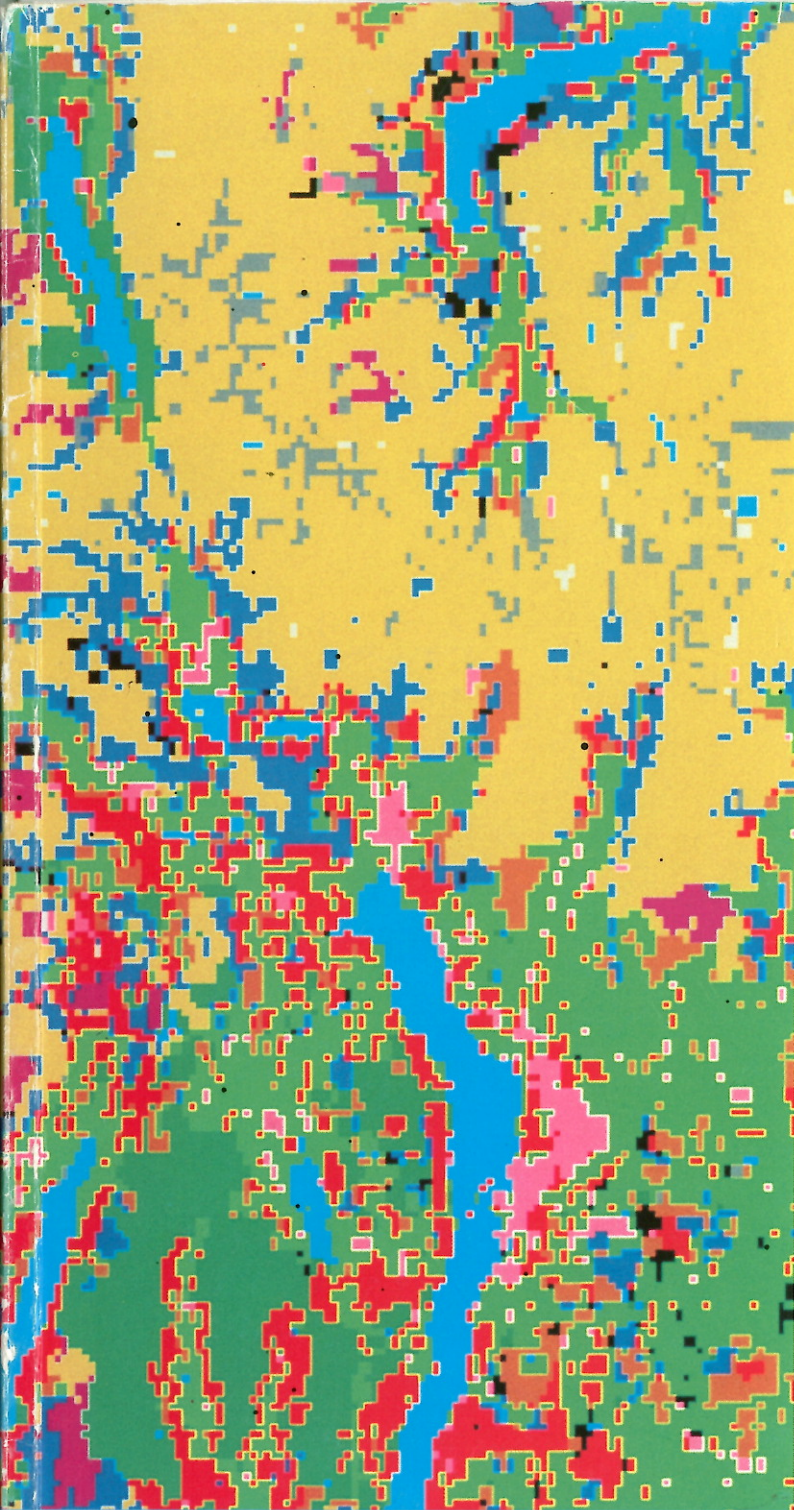


TECHNICAL REPORT

# LANDSCAPE CHANGE IN THE NATIONAL PARKS



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COUNTRYSIDE COUNCIL FOR WALES

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The Countryside Commission works to conserve and enhance the beauty of the English countryside and to help people to enjoy it.

The Countryside Council for Wales is the organisation that deals with countryside matters in Wales on behalf of the Government.



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**Information and Library Services**  
**Nature Conservancy Council for England**

Northminster House  
Peterborough PE 1UA  
Telephone (0733) 340345 Fax (0733) 68834





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## FOREWORD

Our National Parks contain many of the finest landscapes of England and Wales. The National Park authorities work hard to conserve them and to help people to enjoy their beauty. They have been successful in resisting many potentially damaging developments and in encouraging much land management that is appropriate to the special qualities of the Parks.

The last 20 years have seen a number of changes that have benefitted Park landscapes. To give just two examples: the Environmentally Sensitive Areas, created in parts of two Parks, have enabled moorland and flower-rich meadows to be conserved; and the negotiation of management agreements, especially in Exmoor, has virtually halted the previously high rate of moorland reclamation. Yet despite these and other initiatives, some damaging developments have gone ahead:

- extensions to mineral workings in the Peak District;
- the building of the Okehampton by-pass across a corner of Dartmoor;
- smaller scale developments such as blocks of forestry, construction of farm roads and agricultural land improvements, which together have had a considerable effect on a Park such as Snowdonia.

But how significant are such changes? This has been difficult to assess because no comprehensive information about landscape change in the Parks has been available. The need for such information was identified in *Fit for the future: Report of the National Parks Review Panel* (CCP 334). It recommended that each Park authority should establish an environmental inventory and that the Park authorities should collaborate more fully in carrying out research.

The 'Monitoring landscape change in National Parks' project anticipated this need. It was established by the Countryside Commission in 1987 in a joint exercise with all of the Park authorities, to provide,

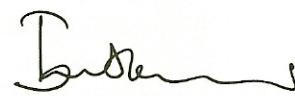
for the first time, a complete survey of land cover in the National Parks in England and Wales. The project, which was carried out by Silsoe College, compared the Parks in the 1970s and the 1980s and used a geographical information system (GIS) to record, store and analyse the information. This makes it possible to study the findings at the national level, for individual Parks, and even at the parish or community scale. It is also a powerful tool for analysing the data in detail, for adding further information and for recording the results of future surveys.

*Landscape change in the National Parks* summarises the key results, both nationally and for each Park, and assesses their significance. More detailed technical reports have been published by Silsoe College in 14 volumes. The results show the dynamic nature of the landscapes of the National Parks. There has been a general trend towards more intensive land management and a decline in traditional features such as hedges and walls, although it is difficult to generalise because the picture is very different in each Park. The great value of the results lies in the factual detail that they provide, which can be used for developing Park policies, assisting management and as a basis for further research.

We hope that the summary published here will assist all those concerned with National Parks to understand the main findings of the project, and that they will be used in ways that will help to secure the future of our National Parks.



ADRIAN PHILLIPS  
Director General  
Countryside  
Commission



IAN MERCER  
Director  
Countryside Council  
for Wales



# I. LOOKING AT LANDSCAPE CHANGE

## Why study change?

The National Parks of England and Wales\*, shown in Figure 1, contain some of our most important and beautiful landscapes. They include much of the wildest and remotest scenery and display a variety of cultural landscapes where human activity and man-made features have combined with natural influences to create areas of distinctive character and high landscape quality. The first purpose of National Parks is to preserve and enhance their 'natural beauty', which embraces landscape, wildlife and other physical and cultural qualities.

Although the word 'natural' is used, most of the Park landscapes are, with a few limited exceptions, moulded by human activity. They are therefore subject to change as social, economic and cultural influences evolve over time. There has been growing concern that we lack basic factual information about the nature of National Park landscapes and about the way in which they are changing. For this reason, the Countryside Commission, the National Park authorities and the Broads Authority commissioned a comprehensive survey to monitor recent landscape change in the Parks, and to provide a baseline against which future change could be assessed. From April 1st 1991 the Countryside Council for Wales has become the agency concerned with the interests of the National Parks in Wales. This report is published jointly by the Countryside Commission and the Countryside Council for Wales.

