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Accounting for nature assessing habitats in the UK countryside

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COUNTRYSIDE SURVEY 2000

executive summary

1 Countryside Survey 2000 (CS2000) and the Northern Ireland Countryside Survey 2000 (NICS2000) have been designed to provide detailed information about the habitats and landscape features that are important elements of our countryside. They can tell us about the 'stock' of these resources, that is how much of them we have and where they are to be found, and they can give us an insight into their condition based on the variety and abundance of the plant species associated with them. Using information from previous surveys, we can also gain an understanding of how the stock and condition of these habitats and landscape features are changing over time. We can build up a sort of balance sheet or an account of natural assets in the UK countryside. In this report we look in particular at the period between the last two surveys, 1990 and 1998.

2 The information collected can be presented in various ways because it is held in flexible, computerised databases. In the light of the importance of the UK Biodiversity Action Plan (BAP), and the Government's requirement to report on biodiversity at the turn of the Millennium, the results are presented in this report in terms of Broad Habitats, as used in the BAP. However, the results also update two of the Government's *Quality of Life Counts* (QOLC) indicators on landscape features and plant diversity.

3 The QOLC indicator for landscape features – hedges, walls and ponds – shows that in Great Britain the declines in lengths of hedges and walls reported for the 1980s have halted. In the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have reversed. Lowland ponds show a small net increase. However, in Northern Ireland the stock of hedges and earth banks declined between the early 1990s and 1998.

4 The QOLC indicator for plant diversity shows that many of the deleterious changes in species richness recorded in Great Britain in the 1980s have reduced in magnitude or halted. Declines in species richness in the 1990s are mostly associated with the vegetation found in managed agricultural grasslands, field boundaries and verges. The continued decline in the diversity of our least agriculturally improved grasslands is a matter of concern. There have also been marked trends in the condition of vegetation indicating increasing levels of nutrient availability – or eutrophication – and conditions which favour tall, competitive plants.

5 The general conclusion from these very broad national indicators is that negative trends in some key components of countryside quality have slowed or halted during the 1990s. The more detailed assessment of Broad Habitats which follows shows how these general trends apply to different features in different parts of the UK. A summary of the 'headline results', which illustrate the main findings is given in Box 1.

Enclosed farmland: Arable and Horticultural, Improved and Neutral Grasslands

6 *Arable and Horticultural* and *Improved Grassland* are the most extensive Broad Habitats in the UK. Their stock has changed little between 1990 and 1998, although small proportions were converted to woodland or developed land. There is some evidence for increasing plant diversity in the *Arable* Broad Habitat, especially in the margins of the fields. Such habitats were very species-poor in 1990 and these changes may reflect rotations between crops and sown ley, as well as managed set-aside and creation of uncultivated headlands and field corners. In *Improved Grassland* plant diversity has declined since 1990. Other changes in the

Box 1: Ten 'headline results'

1. Plant diversity increased in arable fields, especially in the boundaries of the fields. Plant diversity in some arable field boundaries in England and Wales increased by 38%.

2. Plant diversity continued to decline in the least agriculturally improved grasslands in Great Britain. Plant diversity in some meadows fell by 8%, including losses of meadow species important for butterflies. The area of 'neutral' grassland in Northern Ireland decreased by 32%.

3. Following marked losses in the 1980s, there was no significant difference in the 1990 and 1998 estimates of hedgerow length in England and Wales. There is some evidence that losses in the early 1990s have been reversed.

4. Road verges showed evidence of increasing nutrient levels and losses in plant diversity. Plant diversity fell by 9% in some road verges in England and Wales.

5. Broadleaved woodland expanded by 4% in England and Wales and 9% in both Scotland and Northern Ireland between 1990 and 1998. The total area of coniferous woodland in the UK was unchanged.

6. The area of semi-natural 'acid' and 'calcareous' grasslands fell by 10% and 18% in the UK. The area of bog fell by 8% in Northern Ireland. There was evidence of increasing nutrient levels or eutrophication in dwarf shrub heath and bog, suggested by an increase of plant species more typical of lowland grasslands.

7. The number of lowland ponds increased by about 6% between 1990 and 1998 in Great Britain.

8. The biological condition of streams and small rivers improved in Great Britain. Over 25% of sites improved in condition and only 2% were downgraded.

9. Streamside vegetation became more overgrown, and plant diversity decreased by 11% in England and Wales. Fen, marsh and swamp expanded by 27% in England and Wales and 19% in Scotland but declined by 19% in Northern Ireland.

10. More broadleaved woodland was created on formerly developed land than was lost to new development in Great Britain in the 1990s.

vegetation indicate that nutrient levels have increased over the same period.

7 *Neutral Grasslands*, which include some species-rich hay meadows as well as areas of unmanaged grassland, cover less than 4% of the UK. These grasslands show losses in stock in Scotland and Northern Ireland but gains in England and Wales. Overall 13% of *Neutral Grassland* was primarily converted to *Arable, Broadleaved* or *Built-up* Broad Habitats between 1990 and 1998. The floristic character altered, with increases in tall, competitive plants at the expense of more typical meadow plants.

8 The analysis suggests that, whilst little change has taken place on already intensively managed arable land, the stock and condition of surviving parcels of less improved grasslands has diminished. These changes are associated with the declining frequency of typical meadow flowers and grasses, and may reflect increasing fertility levels in these habitats. Since these parcels of 'infertile' grassland have a higher conservation value than intensively managed grasslands, these changes may represent a decline in the overall quality of the grassland habitats associated with the enclosed farm landscape.

Boundary and Linear Features

9 There are an estimated 1.8 million kilometres of the *Boundary and Linear Features* Broad Habitat (excluding roads and railways) in the UK. In England, Wales and Northern Ireland, hedges and other woody features are the dominant field boundary types. In Scotland fences are more widespread.

10 The declines in length of hedges and walls reported for the 1980s in Great Britain have generally halted, and in the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have reversed. This has been achieved by a shift in balance between hedge removal and planting, hedge restoration and damage, and wall removal and re-construction. Comparison with the 1980s shows that rates of hedge planting are similar but rates of removal have fallen markedly. There is evidence for a gradual degeneration of woody linear features as some hedges degenerate to remnant hedges and some of these in turn degenerate to lines of trees or shrubs. But, unlike the 1980s and early 1990s, restoration and management largely counteract these trends. The stock of lines of trees and shrubs is reported for the first time and contributes significantly to the extent of the Broad Habitat. The Northern Ireland Countryside Survey records a net loss of hedges and earth banks between 1990 and 1998.

11 There is some evidence from the analysis of vegetation associated with *Boundary and Linear Features* of a decline in the condition of the Broad Habitat. The vegetation of some hedges and roadside verges is less species-rich and more dominated by tall, competitive plants, associated more fertile situations, compared to 1990. These changes are an issue especially in the intensively farmed landscapes of England and Wales, where linear features serve as an important habitat and refuge for wildlife. However, not all hedges or verges are affected and, for example, species diversity increased on roadside verges in the Scottish lowlands.

Woodlands

12 The changes in *Broadleaved* and *Coniferous Woodlands*, recorded by the surveys in Great Britain and Northern Ireland, suggest that some important environmental gains have been made during the 1990s.

13 The area of the *Broadleaved, Mixed and Yew Woodland* Broad Habitat increased by about 5% to 1.5 million ha in 1998. It now covers more than 6% of the UK. The expansion of *Broadleaved Woodland* is consistent with current policies to increase the area of native woodlands. This gain in area is to some extent offset by evidence of a decline in habitat quality, resulting from widespread nutrient enrichment in longer established woodlands, and a decline in ancient woodland indicator species. New woodlands planted on former agricultural land also have a higher nutrient status than the existing woodland stock. It is uncertain to what extent new woodlands can compensate ecologically for the loss of older woods.

14 The *Coniferous Woodland* Broad Habitat covers an area of about 1.4 million ha in the UK, or 6% of the total land area. The stock of this habitat shows no net change in the 1990s, with losses in the lowlands tending to exceed gains in the uplands. The expansion of *Coniferous Woodland* has been a major feature of the post-war period, often at the expense of semi-natural habitats such as heath and bog. In the 1990s this expansion stopped and Countryside Survey 2000 provides some evidence of conversion of existing plantations to *Broadleaved Woodlands*, especially in the lowlands. However, some continuing losses of *Dwarf Shrub Heath, Bog* and *Broadleaved*

Woodland to the *Coniferous* Broad Habitat have also occurred.

15 The analysis of the vegetation data for the *Coniferous Woodland* Broad Habitat provides no clear evidence that the structure and flora of these plantations is becoming more diverse. However, it may be too early to detect the widespread effects of recent changes in forestry policy.

Mountain, moor, heath and down

16 The major widespread semi-natural Broad Habitats of *Acid Grassland, Dwarf Shrub Heath, Fen Marsh and Swamp, Bog, Calcareous Grassland, Bracken, Montane* and *Inland Rock* cover an estimated 6.4 million ha, a quarter of the UK land area. The Habitats are mostly concentrated in the upland Environmental Zones of England and Wales, Scotland and Northern Ireland, where they are important resources for biodiversity, outdoor recreation and rough grazing.

17 In the 1990s the stock of *Dwarf Shrub Heath* and *Bracken* changed locally but showed no significant net change for the UK as a whole. *Bog* decreased in Northern Ireland. *Acid* and *Calcareous Grassland* Broad Habitats declined by 11% and 18%, respectively. Losses of *Acid Grassland* are greatest in England and Wales and involve changes to *Improved Grassland, Bracken* and *Fen, Marsh and Swamp*. Loss of *Calcareous Grassland* is mainly to *Improved Grassland*.

18 The *Fen, Marsh and Swamp* Broad Habitat increased by about 17% for the UK as a whole, though there are losses reported in Northern Ireland. In the uplands of Great Britain, this habitat gained area from *Improved* and *Acid Grasslands*. The change appears to be associated with grassland reversion and the expansion of rushes. *Fen, Marsh and Swamp* includes a number of priority habitats for conservation and the increase in area may be generally regarded as a benefit for biodiversity, but the exchanges of land with other semi-natural habitats need to be investigated further.

19 The ecological quality of some of the more widespread semi-natural habitats has remained stable but others have declined since 1990. In *Bog* and *Dwarf Shrub Heath* the characteristic heath and bog vegetation declined and moorland grass increased. Changes in vegetation may indicate the impact of increasing fertility levels. It is uncertain to what extent grazing management and deposition of atmospheric nitrogen are the driving forces behind these changes.

20 Countryside Survey 2000 shows that soil acidity has fallen since 1978 in acid soils most commonly associated with upland environments. Moorland grass mosaics and heath and bog vegetation also show shifts in the 1990s in favour of plants associated with less acid soils. These new trends suggest a possible reversal of acidification and deserve closer inspection.

21 Changes in extent and condition of *Acid* and *Calcareous Grassland, Dwarf Shrub Heath* and *Bog* Broad Habitats tend to be contrary to the general objectives and specific targets to maintain and enhance these habitats set out recently in the UK Biodiversity Action Plan. The results of CS2000 and NICS2000 help to clarify the scale and nature of the problems and emphasise the need for concerted action to maintain and enhance biodiversity in these Broad Habitats.

Rivers, Streams and Standing Waters

22 The *Standing Waters* Broad Habitat was assessed in terms of the number and area of inland water bodies. The *Rivers and Streams* Broad Habitat was assessed in terms of the biological condition of the water course, the

structure of the river corridor and the status of streamside vegetation.

23 The total area of the *Standing Waters* Broad Habitat in Great Britain is about 190,000 ha, comprising nearly 400,000 inland water bodies. The area of inland water bodies has not changed significantly during the 1990s, but the number of small inland water bodies has increased over the decade. The results from CS2000 indicate a 6% net increase in lowland ponds between 1990 and 1998. This reverses the losses observed in the 1980s.

24 There has been a marked improvement in the biological condition of small rivers and streams in England and Wales, and Scotland since 1990. Streams in the best biological condition are commonly those with the least modification to their river corridor.

25 These gains within the freshwater environment should be set against evidence of a decline in the diversity of streamside vegetation. During the 1990s, tall growing, common grasses and herbs and woody species increased at the expense of lower growing stress-tolerating plants, which are also declining elsewhere in the landscape. This trend probably results from less intensive or different forms of land management, including the creation of 'buffer strips'.

Developed land in rural areas

26 Countryside Survey 2000 is intended primarily as a survey of rural land, and core urban areas are not included in the field survey. However, the Survey does provide some information about development in rural areas, and how the stock of developed land has changed since 1990. Comparable data have not been calculated for Northern Ireland.

27 Land under settlements or transport infrastructure (e.g. roads and railways) covers about 2.3 million ha, almost 10% of the total land surface of Great Britain. In rural areas the cover of developed land, that is the combined stock of *Built-Up and Gardens* and transport features, increased by about 4% since 1990.

28 Most of the increase in developed land in rural areas has occurred in England and Wales on improved agricultural land, but a significant proportion has taken place at the expense of *Broadleaved Woodland* and *Neutral Grassland*. However, these losses of habitats to development are partly compensated, in simple area terms, by restoration of previously developed land. Indeed, the results suggest that more *Broadleaved Woodland* was restored from developed land in rural areas than was lost to new development.

Developing a landscape view

29 It is valuable to have information about stock and change presented for each Broad Habitat because they are often under different management regimes. However it is also important to consider how the changes for individual Broad Habitats relate to each other, and what consequences these might have in terms of the landscapes in which they occur. In this preliminary analysis we have made a first attempt at a more integrated view of change for the six broad Environmental Zones in Great Britain. The results show some important contrasts between Environmental Zones that may have implications for landscape change and policy responses in different regions. This type of analysis will be developed further when zonal accounts for land cover are completed, and more detailed information on the geographical distribution of habitats becomes available from Land Cover Map 2000.

Where next?

30 This report presents some of the data on stock and change of Broad Habitats including vegetation, linear features, freshwaters and soils; more will be made available on the Countryside Survey 2000 web site. The new Land Cover Map 2000 will be ready in 2001, and the results are being compiled of the survey of breeding birds and soil analyses. A series of important research tasks and issues lay ahead in order to better understand the significance of the results and the underlying causes.

31 One of the most important scientific challenges is to bring together the field survey and Land Cover Map 2000 data. The comprehensive coverage of the Land Cover Map complements the ecological detail of the field survey. Integration of the two data sets will help us to infer more detail about Broad Habitats and their species than the Land Cover Map alone can offer. The Land Cover Map also offers a framework for extrapolation of field observations giving much greater precision than we can achieve at present.

32 Much of the analysis to date has concerned ecological changes in the countryside for which the scientific methods are well developed. However, changes in the appearance and the cultural values of the landscape matter just as much to many people. As part of the *Quality of Life Counts* initiative the Government intends to develop an indicator of 'countryside quality', which will draw together information on countryside character with changes measured in Countryside Survey 2000.

33 The results of Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 clearly show that some of the negative trends of habitat loss evident in the countryside before 1990 have been slowed, halted or reversed. These gains partly result from policy measures implemented over the last decade, such as incentives for hedgerow management and farm woodland schemes. However, it may be too early to see the benefits of more recent policy changes, and so the results of the Countryside Surveys represent a base-line to help assess the effectiveness of these new measures.

34 The results of the Countryside Surveys also allow us to put the gains that have been observed in a broader context. For while there have been some successes, there is evidence that the condition of many habitats has declined since 1990, continuing trends that were apparent in the 1980s. This is especially so in the less improved agricultural grasslands and semi-natural upland habitats of *Dwarf Shrub Heath, Bog* and *Acid Grassland*. There is some evidence from the analysis of vegetation for widespread nutrient enrichment, or eutrophication. Such changes may reflect wider environmental and economic pressures. Further work is required to understand the patterns of change that have been detected and to understand their policy implications.

35 It is clear that if we are to manage change and adapt policies so that they deliver the many things that we want from the countryside then we will need to periodically update our information base and our core indicators. As in the past, it is likely that new information needs will be identified and new methods of survey developed. However some continuity with previous work is essential for the detection and assessment of long term trends. The results of Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 need to be fully and critically evaluated so that we can learn from them and be well prepared to meet the demand for future surveys.

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Accounting for nature: assessing habitats in the UK countryside

November 2000

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Accounting for nature: assessing habitats in the UK countryside

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Land Cover Map 2000

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Foreword by the Minister for the Environment, Rt. Hon. Michael Meacher

This Government is committed to the practical achievement of sustainable development and to the conservation of biodiversity in the UK. In our White Paper 'A Better Quality of Life' we set out our sustainable development strategy which includes social, economic and environmental objectives. Our strategy recognises that the special character of our countryside is highly valued and must be retained and that the decline in wildlife and habitats must be reversed. But these objectives do not mean that the landscape should be frozen in time. The countryside has always changed and will continue to do so. Some change is inevitable and desirable as we seek to balance the social, economic and environmental demands. But change should be well managed, and good management requires reliable information to measure progress, stimulate debate and inform decisions. This report on the results of the Countryside Survey is one such source of information.

I therefore welcome and endorse this report as an important contribution to the debate about the future of our countryside. It is highly fitting that we should mark the end of one Millennium and the start of another with such a comprehensive audit. Only when we take stock of what we have now, and how much we have lost and gained, can we begin to assess what we are handing on to future generations – a key principle of sustainable development. The updates of the two core Quality of Life Counts indicators, on landscape features and plant diversity, are one means to help us to assess the progress that we are making.

Whilst building on the experience and foundations laid by previous surveys, this report is very much a first. The new focus on the assessment of the condition of broad habitats will make an important contribution to the UK Biodiversity Action Plan (BAP) and the Government's requirement to report on progress after the first five years. The BAP broad habitats provide a useful framework to draw together the way in which we manage the countryside – in woods, fields or moors – with an assessment of the biodiversity that the countryside supports. We can thereby begin to create a balance sheet or an 'account for nature' which can inform the priorities for action.

The project is also important because it has brought together the policy and scientific communities in a very productive partnership. Co-funding with the Natural Environment Research Council and other sponsors has helped us take a more comprehensive and strategic view of changes in countryside and their longer term implications.

I particularly wish to acknowledge the support of the Devolved Administrations in Scotland, Wales and Northern Ireland in the preparation of this report. This first UK overview has been achieved by combining results from the Countryside Survey in Great Britain with the separately funded Northern Ireland Countryside Survey. I hope that the Devolved Administrations will take this opportunity to reflect on the findings of these studies in relation to their own priorities and concerns for the countryside.

Finally, I would wish to offer my congratulations to all those involved in the conduct of this study – the surveyors, data analysts, authors, editors and commentators – it is a timely, relevant and accessible assessment of habitats in the UK countryside at the start of a new Millennium.

Michael Meacher

Foreword by Prof. John Lawton, Chief Executive, Natural Environment Research Council

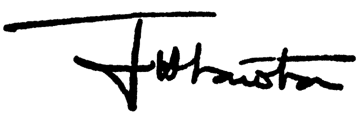
During the next decade the UK is likely to see some of the greatest changes in rural land use policies since the Second World War. The UK faces a number of critical policy decisions if it is to deliver sustainable development with the current and expected pressures on land use, and against a background of major changes to the agricultural industry.

The Countryside Surveys in Great Britain and Northern Ireland provide a unique way of studying the biophysical resources of the UK countryside. They offer an assessment of the landscape, land use and biodiversity of the countryside to a level of detail that is quite remarkable. Even better, we are now getting a clear vision of how the countryside has changed in the last 20 years, providing vital information for policy makers and all those with interests in the land.

The surveys also provide the basis for addressing a host of important scientific issues. The formal statistical basis for the work ensures that we can use the data to ask questions about why changes have happened. We can also consider how future change can be managed so that the countryside is sustained in environmental, social and economic terms. The next, and perhaps hardest step, is addressing questions about cause and effect, pattern and process.

This document is only the first step in reporting the results. By the time the process is completed, we will know much more about the inter-relationships between people, land use, landscape features and biodiversity than we do at present. We will understand much more clearly the process of landscape change and the capacity of ecosystems to cope with change. The links between small scale and large scale will be clearer – how alterations to individual patches of vegetation impact on the wider landscape. The Countryside Surveys are a major step in addressing the challenges of sustainable land use in the UK.

NERC is proud of its support of this major scientific initiative.



Contents

Our countryside is both an important natural asset and a source of well being for us all. It is a place where people live and work, and a space where many of us go to escape the pressures of city life. It is also important for biodiversity, because it is the home of a wide range of plant and animal species, and contains many different types of habitat. Thus we are all keenly interested in the state of our countryside and the way it is changing.

1 countryside survey

The value of information about the countryside

1.1 The Government's *Sustainable Development Strategy*[1] recognises that the special natural characteristics of our countryside are highly valued and must be retained. However, the landscape cannot be frozen in time. Some changes are inevitable but these should be well managed. Good management requires reliable information to measure progress and inform debate.

1.2 The Department of Environment, Transport and the Regions (DETR), and its partners have for over 20 years supported a major programme of monitoring in Great Britain, known as Countryside Survey. The first results of the most recent study, Countryside Survey 2000 or CS2000, are reported here. As part of this initiative, collaboration between DETR and the Environment and Heritage Service of Northern Ireland has enabled the results of CS2000 to be published alongside preliminary results from the Northern Ireland Countryside Survey 2000 (NICS2000), so that information for the United Kingdom can be made available.

1.3 The surveys in Great Britain and Northern Ireland involve a combination of detailed field recording and satellite mapping. Although methods differ, both have been designed to provide detailed information about the habitats and landscape features that are important elements of the countryside. They can, for example, tell us about the 'stock' of these resources, that is, how much of them we have and where they are to be found. In Great Britain, using information from CS2000, we can also gain insight into habitat condition, using data on the variety and abundance of the plant species associated with each habitat. By drawing upon information from previous Countryside Surveys, we can also understand how the stock and condition of habitats and landscape features are changing over time. Both surveys were carried out in 1998, and record change since 1990.

1.4 Data from previous Countryside Surveys have been used in a variety of ways. These include helping to develop hedgerow protection measures, providing the basis of several of the Government's *Quality of Life Counts* indicators and assisting in the design and evaluation of agri-environment schemes. The information has also been used in the calculation of carbon storage in ecosystems, which is important in the context of the problem of climate change. As a result of CS2000 and NICS2000 we can now update our understanding of what is happening in our countryside. This new set of information will help us assess how the countryside has changed during the 1990s and help us to decide what more we may need to do so that its qualities can be sustained for future generations.

AGRICULTURAL LANDSCAPE, WILTSHIRE *(HERBERT GIRARDET)*

1.5 The habitats of Britain were first characterised by ecologists in the early part of the 20th Century. They recognised that there are major vegetation types which have developed in response to climate, soil, natural succession and people's activities. This work has been the

1 DETR (1999) *A Better Quality of Life: A Strategy for Sustainable Development for the UK*, Cm4345, The Stationery Office, London

foundation of more refined vegetation classifications, which have been used to shape many conservation initiatives. For the purposes of the *UK Biodiversity Action Plan*[2], a new system of Broad Habitat categories has been developed which together account for all the terrestrial, freshwater and marine ecosystems of the UK. The list of the BAP Broad Habitats used in CS2000 and NICS2000 is given in Box 1.1. A summary of the way in which they are defined within the Biodiversity Action Plan and the way they have been interpreted in CS2000 and NICS2000 is provided in Appendix A.

1.6 The information collected by CS2000 and NICS2000 can be presented in various ways because both hold data in flexible, computerised databases. In the light of the importance of the *UK Biodiversity Action Plan* (BAP), and the Government's requirement to report on biodiversity at the turn of the Millennium, the results will mainly be presented in this report in terms of the system of BAP Broad Habitats. Because both surveys aim to establish the 'broad picture', they do not provide detailed information for BAP Priority Species and Habitats. Nevertheless, they do give important contextual information about the way in which the fabric of our countryside has been changing during the period in which the BAP has been prepared (1994-1999).

Box 1.1: List of the BAP Broad Habitats included in Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 (i.e. excluding marine habitats). Brief definitions of the Broad Habitats are given in Appendix A.

Chapter 3
Arable and horticultural
Improved grassland
Neutral grassland

Chapter 4
Boundary and linear features

Chapter 5
Broadleaved, mixed and yew woodland
Coniferous woodland

Chapter 6
Calcareous grassland
Acid grassland
Bracken
Dwarf shrub heath
Fen, marsh and swamp
Bog
Montane habitats
Inland rock

Chapter 7
Standing water and canals
Rivers and streams

Chapter 8
Built-up areas and gardens

Coastal habitats
Supralittoral rock
Supralittoral sediment
Littoral sediment

Note: The coastal Broad Habitats were included in the CS2000 and NICS2000 field surveys but the data collected are not considered to be representative of the UK resource of these habitats. Area estimates are reported in Chapter 2 but no further assessment of the habitats is provided in this report. Further information on the distribution of these habitats will be provided by Land Cover Map 2000, which includes the coastal zone.

2 See UK Biodiversity Steering Group (1995) *Biodiversity: The UK Steering Group Report. Volumes 1 and 2*, London, HMSO; UK Biodiversity Group (1998) *Tranche two action plans. Volume II: Terrestrial and freshwater habitats*, English Nature, Peterborough; UK Biodiversity Group (1999) *Tranche two action plans: Volume V: Maritime species and habitats*, English Nature, Peterborough; UK Biodiversity Group (1999) *Trache two action plans: Volume VI: Terrestrial and freshwater species and habitats*, English Nature, Peterborough; and, UK Biodiversity Group (1999) *Tranche two action plans: Volume V Maritime species and habitats*, English Nature, Peterborough. For further information visit: www.jncc.gov.uk/ukbg. For definitions of Broad Habitats see: Jackson DL (2000) *Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other habitat classifications*. JNCC Report, No. 307, Peterborough.

Building up a national picture

1.7 In Great Britain, Countryside Survey 2000 was carried out by the Centre for Ecology and Hydrology (CEH), which is part of the Natural Environment Research Council (NERC). NERC's remit includes supporting the collection and interpretation of environmental data for use in the public and private sectors, and the support of long-term environmental monitoring.

1.8 CS2000 builds on earlier field surveys undertaken by CEH in Great Britain in 1990[3], 1984 and 1978 and land cover mapping in 1990, which was based on the analysis of satellite imagery (Land Cover Map of Great Britain). With each survey, the scope and scale of the work has been increased and the scientific tools used for the analysis of the data have been refined. The continuity of the field data series has, however, been maintained and, as a result, we can use these to build a long-term view of habitat change in Great Britain. As part of CS2000, the earlier satellite mapping will also be updated by Land Cover Map 2000 (LCM2000) which covers the whole of the UK.

1.9 Fieldwork for the Northern Ireland Countryside Survey 2000 (NICS2000) was carried out by the University of Ulster in 1998. In Northern Ireland, previous survey work was undertaken for the first time around 1990[4] and so, where it is compatible with CS2000, we can combine data and begin to put together a complete national view of how the countryside is being modified in the different parts of the UK.

1.10 In order that readers can make judgements about the results of CS2000 and NICS2000, it is important to have an insight into some of the underpinning scientific ideas on which they are based. Much of the underlying methodology has been reviewed and published in the academic literature and is accessible to those who need to understand more of the details that lie behind the surveys. This document can give only an overview of the key aspects.

The CS2000 field survey

1.11 The core of CS2000 is the 'field survey'. One of its aims is to provide national and regional estimates of the extent of the different Broad Habitats found in the countryside and the character of the different vegetation types associated with them. The field survey covers both terrestrial and freshwater habitats. It also aims to report on the extent and condition of important landscape features such as hedges and walls. The field survey component of CS2000 provides most of the information presented in the later chapters of this report.

FIELD SURVEYORS RECORDING A BOUNDARY PLOT (*C BARR*)

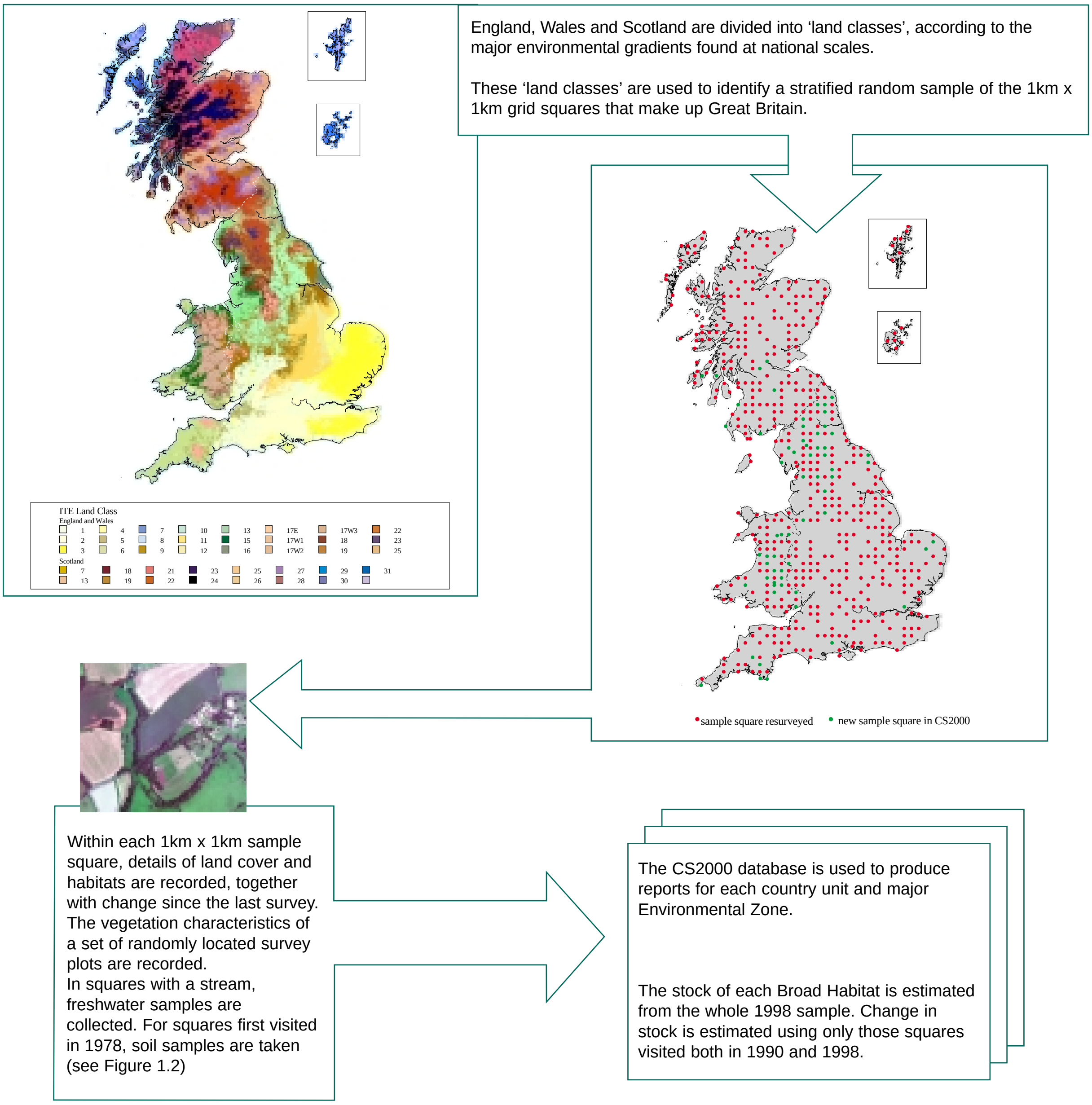
3 Barr, C.J., Bunce, R.G.H., Clarke, R.T., Fuller, R.M., Furse, M.T., Gillespie, M.K., Groom, G.B., Hallam, C.J., Hornung, M., Howard, D.C., and Ness, M.J. (1993). *Countryside Survey 1990 Main Report*, DoE London. Fuller, R.M., Groom, G.B. & Jones, A.R. (1994). The Land Cover Map of Great Britain: an automated classification of Landsat Thematic Mapper data. *Photogrammetric Engineering & Remote Sensing* 60, 553-562.

4 Murray, R., McCann, T. & Cooper, A. (1992) *A Land Classification and Landscape Ecological Study of Northern Ireland*. Report to Environment Service, Department of the Environment for Northern Ireland. University of Ulster, Coleraine.
Cooper, A., Murray, R. & McCann, T. P. (1997) *The Northern Ireland Countryside Survey: summary report and application to rural decision making*, Environment and Heritage Service, Department of the Environment for Northern Ireland, Belfast.

1.12 In order to achieve the aims of the field survey and to collect information at the level of detail required, a sample-based approach has been adopted. This is the first point to note about the results of the CS2000 field survey, namely that they are based on a *sample* of conditions in the countryside.

1.13 The sampling methods used for CS2000 are based on a rigorous, statistical approach[5]. The methods depend on an understanding of the major environmental gradients across Great Britain, which are used to ‘stratify’ or structure the sample to give reliable national statistics[6]. The process of stratification ensures that the

Figure 1.1: The sampling approach used by the CS2000 field survey



5 Barr, C.J., Bunce, R.G.H. & Heal, O.W. (1994) Countryside Survey 1990: a measure of change. *Journal of the Royal Agricultural Society of England*, 155, 48-58. Bunce, R.G.H., Barr, C.J., Clarke, R.T., Howard, D.C., Lane, A.M.J. (1996) The ITE Merlewood Land Classification of Great Britain. *Journal of Biogeography* 23, 625–634. Bunce, R.G.H., Barr, C.J., Clarke, R.T., Howard, D.C., Lane, A.M.J. (1996) Land Classification For Strategic Ecological Survey. *Journal of Environmental Management* 47, 37–60.

6 In the scientific literature, the sample strata are known as ‘Land Classes’

sample is representative of the range of different environments found in England, Scotland and Wales.

1.14 The sample units, within which information has been recorded, are a set of 'survey squares' measuring 1km x 1km. They were selected randomly within the various sample strata (Figure 1.1). Altogether, 569 sample squares were visited; 366 were in England and Wales, and 203 were in Scotland. The sample was made in such a way that estimates can be made for England and Wales combined, and separately for Scotland, using the information from the survey squares that were located in these different geographical units. England and Wales have been aggregated because the number of sample squares in Wales does not allow separate, statistically reliable estimates to be produced using only those squares located within Wales.[7]

1.15 The original plan for CS2000 was that the fieldwork should be undertaken in 1998, but bad weather conditions meant that about 10% of the squares had to be surveyed in the following year. Although small year-to-year variations in the state of the countryside might be expected, there is no evidence (see Chapter 2, Box 2.2) to suggest that this has affected the reliability of the information collected. For convenience, the date of the field survey in CS2000 is referred to throughout simply as 1998, but this includes the results from 1999.

1.16 Many of the sample squares visited during the CS2000 field survey also had information recorded within them in the earlier countryside surveys of 1978, 1984, and 1990. Prior to CS2000, the survey in 1990 was the most extensive, when 508 squares were sampled. The estimates of change reported here are based on the 501 squares surveyed in both 1990 and 1998. More detailed analysis using the older, less complete information will be published later.

1.17 The locations of the sample squares visited during CS2000 are confidential, by agreement with those who gave permission for access to their land. In any case, precise details of location are not important, because the sample is *statistically representative* of conditions in the countryside. Only urban areas were excluded from the field survey. These were defined as potential sample squares with more than 75% cover of developed land. CS2000 is therefore essentially a study of the rural environment, which includes the countryside around towns, ordinary farmland, areas of special landscapes and the more remote moorlands, mountains and islands.

1.18 The range of information collected in the CS2000 field survey squares is summarised in Figure 1.2. In addition to the information about the extent of each Broad Habitat, and the changes that had occurred by comparison with the 1990 field maps, three other important types of data were collected in the CS2000 sample squares. These related to the vegetation associated with the various habitat types, the soil, and information from rivers and streams.

1.19 Information about the range of *vegetation types* found within each of the sample squares was collected using a series of sample plots. Like the survey squares, these plots were also located at random so that the results would be statistically valid. However, to ensure that the plots gave a representative picture of the range of vegetation types, they were placed according to the major landscape elements in the survey squares. These features included the enclosed areas of fields or woods and unenclosed moorland, as well as field boundaries, streamsides

7 It is possible to make separate estimates for England and Wales using other methods.

Figure 1.2: Data gathered from a CS2000 sample square

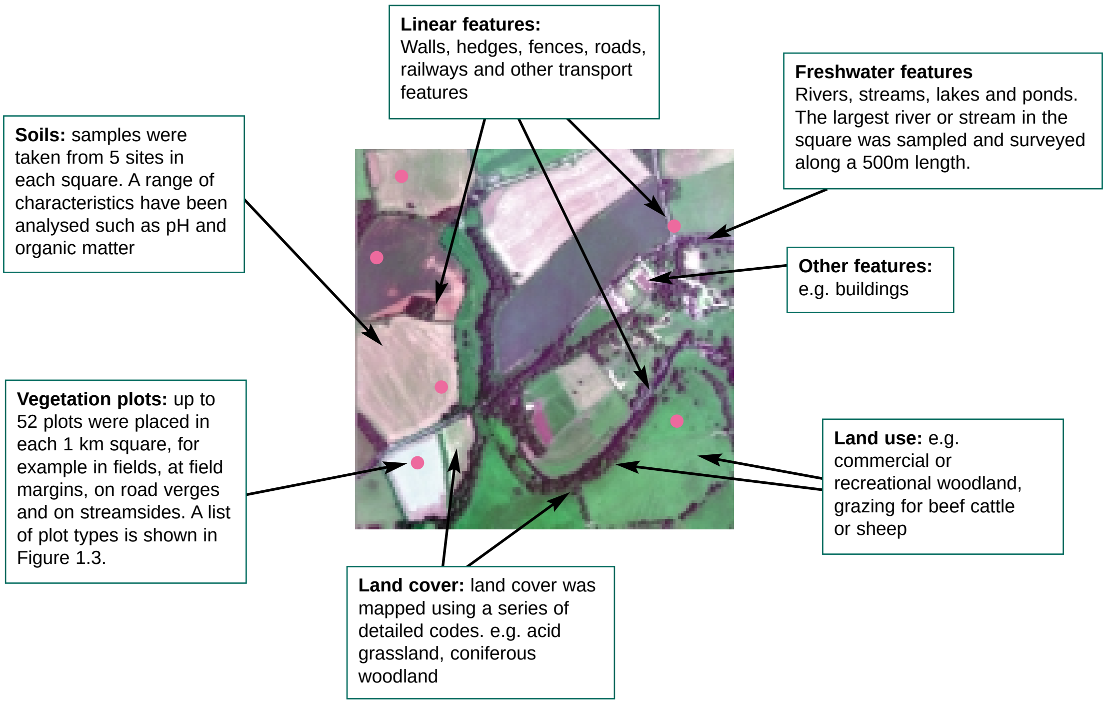
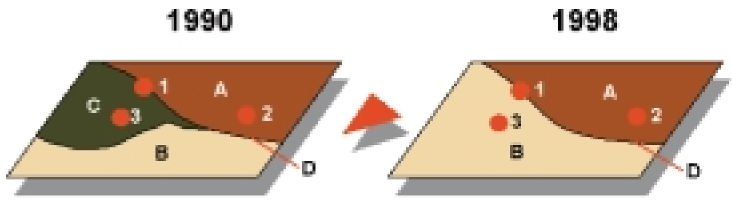


Figure 1.3: Recording detailed changes in plant species composition in a CS2000 sample square.



Land-cover change: Broad Habitat type C is replaced completely by type B. Boundary D remains in position

Vegetation change: Plot 1 measures change in vegetation character of the particular boundary type eg hedge.
Plot 2 measures change in vegetation character of Broad Habitat type A in both 1990 and 1998.
Plot 3 measures change of Broad Habitat type C in 1990 to type B in 1998.

Areas A, B, and C represent mapped units of Broad Habitat such as broadleaved woodland or arable land. D represents a linear feature such as a hedgerow. Points 1 to 3 are the locations of fixed plots in which detailed plant species records were collected in both years. Point 1 represents a linear plot type, for example a hedge (H) plot. Points 2 and 3 represent vegetation plots located at random in fields and unenclosed land away from linear features. These are called X or ‘main’ plots. The figure illustrates how plots were used to characterise the vegetation of Broad Habitats and changes between surveys. A list of the different plot types surveyed in 1998, their size and number in each sample square is given below. A full list of the plant species present in each plot was made on each sampling occasion. This list included common mosses and lichens. Estimates of percentage cover were also made for each species including cover of trees and shrubs shading the plot but not rooted inside.

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

and road verges. The different '*plot types*' used, and the numbers recorded in CS2000 and earlier surveys, are described in Figure 1.3.

1.20 Although some of the vegetation plot types that were sampled in 1998 were new, most had been surveyed in 1990. Some of these also had information first recorded in 1978. These plots, for which repeat data are available, can tell us how the condition of the vegetation associated with the sample squares has changed. In particular, they can give us some insights into changes in the state or condition of the Broad Habitats in which they occur, and therefore help make judgements about changes in their quality.

1.21 Change data are also available for *soils* occurring in the field survey squares. As part of the 1978 Countryside Survey, soil samples were collected next to the vegetation plots that were located in the open, away from any of the boundary features (i.e. the 'main plots', see Figure 1.3). The 1978 field survey was based on a sample of 256 1km x 1km squares, and so for CS2000 the opportunity was taken to resample these areas when the square was revisited. The soil samples collected during CS2000 will eventually allow several key soil characteristics to be studied, including heavy metal concentrations and soil biota. In this report the results from the analysis of soil acidity will be presented.

1.22 The final important type of information collected during the CS2000 field survey relates to *freshwater habitats*. These habitats include rivers and streams, canals, ponds and lakes, and the associated bank-side areas (the 'riparian' zone). For the survey of running waters, a single stream or river was selected from each sample square, and the larger invertebrate species, or macro-invertebrates, were collected. The methods used for sampling and analysis were standard ones that have been applied throughout the UK, so that comparisons can be made with other sources of information. Most importantly, however, the information can be considered in relation to the squares that were first sampled in 1990 so that changes in the biological condition of these aquatic ecosystems can be considered. Altogether about 350 sites were sampled in 1990 and 1998.

Northern Ireland Countryside Survey (NICS)

1.23 The NICS was developed independently from the Countryside Survey in Great Britain, with land cover mapped in 0.5 x 0.5 km grid squares, to take account of the smaller scale of landscape variation in Northern Ireland. The sampling programme was based on the Northern Ireland land classification and a sampling intensity of 1.1% was used to give estimates that could be confidently applied to local areas[8]. Further details are given in Figure 1.4. A detailed presentation of the outputs from NICS2000 will be made in 2001.

Environmental Zones

1.24 In addition to the national and separate country estimates, more detailed geographical breakdowns of the field survey data are possible. In this report information about the major Environmental Zones that make up the UK are provided.

1.25 The Environmental Zones used to present the results of CS2000 are shown in Figure 1.5. Although it is difficult to find simple names to describe them, as this figure shows they cover the range of environmental conditions that we find in the UK from the lowlands of the south and east, through to the uplands and mountains of the north and west. The Zones are based on combinations of the underlying sampling units, or land classes, used for the CS2000 field survey.

8 Cooper, A. (1986). *The Northern Ireland Land Classification.* University of Ulster

Figure 1.4: Structure of the Northern Ireland Countryside Survey

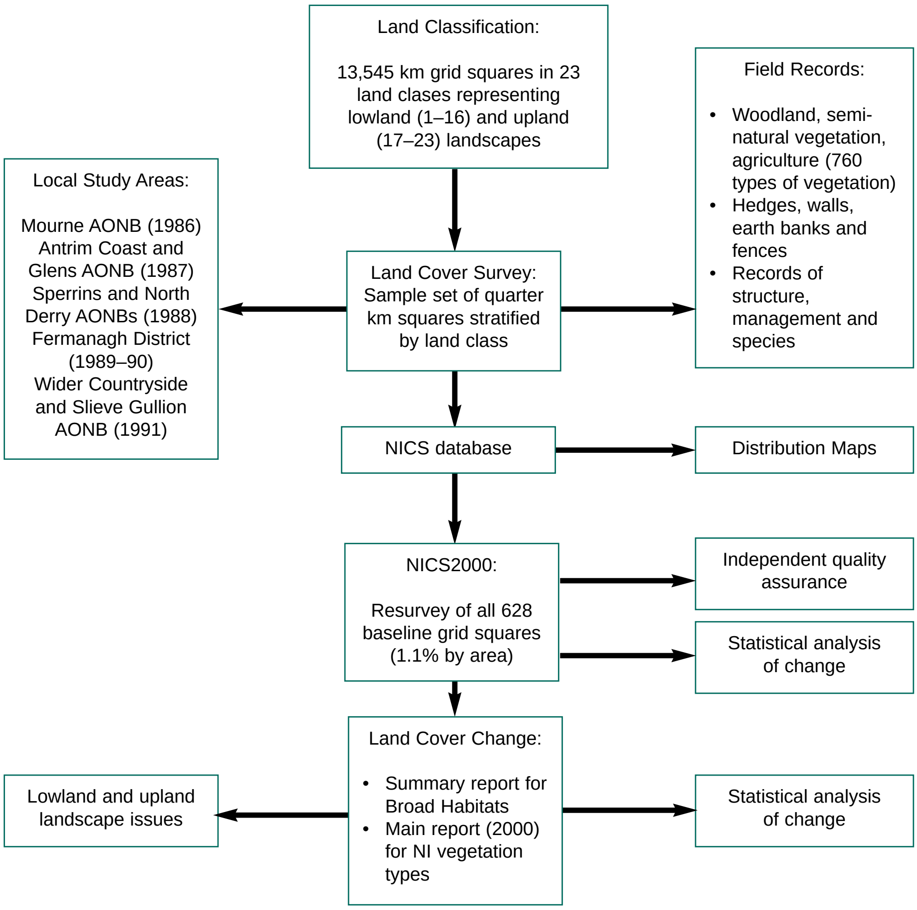
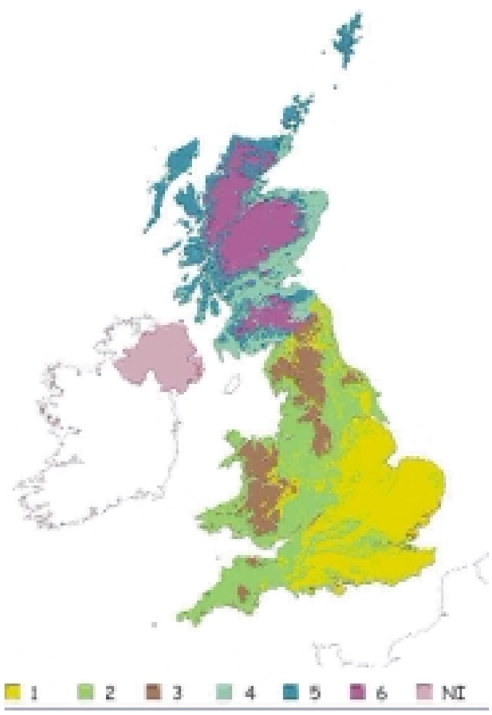


Figure 1.5: Environmental Zones



1. Easterly lowlands (England/ Wales)
2. Westerly lowlands (England/ Wales)
3. Uplands (England/ Wales)
4. Lowlands (Scotland)
5. Intermediate uplands and islands (Scotland)
6. True uplands (Scotland)
7. Northern Ireland

1.26 Northern Ireland has its own set of Environmental Zones that have been devised on a different basis to those used for Great Britain. In this report the Zones have been combined and Northern Ireland treated as a single unit, so as to facilitate presentation at the UK scale.

1.27 Presentation of the results of CS2000 using these Zones is helpful for identifying some of the key geographical contrasts within the UK. However, it is important to note that the information that was collected by the field survey is stored in a very disaggregated way so that different types of report can be made. Results on stock and change of habitats can be calculated for different geographical areas and regions[9]. It is likely that other breakdowns of these data will become available as a result of further work by CEH and the wider science community.

An on-going programme of work

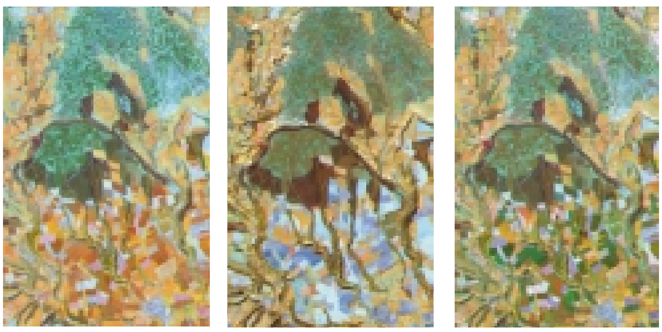
1.28 Although the results of the field survey are an important element of the Countryside Surveys they are part of a much broader programme of work. This report provides an initial look at other important data, for which information and analyses will be published in 2001. One key output will be Land Cover Map 2000 (LCM2000), which is a complete census of the land cover of the UK, based on the analysis of remotely sensed satellite data. Other outputs will include results of the survey of breeding bird populations and details of the soil analysis.

