited amount of land in CS squares which has undergone change in either direction, the lack of information about urban habitats and the fact that artefacts of the spatial data can affect the way CS measures urban habitats mean that it is not wise to put too much emphasis on the results found here.

- If CS is to provide more accurate information about the urban areas covered within squares in the future, various aspects of the survey will need revision.

Question 16: Does the countryside around towns have a different ecological character and trajectory of change than more remote areas in similar environmental classes? Does CS2000 provide a representative sample of countryside around towns?

Lisa Norton, Lindsay Maskell, Sandrine Petit, Rick Stuart, Dave Howard & John Watkins

Background

This question seeks to discover how much CS data can tell us about the land associated with towns and its distinctiveness ecologically from land in more rural areas. Before doing this it was necessary to classify CS squares into Rural and Urban and to provide some definition of their rural/urban context. This was done for squares in England and Wales using the soon to be released Urban Areas dataset for 2001 based on OS data being produced by the Office of the Deputy Prime Minister (ODPM). The dataset showed good correlation with the extent of the *Built up and gardens* Broad Habitat (BH 17). Squares were classified as Rural or Urban on the basis of whether they contained less than or greater than 33ha of urban land (as defined by the ODPM dataset). Surrounding land within a radius of 4km was classified as Urban or Rural on the basis of whether there was more or less than 33% of urban land. The Scottish Executive provided a similar dataset for Scottish Urban areas (although the definition of Urban was based on lower population densities than in England). Due to the comparatively low proportion of urban land found in and surrounding CS squares in Scotland, squares were classified as either Urban or Rural on the basis of whether they had greater or less than 10 ha of urban land in the actual square and/or greater or less than 10% Urban land in the surrounding 4km radius.

Key Findings

- The vast majority of 1km squares in England and Wales were classified as being rural in both nature and context (336) with 280 squares containing no urban land at all. In Scotland, using both a different urban dataset and a different threshold and approach to define Urban (hence making comparisons between countries invalid), only 10 squares of 208 were classified as Urban.
- In England and Wales 15 squares were classified as Urban but set in a Rural context, 9 Rural but set in an Urban context and 6 which were both Urban in nature and extent.
- There were very few differences in the extent (1998) or changes in the extent of Broad Habitats between Urban and Rural squares and their surroundings. For England and Wales only the amount of woodland differed between squares surrounded by Urban and Rural land, with those in Urban surroundings containing higher amounts of *Broadleaf, Mixed and Yew woodland*. For Scotland, the amount of Bog was lower in Urban squares and the amount of Neutral grass higher in Urban squares, possibly reflecting the fact that most Urban squares in Scotland are in EZ 4.
- Condition measures between square types did show some differences, particularly in Scotland. For England and Wales the differences in the 1998 data set tended to show that in general the condition of Broad Habitats in Rural squares was not greatly different from that of Urban squares whilst the change data showed that the eutrophication signal was stronger in Rural than in Urban squares. For Scotland, Urban squares tended to be more fertile and contain more competitive and colonising species than Rural squares and the contrast between Rural and Urban squares was greater than in England and Wales.
- The extent to which river habitats have been modified was significantly higher for Urban squares than for Rural squares in both England and Wales and Scotland.

- England and Wales and Scotland are very different countries in terms of the way in which their populations are distributed across the landscape. This impacts on the way in which squares can be classified into Rural or Urban and on attempts to make comparisons between countries.
- Countryside Survey is, as entitled, a survey of the countryside. The fact that the vast majority of squares fall within the Rural/Rural classification confirms this. Whilst it is possible to carry out appropriate tests on the effects of class types on various measures, the inequality of distribution of squares between the different class types means that we have very small sample sizes in Urban categories.

Implications

- Countryside Survey in its current form is not an appropriate tool for looking at the urban environment. It is able to inform to a certain extent about land in the interface between urban and rural areas, but is limited by the number of squares which occur in such areas in comparison to those which are entirely rural in nature.
- If these areas are important for providing information of the impacts of urban areas on adjacent countryside then a completely independent project focusing on these areas but using CS methodology would need to be set up. This would require increased concentration on relevant areas, both in terms of increases in relevant square types as well as increased efficiency of urban surveying. The nature of CS, in terms of the way in which it is repeated over time is actually a very good format for looking at the impacts of development.

Question 17: How are agri-environment schemes represented in the CS2000 field survey sample? What evidence is there that agri-environment schemes have contributed to the changes in the Broad Habitats and landscape features recorded in CS2000?