The 'Monitoring landscape change in the National Parks' project was carried out by Silsoe College over the period 1988 to 1991. This summary report provides an overview of the findings of the project. It includes analysis of the results for individual Parks and for the Parks as a whole. It looks at the way in which a number of important features of the landscape have changed, including woods and forests, moor and heath, farmland and field boundaries. More detailed analysis of the results can be found in a series of 14 separate technical reports produced by Silsoe College (1). They consist of:

- 11 individual reports on the detailed results for each park;
- a report on the detailed data for the Parks as a whole;

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\* The National Parks of England and Wales, including the Broads Authority, will be referred to collectively in this report as the National Parks. Their distribution is illustrated in Figure 1.

- a technical report describing in detail the methods used;
- a report on the applications of remote sensing (using satellite imagery) to work of this type.

Further details of these reports and how to obtain them are given in the reference section at the end of this report.

## Developing a method for measuring change

The overall objective of the project was:

"to obtain and present, in a refined and accessible form, statistical and mapped information on the extent, distribution and change over time, of a wide range of land cover types that constitute the land surface of the National Parks, at two target dates".

The work was based on aerial photographic interpretation, linked with ground survey. Aerial photographs covering the whole of each Park, taken in the 1970s and the late 1980s, were compared in order to identify the changes that had occurred between these two dates. The period between the photography varied but the average time difference was 15 years. The task was enormous, involving comparisons of thousands of different photographs to build up a complete picture of what was happening in the Parks.

One particular feature of the project was the use of a geographic information system (GIS) to store and analyse the data. A GIS is a combination of computer software and hardware that is designed to manipulate map based data. It has the enormous advantage that, once the data has been stored, a wide variety of analysis can be carried out, allowing landscape change to be illustrated by maps, and quantified statistically, for virtually any area. The project has provided an extremely valuable opportunity to test the use of GIS in work of this type.

The method developed is summarised in Figure 2 (page 7) and is described in more detail in Appendix 1. It had five essential parts:

- identification and measurement of features from 1970s and 1980s aerial photographs and recording of change;
- sample field survey to check identification of features;
- checking the accuracy of the photographic interpretation by comparison with the field survey findings;



- converting the maps or measurements so that they could be handled by computer (digitising);
- analysing and presenting the information about change.

The main land cover types and other landscape features that were recorded are listed in Table 1, with detailed definitions given in Appendix 2. They include 'area' features, such as woodland and moorland, 'linear' features, such as hedgerows and fences, and 'point' features, such as individual trees and inland water.

### Some practical limitations

Some limitations of the survey must be borne in mind

in using the results. Firstly, there is the question of accuracy. Errors were possible from three sources, as follows:

- in identifying landscape features from photographs;
- in measuring the number or length of features or in digitising areas;
- in the handling and analysis of the information.

The study was designed to minimise these sources of error, and checking of accuracy as part of the work suggests that the levels of error compare favourably with other projects of this type.

Other limitations arose from the classification of landscape features devised for the study and the

Figure 1. The National Parks of England and Wales.

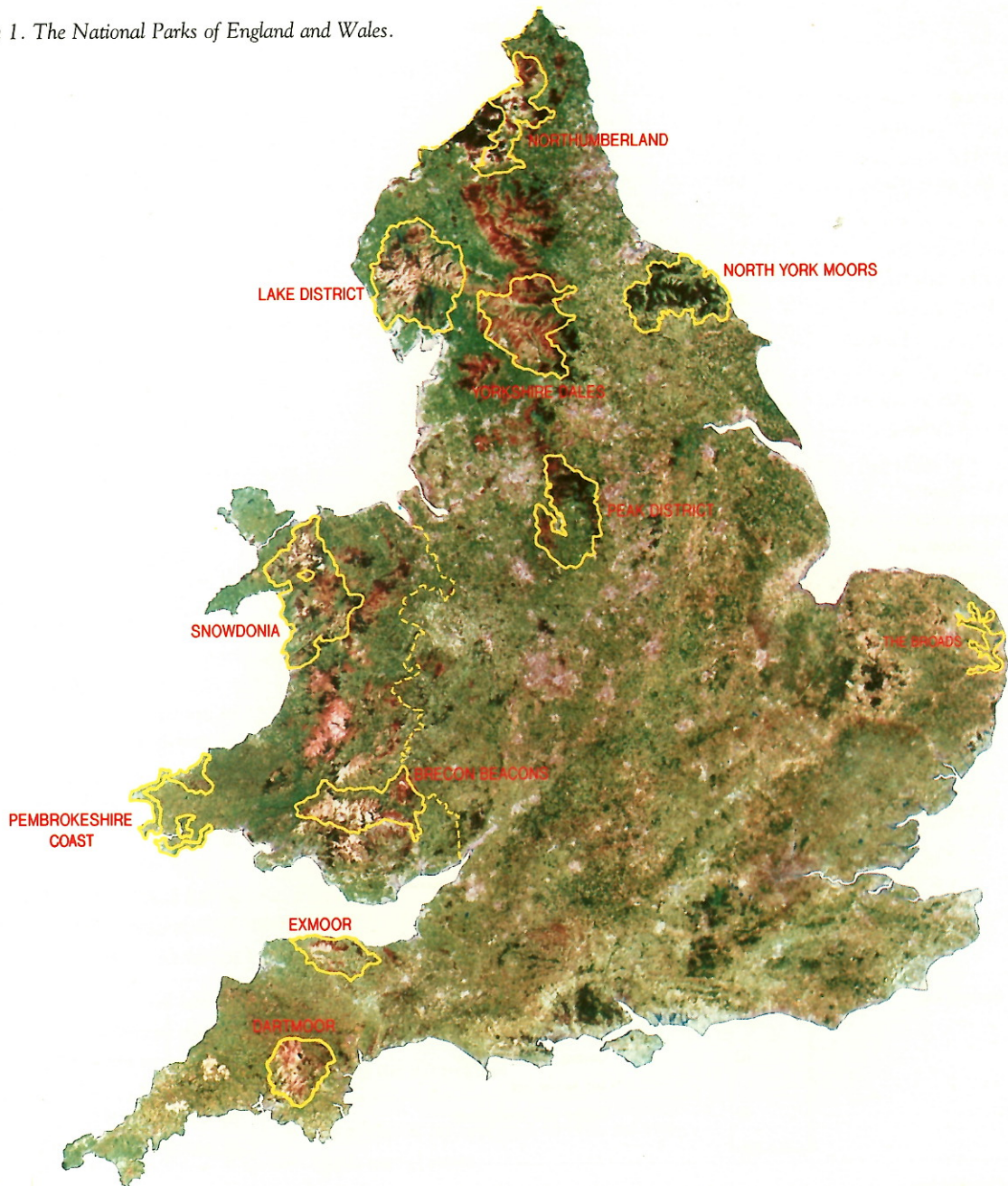


Image processing by the National Remote Sensing Centre, Farnborough.



Table 1. The land cover types and landscape features measured.