Land Cover Map 2000

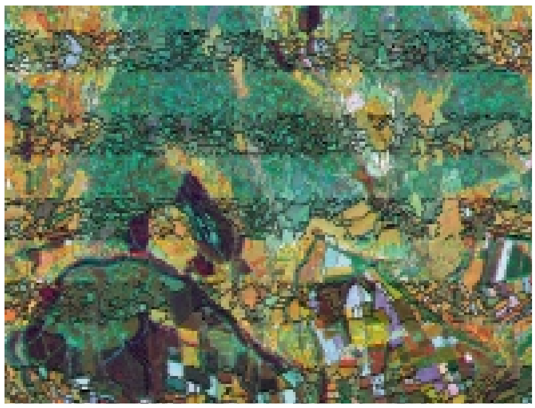
1.29 LCM2000 builds on the experience gained since the first national satellite mapping was undertaken as a demonstration project in 1990. New analytical techniques, based on 'image segmentation', have been developed, and these will provide more accurate mapping than was previously possible (Figure 1.6). The results of

Figure 1.6: Land Cover Map 2000 (LCM2000)

Summer data ... ... plus winter data ... summer/winter composite

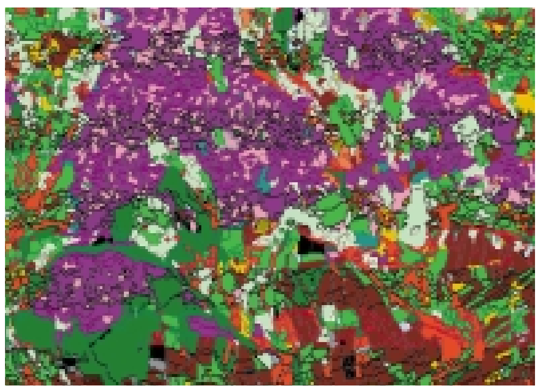


Combining summer and winter satellite data helps to distinguish Broad Habitats – here, in summer, the arable crops (south central) and heathland patterns (to the north) are distinct while, in winter, managed grasslands and belts of deciduous woodland stand out against the bare arable fields (showing blue). Summer/winter images are segmented using geographical information system (GIS) software to build polygons based on spectral uniformity of their image-pixels. The resulting 'vector' dataset represents land parcels with spectral signatures which are diagnostic of Broad Habitats.



The GIS operator identifies representative samples of cover types to 'train' the GIS to 'recognise' the spectral signatures of habitats. This recognition is extrapolated by the GIS to classify all other parcels in the satellite scene. Contextual 'knowledge-based' corrections (e.g. using a soil map to identify acid grasslands) helps to refine the GIS map product.

A wide range of descriptive attributes is attached to each parcel in the GIS:
A unique parcel label
Number of image pixels per parcel
Height, slope, aspect
Terrestrial or maritime context
Acid, neutral or calcareous soil
Peat or non-peat soil
Broad Habitat
Within-parcel habitat mosaics



9 When using the field survey data there is a minimum size limit for these regions, below which the statistical estimates become unreliable. Using data from Land Cover Map 2000, however, stock estimates can be provided at the local scale.

LCM2000 and the field survey will be linked at the level of the BAP Broad Habitats, giving generalised information for the entire UK land surface. The full Land Cover Map will be available in 2001. However, processing for about 75% of the UK has been completed and example outputs are included in this report. These data will be particularly valuable in providing information on the local distribution of habitats on a 'field-by-field' basis. It will also be useful in describing patterns of habitat fragmentation and connectivity in the countryside. The data from LCM2000 will therefore be just as significant as the field survey information itself. The combination of the field survey's detail and LCM2000's overview will allow many new types of analysis to be undertaken.

Survey of breeding birds

1.30 A second important output from CS2000 available during 2001 will be information from the survey of breeding birds recorded in the field survey squares. This work is being undertaken by the British Trust for Ornithology, and uses survey methods similar to those used in the larger, national Breeding Bird Survey. The project started earlier this year and has involved two visits to the survey squares in spring and summer. The results will be particularly valuable in helping us understand how the mosaics and condition of Broad Habitats affects the composition of bird communities. The work provides more detailed information about land cover than is available to interpret data from the Breeding Bird Survey. It will extend the measures of habitat quality available from CS2000 to another important species group. Such work will assist in understanding and forecasting the wider ecological effects of habitat change.

The CS2000 and NICS2000 databases

1.31 The information collected as part of CS2000 and NICS2000 represents a rich resource for those interested in the habitats and landscape features associated with the countryside. In order that the information can be used widely, flexible databases have been created.

1.32 The CS2000 web site[10] provides details of the survey itself, the on-going programme of research, and information about how to obtain CS2000 data. Access to information will be possible in a number of different ways and at several different levels of generalisation. A link to NICS web pages will be available through the CS2000 site. Access to the data for Northern Ireland will be arranged though the Environment and Heritage Service and the University of Ulster.

1.33 At the most general level, national and regional statistics from CS2000 can be downloaded from the web site. This service provides tables, graphical material and map data for the UK, by country and by Environmental Zone, for each of the main themes covered by this report. Technical reports and other documents relating to these will be provided as they become available.

1.34 More detailed data from CS2000 will also be accessible through the Countryside Information System (CIS)[11] (Box 1.2). This provides the capability to map field and satellite land cover data, at the 1km square level, and to derive statistics for any geographical area defined by the user. These include Environmental Zones, landscape character areas, administrative regions, and designated areas such as National Parks, Areas of Outstanding Natural Beauty, Sites of Special Scientific Interest, and

10 www.cs2000.org.uk
11 www.cis-web.org.uk

Environmentally Sensitive Areas. CIS also enables CS2000 data to be combined with other geographic data that can be summarised at the 1km x 1km grid square level. Datasets already available include information from Ordnance Survey, such as altitude, slope, roads, rivers and other specially constructed data sets relating, for example, to soils and climate. A version of the CIS is also available for Northern Ireland.

Box 1.2: The Countryside Information System (CIS)

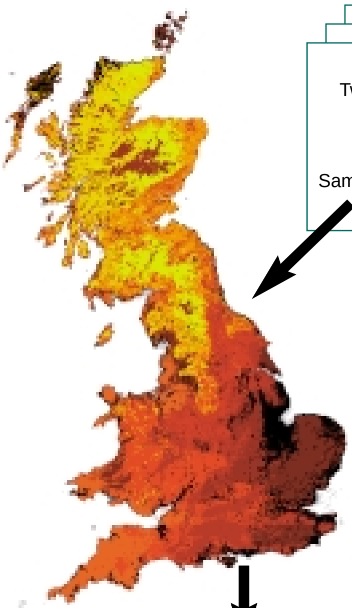
CIS is a Windows 95/NT computer information system that gives users access to Countryside Survey results and other environmental data.

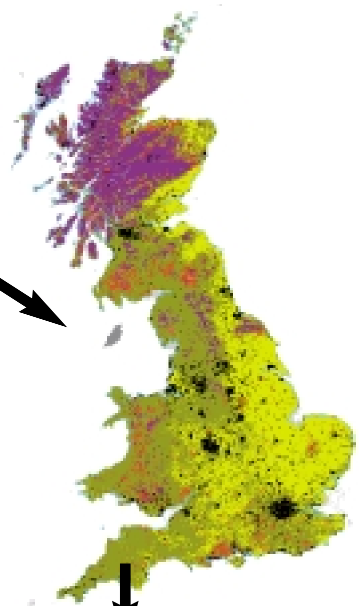
Users define a geographical region about which they require information. The system allows users to generate reports in the form of tables, maps and graphs.

Two types of data are held in the system

Sample data

Census data





Countryside Survey **sample** data that can be used to make statistical estimates for the stock and change of Broad Habitats, and vegetation characteristics in the region of interest.

The estimates are generated using information about the mix of 'land classes' that occur in the selected region. The land classes are the sampling strata used in the field survey. Each of the 1km x 1km grid squares that make up the UK are assigned to a land class, and these data are held on the system. Estimates for regions are produced by selecting the grid squares that fall within it and by using the proportions of different land classes to generate the statistical estimates from the sample data.

Information about a range of environmental characteristics, such as land cover, held as **census**-type data. Information is held for each of the 1km x 1km grid squares that make up the UK. Estimates for regions are produced by selecting the grid squares that fall within them.

The system can hold habitat data from Land Cover Map, and any other environmental data set that can be summarised at the 1km x 1km scale eg. designated areas.

The system holds information about each dataset and how it was collected, and can flag data quality and statistical issues to help users interpret the information. There is also a data catalogue to give users information about what datasets have been converted for use by the CIS. Users can also add their own data to the system and produce customised maps, overlays and data tables. Visit: www.cis-web.org.uk

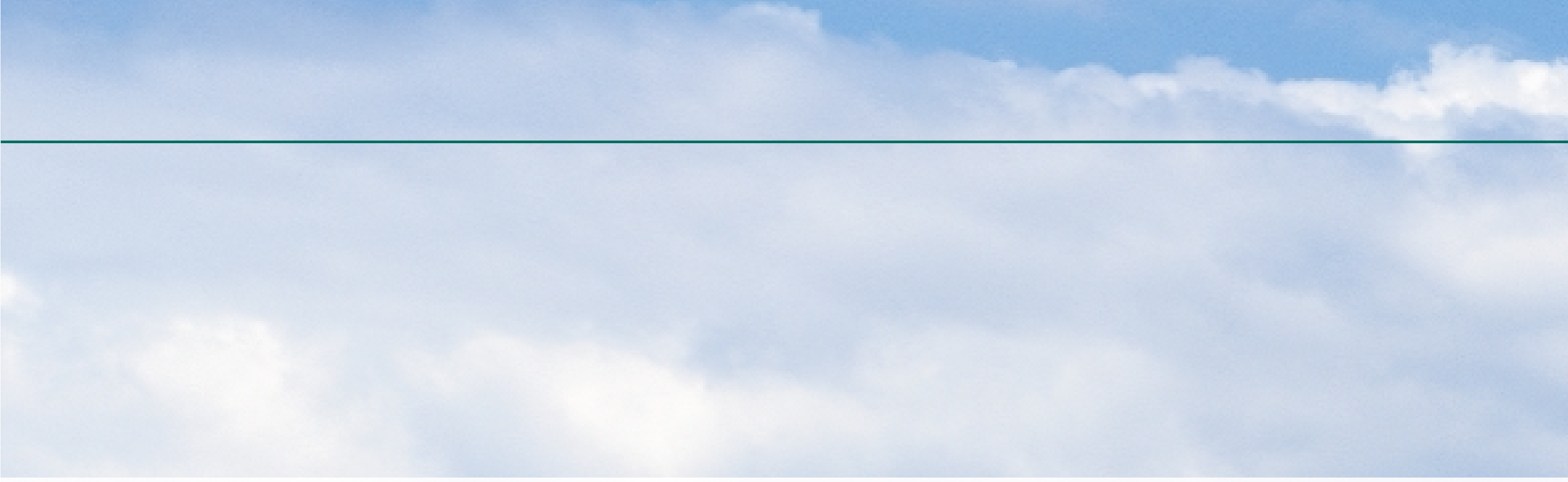
1.35 For most applications, especially those at the national or regional scale, the web site and CIS will be sufficient for the majority of users. In some cases, however, more detailed analyses or data may be necessary, to address complex problems. The *CS2000 Support Service* provided by CEH will help to meet this type of requirement. This Service provides the third way to gain access to CS2000 data.

1.36 The CS2000 Support Service offers the facility for customised analyses of data on behalf of users, or the provision of detailed information for incorporation into a users' own GIS. Information about how to contact the Service is also available on the CS2000 web site.

Taking stock and assessing change

1.37 Chapter 2 of this report provides an overview of the results of CS2000 and NICS2000 at national scales. It also describes some of the scientific tools and methods used to interpret the survey data. In the chapters that follow, the results for the individual BAP Broad Habitats are considered in more detail. The report concludes by considering the key trends that emerge from the study in different parts of the UK and the implications for future scientific work.

1.38 Throughout the report, the field survey results are presented for England and Wales together, Scotland and Northern Ireland. Where appropriate, they have also been aggregated to provide estimates for Great Britain or the UK. Important differences in trends between Environmental Zones are highlighted in the text. The results from Northern Ireland will be presented in more detail in a report to be published in 2001. Data on the distribution of habitats at country, regional and more local levels will be provided by LCM2000, which will also become available in 2001.



The UK is largely an agricultural landscape. The generally intensive agricultural habitats of improved grasslands and arable crops make up nearly half of the land. Broadleaved and coniferous woodlands share, in nearly equal proportions, 12% of the land. Other semi-natural habitats, such as bog, heath and ‘acid’ grassland, make up about a quarter of UK land, a large part of which occurs in Scotland. Built-up areas and other developed land, comprise the remaining 10%.

2 the national picture

2

Introduction

2.1 What can Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 tell us about habitats in the UK countryside and how they have changed over the last decade? This chapter provides a summary of some of the key results at the national level, including updates to two of the national *Quality of Life Counts* (QOLC)[1] indicators. It provides a first look at the results for the Broad Habitats that are used as the framework for the UK's Biodiversity Action Plan (BAP).

2.2 This chapter also introduces some of the methods used to present and analyse the field survey data collected during the CS2000 and NICS2000. In the chapters of the report that follow, a more detailed discussion of the results for each Broad Habitat can be found.

Broad Habitats: UK stock and change

2.3 On the basis of the field surveys undertaken in Great Britain and Northern Ireland, estimates of the area occupied by most of the terrestrial and freshwater Broad Habitats in 1998 can be made. The surveys also provide estimates for the length of linear landscape features and numbers of ponds. These estimates can be compared with data from 1990 surveys in Great Britain and Northern Ireland.

The stock of Broad Habitats

2.4 As the data in Table 2.1 show, the *Improved Grassland* and *Arable and Horticultural* Broad

Table 2.1: Summary of estimated stock (area in '000 ha) of Broad Habitats in the UK in 1998 based on field survey data from Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000. Further details on sampling errors are provided in Chapters 3 to 8.

Broad Habitat	E&W		Scotland		GB		NI		UK	
	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%	'000 ha	%
Improved Grassland	4431	29.1	1051	13.1	5482	23.7	568	41.0	6050	24.7
Arable and Horticultural	4609	30.3	639	8.0	5249	22.7	59	4.3	5307	21.7
Neutral Grassland	444	2.9	168	2.1	613	2.7	254	18.3	867	3.5
Broadleaved, Mixed and Yew Woodland	1171	7.7	300	3.7	1471	6.4	51	3.7	1522	6.2
Coniferous Woodland	380	2.5	993	12.4	1374	5.9	61	4.4	1435	5.9
Bog	180	1.2	2038	25.4	2218	9.6	148	10.7	2367	9.7
Dwarf Shrub Heath	485	3.2	1002	12.5	1487	6.4	13	0.9	1500	6.1
Acid Grassland	547	3.6	748	9.3	1295	5.6	28	2.0	1324	5.4
Fen, Marsh and Swamp	210	1.4	337	4.2	547	2.4	53	3.8	600	2.5
Bracken	273	1.8	166	2.1	439	1.9	4	0.3	443	1.8
Calcareous Grassland	38	0.2	27	0.3	65	0.3	1	0.1	66	0.3
Inland Rock	17	0.1	38	0.5	56	0.2	6	0.4	56	0.3
Montane	1	0.0	48	0.6	49	0.2	n/a	n/a	n/a	n/a
Standing Open Water and Canals	106	0.7	85	1.1	190	0.8	n/a	n/a	n/a	n/a
Rivers and Streams	43	0.3	21	0.3	64	0.3	n/a	n/a	n/a	n/a
Littoral Sediment	136	0.9	2	0.0	138	0.6	n/a	n/a	n/a	n/a
Supralittoral Rock	20	0.1	57	0.7	77	0.3	1	0.1	78	0.3
Supralittoral Sediment	30	0.2	23	0.3	53	0.2	2	0.1	55	0.2
Built-up & Gardens[a]	1180	7.7	151	1.9	1331	5.8	n/a	n/a	n/a	n/a
Boundary and linear features[b]	411	2.7	87	1.1	498	2.2	n/a	n/a	n/a	n/a
Unsurveyed urban land[c]	426	2.8	37	0.1	463	2.0	n/a	n/a	n/a	n/a
Unclassified	93	0.6	2	0.0	95	0.4	143	10.3	n/a	n/a
TOTAL	15230	100	8020	100	23254	100	1385	100.0	24495	100.0

a Figures presented are for *Built-up and Gardens* in rural areas surveyed in CS2000 and NICS2000.

b Figures presented are for transport features (roads, railways, tracks including verges) in rural areas surveyed in CS2000 and NICS2000. Other boundary and linear features are measured by length, not area.

c The CS2000 field survey did not sample areas more that 75% built up.

1 In 1999 the Government published a set of around 150 *'Quality of Life Counts'* indicators. These are intended as a way of assessing progress towards sustainable development in the UK. The Government will be updating these indicators based on new survey information and other data. Two of the indicators – landscape features and plant diversity were derived from Countryside Survey 1990 and new data are now available from CS2000 to update these indicators. Reference: Government Statistical Service (1999) *Quality of Life Counts – Indicators for a strategy for sustainable development: a baseline assessment*, DETR, London. www.environment.detr.gov.uk/sustainable/quality99/index.htm

Habitats are the most widespread in the UK, making up 46% of the land surface area. In England and Wales, these generally intensive agricultural habitats make up 59% of the area, in Northern Ireland 45% and Scotland, only 21%.

2.5 Scotland has a high proportion of our semi-natural habitats. *Bog* is the most extensive Broad Habitat to be found here. Other important semi-natural types include *Acid Grassland, Dwarf Shrub Heath, Fen, Marsh and Swamp*, and *Montane* habitats. Collectively these habitats cover just over half of the land area of Scotland. *Coniferous Woodland* also covers a larger proportion of the land in Scotland than elsewhere in the UK.

2.6 In Northern Ireland, *Improved* and *Neutral Grasslands* make up two thirds of the land cover and a substantial proportion of the UK stock of *Neutral Grassland* is located here.[2] *Neutral Grassland* is less intensively managed than many other agricultural grassland types and includes hay meadows of high conservation value. *Fen, Marsh and Swamp*, and *Bog* are also important landscape elements in Northern Ireland.

2.7 By contrast, England and Wales stand out as having proportionally more *Broadleaved Woodland* and a much higher concentration of developed land. Other semi-natural habitats are only found on 11% of land in England and Wales.

2.8 Coastal (i.e. *Littoral* and *Supralittoral Sediment* and *Rock*), *Montane* and *Inland Rock* Broad Habitats make up less than 2% of the area of the UK and they are not well represented in the CS2000 field sample. For completeness, the estimated areas are given in Table 2.1, but the sampling error means that these estimates are probably unreliable.

Table 2.2: Summary of changes in stock (area in '000 ha) of Broad Habitats in the UK from 1990 to 1998 based on field survey data from Countryside Survey and the Northern Ireland Countryside Survey. '0' indicates an estimated change of less than 500 ha. Statistically significant changes (p<0.05 are shown for England and Wales, Scotland and GB in bold

Broad Habitat	E&W		Scotland		GB		NI		UK	
	'000 ha	%[a]	'000 ha	%[a]	'000 ha	%[a]	'000 ha	%[a]	'000 ha	%[a]
Improved Grassland	-102	-2.3	-1	-0.1	-103	-1.9	141	32.9	37	0.6
Arable and Horticultural	49	1.0	38	6.7	87	1.7	-20	-25.0	67	1.3
Neutral Grassland	38	10.4	-30	-14.8	9	1.6	-118	-31.7	-109	-11.6
Broadleaved, Mixed and Yew Woodland	**42**	**3.9**	**25**	**9.0**	**67**	**4.9**	4	8.5	72	5.1
Coniferous Woodland	-16	-4.2	7	0.7	-9	-0.7	6	11.6	-3	-0.2
Bog	-1	-0.5	-17	-0.9	-19	-0.8	-13	-8.3	-32	-1.3
Dwarf Shrub Heath	0	0.1	**-58**	-5.4	-57	-3.9	-1	-7.6	-59	-3.9
Acid Grassland	**-116**	**-17.1**	-39	-4.9	**-154**	**-10.5**	-2	-8.0	-157	-10.4
Fen, Marsh and Swamp	**43**	**27.1**	**55**	**18.7**	**99**	**21.6**	-12	-18.6	86	16.6
Bracken	24	7.9	4	2.6	28	6.2	0	4.6	28	6.2
Calcareous Grassland	**-9**	**-19.2**	**-5**	**-16.2**	**-15**	**-18.0**	0	-7.2	-15	-17.8
Inland Rock	**-8**	**-28.1**	**15**	**59.4**	7	12.3	n/a	n/a	n/a	n/a
Montane	0	0.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a
Standing Open Water and Canals	1	0.7	1	0.6	1	1.7	n/a	n/a	n/a	n/a
Rivers and Streams	**-1**	**-2.7**	0	0.9	-1	-1.6	n/a	n/a	n/a	n/a
Built-up & Gardens[b]	**57**	**5.3**	3	2.1	**61**	**4.9**	n/a	n/a	n/a	n/a
Boundary and linear features[a]	**-5**	**-1.2**	2	1.8	**-3**	**-0.7**	n/a	n/a	n/a	n/a
Other land[d]	*4*	*1.6*	*-1*	*-0.4*	*4*	*1.1*	n/a	n/a	n/a	n/a

a change as % of 1990 stock.

b Figures presented are for *Built-up and Gardens* in rural areas surveyed in CS2000 and NICS2000.

c Figures presented are for transport features (roads, railways, tracks including verges) in rural areas surveyed in CS2000 and NICS2000. Other boundary and linear features are measured by length, not area.

d Includes small areas of coastal habitats (*Littoral Sediment, Supralittoral Sediment and Rock*), unsurveyed urban land and unclassified.

2 Although careful attention has been given to ensuring comparability with land cover definitions used in CS2000 and NICS2000, minor differences in the field methods make it difficult to compare some types of *Neutral* and *Improved Grasslands*. The Northern Ireland estimates of the *Neutral Grassland* Broad Habitat may include a greater proportion of less intensively managed *Improved Grasslands* than CS2000.

2

2.9 Table 2.2 shows how the stock of each Broad Habitat has changed since 1990 for England and Wales, Scotland and Northern Ireland. The pattern of change varies markedly between the countries, just like the stock distributions noted above.

2.10 In England and Wales, the main, statistically significant[3] changes recorded by CS2000 are the 4% increase in area of the *Broadleaved Woodland* Broad Habitat, the 5% increase in *Built-up* in rural areas and the 17% loss of *Acid Grassland*. *Broadleaved Woodland* showed an even bigger increase of 9% in Scotland, along with a 19% increase in the *Fen, Marsh and Swamp* Broad Habitat. When the results for England, Wales and Scotland are combined, a significant 18% loss of *Calcareous Grassland* is also apparent for Great Britain. Other Broad Habitats showed net losses and gains but these were not all found to be statistically significant at the national level.

2.11 In Northern Ireland there have also been changes between the late 1980s and 1998. There have, for example, been decreases of *Arable and Horticultural* land, losses of *Calcareous Grassland*, and gains in *Broadleaved, Mixed and Yew Woodland* cover. However, the major changes are the reduction in *Neutral Grassland* and the gain in *Improved Grassland*. In 1998, Northern Ireland contained about 30% of all the *Neutral Grassland* of the UK, while in 1990 this figure had been nearly 40%. Given the high conservation status of some hay meadows included in this Broad Habitat, the process of decline deserves investigation.

2.12 When reviewing the data shown in Table 2.2 it is important to note that they represent only the *net changes* in area for each Broad Habitat, that is the change in total stock when all the gains and losses are balanced against each other. When we make an assessment of the significance of change for the countryside, it is just as important to take this turnover of land between 1990 and 1998 into account. The significance of the exchanges of stock between the various Broad Habitats is a particular focus of the later chapters of this report.

TRADITIONAL HAY MEADOW, CO. FERMANAGH *(A STOTT)*

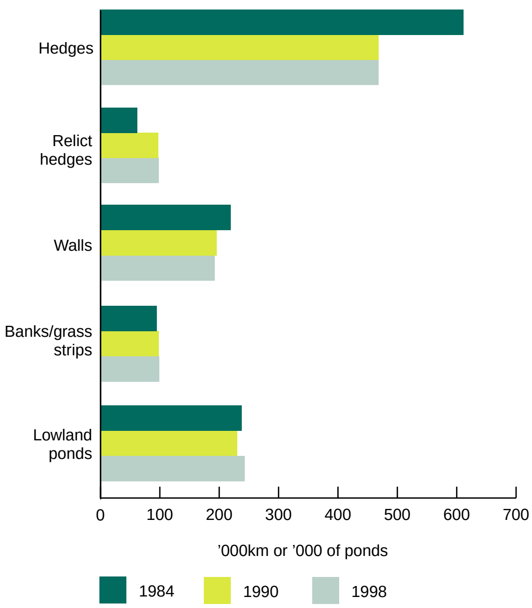
Quality of Life Counts indicator – landscape features

2.13 Linear landscape features and ponds are important habitats for wildlife, particularly in the more intensively managed lowland landscapes of the UK[4]. Figure 2.1 updates the QOLC indicator for landscape features in Great Britain[5]. The indicator includes hedges, relict hedges[6], walls, banks/grass strips and lowland ponds. The data on field boundaries from CS2000 can be

3 The term 'statistically significant' means that the analysis of the data suggests that the difference or change between years is *unlikely* to have come about by chance alone. The difference or change is probably a real one, rather than the product of the sampling process used to collect the data.
4 ETRAC (1998) *The Protection of Field Boundaries*. Environment, Transport and Regional Affairs Committee: Environment Sub-committee, 13th Report. House of Commons, session 1997-98. HMSO: London.
5 Comparable data are not currently available for Northern Ireland.
6 Lines of trees or shrubs originally planted as hedges but without evidence of recent hedge management.

presented in various ways, and in this figure the data have been processed using the same definitions as were used in CS1990 and for the published QOLC indicator[7].

Figure 2.1: Update of the *Quality of Life Counts* indicator for landscape features (S5). Estimated stock ('000 km) of linear features and numbers of lowland ponds ('000) in 1984, 1990 and 1998 in Great Britain.



2.14 The results of CS2000 show that there has been generally little overall change in the length of these landscape features since 1990. Hedges, relict hedges, walls and banks/grass strips show no statistically significant net change in length between 1990 and 1998. This situation contrasts markedly with the period between 1984 and 1990, when 23% of hedges and 10% of walls were lost due to removal or lack of appropriate management. As described in Chapter 4, there is some evidence that hedgerow losses continued in the early 1990s but were reversed by 1998.

2.15 These results for hedgerows may be regarded as an important measure of the success of policies introduced during the 1990s which aimed to encourage hedgerow management, planting and protection. The timing of CS2000 means that the results do not take full account of the effects of the introduction of Hedgerow Regulations in England and Wales, and the recent expansion of agri-environment schemes that should further strengthen the recovery of hedges. Further details about stock and change in linear landscape features are presented in Chapter 4.

2.16 Like the other landscape features shown in Figure 2.1, lowland ponds were also being lost during the 1980s. The results obtained from CS2000 suggest that, over the last decade, the losses have been reversed[8]. Between 1990 and 1998 it is estimated that 24,000 lowland ponds were lost and 37,000 new ponds were created, giving a net increase of 13,000 lowland ponds. Further details on stock and change in freshwater habitats are presented in Chapter 7.

2.17 Overall, the QOLC indicator for landscape features shows that in Great Britain the decline in length of hedges and walls reported for the 1980s has been halted. In the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have been reversed. Lowland ponds show a small net increase. However, in Northern Ireland the stock of hedges and earth banks declined.

Habitat condition: understanding vegetation change

2.18 Information about the stock of the different Broad Habitats is important when making judgements about how the state of the countryside is changing, but these data provide only part of the picture. The extent of a particular habitat may be stable but its 'ecological

7 The estimates of stock of field boundaries and numbers of ponds previously published in QOLC have been revised to take account of the better data quality available from CS2000. The results of interim surveys of hedges in 1993 and lowland ponds in 1996 have been omitted for the purpose of clarity. The details are discussed in Chapters 4 and 7, respectively.

8 A broader definition of ponds was used in CS2000. The data for 1984 and 1990 have been adjusted to correspond with this new definition but the estimates of change for the periods 1984–90 and 1990–98 are not directly comparable.

2

Box 2.1: Measures of vegetation condition used in CS2000

Condition measure	Explanatory notes
Species richness	Species richness per plot (counting only native and consistently identified species). This is a simple and easily understandable measure of plant diversity. However the interpretation is not always straightforward: It can depend on whether the species increasing or decreasing are considered desirable or not.
pH score	An indirect measure of change in soil pH. It reflects changes in the abundance of plants that are known to be associated with different levels of pH based on the Ellenberg value for soil reaction of each species[1,2].
Fertility score	An indirect measure of change in soil fertility. It reflects changes in the abundance of plants that are known to be associated with different levels of nutrient availability based on the Ellenberg value for fertility of each species[1,2].
Soil moisture score	An indirect measure of change in soil wetness. It reflects changes in the abundance of plant species that are known to be associated with degrees of wetness based on the Ellenberg value for soil moisture of each species[1,2].
Light score	An indirect measure of change in light availability at ground level. It reflects changes in the abundance of plants that either tolerate shade or cast shade (e.g. woodland plants) through to weeds found in open, often disturbed situations where there is much less shade. This association is based on the Ellenberg value for light of each species[1,2].
Competitor score	Plant strategy theory predicts that under conditions of high fertility and minimal disturbance, tall perennials well adapted to out-compete other plants for light will eventually dominate plant communities. The resulting vegetation may be species-poor. However woodlands are a good example of a vegetation type dominated by competitors that can be rich in biodiversity. The competitor score is the proportion of competitive species in each plot[3,4,5].
Stress-tolerator score	Stress-tolerant plants are typically well adapted to harsh environmental conditions such as extremes of temperature and shortages of nutrients or light. They are often slow growing and vulnerable to disturbance or increased fertility. This group includes some of the rarest plants in the British flora. The stress-tolerator score is the proportion of such species in each plot[3,4,5].
Ruderal score	Ruderals comprise all those plants often thought of as weeds. Their strategy is one of quick to arrive and quick to go again. They are adapted to take advantage of often short-lived opportunities for growth and reproduction provided by disturbance. As a result they are often small, fast-growing and produce lots of seed. The ruderal score is the proportion of such species in each plot[3,4,5].
Number of bird food plants	The number of plant species in each vegetation plot that are known to be important in the diet of a range of declining farmland birds[4,6].
Number of food plants for butterfly larvae	The number of plant species in each vegetation plot that are known to provide food for butterfly larvae (ie caterpillars). The list of plants includes those that provide food for common as well as scarce butterfly species[4].

1 Hill, M.O., Mountford, J.O., Roy, D.B., Bunce, R.G.H. (1999) *Ellenbergs' indicator values for British plants*. ECOFACT Volume II, Technical Annex: ITE Monkswood, Huntingdon.

2 Ellenberg, H., Weber, H.E., Dull, R., Wirth, V., Werner, W., Paulissen, D. (1991) Zeigerwerte von Pflanzen in Mitteleuropa. *Scripta Geobotanica* 18, 1-248.

3 Thompson, K. (1994) Predicting the fate of temperate species in response to human disturbance and global change. *Biodiversity,Temperate Ecosystems and Global Change* (eds T.J.B. Boyle & C.E.B. Boyle), pp.61-76. Springer-Verlag: Berlin.

4 Smart, S.M, Firbank, L.G., Bunce, R.G.H., Watkins, J.W. (2000) Quantifying changes in abundance of food plants for butterfly larvae and farmland birds. *Journal of Applied Ecology* 37, 398-414.

5 Grime, J.P. (1979) *Plant Strategies and Vegetation Processes*. Wiley and Sons, Chicester.

6 Wilson, J.D., Arroyo, B.E., Clark, S.C. (1996) *The Diet of Bird Species of Lowland Farmland: A Literature Review*. Dept. of the Environment and English Nature: London.

quality' may nevertheless be deteriorating or improving. For example, the abundance of species we normally find associated with a given habitat may be declining as a result of changes in management and environmental conditions, even though the stock of that habitat has not changed. Conversely we may find plant species that are a source of food for farmland birds increasing without a change in area of habitat. As new areas of habitats are created and old ones lost, it is important to know whether the overall condition of habitats is being maintained.

2.19 Questions about changes in habitat quality are more complicated than those about stock, because the concept of **quality** is more difficult to define. As a result of the scientific work that has been undertaken since the time of the last Countryside Survey[9] a number of new analytical tools are available for the analysis of **vegetation condition** in the different types of survey plots recorded by CS2000. A full list, and a summary of what they can tell us about **vegetation condition**, is provided in Box 2.1 (on previous page). These measures can be used to give us some insights into changes in the ecological quality of habitats. They also provide the information for the second QOLC indicator on changes in plant diversity.

Classification of vegetation types

2.20 Following a detailed analysis of the vegetation data collected during Countryside Survey 1990, a classification of the vegetation types commonly found in the countryside has been developed and published as the *Countryside Vegetation System*[10]. The system is based on a statistical analysis of the botanical records, which has created a hierarchical classification of the different vegetation types found in the sample plots.

2.21 The classification of vegetation is made on the basis of the species composition of the sample plots. At the highest level, eight 'aggregate' vegetation types are defined, describing the groupings of plants commonly found in the countryside. The classes are not equivalent to the BAP Broad Habitats. The latter are more general in character and describe larger tracts of land that may contain a range of vegetation communities. For example, an area of the *Broadleaved Woodland* Broad Habitat could contain dense, well-shaded woodland vegetation plus patches of tall grass and herbs along ride edges and infertile grassland in glades. The eight major vegetation types used by CS2000 are described in Table 2.3. They are useful because they allow comparisons within and across Broad Habitats and give us an overview of vegetation found at the national scale.

Table 2.3: Descriptions of the eight major vegetation types of the Countryside Vegetation System (CVS) used in Countryside Survey 2000.

Vegetation type		Description
1	Crops and weeds	Weedy communities of cultivated and disturbed ground, including species-poor arable and horticultural crops.
2	Tall grass and herb	Less intensively managed tall herbaceous vegetation typical of field edges, roadside verges, streamsides and hedge bottoms.
3	Fertile grassland	Improved or semi-improved grassland. Often intensively managed agricultural swards with moderate to high abundance of perennial rye-grass.
4	Infertile grassland	Less-productive, unimproved and often species-rich grasslands in a wide range of wet to dry and acid to basic situations.
5	Lowland wooded	Vegetation dominated by shrubs and trees in neutral or basic situations, generally in lowland Britain. Includes many hedgerows.
6	Upland wooded	Vegetation of broadleaved and conifer woodland often in more acidic situations, generally in upland Britain.
7	Moorland grass mosaics	Extensive, often unenclosed and sheep grazed hill pastures throughout Britain.
8	Heath and bog	Vegetation dominated by heathers. Includes drier heaths as well as bog. Mostly in the uplands.

9 Bunce, R.G.H., Smart, S.M., van de Poll. H.M., Watkins, J.W and Scott, W.A. (1999), *Measuring Change in British Vegetation*, ITE, Merlewood.

10 Bunce, R.G.H. et al. (1999), *Vegetation of the British Countryside – the Countryside Vegetation System*, DETR London.

2

BROADLEAVED WOODLAND BROAD HABITAT, CORNWALL *(ECOSCENE)*

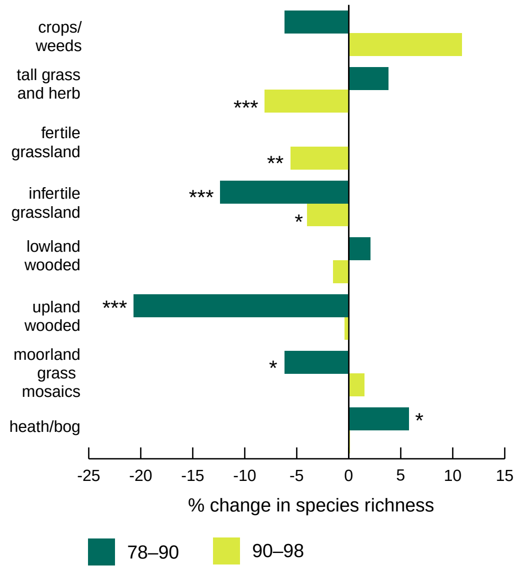
Quality of Life Counts indicator – plant diversity

2.22 A simple measure of vegetation condition is species richness or diversity. This, for the purposes of the report, is the number of plant species found in a sample plot. It is an easily understood and direct assessment of plant diversity in the countryside and can be correlated with diversity in other species groups such as farmland birds and butterflies. By monitoring species richness over time, we can gain some important insights into how the quality of our habitats is changing. The Government's *Quality of Life Counts* indicator of plant diversity is based on the analysis of changes in species richness in the eight major vegetation types described in Table 2.3.

2.23 In the period 1978-90 there were significant declines in species richness recorded in infertile grassland, upland wooded and moorland grass vegetation types. A significant increase was recorded in heath and bog vegetation. These changes were thought to be associated with agricultural intensification, management of field boundaries, afforestation and atmospheric pollution, and are all considered to represent a decline in ecological condition[11].

2.24 An update to the plant diversity indicator is presented in Figure 2.2. Results from CS2000 show that many of the deleterious changes in species richness recorded between 1978 and 1990 have been reduced or even reversed. Significant declines were recorded in tall grass and herb, fertile and infertile grassland vegetation types. The increase in species richness in crops and weeds was not statistically significant, reflecting the high variability in rotational crop management systems. Thus in the 1990s, losses in species richness were generally associated with the vegetation found in managed agricultural grasslands, field boundaries and verges. Upland vegetation types showed greater stability.

Figure 2.2: Update of the *Quality of Life Counts* indicator for plant diversity (S3). This shows the percent change in species-richness in the major vegetation types found in Great Britain for two periods, 1978-90 and 1990-98. For each period of analysis the paired vegetation plots sampled in both years were allocated to the vegetation type present at the earlier date. 1871 paired plots are included in the 1978-90 analysis and 3913 paired plots in the 1990-98 analysis. All the different types of plot originally surveyed in 1978 are included in the analysis (i.e. main (X), hedge (H), streamside (S) and verge (R) plots). Statistically significant changes are marked * P<0.05, ** P<0.01, *** P<0.001.



11 Firbank, L.G., Smart, S.M. van de Poll. H.M., Bunce, R.G.H., Hill, M.O, Howard, D.C., Watkins, J.W and Stark, G.J. (2000), *Causes of Change in British Vegetation*, ITE, Merlewood.

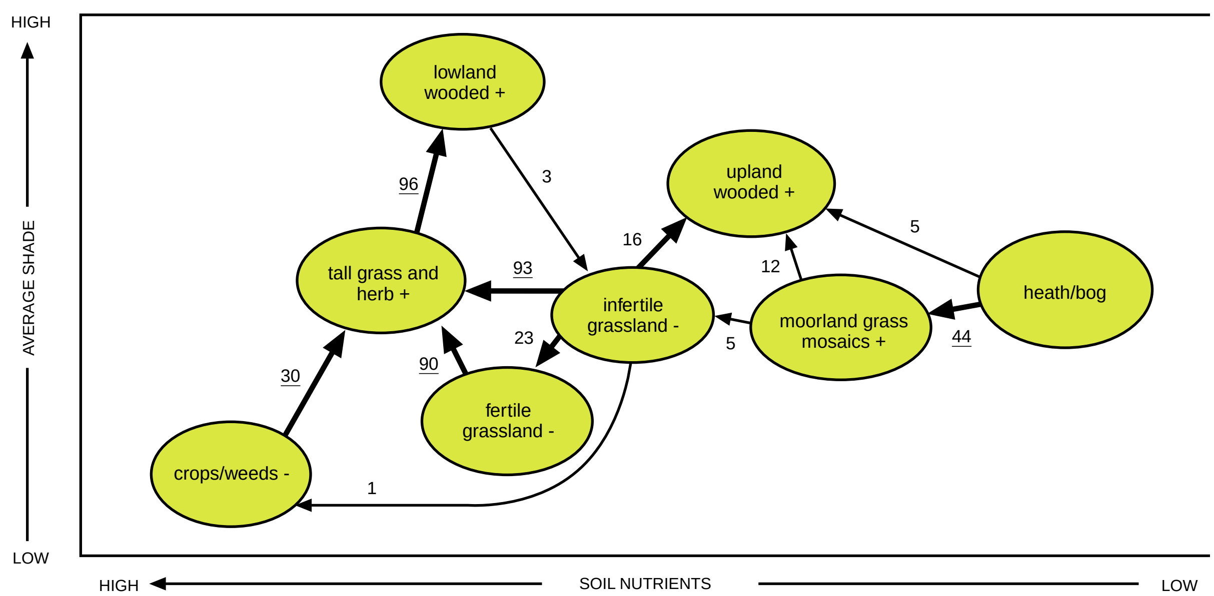
2.25 Changes in species richness have different implications for habitat quality, depending on the situation. It is important to look at which species are being gained or lost, rather than just the overall number. A gain in species number may not necessarily be an improvement if the additional species are not characteristic of the habitat. Thus an increase in species richness within heath and bog as a result of increases in moorland grass species may indicate the bog is drying-out and becoming less favourable for a range of other typical bog species. Conversely, a decline of species number on its own may not necessarily imply that habitats are less able to support a variety of other wildlife. This is why it is important to distinguish between changes in 'condition' and judgements about changes in 'habitat quality'. Further details about changes in vegetation condition for each Broad Habitat are presented in Chapters 3 to 7.

2.26 Overall the indicator shows that changes in plant diversity between 1990 and 1998 are less marked than in the 1980s, and that losses have mostly been associated with the vegetation found in managed agricultural grasslands, field boundaries and verges. Perhaps of greatest concern is the continuing decline in plant diversity in infertile grassland – the vegetation typical of wildflower meadows and species-rich banks and verges.

Other changes in ecological condition

2.27 The relationships between the eight major vegetation types used by CS2000 can be represented in terms of two major environmental gradients – namely nutrient availability and degree of disturbance or shading. Figure 2.3 illustrates how the vegetation types are positioned on these gradients. Thus heath and bog vegetation is at one extreme of low nutrient availability. Highly productive crops and grassland are at another extreme of high nutrient availability and high levels of disturbance. Woodland vegetation appears at the top of diagram where disturbance is low and shading is high.

Figure 2.3: Position of the vegetation types on the two main environmental gradients of soil nutrients and shading. Increasing shade is also correlated with decreasing disturbance. Net transfers of vegetation plots between types, from 1990 to 1998, are indicated by arrows. Significant changes are underlined. Vegetation types that have increased in 1998 are marked with a '+' and those that have decreased are marked with a '-'. The data are for Great Britain.



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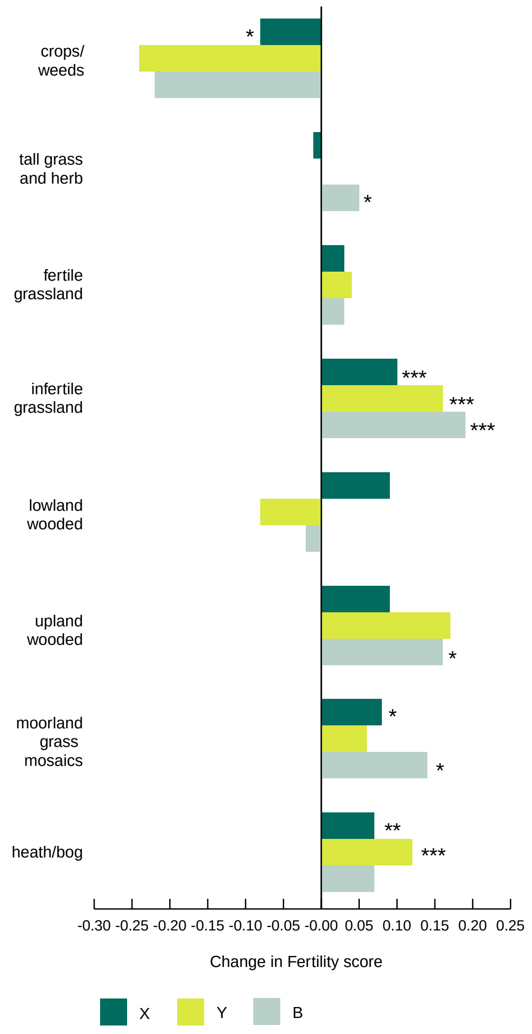
2.28 Figure 2.3 also shows how the sample plots that were allocated to each type in 1990 shifted to another vegetation type by 1998. Two dominant trends can be observed. The first is from right to left; that is from lower to higher levels of nutrient availability, such as from heath and bog to moorland grass. The second is from bottom to top; that is from more disturbed to less disturbed or more shaded situations, such as from tall grass and herb to lowland wooded. Thus there has been an overall tendency for vegetation to become more typical of less disturbed, more shaded and/or nutrient-rich conditions. These trends are a continuation of those detected between 1978 and 1990[12].

2.29 The overall trend in Great Britain towards less disturbed and more nutrient rich conditions is confirmed by the analysis of changes in two of the other condition measures described in Box 2.1.

2.30 Figure 2.4 shows how survey plots that were allocated to the eight vegetation types according to their 1990 vegetation characteristics had changed in terms of their nutrient status according to the 1998 survey. Data for three different types of plots are shown for each of the vegetation types. These are the main 'X' plots, located at random in each sample square, the boundary 'B' plots located on the nearest boundary to each main plot, and the habitat 'Y' plots targeted on the less abundant habitats in each sample square (the other plots – hedge, verge and streamsides – are reported in Chapters 4 and 7). The bars on the chart show the mean change in fertility score for the plots between 1990 and 1998. This is a measure of the nutrient availability or the fertility of the plot as indicated by the plant species present.

Figure 2.4: Changes in the mean Fertility Score for main (X), boundary (B) and targeted plots (Y) in Great Britain 1990-1998. Plots are classified according to the vegetation type in present in 1990. Statistically significant changes are marked * P<0.05, ** P<0.01, *** P<0.001.



2.31 The results shown in Figure 2.4 suggest increasing nutrient availability in five of the eight vegetation types. The largest increases were in the infertile grassland, upland wooded and moorland grass mosaic vegetation types. Only the crops and weeds vegetation type showed evidence of reduced nutrient availability. This may be explained by changes in vegetation in areas of set-aside or grass-ley rotations, or where very species-poor crops were replaced with a larger number of weeds and common grasses.

12 Bunce, R.G.H., Smart, S.M., van de Poll. H.M., Watkins, J.W and Scott, W.A. (1999), *Measuring Change in British Vegetation*, ITE, Merlewood.

No significant changes in the fertility score were detected in fertile grassland or lowland wooded vegetation. Increasing fertility scores provide indirect evidence of increasing nutrient availability in the vegetation; this type of change is often referred to as 'eutrophication'.

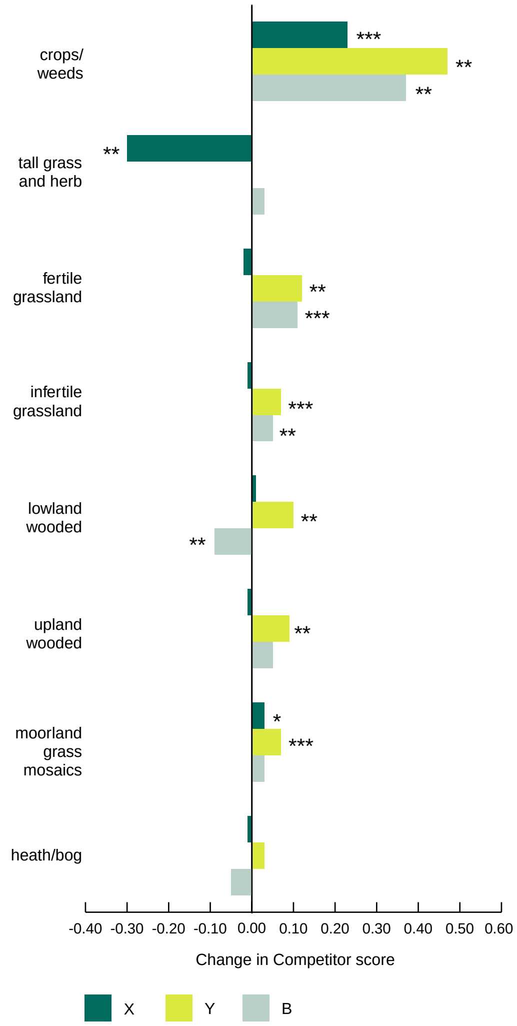
MOORLAND GRASS MOSAIC VEGETATION, PERTHSHIRE *(ECOSCENE)*

2.32 Figure 2.5 uses the same format as that used for the analysis of fertility score, but this time the chart shows changes in the potential intensity of above-ground plant competition in the different vegetation types. Each plant can be scored according to its tendency to out-compete other plants. The vegetation plots can then be given an 'average competitor score' based on the competitor scores for the individual species that occur there.