Lisa Norton & Lindsay Maskell

Background

CS has the potential to provide a reference point, against which changes in habitats within agri-environment schemes and designated areas can be compared. This has been demonstrated with the recent monitoring of the Countryside Stewardship Scheme (CSS), which compared both habitats and vegetation under agreements with those found within CS squares. Here we explore the extent to which CS can be used as a monitoring tool for looking at the impacts of agri-environment schemes on the wider countryside both currently and in the future.

Key Findings

- The extent of data compatible with CS data was somewhat limited both in terms of the schemes covered and the nature of the data available. No data were made available from Scottish schemes, for example. Only data for the two major schemes (Environmentally Sensitive Areas (ESAs) and the CSS) were of sufficient coverage and in the right format to be investigated further. Even then, the absence of dates of entry into ESA agreements limited the extent to which the data could be used to look at changes in the countryside resulting from agri-environment schemes.

- The CS2000 sample squares contained a small amount of land under agreement in an agri-environment scheme. 15% of squares in England contained land under CSS agreement, for the majority (80%) of those squares less than half of the total area of land was in agreement. The sampling rate for area of land under agri-environment agreements was 0.2%, the same as for the countryside as a whole. Therefore agri-environment schemes are represented proportionally to their coverage.

- CS2000 data therefore incorporate the impact of agri-environment schemes, but given the limited amount of agreement land within survey squares, the range of schemes and their various objectives it has not been possible to discriminate any specific effects of the schemes.

Implications

- New policies, notably the Entry Level agri-environment scheme, may affect far greater areas of land, increasing the proportion of CS samples that are within agreements. This may increase the potential for the use of the Countryside Survey database to explore the impacts of agri-environment schemes, but will make CS less valuable as a control data set composed of land largely outside agri-environment schemes.

- However, issues of increased availability and quality of data need to be addressed if CS is to be used as a monitoring tool. It is important that the data supplied includes; compatible spatial coverages, information on the nature of agreements (e.g. whether they are for access, hedge maintenance, decreases in input levels, stocking levels etc.), date of entry into agreement (and departure, where relevant), tier entry level (where relevant) and any other agreement details.

- Potential analyses include differences between agreement and non-agreement land in terms of; the quality and quantity of field boundaries (including hedgerows), Broad Habitat (e.g. arable reversion to grassland) and vegetation quality (including species diversity). These will all help relate changes within schemes to those observed within CS sample areas without agri-environment agreements.

- Another important issue is the comparability of data between monitoring of agri-environment schemes and Countryside Survey. The proposed use of a common $1m^2$ quadrat (involving a modification of the current quadrat size used in CS) for monitoring of agri-environment schemes and CS (Critchley *et al.* 2002) would ensure that data on agri-environment schemes can be looked at in relation to the wider countryside. This would be of particular importance for schemes which will not be sampled effectively by Countryside Survey alone, notably ESAs.

Reference

Critchely, C.N.R., Maskell, L.C., Mitchely, J., Adamson, H.F., Burch, F.M., Carey, P.D., Firbank, L.G., Fowbert, J.A., Parkin A.B., Smart, S.M. & Sparks, T.H. (2002) Review and Recommendations of Methodologies to be used for Botanical Monitoring of Agri-Environment Schemes in England. Report for DEFRA, London.

ANNEX 1 - BROAD HABITATS

The following brief definitions of the Broad Habitats (as listed in UK Biodiversity Action Plan) are taken from 'Accounting for Nature' (Haines-Young *et al.* 2000). Where appropriate, a note is made of where CS2000 has been unable to match the given definitions.

Arable and Horticultural

Includes all arable crops such as different types of cereal and vegetable crops, together with orchards and more specialist operations such as market gardening and commercial flower growing. Freshly ploughed land, fallow areas, short-term set-aside and annual grass leys[1] are also included in this category.

Improved Grassland

Improved Grassland occurs on fertile soils and is characterised by the dominance of a few fast-growing species, such as rye-grass and white clover. These grasslands are typically used for grazing and silage, but they can also be managed for recreational purposes. They are often intensively managed using fertiliser and weed control treatments, and may also be ploughed as part of the normal rotation of arable crops but if so, they are only included in this Broad Habitat type if they are more than one year old.