Main category	Code	Type	Sub division
A Linear features	A1	Hedgerows	
	A2	Fences and insubstantial field boundaries	
	A3	Walls	
	A4	Banks	
	A5	Open ditches	
	A6	Woodland edge	
	A8	Strip woodland	
	A9	Grips	
	B Small or isolated features	B1	Individual trees in linear features
B2		Individual trees outside linear features	
B3		Groups of trees, all species	
B6		Inland water	
C Wood and forest land	C1	Broadleaved high forest	
	C2	Coniferous high forest	
	C3	Mixed high forest	
	C4	Scrub	
	C5	Clear felled/newly planted areas	
D Moor and heath land	D1	Upland heath	
	D2	Upland grass moor	(b) grass moor (d) blanket peat grass moor
	D3	Bracken	
	D4	Unenclosed lowland areas	(a) rough grassland (b) heath
	D6	Upland mosaics	(a) heath/grass (b) heath/bracken (c) heath/blanket peat
	D7	Eroded areas	(a) peat (b) mineral soils
	D8	Coastal heath	
	E Agro-pastoral land (enclosed farmland)	E1	Cultivated land
E2		Grassland	(a) improved pasture (b) rough pasture
F Water and wetland	F1	Open water, coastal	
	F2	Open water, inland	
	F3	Wetland vegetation	(a) peat bog (b) freshwater marsh (c) saltmarsh
G Rock and coastal land	G2	Bare rock	(a) inland (b) coastal
	G3	Other coastal features	(a) dunes (b) sand beach (c) shingle beach (d) mud flats
H Developed land	H1	Built-up land	(a) urban area (b) major transport routes
	H2	Quarries, mineral workings and derelict land	(a) quarries and mineral working (b) derelict land
	H3	Isolated rural developments	(a) farmsteads (>0.25 ha) (b) other (>0.25 ha)
I Unclassified land			

Refer to Appendix 2 for more detailed descriptions of these categories.



practical difficulties of picking up some features from aerial photographs. Some key points to note are as follows:

- limitations of the photography — cloud cover, steep terrain and shadow resulted in missing data;
- constraints imposed by the nature of the photography — its scale and timing of acquisition added to the difficulties of consistent aerial photographic interpretation;
- neither the condition nor the quality of landscape features was assessed;
- subtle changes such as localised gully erosion of peat, and encroachment of bracken into moorland, could not always be detected or accommodated by the classification system;
- some features, especially bracken, were particularly difficult to identify at certain times of the year.

## Relationship to other surveys

There is considerable interest in the question of landscape change, which is demonstrated by the number of studies on related topics, such as the Mid Wales uplands study (2). The predecessor of the Landscape change in National Parks project was the 'Monitoring landscape change' project, which assessed

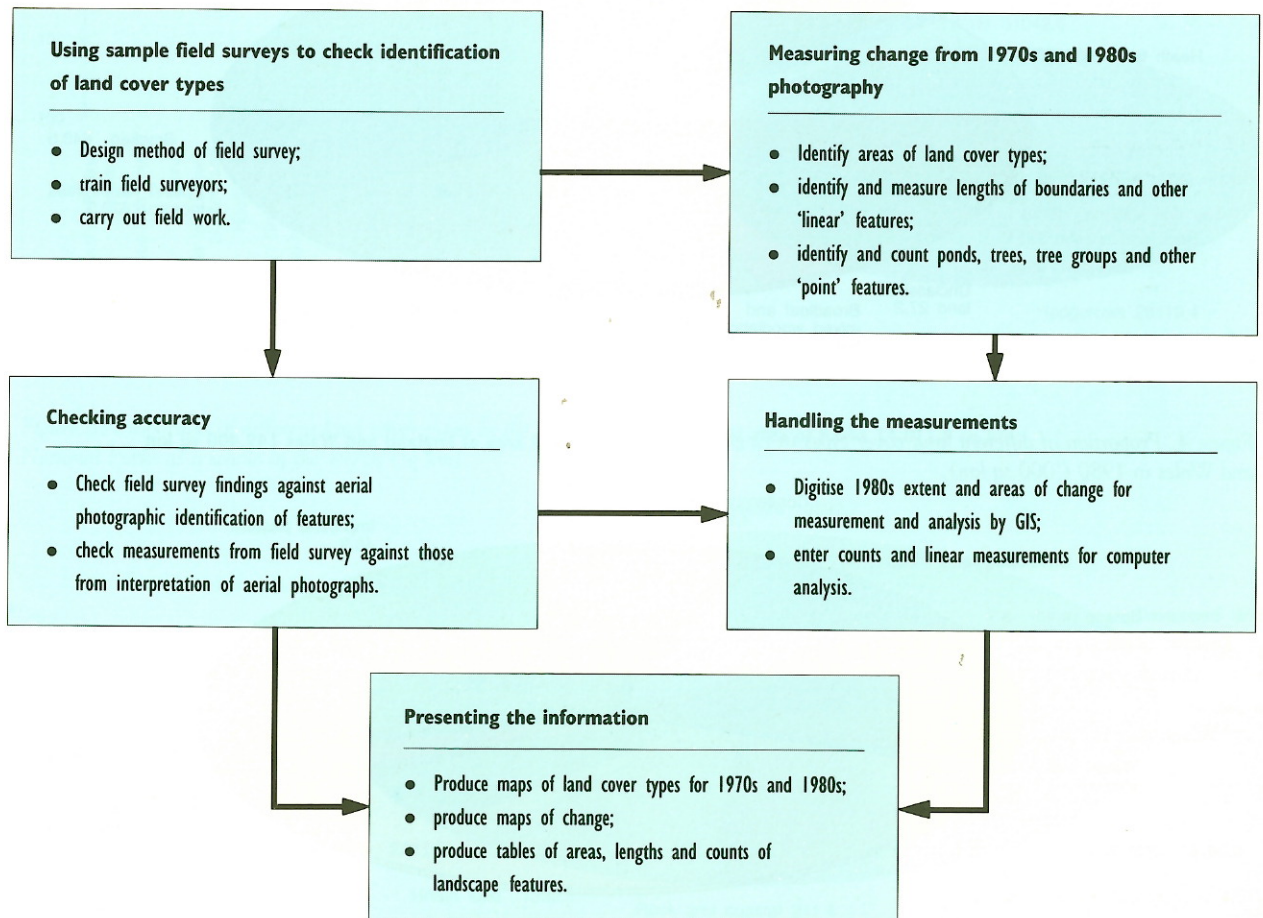
change throughout England and Wales (3) and (4). The methods used were broadly similar, but a number of changes were made for the National Parks study, for example:

- the timescale was different, covering the 1970s and 1980s for the National Parks compared with 1947, 1969 and 1980 for the England and Wales study;
- although the broad categories of landscape features are very similar, the detailed classification system was changed;
- the National Park survey was a census, while the figures for England and Wales were estimated from a sample.

Only very generalised comparisons can therefore be made between the findings of this work and those of the National Parks study reported here.

Similar difficulties exist in relating this study to other work on monitoring rural land use change, and to other more specific surveys of particular types of change. All studies of this type contribute to the debate about the nature and extent of change in the landscape, but differences in approach mean that the results can rarely be directly compared.

Figure 2. The method used.





## 2. THE CHANGING LANDSCAPES OF THE NATIONAL PARKS

### The National Parks as a whole

If the findings of the survey for the National Parks as a whole are totalled, they provide a comprehensive picture of our National Park landscapes in the late 1980s and show the way in which they have changed over the last decade or so. In presenting the information for England and Wales and for the National Parks as a whole, some of the categories have been amalgamated to provide a simplified picture. See Appendix 3 for the detailed definitions.

### Landscape character

Figure 3 illustrates the make up of the National Park landscapes in the 1980s. This is set above Figure 4, which is a pie-chart for England and Wales, based on

the findings of the earlier 'Monitoring landscape change in England and Wales' project (3). The National Parks are, not surprisingly, very different in character from the country as a whole. The main difference is in the extent of upland semi-natural vegetation, which made up 36 per cent of the area of the Parks in the 1980s, but only 9 per cent of England and Wales in 1980. By comparison, only 41 per cent of the total area of the National Parks was enclosed farmland, compared with 72 per cent in England and Wales; 13 per cent of the Parks' total area was woodland, compared with 8 per cent in England and Wales; and less than 2 per cent was developed land compared with 10 per cent in England and Wales. The Parks are therefore more natural, less intensively managed and less developed than the country as a whole — as might be expected.