2.33 Figure 2.5 shows that, in six out of the eight vegetation types, the proportion of competitive species has increased since 1990. Increases in competitor score were concentrated in the targeted habitat 'Y' plots and boundary 'B' plots. These plots are often less affected by the regular management that takes place within fields. Such increases in tall, competitive plant species might be expected, given the general increase in fertility and reduced disturbance observed across all the vegetation classes.

Decreases in competitor score were detected in main 'X' plots in tall grass and herb and boundary 'B' plots in lowland wooded vegetation (i.e. mostly hedges). Such reductions could be associated with the management of set-aside fields and hedges. No changes were detected in heath and bog vegetation.

Figure 2.5: Changes in the mean Competitor Score for main (X), boundary (B) and targeted (Y) plots in Great Britain, 1990-1998. Plots are classified according to the vegetation type present in 1990. Statistically significant changes are marked * P<0.05, ** P<0.01, *** P<0.001.



2.34 The overriding patterns of change in vegetation in Great Britain between 1990 and 1998 can be summarised in terms of two broad trends. First, a widespread tendency for changes in species composition to favour those plants

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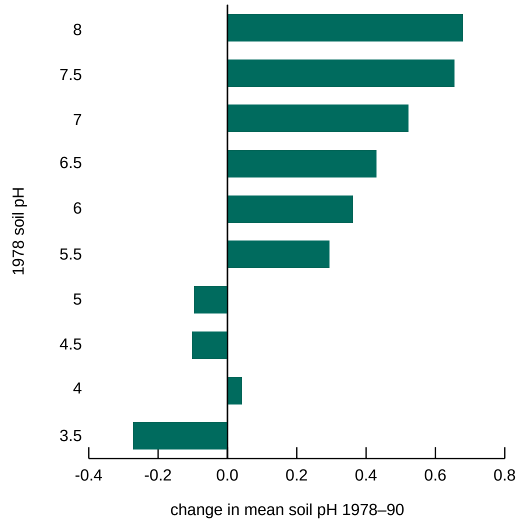
more suited to fertile conditions. Second, a divergence between plots in fields and their boundaries, such that some boundaries tended to become more overgrown and dominated by competitive plants whilst fields were unchanged.

2.35 Condition measures such as those developed for the analysis of CS2000 vegetation data provide information about the prevailing ecological conditions. It is important, however, to back up such analysis with other, more direct measurements of the environment. As described in Chapter 1, soil data were also collected as part of CS2000, and some preliminary results are available.

2.36 Analysis of the information on soil acidity suggests that, since 1978 when the data were last collected, soils have become slightly less acid overall (Figure 2.6). However, the change is most marked for the soils that were most acid in 1978, while neutral and base-rich soils show a slight increase in acidity. Although falling acidity would be in line with the recent success in reducing levels of acid deposition in the environment, the full analysis of soils has not yet been completed and it is too early to draw firm conclusions.

2.37 Although we can infer some of the possible causes of vegetation change from the analysis of CS2000 data alone, it is also necessary to consider the results in relation to other scientific work, so that ideas and hypotheses about the drivers of change can be tested critically. An important issue, for example, is the extent to which the changes in vegetation condition between 1998 and the earlier Countryside Surveys are due to random differences in weather conditions at the time of the survey, changes in land management or global climate change.

Figure 2.6: Changes in mean soil pH between 1978-98. Each bar gives the mean change in pH for soil samples grouped according to their pH in 1978. Soil samples were taken adjacent to the main (X) plots originally surveyed in 1978. There was an overall statistically significant increase in mean pH between 1978 and 1998 ($P<0.05$, $n=573$).



2.38 The possible influence of year-to-year weather variation on CS2000 results has been investigated in a parallel study of vegetation recorded at monitoring sites in the UK Environmental Change Network (ECN). A summary of this work is presented in Box 2.2 (overleaf).

Conclusions

2.39 In this chapter, some of the key national trends that emerge from the analyses of CS2000 and NICS2000 information have been presented. Some of the changes we have seen in Great Britain between 1990 and 1998 differ markedly from those observed prior to 1990.

2.40 In England and Wales, the area of the *Broadleaved Woodland* and *Built-up* Broad Habitats both increased by 4% and 5%, respectively, reflecting policies for woodland planting and the impact of urban growth. Less expected was the 17% decline in the semi-natural *Acid Grassland* Broad Habitat. In

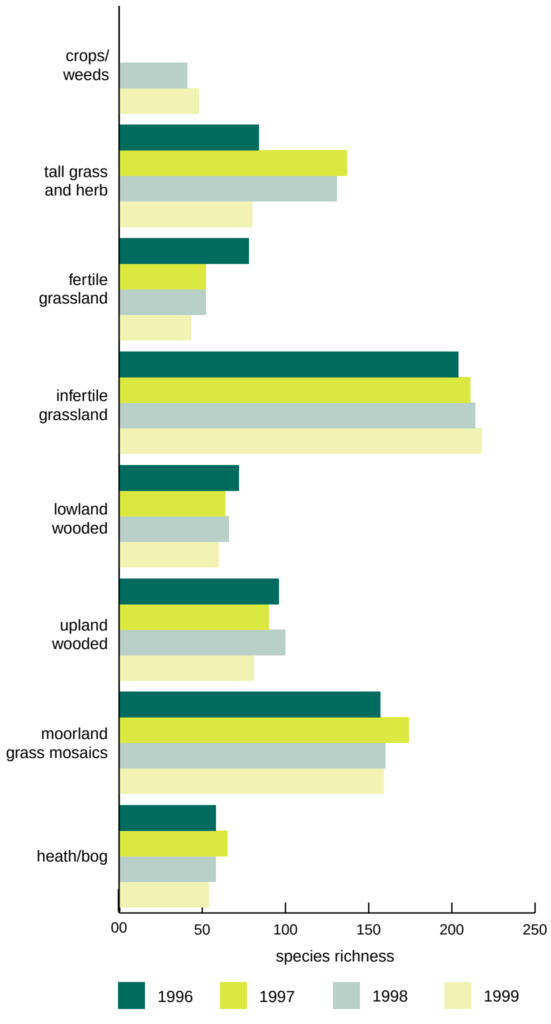
Scotland, *Broadleaved Woodland* showed an even bigger increase of 9%, along with a 19% increase in the semi-natural *Fen, Marsh and Swamp* Broad Habitat. For Great Britain as a whole there was an 18% loss of *Calcareous Grassland*, a habitat of conservation importance.

2.41 In Northern Ireland there have been decreases of the *Arable and Horticultural* and *Calcareous Grassland*, and gains in *Broadleaved Woodland* Broad Habitats. *Improved Grassland* has increased largely by the more intensive agricultural use of formerly *Neutral Grassland*. Given the high conservation status of some hay

Box 2.2: Year-to-year variations in vegetation

A total of 158 vegetation plots were recorded at ten of the Environmental Change Network (ECN) sites, 107 of which had been monitored for at least four consecutive years up to, and including 1999.

The range of vegetation conditions found at the ECN sites is narrower than that recorded in the CS2000 field survey because the sample is much smaller. However, these data are valuable because they help us understand how variable these measures are from year to year, and whether these differences are as large as the changes recorded by successive Countryside Surveys.



Each of the condition measures described in Box 2.1 can be calculated using the data from ECN sites. The largest differences between years were found in species richness (see graph opposite); other condition measures were more stable. As would be expected, the highest variability was seen in arable fields and agricultural grasslands, where weed species can come and go from one year to the next. Some of this variability is likely to have been caused by climatic factors.

Some changes between years reflected longer term trends seen in CS2000. In particular, in infertile grasslands there was a relative increase in species adapted to high nutrient levels between 1997 and 1999, consistent with on-going eutrophication.

Year to year variation cannot by itself account for most of the long-term changes in CS2000 between 1990 and 1998. It is, however, an important issue, on which further work is required over longer time spans. In the context of CS2000, the ECN Study will provide valuable background information that can help with the more detailed interpretation of the results of the Survey.

Visit the ECN web site:www.ecn.ac.uk

2

meadows included in *Neutral Grassland*, the process of decline deserves investigation.

2.42 One of the most significant results of CS2000 concerns landscape features, such as hedges, walls and lowland ponds, used in the Government's *Quality of Life Counts* indicator. Overall, the indicator for landscape features shows that in Great Britain the decline in length of hedges and walls reported for the 1980s has been halted. In the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have been reversed. Lowland ponds show a small net increase. However, in Northern Ireland the stock of hedges and earth banks declined.

RECENTLY PLANTED HEDGE, SOUTH CUMBRIA *(C BARR)*

2.43 The overall analysis of vegetation condition in Great Britain shows very marked trends towards increasing levels of nutrient availability – or eutrophication – and conditions, which favour tall, competitive plants especially on linear features. These trends were evident in the majority of vegetation types and especially in the semi-natural vegetation types important for biodiversity – infertile grassland, upland wooded, moorland grass and heath and bog vegetation. A different trend towards lower nutrient levels and more competitive plants was shown in the vegetation of crops and weeds, perhaps showing the effects of set-aside and arable-ley rotations.

2.44 The Government's *Quality of Life Counts* indicator for plant diversity shows that changes in plant diversity have reduced in magnitude since the 1980s, but during the 1990s losses have been mostly associated with the vegetation found in managed agricultural grasslands, field boundaries and verges. Perhaps of greatest concern is the continuing decline in plant diversity in infertile grassland – the vegetation typical of wildflower meadows and species-rich banks and verges. A more detailed analysis of these changes is presented for each of the Broad Habitats in the Chapters that follow.

Arable and Horticultural and *Improved Grassland* are the most extensive Broad Habitats in the UK. Their stock has changed little between 1990 and 1998. There was some evidence for increasing plant diversity in the *Arable* Broad Habitat, especially in the margins of the fields. In *Improved Grassland* plant diversity declined and nutrient levels may have increased. *Neutral Grassland*, which includes some species-rich hay meadows as well as areas of unmanaged grassland, covers less than 4% of the UK. These grasslands showed losses in stock in Scotland and Northern Ireland but gains in England and Wales.

3

enclosed farmland – arable and horticultural, improved and neutral grasslands

Introduction

3.1 Of all the factors shaping the character of our countryside, agriculture is one of the most important. Much of the farmed landscape, particularly in the enclosed lowlands, is made up of the *Arable and Horticultural, Improved* and *Neutral Grassland* Broad Habitats, which together account for half of the rural land area of the UK.

3.2 Views about the impact of agriculture on our natural heritage have changed during the twentieth century. In the mid 1940s, the ecologist Arthur Tansley argued[1] that the great expansion of agriculture during the war had not diminished the beauty of the countryside but rather that the reverse was true. By the 1960s and 70s, however, with the development of more industrialised and intensive forms of farming, many people felt this image no longer held true. With the advent of the Common Agricultural Policy, they saw agriculture as damaging, rather than creating, the essential character of our countryside.

3.3 Whatever view we take of the impacts of farming, the 1990s was a decade in which the importance of better environmental management in farming had been more widely recognised. There has been, for example, the implementation of a number of agri-environmental schemes, tighter regulations and other policy measures, aimed at maintaining various landscape features and promoting the conservation of biodiversity and historical sites. A wide range of information about environmental best practice is also now available to farmers.

3.4 The BAP objectives for these Broad Habitats are summarised in Box 3.1. Important policy measures that are relevant to the Broad Habitats characteristic of the enclosed farm landscape include the Countryside Stewardship and the Environmentally Sensitive Area (ESA) schemes in England, the Countryside Premium Scheme in Scotland, Tir Cymen and Tir Gofal in Wales, and the ESA and Countryside

Box 3.1: Key objectives and targets for the Broad Habitats associated with enclosed farmland

Broad Habitat	BAP Objectives and Targets
Arable and Horticultural	• Protect arable areas important for wildlife from inappropriate land use or intensification. • Discourage conversion of valuable semi-natural habitats to arable. • Maintain and enhance 15,000 ha of cereal field margins (see Box 3.3).
Improved Grassland	• Protect important sites and enhance value for wildlife. • Re-create semi-natural habitats on areas of improved grassland. • Target development to improved grassland that would otherwise damage more valuable sites. • Encourage environmentally sensitive farming. • Maintain and enhance 300,000 ha of grazing marsh.
Neutral Grassland	• Protect and restore species rich grasslands, and expand remnant patches. • Encourage appropriate management. • Maintain and enhance up to 17,000 ha lowland hay meadows and up to 1,100 ha of upland hay meadows.

1 Tansley, A.G. (1945) *Our heritage of wild nature. A plea for organised nature conservation.* Cambridge University Press, Cambridge.

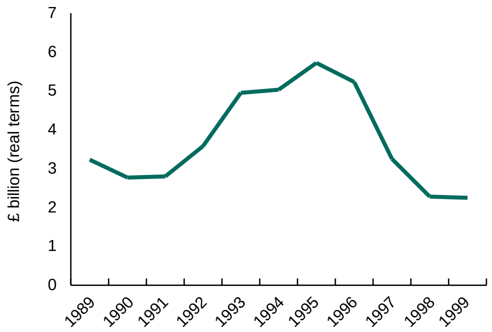
Management schemes in Northern Ireland. Each broadly aims to maintain and enhance the conservation, landscape and historical value of the key environmental features of the countryside.

3.5 Over the last decade the fortunes of farming have changed dramatically. The early years of the 1990s were a period of high profitability. They were followed after about 1996, however, by a deep, on-going recession (Box 3.2). In real terms total farm income doubled between 1990 and 1995, before falling back by over 60% between 1995 and 1999. The early period was one that maintained the 'expansionary trend' that characterised agriculture in the 1980s. The second half of the decade is one in which farmers appear to be seeking strategies for cost reduction, efficiency gains and greater management flexibility.

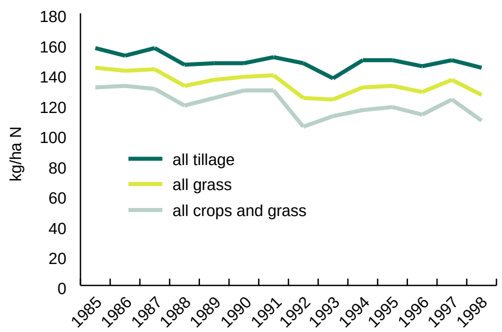
3.6 Agricultural statistics suggest that since 1990 in the more intensively farmed areas, there has been a trend towards fewer, larger farms. Moreover, farms have tended to specialise in terms of the range of agricultural enterprises, while at the same time diversifying their sources of income through other activities such as farm-based tourism, agricultural contracting and off-farm working.

3.7 Box 3.2 shows that there has been a tendency for the rates of nitrogen use to fall towards the end of the decade. The *Survey of British Fertiliser Practice*, reports that current levels are well below the annual rates recorded

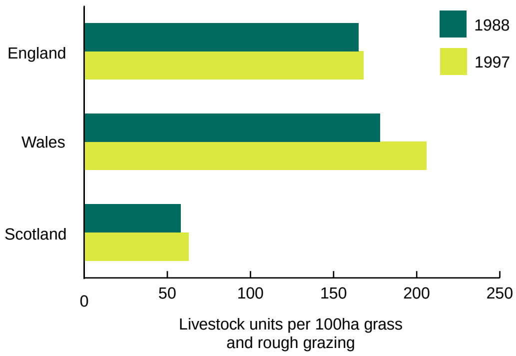
Box 3.2: Some changes in farming during the 1990s



Changing farm incomes. Source: *'Farm Incomes in the United Kingdom, 1998/99'*
web-site: www.maff.gov.uk/esg/pubs/fiuk/fiuk9899/



Changes in nitrogen use in Great Britain.
Source: *The British Survey of Fertiliser Practice 1998*.



Changes in grazing intensity 1988-1997.
A livestock unit is based on the relative metabolic energy requirements of different types of livestock in a yearly period. Livestock numbers have been taken from *MAFF June Census.*

in the mid- to late-1980s, which stood at about 143 kg/ha. Grazing intensity, as measured by the number of livestock units per 100 ha of grass and rough grazing, appears, by contrast, to have increased[2].

3.8 The overall impact of these major economic shifts on the countryside is, however, difficult to determine, and so a range of information is required to support the development of policy. In addition to the design of environmental indicators[3], monitoring programmes have been implemented which aim to measure the success of recent policy initiatives. These include monitoring the Environmentally Sensitive Areas and Countryside Stewardship, and their equivalents in Scotland, Wales and Northern Ireland. Such monitoring provides valuable, but highly specific information about the countryside. With publication of the field survey results of CS2000 and NICS2000, however, a much broader range of information is available, particularly for those areas that lie outside targeted schemes.

3.9 As a result, CS2000 and NICS2000 provide the important contextual information against which the impact and relevance of current policy initiatives directed towards agriculture and the countryside can be judged. This chapter focuses on those Broad Habitats that are characteristic of the more intensively managed fields of enclosed agricultural landscapes.

Characterising the Broad Habitats of enclosed farmland

3.10 The *Arable and Horticultural* Broad Habitat includes the different types of cereal and vegetable crops, together with orchards and more specialised operations such as market gardening and commercial flower growing. Newly ploughed land, fallow areas, set-aside and annual grass leys are also included in this category.

3.11 By contrast, most of the permanent grasslands that occur widely in enclosed landscapes are covered by two other Broad Habitats, namely *Improved* and *Neutral Grassland*. The former occurs on fertile soils and is characterised by swards dominated by fast-growing species such as rye grass (*Lolium* species) and white clover (*Trifolium repens*). These grasslands are used for grazing and silage, and are also sometimes managed for recreational purposes. They are often intensively managed using fertiliser and weed control treatments, and can also be ploughed as part of the normal rotation of arable crops. To be included in this Broad Habitat they must be more than one year old.

INTENSIVELY MANAGED IMPROVED GRASSLAND, OXFORDSHIRE *(C BARR)*

3.12 *Neutral Grassland* includes unimproved and semi-improved grasslands on soils that are neither strongly acid nor lime-rich. Traditionally they are managed as hay meadows and pastures, while some examples are also used for silage.

2 These data relate to both the more intensively managed, enclosed landscapes, and the grasslands and moorlands of the marginal uplands and uplands.

3 See also MAFFs indicators of sustainable agriculture: www.maff.gov.uk/farm/ sustain/pilotind.pdf

They differ from the *Improved Grassland* Broad Habitat 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%. In more intensively farmed lowland landscapes, *Neutral Grassland* often occurs in situations where there is little active management, as fragments of taller and sometimes more herb-rich vegetation found in uncultivated field corners, verges, riparian strips and banks. *Neutral Grassland* may also be found on abandoned land that is awaiting development, derelict land and 'reclaimed' land.

3.13 Appendix A provides a more detailed description of the ways in which these Broad Habitats are defined by the BAP, and they way in which they have been interpreted by CS2000 and NICS2000.

Broad Habitats of enclosed farmland: stock and change

3.14 In the UK, the *Arable and Horticultural*, and *Improved Grassland* Broad Habitats cover about 5.3 and 6.1 million hectares respectively (Table 3.1). Their geographical distributions are, however, very different. In England and Wales, for example, the bulk of the *Arable and Horticultural* Broad Habitat is in the lowlands of the east and south (Environmental Zone 1). By contrast, *Improved Grassland* is more widespread in the lowlands of the west and southwest (Environmental Zone 2). In Scotland both Broad Habitats show their largest area in the lowlands of the south and east (Environmental Zone 4). *Neutral Grassland* is much less extensive than the other two Broad Habitats. It is mainly found in lowland areas (Environmental Zones 1, 2 and 4).

3.15 Within Great Britain, the small net changes observed for *Improved Grassland* and *Arable* mask differences in the patterns of gains and losses across the different Environmental Zones. For example, the losses of *Arable* are mainly concentrated in Zone 1, the lowlands of the east and south. By contrast Zone 2, the pastural lowlands, show gains in area of *Arable*. The losses to *Improved Grassland* occur in all lowland Environmental Zones within Great Britain (Zones 1, 2 and 4). For *Neutral Grassland*, gains were recorded in all Zones except 5 and 6, the 'intermediate uplands and islands' and 'true uplands' of Scotland, where it has declined.

3.16 The landscapes of Northern Ireland are dominated by the *Improved* and *Neutral Grassland* Broad Habitats. *Arable and Horticultural* occupies a smaller area. Agriculture is mainly based on

Table 3.1: Stock and Change of *Arable* and *Horticultural*, Improved and *Neutral Grassland* Broad Habitats ('000ha). Changes which are statistically significant (P<0.05) are indicated in bold.

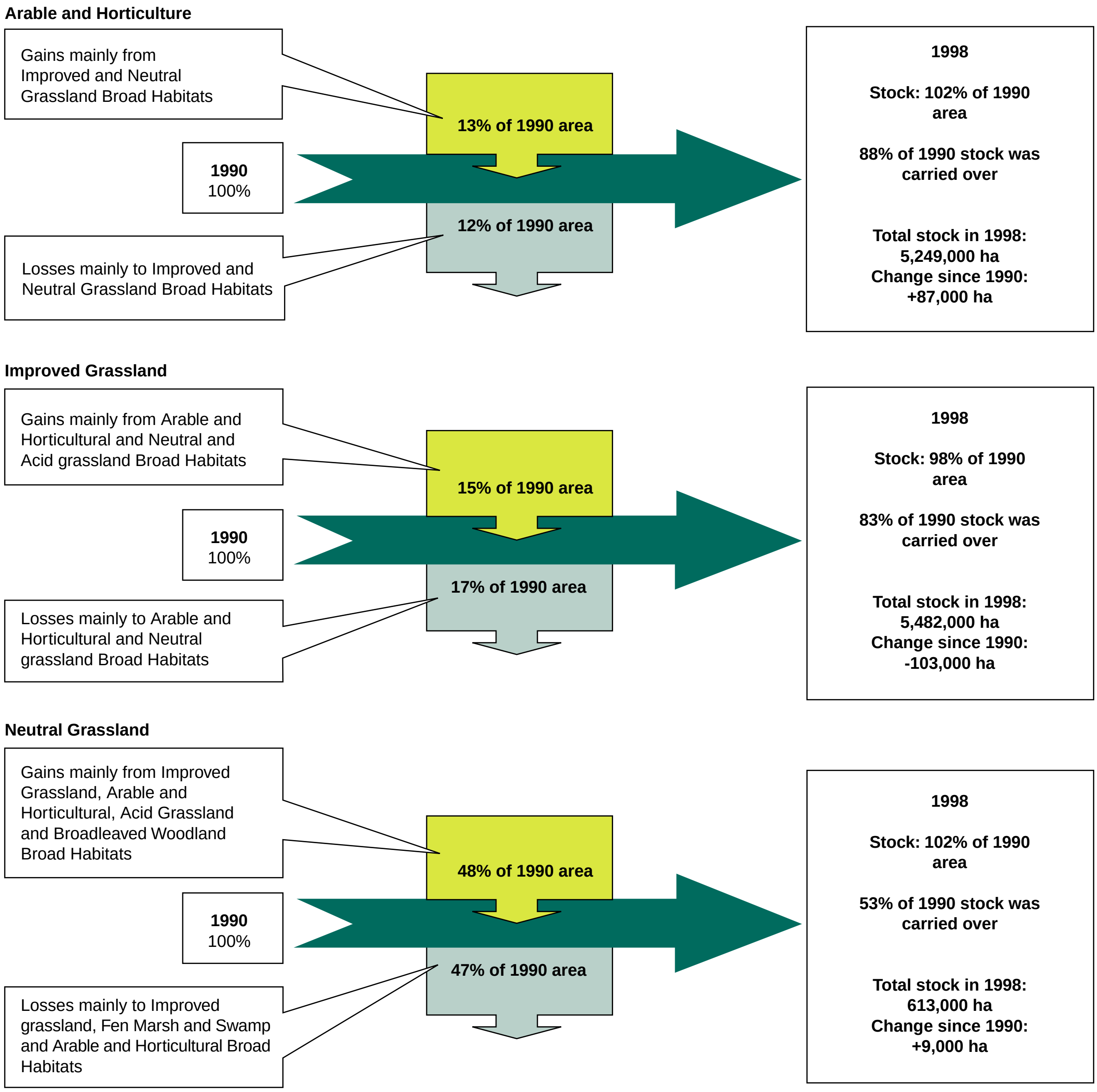
Country	Environmental Zone	Arable and Horticultural			Improved Grassland			Neutral Grassland		
		1998 stock	change 1990–98	% change	1998 stock	change 1990–98	% change	1998 stock	change 1990–98	% change
England & Wales	1	3278	-35	-1	1322	-25	-1.9	185	28	20.4
	2	1277	**86**	7.1	2379	**-119**	-4.8	178	3	1.5
	3	54	-2	-4.4	730	**43**	7	81	8	15.5
	Total	4609	49	1.0	4431	-102	-2.3	444	38	10.4
Scotland	4	536	15	3.1	660	-20	-3	119	(+)	0.8
	5	100	**24**	33.3	299	(+)	0.3	38	**-24**	-38.9
	6	4	(-)	-15.6	92	18	23.1	11	-7	-37.4
	Total	639	38	6.7	1051	-1	-0.1	168	-30	-14.8
NI	Total	59	**-20**	-25.0	568	**141**	32.9	254	**-118**	-31.7
UK	Total	5307	67	1.3	6050	37	0.6	867	-109	-11.6

(+) = value between 0.0 and 0.5 (-) = value between 0.0 and -0.5
% change represents change 1990–98 as a % of 1990 stock.

grassland production. The area of *Arable and Horticultural* has decreased markedly. There has been a large increase in the extent of *Improved Grassland*, mirrored by a decrease in the extent of *Neutral Grassland*.

3.17 An analysis of the exchanges of land between the different Broad Habitats suggests that despite the small net changes recorded, there has been considerable turnover of land associated with each habitat type (Figure 3.1). In the case of the *Arable* and *Improved Grassland* Broad Habitats, for example, about 10% of the 1990 area moved to the other category by 1998. This is to be expected, since the ploughing and re-sowing of grassland is part of the normal arable rotation. The losses of the *Arable* and *Improved Grassland* to the *Broadleaved* and *Built-up* Broad Habitats are also to be expected, given policies to encourage woodland planting (see Chapter 5), and the development pressures that exist in some parts of the UK (see Chapter 8).

Figure 3.1: Flow accounts for *Arable and Horticultural, Improved* and *Neutral Grassland* Broad Habitats in Great Britain, 1990–1998.



3.18 For the *Arable* Broad Habitat in Great Britain, about 27,000 ha were transformed into *Broadleaved Woodland* between 1990 and 1998. This was about twice that lost to development for this Broad Habitat. Although the transfer of *Improved Grassland* to *Broadleaved Woodland* (27,000 ha) was similar to that recorded for *Arable*, the loss of these grasslands to development was, however, much larger (48,000 ha).

3.19 The transfers in and out of *Neutral Grassland* are, perhaps, of more concern than those for the two, more extensive Broad Habitats associated with enclosed farmland because *Neutral Grassland* includes semi-natural grasslands, such as species-rich hay meadows, for which conservation targets have been set. Figure 3.1 shows that in Great Britain, only about 53% of *Neutral Grassland* that existed in 1990 was carried over to 1998. About two fifths of the 1990 stock of *Neutral Grassland* was transformed into *Improved Grassland* and smaller amounts were converted to the *Broadleaved Woodland* and development.

SPECIES-RICH HAY MEADOW, NORTH YORKSHIRE *(DAVID WOODFALL)*

3.20 These results for the transfers between *Neutral* and *Improved Grasslands,* must however, be considered carefully, because it is not always easy to distinguish between these Broad Habitats in the field. This seems to be confirmed by the patterns of exchange in stock between the two grassland types between 1990 and 1998. Although the loss of *Neutral Grassland* to *Improved* is large, a similar size transfer in the opposite direction balances it. In fact, the bulk of the land entering the *Neutral Grassland* Broad Habitat since the time of the last Countryside Survey was from the *Improved Grassland* Broad Habitat. Losses in *Neutral Grassland* tended to occur in Scotland and Northern Ireland and gains occurred in England and Wales. Further analysis is required to investigate the extent to which these changes reflect real shifts in grassland composition.

3.21 However, even if the exchanges between *Improved* and *Neutral Grassland* are discounted, the losses of *Neutral Grassland* to woodland and development are easier to identify. The proportion of *Neutral Grassland* converted to woodland was higher than for *Improved Grassland* suggesting that new woodlands may have been preferentially targeted on less intensively managed grassland types. This pattern deserves closer scrutiny because it seems to conflict with current planting policy, though it may simply reflect that planting is sometimes preceded by temporary cessation of grassland management in advance of woodland planting.

3.22 In Northern Ireland the transfers between *Neutral* and *Improved Grassland*, and *Arable and Horticultural* are large and are probably the result of agricultural rotation. The net increase in the area of *Improved Grassland* is largely accounted for by the decrease in the area of *Neutral Grassland* and the small loss in *Arable*. However, there is some evidence that *Improved* and *Neutral Grasslands* were also lost by development in rural areas.

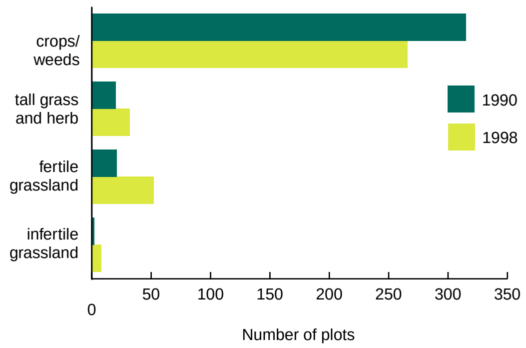
3.23 Further work is required to examine the ecological significance of the large turnover of land observed for the *Neutral Grassland* Broad Habitat. The issue is considered in the next section of this Chapter, which reviews the information from the vegetation plots that were recorded 1990 and 1998.

The condition of the Broad Habitats of enclosed farmlands

Arable and Horticultural

3.24 Although the stock and transfers of land for the *Arable and Horticultural*, *Improved* and *Neutral Grassland* Broad Habitats are important, it is not so much the total areas of these habitats that are significant, but their associated biodiversity. One of the key conclusions to emerge from the 1990 Countryside Survey, for example, was the loss of weed species from arable fields. Since many of these species are important food sources for lowland farmland birds, the loss was considered to be significant ecologically.

Figure 3.2: Changes in the frequency of different vegetation types within the *Arable and Horticultural* Broad Habitat in Great Britain, 1990-98. The chart traces changes in the vegetation types of plots located within the Broad Habitat in 1990.



These data are for plots located randomly within the Broad Habitat (X Plots) in GB. Each plot is assigned to a vegetation class on the basis of its composition at the two survey dates. The same plots were surveyed in 1990 and 1998.

3.25 There is some evidence from the CS2000 results for the *Arable and Horticultural* Broad Habitat that the overall quality of this habitat has stabilised or improved since the time of the last survey. However, not surprisingly for such intensively managed land, the overall species composition of many fields remained much as it was at the start of the decade, and the Broad Habitat was dominated by vegetation characteristic of cropped fields with a limited weed flora (Figure 3.2).

3.26 Changes in vegetation condition were examined using data from vegetation plots containing the crops and weeds vegetation type. As Figure 3.3 shows, species richness increased significantly between 1990 and 1998 in England and Wales for those plots located within arable fields. In the plots located close to the boundaries of fields, significant increases were found for both species richness and the frequency of some plants that are food sources for butterfly larvae. Once again the changes were significant for England and Wales. Too few plots were available for analysis of Scottish data. The plant species that increased in frequency included two common grasses, common bent (*Agrostis capillaris*), which is important for the hedge brown butterfly, and cock's-foot (*Dactylis glomerata*), a food source for the large skipper (Figure 3.4).

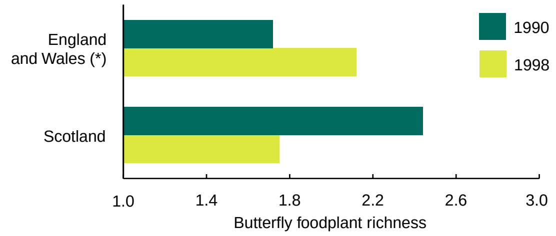
PHOTOGRAPHIC RECORD OF RANDOM 'X' PLOT LOCATION IN AN ARABLE FIELD, SOUTHERN ENGLAND *(C BARR)*

3.27 Although the increase in frequency of plant species that are important for butterflies is beneficial, the analysis of individual species changes showed that other groups of plants,

Figure 3.3: Selected condition indicators for the *Arable and Horticultural* Broad Habitat

Condition measure

Frequency of butterfly food plants in survey plots that were in the arable broad habitat in 1990 and 1998, and which contained the crop and weed vegetation type (**X plots**).

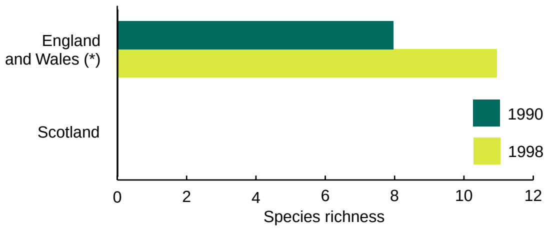


Interpretation and significance

The change for England and Wales is significant, but it is not for Scotland.

The change for England and Wales represents a small but significant **increase** in frequency of butterfly food plants. The mean difference in number was +0.4 and the 95% confidence limits for this change were ±0.37. The analysis was based on 238 sample plots.

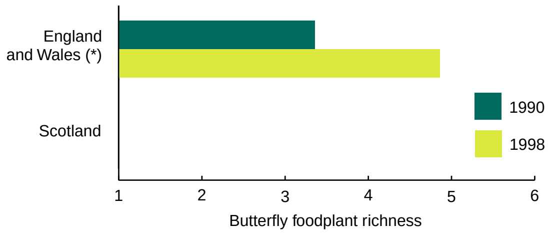
Average number of species (species richness) found in vegetation survey plots on field boundaries (**B plots**) associated with arable fields, and which contained the crop and weed vegetation type in 1990 and 1998.



The change for England and Wales is significant. Too few plots were available for analysis of data from Scotland

The change for England and Wales represents a significant **increase** in richness. The difference was +3.0 and the 95% confidence limits for this change were ±2.84. The analysis is based on 22 sample plots.

Frequency of butterfly food plants found in vegetation survey plots on field boundaries (**B plots**) associated with arable fields, and which contained the crop and weed vegetation type in 1990 and 1998.



The change for England and Wales is significant. Too few plots were available for analysis of data from Scotland

The change for England and Wales represents a small but significant **increase** in the frequency of butterfly food plants in boundary plots associated with the Arable Broad Habitat in England and Wales. The mean difference was +1.5. The 95% confidence limits for the change were ±1.23. The analysis was based on 22 sample plots.

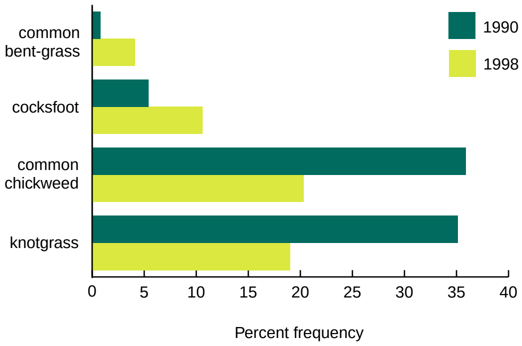
particularly those that are food sources for seed eating birds, have declined. These species included common chickweed (*Stellaria media*) and knotgrass (*Polygonum aviculare* agg.) (Figure 3.4). These are key food plants for declining farmland birds such as skylark and grey partridge[4]. The condition measure for the overall frequency of plants that are important as food sources for birds did not show a significant change in this Broad Habitat.

3.28 Changes in biodiversity around the edges of arable fields are of particular concern within the Biodiversity Action Plan, because it has been recognised that these habitats are important for many of the rare and vulnerable weed species associated with tilled land. So important are these areas that *Cereal Field Margins* are now a BAP Priority Habitat, with a specific target for restoration (Box 3.3).

4 Wilson, J.D., Arroyo, B.E. & Clark, S.C. (1996) *The Diet of Bird Species of Lowland Farmland: A Literature Review*. Department of the Environment and English Nature, London.

3

Figure 3.4: Changes in the frequency of plant species important as butterfly and bird food sources in the *Arable and Horticultural* Broad Habitat in Great Britain, 1990-98. All changes statistically significant at, at least P<0.05. Analyses based on X plots located in the crops/weeds vegetation type in 1990.



3.29 *Cereal Field Margins* were not sampled explicitly as part of the 1990 Countryside Survey. The boundary plots discussed above were always placed in the uncropped areas, and the plots located in the fields were often well away from the field edge, where plants of conservation importance are less likely to be found. To fill this gap, a new type of sample plot was set down during CS2000, which extended 100 m along the cultivated edge of arable fields, and 1 m in towards the field centre.[5]

3.30 Since the cereal field margin plots were recorded for the first time in 1998, no change data are available. They will however be valuable for monitoring future trends. The CS2000 data show that they contained between 5 and 25 species. Several that are of conservation interest were recorded at low frequency, including corn marigold (*Chrysanthemum segetum*). However, no BAP Priority Species were found in this random sample.

Improved and Neutral Grassland

3.31 Analysis of agricultural statistics for the period since the last Countryside Survey suggests that there has been little change in the intensity of grassland management. As noted above (Box 3.2) general levels of fertiliser use have declined since the peak in the late 1980s, although they remain high when these data are viewed in historical terms. However, stocking densities are similar, or are generally a little higher, than they were at the time of the last Countryside Survey. A key question for CS2000 is whether these relatively stable levels of agricultural use have stabilised the vegetation condition as it was in 1990, or whether there have been continuing declines.

3.32 When interpreting the results for these Broad Habitats, it is important to note that each of them is a mosaic of different types of vegetation

Box 3.3: The *Cereal Field Margin* Habitat Action Plan

For the purposes of this Action Plan the term ‘cereal field margin’ refers to strips of land lying between cereal crops and the field boundary, and extending for a limited distance into the crop, which are deliberately managed to create conditions that benefit key farmland species.

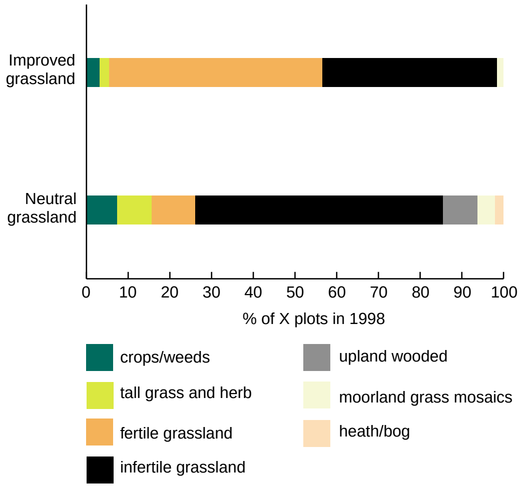
Cereal field margins could provide nesting and feeding sites for game birds and some song-birds. Many species of butterflies, grasshoppers, and plant bugs are associated with such sites. Invertebrates breed in crops, and spend the winter in grassy banks and where crops meet hedges and other features. Even excluding soil invertebrates, micro-organisms and transients, some 2,000 species of invertebrate are commonly found in cereal fields. Even more dependent on cereal field margins are the rare arable flowers.

The BAP target is to maintain, improve and restore by management the biodiversity of some 15,000 ha of cereal field margins in the UK by 2010. Key actions include the introduction of the Arable Stewardship Scheme in England in 1998.

5 These are known as ‘Arable’ or A plots. See Figure 1.3.

(Figure 3.5). Although similar types occur in both, the proportions in which they occur are not the same, because of the different management and environmental conditions within them. The two Broad Habitats could be thought of as representing the two ends of a spectrum of grassland types, ranging from the species poor, nutrient rich *Improved Grassland* at one end to the species rich, more infertile, *Neutral Grassland* at the other.

Figure 3.5: Vegetation composition of random (X) plots in *Improved* and *Neutral Grassland* Broad Habitats in 1998.



3.33 As Figure 3.5 shows, the most common types of vegetation that are found in the *Improved Grassland* Broad Habitat are those characteristic of fertile pastures. Patches of vegetation that are typical of less intensively managed, 'infertile' pastures can be found, but they are not so common. This pattern contrasts markedly with that in *Neutral Grassland*. Here the dominant vegetation type is one typical of infertile pastures and meadows. The frequency of vegetation types typical of more intensively managed, fertile grasslands is greatly reduced.

3.34 An analysis of the mixtures of different vegetation types within the two grasslands, and the way the different components are changing over time, can give an insight into the pressures upon these Broad Habitats (Figure 3.5). In the case of *Improved Grassland*, for example, it appears that the vegetation types characteristic of more nutrient rich situations are fairly stable, but that parcels of less improved grasslands within the Broad Habitat are undergoing nutrient enrichment and are experiencing a loss of species.

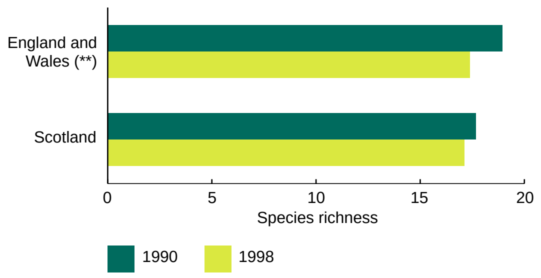
3.35 Figure 3.6 shows how vegetation survey plots that were assigned to the infertile grassland vegetation type in the *Improved Grassland* Broad Habitat in 1990 and 1998 changed in terms of their species richness, fertility score and frequency of plant species important as food sources for butterfly larvae. Significant changes were only found in England and Wales, where a larger sample size reflected the much greater extent of the Broad Habitat compared to Scotland. These data suggest that the more infertile meadows found in the *Improved Grassland* Broad Habitat, may be undergoing nutrient enrichment, and that this change is associated with a general loss of species from the community.

3.36 Part of this loss of biodiversity has arisen from the reduction in frequency of plant species that are food sources for butterflies. These include sheep's fescue (*Festuca ovina*), cock's-foot (*Dactylis glomerata*) and red clover (*Trifolium pratense*). Although more reductions than increases were recorded, some larval food plants did increase, such as rough-stalked meadow grass (*Poa trivialis*), while others remained very scarce but did not change in abundance. These included meadow vetchling (*Lathyrus pratensis*) and bird's-foot trefoil (*Lotus corniculatus*) (Figure 3.7).

3

Figure 3.6: Changes in condition indicators for infertile grassland vegetation within the *Improved Grassland* Broad Habitat, 1990–98.

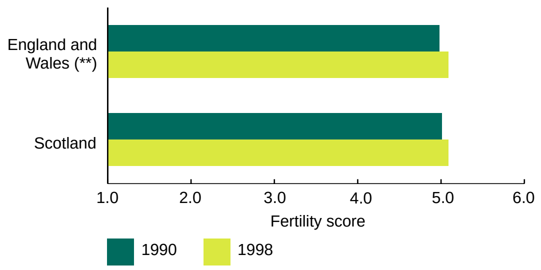
Condition measure	Conclusion and significance
Average number of species (species richness) found in survey plots containing infertile grassland vegetation in 1990 and 1998 (**X plots**).	**The change for England and Wales is significant, but it is not for Scotland.**



The change for England and Wales represents a significant **decrease** in species richness. The mean difference was -1.6 and the 95% confidence limits for the change were ±1.07. The analysis was based on 144 sample plots.

Mean fertility score for vegetation survey plots containing infertile grassland vegetation in 1990 and 1998. (**X plots**)

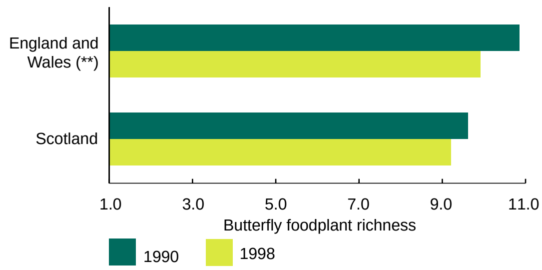
The change for England and Wales is significant, but it is not for Scotland.



The change for England and Wales represents a significant **increase**. The mean difference was +0.1 and the 95% confidence limits for the change were ±0.07. The analysis was based on 144 sample plots.

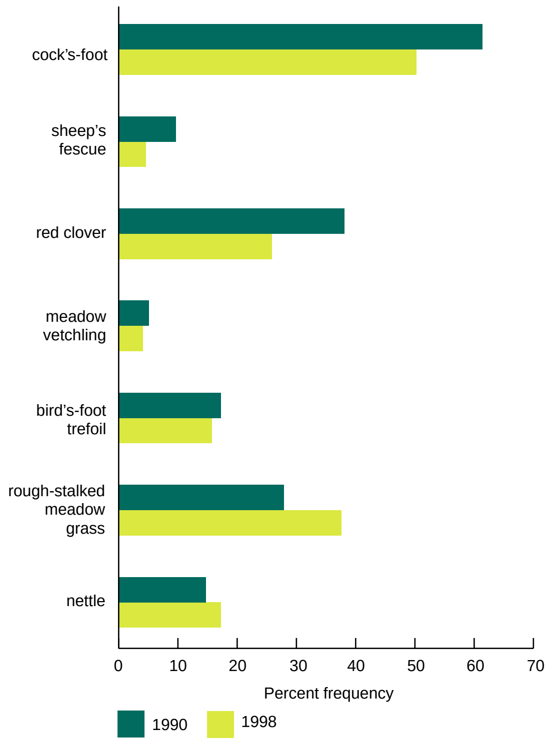
Frequency of butterfly food plants in vegetation survey plots containing infertile grassland vegetation in 1990 and 1998 (**X plots**).

The change for England and Wales is significant, but it is not for Scotland.



The change for England and Wales represents a significant **decrease** in the frequency of butterfly food plants. The mean difference was -0.9 and the 95% confidence limits for the change were ±0.59. The analysis was based on 144 sample plots.

Figure 3.7: Changes in the frequency of plant species that are important food sources for butterfly larvae in the *Improved Grassland* Broad Habitat in Great Britain, 1990-98. Analyses based on X plots in fields in the Broad Habitat containing the infertile grassland vegetation type.



3.37 The data in Figure 3.8 show change in condition measures for the targeted habitat plots containing the infertile grassland vegetation type that remained in the *Neutral Grassland* Broad Habitat throughout the survey period. The targeted habitat plots record conditions in the smaller fragments of the Broad Habitat that are found in the countryside. These locations often occupy less intensively managed meadows, overlooked corners of fields or steep banks. Even so, these situations are important in supporting patches of species-rich *Neutral Grassland*.

3.38 Analysis of the range of condition measures for the targeted habitat plots within the *Neutral Grassland* Broad Habitat showed that fertility levels have increased and species richness has declined. The changes are most marked in England and Wales. Although *Neutral Grassland* in Scotland also showed an increase in mean fertility score in the targeted plots, this change was not statistically significant.

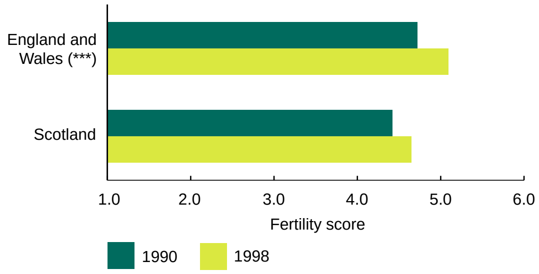
3.39 The frequency of competitive species in the vegetation types associated with this Broad Habitat also appears to have increased, while plants that are more characteristics of nutrient poor conditions ('stress tolerators') have declined (Figure 3.8). Once again the changes are only significant in England and Wales, probably reflecting the larger number of vegetation plots that were sampled.

HORSES GRAZING NEUTRAL GRASSLAND, GLOUCESTERSHIRE *(A STOTT)*

Figure 3.8: Changes in condition indicators for infertile grassland vegetation types within the *Neutral Grassland* Broad Habitat, 1990-98.

Condition measure

Mean fertility score for targeted vegetation survey plots that contained vegetation typical of more infertile grasslands in 1990 and 1998 (**Y plots**)

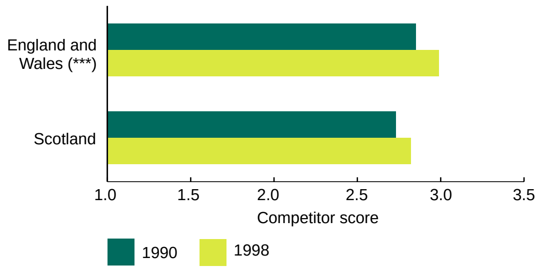


Conclusion and significance

The change is significant for England and Wales but not for Scotland.