Neutral Grassland

Neutral Grasslands are found on soils that are neither very acid nor alkaline. They support different types of vegetation communities compared to *Acid Grassland* and *Calcareous Grassland* described in Chapter 6 in that they do not contain calcifuge ('lime-avoiding') plants which are found on acid soils, or calcicole (lime-loving) plants which are found on calcareous soils. Unimproved or semi-improved *Neutral Grasslands* may be managed as hay meadows, pastures or for silage. They differ from *Improved Grassland* in that they are less fertile and contain a wider range of herb and grass species. Usually the cover of rye grass is less than about 25%.

Boundary and Linear Features

This habitat includes a diverse range of linearly arranged landscape features such as hedgerows, lines of trees (whether they are part of a hedgerow or not), walls, stone and earth banks, grass strips and dry ditches[2]. These features may occur separately or in combinations forming multi-element boundaries. This habitat type also includes some of the built components of the rural landscape, including roads, tracks and railways. The narrow strips of semi-natural vegetation along verges or cuttings are also included[3].

Broadleaved, Mixed and Yew Woodland

This form of woodland is dominated by trees that are more than 5 m high when mature, which form a distinct, although sometimes open, canopy with a cover of greater than 20%[4]. It includes stands of native broadleaved trees (such as oak, ash and beech), non-native broadleaved trees (such as sycamore and horse-chestnut), and yew trees, where the percentage cover of these trees in the stand exceeds 20%[4] of the total cover of the trees present. Scrub vegetation, where the woody component tends to be mainly shrubs (usually less than 5 m high), is included if the cover of woody species is greater than 30%.

Coniferous Woodland

Coniferous Woodland is dominated by trees that are more than 5 m high when mature, which form a distinct, although sometimes open, canopy which has a cover of greater than 20%[5]. It includes stands of both native conifers (Scots pine but not yew) and non-native conifers (such as larch and Sitka spruce) where the percentage cover of these trees in the stand exceeds 80%[6] of the total cover of the trees present. Recently felled woodland is also included in this category if there is a clear intention to return the area to *Coniferous Woodland*.

Comment on mixed woodland

Many areas of woodland contain both broadleaved and coniferous trees. There is not a separate Broad Habitat for mixed woodland. Instead where mixtures occur they are assigned to the *Broadleaved, Mixed* and *Yew* Broad Habitat if the proportion of conifers is less than 80%[7]. However, the separation of coniferous from *Broadleaved, Mixed* and *Yew* habitat is applied at a stand or sub-compartment level within large woodlands to avoid areas that are predominantly coniferous being treated as mixed because they are part of a larger wood, of which 20%[5] consists of pure broadleaved trees. Therefore, most areas of mixed woodland that are assigned to the *Broadleaved, Mixed* and *Yew* Broad Habitat would normally have much more than 20%[8] broadleaved or yew trees.

Acid Grassland

Vegetation dominated by grasses and herbs on a range of lime-deficient soils which have been derived from acidic bedrock or from superficial deposits such as sands and gravels. They characteristically include a range of calcifuge or 'lime-avoiding' plants.

Dwarf Shrub Heath

Dwarf Shrub Heath comprises vegetation that has a greater than 25% cover of plant species from the heath family or dwarf gorse species. It generally occurs on well-drained, nutrient-poor, acid soils.

Fen, Marsh and Swamp

This habitat occurs on ground that is permanently, seasonally or periodically waterlogged as a result of ground water or surface run-off. It can occur on peat, peaty soils, or mineral soils. It covers a wide range of wetland vegetation, including fens, flushes, marshy grasslands, rush-pastures, swamps and reedbeds[9].

Bog

Wetlands that support vegetation that is usually peat-forming and which receive mineral nutrients principally from precipitation rather than ground water. Where bogs have not been modified by surface drying and aeration or heavy grazing the vegetation is dominated by plants tolerant of acid conditions, such as bog-mosses, cotton-grass and cross-leaved heath. Purple moor-grass or hare's-tail cotton-grass can become dominant on modified bogs.

Calcareous Grassland

Vegetation dominated by grasses and herbs on shallow, well-drained soils, which are alkaline, as a result of the weathering of chalk, limestone or other types of base-rich rock. They characteristically include a range of calcicoles or 'lime-loving' plants[10].

Bracken

Stands of vegetation greater than 0.25 ha in extent which are dominated by a continuous canopy cover (>95% cover) of bracken (*Pteridium aquilinum*) at the height of the growing season.

Montane

Vegetation types that occur exclusively above the former natural tree-line on mountains[11]. It includes prostrate dwarf shrub heath, snow-bed communities, sedge and rush heaths, and moss heaths. They contain species which are characteristic of the arctic and alpine regions and the vegetation is often 'wind-clipped' or prostrate.