Figure 3. Proportion of different land cover types in the National Parks as a whole in the 1980s (sq km).

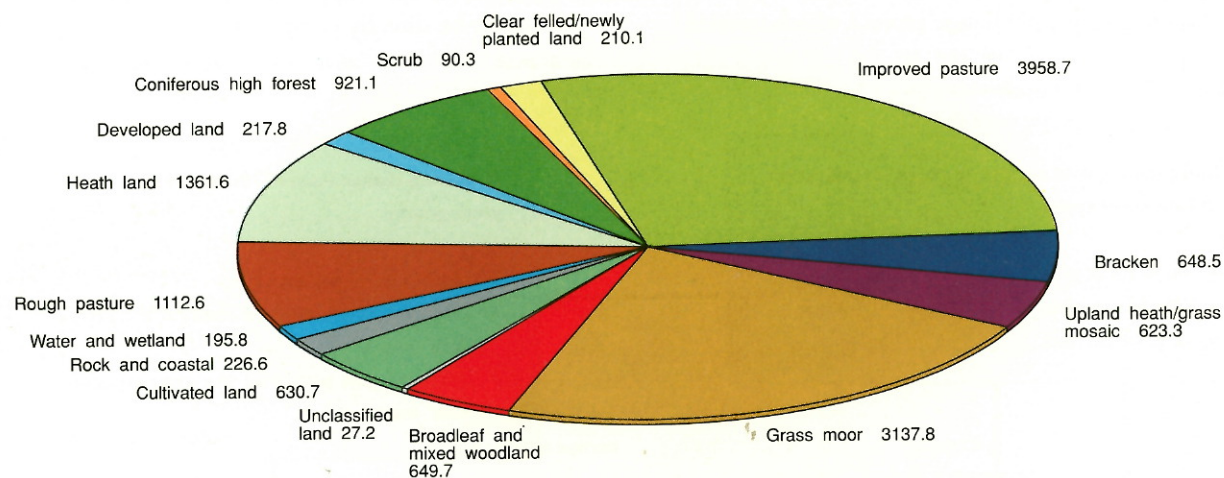
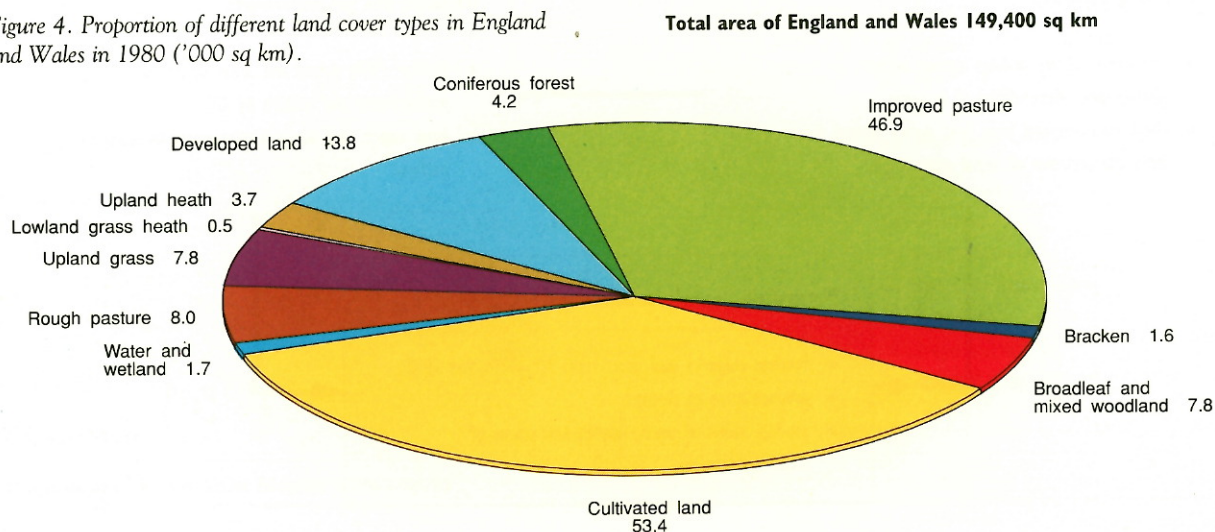


Figure 4. Proportion of different land cover types in England and Wales in 1980 ('000 sq km).





## Overall changes

Figure 5 summarises the overall gains and losses in the main land cover types for all of the National Parks between the 1970s and the 1980s, shown as net change. The bar chart shows the extent of these changes, while the pie chart (Figure 6) shows the situation in the 1970s, providing the baseline against which their significance can be judged. Figures 7 and 8 show comparable information for field boundaries in the Parks as a whole. It shows the losses in hedgerows

Figure 5. Overall gains and losses in land cover types in the National Parks as a whole from the 1970s to the 1980s (sq km).

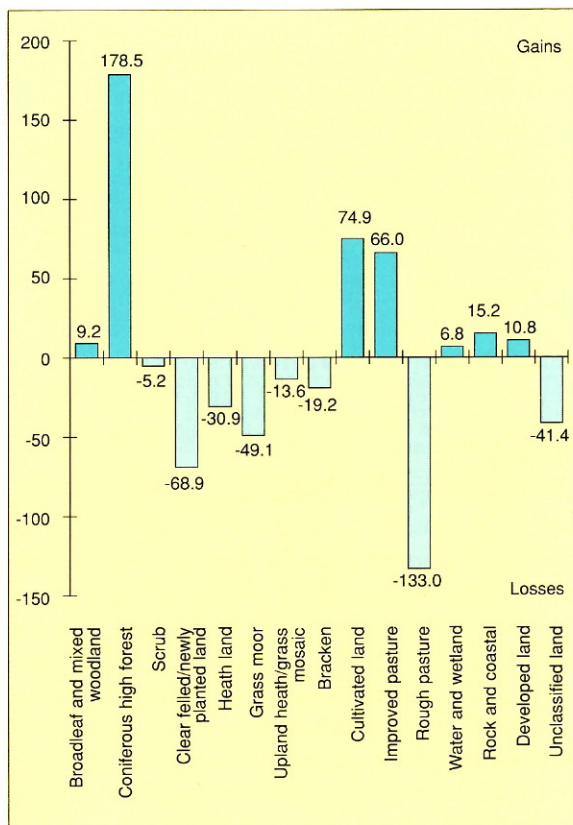


Figure 6. Proportion of different land cover types in the National Parks as a whole in the 1970s (sq km).

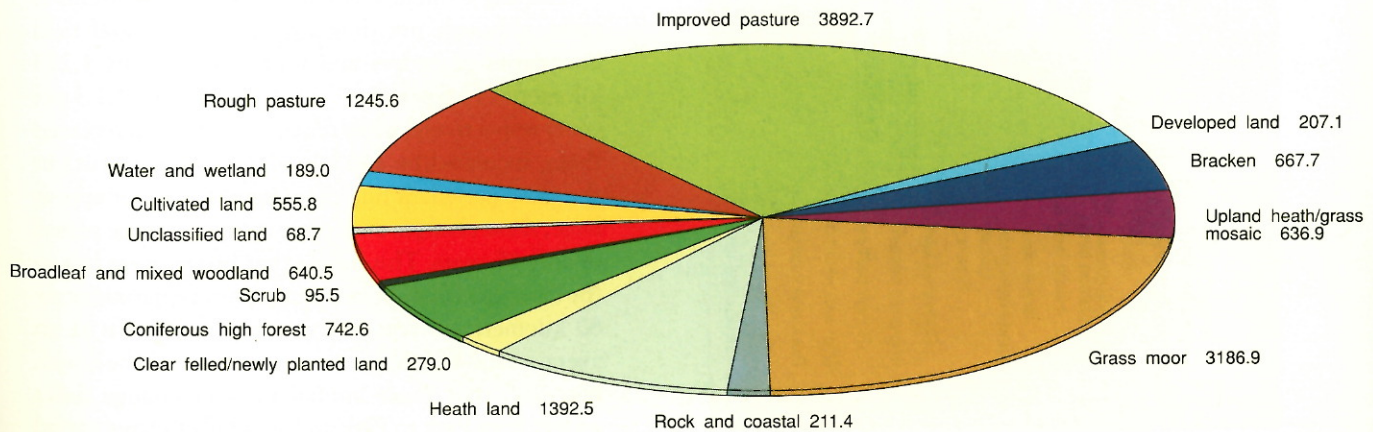


Figure 7. Changes in field boundaries in the National Parks as a whole from the 1970s to the 1980s (km).