The change for England and Wales represents a highly significant **increase** in fertility score. The mean difference was +0.4 and the 95% confidence limits for the change were ±0.14. The analysis was based on 62 sample plots.

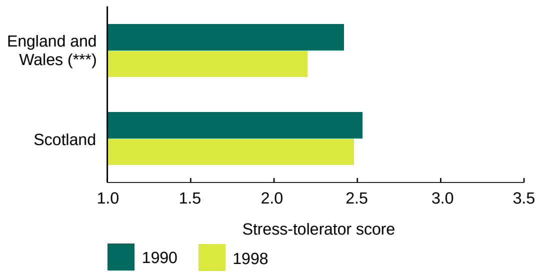
Frequency of competitive species for targeted vegetation survey plots that contained vegetation typical of more infertile grasslands in 1990 and 1998 (**Y plots**).



The change is significant for England and Wales, but not Scotland.

The change for England and Wales represents a highly significant **increase** in the frequency of competitive species. The mean difference was +0.1 and the 95% confidence limits for the change were ±0.09. The analysis was based on 62 sample plots.

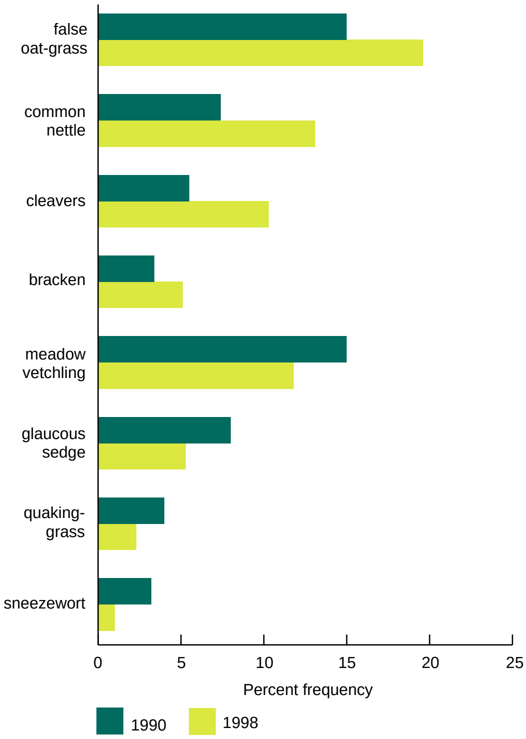
Frequency of stress tolerant species for targeted vegetation survey plots that contained vegetation typical of more infertile grasslands in 1990 and 1998 (**Y plots**).



The change is significant for England and Wales, but not Scotland.

The change for England and Wales represents a highly significant **decrease** in the frequency of stress tolerant species for England and Wales. The mean difference was –0.2 and the 95% confidence limits for the change were ±0.08. The analysis was based on 62 sample plots.

Figure 3.9: Changes in frequency of species within targeted habitat (Y) plots containing infertile grassland vegetation in Great Britain 1990–98. All changes were statistically significant at, at least P<0.05.



3.40 Figure 3.9 shows how these changes are reflected at the level of individual species. For Great Britain as a whole there was, for example, an increase in more vigorous, competitive species, such as false oat-grass (*Arrhenatherum elatius*), common nettle (*Urtica dioica*), cleavers (*Galium aparine*) and bracken (*Pteridium aquilinum*), together with declines in a range of smaller, less competitive plants such as meadow vetchling (*Lathyrus pratensis*), glaucous sedge (*Carex flacca*) quaking-grass (*Briza media*), sneezewort (*Achillea ptarmica*). The decline in frequency of these species suggests an erosion of the floristic diversity of the less improved examples of grasslands within this Broad Habitat.

Conclusions and implications

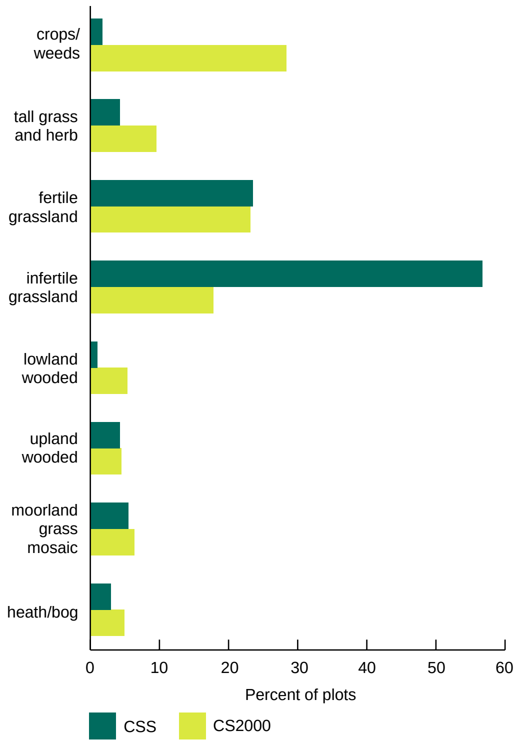
3.41 The changes between Broad Habitats and assessment of vegetation condition provide complementary information about changes in enclosed farmland habitats. The overall extent of the *Arable* and *Improved Grassland* Broad Habitats, which are the most extensive habitats in the UK, changed little between 1990 and 1998. Small proportions were converted to woodland or developed land. There was some evidence for increasing plant diversity in the *Arable* Broad Habitat, especially in the margins of the fields. These changes may reflect rotations between crops and sown leys, as well as managed set-aside and creation of uncultivated headlands and field corners. In *Improved Grassland,* plant diversity tended to decline and nutrient levels increased.

3.42 *Neutral Grassland*, which includes some species-rich hay meadows as well as areas of unmanaged grassland, represents only 7% of the area of enclosed farmland. These grasslands showed large fluxes with losses in Scotland and Northern Ireland but gains in England and Wales. Overall 13% of *Neutral Grassland* was converted to the *Arable, Broadleaved* or *Built-up* Broad Habitats. The floristic character altered with increases in tall, competitive plants at the expense of more typical meadow plants.

3.43 Given the continuing high intensity and specialisation of agricultural production in the UK countryside, it is perhaps not surprising that enclosed farmland habitats, particularly grasslands, have continued to decline in diversity and value as wildlife habitats. The analysis suggests that whilst little change may have taken place on already highly intensive agricultural land there has been a steady loss of the surviving parcels of less improved grasslands, especially in Scotland and Northern Ireland. These changes are synchronous with the declining frequency of typical meadow flowers and grasses and increasing levels of fertility in England and Wales. The botanical trends deserve more detailed analysis to determine their significance for other species groups, such as farmland birds, for which BAP targets have been set, and to assess the causes of the changes.

3.44 Results of CS2000 and NICS2000 for the general countryside cannot provide direct evidence about the effects of particular targeted agri-environment schemes. However, as Figure 3.10 shows, grasslands that are covered by the Countryside Stewardship Scheme in England are of better 'average quality' than those found in the wider countryside. Thus these policy measures do appear to have been directed towards conserving the more important elements of our ecological capital.

Figure 3.10: Frequency of different vegetation types in areas covered by the Countryside Stewardship Scheme (CSS) compared with land across England as surveyed by CS2000.



The CSS plots were sampled at random in 1998. CS2000 frequencies are from all main (x) plots in England in 1998.

3.45 Nor can the results be used directly to assess progress towards BAP targets for Priority Habitats. The *Grazing Marsh* and *Hay Meadow* Priority Habitats are localised in occurrence and are not well represented in the sample surveys. However, new plots established in 1998 in arable fields will provide a baseline for assessing future changes in the *Cereal Field Margins* Priority Habitat.

3.46 The extent to which agri-environment schemes are adequate, in terms of maintaining and improving the overall quality of the farmed landscape, cannot be determined here. Such issues will be an important focus for future research and more detailed analysis of CS2000 and NICS2000 data. The value of the Countryside Surveys is that they provide an unbiased view of large-scale vegetation change that can be used to evaluate local trends.

The *Boundary and Linear Features* Broad Habitat includes linear landscape features such as hedges, walls, banks and lines of trees. There are an estimated 1.8 million kilometres of Linear Landscape Features in the UK. In England, Wales and Northern Ireland, hedges and other woody features are the dominant field boundary type, whereas, in Scotland fences are more widespread.
The declines in length of hedges and walls reported for the 1980s have been halted.

4 boundary and linear features

4

Introduction

4.1 When results of the last Countryside Survey were published, one of the most notable findings was a loss of field boundaries. Between 1984 and 1990, it was estimated that the length of hedges declined by about 23% and the length of walls by about 10% in Great Britain[1].

4.2 The loss of these *Boundary and Linear Features* is serious because they contribute much to the overall character of the countryside. As we have seen in Chapter 2 they are used as one of the Government's *Quality of Life Counts* indicators. Together with road and railway verges, hedges and walls have considerable ecological value as habitats for plants and animals. They can also serve as corridors for movement and dispersal for some species. They thus provide vital connections between the many other habitats that make up the countryside, and by so doing help to maintain biodiversity. In many locations *Boundary and Linear Features* are an essential component of the landscape both in terms of overall visual appearance and as a record of the historical use and partitioning of the land.

4.3 As a result of the losses of hedges and walls observed up to 1990, a number of steps have been taken to reverse or slow the pace of change (Box 4.1). For example, a range of grant schemes has been introduced to encourage, amongst other things, the creation and restoration of hedgerows and walls. Statutory controls have been placed on removal of important hedgerows in England and Wales, to protect those hedges of ecological, historical and landscape value. Greater awareness has developed amongst both farmers and the wider community of the importance of hedgerows, and the need to conserve them. At the same time, as noted in Chapter 3, there has been a downturn in the profitability of farming, which may also have reduced pressures for land improvement and the removal of boundaries. However, boundaries are also at risk from reduced labour inputs resulting in less frequent or less expert management of boundaries. The results from CS2000 will make a contribution to assessing the overall impact of these changes in policy and farm businesses on field boundaries. However, it should be noted that the survey results reported here for the period 1990-98 cannot be used to assess the recent effects of the introduction of Hedgerow Regulations or increases in funding for agri-environment schemes.

Box 4.1: Key elements of recent policy towards hedges and walls in the UK

Since the late 1980s grant schemes have been introduced across the UK to encourage the creation and restoration of hedges, walls and other boundary features. The active management and conservation of these features has been supported by free conservation advice and guidance on good practice based on the latest research. The England Rural Development Programme provides for a major increase in spending on these schemes over the 7-year programme starting in 2000.

Ancient and/or species-rich hedgerows were included as a Priority Habitat in the UK Biodiversity Action Plan in 1995. The targets are to halt the loss of all such hedgerows by 2005; achieve favourable management of 50% of these hedges by the same date; and maintain overall numbers of hedgerow trees.

Important hedgerows in England and Wales were given statutory protection under the Hedgerow Regulations in 1997.

1 Barr, C.J., Bunce, R.G.H., Clarke, R.T., Furse, M.T., Gillespie, M.K., Groom, G.B., Hallam, C.J., Hornung, M., Howard, D.C. and Ness, M.J. (1993), *Countryside Survey 1990,* Main Report, DOE London.

Reporting the Boundary and Linear Features Broad Habitat

4.4 The Biodiversity Action Plan Broad Habitat for *Boundary and Linear Features* includes a wide range of elements (Appendix A). On the one hand it takes in hedgerows, lines of trees (whether they are part of a hedgerow or not), walls, stone or earth banks, grass strips and dry ditches. On the other, it includes some of the built elements of the rural landscape such as roads, tracks and railways. The narrow semi-natural strips of vegetation along verges or cuttings that are associated with them are also part of this Broad Habitat. As a result, the reporting of the stock and condition of this Broad Habitat is complex.

HEDGE BANKS WITH GORSE, CO. DOWN *(DAVID WOODFALL)*

4.5 In this report, information about the different elements of the *Boundary and Linear Feature* Broad Habitat has been split between two chapters. This chapter focuses on what will be called *Linear Landscape Features*, whose stock is best assessed in terms of their length, namely: hedges, walls, banks, lines of trees, and grass strips. Other linear features in the countryside, such as roads and tracks, whose stock is measured in terms of their area, will be considered in Chapter 8, as part of developed land in rural areas. However, the condition of vegetation plots associated with hedges and roadside verges will be considered in this Chapter.

4.6 *Linear Landscape Features* pose special problems for surveying and recording. Not only do they generally occur as continuous networks, rather than as discrete habitat patches, but also their character can be highly variable. They can be found singly or in combinations forming multi-element features.

4.7 Hedges, for example, may comprise anything from single-species hedges of recent origin, to ancient hedges with high species diversity. They may form complex and continuous networks, or occur as disconnected remnants; they may range from little more than low tangles of vegetation, to lines of trees. Walls, equally, may vary from well-kept traditional dry stone walls, to derelict

Table 4.1: Definition of *Linear Landscape* Features used within CS2000

Feature	Description
Hedge	A more or less continuous line of woody vegetation that has been subject to a regime of cutting in order to maintain a regular shape. This category includes both recently-managed and other hedges, including hedges with walls or fences.
Remnant Hedge	A woody field boundary feature with a residual hedge structure but without evidence of recent hedge management, with or without a fence.
Wall	A built structure of natural stone or manufactured blocks, mostly of traditional dry stone wall construction but including mortared walls. Includes walls with fences and lines of trees or shrubs.
Line of trees/shrubs and relict hedge and fence	Line of trees or shrubs, including those originally planted as hedges but lacking any significant hedge structure and with a fence forming a field boundary.
Line of trees/shrubs and relict hedge	Line of trees or shrubs, including those originally planted as hedges, but lacking any significant hedge structure or a fence. Includes avenues of trees. Not an effective stockproof field boundary.
Bank/grass strip	An earth or stone-faced bank with or without a fence. A grass strip without a fence.
Fence	A permanent post and wire or rail structure, including wooden, concrete or metal posts without any other associated feature other than a grass strip, ditch or stream.

features that are little more than piles of stones made stock proof with a fence, through to new brick-built or concrete walls.

4.8 During the CS2000 field survey, information about these *Linear Landscape Features* was recorded as a series of detailed codes. These allow the results to be reported in various ways depending on how the codes are combined. For the purposes of reporting the results of CS2000, a hierarchical system of classes has been devised. In this report information will be presented for the most general level, which includes seven major types of feature (see Table 4.1). The important point to note about the way in which the classes are defined is that when reporting the stock of these features there is no 'double counting' of multi-element features. As shown in Table 4.1, a hedge is any feature that contains a hedge element. It can be beside a wall and/or a fence. However, the estimates for the stock of walls and fences does not include the length of walls and fences that are found with a hedge. The hierarchy was defined in this order because it is was considered that hedges are more important ecologically than the other elements and that remnant hedges and walls are more significant than banks or fences.

4.9 When using the results of CS2000 it should be noted that the sampling methods and some definitions were different to the last Countryside Survey and other surveys of hedges carried out in the intervening period[2]. In particular, features previously called 'relict hedges' are now divided into three categories – remnant hedges and lines of trees and shrubs with and without fences. Remnant hedges are differentiated from other lines of trees and shrubs by the presence of a residual hedge structure. At a more advanced stage of degeneration there is little to distinguish former hedges from other lines of trees and shrubs in the countryside. Therefore in this summary of CS2000 results these types of woody linear feature are put together but differentiated by presence or absence of a fence. This is the first time that information on lines of trees and shrubs has been calculated and published.

4.10 In order to enable direct comparisons with results from the last Countryside Survey, the previous definitions have been used in the *Quality of Life Counts* indicator in Chapter 2.

4.11 Field boundary data in the Northern Ireland Countryside Survey were recorded independently and used a different approach to defining field boundaries.

Stock and change

4.12 Table 4.2 shows the stock and change of *Linear Landscape Features* for England and Wales, and Scotland recorded by CS2000. The results for Northern Ireland are presented in Box 4.2. The total length of these features in the UK is over 1.8 million km, two thirds of which are in England and Wales, a fifth in Scotland and an eighth in Northern Ireland. The density of *Linear Landscape Features* is highest in Northern Ireland and lowest in Scotland. The stock of *Linear Landscape Features* in the six Environmental Zones in Great Britain is illustrated in Figure 4.1.

4.13 In England and Wales as a whole, hedges (449,000 km) and remnant hedges (52,000 km) were the dominant *Linear Landscape Feature*. No significant difference was detected in the total stocks of hedges and walls in 1990 and 1998, but the length of remnant hedges declined by about 14,000 km (21%). The length of the two categories of lines of trees and shrubs totalled some 153,000 km in 1998, a net increase of about 35,000 km 31%). Fences had an estimated length of 423,000 km in 1998, an increase of 26,000 km (7%).

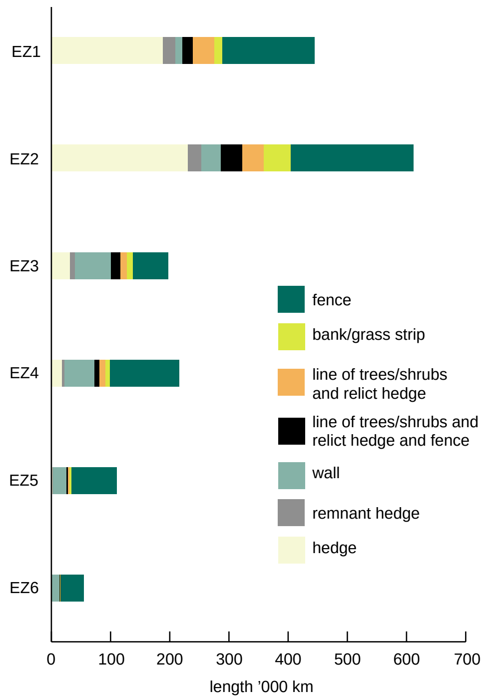
2 Barr, C.J., Gillespie, M.K. and Howard, D.C. (1994), *Hedgerow Survey 1993*, Contract Report to DOE by the Institute of Terrestrial Ecology.

Table 4.2: Estimates of the stock in 1998 and change 1990 to 1998 of linear landscape features in (a) England and Wales and (b) Scotland. Standard Error (SE) terms for the estimates are provided. Changes which are statistically significant (p<0.05) are indicated in bold.

(a) England and Wales	Stock in 1998			Change in stock 1990-98		
	Length ('000km)	SE ('000km)	% of 1998 stock	Length ('000km)	SE ('000km)	% change from 1990
Hedge	449.3	21.2	35.8	-0.4	4.8	0.0
Remnant Hedge	52.3	4.3	4.2	**-13.5**	3.6	-20.9
Wall	105.8	12.8	8.4	-2.7	1.7	-2.5
Line of trees/shrubs and relict hedge and fence	70.0	5.1	5.6	**15.5**	3.1	30.8
Line of trees/shrubs and relict hedge	83.4	5.1	6.7	**19.6**	3.0	31.4
Bank/grass strip	70.0	7.4	5.6	-1.9	2.5	-2.5
Fence	423.2	16.9	33.7	**25.6**	8.9	6.6
Total	1253.9	32.1	100.0	**42.3**	8.4	3.5

(b) Scotland	Stock in 1998			Change in stock 1990-98		
	Length ('000km)	SE ('000km)	% of 1998 stock	Length ('000km)	SE ('000km)	% change from 1990
Hedge	19.0	4.4	5.0	0.8	0.8	4.6
Remnant Hedge	5.3	1.8	1.4	-0.9	0.5	-20.0
Wall	87.1	12.0	22.8	-1.5	1.6	-1.7
Line of trees/shrubs and relict hedge and fence	11.1	1.9	2.9	**1.4**	0.6	14.0
Line of trees/shrubs and relict hedge	13.3	1.9	3.5	**2.4**	0.7	22.2
Bank/grass strip	12.4	3.4	3.2	0.8	1.0	6.3
Fence	233.7	16.9	61.2	8.6	3.3	3.9
Total	382.0	21.6	100.0	11.7	3.2	3.2

Figure 4.1: Stock ('000 km) of linear landscape features by Environmental Zone in Great Britain in 1998. The greatest stock of linear features is found in the lowlands of England and Wales (EZ1 & 2) where hedges and fences are the dominant features. In the uplands of England and Wales (EZ3) and the lowlands of Scotland (EZ4) walls are more significant features than hedges. The stock of linear features is lowest in the marginal uplands and uplands in Scotland (EZ5 & 6) where fences and walls dominate. See Figure 1.5 for description of Environmental Zones.



Box 4.2: Linear Landscape Features in Northern Ireland

The Northern Ireland Countryside Survey estimates 233,000 km of field boundaries in 1998, consisting mainly of *Hedges* (118,000 km), *Earth Banks* (41,000 km) and *Fences* (55,000 km), with *Dry Stone Walls* (6,000km), *Ruined Dry Stone Walls* (3,000 km) and *Mortared Walls* (2,000 km) less common. There was a 3% decline in net length of field boundaries from the late 1980s, to 1998. The most important changes in terms of biodiversity are an estimated net loss of 5,000 km of *Hedges* (-4.5%) and a 4,000 km decrease in *Earth Banks* (-10%). Changes in the number, length and type of walls and fences impact more on the visual landscape.

4.14 In Scotland, the dominant *Linear Landscape Features* were fences (234,000 km) and walls (87,000 km). Neither showed a significant change in net length, though the estimated stock of fences had increased and walls decreased.

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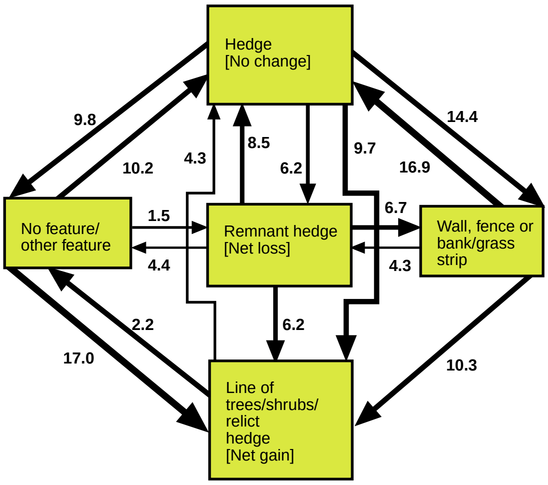
Hedges and remnant hedges were much less widespread in Scotland and showed no significant changes in net length. As in England and Wales, the length of both categories of lines of trees and shrubs increased, by about 4,000 km (18%), to a total of 24,000 km in 1998.

4.15 Although there was no net change for hedges in England and Wales over the full period from 1990 to 1998, there is some evidence from the interim survey of hedges in 1993[3] that net losses, recorded in the first part of this period, 1990-93, were reversed in the latter part. The apparent increase in hedges between 1993 and 1998 needs to be confirmed by a more detailed analysis of the data for 1993, and comparison with other sources of information on hedgerow planting within agri-environment schemes.

4.16 The results of CS2000 indicate that the declines in length of hedges and walls reported for the 1980s have been halted, and in the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have been reversed. However, when making a judgement about these data, it is important to note that the calculation of net change may obscure large transfers into and out of each category. If these transfers tend to balance each other out, the stock of a given feature may appear stable when it is actually in a state of flux. Newly created or restored features may not have the same value in terms of ecology, landscape and historical significance as long-established features. Consequently even if the total is unchanged, the 'value' of the resource may change over time depending on the patterns of removal, recruitment, restoration and management.

4.17 Figure 4.2 illustrates the complex interchanges between different woody *Linear Landscape Features* in England and Wales between 1990 and 1998. All the transfers are estimates based on the sample survey and should be interpreted as an indication of the magnitude and direction of trends rather than an accurate measurement.

Figure 4.2: Transfers between woody linear landscape features in England and Wales, 1990 to 1998. The weight of arrow is proportional to the size of the transfer. Numbers are length of feature in '000 km.



HEDGE RESTORATION, SHROPSHIRE *(C BARR)*

3 Hedgerow Survey 1993 was limited to 108 sample squares containing hedges in England and Wales. The survey estimated a net loss of 13% of hedges between 1990 and 1993, mostly attributed to management neglect. The differences in sample size and field methods mean that further work is required in order to compare the results of the survey directly with Countryside Survey 2000. However, losses in the early 1990s must have been reversed between 1993 and 1998 for there to have been no net change over the 1990-98 period as a whole. Reference: Barr, C.J., Bunce, Gillespie, M.K. and Howard, D.C. (1994) *Hedgerow Survey 1993*, Contract report to DOE by Institute of Terrestrial Ecology.

4.18 The total stock of hedges was maintained by a balance between the various losses and gains. About 10,000 km (2%) of hedges were removed and a similar amount planted. The amount of hedges degenerating into remnant or relict features (15,900 km) exceeded the restoration of such woody boundaries into hedges (12,800 km). However, more hedges were planted beside other boundary types (16,900 km), mainly fences, than were replaced by these features (14,400 km).

4.19 The net losses to remnant hedges in England and Wales are a consequence of further degeneration into lines of trees and shrubs (6,200 km) and removal or replacement by fences or other boundaries (11,100 km). However, a substantial amount (8,500 km) of the stock that was recorded as remnant in 1990, was restored to a hedge in 1998.

4.20 The net gains in lines of trees and shrubs/relict hedges have come from three main sources. The largest part of this increase (about 17,000 km) was accounted for by 'new' features in 1998. A further amount (9,400 km) was derived from existing fences and banks. The analysis of results so far does not permit the definite distinction of new lines of trees and shrubs from pre-existing features recorded for the first time in 1998. However, it is likely that much of the increase is a consequence of reclassification of existing features. The third source of the increase (16,000 km) was, as we have seen above, through the management neglect of hedges and remnant hedges. A small amount (2,200 km) of the lines of trees and relict hedges recorded for 1990 were removed.

4.21 This analysis of transfers between woody *Linear Landscape Features* in England and Wales shows that, while the net loss of hedges may have been reversed during the last decade, this is because a delicate balance has been achieved between planting and removal, degeneration and restoration. Comparison with the 1984-90 period[4] shows that rates of hedge planting are similar but rates of removal have fallen by a factor of seven. There is evidence for a gradual degeneration of woody linear features as some hedges become remnant hedges and some of these in turn become lines of trees or shrubs. But, unlike the 1980s and early 1990s, restoration and management has largely counteracted these trends.

EXAMPLE OF A RELICT HEDGE/LINE OF SHRUBS, CUMBRIA *(C BARR)*

4.22 The patterns of transfer observed in Scotland were similar to those in England and Wales, except that they were smaller.

4.23 The losses of managed hedges, reported in Countryside Survey 1990 and the interim survey in 1993, appear to have been reversed in the mid-1990s. However, although the net length of hedges now appears stable or possibly increasing this does not necessarily imply that the value of the resource is stable as newly planted or restored hedges may not compensate in all respects for the older features which have been lost. Evidence of changes in the ecological condition of the hedgerow stock is reported below.

4 Barr, C.J., Bunce, R.G.H., Clarke, R.T., Furse, M.T., Gillespie, M.K., Groom, G.B., Hallam, C.J., Hornung, M., Howard, D.C. and Ness, M.J. (1993), *Countryside Survey 1990,* Main Report, DOE London.

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4.24 There was no statistically significant change detected in net length of walls for England and Wales, and Scotland. However, there was a small but significant net loss of 1,600 km (13%) of walls in the easterly lowlands of England and Wales (Environmental Zone 1). Compared to hedges, walls showed few transfers with other features. The survey estimates that slightly more (4,700 km) of the stock of walls had been removed than had been constructed (3,200 km) in Great Britain as whole between 1990 and 1998, with similar trends in Scotland, and England and Wales. Overall rates of wall removal were reduced by a factor of five from the 1984-90 period. Widespread losses in walls reported for the 1980s therefore appear to have been slowed or halted. The loss of walls in Environmental Zone 1 may be a localised effect and deserves further investigation.

MAINTAINING A DRY STONE WALL, CUMBRIA *(WOODFALL WILD IMAGES)*

4.25 There was no significant change in net length of banks and grass strips. Fences, on the other hand, showed marked increases everywhere.

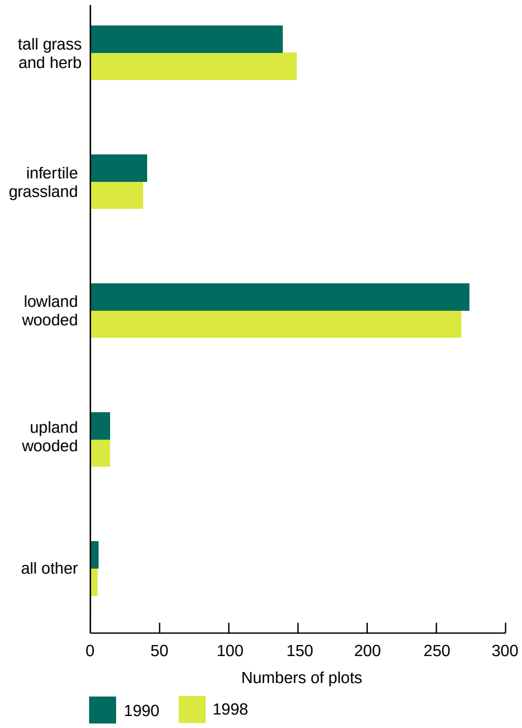
Changes in habitat condition – hedges and roadside verges

4.26 In addition to information about the stock and change of *Boundary and Linear Features*, CS2000 can provide further insights into the ecological character of these habitats though the analysis of the vegetation plot data collected as part of the field survey.

4.27 As described in Chapter 1 several different types of plot were located within the field survey squares to assess the range of vegetation conditions found there. Two of these plot types are particularly valuable for assessing the *Boundary and Linear Features*, namely those located along the hedgerows themselves, known as 'hedge plots' and those sampled along roadside verges, the so called 'verge plots'. These plots can be used to understand conditions in the narrow strips of semi-natural vegetation associated with these widespread linear habitats.

4.28 When reviewing the data from the hedge and verge plots, it is important to note that judgements about the condition of vegetation, and the way it is changing over time, must take account of the landscape context in which they occur. In some areas, particularly those that are intensively farmed, linear habitats can be important reservoirs of biodiversity, even though the area covered may be small.

Figure 4.3: The composition of hedge plots sampled in Great Britain in both 1990 and 1998 in terms of the major vegetation types.



Hedgerow condition

4.29 Chapter 2 has described how vegetation data can be used to assess aspects of habitat condition. Two hedge plots, measuring 10m x 1m, were located in each survey square in which hedges were found. They record the vegetation growing along the bottom of the hedges as well as the shrubs in the hedge itself. The same plots were surveyed in 1990 and 1998. The hedge plots were not surprisingly dominated by 'lowland wooded' and 'tall grass and herb' vegetation types (see Figure 4.3). The proportion of hedge plots comprising the tall grass and herb vegetation type increased between 1990 and 1998.

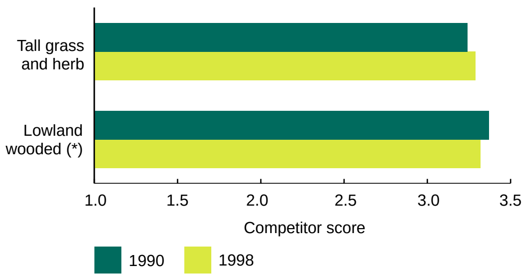
4.30 Results for changes in vegetation condition for hedges characterised by tall grass and herb vegetation and lowland wooded vegetation in England and Wales are shown in Figure 4.4. The hedge plots comprising lowland wooded vegetation in 1990 showed few significant trends in the condition indicators between 1990 and 1998. There was an overall reduction in competitive species and an increase in 'ruderal' species typical of disturbed ground, perhaps an indication of management impacts on these wooded hedges.

4.31 The hedge plots that were characterised by tall grass and herb vegetation in 1990 showed a statistically significant, 12% decline in species richness. There were reductions in the frequency of plants that are important food sources for butterflies and 'ruderal' plants that are able to tolerate more disturbed conditions. The frequency of shade tolerant species increased, indicating a general increase in the size of hedge canopies and undergrowth, possibly because of less intensive management of the hedges. These changes were concentrated in the eastern lowlands of England (Environmental Zone 1)

Figure 4.4a: Changes in vegetation condition in hedge plots comprising tall grass and herb vegetation and lowland wooded vegetation types in England and Wales, 1990-98. (a) Competitor and Ruderal Scores.

Condition measure

Mean proportion of Competitive species found in hedge plots in England & Wales in tall grass/herb and lowland wooded in 1990 and 1998.

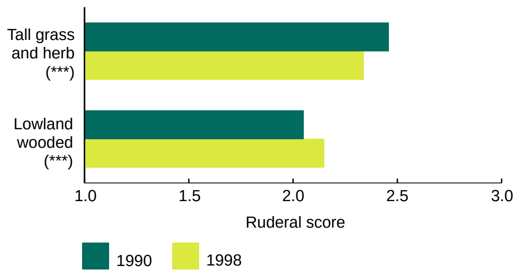


Conclusion and significance

The change was significant for lowland wooded but not for tall grass and herb.

The change for lowland wooded represents a small but significant **decrease** in in the proportion of competitive species. The mean difference was –0.1 and the 95% confidence limit for the change was ±0.04. There were 268 lowland wooded plots and 119 tall grass and herb plots.

Mean proportion of Ruderal species found in hedge plots in England & Wales in tall grass and herb and lowland wooded in 1990 and 1998.



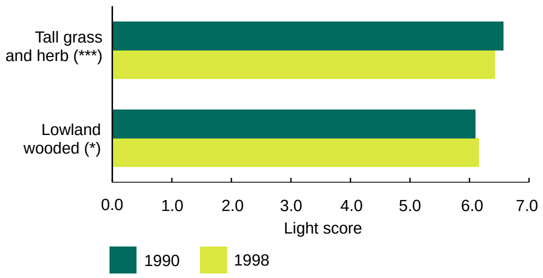
The change was significant for both lowland wooded and tall grass and herb.

A highly significant **increase** in the proportion of ruderal species was found in lowland wooded and a highly significant **decrease** for tall grass and herb. The mean difference was 0.1 for lowland wooded and –0.1 for tall grass and herb. The 95% confidence limit for the change was ±0.05 for lowland wooded and +0.06 for tall grass/herb. There were 268 lowland wooded plots and 119 tall grass and herb plots.

Figure 4.4b: Changes in vegetation condition in hedge plots comprising tall grass and herb vegetation and lowland wooded vegetation types in England and Wales, 1990-98. (b) Light Score and Species Richness.

Condition measure

Mean light score in hedge plots in England & Wales in tall grass and herb and lowland wooded in 1990 and 1998.

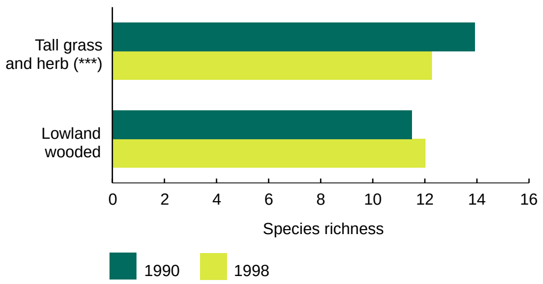


Conclusion and significance

The change was significant for both lowland wooded and tall grass and herb.

A highly significant decrease in light score was found in tall grass and herb and a small but significant **increase** in lowland wooded. The mean difference was –0.2 for tall grass and herb and 0.1 for lowland wooded. The 95% confidence limit for the change was +0.05 for tall grass and herb and ±0.05 for lowland wooded. There were 268 lowland wooded plots and 119 tall grass and herb plots.

Mean species richness in hedge plots in England & Wales in tall grass and herb and lowland wooded in 1990 and 1998.



The change was significant for tall grass and herb but not for lowland wooded.

The change for tall grass and herb represents a highly significant **decrease** in species richness. The mean difference was –1.6 and the 95% confidence limit for the change was ±0.89. There were 268 lowland wooded plots and 119 tall grass and herb plots.

in hedges adjacent to both the *Arable* and *Improved Grassland* Broad Habitats. There was also some evidence of increasing nutrient status, but only in hedges adjacent to *Improved Grassland* in the western lowlands of England and Wales (Environmental Zone 2).

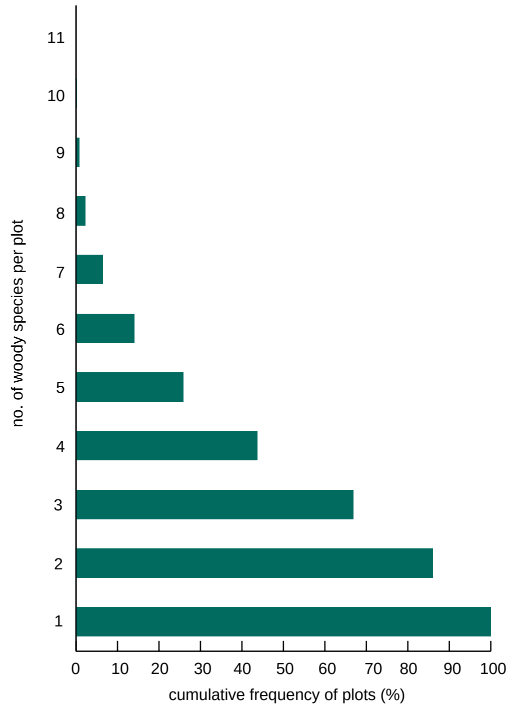
SURVEYING A HEDGE PLOT, MONMOUTHSHIRE *(A STOTT)*

4.32 In Scotland the number of hedge plots was small, and no significant changes were detected.

4.33 The results suggest that the value of hedgerow vegetation as a habitat for wildlife is generally stable but there is some evidence for decline in plant diversity of tall grass and herb vegetation associated with hedgerows. The analysis completed so far does not enable an assessment of whether the balance of planting and removal, and restoration and degeneration, described above (see paragraph 4.21) has had an affect on the overall ecological condition of hedges.

4.34 A further set of hedgerow vegetation plots were sampled for the first time in Great Britain by CS2000. These plots were intended to establish a baseline for assessing the diversity of tree and shrub species in hedges. In each sample square with hedges, up to ten 30m lengths of hedge were surveyed and the woody species were recorded. Diversity of woody species in a standard 30m length of hedge is used in the definition of species-rich hedgerows in the BAP Habitat Action Plan and in the Hedgerow Regulations. The preliminary results of this survey show that in the sample as a whole about a quarter (26%) of hedges had five or more woody species and would therefore be defined as a species-rich hedge (Figure 4.5).

Figure 4.5: Diversity of woody species in hedgerows. The chart shows the cumulative frequency of plots with different numbers of woody species per 30m length. Thus the chart shows that 86% of plots had two or more woody species and that over a quarter (26%) had five or more woody species. One plot had eleven woody species. Nearly 2500 plots were included in the analysis. The preliminary results presented here are not weighted according to the area of the sampling strata or length of hedges.

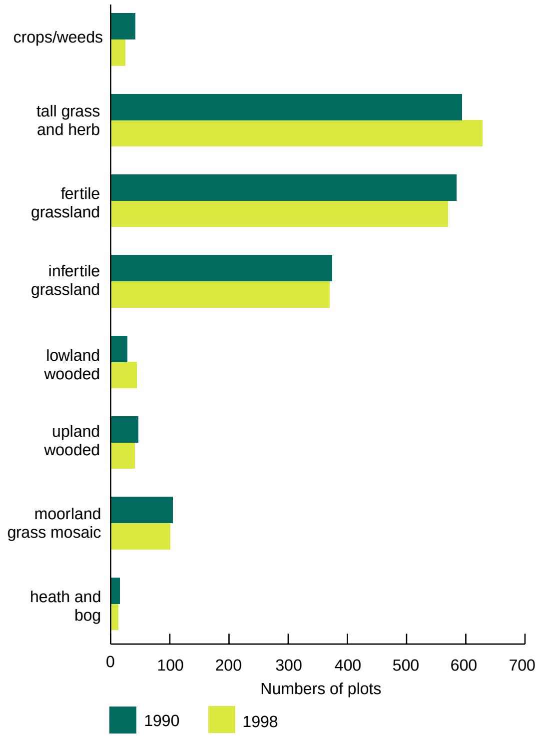


Roadside verges

4.35 Roadside verge plots are characterised by a wide range of vegetation types in different environmental situations throughout the country (see Figure 4.6). The most widespread are the tall grass and herb, grassland and infertile grassland vegetation types. Road verges provide an important refuge for unimproved, species-rich infertile grassland, which has generally declined in enclosed farmland due to agricultural intensification. Between 1990 and 1998 there were minor net shifts from acidic upland vegetation to infertile grassland, from infertile grassland to tall grass and herb vegetation and from tall grass and herb to wooded vegetation. This resulted in increases to the overall proportion of verges comprising tall grass and herb and lowland wooded vegetation.

ROAD VERGE CHARACTERISED BY 'INFERTILE GRASSLAND' VEGETATION, TAYSIDE REGION, SCOTLAND *(C BARR)*

Figure 4.6: The composition of roadside verge plots sampled in Great Britain in both 1990 and 1998 in terms of the major vegetation types.



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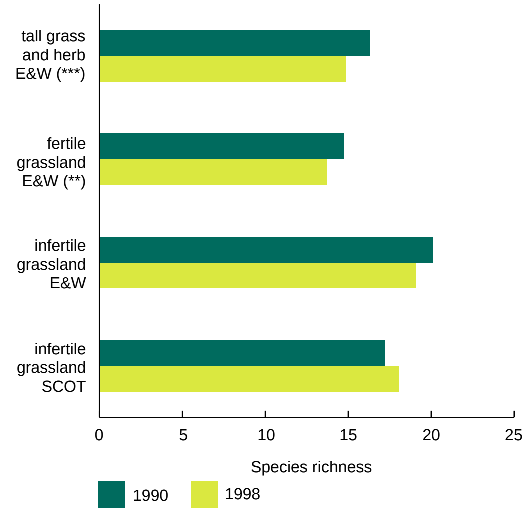
4.36 Some of the changes in condition recorded by CS2000 for the roadside verge plots are shown in Figure 4.7. For ease of presentation only the changes in species-richness and fertility for the three most widespread vegetation types are shown.

4.37 Several different statistically significant trends can be seen in the verge plots at national scales. In England and Wales, species richness declined by 9% in tall grass and herb and by 7% in fertile grassland verges. Species richness also declined by 11% in infertile grassland verges but only in the westerly lowlands (Environmental Zone 2). In tall grass and herb verges, vegetation change favoured species associated with less fertile conditions whereas the reverse was true in infertile grassland verges. In the Scottish lowlands (Environmental Zone 4) vegetation changes in infertile grassland road verges favoured plants associated with increased nutrient levels, more disturbance and an overall increase in species richness.

Figure 4.7: Changes in vegetation condition in roadside verge plots comprising tall grass and herb and fertile grassland in England and Wales and infertile vegetation in England and Wales, and Scotland, 1990-98.

Condition measure

Mean species richness in road verge plots in England & Wales in tall grass/herb and infertile grassland in 1990 and 1998.

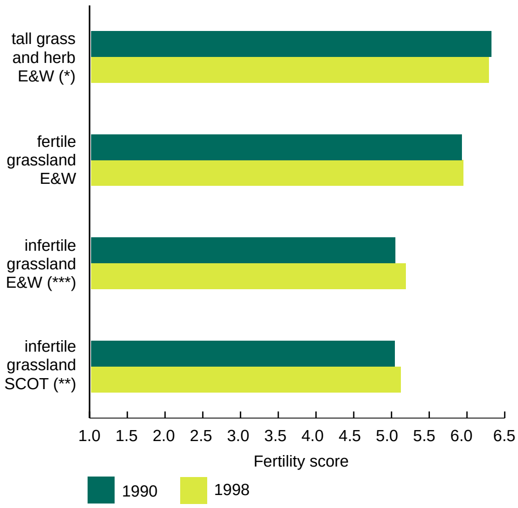


Conclusion and significance

The change was significant for both tall grass and herb and fertile grassland verges in England and Wales. Changes in infertile grassland verges were not significant.

Species richness **decreased** significantly in both tall grass and herb and fertile grassland. The mean difference was –1.5 for tall grass and herb and –0.96 for fertile grassland. The 95% confidence limit for the change was ±0.55 for tall grass and herb and ±0.67 for fertile grassland. There were 553 tall grass and herb plots and 457 fertile grassland plots.

Mean fertility score in road verge plots in England & Wales in tall grass and herb and in fertile and infertile grassland in 1990 and 1998.



The change was significant for tall grass and herb and infertile grassland in England & Wales and in Scotland.

A small but significant **decrease** in fertility score was found in tall grass and herb in England & Wales. A significant **increase** in fertility score was found in infertile grassland in Scotland and a highly significant **increase** in infertile grassland in England & Wales. The mean difference was –0.03 for tall grass and herb, 0.14 for infertile grassland in England & Wales and 0.08 for infertile grassland in Scotland. The 95% confidence limits for the changes were ±0.03 for tall grass and herb, ±0.06 for infertile grassland in England & Wales and ±0.06 for infertile grassland in Scotland. There were 553 tall grass and herb plots, 177 infertile grassland plots in England & Wales and 199 infertile grassland plots in Scotland.

4.38 The implication of increasing nutrient levels and local reductions in species-richness in some infertile grassland verges is a particular cause of concern. Such roadside verges are an important refuge for unimproved grassland species in intensively farmed landscapes. The losses in plant diversity in tall grass and herb and fertile grassland verges were also associated with reductions in the availability of food plants for butterfly larvae.

Conclusions

4.39 For the *Boundary and Linear Features* Broad Habitat the most significant finding of CS2000 is that the declines in length of hedges and walls reported for the 1980s have been halted, and in the case of hedges in England and Wales, there is some evidence that losses in the early 1990s have been reversed. This has been achieved by a shift in balance between hedge removal and planting, hedge restoration and damage, and wall removal and re-construction.

4.40 Comparison with the 1984-90 period in England and Wales shows that rates of hedge planting are similar but rates of removal have fallen markedly. There is evidence for a gradual degeneration of woody linear features as some hedges degenerate to remnant hedges and some of these in turn degenerate to lines of trees or shrubs. But, unlike the 1980s and early 1990s, restoration and management has largely counteracted these trends. These changes coincide with the general downturn in the agricultural economy during the mid-1990s and the increased incentives, advice and regulation over this period. However, the large turnover has implications for the quality of the resource. The issue that is now apparent is one of maintaining this balance by promoting good management, as well as the protection of the most important of these features. The Hedgerow Regulations introduced in 1997 and recent expansion of agri-environment schemes are already addressing this issue.

4.41 There is some evidence, however for a decline in aspects of the quality of the Broad Habitat. The vegetation of some hedges and roadside verges has become less diverse and more dominated by tall, competitive plants, associated with increasing nutrient status. These changes are an issue especially in the intensively farmed landscapes of England and Wales, where linear features serve as important refuges for biodiversity. The reasons for these changes require more detailed investigation.

4.42 The preliminary analysis presented here has not considered the relationships between management and substitution of linear features, adjacent land use, connectivity and ecological condition, including woody species diversity in hedges. Nor have the implications of changes to the local landscape character been addressed. These are topics for future work.

The Countryside Surveys in Great Britain and Northern Ireland estimate that woodland covers 12% of the UK. Changes in the *Broadleaved* and *Coniferous Woodlands* suggest that some important environmental gains have been made during the 1990s. The stock of *Broadleaved Woodland* in the UK has increased by about 5% since 1990, to around 1.5 million ha in 1998. The national expansion of *Coniferous Woodland* over previous decades came to a halt in the 1990s at around 1.4 million ha, losses in the lowlands tending to be balanced by gains in the uplands.

5 woodlands

Introduction

5.1 Woodlands are a distinctive feature of the UK landscape. Not only are they important reservoirs of biodiversity, but they also contribute much to the character of the countryside. They are significant because they provide people with a range of economic and recreational opportunities.

5.2 During the 1990s, woodlands have been the focus of a range of environmental policies. The most recent statements include the 1998 UK Forestry Standard and the UK Strategy for Sustainable Development[1]. In general terms, these policies aim to maintain and enhance the environmental characteristics of woodlands, and the contribution that they make to the quality of the countryside. Box 5.1 provides a summary of key policy objectives.

5.3 In order to help measure progress towards these goals, the area of woodland has been included as one of the Government's *Quality of Life Counts* indicators. The indicator is based on statistics collected by the Forestry Commission, and shows that there has been some progress towards increasing the total area of woodlands in the UK. The information provided by CS2000 will provide further complementary information to help determine whether other aspects of woodland policy are being achieved.

Box 5.1: Key elements of recent policy towards woodlands in the UK

Habitat statements were first published for Broad Habitats in 1994, in *Biodiversity: The UK Action Plan*. For the *Broadleaved, Mixed and Yew Woodland* Broad Habitat, key objectives included:

- To maintain the extent of woodlands and to reduce conversion to other use; there is a presumption against the conversion of woodland to other uses.
- To restrict planting on sites that would adversely affect conservation value.
- To encourage natural processes.
- To restore selected ancient woodland sites.