Inland Rock

Habitat types that occur on both natural and artificial exposed rock surfaces, such as inland cliffs, caves, screes and limestone pavements, as well as various forms of excavations and waste tips, such as quarries and quarry waste.

Standing Waters and Canals

This Broad Habitat category includes lakes, meres and pools, as well as man-made water bodies such as reservoirs, canals, ponds, gravel pits and water-filled ditches[12]. A variety of vegetation types can be found associated with *Standing Water*, including aquatic vegetation (which may be free-floating or rooted in the sediments at the bottom of open water), and vegetation which is found in the shallower water of the margins.

Rivers and Streams

This category includes rivers and streams from bank top to bank top; where there are no distinctive banks or banks are never overtopped, it includes the extent of the mean annual flood. This includes the channel that may support aquatic vegetation and water fringe vegetation.

Built-up and Gardens

Covers urban and rural settlements, farm buildings, caravan parks and other man-made built structures such as industrial estates, retail parks, waste and derelict ground, urban parkland and urban transport infrastructure[13]. It also includes domestic gardens and allotments.

Reference

Haines-Young, R.H., Barr, C.J., Black, H.I.J., Briggs, D.J., Bunce, R.G.H., Clarke, R.T., Cooper, A., Dawson, F.H., Firbank, L.G., Fuller, R.M., Furse, M.T., Gillespie, M.K., Hill, R., Hornung, M., Howard, D.C., McCann, T., Morecroft, M.D., Petit, S., Sier, A.R.J., Smart, S.M., Smith, G.M., Stott, A.P., Stuart, R.C. and Watkins, J.W. (2000) *Accounting for nature: assessing habitats in the UK countryside*, DETR, London.

1 CS2000 includes annual grass leys under Improved Grassland.

2 CS2000 does not distinguish between wet and dry ditches (because only one visit is made during the year).

3 CS2000 also includes fences and associated vegetation.

4 CS2000 uses a percentage cover of 25%, not 20%

5 CS2000 uses a percentage cover of 25%, not 20%

6 CS2000 uses a percentage cover of 75%, not 80%

7 CS2000 uses a percentage cover of 75%, not 80%

8 CS2000 uses a percentage cover of 25%, not 20%

9 CS2000 includes areas of high rush (*Juncus* spp.) cover in this category, irrespective of associated species.
10 CS2000 may have under-recorded Northern limestone grasslands because they may be dominated by species that are not calcicoles.
11 In CS2000, the Zone was defined by recognising a threshold annual accumulated temperature of 2,000°C, to delimit those areas with a montane climate (mostly in Scotland).
12 CS2000 is likely to record an under-estimate because some areas of small, closely adjacent water bodies in Scotland were necessarily mapped as single units.
13 CS2000 includes all transport infrastructure in this category, whether urban or rural.

ANNEX 2 - PLOT TYPES

The following table is taken from 'Accounting for Nature' (Haines-Young *et al.* 2000). It describes the different Plot Types used in CS2000.

Code letter	Plot type	Size	Maximum no. per km square	First surveyed
X	Fields and other main land cover parcels	14 x 14 m	5	1978
R	Road verges	1 x 10 m	2	1978
V	Additional road verges	1 x 10 m	3	1990
S	Stream and riverside	1 x 10 m	2	1978
W	Additional stream and riverside	1 x 10 m	3	1990
B	Field boundaries	1 x 10 m	5	1990
H	Hedgerows	1 x 10 m	2	1978
Y	Targeted habitat plots	2 x 2 m	5	1990
A	Arable field margins	1 x 100 m	5	1998
D	Woody species only in hedges	1 x 30 m	10	1998
U	Unenclosed Broad Habitats	2 x 2 m	10	1998

ANNEX 3 - ENVIRONMENTAL ZONES

Four '*Landscape Types*' were created by aggregating ITE Land classes for the purposes of reporting the results of Countryside Survey 1990 at a sub-GB level. Land classes were completely contained within a single Landscape Type making the regions a statistically sound. Subsequent changes in the ITE Land Classification, and lack of acceptance of the Landscape Types meant that a new aggregation of classes was necessary to report the results of Countryside Survey 2000 (CS2000).

New aggregations of classes, termed *Environmental Zones*, were derived to be consistant with the Landscape Types. The ITE Land Classification had been modified so that Scotland and England & Wales did not share land classes. This, along with the policy review of CS1990 that had identified a need to derive Zones which did not cross the Scotland/England border led to the production of a new set of Zones. The Zones are hierarchical within the national division between Scotland and England and Wales; there are three Zones in Scotland and three Zones in England and Wales. As they are derived from an environmental classification they can be seen the divide Britain in terms of physical geography and climate.