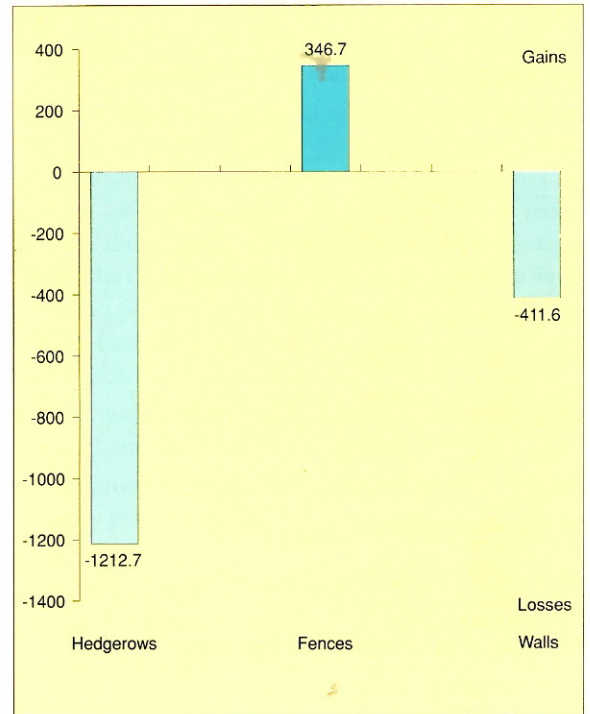
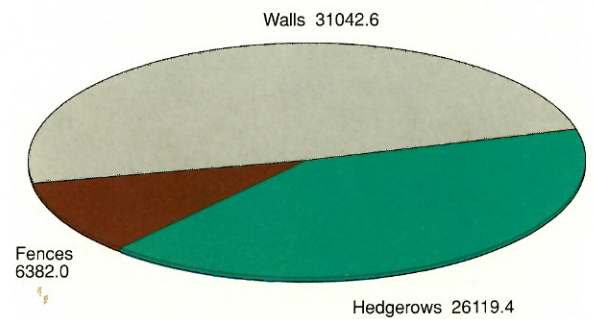


Figure 8. Proportion of different boundary features in the National Parks as a whole in the 1970s (km).





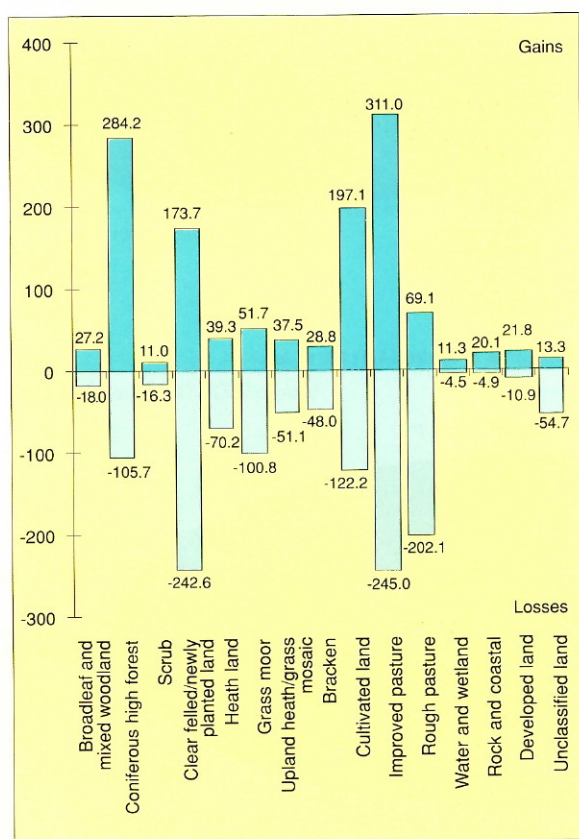
and walls which are such an important, traditional feature in so many of the Parks, and the gains in the fences that often replaced them.

What, then, do these figures mean? The main gains and losses that they show for all of the Parks are:

- little overall change in
  - water and wetland,
  - developed land,
  - rock and coastal features,
  - broadleaved and mixed woodland;
- a total increase in
  - cultivated land,
  - coniferous high forest,
  - improved pasture,
  - length of fences;
- a total decrease in
  - rough pasture,
  - moor and heath,
  - clear felled/newly planted land,
  - length of walls,
  - length of hedges.

There was considerable movement between different types of land cover, which is described as gross change.

Figure 9. Areas gained from and lost to each land cover type in the National Parks as a whole from the 1970s to the 1980s (sq km).



The differences between 'net', or overall change and 'gross' change is explained more fully in Appendix 1. Figure 9 shows that for the National Parks as a whole a number of different types of land cover showed a large amount of gains and losses, particularly:

- coniferous high forest,
- clear felled and newly planted areas,
- moor and heath,
- cultivated land,
- improved pasture,
- rough pasture.

## Trends in the National Parks as a whole

The area of enclosed farmland increased overall although the main source of change was movement between one sort of enclosed farmland and another. There was considerable change between rough pasture, improved pasture and cultivated land as land was improved, cultivated or allowed to revert at different times. The general trend, however, was one of intensification of farming.

The overall extent of moor and heath showed a small decline mainly due to loss to forestry and to reclamation as pasture. There was also some movement between different types of semi-natural upland vegetation as grazing and management systems changed.

The most apparent change in the 1970s and 1980s was the increase in the total area of coniferous forest. Young and mature coniferous forest appeared to show a substantial increase of 178 km<sup>2</sup> from a 1970s total of 743 km<sup>2</sup>. However, much of this resulted from the growth of trees planted before the 1970s becoming more evident in the landscape. During the period 116.1 km<sup>2</sup> of land that had been moor and heath or enclosed farmland changed to newly planted land (65.5 km<sup>2</sup>) or young coniferous forest (50.6 km<sup>2</sup>). There was an overall decrease in the total area of clear felled or newly planted land, which suggests that the amount of new planting decreased in the 1970s and 1980s.

Turning to field boundaries, the overall trend is clear, although not dramatic. The traditional field boundaries of hedges and walls decreased by 1,213 kilometres (4.6 per cent) and 412 kilometres (1.3 per cent) respectively, while fences, which often replaced them, increased by 346 kilometres (5.4 per cent) in the same period. While these figures may not appear large, these changes took place over an average period of only 15 years. This means that hedges were lost in the Parks as a whole at an average rate of approximately 80 kilometres a year in this period and walls at an average rate of 27 kilometres a year. It should be noted, however, that these annual rates of change differ widely from Park to Park and are likely to have varied



at different times during the period of the study, rather than being evenly spread.

In parallel with the loss of hedgerows, the numbers of individual trees in hedgerows also declined, whereas the number of other individual trees did not change noticeably. Groups of trees increased slightly, while other small features such as ponds and farm reservoirs decreased.

## Variations between the Parks

These overall trends for the Parks as a whole are, of course, a simplification of a much more complex picture. The individual Parks vary widely in character and in the mix of land cover types that contribute to this. Each has experienced its own unique pattern of change in the last two decades, as a result of the characteristic system of land management and the particular social, economic and cultural pressures in the area.