For the *Coniferous Woodland* Broad Habitat the objectives were:

- To restrict planting to sites of low conservation value.
- To promote diversification by restructuring.

These objectives have been refined though the development of Biodiversity Action Plans for the more specific Priority Habitats included within each of the woodland Broad Habitats, and promoted by a range of policy initiatives. The extension of woodland cover has, for example, been encouraged though agri-environment and community forest schemes, and the re-establishment of mature Caledonian Pine forest. The sustainable management of woodlands is promoted though the 1998 UK Forestry Standard.

Key sources:
Forestry Commission (1998) *UK Forestry Standard: The Government's approach to sustainable forestry*. Forestry Commission, Edinburgh.
DETR (1999) *A better quality of life: A sustainable development strategy for the UK*. The Stationery Office, London, Cm 4345

1 Forestry Commission (1998) *UK Forestry Standard*, Forestry Commission, Edinburgh; HMSO (1994) *Sustainable Forestry: The UK Programme*. HMSO London; DETR (1999) *A better quality of life: A sustainable development strategy for the UK*. The Stationery Office, London, Cm 4345. Forestry Commission (1998) *The England Forestry Strategy*, Forestry Commission, Edinburgh; Strategies for Scotland, Wales and Northern Ireland are presently in draft.

5

Characterising woodlands

5.4 Woodlands are covered by two of the BAP Broad Habitats: *Broadleaved, Mixed and Yew*, and *Coniferous* (Appendix A). Although most people can visualise the sorts of habitats to which these labels might be applied, it is important to understand how CS2000 has distinguished between them.

5.5 For a parcel of land to be recorded as part of *Broadleaved Woodland*[2], it must be dominated by trees that will be more than 5m tall when mature. The woodland must have a distinct canopy, with cover of at least 20% trees. This Broad Habitat includes stands of native and non-native trees such as oak (*Quercus* spp.), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*), sycamore (*Acer pseudoplatanus*) and yew (*Taxus baccata*), in which the proportional cover of broadleaved species is more than 20% of the tree cover present. Scrub vegetation, which is usually less than 5m high, is also included in this habitat if the cover of woody shrubs is over 30%[3].

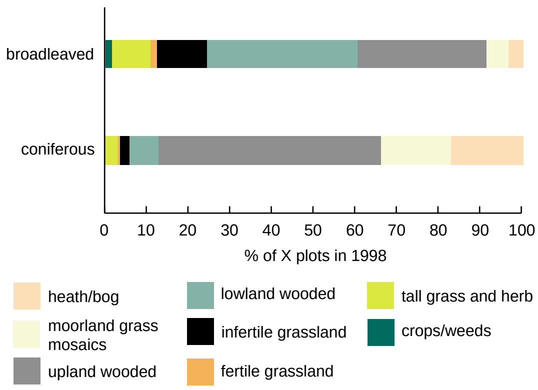
5.6 *Coniferous Woodlands* is dominated by native and non-native conifers such as Scots pine (*Pinus sylvestris*), Sitka spruce (*Picea sitchensis*) and larch (*Larix* spp.). For an area of land to be assigned to this Broad Habitat, it must contain trees that are more than 5m high when mature and which will form a canopy with at least 20% cover. Recently felled woodland is included in this habitat type where there is a probable intention to return the area to woodland; otherwise it is included in another habitat category, depending on the type of change that has taken place. When a felling licence is granted there is normally an obligation to restock, except where clearance is sanctioned for development or restoration.

5.7 Clearly some woodland may contain both coniferous and broadleaved trees. There is no separate 'mixed woodland' category in the list of BAP Broad Habitats. Instead, where mixtures occur, they are assigned to *Broadleaved, Mixed and Yew Woodland* if the proportion of conifer is less than 80% and to *Coniferous Woodland* if it is more.

CONIFER WOODLAND **PLANTATION WITH YOUNG CONIFER AND BROADLEAVED TREES, STAFFORDSHIRE** *(DAVID WOODFALL)*

5.8 The results of CS2000 show that *Broadleaved Woodland* is characterised by a range of vegetation types including tall grass and herb and infertile grassland but mostly lowland wooded and upland wooded vegetation types (Figure 5.1). *Coniferous Woodland* also has a wide range of vegetation but with higher proportions of upland wooded, moorland grass and heath and bog.

Figure 5.1: Vegetation types in *Broadleaved* and *Coniferous Woodland* Broad Habitats in 1998



These data show the proportions of each vegetation type found in random (X) plots located within each Broad Habitat in 1998.

2 In this report the *Broadleaved, Mixed and Yew* Broad Habitat will be referred to more simply as *'Broadleaved Woodlands'*
3 25% for the NICS2000

Broadleaved, Mixed and Yew Woodland

The changing stock of woodlands

5.9 The combined results of CS2000 and NICS2000 suggest that the UK stock of *Broadleaved Woodland* was about 1.5 million ha, and that there has been a net increase in area of about 5% since 1990 (Table 5.1).

5.10 Table 5.1 also shows how the gains were distributed in different parts of the UK. All Environmental Zones showed an increase. In England and Wales, cover increased by about 4%, with statistically significant increases in Environmental Zone 2, which includes landscapes that are mainly pastural in character. In Scotland, *Broadleaved Woodland* cover increased by 9%, with the most marked gains occurring in the lowlands, Environmental Zone 4, and the uplands, Zone 6. Northern Ireland showed an increase in cover of about 9%.

5.11 Such changes are broadly in line with our expectations, in that expansion of woodland cover has been the goal of Government policy during the 1990s (Box 5.1). Planting schemes and incentives have, for example, been targeted at lowland areas that include much of our arable and intensively managed grassland habitats.

5.12 The data in Table 5.1 show the net changes in *Broadleaved Woodland* cover by Environmental Zone and by country. When assessing the significance of these changes it is important to understand that they are the result of the balance between gains and losses to the woodland stock. Figure 5.2 shows how land has been exchanged between *Broadleaved Woodland* and the other Broad Habitats. These data are presently only available for Great Britain. The main gains have been from the *Arable and Horticultural*, *Improved* and *Neutral Grassland* and *Coniferous Woodland* Broad Habitats, but some of the 1990 stock has also been lost to *Improved Grassland*, *Acid Grassland*, and *Coniferous Woodland*.

5.13 The data for the transfers of land between woodland and other habitat types suggest that in Great Britain as a whole, about 93% of the 1990 stock of *Broadleaved Woodland* has been carried over to 1998. These patterns of flows between habitat types need to be investigated in more detail because a 7% loss of stock in 8 years

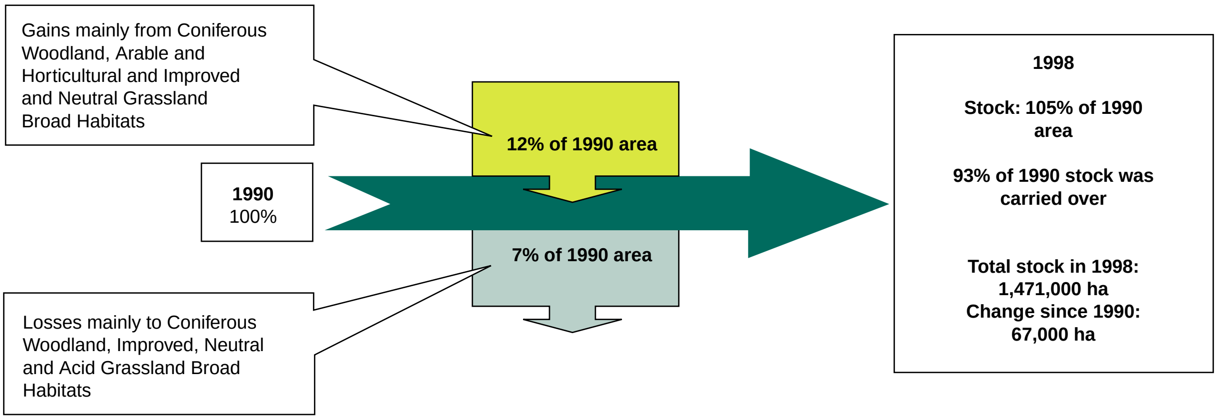
Table 5.1: Stock and change for woodland Broad Habitats in the UK. Changes which are statistically significant (p<0.05) are indicated in bold.

Country and Environmental Zone		Broadleaved, Mixed and Yew						Coniferous					
		1998 stock			change since 1990			1998 stock			change since 1990		
		'000 ha	SE[a]	%[b]	'000 ha	SE[a]	%[c]	'000 ha	SE[a]	%[b]	'000 ha	SE[a]	%[c]
England & Wales	1	563	66	8.8	22	16	4.3	68	17	1.1	-8	6	-11.6
	2	451	43	7.5	**17**	8	3.8	162	51	2.7	3	5	2.1
	3	157	29	6.1	5	7	3.6	150	48	5.8	-11	8	-6.7
	Total	1171	84	7.7	**42**	19	3.9	380	72	2.5	-16	11	-4.2
Scotland	4	118	15	5.3	**10**	6	10.9	171	47	7.6	-2	14	-1.2
	5	71	19	2.6	4	3	6	351	81	12.9	19	25	5.6
	6	111	45	3.5	11	11	10.5	472	98	14.7	-10	16	-2.1
	Total	300	51	3.7	**25**	13	9.0	993	135	12.4	7	32	0.7
GB		1471	98	6.5	**67**	23	4.9	1374	153	6.0	-9	34	-0.7
Northern Ireland		51	5	4.4	**4**	1	8.5	61	8	4.4	6	2	11.6
UK		1522	98	6.3	72	23	5.1	1435	154	5.9	-3	35	-0.2

Note: [a]. SE = Standard Error of the stock and change estimates
%[b] percentage of subtotal/total
%[c] percentage change as a % of 1990 stock

5

Figure 5.2: Turnover of *Broadleaved Woodland* stock between 1990 and 1998 for Great Britain.



represents a high turnover rate. If it is confirmed, then it is a matter of concern, given the very slow rate at which *Broadleaved Woodland* gathers biodiversity value. The problem of turnover will be discussed further in the context of *Coniferous Woodland* (see below).

5.14 It should be noted that these estimates of stock for the *Broadleaved Woodland* Broad Habitat obtained from CS2000 differ from those derived from the Forestry Commission's *National Inventory of Woodlands and Trees*. The latter estimates the cover of *Broadleaved Woodland* in England and Wales, and Scotland in 1998 to be 851,000 ha and 243,000 ha, respectively. Further work is required to determine the reasons for the difference, which may reflect differences in survey methodologies or definitions.

5.15 Moreover, Forestry Commission statistics also suggest that there was about 75,000 ha of new broadleaved planting in Great Britain between 1991 and 1998. This figure is about half that reported by CS2000. The difference between the estimates is possibly due to the fact that CS2000 records all types of woodland development, not just that which can be attributed to formal planting schemes, and also includes natural regeneration and conversion from coniferous plantations.

Changes in habitat condition

5.16 In order to build up a complete picture of what is happening to our environment, we need information on changes in the area of the Broad Habitats and their ecological condition. CS2000 can help with the exploration of some of these more qualitative issues through the data it provides from the vegetation plots recorded within each Broad Habitat. These vegetation data are available for England and Wales combined, and Scotland.

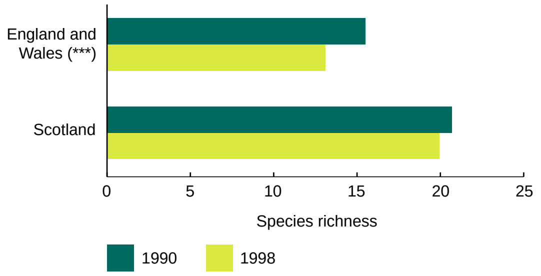
5.17 In general, the vegetation surveys in 1990 and 1998 suggest that there has been some change in the ecological characteristics of the *Broadleaved Woodland* Broad Habitat. For Great Britain as a whole, for example, there has been a decline in plant species richness (Figure 5.3). The analysis is based on those vegetation plots that remained within *Broadleaved Woodland* throughout the survey period. The decline in richness was most marked in Environmental Zone 1, which comprises much of south and south east England. The change observed in Scotland was not significant.

5.18 Amongst the plant species that showed a decline in frequency at national scales, are five commonly associated with ancient woodlands in some areas. These are barren

Figure 5.3: Changes in vegetation condition indicators for the *Broadleaved, Mixed and Yew* Broad Habitat, 1990-98.

Condition measure

Mean Species richness in random vegetation (X) plots that were in Broadleaved Woodland in 1990 and 1998.

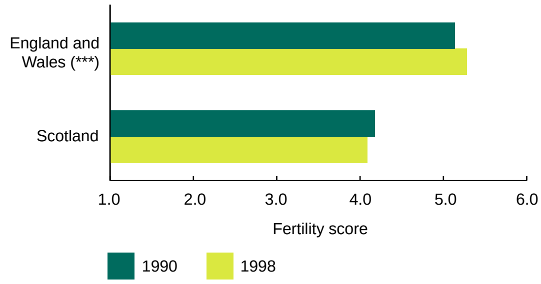


Interpretation and significance

The change for England and Wales is significant, but it is not for Scotland.

The change for England and Wales represents a highly significant **decrease** in species richness. The mean difference was -2.4 and the 95% confidence limits for this change were ±1.33. The analysis was based on 104 sample plots.

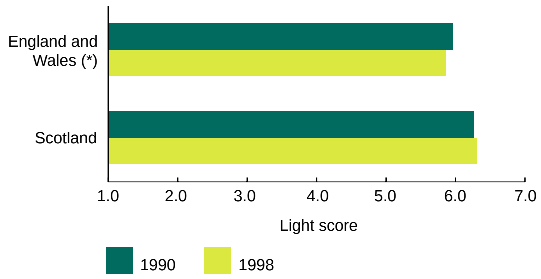
Mean fertility score recorded from random vegetation (X) plots that were in Broadleaved Woodland in 1990 and 1998



The change for England and Wales is significant, but it is not for Scotland.

The change for England and Wales represents a highly significant **increase** in mean fertility score. The mean difference was 0.1 and the 95% confidence limits for this change were ±0.08. The analysis was based on 104 sample plots.

Mean light score recorded from random vegetation (X) plots that were in Broadleaved Woodland in 1990 and 1998



The change for England and Wales is significant, but it is not for Scotland.

The change for England and Wales represents a small but significant **decrease** in light score. The mean difference was -0.1 and the 95% confidence limits for this change were ±0.07. The analysis was based on 104 sample plots.

strawberry (*Potentilla sterilis*), bugle (*Ajuga reptans*), wood anemone (*Anemone nemorosa*), bluebell (*Hyacinthoides non-scripta*) and yellow archangel (*Lamiastrum galeobdolon*). By contrast, only one ancient woodland indicator, moschatel (*Adoxa moschatelina*), showed an increase. The causes of these changes are unclear, and require further analysis. A particular issue that must be considered is how the frequencies of these species are changing elsewhere in the landscape.

BLUEBELL WOODLAND, CO. FERMANAGH *(A STOTT)*

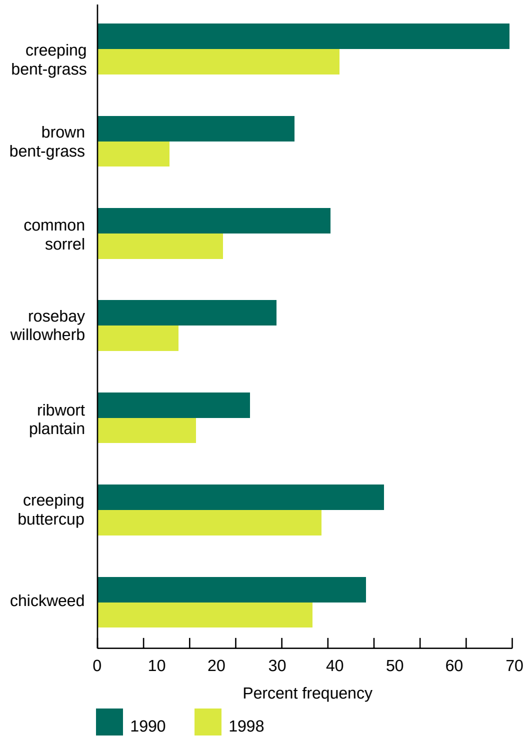
5

5.19 In addition to the changing frequency of ancient woodland indicators two other trends emerge from the preliminary analysis of CS2000 results for *Broadleaved Woodland*. There is some evidence that the frequency of plant species associated with more nutrient-rich conditions have increased since 1990 in England and Wales. Figure 5.3 shows the changes recorded for the mean fertility score for vegetation plots surveyed in 1990 and 1998. The data for England and Wales show a significant increase in fertility score for plots in England and Wales. No significant difference was observed in Scotland.

5.20 There is also evidence from the analysis of the *Broadleaved Woodland* vegetation data that a developmental or 'successional' trend may have occurred between 1990 and 1998. This has involved a change in the balance between species suited to well lit conditions versus those suited to shaded, less disturbed conditions. Changes in light score for vegetation plots in England and Wales, and Scotland are shown in Figure 5.3. The data for England and Wales show a significant decrease in the light score, indicating more shaded conditions. The change in Scotland was not significant. Figure 5.4 shows how the frequency of a range of shade sensitive species found in woodland plots has changed between 1990 and 1998.

5.21 Evidence of successional change is perhaps to be expected, because the woodlands established in the 1980s will have developed and longer established woodlands would have continued to mature. However, such trends may also reflect changes in the nature and intensity of management of the longer established woodland stock, which may have been relaxed in the lowlands over the same period. Sycamore (*Acer pseudoplatanus*) has, for example, shown a marked increase in frequency since 1990, particularly on streamsides associated with the *Broadleaved Woodland* Broad Habitat, and in small woodland fragments.

Figure 5.4: Change in frequency of species sensitive to shade in Great Britain, 1990-1998.



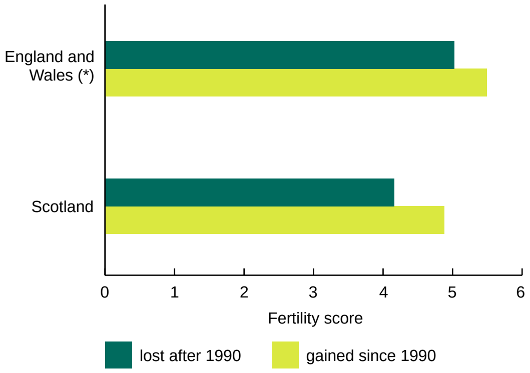
These data are from X plots in the Broadleaved Woodland Broad habitat, irrespective of their vegetation type. The data are for Great Britain as a whole.

5.22 The ecological significance of these successional changes and the factors that have driven them may be explored by more detailed analysis of the CS2000 results. An understanding of the underlying causes is important because it has occurred over a period when broadleaved woodland management has been encouraged through the Woodland Grant Scheme.

5.23 An additional issue that could be investigated in relation to the longer-term development of woodlands concerns the difference in nutrient status between newly established and older woodlands. Figure 5.5 shows fertility scores recorded in woodlands that had been established after 1990 and those from woodlands that existed before the last Countryside Survey and have subsequently been lost. These data suggest that new woodlands tend to have a higher nutrient status than the longer established ones. The difference is statistically significant for England and Wales, but not for Scotland.

5.24 It might be expected that new woodlands should have a higher nutrient status than older ones, because they have mostly been planted on land that was formerly in agriculture. However, the extent to which the nutrient conditions will eventually become more like those in older woodlands is unknown. For future work it would be interesting to split the pre-1990 woods into age classes to see if there was a trend of declining nutrient status with age. The impact on the general nutrient enrichment of woodlands noted above on successional change also needs to be considered.

Figure 5.5: Difference in indication of nutrient levels in newly established *Broadleaved Woodland* compared to older woodland stock present in 1990 but no longer present in 1998.



The difference was small but statistically significant for England and Wales but not Scotland where the sample size was much smaller. The analysis in England and Wales was based on 1990 data from 46 plots and 1998 data from 78 plots.

Coniferous Woodland

The changing stock of woodlands

5.25 The 1998 UK stock of *Coniferous Woodlands* is estimated as 1.4 million ha, and there was no significant change in area since 1990 (Table 5.1). This Broad Habitat covers about 6% of the UK land area, the majority of which has been planted for timber production.

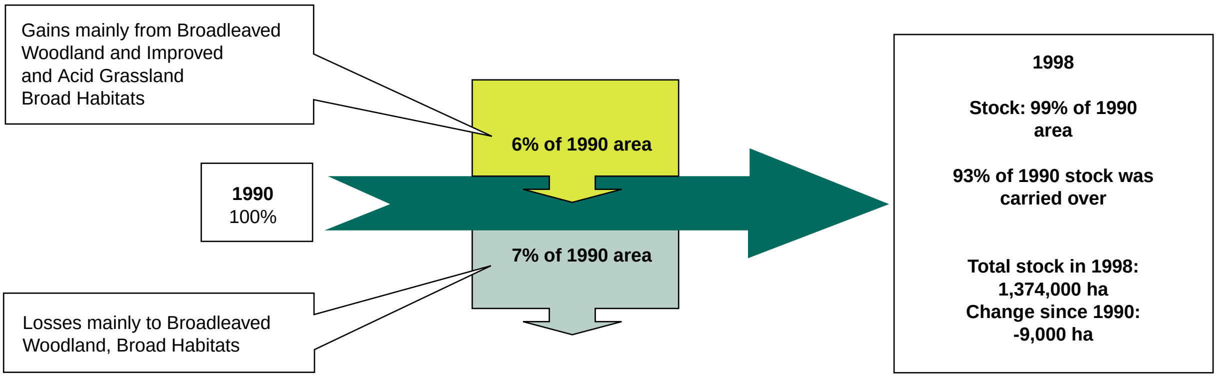
5.26 Despite no overall net change in area, there is some evidence for different trends across the UK (Table 5.1). The trend is downward in England and Wales, especially in the easterly lowlands (Environmental Zone 1) and the uplands (Environmental Zone 3). Scotland shows little overall change, with the small losses in the lowlands and the highlands (Environmental Zones 4 and 6) countered by gains in the intermediate uplands and islands (Environmental Zone 5). Northern Ireland shows an increase in cover of around 12%.

5.27 In Great Britain the patterns of transfers of land into and out of the *Coniferous Woodland* Broad Habitat are of interest (Figure 5.6), with losses to *Broadleaved Woodland* and *Acid Grassland*, counterbalanced by gains from *Broadleaved Woodland, Dwarf Shrub Heath* and *Bog*.

5.28 The loss of *Coniferous Woodland* to *Acid Grassland* probably does not reflect the effects of normal forest rotations, because felled woodland is still recorded as part of the *Coniferous Woodland* Broad Habitat. It may be due to the restoration of plantations, to create more diverse woodland environments (cf. Box 5.1), but further work is needed to establish whether this is the case.

5.29 The loss of *Dwarf Shrub Heath* and *Bog* to *Coniferous Woodland* may cause concern, given the BAP objectives to maintain and increase heathland habitats. The loss of *Dwarf shrub Heath* could be due to the effects of planting in the late 1980s and early 1990s, before recent changes in policy. In some cases in Scotland, loss

Figure 5.6: Turnover of *Coniferous Woodland* stock between 1990 and 1998 for Great Britain.



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of *Dwarf Shrub Heath* may reflect the re-establishment of native Caledonian Pine Forest, a BAP Priority Habitat.

5.30 The exchanges of land between the *Coniferous* and *Broadleaved Woodlands* are also relevant to current policy, which seeks to increase the proportion of broadleaved trees in plantations. For Great Britain as a whole, *Broadleaved Woodland* is gaining area from *Coniferous Woodland*. Analysis of the data on the transfers between these two woodland types suggests that about twice as much *Coniferous Woodland* was transferred to *Broadleaved Woodland* as moved in the opposite direction.

RE-STOCKING OF FORMER CONIFER WOODLAND WITH BROADLEAVED TREES, DEVON *(ANDREW BROWN)*

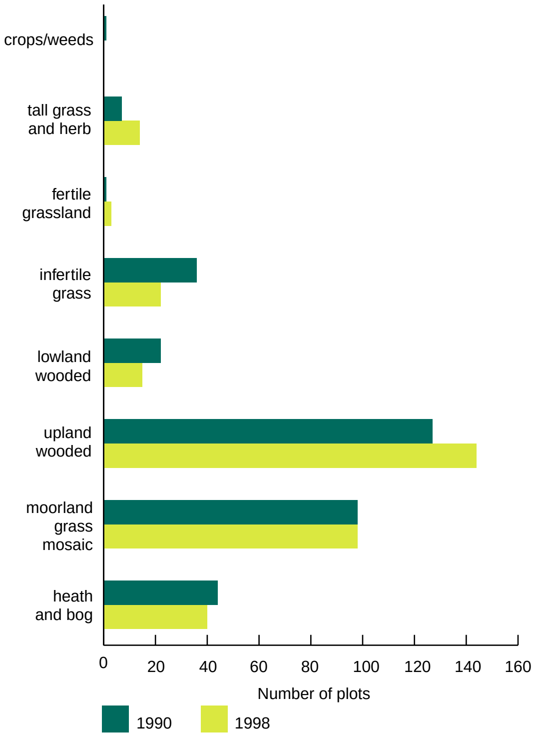
5.31 The losses of *Coniferous* to *Broadleaved Woodland* may indicate that policies of re-stocking plantations with broadleaved trees, planting for amenity and conservation purposes are starting to have an effect. However, these gains may be partly counterbalanced by the delayed effects of past conversion of *Broadleaved* to *Coniferous Woodland* by under-planting. Although this practice ceased in the mid-1980s as a result of the Forestry Commission's Broadleaves Policy, the gradual shading out to the point where less than 20% of the canopy is now broadleaved has continued in some woods.

5.32 The net transfer between *Coniferous* and *Broadleaved Woodland* is clearly consistent with policies to increase the area of native woodlands, but further analysis of these data is required to determine the reasons for the high rates of transfer. As noted above, the results of CS2000 suggest that the turnover of *Broadleaved Woodland* stock is high and the loss to *Coniferous Woodland* represents an important part of the overall flux. It is important to establish whether the transfers between the two woodland types are real, or come about because of the difficulty of distinguishing between them in the field. Small changes in the proportions of conifers and broadleaved trees in mixed woodland may have cause reclassification of the habitat parcels between 1990 and 1998.

Changes in habitat condition

5.33 As noted above, present policy objectives and water quality regulations seek more sustainable forms of forest management and the protection of surface waters. These initiatives aim to promote management that results in a more diverse forest structure in plantations and the removal of conifers from streamsides, especially in areas that may be sensitive to acidification. The results of CS2000 do not, however, provide evidence that such changes are yet widespread.

Figure 5.7: Changes in frequency of different vegetation classes within the *Coniferous Woodland* Broad Habitat in Great Britain, 1990-1998. The chart traces changes in the vegetation types of plots located within the Broad Habitat in 1990.



Graph based on combined data from plots located randomly within the woodland parcel (X plots), targeted habitat plots (Y plots) and plots located along streamsides (SW plots). Each plot was assigned to a vegetation class on the basis of its composition at the two survey dates. The same plots were surveyed in 1990 and 1998.

5.34 The results of CS2000 suggest that the variety of vegetation types found in the *Coniferous Woodland* Broad Habitat has diminished in the 1990s (Figure 5.7). Plots located in *Coniferous Woodland* and associated streamsides in 1990 have become increasingly dominated by upland wooded vegetation at the expense of infertile grassland and heath and bog vegetation. However, there has been a reduction in the frequency of Sitka spruce (*Picea sitchensis*), and an increase in species associated with more open, woodland habitats. Such species include the broad buckler fern (*Dryopteris dilatata*) and native broadleaved trees such as birch (*Betula pendula*). These changes probably reflect complex changes in ground flora as the tree canopy develops in some sample sites whilst in others the canopy is thinned or clear-felled. Overall, there is no evidence of a loss of species richness in plots that remained within the *Coniferous Woodland* Broad Habitat between 1990 and 1998.

TYPICAL 'UPLAND WOODED' VEGETATION OF CONIFEROUS WOODLAND, SCOTLAND *(C BARR)*

5

5.35 Further work would be needed to assess these contrasting trends towards diversification but it may well be that it is too soon to see the ecological effects of the policy changes introduced in the 1990s.

5.36 Future work must also consider how the dynamics of vegetation within these woodlands is linked to those associated with the exchanges of land between *Coniferous Woodland* and other Broad Habitat types. The availability of data from Land Cover Map 2000 will be valuable in gaining a better understanding of the structure of the land cover mosaics in which these woodland occur, and the spatial relationships between the different Broad Habitat types. An example of some output from LCM2000, showing patterns of woodland distribution in Devon is shown in Box 5.2.

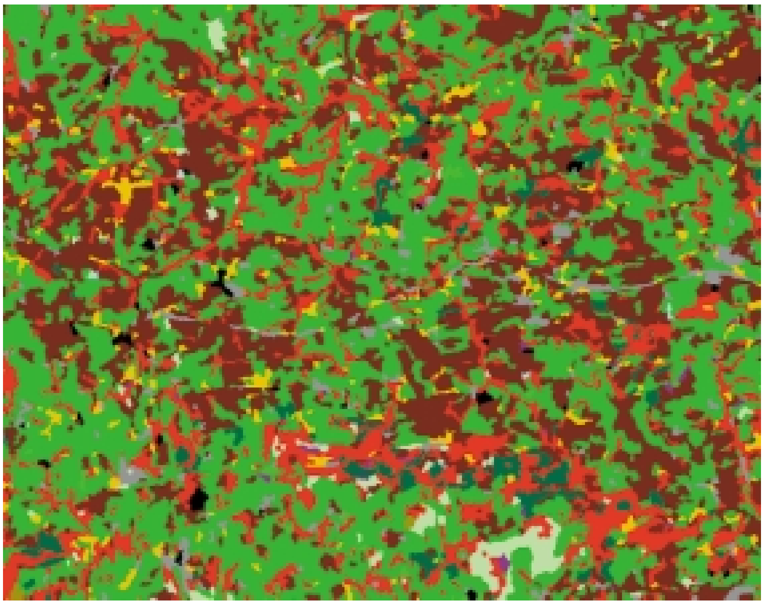
Conclusions

5.37 The changes in the stock and quality of *Broadleaved* and *Coniferous Woodlands* that have been recorded by the surveys in Great Britain and Northern Ireland suggest that some important environmental gains have been made during the 1990s. The stock of *Broadleaved Woodland* in the UK has increased by about 5% since 1990, to around 1.5 million ha in 1998. The area of *Coniferous Woodland* was stable over the same period, at around 1.4 million ha or 6% of the UK land area.

5.38 The expansion of *Broadleaved Woodland* cover is consistent with current policies to increase the area of native woodlands. However, at the annual rate of expansion recorded by CS2000, it would take about 150 years to double the current stock of *Broadleaved Woodland*. The expansion of *Coniferous Woodland* that was a feature of the post-war period, often at the expense of high quality wildlife habitat such as heath and bog, has slowed in some areas and reversed in others. CS2000 provides some evidence of conversion of these plantations to *Broadleaved Woodland*, especially in the lowlands.

5.39 These environmental gains must, however, be offset by some of the changes in woodland condition recorded by CS2000. There is

Box 5.2: Part of the CS2000 Land Cover Map showing an area of Devon



The river valley woodlands in mid-Devon, east of Dartmoor, form a complex mosaic, in a landscape of improved grassland (bright green) with pockets of arable farmland (brown). In the Teign valley in the south of this Land Cover Map section, a large area shows intermixed blocks of coniferous (dark green) and deciduous woodland (red).

Scale – approx 16 km across

evidence, for example, of widespread nutrient enrichment of longer established *Broadleaved Woodland* since 1990. Moreover, new woodland, which is now often being planted on former agricultural land, tends to have a higher nutrient status than the stock which is being lost.

5.40 The long-term implications of a general nutrient enrichment of the *Broadleaved Woodland* stock is unclear. The trend poses some challenging questions in the context of policies which seek to sustain and enhance the key qualities of the woodland stock. A crucial issue, for example, is whether the newer woods will become ecologically equivalent to the older woodland and, if so, over what time scales. Further work is required to determine the extent to which recently planted woodlands compensate for those that have in the past been lost.

5.41 The analysis of the vegetation data for the *Coniferous Woodland* Broad Habitat provides no clear evidence that the structure of these plantations is becoming more diverse. Moreover, there appears to have been a continuing loss of the *Broadleaved Woodland, Dwarf Shrub Heath* and *Bog* Broad Habitats to *Coniferous Woodland*. It may be too early to detect the effects of recent changes in forestry policy in these data.

The major widespread semi-natural Broad Habitats of *Acid Grassland, Dwarf Shrub Heath, Fen Marsh and Swamp, Bog, Calcareous Grasslands, Bracken, Montane* and *Inland Rock* extend to an estimated 6.4 million ha, covering a quarter of the UK. Mostly concentrated in the upland Environmental Zones of Scotland, England and Wales and Northern Ireland, they are important resources for biodiversity, outdoor recreation and less intensive agriculture.

6 mountain, moor, heath and down

Introduction

6.1 Nowhere in the UK do we find habitats that have not been shaped to some extent by the activities of people. However, there are some with an ecological character dominated by self-sown wild vegetation, where the signs of management are less obvious, and for many people they retain something of the quality of wilderness. These 'semi-natural' habitats include *Acid Grassland, Dwarf Shrub Heath, Calcareous Grasslands, Bracken, Fen Marsh and Swamp, Bog, Montane* and *Inland Rock*. Such habitats contribute much of the character to some of the finest landscapes and scenery that we have in the UK. This chapter describes their current status and how they have changed since the previous Countryside Surveys.

6.2 Although these habitats are described as 'semi-natural', most examples have been and still are affected by human activities. They have been, and often continue to be, managed for agriculture, recreation and wildlife. Information about the impacts of changing farming practices, and policies towards agriculture, the environment and the countryside, is just as essential to understanding the pressures that shape these habitats, as it is for woodland or the enclosed farmed landscapes described in Chapters 3 and 5.

6.3 Most of the Broad Habitats considered in this Chapter had 'habitat statements' prepared for them when the *UK Biodiversity Action Plan* was first published in 1994. Most are now covered at least in part by more detailed Habitat Action Plans. The key management objectives and targets for the Broad and Priority Habitats are summarised in Box 6.1. Habitat statements have not been prepared for *Bracken* and *Inland Rock*, which were added later as the classification system developed.

6.4 Many of the conservation objectives outlined in Box 6.1 have been supported by recent policy initiatives. These initiatives operate in the context of the Common Agricultural Policy, which has led in some places to high grazing pressure. The Environmentally Sensitive Areas (ESA) scheme, for example, covers a number of areas that include these habitats. The scheme aims to encourage appropriate agricultural practices in areas designated as having high environmental value. As noted in Chapter 3, it covers both lowland and upland situations. In the context of the semi-natural habitats considered here, for example, it promotes the enhancement of heather moorland.

6.5 The Moorland Scheme, launched in England by MAFF in 1995, is also relevant in the context of habitats covered in this chapter, although its uptake has been low. This scheme aims to protect and improve the moorland environment by encouraging upland farmers outside ESAs to graze fewer sheep, where this will improve the condition of heather and other moorland vegetation. Farmers can receive an annual payment to reduce stocking densities, and may undertake bracken control or put up temporary fencing to exclude stock from heather regeneration areas. The Countryside Premium Scheme has similar objectives in Scotland, while the equivalent in Wales is Tir Cymen and its successor Tir Gofal. In Northern Ireland the initiatives include the ESA and Countryside Management schemes.

6

Box 6.1: Key objectives and targets for the semi-natural Broad Habitats

Refs: *Biodiversity*: The UK Steering Group Report Volume 2 (1995), *The Tranche 2 Action Plan* Volumes II & VI (1998-99)

Broad Habitat	Key objectives and targets
Acid Grassland	■ Encourage appropriate grazing regimes ■ Protect from intensification ■ Restore important or vulnerable sites ■ Maintain and enhance all *Lowland Dry Acid Grassland*
Bog	■ Protect from inappropriate use and loss ■ Encourage appropriate grazing, burning & other management for blanket bogs ■ Maintain the current distribution and extent of 6,000 ha of near natural *Lowland Raised Bog* and restore 7,000 ha of degraded bog by 2015 ■ Restore 845,000 ha of degraded Blanket Bog to favourable condition by 2015
Bracken	No published habitat statement or targets
Dwarf Shrub Heath	This Broad Habitat includes both upland and lowland heaths ■ Maintain and improve management ■ Reduce habitat fragmentation ■ Protect from development and conversion to inappropriate use ■ Seek to increase dwarf shrubs to at least 25% cover on at least 50,000 ha degraded *Upland Heathland* by 2010 ■ Maintain and enhance 58,000 ha of existing *Lowland Heathland* and re-establish 6,000 ha of heathland by 2005
Fen, Marsh and Swamp	■ Protect, restore and recreate ■ Encourage appropriate management ■ Maintain and enhance 13,500 ha of existing *Purple Moor Grass* and *Rush Pastures* and re-create 500 ha by 2005 ■ Maintain and enhance 1,200 ha of *Fens* ■ Maintain and enhance 5,000 ha of *Reedbeds* and re-establish 1,200 ha by 2010
Calcareous Grassland	■ Protect from inappropriate management ■ Encourage appropriate grazing ■ Maintain distribution and extent of 25,000 ha of *Upland Calcareous Grassland* and re-create 200 ha by 2005 ■ Maintain and enhance up to 41,000 ha of *Lowland Calcareous Grassland*
Montane	■ Encourage lower levels of grazing and burning ■ Protect and discourage inappropriate forms of development
Inland rock	■ Ensure there is no further loss to the extent or quality of *Limestone Pavement* Priority Habitat.

Characterising the Broad Habitats

6.6 A definition of each of the Broad Habitats covered in this chapter is given in Appendix A. The *Acid Grassland* Broad Habitat is dominated by grasses and herbs on lime-deficient or acidic soils. *Dwarf Shrub Heath* also occurs on well-drained, nutrient-poor, acid soils but it is distinctive in that the cover of plant species from the heath family or dwarf gorse species is greater than 25%. By contrast, the *Calcareous Grassland* Broad Habitat is 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.

6.7 *Fen, Marsh and Swamp* is found 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. Wetlands that support vegetation that is usually peat-forming and which receive mineral nutrients principally from precipitation rather than ground water, are covered by the *Bog* Broad Habitat. Where they have not been modified by surface drying and aeration, or heavy grazing, the vegetation is dominated by plants tolerant of acid conditions.

6.8 Vegetation types that occur exclusively above the former natural tree-line on mountains are included within the *Montane* Broad Habitat. They include low-growing dwarf shrub heath, snow-bed communities, sedge and rush heaths, and moss heaths. At lower altitudes 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, are included within the *Inland Rock* Broad Habitat.

SEDGES AND MOSSES IN BOG BROAD HABITAT, CO. TYRONE *(A STOTT)*

6.9 Stands of vegetation that are greater than 0.25 ha in area, and which are dominated by a continuous canopy cover of bracken (*Pteridium aquilinum*) at the height of the growing season are included within the *Bracken* Broad Habitat.

Semi-natural habitats: stock and change

6.10 Table 6.1 shows the area covered by the different types of semi-natural habitat in 1998 and how the stock has changed since 1990. The most widespread is *Bog*, followed by *Dwarf Shrub Heath* and *Acid Grassland*. All are associated with the upland Environmental Zones. For example, in England and Wales, all three show their largest area in Environmental Zone 3. In Scotland, these habitats show their largest areas in Zone 5, the intermediate and islands, and Zone 6, the true uplands.

6.11 The data for net change in area since 1990 suggest that the UK stocks of *Bog, Dwarf Shrub Heath* and *Acid Grassland* Broad Habitats have declined. The loss of *Acid Grassland* is statistically significant within Great Britain, but not Northern Ireland.

6.12 In the UK, *Acid Grasslands* showed a loss of 157,000 ha, or about 10% of its 1990 area. Most of the loss was concentrated in England and Wales, especially in the uplands (Environmental Zone 3), where it was lost to *Improved Grassland* and other semi-natural habitats such as *Bog, Dwarf Shrub Heath* and *Bracken* (see Figure 6.1). Where *Acid Grassland* occurs in the lowlands (Zones 1 and 2) the loss was mainly to *Improved Grassland*. The loss of *Acid Grassland* to *Bog* and *Dwarf Shrub Heath* is a positive feature, consistent with objectives contained in the upland Habitat Action Plans. However, the loss to *Improved Grassland* is a matter of concern, since it goes against the BAP objectives set for this Broad Habitat, particularly where it occurs in lowland environments (See Box 6.1).

6.13 The *Bog* Broad Habitat shows some geographical contrasts in the changes observed between 1990 and 1998. There is a significant decline in Northern Ireland with losses primarily to *Coniferous Woodland* and grassland types associated with the uplands. Elsewhere, most of the loss is concentrated in Scotland, where it constitutes the most extensive of all the Broad Habitats. In Scotland the decline was mostly in Environmental Zones 4 and 5. These changes are not consistent with BAP objectives for this Broad Habitat or relevant Priority Habitats

6

Table 6.1: Stock and change ('000ha) for the more extensive Semi-natural Broad habitats, 1990-98. Changes which are statistically significant (p<0.05) are indicated in bold.

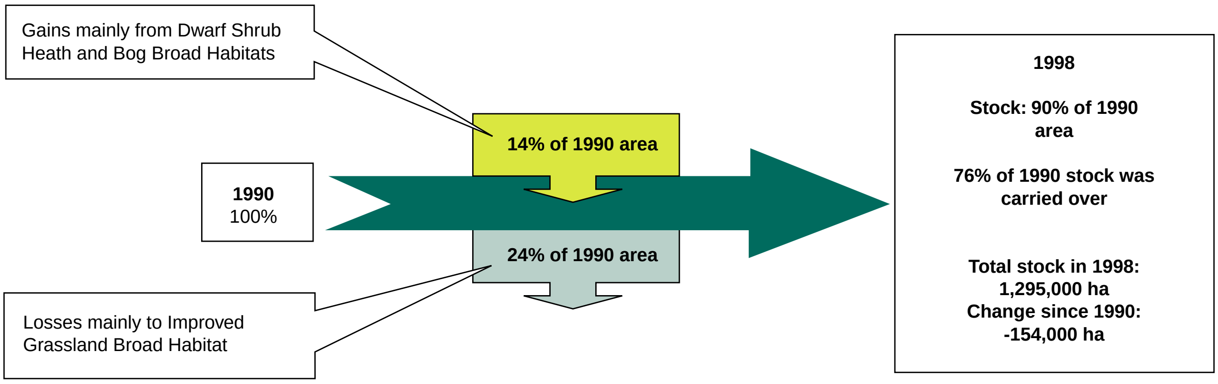
Country and Environmental Zone		Acid Grassland			Bog			Dwarf Shrub Heath		
		98 stock	change	%[a]	98 stock	change	%[a]	98 stock	change	%[a]
E&W	1	24	-7	-53.1	5	4	534.2	12	(+)	4.6
	2	60	-33	-35.9	21	**2**	9.0	56	-12	-17.7
	3	464	**-77**	-13.3	154	-7	-2.8	417	12	3.5
	Total	547	**-116**	-17.1	180	-1	-0.5	485	(+)	(+)
Scotland	4	84	**-15**	-14.8	117	-13	-9.1	91	5	5.9
	5	159	-16	-9.4	884	-19	-2.2	220	**-21**	-8.3
	6	506	-8	-1.4	1037	14	1.4	691	-42	-5.7
	Total	748	-39	-4.9	2038	-17	-0.9	1002	-58	-5.4
NI		28	-2	-8.0	148	**-13**	-8.3	13	-1	-7.6
UK		1323	-157	-10.4	2366	-32	-1.3	1500	-59	-3.9

Country and Environmental Zone		Fen Marsh and Swamp			Bracken			Calcareous Grassland		
		98 stock	change	%[a]	98 stock	change	%[a]	98 stock	change	%[a]
E&W	1	21	**13**	123.0	15	4	48.6	27	-7	-20.0
	2	83	20	30.5	88	2	2.6	11	-3	-17.8
	3	107	10	12.2	170	18	8.2	(+)	(+)	0.0
	Total	210	**43**	27.1	273	24	7.9	38	**-9**	-19.2
Scotland	4	71	2	3.0	44	2	4.9	(-)	(-)	0.0
	5	177	33	22.0	67	(-)	-1.6	27	**-5**	-16.3
	6	89	20	27.4	55	2	4.6	(+)	(+)	0.0
	Total	337	**55**	18.7	166	4	2.6	27	**-5**	-16.2
NI		53	**-12**	-18.6	4	(+)	4.6	0.9	(+)	-7.2
UK		600	86	16.6	443	28	6.2	66	-15	-17.8

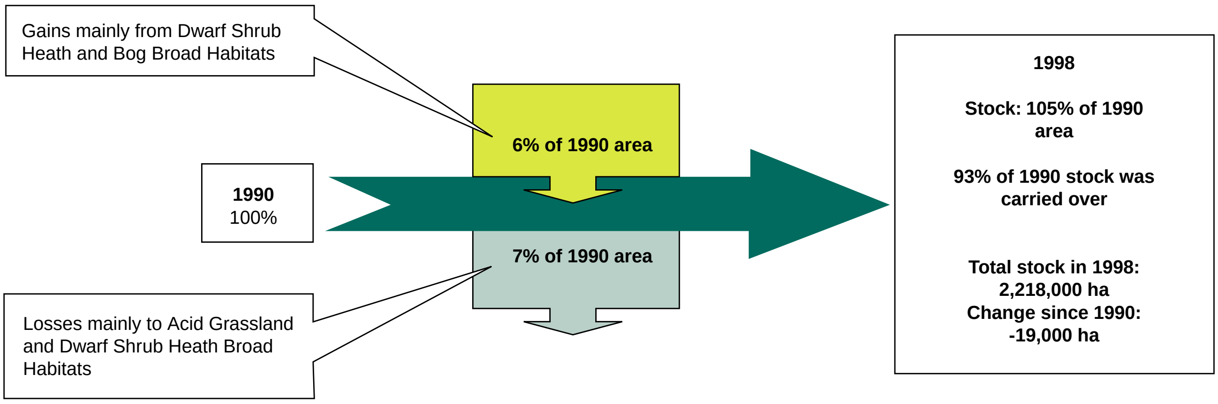
(+) = value between 0.00 and 1 (-) = value between 0.00 and -1
%[a] Percentage change as a % of 1990 stock

Figure 6.1: Turnover of *Acid Grassland*, *Bog*, *Dwarf Shrub Heath*, *Fen Marsh and Swamp*, *Bracken* and *Calcareous Grassland* Broad Habitats in Great Britain from 1990–1998

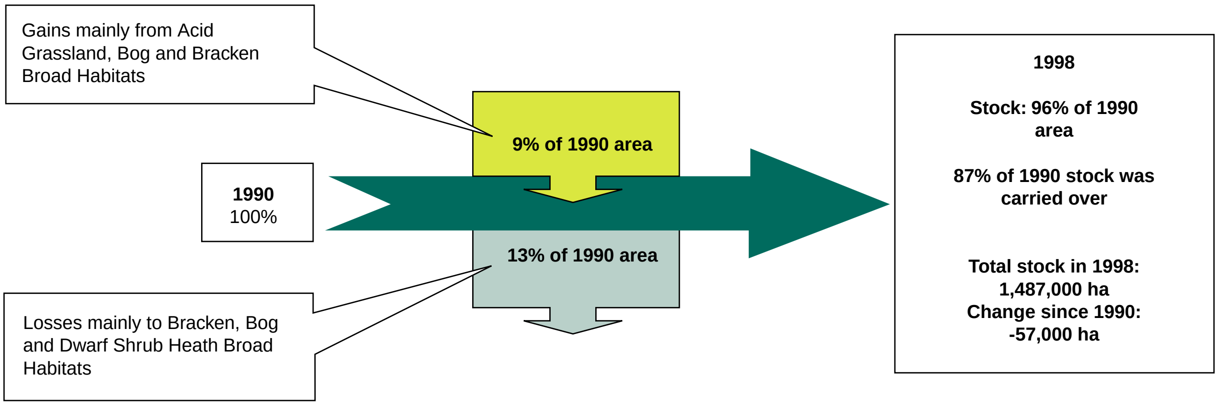
Acid Grassland



Bog



Dwarf Shrub Heath

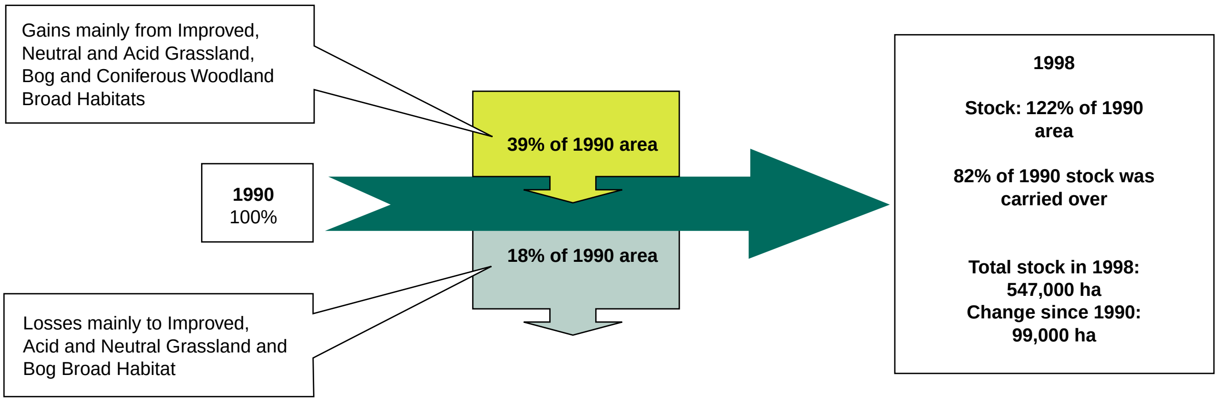


(Box 6.1). The large percentage gain in England, in Environmental Zone 1, is not statistically significant, and arises as a result of the small initial area used to calculate the percentage change.