The Environmental Zones shown in figure A3.1, a brief description of each Zone is provided below:

1. ***Environmental Zone 1: Easterly lowlands (England/Wales)***

The largest Zone covering 26% of GB. The kilometre squares tends to be low lying (mean altitude 72 m) and located in the south and east. The dominant Broad Habitat is *Arable and horticultural* (48% LCM2000) and it has 11% urban (towns and villages, OSgref data).

2. ***Environmental Zone 2: Westerly lowlands (England/Wales)***

A comparable extent to EZ 1, the Zone covers 24% of GB. The kilometre squares tends to be low lying (mean altitude 83 m) but more undulating than EZ 1 and located in the west. The dominant Broad Habitat is *Improved grassland* (33% LCM2000) but Arable & horticultural is still extensive (27%); it contains 12% urban (towns and villages, OSgref data).

3. ***Environmental Zone 3: Uplands (England/Wales)***

The smallest of the three English and Welsh Zones covering 11% of GB. The kilometre squares cover the higher ground in England and Wales (mean altitude 325 m) and located in the west and north. The dominant Broad Habitats are in the *Semi-natural grass* group identified in LCM2000 (43%) and it has 2% urban coverage (towns and villages, OSgref data).

4. ***Environmental Zone 4: Lowlands (Scotland)***

The smallest Zone covering only 9% of GB. The kilometre squares tends to be low lying (mean altitude 99 m) and located in the south and east. The dominant Broad Habitats are *Arable and horticultural* and *Improved grassland* (both with 27% LCM2000) and 6% of the land is urban (towns and villages, OSgref data).

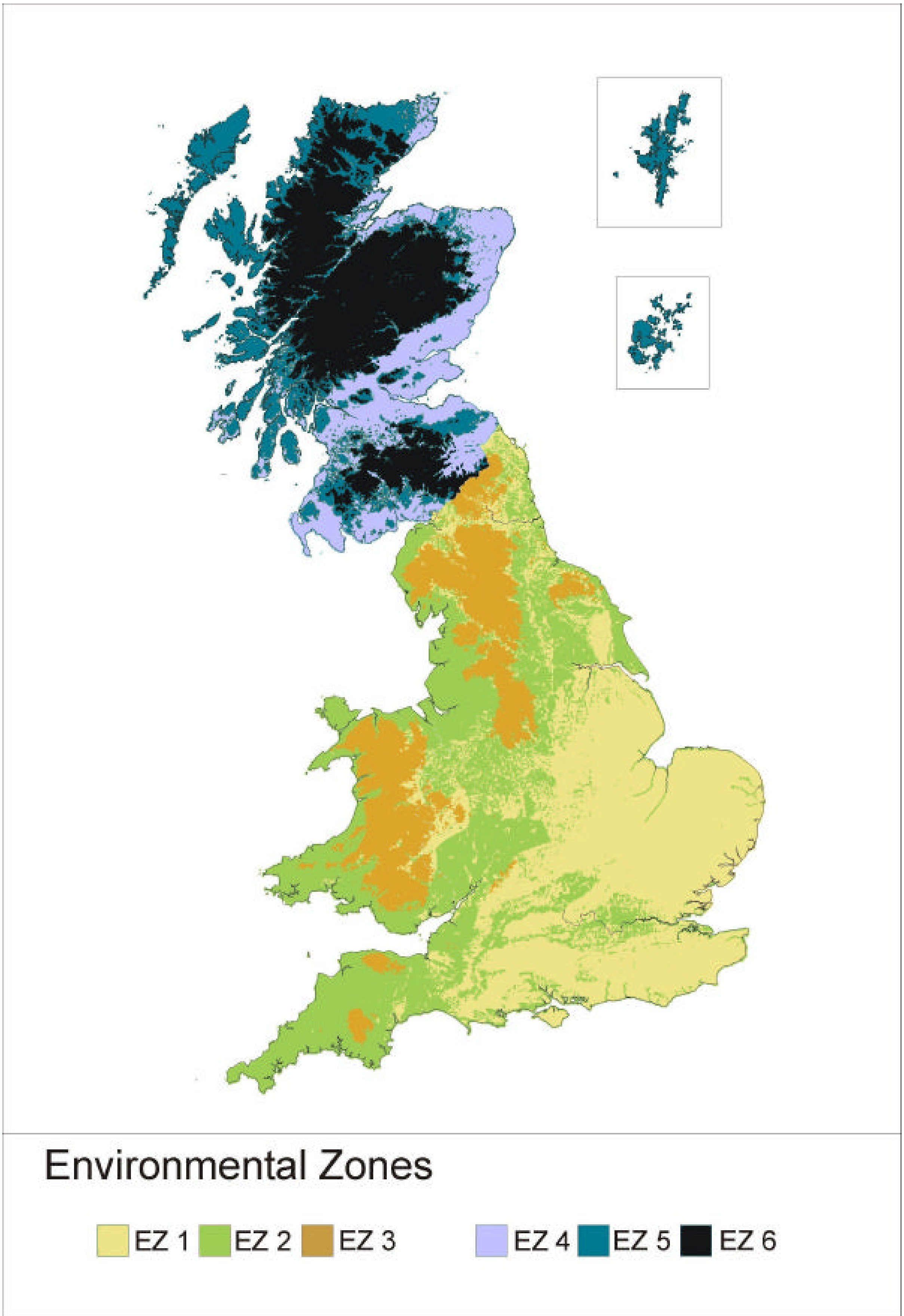
5. ***Environmental Zone 5: Intermediate and Islands (Scotland)***