The information from the monitoring study allows this variety to be clearly demonstrated. In the following sections, each of the Parks is described in turn. In each case a map of the whole Park shows the distribution of the characteristic land cover types in the 1980s, providing a 'snapshot' of the landscape in the last decade. This is related to an overall description of the character of the Park and to pie charts summarising the make up of the Park. Such information enables the typical land cover features and the character of the Parks to be compared.

The pattern of change in each Park is then illustrated by bar charts that show both the overall gains and losses and the extent to which there has been movement both into and out of particular categories, reflected in a high level of gross change. The main changes are then summarised.

In presenting this information, the detailed categories of land cover have been amalgamated to produce a simplified picture, but one which is more detailed than that revealed by the six main groups alone. The combined categories vary a little from Park to Park in order to best reflect the particular character of each (see Appendix 3 for detailed definitions for each Park), but in general are as follows:

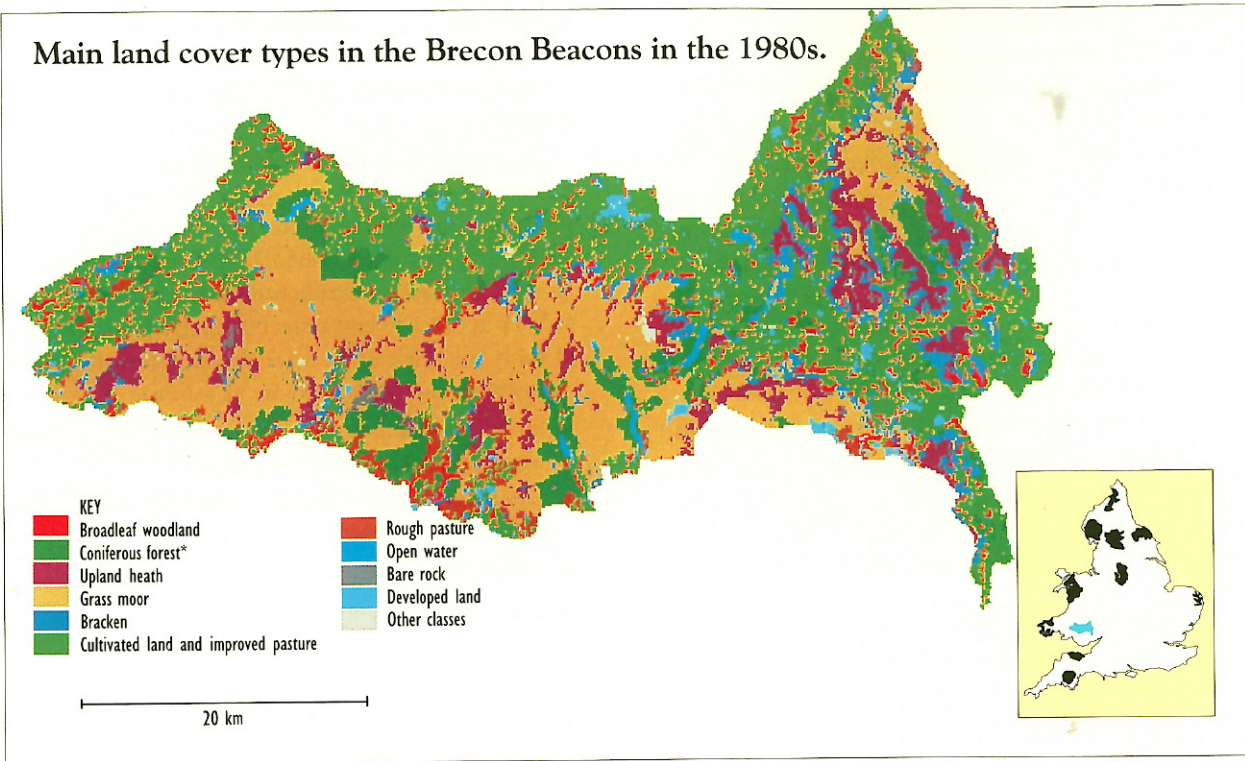
- broadleaf woodland (including broadleaf and mixed woodland and, sometimes, scrub);
- coniferous forest (usually including clear felled/newly planted land);
- upland heath;
- grass moorland;
- bracken;
- cultivated land;
- improved pasture;
- rough pasture;
- open water;
- developed land;
- coastal features.

The technical reports for each National Park (1) provide an additional source of information.



# The Brecon Beacons

Main land cover types in the Brecon Beacons in the 1980s.



## The character of the landscape

The Brecon Beacons National Park consists of four main mountain groups that form the backbone of the National Park, namely the Black Mountain, Fforest Fawr and the Beacons themselves in the west, separated from the Black Mountains in the east by the broad valley of the River Usk. The western and central upland areas contain extensive areas of grass moorland. Further east, as rainfall decreases, there are areas of heather moorland and bracken on most of the valley sides. Enclosed farmland, which is predominantly improved pasture divided by hedges, forms a contrasting landscape on the lower slopes and in the valleys, fringing the mountains to the north and east.

Broadleaved woodlands are confined mainly to valleys, and coniferous forests are widespread on the moorland plateaux and fringes and on valley sides.

Figure 11. Proportion of different boundary features in the Brecon Beacons in the 1980s (km).

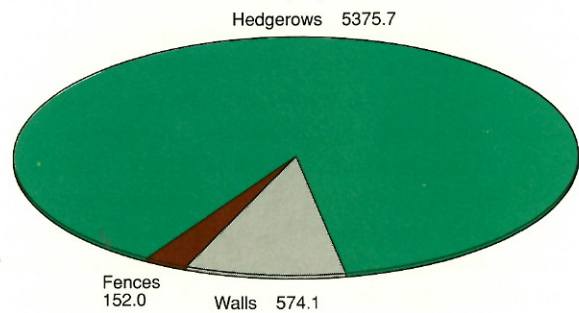
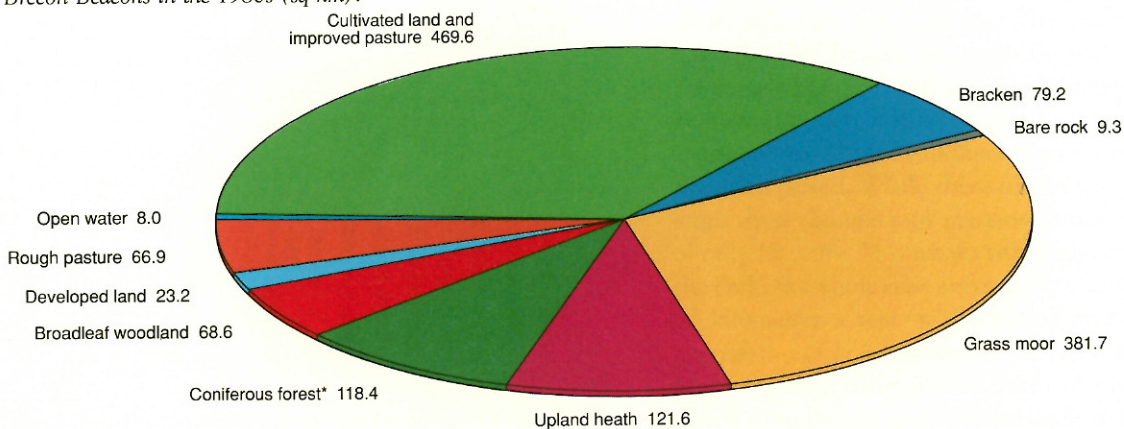


Figure 10. Proportion of different land cover types in the Brecon Beacons in the 1980s (sq km).



\*Including clear felled/newly planted land



## What has happened to the Brecon Beacons landscape?

Figure 12 summarises the overall gains and losses in the main land cover types in the Brecon Beacons between the 1970s and 1980s, shown as net change. Figure 13 shows the degree of movement between land cover types, and Figure 14 shows the gains and losses in hedges, fences and walls.