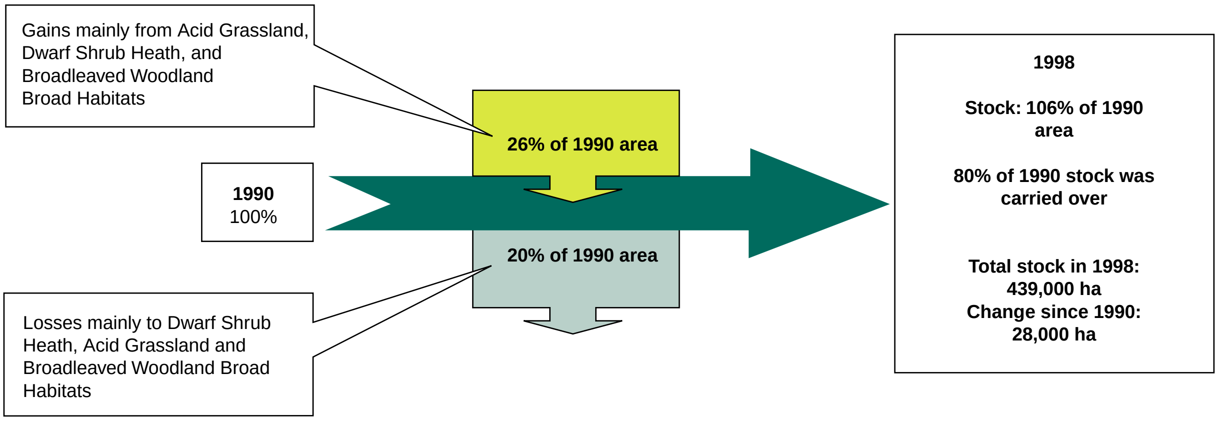
6.14 The national stock of *Dwarf Shrub Heath* has also not changed significantly since 1990 but, in view of the high conservation importance of this Broad Habitat, the small loss in the sample should be investigated further. Table 6.1

Figure 6.1 (continued)

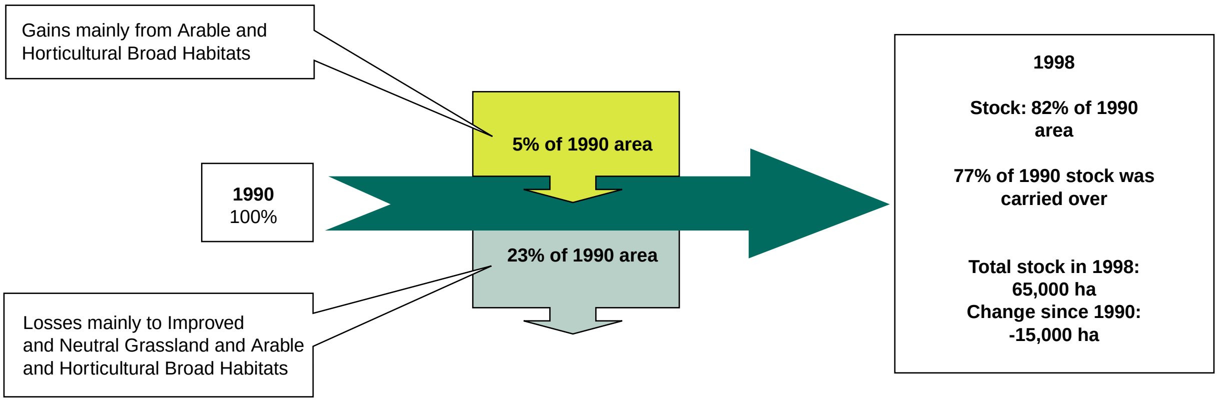
Fen, Marsh and Swamp



Bracken



Calcareous Grassland



suggests that the losses were widespread, occurring in Scotland, in Environmental Zones 5 and 6, in England and Wales, in lowland Environmental Zone 2, and Northern Ireland.

Detailed analysis of the transfers into and out of this habitat type suggests that in Great Britain the losses are mainly to the *Coniferous, Acid Grassland* and *Bog* Broad Habitats (Figure 6.1).

6.15 The loss of *Dwarf Shrub Heath* to *Coniferous Woodland* is of concern, given the BAP objectives for this habitat. However, as noted in Chapter 5, part of the decline could be due to young woodland that was planted in heather being classed as *Heath* in the last Countryside Survey. CS1990 and the first NICS took place at the end of a period of widespread conifer afforestation of heath. By 1998, such woodland would have become established and the habitat reclassified as *Coniferous Woodland*.

6.16 The losses of *Dwarf Shrub Heath* to *Acid Grassland* may be the result of overgrazing, inappropriate burning and possibly nutrient inputs. If so, both trends are inconsistent with current BAP objectives (Box 6.1). The extent to which the small gain in upland England and Wales (Zone 3) reflects conservation efforts in these areas is also an issue that requires further investigation. Changes to *Bog* probably reflect different interpretations by field surveyors in complex habitats.

6.17 The area of *Bracken* does not show a significant change over the period 1990 to 1998. This result is of interest because it showed a marked decline between 1984 and 1990, a change that was in line with general policy objectives for this habitat. The results of CS2000 suggest that this trend has slowed or even reversed in some areas, such as the uplands of England and Wales (Zone 3), where expansion seems to have occurred at the expense of *Acid Grassland, Dwarf Shrub Heath* and *Bog*. If the area of *Bracken* is once again increasing locally, then this is inconsistent with policy initiatives such as the Moorland Scheme.

6.18 *Calcareous Grassland* occupies only a small area within the UK, but it is an important habitat because of its high biodiversity. This habitat is one that has experienced considerable loss during the twentieth century. The results of CS2000 and NICS2000 suggest that, although the rate of decline in the 1990s is now much smaller than in the past, some loss is still occurring. An estimated 18% of the UK stock has been lost since 1990, mainly to *Improved Grassland*.

6.19 Given the geographical concentration of the *Calcareous Grassland* Broad Habitat it is unlikely that a general survey like CS2000 would be able to report stock and change precisely. The stock estimate obtained from CS2000 and NICS2000 is, however, close to that published in the relevant Habitat Action Plan, which suggests that the UK area of upland and lowland *Calcareous Grassland* is between 55,000 and 66,000 ha. Despite the similarity it should be noted, however, that CS2000 records very little stock in the uplands of England and Wales (Environmental Zone 3), although limestone grasslands are locally extensive in some upland regions. The issue requires further investigation, because at the very least the results suggest a decline in the stock of less intensively managed grasslands on calcareous substrates.

RUSH PASTURES, PART OF THE FEN, MARSH AND SWAMP BROAD HABITAT, SOUTH-WEST SCOTLAND *(C BARR)*

6

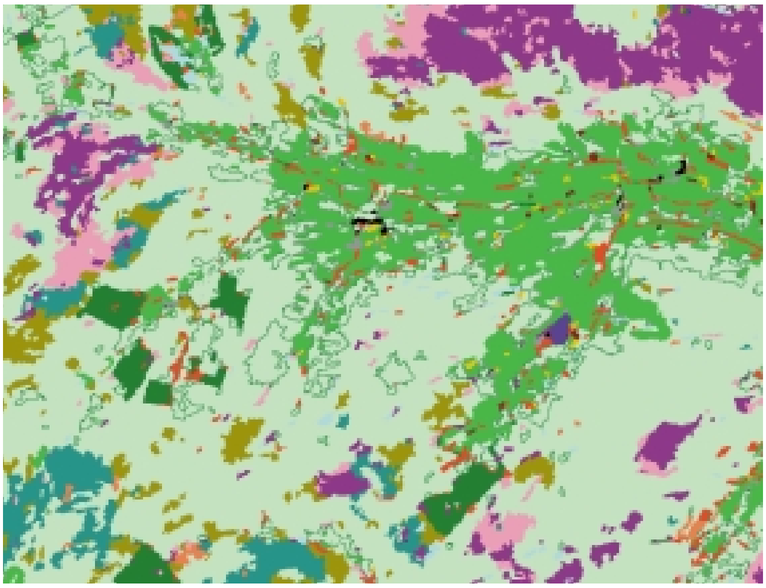
6.20 The *Fen, Marsh and Swamp* Broad Habitat has shown a significant increase in area since 1990, in England and Wales (27%), and in Scotland (19%) separately. The gains occurred in all Environmental Zones in Great Britain. It showed a significant decline in Northern Ireland (-19%). Detailed analysis of the transfers between Broad Habitats in Great Britain suggests that it has mainly gained area from the *Improved, Acid* and *Neutral Grassland* Broad Habitats, and *Bog*.

6.21 Although the expansion of *Fen, Marsh and Swamp* is consistent with the general BAP objectives for this Broad Habitat (Box 6.1), the gain is perhaps offset by the loss of areas of *Acid* and *Neutral Grasslands*, and *Bog*. Analysis of the vegetation data collected as part of CS2000, suggests that the assignment of habitats to the *Fen, Marsh and Swamp* class may have been the result of the expansion of rushes (*Juncus* spp.). These are plant species that are characteristic of this habitat.

6.22 Management neglect following a history of grazing is the most likely cause of the expansion of rushes, although further work is required to confirm that this is the case. If it is, then additional analysis may also be required to investigate what is happening to the wetter components of the *Fen, Marsh and Swamp* Broad Habitat, which contain much of their special conservation value. If the reassignment of areas to *Fen Marsh and Swamp* has mainly been due to the expansion of rushes, then there has probably been limited conservation gain. LCM2000 may be useful in taking this work forward since early outputs from this research indicate that the image analysis techniques are able to detect detailed ecological patterns within a Broad Habitat. The example shown in Box 6.2 illustrates how rush-dominated grasslands can be mapped.

6.23 CS2000 also recorded the stock of the *Montane* and *Inland Rock* Broad Habitats. Neither showed any significant change since 1990. The total stock of *Montane* was 49,000 ha. It occurred mostly in Environmental Zone 6, the highlands of Scotland. The stock of *Inland Rock* was about 56,000 ha.

Box 6.2: *Rush*-dominated grasslands – Wensleydale and the Pennines



The Land Cover Map records boundaries of all spectrally distinct land parcels, with class-subdivisions going below the level of the Broad Habitats. The dull green area here shows *Acid Grassland* in Wensleydale. The LCM2000 database has been searched to highlight land parcels classifed as *rush*-dominated acid swards. Notice their distinctive distribution, typically around the margins of the *Improved Grasslands* (shown in bright green).

6.24 Most of the changes in stock of semi-natural habitats were not statistically significant. This is partly because the relatively small area and concentrated distribution of these habitats means that they are not well-represented in the CS2000 and NICS2000 samples. Also highly variable changes, with increases in some areas and losses elsewhere, are the most difficult to detect. There are some difficulties in the identification of complex habitat mosaics in the field. To help address these problems additional sample squares were included in the uplands of England and Wales in CS2000. The new squares cannot be used now to estimate change, but they improve the baseline for detection of changes in these habitats in the future, in conjunction with the new Land Cover Map 2000.

Habitat condition

6.25 One of the key findings of Countryside Survey 1990 was that the quality of some upland vegetation types was declining. The Broad Habitats classification was not used in Countryside Survey 1990 and the conclusion was based on the observation that species richness had declined in upland wooded and moorland grass mosaic vegetation types between 1978 and 1990. At the same time there were increases in species richness in heath and bog, vegetation types that are inherently species poor (see *QOLC* indicator for plant diversity in Chapter 2). The increase in species richness appeared to be due to the increased frequency of 'weedy' species characteristic of disturbed and nutrient rich grassland. Using the new analytical tools available to CS2000 we can make a more detailed assessment of how the condition of the Broad Habitats has changed since 1990. These data are only available for Great Britain.

6.26 Data from the vegetation sample plots located within the semi-natural Broad Habitats suggest that further losses of ecological quality may have occurred since 1990. Within the *Acid Grassland, Dwarf Shrub Heath, Fen, Marsh and Swamp*, and *Bog* Broad Habitats there has been an increase in species characteristic of more fertile situations, and reduced abundance of others that are able to tolerate the low nutrient conditions normally associated with these habitats. The species showing an increase are those more typical of semi-improved grasslands in lowland areas rather than these semi-natural habitats in upland locations. The magnitudes of these changes are relatively small, but the trend is one that has previously been linked to the parallel influences of over-grazing, disturbance and atmospheric deposition[1]. There is also evidence that vegetation might be responding to changes in soil acidity in these environments.

DWARF SHRUB HEATH BROAD HABITAT, NORTH YORKSHIRE *(DAVID WOODFALL)*

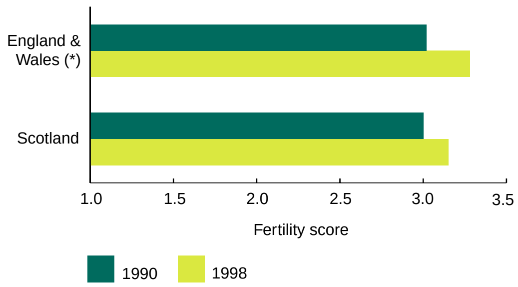
6.27 The *Acid Grassland* Broad Habitat consists of a mosaic of different vegetation types. Figure 6.2 shows how the composition of this mosaic has changed between 1990 and 1998. In general there was a shift towards those vegetation types

1 Firbank, L.G., Smart, S.M., van de Poll, H.M., Bunce, R.G.H., Hill, M.O., Howard, D.C., Watkins, J.W. and Stark, G.J. (2000) *Causes of Change in British Vegetation*, ITE, Merlewood.

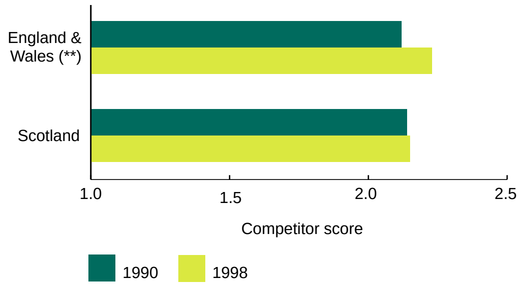
Figure 6.2: Changes in vegetation condition measures for the *Acid Grassland* Broad Habitat, 1990-1998.

Condition measure	Conclusion and significance
Change in the proportions of different vegetation types within repeat plots located in the **Acid Grassland** Broad Habitat in 1990	These data are for random (X) plots located within the Broad Habitat in GB. Each plot was assigned to a vegetation class on the basis of its species composition at the two survey dates. The same plots were surveyed in 1990 and 1998. Between 1990 and 1998 there was a shift towards vegetation types characteristic of fertile and infertile grasslands, and movement away from moorland grass mosaics and heath/bog.

Condition measure	Conclusion and significance
Change in mean fertility score 1990-1998 for random (X) plots in the moorland grass mosaics vegetation type in the Acid Grassland Broad Habitat.	The change for England and Wales is significant, but it is not for Scotland. The change for England and Wales represents a small but significant **increase** in fertility score. The mean difference was 0.3 and the 95% confidence limit for this change was ±0.23. The analysis was based on 23 paired sample plots.



Condition measure	Conclusion and significance
Change in mean competitor score 1990-1998 for random (X) plots in the moorland grass mosaics vegetation type in the Acid Grassland Broad Habitat.	The change for England and Wales is significant, but it is not for Scotland. The change for England and Wales represents a significant **increase** in competitor score. The mean difference was 0.1 and the 95% confidence limit for this change was ±0.08. The analysis was based on 23 paired sample plots.

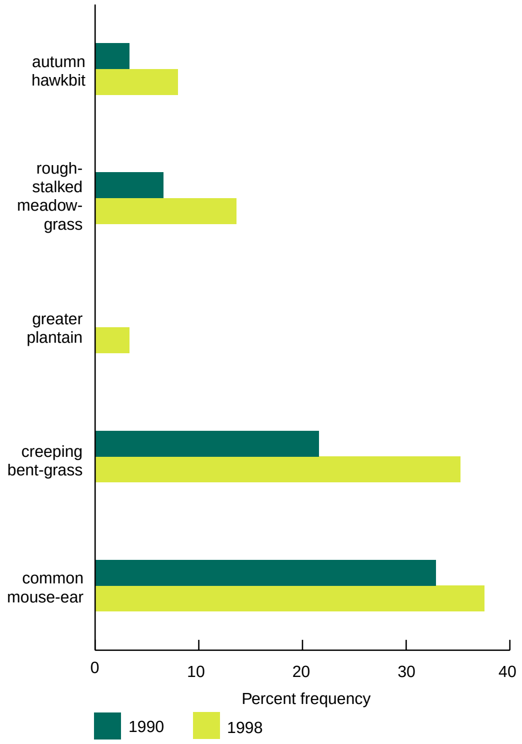


more typical of fertile and infertile grasslands. As Figure 6.2 also shows this has resulted in a significant increases in the fertility and competitor scores of plots within this Broad Habitat in England and Wales.

6.28 Figure 6.3 shows how the frequency of plant species normally associated with more competitive, nutrient rich habitats have changed between 1990 and 1998 in the *Acid Grassland* Broad Habitat. The data are for those plots assigned to the moorland grass vegetation type.

Although the changes are small they are potentially significant for the future of this Broad Habitat, because the trend is a continuation of that recorded by the last Countryside Survey for the period 1978 to 1990. They also occur at a time when there is evidence that the soils associated with these habitats are becoming slightly less acidic.

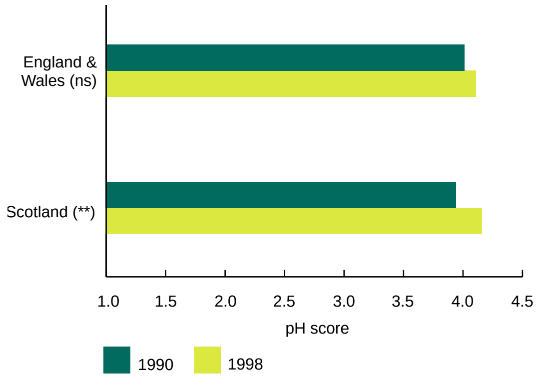
Figure 6.3: Change in frequency of individual plant species in main (X) plots in GB that were assigned to the moorland grass mosaic vegetation type in 1990. The species shown are more typically associated with fertile, lowland situations.



Note: All changes apart from common mouse-ear were statistically significant at P<0.05, .

6.29 The analysis of soil samples collected alongside vegetation plots in 1978 and 1998 suggests that there has been a significant reduction in soil acidity over the last 20 years. The reduction is especially marked for those soils that are most acid, such as those found in association with acid grasslands (See Chapter 2 for discussion). As Figure 6.4 shows, analysis of vegetation plots from within the *Acid Grassland* Broad Habitat provides further, independent data that are consistent with the trend detected from the analysis of soils. For vegetation plots in Scotland, there was a significant increase in the condition measure for soil acidity, indicating a decrease in frequency of plants that are normally favoured by the extreme acidic conditions associated with this Broad Habitat.

Figure 6.4: Changes in pH score for plots in the *Acid Grassland* Broad Habitat, 1990-98.



An increase in mean pH score indicates an average **increase** in the proportion of plants adapted to less acid soils. These data are for all vegetation types found within sample plots located within the Broad Habitat (X plots). The increase was not significant for England and Wales, but it was for Scotland. In Scotland, the mean difference in between 1990 and 1998 was 0.2 and the 95% confidence limit for this change was ±0.13. The analysis was based on data from 47 paired plots.

6.30 The *Dwarf Shrub Heath* Broad Habitat is made up of a mosaic of different vegetation types. The most widespread of these are moorland grass and heath and bog (Figure 6.5). Analysis of the vegetation plots that remained in this Broad Habitat between 1990 and 1998 shows that there was a net change in the proportions of the different vegetation types with an overall shift from the heath and bog type to moorland grass mosaic. In England and Wales, the number of plots with heath and bog vegetation declined by 16%. This change is a continuation of the net movement of heath and bog into vegetation with a higher proportion of grasses that was seen between 1978 and 1990. Given the conservation value of these areas, this preliminary result deserves a more detailed analysis of the data.

6

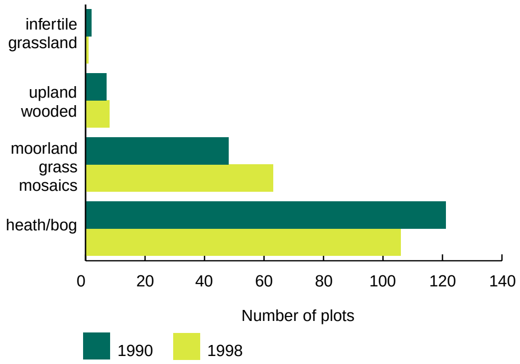
6.31 Changes in heath and bog vegetation were associated with a statistically significant increase in mean fertility score in England and Wales (Figure 6.5). This indicates a shift in favour of plant species associated with situations typical of higher nutrient availability. In Scotland the moorland grass vegetation type associated with *Dwarf Shrub Heath* showed a similar pattern of change to that observed within *Acid Grassland*. Competitive species showed a significant increase while the frequency of 'stress tolerators' declined. The changes to the vegetation plots associated with *Dwarf Shrub Heath* suggest a degradation of habitat quality. Given the conservation value of these areas, and the BAP targets to increase the cover of dwarf shrubs, this preliminary result needs to be examined in more detail.

6.32 The *Bog* Broad Habitat is also characterised by a mixture of 'moorland grass' and 'heath and bog' vegetation types. Most of the *Bog* surveyed in the Countryside Survey is upland blanket bog. Between 1990 and 1998 there was an 8% decrease in plots containing the heath and bog vegetation and a corresponding increase in moorland grass vegetation within the Broad Habitat (Figure 6.6). The analysis of the vegetation plot data suggests that these changes in character could be associated with higher soil fertility and higher grazing pressure.

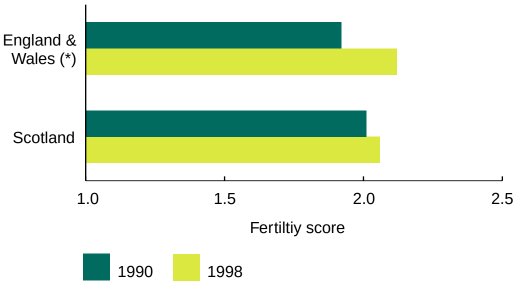
6.33 Over the same period, there was a statistically significant increase in fertility score for plots assigned to the 'heath and bog' vegetation type that occurred within the *Bog* Broad Habitat both in Scotland as a whole and within the

Figure 6.5: Changes in vegetation condition measures for the *Dwarf Shrub Heath* Broad Habitat, 1990-98.

Condition measure	Conclusion and significance
Changes in proportions of different vegetation types within **Dwarf Shrub Heath** Broad Habitat in Great Britain, 1990-1998	These data are for random (X) plots located within the Broad Habitat in GB. Each plot was assigned to a vegetation class on the basis of its species composition at the two survey dates. The same plots were surveyed in 1990 and 1998. Between 1990 and 1998 there was a shift towards vegetation types characteristic of moorland grass mosaics and net movement away from heath/bog.



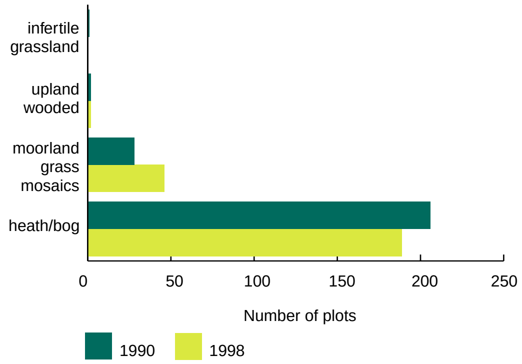
Condition measure	Conclusion and significance
Change in mean fertility score 1990-1998 for heath/bog vegetation type in Dwarf Shrub Heath Broad Habitat. The data are for the targeted habitat (Y) plots.	The change for England and Wales is significant, but it is not for Scotland. The change for England and Wales represents a small but significant **increase** in mean fertility score. The mean difference was 0.2 and the 95% confidence limit for this change was ±0.15. The analysis was based on 16 paired sample plots.



intermediate uplands and islands in Scotland (Environmental Zone 5). For plots in Scotland there was also a decrease in the frequency of 'stress-tolerators', that is plants adapted to the more extreme conditions found in this Broad Habitat. As in the case of *Acid Grassland*, the vegetation plots recorded within the *Bog* Broad Habitat also show evidence of a reduction in soil acidity in Scotland (Figure 6.7). The reduction in acidity is indicated by the increase in the mean pH score in plots containing the heath and bog vegetation in this Broad Habitat.

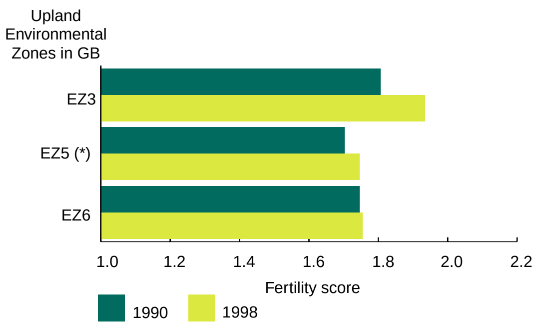
Figure 6.6: Changes in vegetation condition measures for the *Bog* Broad Habitat in Great Britain, 1990-98.

Condition measure	Conclusion and significance
Changes in proportions of different vegetation types within **Bog** Broad Habitat in Great Britain, 1990-1998.	These data are for random (X) plots located within the Broad Habitat in GB. Each plot was assigned to a vegetation class on the basis of its species composition at the two survey dates. The same plots were surveyed in 1990 and 1998.



Changes in fertility score by Environmental Zone for main (X) plots assigned to the heath/bog vegetation type within the Bog Broad habitat, 1990-1998.

The change in fertility score is significant in Zone 5, but not Zones 3 or 6.

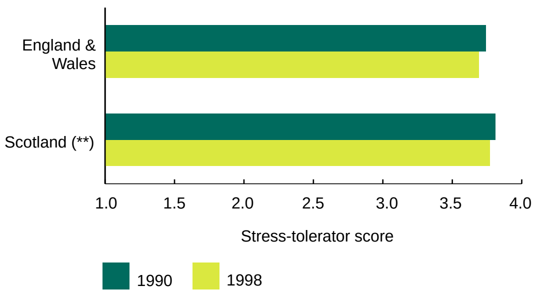


The change for Zone 5, the intermediate uplands and islands in Scotland, represents a small but significant **increase** in mean fertility score. The difference was 0.05 and the 95% confidence limit for this change was ±0.04. The analysis was based on 95 paired sample plots.

There was also a significant **increase** when all Scottish Environmental Zones were aggregated together. Although the difference recorded for plots in Zone 3 is larger than that found in Zone 5, it is not statistically significant since only 13 paired plots were available for analysis.

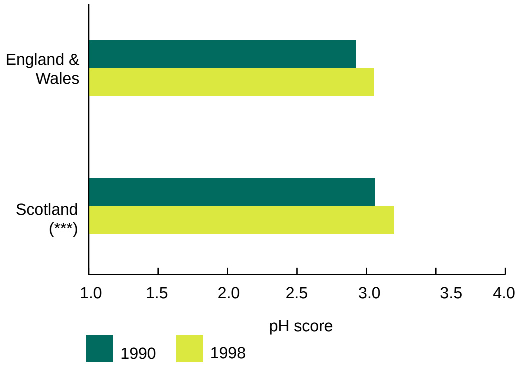
Change in the stress-tolerator score for main (X) plots assigned to the heath/bog vegetation type within the Bog Broad Habitat, 1990-98.

The change is significant for Scotland, but not England and Wales.



The change for Scotland represents a statistically significant **decrease** in the mean stress tolerator score. The mean difference was -0.04 and the 95% confidence limit for this change was ±0.03. The analysis was based on 175 paired plots.

Figure 6.7: Changes in the vegetation condition measure for soil acidity for plots in the *Bog* Broad Habitat, 1990-98.

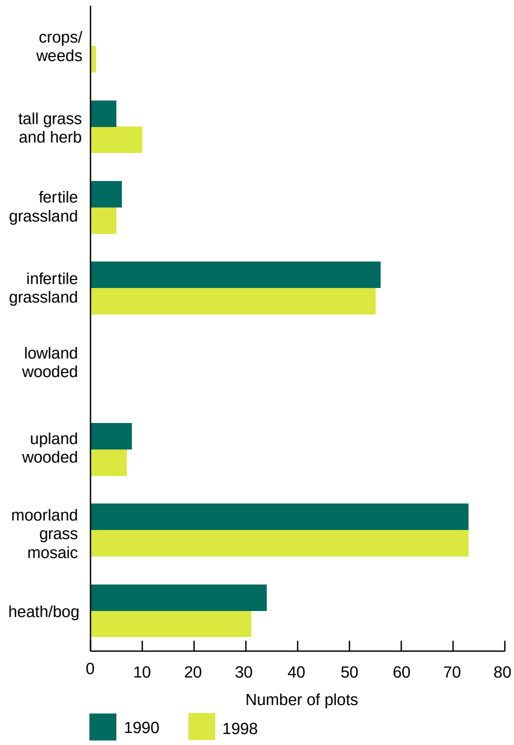


An increase in mean pH score indicates an average **increase** in the proportion of plants adapted to less-acid soils. These data are for all vegetation types found within main (X) plots located within the Broad Habitat. The increase is not significant for England and Wales, but it is for Scotland. In Scotland, the mean difference in scores was 0.1 and the 95% confidence limit for this change was ±0.06. The analysis was based on data from 198 paired plots.

6.34 The range of vegetation types associated with the *Fen, Marsh and Swamp* Broad Habitat is similar to that of *Acid Grassland*, except there is a greater proportion of infertile and fertile grassland types (Figure 6.8). There are relatively few sample plots in CS2000 to represent this very diverse group of habitats and it is difficult to draw conclusions about changes in vegetation condition from the preliminary analysis.

6.35 Although vegetation plots in the other semi-natural Broad Habitats – *Calcareous Grassland, Bracken, Montane* and *Inland Rock* were surveyed in CS2000, the sample size was also too small to allow general statements about their condition. The data may however provide some indications of the changes affecting these less widespread habitats. For example, of the 21 targeted 'habitat' plots in the *Calcareous Grassland* Broad Habitat classified as infertile grassland in 1990, two (10%) had been 'improved' to fertile grassland and one (5%) had transferred to lowland wooded vegetation by 1998, consistent with the decline in extent of this habitat noted above.

Figure 6.8: Change between 1990 and 1998 in proportions of different vegetation types in repeat plots located within the *Fen, Marsh and Swamp* Broad Habitat in Great Britain in 1990.



The chart shows changes in main (X) plots and targeted habitat (Y) plots together. Each plot was assigned to a vegetation class on the basis of its species composition at the two survey dates. The same plots were surveyed in 1990 and 1998.

Conclusions and implications

6.36 The major widespread semi-natural Broad Habitats of *Acid Grassland, Dwarf Shrub Heath, Fen Marsh and Swamp, Bog, Calcareous Grasslands, Bracken, Montane* and *Inland Rock* extended to an estimated 6.4 million ha in 1998, a quarter of the UK. These are mostly concentrated in the upland Environmental Zones of England and Wales, Scotland and Northern Ireland where they are important resources for biodiversity, outdoor recreation and rough grazing.

6.37 In the 1990s, the stock of *Dwarf Shrub Heath* and *Bracken* has varied locally but showed no significant net change for UK as a whole. *Bog* decreased in Northern Ireland. *Acid* and *Calcareous Grassland* Broad Habitats showed declines of 10% and 18%, respectively. Losses of *Acid Grassland* were greatest in England and Wales and involved transfers to *Improved Grassland, Bracken* and *Fen, Marsh and Swamp*. Losses of *Calcareous Grassland* were mainly to *Improved Grassland*.

6.38 The *Fen, Marsh and Swamp* Broad Habitat increased by about 17% for the UK as whole, though there were losses in Northern Ireland. In the uplands of Great Britain, this habitat gained area from *Improved* and *Acid Grasslands*. The change appears to be associated with grassland reversion and the expansion of rushes. *Fen, Marsh and Swamp* includes a number of Priority Habitats and the increase in area may be generally regarded as a benefit for biodiversity, but the transfers with other semi-natural habitats need to be investigated further.

6.39 The ecological quality of some of the more widespread semi-natural habitats has remained stable but others have declined since 1990. In *Bog* and *Dwarf Shrub Heath* the characteristic heath and bog vegetation declined and moorland grass increased. Changes in vegetation implied increasing fertility levels. It is uncertain to what extent grazing management and deposition of atmospheric nitrogen are the driving forces of these changes.

6.40 Countryside Survey 2000 shows that soil acidity has decreased since 1978 in acid soils most commonly associated with upland environments. Moorland grass mosaics and heath and bog vegetation also showed shifts in the 1990s in favour of plants associated with less acid soils. These new trends suggest a possible reversal of acidification and deserve closer inspection.

6.41 The analysis of the results of CS2000 and NICS2000 for the semi-natural Broad Habitats as a whole suggests that the trends observed from 1990 to 1998 are generally contrary to the objectives and specific targets to maintain and enhance these habitats, as set out in the Biodiversity Action Plan. This is perhaps not surprising, as it is the concern about the losses in extent and quality of these habitats in recent decades that have stimulated the UK Biodiversity Group to develop action plans for the Priority Habitats. The first habitat action plans were published in 1995 but the full set, including the extensive upland habitats primarily considered here, were not published until 1999. The targets for restoration of Priority Habitats are set for 5 to 15 years hence (Box 6.1). The results of CS2000 help to clarify the scale and nature of the problems and emphasise the need for concerted action.

MOSAIC OF HEATHER AND MOORLAND GRASS IN DWARF SHRUB HEATH, POWYS (A STOTT)

Standing Waters were assessed in terms of the number and area of inland water bodies. *Rivers and Streams* were assessed in terms of the biological condition of the water course, the structure of the river corridor and the status of streamside vegetation. The total area of the *Standing Waters* is about 190,000 ha and there are nearly 400,000 inland water bodies in Great Britain. The area of inland water bodies has not changed significantly during the 1990s, but the number of small water bodies has increased. There have been significant improvements in the biological condition of *Rivers and Streams* in England and Wales and in Scotland.

7 rivers, streams and standing waters

Introduction

7.1 This chapter presents the results of CS2000 for the two freshwater Broad Habitats: *Standing Waters and Canals*, and *Rivers and Streams*. Each takes in both the water body itself and the associated waterside vegetation, and as a result each can be extremely varied in character. *Standing Waters and Canals* includes ponds, lakes, canals, ditches and reservoirs, whilst *Rivers and Streams* ranges from large rivers to small headwater streams. A more complete definition of each Broad Habitat is given in Appendix A.

7.2 These two freshwater Broad Habitats are valuable components of our countryside. Their qualities can be major influences on the character of landscapes. The habitats also support a wide range of plant and animal species, and are important for the management of water resources and recreation in the countryside. In the last decade the Environment Agency in England and Wales, the Scottish Environment Protection Agency and others have directed much effort to improving the biological condition of the freshwater environment. Box 7.1 provides an overview of the BAP objectives for these Broad Habitats.

7.3 The *Standing Waters* Broad Habitat was assessed in terms of its area and the number of inland water bodies. The *Rivers and Streams* Broad Habitat was assessed in terms of the biological condition of the water course, the structure of the river corridor and the status of

Box 7.1: Key objectives and targets for standing waters, canals, rivers and streams

Refs: *Biodiversity:* The UK Steering Group Report Volume 2 (1995), *The Tranche 2 Action Plan* Volume II (1998)

Broad Habitat	Key Objectives
Standing Water and Canals	■ Encourage appropriate management of standing waters and the adjacent land ■ Reduce nutrient enrichment in standing waters caused by fertilisers and nitrogen rich gases ■ Maintain appropriate hydrological regimes ■ Reduce acid emissions to reduce damage to standing waters from acid rain ■ Maintain the characteristic plant and animal communities of standing waters which are not significantly damaged by human activity ■ By 2010 implement remedial action to restore characteristic plant and animal communities to standing waters which have been damaged by human activity and that have been identified as a priority for restoration
Rivers and Streams	■ Encourage appropriate management of rivers and streams and the adjacent land ■ Reduce nutrient enrichment in rivers and streams caused by fertilisers and nitrogen rich gases ■ Maintain appropriate hydrological regimes ■ Reduce acid emissions to reduce damage to rivers and streams from acid rain ■ Maintain the characteristic plant and animal communities in the *chalk rivers* Priority Habitat ■ Restore water quality, flows and habitat diversity where they have deteriorated in *chalk rivers* which have been designated as SSSIs

7

streamside vegetation. This chapter describes the current state of the two freshwater Broad Habitats and how they have changed in England and Wales, and Scotland since 1990. Information about the biological condition of rivers and streams and vegetation along streamsides was not collected in Northern Ireland.

Habitat stock and change

7.4 The area covered by the two freshwater Broad Habitats is comparatively small and has changed little since 1990 (Table 7.1). As with the linear features, area alone is not the best guide to the stock of each of these habitats. For standing water bodies, changes in number give a better guide to the status of the resource. Stock and change data on numbers of standing water bodies are given in Table 7.2. These data show that while the area of standing waters has changed little since 1990, the number of inland water bodies increased by about 24,000 (ca. 4%) between 1990 and 1998.

7.5 Detailed analysis of the new standing water bodies recorded by CS2000 suggests that the bulk of the change was due to an increase in water bodies that were less than 20m x 20m in area. All of the increase occurred in England and Wales, especially in the westerly lowlands (Environmental Zone 2).

7.6 The change in the number of small water bodies or ponds is used in the Government's *Quality of Life Counts* indicator for landscape features, which was presented in Chapter 2.

Table 7.1: Stock and change (1990-98) for the Standing Waters and Canals and the Rivers and Streams Broad Habitats in Great Britain. Standard Error (SE) terms for the estimates are provided. Statistically significant changes (P<0.05) are shown in bold.

Country and Environmental Zone		Standing Waters and Canals					Rivers and Streams				
		1998 stock		change since 1990–98			1998 stock		change since 1990–98		
		Area '000 ha	SE '000 ha	Area '000 ha	SE '000 ha	%[a]	Area '000 ha	SE '000 ha	Area '000 ha	SE '000 ha	%[a]
England & Wales	1	65	43	(+)	1	1.0	16	3	(-)	(+)	-1.8
	2	17	6	(-)	(+)	-0.9	20	5	(-)	(+)	-2.0
	3	23	14	(+)	(+)	0.6	7	2	(-)	(+)	-6.5
	Total	106	46	(+)	1	0.7	43	6	**-1**	(+)	-2.7
Scotland	4	6	4	**1**	(+)	19.9	7	3	(-)	(+)	-0.4
	5	36	12	(-)	(+)	-2.1	8	3	(+)	(+)	8.2
	6	43	29	(+)	(+)	0.5	7	2	(-)	(+)	-5.3
	Total	85	32	(+)	1	0.6	21	4	(+)	(+)	0.9
GB		190	56	1	2	0.7	64	8	-1	1	-1.6

(+) = value between 0.0 and 0.05
(-) = value between 0.0 and -0.5
%[a] Percentage change as a % of 1990 stock

Table 7.2: Stock and change (1990–98) in numbers of standing water bodies in Great Britain. Standard Error (SE) terms or the estimates are provided.

Country and Environmental Zone		1998 Stock (number x100)	SE (number x100)	Change 1990–98 (number x100)	SE (number x100)
England & Wales	1	1321	193	73	44
	2	1082	136	**150**	67
	3	112	23	35	26
	Total	2515	237	**259**	84
Scotland	4	135	28	-1	11
	5	1128*	826	-10	12
	6	199*	83	-5	9
	Total	1462	831	-16	19
GB		3977	864	**244**	86

*This is likely to be a significant under-estimate because some areas of small, closely adjacent water bodies in Scotland were necessarily mapped as single units.

This is the result of an analysis of the data on 'lowland ponds' in England, Wales and Scotland. The analysis uses a definition of lowland ponds introduced in 1996, which included seasonal ponds.[1] For direct comparison with the 1996 and 1990 data the analysis of ponds is restricted to a sub-sample of 150 of the 1km x 1km CS2000 sample squares recorded in the lowlands. On the basis of these data, it is estimated that there were 243,000 lowland ponds in England, Wales and Scotland in 1998 (Table 7.3). There was a small net increase in the number of ponds in 1990-96[2] and a larger increase in 1996-98. Over the full period, 1990 to 1998, it is estimated that about 24,000 lowland ponds were lost and 37,000 new ponds were created, giving a net increase of about 13,000 ponds, equal to 6%.

LOWLAND PONDS ARE AN IMPORTANT RESOURCE FOR BIODIVERSITY, EAST ANGLIA *(C BARR)*

7.7 The gain in the stock of ponds between 1990 and 1998 represents a reversal of trends observed in the 1980s. Although new ponds may not necessarily compensate ecologically for ponds lost, as the report of the Lowland Pond Survey noted, they could in some circumstances have a higher conservation value than some old, neglected ponds. A biological assessment of ponds was not undertaken as part of CS2000.

Habitat condition

Streamside vegetation

7.8 As noted in Chapter 1, several types of vegetation survey plot were placed within the CS2000 field survey squares. These included 'streamside' plots, 10m x 1m, set down along the edge of the watercourse. Most linear streamside plots were located along small watercourses, rather than large rivers and standing water bodies. Thus we confine the assessment of vegetation condition to those areas neighbouring these streams, ditches and small rivers.

7.9 The streamside plots recorded in 1998 exhibited a varied botanical composition (Figure 7.1), with examples of seven of the eight general vegetation types described in Chapter 2. For the sample plots that have remained in the Broad Habitat since 1990, several key changes can be

Table 7.3: Stock and change (1990–98) in number of lowland ponds in Great Britain. Standard Error (SE) terms for the estimates are provided.

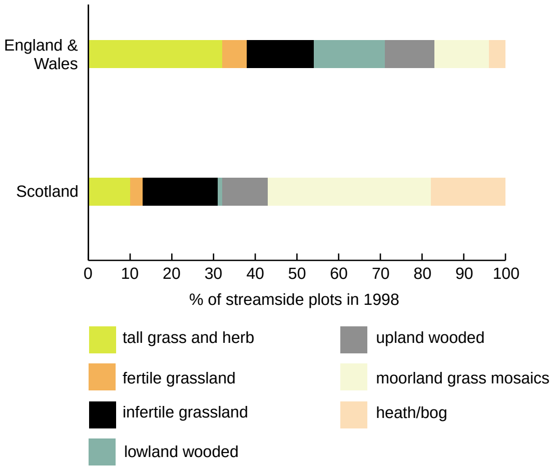
Country	1998 Stock ('000)	SE ('000)	%	Change 1990–1998	% 1990 stock
England and Wales	230.9	25	95	12.2	6
Scotland	11.7	3	5	0.5	5
Great Britain	242.6	28	100	12.7	6

1 A pond is defined as a body of standing water 0.25ha to 2 ha, in area, which usually holds water for at least four months of the year. Lowland is defined in terms of Environmental Zones 1, 2 & 4. Urban, garden and farmyard ponds were excluded. See 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.

2 The Lowland Pond Survey in 1996 reported a very small (2,000) net loss of ponds between 1990 and 1996. The surveyors in 1998 found that a number of new ponds in one sample square in Wales had been under recorded in 1996. When these new ponds were included in the analysis for 1990 to 1996 the small loss was converted to an estimated small net gain of 3,000 ponds. Surveyors also found a substantial number of newly created ponds in other sample squares in 1998.

observed for the various vegetation condition measures developed for the analyses of CS2000 data. There has been a general increase in fertility score, an overall reduction in species richness and an increase in competitive, tall growing vegetation, mainly comprising woody plants (Figure 7.2).

Figure 7.1: Vegetation type composition of streamside plots in the *Rivers & Streams* Broad Habitat in 1998, by country.



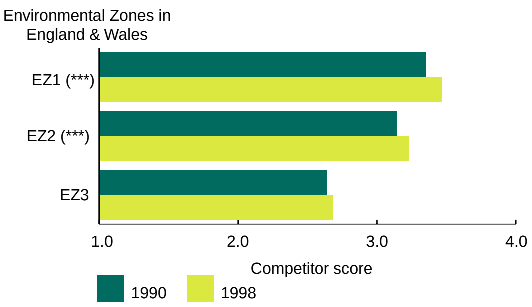
These data show the proportions of each vegetation type found in random (X) plots located within the Broad Habitat in 1998.

7.10 The changes recorded in the streamside plots were amongst the strongest shown by any of the plot types recorded in CS2000. At the level of the Environmental Zones, the changes were most marked in the lowland Zones 1 and 2, in England and Wales, and in Zone 4, in Scotland. In the upland Environmental Zone 3 of England and Wales, changes were less marked. In the lowlands, the changes are consistent with continuing successional changes (i.e. colonisation by tall herbs, shrubs and trees) that, in the long term, will result in more extensive cover of woody vegetation along streams. In the lowlands, hawthorn (*Crataegus monogyna*) and bramble (*Rubus fruticosus* agg.) have shown marked increases in abundance along streamsides since 1990 (Figure 7.3).

Figure 7.2: Change in condition measures for the *Standing Waters and Canals* and *Rivers and Streams* Broad Habitat in Great Britain, 1990-98. Analyses based on plots in all vegetation types sampled.

Condition measure

Mean competitor score in streamside (s/w) plots in Environmental Zones in England & Wales in 1990 and 1998.

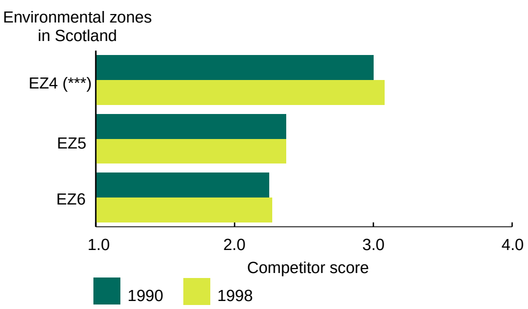


Conclusion and significance

The change was significant for the two lowland zones 1 and 2.

Highly significant **increases** in the proportion of competitive species were found in both zones. The mean difference in Zone 1 was 0.1 and the 95% confidence limit for the change was 0.04. The mean difference for Zone 2 was 0.1 and the 95% confidence limit for the change was 0.04. The analysis for Zone 1 was based on 396 plots. In Zone 2 there were 440 plots.

Mean competitor score in streamside (s/w) plots in Environmental Zones in Scotland in 1990 and 1998.



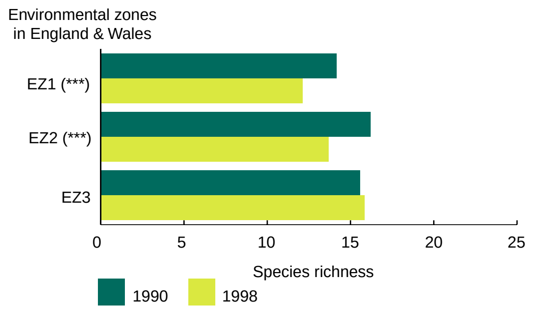
The change was only significant for the lowland zone 4.

A highly significant **increase** in the proportion of competitive species was found in Zone 4. The mean difference was 0.1. The 95% confidence limit for the change was 0.05. The analysis was based on 236 plots.