The Zone covers 12% of GB. The kilometre squares tends to be of intermediate altitude (mean altitude 118 m) and located on the coastal fringe and islands to the north and west. The dominant Broad Habitats are in the group called *Upland* (35% LCM2000) and it has 2% urban land (towns and villages, OSgref data).

6. ***Environmental Zone 6: Highlands (Scotland)***

The Zone has 13% of GB. The kilometre squares include the most upland in GB (mean altitude 404 m) and located in central Scotland. The dominant Broad Habitat is in the group *Upland vegetation* (60% LCM2000); there is negligible urban land (< 1% towns and villages, OSgref data).

Figure A3.1 Map showing the six Environmental Zones in GB



Annex 4 Abbreviations and Units

Units used are SI

Lengths

m	- metres
km	- kilometres

Area

m^2	- square metres
ha	- hectares
km^2	- square kilometres

ASRH	- Ancient Species Rich Hedgerow
AWI	-Ancient Woodland Inventory
BAP	- United Kingdom Biodiversity Action Plan
CCW	- Countryside Council for Wales
CEH	- Centre for Ecology and Hydrology
CS	- Countryside Survey
CS1978	- Countryside Survey 1978
CS1984	- Countryside Survey 1984
CS1990	- Countryside Survey 1990
CS2000	- Countryside Survey 2000
DEFRA	- Department of the Environment, Food and Rural Affairs
DSH	- Dwarf Shrub Heath
EIA	- Environmental Impact Assessment
EN	- English Nature
ESA	- Environmentally Sensitive Area
EZ	- Environmental Zone (EZ 1, EZ2, etc.)
FC	- Forestry Commission
FE	- Forest Enterprise
GB	- Great Britain
HAP	- Habitat Action Plan
JNCC	- Joint Nature Conservation Council
LCM2000	- Land Cover Map 2000 (satellite derived map)
LFA	- Less Favoured Area
n	- number of observations
NIWD	- NIWT Digital map (updated to 2000)
NIWT	- National Inventory of Woodland and Trees
ns	- Not significant (statistically)
OS	- Ordnance Survey of Great Britain
r	- correlation coefficient
SNH	- Scottish Natural Heritage
UK	- United Kingdom
WFD	- Water Framework Directive

Annex 5 FOCUS Recommendations

1- Scope of CS

FOCUS has shown that Countryside Survey (CS) data are limited in their capacity to answer questions about certain habitats or types of land. It is essentially, as planned, a general survey of rural UK and as such does not have the capacity to provide detailed information about, for example, urban areas and Priority Habitats. Another potential limitation is reporting change in Broad Habitats which have a rapid turnover.

Recommendations:

- To effectively address specific issues would require different sampling strategies, intensities and methodologies. Rather than modifying CS to incorporate special topics, it is best viewed as a dataset that will set other projects and programmes in context. It is recommended that independent research programmes are devised, but that they use methods that are compatible with CS - a good example is the Countryside Stewardship project led by Peter Carey.
- The objectives of the satellite projects and programmes should be clearly defined at the outset and there should be no expectation of being capable of meeting modified targets.
- There needs to be dialogue between the different research projects and programmes so that the data that are collected within CS are compatible. Alteration of data recorded within CS (e.g. for surveying land within urban areas) should be avoided if possible.
- The strength of the CS research programme should be recognised as an integrated assessment rather than being targeted at specific indicators.
- A repeat survey of 'Key Habitat' squares should be mounted to improve cover of Priority Habitats. The survey should be compatible with, but not part of, CS.
- A complimentary survey of urban land should be considered.