The main gains and losses in the Brecon Beacons can be summarised as follows.

Figure 12. Overall gains and losses in land cover types in the Brecon Beacons from the 1970s to the 1980s (sq km).

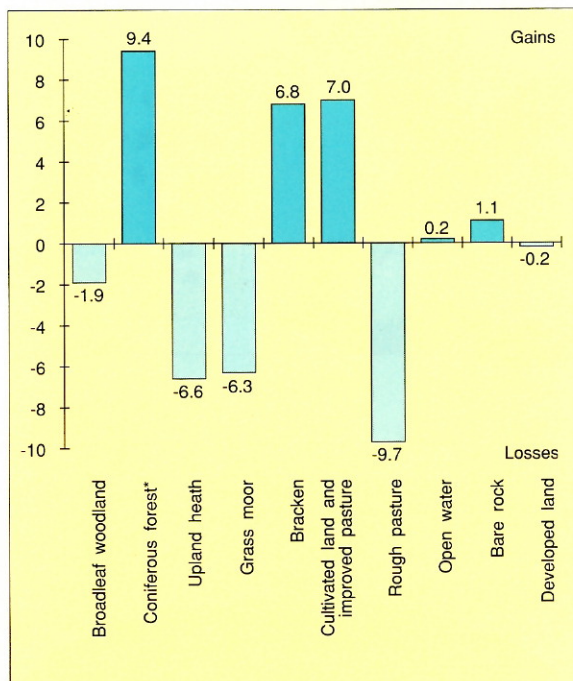
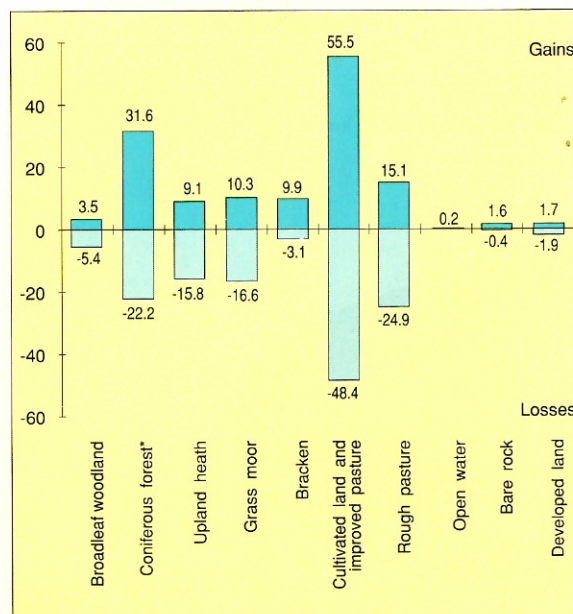


Figure 13. Areas gained to and lost from each land cover type in the Brecon Beacons from the 1970s to the 1980s (sq km).



\*Including clear felled/newly planted land

### Little overall change in:

- open water or ponds;
- bare rock;
- developed land;
- trees or tree groups;
- length of fences and walls.

### An overall increase in:

- improved pasture (+ 13.1 km<sup>2</sup>) (gained from cultivated land and rough pasture);
- clear felled/newly planted land (+ 7.5 km<sup>2</sup>) (gained mainly from upland grass moor);
- bracken (+ 6.8 km<sup>2</sup>) (gained mainly from grass moor and rough pasture);
- coniferous forest (+ 1.9 km<sup>2</sup>, not including clear felled/newly planted land) (gained mainly from clear felled/newly planted land).

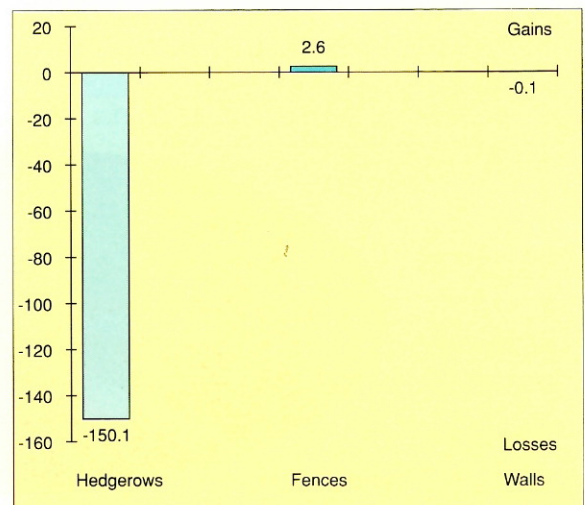
### An overall decrease in:

- rough pasture (- 9.7 km<sup>2</sup>) (lost to improved pasture);
- upland heath (- 6.6 km<sup>2</sup>) (lost to grass moor and moor and heath mosaics);
- cultivated land (- 6.1 km<sup>2</sup>) (lost to improved pasture);
- broadleaved woodland including mixed woodland and scrub (- 1.9 km<sup>2</sup>) (lost to improved and rough pasture);
- length of hedges (- 150.1 km).

### Considerable movement into and out of:

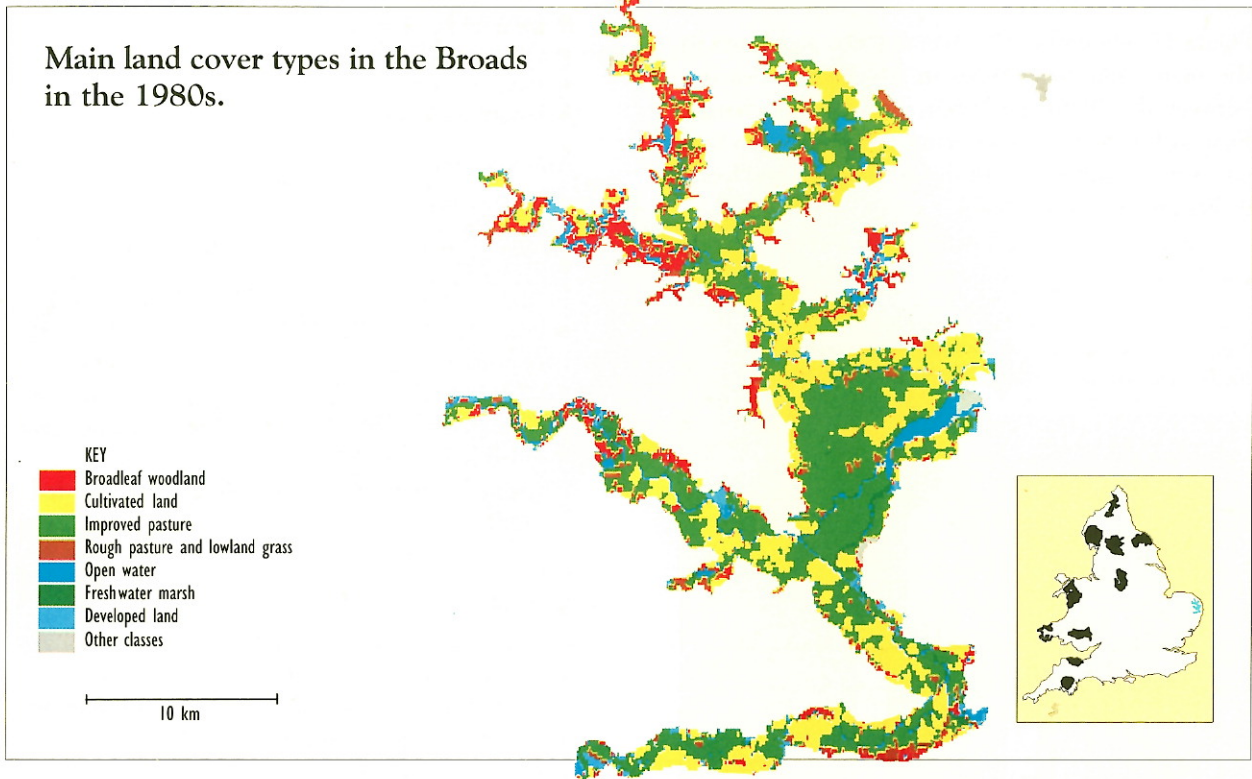
- all types of enclosed farmland (gross change 143.9 km<sup>2</sup>);
- moor and heath (gross change 51.7 km<sup>2</sup> including upland heath and grass moor);
- clear felled/newly planted land (gross change 30.8 km<sup>2</sup>);
- coniferous forest (gross change 23.0 km<sup>2</sup>, not including clear felled/newly planted land).