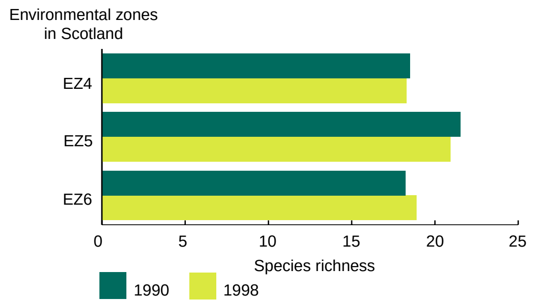
Figure 7.2: continued

Condition measure

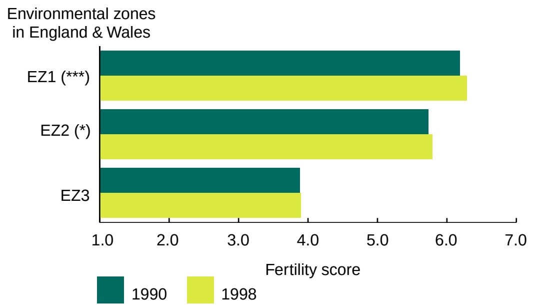
Mean species richness in streamside (s/w) plots in Environmental Zones in England and Wales in 1990 and 1998.



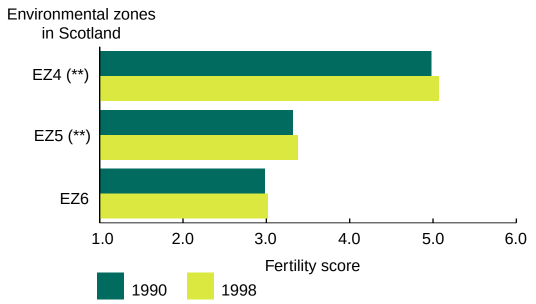
Mean species richness in streamside (s/w) plots in Environmental Zones in Scotland in 1990 and 1998.



Mean fertility score in streamside (s/w) plots in Environmental Zones in England & Wales in 1990 and 1998.



Mean fertility score in streamside (s/w) plots in Environmental Zones in Scotland in 1990 and 1998.



Conclusion and significance

The change was significant for both the lowland zones 1 and 2.

Highly significant decreases in mean species richness were found in both Zones. The mean difference in Zone 1 was –2.0 and the 95% confidence limit for the change was 0.75. The mean difference for Zone 2 was –2.5 and the 95% confidence limit for the change was 0.75. The analysis for Zone 1 was based on 396 plots.
In Zone 2 there were 440 plots.

None of the changes were statistically significant even though sample sizes were relatively large.

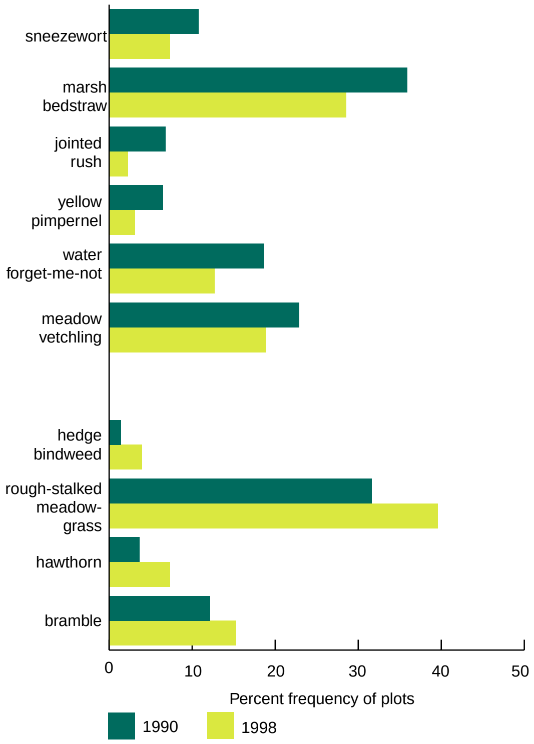
The change was significant for both the lowland Zones 1 and 2.

A highly significant **increase** in mean fertility score was found in Zone 1 and a small but significant **increase** in Zone 2. The mean difference in Zone 1 was 0.1 and the 95% confidence limit for the change was 0.05. The mean difference for Zone 2 was 0.1 and the 95% confidence limit for the change was 0.05. The analysis for Zone 1 was based on 396 plots. The analysis for Zone 2 was based on 442 plots.

The change was significant for both the lowland Zone 4 and the upland Zone 5.

In both Zones mean fertility score significantly **increased**. The mean difference in Zone 4 was 0.1 and the 95% confidence limit for the change was 0.05. The mean difference for Zone 5 was 0.1 and the 95% confidence limit for the change was 0.04. The analysis for Zone 4 was based on 236 plots. In Zone 5 there were 268 plots.

Figure 7.3: Examples of plant species that changed in abundance between 1990 and 1998 in streamside (S and W) plots located in infertile grassland in Great Britain in 1990. Those in the bottom half of the graph are relatively taller species that can dominate plant communities and can take advantage of high nutrient availability. Those in the upper half are generally smaller plants more typical of less fertile, agriculturally unimproved grasslands. All changes were significant at (P<0.05), except for meadow vetchling.



TALL GRASS AND HERB VEGETATION ON STREAMSIDES, WEST MIDLANDS

(DAVID DRAIN STILL PICTURES)

7.11 Changes appear to be the result of a reduction in the frequency of disturbance and probably less intensive management of these waterside habitats. The frequency of competitive plant species could also be affected by greater nutrient loads from enriched run-off and river water. Further work is required to examine the possible causes of these changes more fully.

7.12 The changes in vegetation condition observed in the linear streamside plots could be considered as beneficial for the overall chemical, biological and aesthetic condition of the water bodies and in this sense represent a gain in habitat quality. Recent research[3] suggests that riparian (i.e. bankside) buffer strips, managed separately from the rest of the field, have the potential to reduce sedimentation, diffuse pollution from fertilisers and pesticides, and reduce downstream flood risk. They can also enhance the visual quality and amenity of the landscape. Well-developed buffer strips may provide diverse habitats for freshwater and terrestrial wildlife and act as corridors for their movement. Finally they may improve fisheries by, for example, lowering the temperature of water by shading.

7.13 Such ecological gains due to development of these more woody, riparian buffer strips may, however, be offset by the loss of habitat quality for plant species that are under threat elsewhere in the landscape. Analysis of the changes in the frequency of plant species in the streamside plots suggested a loss of some species that had also become uncommon in the wider countryside, and for which the streamsides had become a refuge by the time of the 1990 survey. These species included sneezewort (*Achillea ptarmica*), yellow pimpernel (*Lysimachia nemorum*) and

3 Environment Agency (1996) *Understanding buffer strips*. An information booklet. Environment Agency, Bristol: 12pp,

marsh bedstraw (*Galium palustre*) (Figure 7.3). These changes could therefore be used to support the counter argument for a reduction of habitat quality, on grounds that banksides are becoming less effective as refuges for these plants, which are now being out-competed by the more aggressive, taller growing species in these environments.

7.14 Judgements about the significance of these changes in vegetation condition for overall 'habitat quality' will depend on conservation objectives and priorities in different situations. What is clear, however, is that these habitats have been particularly dynamic in recent years, and that for the future, site specific management regimes may need to be developed. These regimes could, for example, seek to maintain and enhance structural diversity of freshwater habitats which favour freshwater animals, invertebrates, small mammals and birds, whilst seeking to minimize the loss of rare or characteristic bankside plants.

The biological condition of streams

7.15 The biological condition of watercourses in the Countryside Survey sample squares was first recorded in 1990. The assessment was based on a survey of macro-invertebrates. The availability of CS2000 data provides an opportunity to find out how the condition of these important habitats has changed in England, Wales and Scotland. Equivalent data for Northern Ireland are not available. Altogether about 350 sites were sampled in both 1990 and 1998, about half of which were in England and Wales, and half in Scotland.

7.16 The methods used to assess the condition of streams were an index system called the *Biological Monitoring Working Party* (BMWP) score[4] and a software package called RIVPACS[5]. Explanations of these techniques are given in Box 7.2.

7.17 These techniques allow the types of animals collected at a site to be compared with the sorts of macro-invertebrate animals that should be present if the site were unpolluted. Figure 7.4a shows how the average number of groups of animals (taxon richness) at CS2000 sites in each of the six Environmental Zones compares with the average number of animals that should occur in each of these zones if all the same sites were unpolluted (i.e. in the 'reference state').

7.18 It can be seen that the expected richness of lowland sites (Zones 1, 2 and 4) is naturally higher than upland sites (Zones 3, 5 and 6). Overall, sites in England and Wales also have higher natural richness than in Scotland. These results reflect the intrinsic variation in physical and chemical character of the streams. By contrast, the observed richness for the samples collected by CS2000 showed smaller differences between Environmental Zones and countries than the expected values.

7.19 The relatively large differences between the observed and expected richness in England and Wales (Figure 7.4a) were due to the greater frequency of polluted rivers. This situation contrasts with Scotland, where the incidence of pollution appeared to be lower and less severe. Here the observed values are much closer to the 'reference state'.

4 Armitage, P.D., Moss, D., Wright, J.F. and Furse, M.T. (1983). The performance of a new biological water quality score system based on macro-invertebrates over a wide range of unpolluted running-water sites, *Water Research*, 17, 333-347.

5 Wright, J.F., Sutcliffe, D.W. and Furse, M. T. (eds.) (2000) *Assessing the biological quality of fresh waters. RIVPACS and other techniques*. Freshwater Biological Association, Ambleside: 400 pp.

7

Box 7.2: An explanation of the Biological Monitoring Working Party (BMWP) score system and the River Invertebrate Prediction and Classification System (RIVPACS)

The BMWP Score system provides a method of converting samples of animals taken from a water body into a set of simple numerical values. The animals used in this system are aquatic macro-invertebrates.

Aquatic macro-invertebrates are water-dwelling animals without backbones. They include groups such as snails, worms, leeches, shrimps, mayflies, dragonflies, water-bugs, beetles, caddis flies and midges.

In the ***BMWP Score system***, 82 different groups of animals are given scores that represent their tolerance to pollution. Animals that are intolerant to pollution are given a high score and those that are tolerant to pollution are given a low score. When a sample of animals is collected from the river the scores of all the different groups of animals present are added together to give the ***site score***. If there are many pollution intolerant groups present then the ***site score*** is high and its biological condition tends to be good.

Two indices of condition are derived from the ***BMWP Score system***. One is the number of groups present (***taxon richness***). The other is the average score, and, therefore, average pollution tolerance, of the animals present (i.e. the ***site score*** divided by the ***taxon richness***). This is called the ***ASPT***, or Average Score Per Taxon.

Because different types of watercourse can support different ranges of animals, the software package ***RIVPACS*** (River Invertebrate Prediction and Classification System) was developed to predict the ***taxon richness*** and ***ASPT*** to be expected at each different sort of site, if those sites were unpolluted. The expected values for a particular site may be considered to be its ***reference state***.

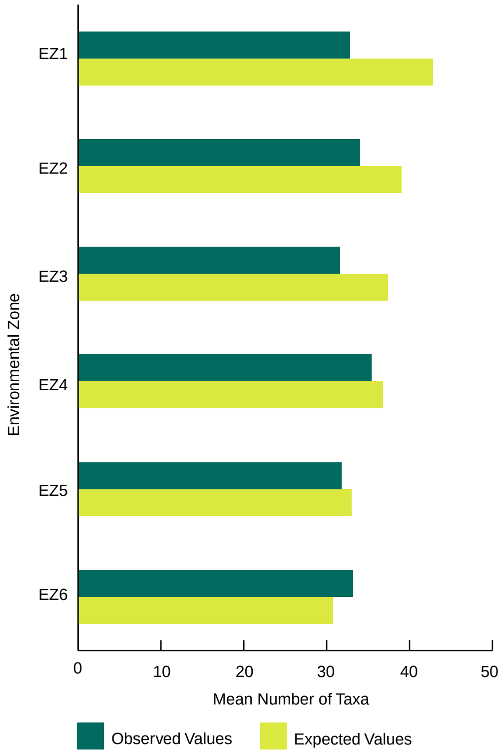
The true biological condition of sites can be judged by comparing the actual ***observed*** values of ***taxon richness*** and ***ASPT*** at a site with those that are ***expected*** if the site is not polluted.

The comparison of the ***observed*** and ***expected*** values can be expressed as a mathematical ratio (***observed*** index value/***expected*** index value). In unpolluted sites the ***observed*** and ***expected*** index values are very similar and the ratio is about unity. As pollution increases the ***observed*** index values fails to meet expectations and the value of the ratio falls. For reporting purposes this ratio is divided into a series of five or six ***grades*** of biological condition.

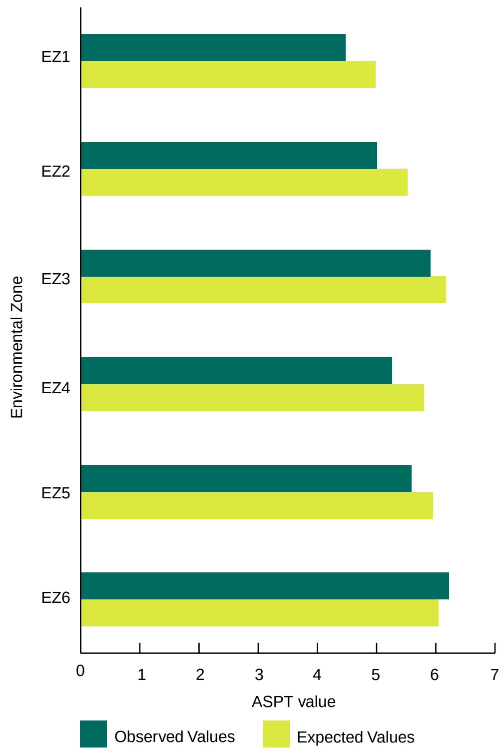
RIVPACS contains statistical tests that can be used to assess whether a site has truly changed its biological condition from one survey to the next. The likelihood that there has been a real change is normally assessed by whether the chances of the change are more likely than not (i.e. greater than 50% chance) and by whether it is almost certain (at least 95% chance).

Figure 7.4: A comparison of the observed and expected (reference state) values of two indices of biological condition of streams, in 1998, by Environmental Zone in England and Wales, and Scotland.

a) Mean number of taxa



b) Average Score Per Taxon (ASPT)



7.20 Although fewer animals are expected at upland sites, those that are expected tend to be less tolerant of pollution. This is shown by the higher than expected ASPT values in sites in the upland zones (Figure 7.4). These natural geographical differences are very important in making judgements about the biological condition of individual sites.

7.21 For the lowland zones in all countries, the observed and expected ASPT values showed larger differences than in the upland zones (Figure 7.4b). Although not shown here, the observed values of ASPT for lowland sites were also more variable than those recorded for the upland sites, reflecting an apparently wider range and intensity of pollution incidence in these zones.

7.22 Comparing the observed and expected index values of individual sites allowed each of them to be allocated to one of six grades of biological condition (see Box 7.2). These six grades are the same as those used by the Environment Agency[6]. They range from grade “a” (very good) to grade “f” (bad). In Scotland grades “e” and “f” are combined and a different labelling system is used. Environment Agency grades are used here for comparative purposes.

7.23 The allocation of CS2000 sites to these grades of biological condition is shown in Table 7.4 for the six Environmental Zones. The proportions of sites in the two highest grades of biological condition, “a” and “b”, tend to be greater in the uplands than the lowlands, and in Scotland as a whole, compared to England and Wales.

6 Environment Agency (1997) *The quality of rivers and canals in England and Wales 1995*. Environment Agency, Bristol: 35pp.

Table 7.4: Proportion of sites (%) in each overall grade of biological condition in 1998, by Environmental Zone and country

Biological Grade	England & Wales				Scotland				GB
	EZ1	EZ2	EZ3	Total	EZ4	EZ5	EZ6	Total	Total
a (very good)	15	26	26	23	23	37	61	40	32
b	30	30	32	31	26	12	22	20	25
c	30	17	25	23	35	27	12	24	24
d	9	15	6	11	12	18	0	10	11
e	13	10	6	10	2	7	3	4	7
f (bad)	2	3	4	3	2	0	2	1	2

7.24 When the biological grades of sites sampled in 1990 and 1998 were compared it was evident that there had been a marked improvement in the overall biological condition of sites over the eight-year period. This improvement occurred in each of the six Environmental Zones in Great Britain.

Figure 7.5: Change in the percentage of sites (ie. rivers and streams) in the two best grades (“a” & "b") of biological condition between 1990 and 1998, by Environmental Zone.

7.25 The improvement was highlighted by the increase in the proportion of sites with an overall grade of ‘a’ (very good) or ‘b’ (good) (Figure 7.5). Five of the six zones showed an increase in the proportion of ‘a’ grade streams. The exception was the uplands of England and Wales (Zone 3). Even here, the large increase in grade ‘b’ sites led to an overall increase in the combined proportions of ‘a’ and ‘b’ sites. The substantial increase in the proportion of grade ‘a’ streams in the Scottish Highlands, from 19% to 61%, was particularly striking.

7.26 The possibility exists that some of these changes may be due to chance. However, as indicated in Box 7.2, RIVPACS provides tests that can be used to calculate the probability that an individual site has changed its grade of biological condition after sampling and methodological variation has been discounted.

7.27 When RIVPACS was used to compare the results of the Countryside Surveys of 1990 and 1998 (Table 7.5), it was found that 54% of sites in Great Britain had more likely than not (i.e. with probability >50%) improved in grade. Furthermore, 25% of sites had ‘almost certainly’ (i.e. with probability ≥ 95%) improved in grade. In contrast, only 15% of sites had more likely than not deteriorated in grade and only 2% of sites had almost certainly deteriorated in grade.

Causes of change in biological condition

7.28 It is unlikely that the changes in biological condition noted above are due to differences in sampling methods between the 1990 and 1998 surveys. The methods used for sampling, sample processing and identification were the same. Although different field workers carried out the

Table 7.5: Percentage of sites in each Environmental Zone and country that have changed their grade of biological condition between 1990 and 1998

Country and Environmental Zone		Downgraded		Stayed the same grade	Upgraded	
		"almost certainly"*	"more likely than not"**		"more likely than not"**	"almost certainly"*
England & Wales	1	2	15	44	41	11
	2	5	20	32	48	22
	3	0	19	38	43	15
	Total	3	19	37	45	17
Scotland	4	4	19	21	60	30
	5	0	7	32	62	32
	6	0	7	25	68	37
	Total	1	11	26	63	33
Great Britain		2	15	31	54	25

* "almost certainly" = probability ≥95%
** "more likely than not" = probability >50% (see Box 7.2)

work, they had the same levels of experience and, as far as possible, received identical training on the two occasions. The same experienced staff identified the specimens for both survey years.

7.29 These results are supported by other studies. Thus, the Environment Agency reported a net improvement in biological condition of rivers in England and Wales from a national study of matched sites in 1990 and 1995[7]. A smaller proportion (31%) of sites had more than 50% probability of improvement than from the two Countryside Surveys, but the net rates of overall improvement were similar (21% and 26% respectively) in the two pairs of surveys.

7.30 A number of factors might be responsible for the improvement in the biological condition of *Rivers and Streams*. Hence, for the last decade, the Environment Agency has reported a 31% improvement in the chemical grades of rivers in England and Wales, with the most substantial increases (35%–45%) in Wales and the north west of England[8]. The pollutant load from sewage works has also decreased sharply during the 1990s, whether measured in terms of suspended solids, biochemical oxygen demand or ammonia. The Agency has concluded that these change are linked both to tighter regulation of water companies, the substantial investments that they have made in recent years, and the pollution prevention activities of the Agency, such as visits to farms and industrial sites.

7.31 It is more difficult to explain the improvement in biological condition in Scotland, particularly in the uplands. The assignment of 82% of Scottish CS2000 sites to biological grades 'a' or 'b' is compatible with the Scottish Environment Protection Agency's allocation of about 91% of river length, in 1996, to the top two classes in the Scottish River Classification Scheme[9]. The remaining 9% of Scottish rivers include over 1,000 km of poor quality rivers and 135 km of seriously polluted ones. These waters are predominantly in the more populated central lowland areas, within Environmental Zone 4, where much still needs to be done to improve environmental quality.

7 Clarke R.T., Furse M.T. and Davy-Bowker J. (1999). *Analysis of 1995 Survey Data. Phase 2 Post-survey Appraisal. Unit II: Changes in Biological Condition*. R&D Technical Report E101, Environment Agency, Bristol: 130pp.
8 www.environment-agency.gov.uk/s-enviro/ viewpoints/3compliance/2fwater-qual/3-2-1.html [9th November 2000]
9 The Scottish Office (1999) *Improving Scotland's Water Environment*. Edinburgh: The Scottish Office Environment Department. Also www.sepa.org.uk/stateenv/1996waterclass.htm. [1st September 2000]

7.32 One possible explanation for poorer biological condition of Highland rivers in 1990 is climate. In their report on the 1990 Water Quality Survey of Scotland[10], the Scottish Office noted that the exceptionally wet weather of spring 1990 may have contributed to the particularly low faunal diversity at many Highland sites. Taxon richness is one of the two indices used by Countryside Survey to assess changes in biological condition. Thus improvement in the uplands recorded by CS2000 may partly be related to weather rather than better environmental management, but more detailed analysis of the differences in weather conditions between the two surveys is necessary to determine the extent of such effects. The improvements elsewhere in Scotland are, however, likely to be due to the same sorts of causes as in England and Wales.

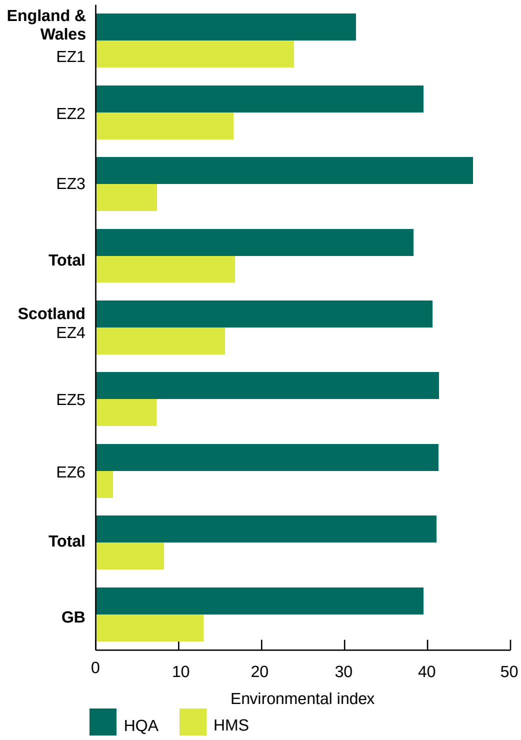
River Habitat Survey

7.33 A River Habitat Survey (RHS) was included in CS2000 for the first time in 1998. This is a standard assessment procedure for evaluating the physical structure of a watercourse. RHS is based on a standard 500 m survey section, and takes account of both in-stream and bankside, or riparian, features.

7.34 The data can be used to derive two indices of river corridor status. These are the Habitat Quality Assessment (HQA) and the Habitat Modification Score (HMS). The quality assessment is a measure of the structural diversity of the river corridor and the HQA score increases with improved habitat quality. By contrast, the modification score is a measure of the extent to which the natural character of the river has been modified by people. A score of zero indicates no significant modification and represents natural (good) conditions.

7.35 The CS2000 sites provide a baseline assessment of the condition of the *Rivers and Streams* Broad Habitat. The results obtained are shown in Figure 7.6. The highest habitat quality scores were recorded in the upland Zones, 3, 5 and 6, while the lowest values were observed in Environmental Zone 1. Overall, the mean index for Scotland is higher than that for England and Wales. Future work will compare the observed quality score with expected values, based on national benchmark sites. It is anticipated that this will confirm that the conditions of river corridors in the uplands are generally better than those of the lowlands.

Figure 7.6: A comparison of the mean values of two River Habitat Survey indices, Habitat Quality Assessment (HQA) and Habitat Modification Score (HMS), in six Environmental Zones in 1998.



7.36 The values of the Habitat Modification Score (HMS) depend on current and historical management practices, and can be very variable from site to site. The results of CS2000 suggest

10 The Scottish Office (1992) *Water Quality Survey of Scotland 1990*. The Scottish Office Environment Department, Edinburgh: 62pp

(Figure 7.6) that the lowest levels of stream modification are in the upland Environmental Zones, 3, 5 and 6, with most sites showing little modification. The overall mean modification score for sites in England and Wales was almost twice that for Scotland, reflecting the larger number of more modified lowland sites in the former. These results are supported by surveys of river habitats that were carried out on more than 5,000 sites in the UK over a period from 1994 to 1996[11].

HIGHLY MODIFIED DRAINAGE CHANNEL, ENVIRONMENTAL ZONE 1, LINCOLNSHIRE *(C BARR)*

7.37 The CS2000 data can be used to explore the relationship between river habitat condition and the biological status of the stream flowing through the surveyed habitat section. The results are shown in Table 7.6. They show statistically significant correlations between the indices of biological condition of the watercourses and river habitats, especially in lowland environments. This suggests a possible link between poor quality of river habitats and poor biological condition of rivers.

Conclusions

7.38 For the *Standing Waters* Broad Habitat the results from CS2000 indicate a small, 6%, net increase in lowland ponds between 1990 and 1998 in England, Wales and Scotland. This reverses the losses observed in 1980s. Biological condition of standing waters was not assessed.

7.39 There have been significant improvements in the biological condition of *Rivers and Streams* and the habitat quality of their corridors in England and Wales, and in Scotland. These changes are consistent with some of the key BAP objectives for this Broad Habitat (Box 7.1), most notably, the goal of reducing nutrient enrichment.

7.40 A general improvement in the biological condition of *Rivers and Streams* as measured by macro-invertebrates has coincided with reduced inputs of pollutants into the waters following tighter regulation and more rigorous enforcement[12]. At the same time, in England and Wales, the Environment Agency's strategy has been to encourage separate forms of management for river corridors, which are designed to be beneficial in several ways,

Table 7.6: Relationships between indices of biological condition for watercourses (taxon richness or ASPT) and measures of river habitat quality (HQA) and modification (HMS). Correlation coefficients in bold are statistically significant (P< 0.05).

Environmental Zone	Number of sites	ASPT		Taxon richness	
		HQA	HMS	HQA	HMS
EZ1	77	**0.43**	**0.57**	0.20	**0.26**
EZ2	103	**0.60**	**0.49**	**0.39**	**0.35**
EZ3	57	0.20	0.20	0.21	0.17
EZ4	60	**0.42**	**0.45**	0.11	0.19
EZ5	66	**0.44**	0.21	0.19	0.00
EZ6	62	**0.28**	**0.28**	0.10	0.03

11 Raven, P.J., Holmes, N.T.H., Dawson, F.H., Fox, P.J.A.,Everard, M., Fozzard, I.R. and Rouen, K.J. (1998) *River Habitat Quality – the physical character of rivers and streams in the UK and Isle of Man*. River Habitat Survey Report Number 2, Environment Agency. Bristol: Scottish Environment Protection Agency. Stirling: Environment and Heritage Service, Belfast: 84pp.

12 Environment Agency (1997) *The quality of rivers and canals in England and Wales 1995*. Environment Agency, Bristol: 35pp.

including improvements in water quality[13]. Thus it is possible that this policy has contributed to the general improvement of the biological condition of the CS2000 sites.

7.41 These gains within the freshwater environment must, however, be set against evidence for a decline in the ecological quality of streamside vegetation. During the 1990s, there has been an increase in tall growing, common grasses and herbs and an increase in woody species at the expense of lower growing stress-tolerating plants that are also declining elsewhere in the landscape.

7.42 The reduction in vegetation species richness and increase in woody plant species along the sides of streams probably results from less intensive or different forms of land management. This change in vegetation may be beneficial for birds and small mammals and for the biological condition of streams and rivers. At the same time the frequency of some plants typical of infertile grassland habitats that are found along streamsides may also be declining.

7.43 Thus, while the changes recorded in biological condition of *Rivers and Streams* are concordant with BAP objectives, the extent to which the changes in vegetation indicate the 'appropriate management' of adjacent land along streamsides must be considered carefully. The results of CS2000 suggest that further management strategies may need to be developed to ensure that the plant and animal diversity of streams, rivers and their banks is maintained.

13 Environment Agency (1996) *Understanding buffer strips. An information booklet*. Environment Agency, Bristol: 12pp.

In Great Britain, the stock of the *Built-up and Gardens* Broad Habitat and transport features totalled about 2.3 million ha in 1998, about 10% of the land surface. Between 1990 and 1998 the cover of developed land in rural areas increased by about 4%, but more *Broadleaved Woodland* was created on previously developed land than was lost to development.

8 developed land in rural areas

8

Introduction

8.1 Development is one of the key pressures on the countryside. Without careful planning and design, it can transform the character of rural areas and significantly change the ecological and aesthetic qualities of the landscape. In this chapter we consider what CS2000 can tell us about the change that have taken place in developed land in rural areas in Great Britain since 1990. Similar data are not currently available for Northern Ireland.

8.2 All developed land, apart from transport features in rural areas, is included in a single BAP Broad Habitat, called *Built-up and Gardens*[1]. It covers both urban and rural settlements, farm buildings, and all man made structures such as industrial estates, retail parks, waste and derelict ground, mineral workings, airports, urban parkland, and transport infrastructure in urban areas. Amenity grassland is excluded; this is considered part of the *Improved Grassland* Broad Habitat.

8.3 Roads, tracks and railways in rural areas are included within the definition of the *Boundary and Linear Features* Broad Habitat. However, as noted in Chapters 2 and 4, they are more conveniently dealt with here, along with other forms of development, in order to give a better insight into a key pressure acting on the countryside. For the purposes of this report, *Built-up* and the transport features of *Boundary and Linear Features* are aggregated and collectively referred to as 'developed land in rural areas'.

8.4 Although the CS2000 field survey can give us some insight into how the stock of developed land has changed in recent years, at the outset it is important to note the limitations associated with these data. The most important issue to consider is that CS2000 was not designed to be a survey of urban areas. Indeed, these areas were specifically excluded by rejecting any of the randomly selected sample squares that had more than a 75% urban cover in 1990. Such 'urban core' squares represent about 2% of the total land surface of Great Britain.

8.5 The CS2000 field survey included the urban fringe, smaller areas of built-up land in the countryside and transport features (roadways, railways and associated verges) outside urban areas, it was not designed to be representative of the areas where urban development is concentrated. Thus strictly speaking, the field survey component of CS2000 can only tell us about that portion of developed land that is part of, or associated with, the 'rural environment'. Nevertheless, these data are valuable in helping to make judgements about development and the condition of the countryside, and its village and urban fringe components.

DEVELOPED LAND IN RURAL AREAS INCLUDES SMALL VILLAGES AND FARM BUILDINGS, WEST LULWORTH, DORSET *(BRUCE COLEMAN)*

1 A detailed definition of the Broad Habitats covered in this Chapter is given in Appendix A, together with a note of how they were interpreted in CS2000. In this Chapter *Built-up and Gardens* is also referred to more simply as *'Built-up'*.

8.6 The new satellite-based LCM2000 does, however, cover industrial, urban and suburban and rural areas for the whole of the UK. As such, it will in the future be capable of extending the scope of CS2000. The survey also examines heterogeneity of the urban landscape, recording urban grasslands, woodlands and larger gardens. The LCM2000 data will be available in 2001. The stock estimate for the *Built-up and Gardens* Broad Habitat is likely to exceed other estimates of extent of urbanisation in rural areas. This is because they will include a wide range of built-up and developed land, including farm yards and buildings, mineral workings, caravan parks and urban parkland, that may not be included in other definitions of urban land.

Stock and change

8.7 Table 8.1 gives estimates for the stock of developed land for England and Wales, and Scotland. The figure for the 'unsurveyed urban core' is included in order to derive national totals. The total is broken down for the *Built-up and Gardens* Broad Habitat and transport features in rural areas. These estimates correspond to the figures that were given earlier in Chapter 2.

8.8 Table 8.1 shows that in 1998 the total area of developed land in Great Britain was about 2.3 million ha, or about 10% of the total land surface. Of this total, in rural areas we find about 1.3 million ha (6%) is represented by the *Built-up and Gardens* Broad Habitat, while transport features make up a further 0.5 million ha (2%).

Table 8.1: CS2000 estimates of stock of *Built-up and Gardens* Broad Habitat and total developed land in Great Britain, 1998.

Environmental Zone and Country		Unsurveyed Urban Core		Built-up and Gardens in rural areas			Total Built-up and Gardens		Transport features in rural areas			Total developed land	
		Area ('000 ha)	%[a]	Area ('000 ha)	SE	%[a]	Area ('000 ha)	%[a]	Area ('000 ha)	SE	%	Area ('000 ha)	%[a]
England and Wales	1			512	80	8			173	12	2.7		
	2			640	76	10.7			199	16	3.3		
	3			28	6	1.1			39	6	1.5		
	Total	426	2.8	1180	111	7.9	1606	10.7	411	21	2.7	2017	13.5
Scotland	4			113	26	5.1			53	5	2.4		
	5			30	9	1.1			23	4	0.8		
	6			8	4	0.2			11	3	0.4		
	Total	37	0.1	151	28	1.8	188	2.0	87	7	1.1	275	3.1
GB		463	2.0	1331	114	5.8	1794	7.8	498	22	2.2	2292	10.0

Data for the *Built-up and Gardens* and *Transport Features* are not available for Northern Ireland.
%[1] Percentage of region

Table 8.2: Estimated changes in the stock of Built-up and Gardens Broad Habitat and transport features in rural areas of Great Britain, 1990-1998, by Environmental Zone ('000 ha). Changes which are statistically significant (P<0.05) are indicated in bold.

Country	Environmental Zone	Built-up and Gardens in rural areas			Transport features in rural areas			Total developed land in rural areas		
		Area ('000 ha)	SE	%[a]	Area ('000 ha)	SE	%[a]	Area ('000 ha)	SE	%[a]
England and Wales	1	25	15	5.6	-7	3	-4.1	18	15	2.8
	2	**28**	8	4.6	2	5	1.1	30	12	3.8
	3	**4**	2	14.8	(+)	2	-1.5	5	3	7.3
	Total	57	17	5.3	**-5**	6	-1.2	53	18	3.5
Scotland	4	-3	5	-2.7	2	2	3.7	-1	5	-0.7
	5	6	6	26.2	(-)	(+)	-1.6	6	6	11.9
	6	(+)	(+)	3.5	(+)	(+)	-0.1	(+)	(+)	1.4
	Total	3	7	2.1	2	2	1.8	5	8	2.0
GB	All	**61**	19	4.9	**-3**	6	-0.7	57	20	3.3

Note: Data for the *Built-up and Gardens* and transport features are not available for Northern Ireland. Data exclude the unsurveyed urban core. When this is included, the estimated percentage increases in total developed land, 1990-98, are 2.1% in England and Wales, 1.1% in Scotland, and 1.9% in GB.

(-) = value between 0.00 and -1 (+) = value between 0.00 and 1.

%[a] Percentage change as a % of 1990 stock

8.9 The distribution of developed land in rural areas by Environmental Zone is also shown in Table 8.1. The largest proportion of land under development is in England and Wales, especially in the lowlands, in Environmental Zones 1 and 2.

8.10 The area of developed land in rural areas has increased since 1990. The data in Table 8.2 show that over this period, the total area of the developed land in rural areas went up by about 58,000 ha in Great Britain. However, this total masks differences both between *Built-up* and transport features, and between different geographical areas.

8.11 In absolute terms, the greatest changes have occurred in England and Wales, especially in the lowlands (Environmental Zones 1 and 2), which account for over 90% of the increase in *Built-up* in Great Britain. The estimated increase of 57,000 ha of the *Built-up and Gardens* Broad Habitat and transport features in rural areas in England and Wales can be compared with data from DETR's Land Use Change Statistics[2]. The latter estimates a larger increase of 65,000 ha in urban uses in England only, over approximately the same period. Given the different survey methods, definitions and errors associated with both surveys, these figures are reasonably close. Further work to compare these data is in progress.

8.12 The growth in the area of the *Built-up and Gardens* Broad Habitat reflects the continued pressures for urban development, especially in the south and east of England. The apparent stability of the stock figure for transport features in rural areas recorded by CS2000 is not an indication that areas of the countryside have not been lost to road building during the survey period. Rather, the expansion of transport features may be masked in these data because some roads in rural areas have been incorporated into new developments and classified as part of *Built-up and Gardens*. There are also cases where farm tracks and disused railways, included with transport features, have been converted to other Broad Habitats. Thus the change in the total area of developed land in rural areas is possibly a better guide to the area of the countryside that has been lost between 1990 and 1998.

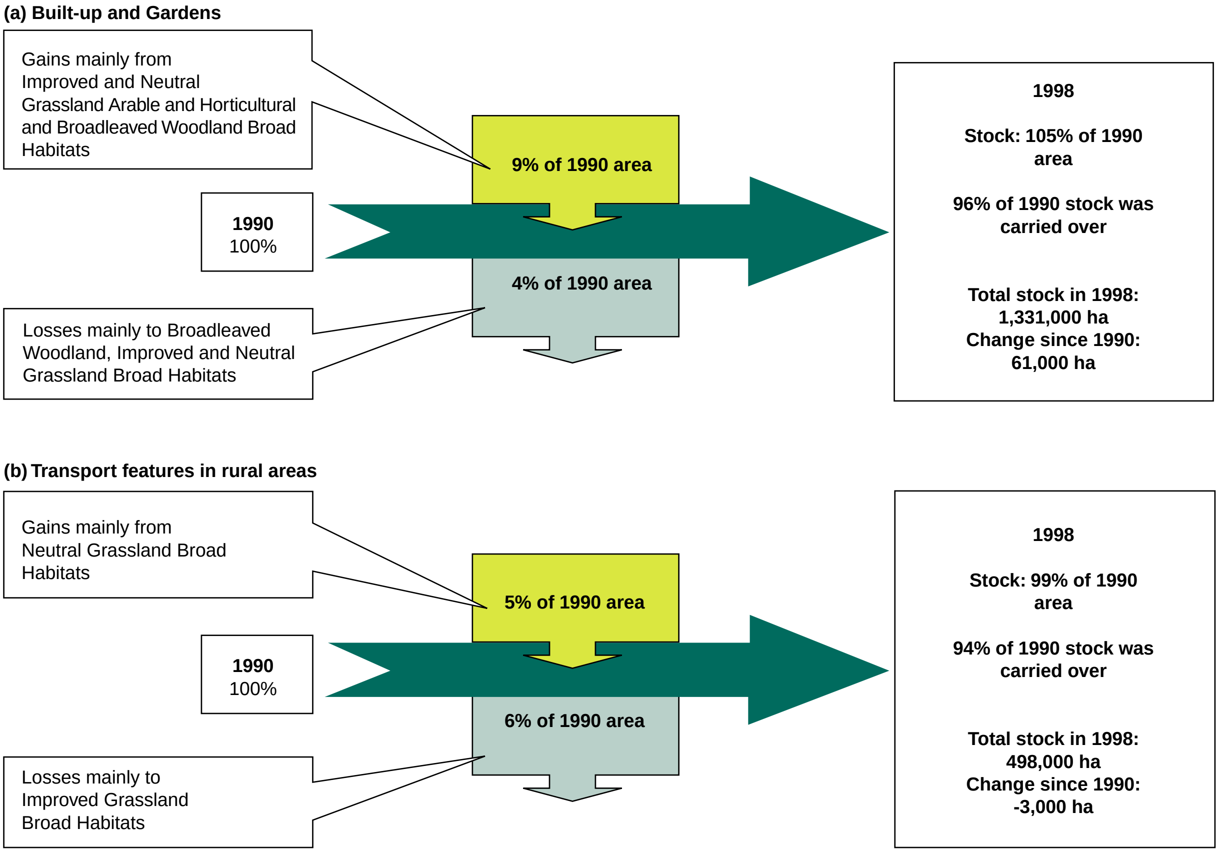
8.13 The patterns of transfer between other Broad Habitats and developed land since 1990 can be calculated for the data from England and Wales, and Scotland. The summary of results in Figure 8.1 shows that development in rural areas has been mostly at the expense of *Improved Grassland* and *Arable and Horticultural* Broad Habitats. About 60% of the gain in developed land came from these two Broad Habitats. Perhaps of more concern from an ecological perspective is the 9% of development taking place on land previously assigned to *Broadleaved Woodlands* and 25% on *Neutral Grassland*. These figures need to be interpreted with some caution because the habitats may to some extent have been retained within the development. It is also likely that the *Neutral Grassland* that was lost was unmanaged grasslands, rather than meadows of particular conservation value. Thus further work is required to determine the ecological significance of these losses.

TREE PLANTING ON FORMER MINERAL WORKINGS, MERSEYSIDE

(DAVID WOODFALL)

2 DETR (2000) *Land Use Change in England* No 14, DETR, London.

Figure 8.1: Flows into and out of developed land



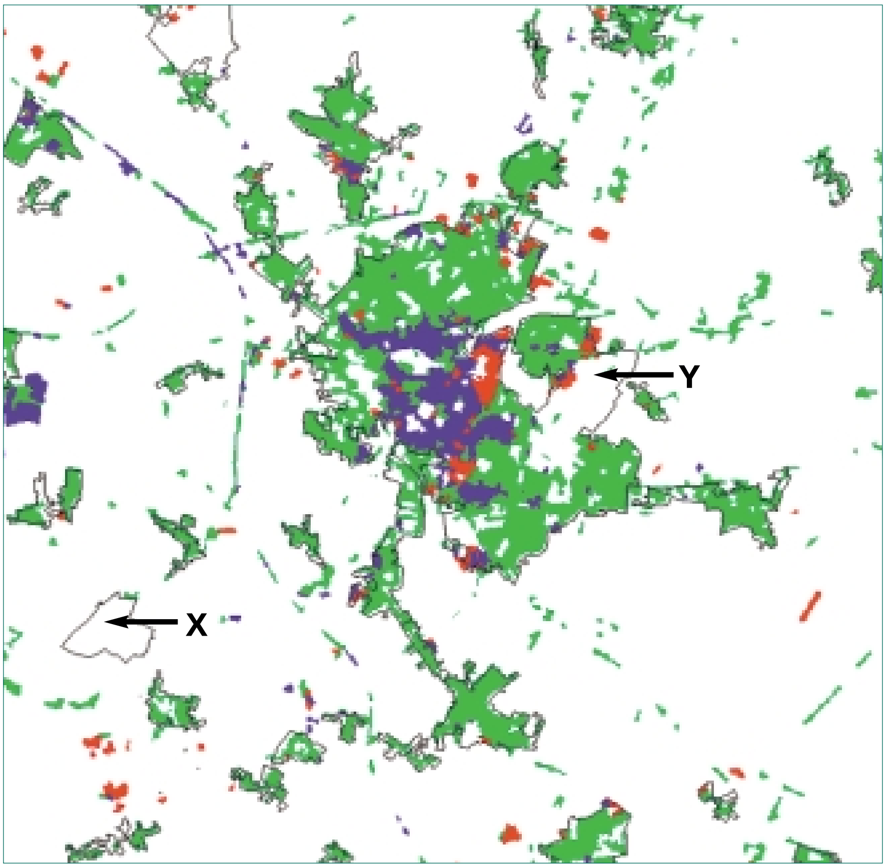
8.14 The conversion of formerly *Built-up and Gardens* to other Broad Habitats is most likely to have come about through reclamation of mineral workings and derelict sites, as part of general schemes for environmental improvement. Creation of *Broadleaved Woodland* on land previously assigned to either *Built-up and Gardens* or transport features in rural areas more than compensated, in area terms, for losses of woodland to development. Woodland was the main beneficiary of restoration, accounting for about a third (33%) of such land. The losses of *Neutral Grassland* to development were also partly compensated for by restoration. These results may reflect the impacts of urban and community woodland initiatives in many parts of the country.

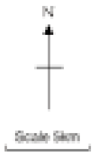
Conclusions

8.15 The *Built-up and Gardens* Broad Habitat and transport features totalled about 2.3 million ha in 1998, almost 10% of the total land surface of Great Britain. In rural areas in Great Britain, the cover of developed land has increased by about 4% since 1990.

8.16 Rates of urban expansion and road development depend on three main factors: the policy context, the state of the general economy and demographic trends. Over the last two decades, these factors contributed to a period of rapid growth. Economic and demographic pressures are likely to remain for the foreseeable future. For example, increased people's life expectancy, higher separation rates, and later family-establishment together mean that it is likely that household growth will continue for years to come.

Box 8.1: Using LCM2000 to monitor urban land and development in and around Cambridge





KEY
Industrial
Continuous Urban
Suburban
DETR Urban boundaries

The ability of LCM2000 to identify and map different urban land cover types is shown here. The map depicts the distribution of continuous urban, suburban and industrial land around Cambridge. In addition to data on land cover, derived from LCM2000, the map includes 1991 boundaries of urban land, as defined by DETR on the basis of Ordnance Survey information.

LCM2000 identifies urban land covers. Comparison with other definitions of urban areas, such as DETR 1991 urban areas, reveals differences. In particular, several areas (e.g. those labelled X and Y), which are identified as urban by the DETR classification, actually contain very little built-up land. Area X is, in fact, the University of Cambridge radio telescopes and Y is Cambridge Airport: both sites thus consist of large, open grassland areas with only isolated buildings and structures. Many of the other areas of discrepancy between the two data sets relate to areas of open urban land (e.g. sports fields), which are not separately identified in the DETR data. Other elements are smaller urban areas, which the generalised DETR boundaries exclude. Yet others are new developments, built since DETR mapping.

In all these cases, use of the LCM2000 data helps to delineate built-up areas more precisely, and adds value to other data sets.

8.17 Much of the need for new homes has hitherto been in areas such as the south east of England. It is unlikely that this pressure will diminish in the short term. Government policies are to direct as much housing development as possible towards brownfield sites, but the area of previously developed sites is limited. It is likely, therefore that some greenfield development will also be needed in the future, but Government policy is to restrict the level of greenfield development considerably.

8.18 Results of CS2000 suggest that most greenfield development has occurred on improved agricultural land but that a proportion has taken place at the expense of *Broadleaved Woodland* and *Neutral Grasslands*. However, these losses of habitats to development are partly compensated, in simple area terms, by restoration of previously developed land. For example, more *Broadleaved Woodland* was created on previously developed land than was lost to development. In order to establish a more complete picture, the field survey data must be integrated with other information sources, such as DETR's Land Use Change Statistics, which are available for England and Land Cover Map 2000 for UK as a whole.

8.19 Land Cover Map 2000 (LCM2000) will provide information on the distribution of *Built-up and Gardens* throughout the UK at the resolution of individual estates and developments. An example of the application of LCM2000 is shown in Box 8.1. Here LCM2000 is used to show the stock of *Built-up* land, and to identify areas of recent urban development in the Cambridge area.

8.20 As already mentioned, Government policy has in recent years increasingly emphasised the need to make use of brownfield sites for development, in order to reduce land take in the countryside. Thus considerable changes may be expected within the core urban area and around the urban fringe. The new classification methods developed for the production of LCM2000 will allow such changes to be monitored, and the link with the CS2000 field survey data will enable us to understand their wider ecological significance.

The changes in Broad Habitats do not take place in isolation, they happen as part of the evolution of the landscapes in which they are found. The main results of Countryside Survey 2000 are presented for each of the six Environmental Zones in Great Britain.

9 countryside change: developing an integrated view

Introduction

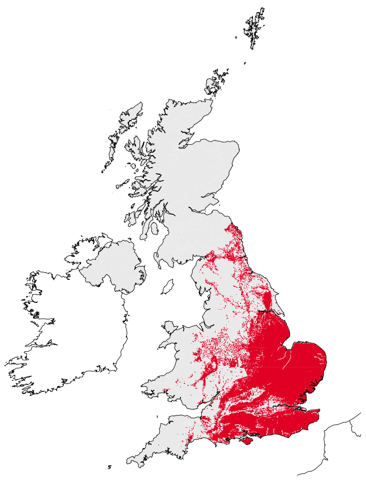
9.1 Countryside Survey 2000 and NICS2000 have been designed to provide detailed information about the habitats and landscape features that are important elements of the countryside. This report has given a first view of these data using the system of 'Broad Habitats' defined by the *UK Biodiversity Action Plan (BAP)*. It has given national estimates for the stocks of these Broad Habitats, and how they have changed since 1990. It has also described how the Habitats have changed in more qualitative terms, using various measures of ecological condition.

9.2 It is valuable to have information about stock and change for each Broad Habitat because they are often under different management regimes. Thus, for example woodlands are managed by foresters and crops by arable farmers. However, a discussion of each Broad Habitat in isolation from the others only gives a partial view of what might be happening in the countryside. It is also important to consider how the changes for individual Broad Habitats relate to each other, and what consequences these might have in terms of the landscapes in which they occur. The aim of this chapter is to provide a general 'landscape view' of these data using the six Environmental Zones in Great Britain that have been used in the CS2000 sample design. Northern Ireland results will be reported separately.