2 - Data integration

2.1 Internal (CEH) integration

CS consists of different components (e.g. Land Cover Map, Field Survey land cover, vegetation plots, soil maps, soil samples, water samples etc.) whose relationship is not always clear. The integration not only requires spatial co-registration, but also a cohesive database with a robust data structure. Temporal differences between datasets also need to be taken into account. The recommendations can be subdivided into general issues, those parts that are relevant to spatial data recording and those aspects that effect vegetation data. An important aspect of the integration is in the sharpening of the field methods so that problems are addressed as the data are recorded.

General Recommendations:

- The precision of the spatial co-registration and the database structure should be reported.
- Dataset matches and comparisons that are not valid should be highlighted.
- Develop more integrated field-recording protocols that will force cross-checking between mapped and sampled data e.g. H plots must be geographically referenced adjacent to a 'hedge' boundary feature.

Recommendations for spatial data:

- Investigate potential of developments in field recording technology to enable direct data-entry by field staff. Apart from reducing time to reporting, the benefits will include the potential to automatically check data integrity and validate the observations. Many of the problems encountered can only be properly addressed at the point of recording the information. Modifications to data collection must be secure (i.e. must not risk loss of information) and conservative (i.e. must not compromise existing data and remain consistent with them) to guarantee the authority of change information.
- Quality criteria must be agreed in advance and the results should not be interpreted beyond them.
- Spatial data should be taken into field and used to positively confirm features or record changes. Surveyors may still be asked to make an independent assessment of the habitats they are surveying, but using portable electronic recording devices will allow the results to be compared immediately.
- Information should be recorded in detail to permit different forms of post-survey classification.
- The information gathering should be mandatory to ensure comprehensive and consistent data.

Recommendations for vegetation data

- The Global Positioning System (GPS) locations recorded for plots need to be tested for assisting plot re-location and to aid with data integration. There may be different guidelines needed for plots in unenclosed landscapes.
- The additional information on the plot sheets could be of greater value if recorded in a consistent way. It needs to identify relevant elements that are not held within the other sections of the survey.
- The plot location maps need to be drawn so they can easily be read in context of the field mapping.
- Better instructions about the use of photography for plot relocation may provide a more comprehensive additional data source.
- Review the status of the category 1 species.

2.2 External integration

As part of FOCUS work the importance of compatible additional data sets became very apparent to support the development of evidence based policy in Great Britain. However, the compatibility, availability and appropriateness of datasets caused problems within the project. For example, data on agri-environment schemes for various countries were often either not available or not in a useful format for use alongside CS data. The recommendations can be divided into those relevant to integration with British data (i.e. where there is spatial overlap) and those from outside Britain where the link is a geographic addition.

Recommendations for British data:

1. Identify different datasets and their sources along with any their data format and spatial structure. Projects such as MAGIC may aid with this process. MAGIC should be made fully aware of the potential of CS data.
2. In order to significantly enhance the scientific potential of CS data it is necessary to liaise closely with relevant bodies who collect data on a national scale to ensure compatibility of datasets. This is a particular issue when requiring data from devolved countries. Examples of the kind of datasets that will complement the CS data include; DEFRA data on agri-environment (Topic 7) schemes, IACS data, CSL pesticide data (Topic 1), NIWT, AWI (Topic 3) and the River Habitat Survey (Topic 5).
3. Where data are spatial attempt to use a compatible or identical recording units (e.g. OS MasterMap TOIDs)

CS2000 is the first in the series to report for UK. Different statistical methodologies and classifications were used in presenting Broad Habitat information, although attempts were made to keep the datasets compatible.

Recommendations for data from outside Britain:

- Closer liaison with Northern Ireland at the outset to produce a more unified survey
- Identification of areas (partially) omitted (e.g. Isle of Man, Scilly and Channel Islands) and agreement of their omission
- Integration with Europe (EUNIS, CORINE and BioHab)

3-Devolution

There were clear communication problems in gaining access to data when dealing with Scotland. It may be because the project seems less relevant or more targeted towards (and funded by) England. For the next survey other areas of regional government, (such as Wales and the English regions) may pose similar problems. CS data are currently being investigated for use in the Countryside Quality Counts project, the data do offer potential within the project, but cannot be partitioned with sufficient confidence into individual Countryside Character Areas. CS is succeeding in giving an overview of the changing state of the British environment, there are levels of spatial interpretation below those for which CS was designed.