Figure 14. Changes in field boundaries in the Brecon Beacons from the 1970s to the 1980s (km).





## The Broads



### The character of the landscape

The Broads are a network of inland waterways created by five rivers, the Rivers Bure, Waveney and Yare and their tributaries the Ant and the Thurne. It is a landscape of long, flat horizons and huge open skies, slowly moving rivers, marshland, fens, damp woods of willow and alder, flat grazing land and small villages. The Broads themselves were created entirely by human activities, a result of peat digging during the Middle Ages.

Figure 16. Proportion of different boundary features in the Broads in the 1980s (km).

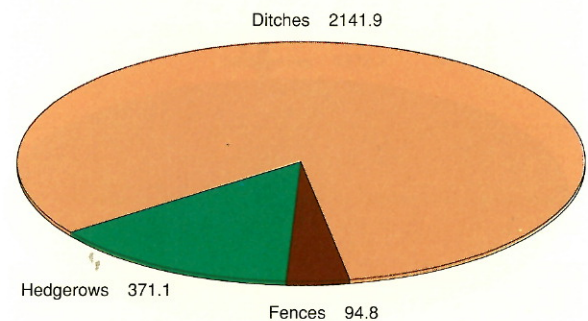
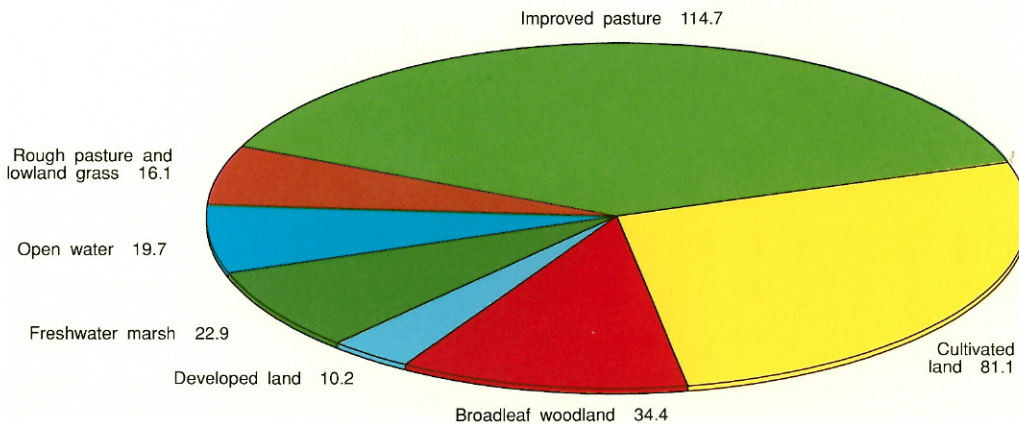


Figure 15. Proportion of different land cover types in the Broads in the 1980s (sq km).





## What has happened to the Broads landscape?

Figure 17 summarises the overall gains and losses in the main land cover types in the Broads between the 1970s and 1980s, shown as net change. Figure 18 shows the degree of movement between land cover types, and Figure 19 shows the gains and losses in hedges, fences and ditches.

Figure 17. Overall gains and losses in land cover types in the Broads from the 1970s to the 1980s (sq km).

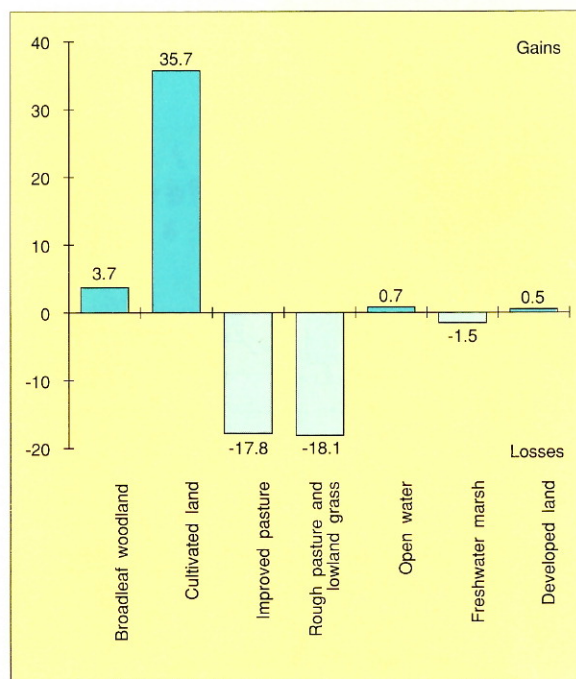
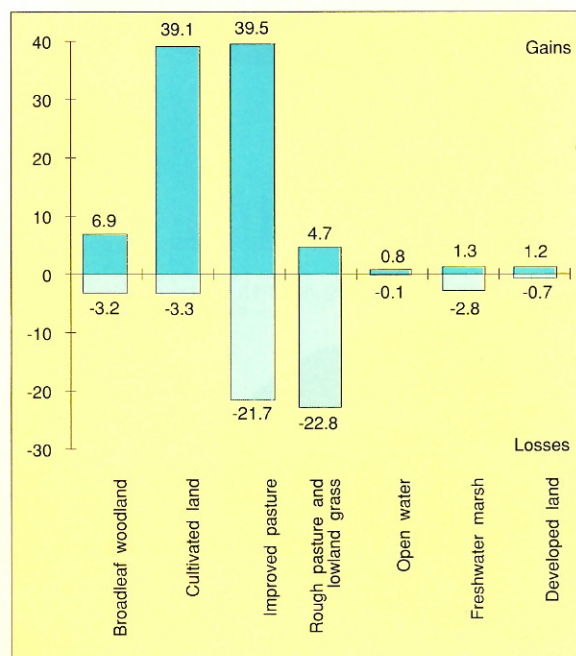


Figure 18. Areas gained to and lost from each land cover type in the Broads from the 1970s to the 1980s (sq km).



The main gains and losses in the Broads can be summarised as follows.

### Little overall change in:

- coastal land and coastal open water.

### An overall increase in:

- cultivated land (+ 35.7 km<sup>2</sup>) (gained mainly from improved and rough pasture);
- broadleaved woodland (excluding scrub) (+ 5.4 km<sup>2</sup>) (gained mainly from scrub and fresh water marsh);
- open water (+ 0.7 km<sup>2</sup>) (gained from fresh water marsh);
- urban land (+ 0.4 km<sup>2</sup>) (gained from enclosed farmland);
- length of fences (+ 10.2 km);
- trees and tree groups.

### An overall decrease in:

- improved pasture (- 17.8 km<sup>2</sup>) (lost to cultivated land);
- rough pasture (- 17.8 km<sup>2</sup>) (lost mainly to improved pasture);
- scrub (- 1.7 km<sup>2</sup>) (lost to broadleaved woodland);
- fresh water marsh (- 1.5 km<sup>2</sup>) (lost mainly to scrub and deciduous woodland);
- length of ditches (- 137.8 km).

### Considerable movement into and out of:

- all types of enclosed farmland (gross change 130.5 km<sup>2</sup>).

Figure 19. Changes in field boundaries in the Broads from the 1970s to the 1980s (km).