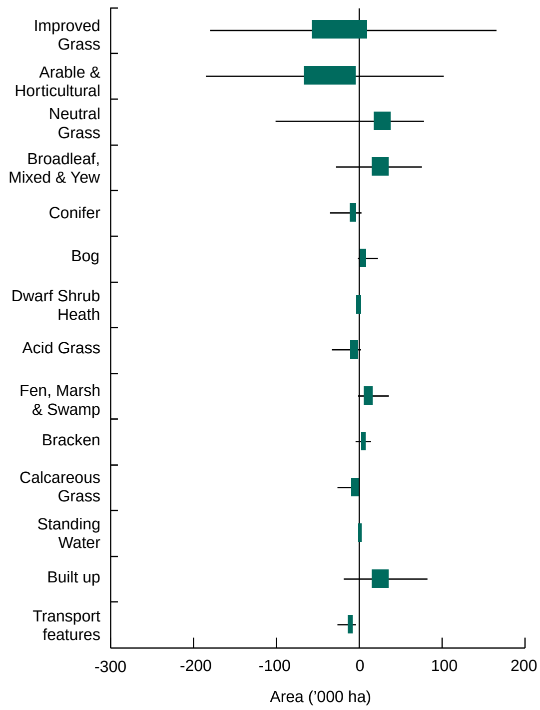
The lowlands of England and Wales

9.3 Two Environmental Zones cover the lowlands of England and Wales. Zone 1 includes the bulk of the relatively flat lowlands of England and Wales (Figure 9.1). It occurs mostly in the easterly and more southerly regions, although small areas along the border between England and Wales are also assigned to Zone 1 on the basis of their environmental characteristics. Environmental Zone 2 includes most of the western and central lowlands of England and

Figure 9.1: Habitat change in the arable dominated lowlands of England and Wales (Environmental Zone 1)



Zone 1 occurs mostly in the easterly and more southerly regions, although small areas along the borders between England and Wales are also assigned to this Zone.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

Key changes: Losses of Arable and Improved Grassland Broad Habitats and an expansion of Broadleaved Woodlands, Neutral Grassland and Built-up. On arable land, small but significant increases in overall species richness of crop and weed vegetation, and increase in the frequency of plants that are important as food sources for common butterfly species. Evidence of nutrient enrichment as well as local loss of species richness in vegetation associated with grasslands, streamsides and roadside verges. Succession and increases in species associated with more fertile conditions on stream and river banks. A general improvement in the biological condition of rivers and streams was observed.

Wales (Figure 9.2). Like Zone 1 these areas are flat or undulating and of low elevation, but some land does border the uplands.

ARABLE FARMLAND, ENVIRONMENTAL ZONE 1, CAMBRIDGESHIRE *(A STOTT)*

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9.4 Environmental Zone 1 is dominated by the *Arable and Horticultural* Broad Habitat which covers about half the land area. However, the landscapes are by no means exclusively devoted to arable farming. *Improved Grassland* is also widespread, accounting for a further 20% of the land area, along with *Broadleaved Woodland* and developed land[1], accounting for 9% and 11%, respectively. The general landscape changes that are occurring within this Zone can be understood mostly in terms of the changing balance between these four habitat types.

9.5 Although the landscapes of Environmental Zone 1 continue to be dominated by the *Arable and Horticulture* Broad Habitat, its cover, along with that of *Improved Grassland*, has declined since 1990. By contrast the cover of developed land and the *Broadleaved Woodland* Broad Habitat has increased. *Neutral Grassland* also showed a gain, suggesting a reduction or temporary cessation of grassland management in some areas. However, the total stock of this Broad Habitat within the Environmental Zone is small (3%).

9.6 In 1998, *Broadleaved Woodland* accounted for about 9% of the area of Zone 1, an increase of 4% since 1990. In many cases, the visual impact of this change is at present likely to be small, because the woodlands are immature. In the longer term, however, such planting will result in a more densely wooded aspect in many parts of this Zone.

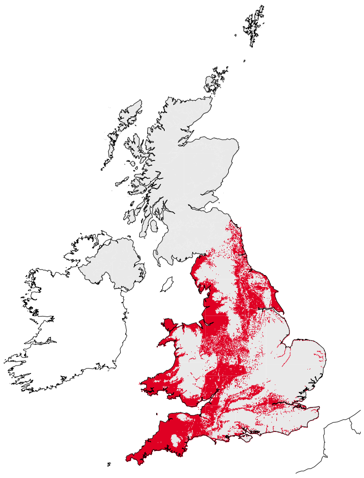
9.7 The total area of developed land in rural areas increased by about 3% in Environmental Zone 1 since 1990.

9.8 Within Environmental Zone 2 (Figure 9.2), *Improved Grassland* is the most widespread Broad Habitat, accounting for about 40% of the land area. *Arable and Horticultural* covers about 21%. Compared to Zone 1, it has a slightly lower proportional cover of *Broadleaved Woodlands*, while developed land in rural areas is more extensive (14%). Overall there is a more even mix of cover types in these areas than in Zone 1, and a higher representation of 'semi-natural' Broad Habitats.

9.9 The changes in land cover between 1990 and 1998 in Zone 2 are somewhat similar to those found in Zone 1, although some divergent trends are also apparent. For example, *Broadleaved Woodlands* increased by about 4% over the survey period, while the stock of developed land in rural areas also increased by about 4%. These changes are similar to those observed in Zone 1. However, the stock of *Coniferous Woodlands* was stable or possibly increasing slightly in Zone 2, in contrast to Zone 1, where it showed a marked decline from a small base. Moreover, while the area of *Arable and Horticultural* declined slightly in Zone 1, it increased in extent within Zone 2. This change, coupled with the decline in stock of *Improved Grassland*, suggests that at very broad scales, the agricultural landscapes of Zone 2 have become more mixed in character than they were before 1990.

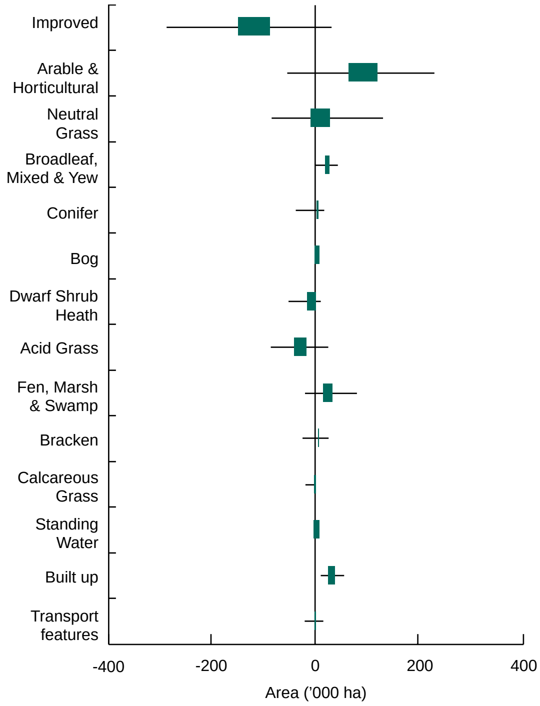
1 In this chapter this is an aggregation of the *Built-Up and Gardens* and the transport elements of *Boundary and Linear Features* Broad Habitats. See Chapter 8.

Figure 9.2: Habitat change in the pasture dominated lowlands of England and Wales (Environmental Zone 2)



Zone 2 includes most of the western and central lowlands of England and Wales, and areas that border the uplands.

Key changes: Losses of Improved and Acid Grasslands, gains in Broadleaved Woodland, Arable and Horticultural, Fen, Marsh and Swamp and Built-up. Vegetation shows locally less intensive cultivation in some arable fields, and an increased frequency of plants associated with more fertile conditions in the more species rich grassland fragments. Marked succession on linear features and vegetation fragments including road verges, stream and riversides, and field boundaries. Loss of species richness observed for infertile grassland fragments on roadside verges and streamsides. A general improvement in the biological condition of rivers and streams was observed.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

MIXED FARMING LANDSCAPE, ENVIRONMENTAL ZONE 2, SOMERSET *(C BARR)*

9.10 A difference between the two lowland Environmental Zones in England and Wales is that a higher proportion of other semi-natural habitats occurs in Zone 2 than Zone 1. Zone 2 contains about 11% of the total stock of the *Acid Grassland* Broad Habitat in England and Wales, along with about 12% of the total stock of *Dwarf Shrub Heath* and 39% of the *Fen, Marsh and Swamp* Broad Habitats. The results of CS2000 show that both *Acid Grassland* and *Dwarf Shrub Heath* have declined in area since 1990, while *Fen, Marsh and Swamp* has expanded. These changes would need to be examined in further detail to determine the extent to which they are compatible with the BAP objectives and targets for these habitats.

9.11 The analysis of changes in the extent of the different Broad Habitats within the two lowland Zones of England and Wales must also be looked at in the context of the changes occurring in the vegetation associated with them.

9.12 Chapter 3 has described some of the key changes observed for the vegetation plots associated with the enclosed farmed landscapes of the UK. For the *Arable and Horticultural* Broad Habitat it was apparent that there were small, but significant increases in overall species richness in those plots which contained crop and weed vegetation, together with an increase

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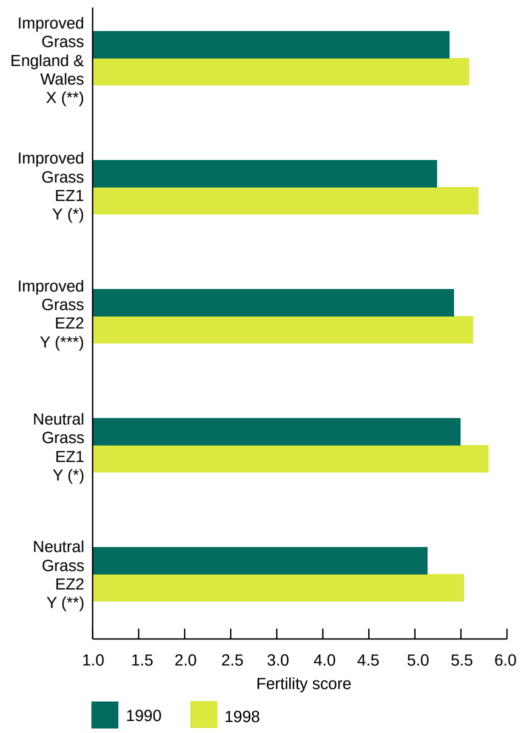
in the frequency of plant species that are important as food sources for butterflies. Preliminary analysis of these data by Environmental Zone does not suggest that the change is confined to any one area.

9.13 Similarly, the analysis of vegetation data for the *Improved* and *Neutral Grassland* Broad Habitats show a trend towards nutrient enrichment of the infertile grassland, especially in the habitat 'Y' plots targeted at the less abundant habitats. As Figure 9.3 shows, the vegetation plots associated with these Broad Habitats indicated significant increases in fertility in both of the lowland Environmental Zones of England and Wales. The causes of this general eutrophication, which is also detected in other Broad Habitats in other Environmental Zones (see below), are uncertain.

Figure 9.3: Change in mean fertility score for sample plots containing infertile grassland vegetation in the *Improved* and *Neutral Grassland* Broad Habitats in England & Wales, 1990-98.



Results based on condition data for random X plots located in fields and unenclosed land, or targeted Y plots that sampled vegetation not typical of the majority of habitats in each sample square that were assigned to the infertile grassland vegetation type in 1990. * P<0.05, ** P<0.01, *** P<0.001.

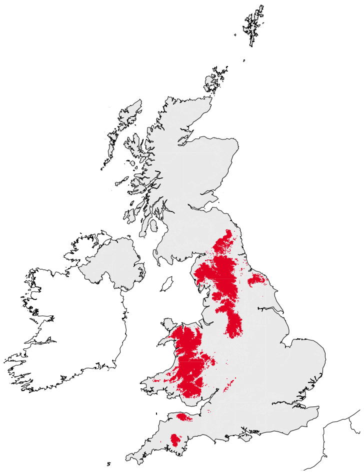
9.14 A key difference to emerge in terms of vegetation change between the two lowland Environmental Zones concerns hedgerows and roadside verges. As Chapter 4 showed, the hedge plots that were characterised by tall grass and herb vegetation in 1990 showed a statistically significant decline in species richness. These changes were concentrated in Zone 1 in hedges adjacent to both *Arable* and *Improved Grassland* Broad Habitats. In Zone 2, there was evidence of increasing nutrient status in the hedgerow vegetation plots adjacent to *Improved Grassland.* In this Zone species richness also declined in infertile grassland patches along roadside verges.

9.15 A particular issue that deserves further analysis is the relationship between the trend towards nutrient enrichment in the countryside and the marked improvement in the biological condition of rivers and streams. As Chapter 7 has shown, a comparison of a range of ecological indices for sites on rivers sampled as part of CS2000 shows that a general improvement in the biological condition has occurred between 1990 and 1998. These data showed that while Environmental Zone 2 had more sites in the best condition categories, both Zone 1 and Zone 2 have shown a similar, marked improvement over the survey period. Analysis of streamside vegetation over the same period shows evidence of nutrient enrichment, and the expansion of taller, more competitive species. The losses in species richness in these streamside areas were most marked in Zones 1 and 2.

The uplands of England and Wales

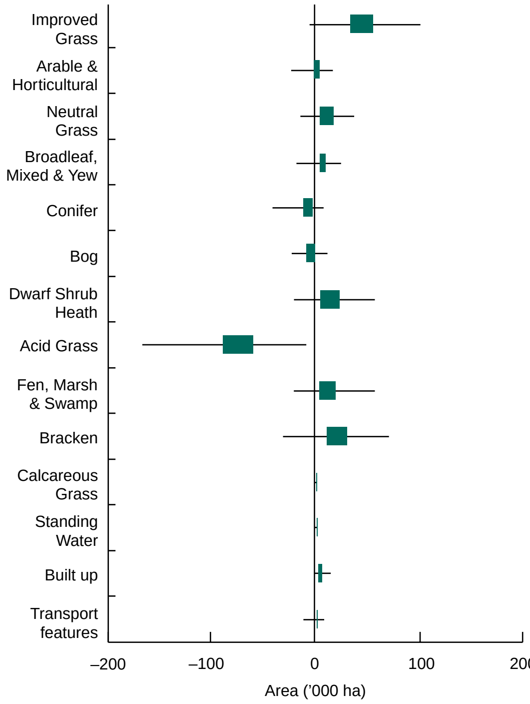
9.16 The uplands of England and Wales are included in Environmental Zone 3 (see Figure 9.4). The Zone occurs mostly in Wales and the north of England , but also includes high ground in the South West. Marginal areas, which

Figure 9.4: Habitat change in the uplands of England and Wales (Environmental Zone 3)



Zone 3 occurs mostly in Wales and the north of England, but also includes high ground in the South West.

Key changes: Losses of Acid Grassland and Coniferous Woodland Broad Habitats, and gains in Improved Grassland, Bracken, Dwarf Shrub Heath, and Fen, Marsh and Swamp. Plants adapted to the acidic and nutrient poor conditions normally found in Acid Grassland showed small reductions in frequency. Local succession on road verges and streamsides at lower altitudes. Streamside vegetation in this Zone showed less evidence of nutrient enrichment and successional change than in the lowland Zones of England and Wales.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

represent the transition between the lowlands and the upland proper, are also included in Environmental Zone 3.

IMPROVED IN-BYE AND HILL GRAZING LANDSCAPE, ENVIRONMENTAL ZONE 3, NORTH YORKSHIRE *(A STOTT)*

9.17 Although *Improved Grassland* is the most widespread Broad Habitat found in Zone 3, covering about 28% of the total land area, these landscapes are distinctive in that they also have extensive cover, about a third, of semi-natural habitats such as *Acid Grassland* and *Dwarf Shrub Heath*. In fact, this Zone holds roughly 85% of the total England and Wales stock of each of these Broad Habitats. While semi-natural Broad Habitats such as *Bog, Bracken* and *Fen, Marsh and Swamp*, are less extensive in terms of their area, this Zone also holds the greater part of the total stock of these habitats in England and Wales.

9.18 The upland areas in Zone 3 were sampled more intensively in CS2000 than in previous Countryside Surveys, so more reliable estimates of stock could be made for England and Wales. The estimates for habitat change, however, are based on a smaller number of sample squares that were surveyed in this Zone in both 1990 and 1998. Thus, when reviewing the data on change, the statistical reliability of the results needs to be considered carefully.

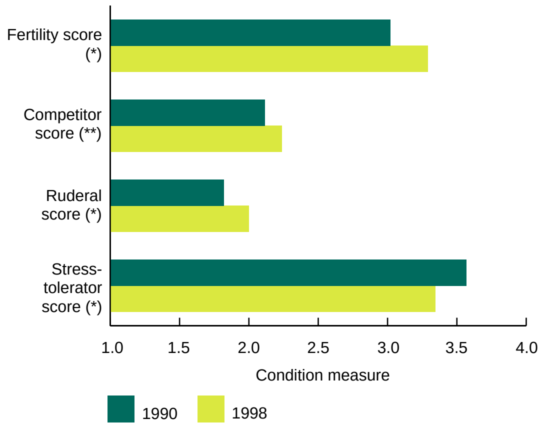
9.19 The most marked change detected by CS2000 for Environmental Zone 3 was the decline in the area of *Acid Grassland.* Between 1990 and 1998, about 13% of the stock was lost; in area terms it was the largest experienced for any Environmental Zone in the UK. The *Acid Grassland* Broad Habitat declined across all UK Environmental Zones, but Zone 3 contributed nearly half the total loss recorded.

9.20 Within Zone 3, over the same period, *Improved Grassland* showed an increase of about 7%. The *Bracken, Dwarf Shrub Heath* and *Fen Marsh and Swamp* Broad Habitats also showed increasing trends. Further analysis of the transfers between *Acid Grassland* and the other Broad Habitat types found in the uplands is required. Losses of *Acid Grassland* may arise from both agricultural improvements, such as increased fertiliser inputs, and from changes in grazing regimes allowing, for example, the spread of bracken. Increases in *Dwarf Shrub Heath* may reflect conservation schemes aimed at restoring heather moorland.

9.21 Between 1990 and 1998, the area covered by the *Coniferous Woodland* Broad Habitat declined by about 7%, while *Broadleaved Woodland* increased by about 4%. Such changes may reflect restructuring and landscape design of plantations to create a more diverse habitat structure that includes more native, broadleaved tree species, and areas of semi-natural vegetation, especially alongside watercourses.

9.22 Not only is the *Acid Grassland* Broad Habitat declining in area, the associated plant communities have shown subtle changes since 1990. As Figure 9.5 shows, the general trend towards the nutrient enrichment of these habitats that was described in Chapter 6 is evident when the vegetation data from Zone 3 is considered separately. For those survey plots that contained the moorland grass mosaic vegetation type in 1990, there was a significant increase in fertility scores, along with an increase in the proportional contribution of competitive species and weedy species. Plants more adapted to the nutrient poor conditions normally found in the *Acid Grassland* Broad Habitat showed a reduced occurrence.

Figure 9.5: Changes in condition indicators for the *Acid Grassland* Broad Habitat in the uplands of England and Wales (Environmental Zone 3), 1990-98.



Results based on condition data for X plots that were assigned to the moorland grass mosaic vegetation type in 1990.
*P<0.05, ** P<0.01, *** P<0.001.

9.23 As noted in Chapter 7, while there was a general improvement in the condition of streams, Zone 3 was distinctive in that it was the only Zone not to show an increase in the proportion of sample sites assigned to the best condition grade. Streamside vegetation in this Zone showed less evidence of nutrient enrichment and successional change, however, than in the lowland Zones of England and Wales.

9.24 The results of CS2000 suggest that in the 1990s the vegetation and habitats of the uplands in England and Wales have changed considerably. Unlike previous decades this cannot be easily explained by losses due to agricultural improvements and afforestation. Instead the evidence is for more subtle changes between semi-natural vegetation types perhaps arising from a combination of overgrazing,

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localised undergrazing, habitat restoration, forest management and changes in levels of atmospheric pollutants. The general trend towards increasing nutrient availability and the increasing abundance of competitive plant species at the expense of characteristic heath and bog species indicates a potential decline in the conservation status of some of these habitats.

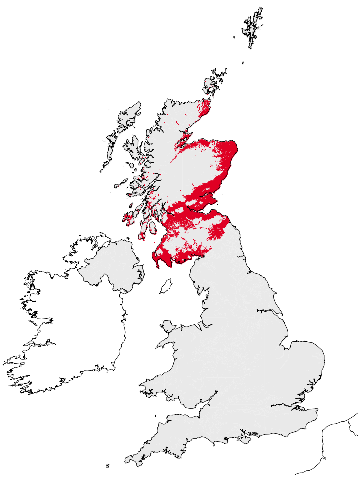
The lowlands in Scotland

9.25 The lowlands in Scotland are covered by Environmental Zone 4, which occurs mainly in the south and east of the country (Figure 9.6). It is essentially a mixed agricultural region. *Improved Grassland* and *Arable and Horticultural* are the most extensive Broad Habitats covering about 30% and 24% of the area. It is also characterised as having a more diverse landscape, with a greater range of semi-natural cover types than in either of the lowland Zones in England and Wales. *Broadleaved* and *Coniferous Woodlands*, *Neutral Grassland*, *Acid Grassland*, *Dwarf Shrub Heath*, and *Bog* each occupy approximately 5% of the area. Developed land in rural areas covers about 8% of the area of this Zone.

9.26 Between 1990 and 1998, there was a decline of about 3% in *Improved Grassland* and a similar increase in the area of *Arable and Horticultural.* Other losses within the Zone were for *Acid Grassland* and *Bog*. There was no significant change in the stock of developed land in rural areas.

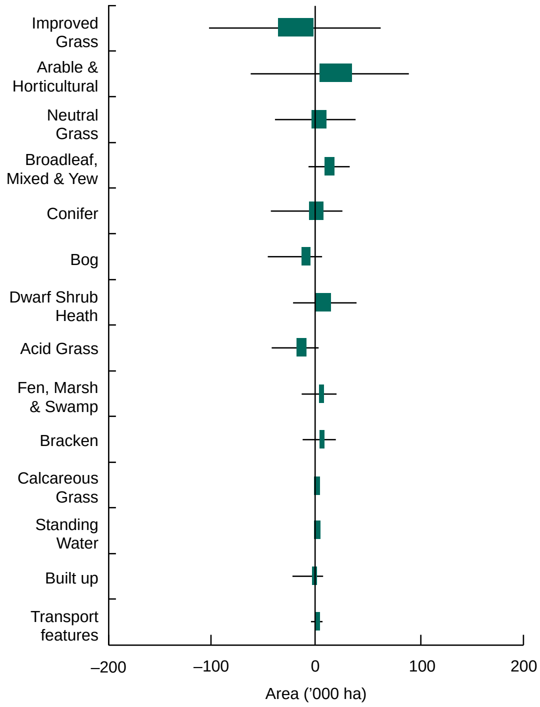
PATCHWORK OF MIXED FARMING, ENVIRONMENTAL ZONE 4, GRAMPIAN *(C BARR)*

Figure 9.6: The lowlands in Scotland (Environmental Zone 4)



Zone 4 occurs mainly in the lowlands of the south and east of Scotland.

Key changes: A decline in area Improved Grassland and a similar increase in the area of Arable and Horticultural and Broadleaved Woodland. No significant change in the stock of developed land in rural areas. Vegetation of fields and unenclosed land relatively stable, but succession on stream and riverbanks, and shifts in favour of plants associated with higher fertility on all linear features. A marked improvement in the biological condition of streams was observed.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

9.27 The most marked change detected in Environmental Zone 4 was the 11% expansion of *Broadleaved Woodland* between 1990 and 1998. By contrast, the area of *Coniferous Woodland* did not change significantly. As in Environmental Zone 1, the effects of new planting will take some time to have a landscape impact. In the long-term the trend is likely to lead to a more even mix of woodland types within the region.

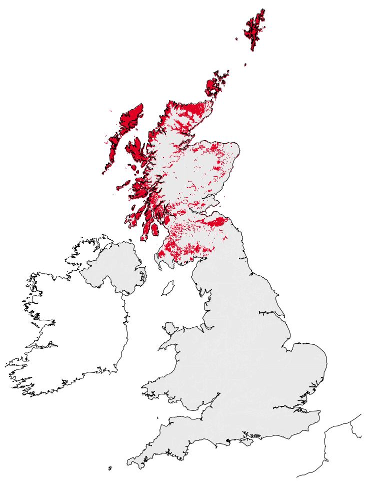
9.28 Preliminary analyses of the vegetation plots located in this Zone showed few significant changes compared to their counterparts in the lowland Zones of England and Wales, perhaps reflecting the greater heterogeneity. There was no clear trend towards nutrient enrichment or eutrophication of grasslands. However, the vegetation changes in infertile grassland in road verges did suggest increased nutrient levels, more disturbance and an overall increase in species richness.

9.29 Zone 4 showed the same marked improvement in the biological condition of streams that was found in the lowlands of England and Wales. In 1998, nearly 50% of the sites sampled were found to be in the best two classes, which puts it in an intermediate position between Environmental Zones 1 and 2. Zone 4 did, however, show a larger increase in the proportion of sites in the best grade class than either of the lowland Zones in England and Wales. Nutrient enrichment of streamside vegetation was, however, apparent in this Zone.

The marginal uplands, islands and true uplands of Scotland

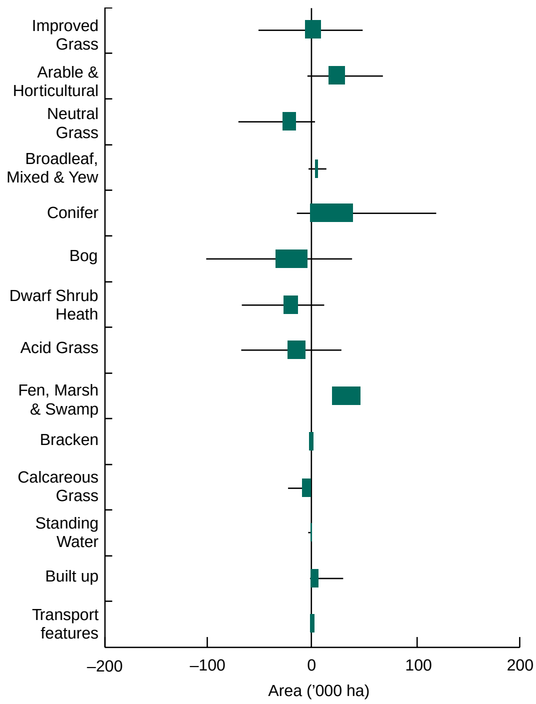
9.30 Environmental Zone 5 covers marginal land at sea level and intermediate altitudes, mostly in the west and including the Scottish islands from Shetland to Kintyre (Figure 9.7). By contrast, Environmental Zone 6 includes all of the 'true' uplands in Scotland, occurring mainly in the north central areas, with high relief (Figure 9.8).

Figure 9.7: The marginal uplands and islands of Scotland (Environmental Zone 5)



Zone 5 covers marginal land at sea level and intermediate altitudes, mostly in the west and including the Scottish islands from Shetland to Kintyre.

Key changes: Losses from Neutral Grassland, Dwarf Shrub Heath, Bog and Acid Grassland but gains in area for Fen, Marsh and Swamp, Arable, Broadleaved and Coniferous Woodlands. Main changes in vegetation suggest a small shift in favour of plants associated with higher fertility in the Bog Broad Habitat, together with evidence of a reduction in soil acidity. The biological condition of rivers and streams showed a marked increase in quality between 1990 and 1998.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

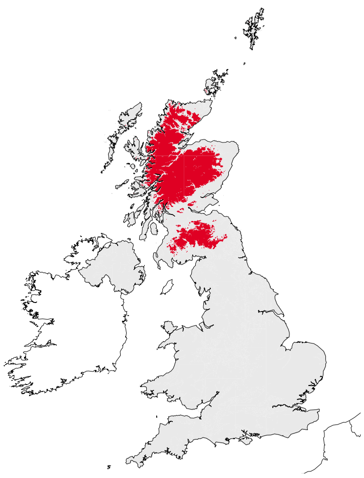
9.31 Both Zones are dominated by the *Bog* Broad Habitat, which accounted for about 30% of their area. The landscapes of these Zones also include a range of grassland and semi-natural cover types associated with upland and marginal environments. The major difference between the two is that Zone 5 includes a far greater cover of *Improved Grassland* than Zone 6, whereas the latter has more extensive areas of *Acid Grassland.* Similarly, the *Fen, Marsh and Swamp* Broad Habitat is more extensive in Zone 5, whereas *Dwarf Shrub Heath* is more widespread in Zone 6. The area of *Coniferous Woodland* in both Zones is similar, covering 13% and 15% of the land area in Zones 5 and 6 respectively. By contrast the area of *Broadleaved Woodland* is smaller, each having around 3-4% cover.

9.32 The largest changes of stock in the Broad Habitats that dominate these Zones were the losses from *Neutral Grassland*, *Dwarf Shrub Heath*, *Bog* and *Acid Grassland.* The habitats that gained in area were *Fen, Marsh and Swamp*, *Arable, Broadleaved* and *Coniferous Woodland.* Zone 6 generally showed fewer changes than Zone 5, although *Dwarf Shrub Heath* did show a marked decline, while *Fen, Marsh and Swamp* increased.

CROFTING LANDSCAPE, ENVIRONMENTAL ZONE 5, INNER HEBRIDES *(C BARR)*

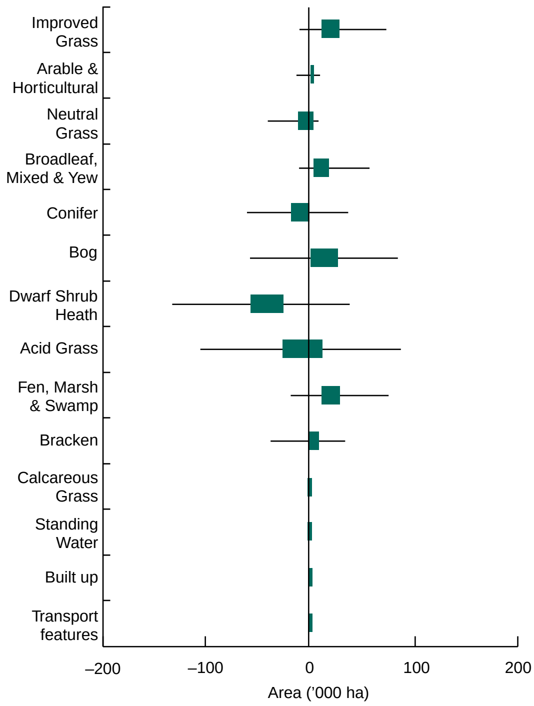
9.33 Chapter 6 provided an analysis of the vegetation data associated with the semi-natural Broad Habitats for Scotland as a whole. It was found that the most marked change was for the *Bog* Broad Habitat, which showed a small, but

Figure 9.8: The true uplands of Scotland (Environmental Zone 6)



Zone 6 includes all of the 'true' uplands in Scotland, and occurs mainly in the north central areas, with high relief.

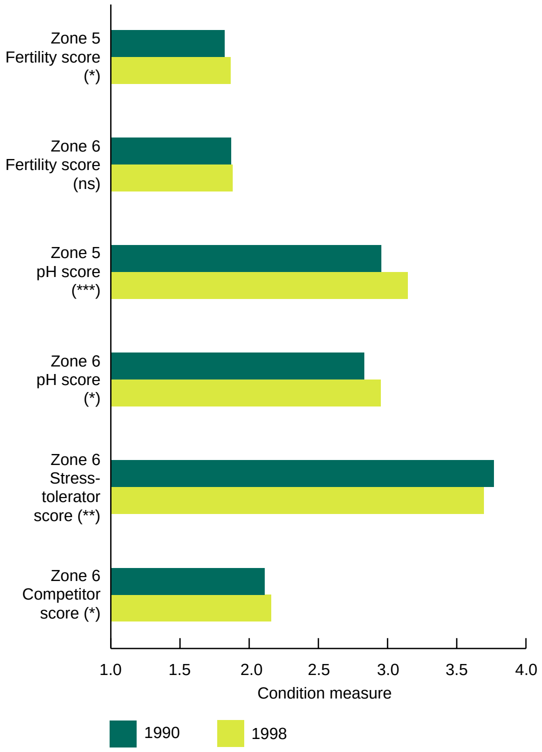
Key changes: Land cover fairly stable, but some evidence of loss of Dwarf Shrub Heath and gain in Fen, Marsh and Swamp. Main changes in vegetation suggest a reduction in the proportion of stress-tolerant plants in Acid Grassland and Bog Broad Habitats, together with a small increase in less 'acid-loving' plant species in Bog. The biological condition of rivers and streams in showed a marked increase in quality between 1990 and 1998.



'Box and Whisker' diagram: Whiskers show total range of data; boxes show range within which 50% of values occur, around the mean

significant increase in fertility in those plots that contained vegetation most typical of this habitat type, namely heath and bog. This change was associated with increases in species number and a decline in the frequency of stress tolerant species. There was also evidence that vegetation was responding to an increase in pH (i.e. reduction in soil acidity). These changes are also apparent when these data are analysed by Environmental Zone (Figure 9.9).

Figure 9.9: Changes in condition indicators for the *Bog* Broad Habitat in Environmental Zones 5 and 6 in upland Scotland, 1990-1998.



Results based on condition data for X plots that were assigned to the heath/bog vegetation type in 1990. * P<0.05, ** P<0.01, *** P<0.001.

9.34 Figure 9.9 shows that the increase in fertility appears to be most marked in Environmental Zone 5. No significant change was observed for fertility score in Zone 6. The increase in pH (i.e. reduction in soil acidity) is however, apparent in both Zones.

MOUNTAIN LANDSCAPE, ENVIRONMENTAL ZONE 6, WESTERN SCOTLAND

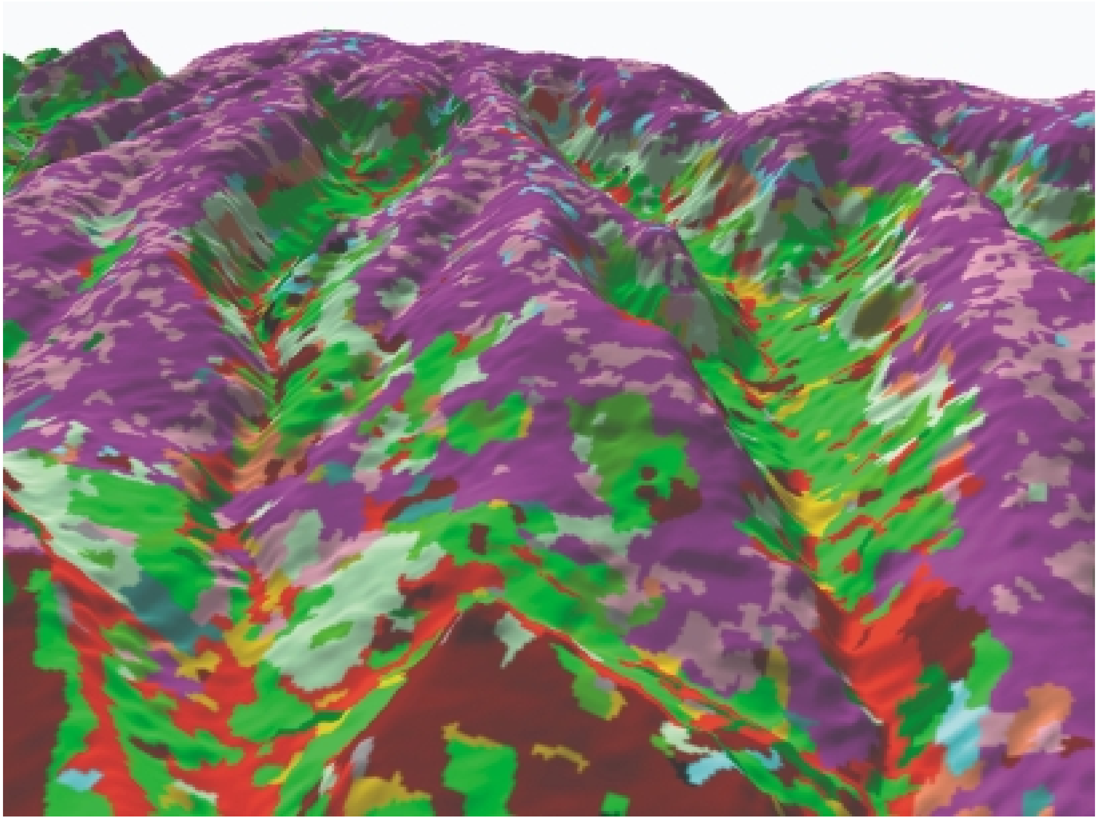
(C BARR)

9.35 The biological condition of rivers and streams in Zone 5 and 6 showed a marked increase in quality between 1990 and 1998. It was suggested that a number of factors could be responsible for the change in these particular Zones, including differences in weather conditions at the time of the two surveys.

Developing the landscape view

9.36 This chapter presents a preliminary view of the results of CS2000 in terms of the major Environmental Zones that make up England and Wales, and Scotland. This type of analysis merits further work both within the framework of the Zones and also using other regional breakdowns and landscape character assessments. Zonal 'land cover accounts' will be produced, which will provide a balance sheet for Broad Habitats and the flows between habitats in each Zone. The Countryside Information System (CIS) enables CS2000 and NICS2000 data to be estimated for any geographical area in the UK, though most estimates will only be reliable for relatively large areas.

Figure 9.10.



A simulated perspective view, made by overlaying Land Cover Map 2000 onto a digital terrain model, showing the North York Moors from Kirkbymoorside northwards over Rudland Rigg. The moors with Dwarf Shrub Heath (mauve), in places burnt to encourage new growth (pink), are deeply cut by valleys with Acid Grassland (pale green), Bracken (dull orange) and Broadleaved woodlands (red) on valley sides with Improved Grasslands (green) in the valley bottoms.

9.37 The availability of a field-by-field map of Broad Habitats from Land Cover Map 2000 will offer new opportunities for regional and local assessments, including aspects of landscape structure and pattern which cannot be assessed at the scale of individual 1 km squares used in the field survey. It will enable basic stock data to be constructed at local scales. An example of the type of output that will be available is shown in Figure 9.10. The data from the satellite land cover will be calibrated with the field survey so that it will be possible to check the comparative accuracy of the two surveys. It will also enable the detailed ecological characteristics of the land, as viewed from space, to be determined.

Some aspects of the habitats and landscapes of the United Kingdom are changing rapidly, and it is clear that if we are to manage this change so that it delivers the many things that we want from the countryside, then we will need to periodically update our information base. The results of the Countryside Surveys need to be fully and critically evaluated, so that we can learn from them and develop appropriate responses.

10 countryside survey – where next?

10.1 This report has presented some of the results from Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000. Even at this early stage of scientific analysis they reveal much about the changes that have taken place in the UK countryside between 1990 and 1998. However, further work is needed if we are to have a more complete understanding of the ecological patterns and processes associated with our rural areas, the causes of landscape and habitat change and the consequences for biodiversity and quality of the countryside.

10.2 This report has provided some data on stock and change of Broad Habitats including vegetation, linear features, freshwaters and soils; more will be made available on the CS2000 website[1]. The new Land Cover Map 2000 will be completed in 2001, and the results are being compiled of the survey of breeding birds and soil analyses. A series of important research tasks and issues lies ahead to better understand the significance of the results and the underlying causes.

Understanding what has been measured

10.3 The CS2000 field data have been analysed using a series of condition measures. Some of these indicators are straightforward, such as the area of a particular Broad Habitat. Others are more complex, such as the various measures that relate to the environmental situation under which plant species are typically found. Increases in nutrient scores may well indicate eutrophication – i.e. an increase in nutrient inputs to the land. However, a degree of increase in these scores may also occur through natural succession from disturbed to undisturbed land. Further work is needed to clarify how the measures should be interpreted.

Bringing the data together

10.4 Integration of the different data sets developed as part of CS2000 and NICS2000 will allow a range of environmental issues to be considered. We already have one clear example from this report, namely the relationship between the improvements in biological condition of freshwaters, and the tendency for stream and riverbanks to have become more overgrown. Are these changes linked, and if so, are there lessons to be learned about creating a diversity of waterside management regimes to conserve both freshwater life and the diversity of vegetation of watersides?

10.5 One of the most important challenges is to bring together the field survey data with the new Land Cover Map 2000 (LCM2000). The comprehensive coverage of the Land Cover Map complements the detail of the field survey. Integration of the two datasets will help us to infer more detail about Broad Habitats and their species than either can provide alone. The Land Cover Map offers a framework for extrapolation of field observations giving greater precision than we can achieve at present. Further work will seek to quantify the inter-relationships between soils, land use, habitat management, vegetation, bird life and freshwater conditions from the survey squares, and extend this knowledge regionally and nationally through LCM2000.

10.6 Much of the CS2000 data analysis to date has concerned ecological changes in the countryside where the scientific methods are well developed. However, changes in the appearance and the cultural values of the landscape matter just as much to many people. Different

1 www.cs2000.org.uk

approaches have been developed for evaluating landscapes in different parts of the UK. In England, for example, the Countryside Agency has undertaken an assessment of Countryside Character, which provides a framework for targeting advice on countryside management and planning. We need to see how information from CS2000 and NICS2000 can help us to measure changes in countryside character. As part of the *Quality of Life Counts* initiative, the Government intends to develop an indicator of 'countryside quality' which will draw together information on countryside character with changes measured in CS2000.

Understanding causes of change

10.7 CS2000 data describe what has happened. It is clearly better both to *know* and *understand* what has happened, so that it is possible to plan ahead for change in the future. For example, the results so far suggest eutrophication in many Broad Habitats, and a decline in the quality of those grasslands that are more important for conservation. Why have these changes happened? What are the respective roles of agriculture and atmospheric deposition, and are we seeing the effects of recent nutrient inputs or the slower response to nutrients that were entering the soil years ago?

10.8 Using CS2000 data, we can identify the patterns of nutrient change, and relate them to the patterns of fertiliser use and atmospheric deposition, taking into account differences in soils. We can look to experiments to help us distinguish between slow and rapid vegetation responses, and experience of habitat restoration techniques will help tell us how changes in vegetation can be controlled and reversed.

APPLYING FERTILISER TO IMPROVED GRASSLANDS, CUMBRIA *(C BARR)*

Evaluating present and future policies

10.9 The *Quality of Life Counts* indicators on landscape features and plant diversity give a general impression of the success of policies to manage the countryside. But we need to go further to examine the effects of policies in more detail. CS2000 provides a reference point, against which changes in habitats within agri-environment schemes and designated areas can be compared. The data on vegetation and soils can be used to calculate the effects of land use changes on the amounts of carbon being stored in the ground and released to the atmosphere – an important part of the Kyoto Protocol on climate change. The data provide a baseline for future monitoring of the effects of global climate change and can be used in models, which aim to predict how the countryside may change in the future.

10.10 Not all policies work directly on the land, they often apply to the people that work upon it. CS2000 provides data which can help us understand how land use and management affects the landscape and the species within it. If we learn about the relationships between policies, socio-economic circumstances and how land is used and managed, then it becomes possible to suggest how economic policies (such as the Common Agricultural Policy) may affect the fabric of the countryside.

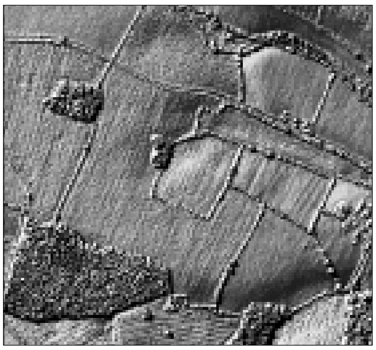
Planning future landscapes

10.11 The capacity of wildlife species to thrive in the countryside depends partly upon landscape pattern. Habitat patches that are small and isolated will tend to lose their distinctive species over time while landscape patterns, which help wildlife to disperse, may reduce this isolation. It will be possible to assess landscape structure, using the Land Cover Map 2000 remote sensing technologies (Box 10.1), to

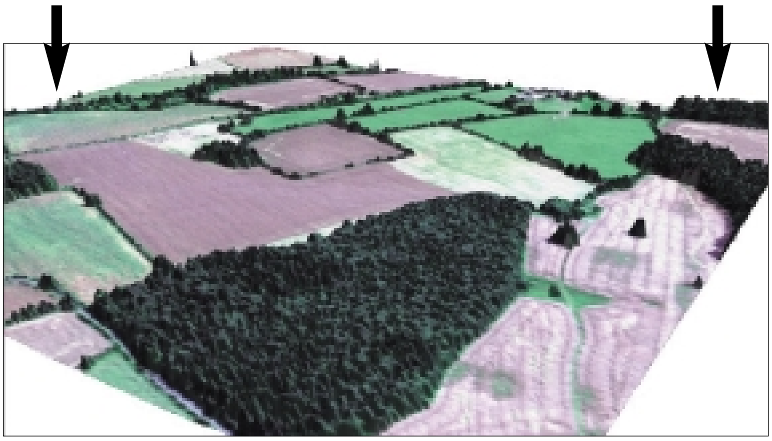
Box 10.1: New opportunities for countryside monitoring

As part of the forward-looking programme of scientific activity within the CS2000 work programme, research has considered what opportunities new technologies offer for the collection of habitat and landscape data. Airborne remote sensing techniques may well provide new sources of data for any future Countryside Survey. The images below are for a 1km sample square in an area of southern England dominated by arable farming.

This image shows land cover data obtained from the Compact Airborne Spectrographic Imager (CASI). This sensor records spectral radiance in visible and near-infrared wavelengths that can give information for vegetation analysis. Not only can land cover and Broad Habitat data be derived from the image, but it can also tell us much about the structure of linear features such as hedgerows.



LIght Detection And Ranging (LIDAR) is a terrain mapping system using an airborne scanning laser. This can calculate surface height at an accuracy within 15cm, giving detailed digital elevation data, and spatial data on vegetation canopy height. Such data literally add an extra dimension to land-cover classification using spectral imagery. In the case of hedgerows, for example, the imagery can provide important, quantitative information about structure.



CASI and LIDAR can also be combined to give a '3-dimensional view' of the countryside so that we can more easily interpret and understand landscape structure and pattern. In this scene the sample square is viewed from the bottom left hand corner.

suggest what changes would help conserve our biodiversity in the face of changing land use and climates. We can also develop computer models to suggest alternative visions for landscapes. We can assess land around towns, to see whether it gives a combination of open access areas, landscape quality, biodiversity and economic productivity that will be valued, or whether some changes are needed.

The next Countryside Survey?

10.12 The results of Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 clearly show that some of the negative trends of habitat loss evident in the countryside before 1990 have been slowed, halted or reversed. These gains partly result from policy measures implemented over the last decade, such as incentives for hedgerow management and farm woodland schemes. However, it may be too early to see the benefits of more recent policy changes, and so the results of the Countryside Surveys represent a base line to help assess the effectiveness of these new measures.

10.13 The results of the Countryside Surveys also allow us to put the gains that have been observed in a broader context. For while there have been some successes, there is evidence that the condition of many habitats has declined since 1990, continuing trends that were apparent in the 1980s. This is especially so in the less improved agricultural grasslands and semi-natural upland habitats of *Heath*, *Bog* and *Acid Grassland*. There is some evidence for widespread nutrient enrichment, or eutrophication. Such changes may reflect wider environmental, social and economic pressures. Further work is required to understand the patterns of change that have been detected and to understand their policy implications.

10.14 It is clear that if we are to manage this dynamic situation so that it delivers the many things that we want from the countryside, then we will need to periodically update our information base. As in the past, it is likely that new information needs will be identified, and new methods of survey developed, see Box 10.1. However continuity with previous work is essential for the detection and assessment of long term trends. The results of Countryside Survey 2000 and the Northern Ireland Countryside Survey 2000 need to be fully and critically evaluated, so that we can learn from them and be well prepared to meet the demand for future assessments of the condition of the countryside.

Appendix A

broad habitat definitions

The following brief definitions of the Broad Habitats (as listed in UK Biodiversity Action Plan) have been provided by the Joint Nature Conservation Committee. Where appropriate, a note is made of where CS2000 has been unable to match the given definitions. The list is ordered here in relation to the chapters of this report.

Chapter 3 Enclosed farmland – Arable and Horticultural, Improved and Neutral Grasslands

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* and *Calcareous Grasslands* 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%.

Chapter 4 Boundary and Linear Features

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].

Chapter 5 Woodlands

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]

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%

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.

Chapter 6 Mountain, Moor, Heath and Down

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.

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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.

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 contains 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.

Chapter 7 Rivers, Streams, and Standing Waters

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.

Chapter 8 Developed Land in Rural Areas

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.

A

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.