Recommendations:

- Raise the profile of CS as a comprehensive and holistic UK programme and encourage the different relevant authorities to buy in.
- Identify key personnel in each country/region with responsibility for communication and data transfer
- Hold some of the management meetings in the different principalities and countries.

4- Changes in protocols

Work on FOCUS revealed that certain aspects of the survey methodology may need to be refined if we are to get a more accurate picture of change in particular habitat types.

Recommendations:

Topic 1

Topic 2

- Attribute data recording needs to be modified to allow assessment of the 'favourable condition' HAP target (process ongoing in relation with HAP SG). This will include the recording of width for all linear woody boundary features so that the volume of hedgerows can be estimated.
- Hedge structure/composition/characteristics should be recorded more consistently. The relationship between information recorded and management procedures (especially of hedge bottoms) should be investigated.

Topic 3

- Consider the conversion of the mapped land parcels into OS MasterMap polygons.
- Record land management units within woodland so that internal and external dynamics can be differentiated.

Topic 4

- Evluate field recording and mapping methods to standardise and minimise the problem of defining boundaries of semi-natural vegetation
- Use mandatory coding and data validation in the field to guarantee that codes are recorded to increase the confidence in the identification of changes in habitat quality

Topic 5

- There need to be stronger ties between the freshwater survey component and CS on streamside plots and closer liaison between the two surveys pre-survey. Currently, not all stretches of river surveyed for the freshwater survey include a CS streamside plot. In addition, problems with digitising from the plot location sheets to the spatial database resulted in difficulties matching streamside plots with stretches of river. This can be overcome with changes to the methodology for collecting spatial data.
- Information for catchment areas outside the survey squares would also be valuable for interpretation.

- Additional, or more effective, collection of data on general aspects of the watercourse including; size and type of watercourse, direction of flow, management of land in streamside plot (e.g. whether it constitutes part of a buffer strip, a managed field, woodland etc.) and more effective use of photographs by using the same position as previous surveys to take the photo from where possible.
- In addition, problems with digitising from the plot location sheets to the spatial database resulted in difficulties matching streamside plots with stretches of river. This can be overcome with changes to the methodology for collecting spatial data.

Topic 6

- CS cannot to make authoritative statements about urban habitats since the predominantly urban land is not surveyed. The coding used to describe the built up component of surveyed land is also rudimentary.
- The method of mapping and coding Built up and gardens should be reviewed.

Topic 7

- Plot size to be compatible with monitoring of agri-environment schemes

5 - Training

FOCUS revealed that training of surveyors often had an effect on the data collected, with emphasis in, or away, from particular directions affecting data quality. The two week training course involved communicating a great deal of information in a short period of time which can lead to confusion. It is likely that there will be substantial changes in field recording methodology in the next survey.

Recommendations:

- Training should be rethought. Longer and more continuous training should involve surveyors in understanding what happens to the data when it is collected, so that they can see the underlying rationale for survey methodology and refine it pre-survey in order to minimise problems in the final dataset.
- The use of electronic data-loggers in the field will require an additional set of skills for the surveyors. The time required to train surveyors with these techniques should not be underestimated. The systems carried into the field need to be both physically and conceptually robust.

6 – Reporting and data presentation

FOCUS (and Countryside Survey 2000) have used different forms of dissemination including

- Paper reports
- Scientific papers
- World wide web copies of articles
- Countryside Information System
- Verbal presentations

Recommendations:

- As there is increasing emphasis on Web-based dissemination, there should be a programme of development such facilities for use in reporting and analysing the next CS.
- The proposed Web-based facilities would not replace current methods of reporting but would extend what reports and data users could obtain specific to their own requirements. For example, specific regional reporting using different elements of the data or production of CIS data sets on demand would be possible.
- The development of reports and data on demand would increase users ability to explore results from the CS survey beyond the summaries presented in published reports. This facility would need to be accompanied by the development of statistical methods capable of informing users of the level of confidence in particular results and possibly blocking lines of enquiry that are either statistically unsupportable or endanger the confidentiality of survey locations
- Such a facility should integrate with rather than duplicate the stand-alone CIS functionality. The products of particular data enquiries should be capable of export as CIS sets where they can produce statistically supportable results.
- There needs to be a long term commitment to support Web-based publication to secure access to completed reports.