Countryside Survey

Countryside Survey:

UK Headline Messages from 2007

www.countrysidesurvey.org.uk

Foreword by Rt. Hon. Hilary Benn, M.P. Secretary of State for Environment, Food and Rural Affairs

The countryside lies at the heart of our prosperity, our health and our well-being. It provides us with food and water, it helps deal with flooding and store carbon, and it enriches our lives.

Now, more than ever, we cannot afford to take the countryside for granted. Faced with new pressures we must rebalance our relationship with the natural world. We must ensure that the landscapes, wildlife and ecosystems that provide us with the essentials of life are not only looked after but are improved for future generations.

The health of the countryside is increasingly affected by climate change, pollution and the demand for land. These powerful, constantly shifting forces threaten the benefits that the natural world provides. So in responding it is vital that we improve our understanding of their impact.

The UK Countryside Survey helps us to do that. It provides the hard scientific evidence that we need to build a clear picture of the plants, habitats, soils and watercourses which determine the health of the countryside as a whole. I will be studying the findings of this report very carefully.

Carrying out a national survey on this scale is an impressive undertaking and I am greatly indebted to the team of research scientists and surveyors who worked through the exceptionally wet summer of 2007 to make it happen. I would like to acknowledge the support of the many land owners and managers throughout the country who gave permission for the survey to take place. The project was also made possible by the relationship between the Natural Environment Research Council and the other government partners representing all the devolved administrations and relevant agencies across the UK.

Hilary Benn

Foreword by Professor Alan Thorpe, Chief Executive, Natural Environment Research Council

The issue of the changing ecology of the UK countryside is of growing scientific and political importance, driven by concerns about land use changes, climate change, increased flood risks and sustainable energy resources.

The UK Countryside Surveys bring together the policy and scientific communities, and provide the basis to deal with a great number of scientific issues. They offer a unique way to monitor the changes in the environment's ecosystems brought about by our constant and varied demands on land and water resources, and by the impacts of climate change and air pollution. They analyse the relationships between soils, vegetation and water quality and identify when and how these affect biodiversity.

We now have a remarkably detailed 30 year record of where environmental changes have occurred. This is vital scientific evidence for policy makers and all those with interests in sustainable land management. The results from these surveys help to answer questions about why the changes have happened, and decide what policy decisions are needed to manage future change. They will be an invaluable data source for other strategic programmes, such as the 'Living With Environmental Change' partnership.

The Natural Environment Research Council is very proud to support this important scientific initiative, which addresses the environmental, social and economic challenges of providing a sustainable countryside for the UK.

Alan Thorpe

Countryside Survey

▲ Dyffryn Ogwen, Wales • © *NERC*

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Headline Messages

1. Which plant species are increasing and decreasing the most?

Common plant species that have become more abundant since 1998 were Stinging Nettle, Hawthorn and Bramble, which all benefit from reduced management. Climbing species and species of unmanaged land were more frequent; species of wetland edges and short turf less frequent. Four of the most common non-native species became more frequent between 1998 and 2007.

2. Has botanical diversity in the countryside changed?

The species richness of plants growing in fields, woods, heaths and moors decreased by 8% in Great Britain between 1978 and 2007, but there was no decrease between 1998 and 2007. There was a greater decrease alongside linear features and in areas targeted because of their botanical interest, which continued from 1998 to 2007.

3. Has the biodiversity of arable land changed?

The area of arable land decreased by 9.1% in the UK between 1998 and 2007, mostly through conversion to grassland. Since 1998 plant species richness has increased in arable land by 30% in Great Britain, often associated with set-aside.

4. Has the area and condition of lowland agricultural grassland changed?

The area of agriculturally improved and neutral grasslands increased (by 5.4% and 6.0% respectively) in the UK between 1998 and 2007. In Great Britain, between 1998 and 2007, there was no change in plant species richness but there was a relative increase in taller species or those species that prefer shadier and/or wetter conditions.

5. Has the length and condition of hedges changed?

The total length of 'managed' hedges decreased by 6% between 1998 and 2007 in Great Britain, following a sharp decline from 1984 to 1990 and a period of stability from 1990 to 1998. The length of lines of trees increased between 1998 and 2007. Slightly less than half (48%) of the managed hedges in Great Britain were classified as being in good structural condition in 2007.

6. Has the area and condition of woodland changed?

The area of broadleaved woodland increased by 6.9% and there was no significant change in the area of coniferous woodland in the UK between 1998 and 2007. Plant species richness of the woodland ground flora in broadleaved woodlands in Great Britain did not change between 1998 and 2007, but a longer term decrease of 7% was detected between 1990 and 2007.

7. Has the area and condition of moorland, heathland and bog changed?

The estimated area of bracken decreased and acid grassland increased in the UK between 1998 and 2007. Heathland increased in England by 15% between 1998 and 2007. Competitive species, especially grasses, increased in heathland and bog in Great Britain between 1998 and 2007, suggesting a deterioration in condition.

8. Has the condition of freshwater habitats continued to improve?

The first results for freshwaters from Countryside Survey in 2007 show continued improvements in condition in headwater streams in Great Britain. The number of ponds increased by 11% but their biological condition deteriorated in Great Britain between 1996 and 2007.

9. Have there been detectable effects of air pollution and nutrient inputs on vegetation and soils?

Soil acidity decreased from 1978 to 2007 in Great Britain, mirroring declining emissions and deposition of sulphur. Vegetation showed only a partial recovery. Plant species that prefer higher nutrient levels increased between 1978 and 1998 but decreased between 1998 and 2007.

10. Has average carbon concentration in soils (0-15cm) changed?

Countryside Survey found no overall change in average carbon concentration in soil (0-15cm) in Great Britain since 1978, contrasting with a previous study in England and Wales. Changes in carbon concentration in soil are important as losses could contribute to climate change.

11. Have climate change impacts been detected in the UK countryside?

Since 1978, Countryside Survey has detected no changes in plant distribution or abundance that appear consistent with climate change. As the weather has generally become warmer and wetter since 1978, taller plant species and those preferring wetter conditions have become more abundant across Great Britain. No direct cause-and-effect relationship has yet been established.

▲ Surveyors at work, Scotland • © *NERC*

Introduction to Countryside Survey

Countryside Survey is a unique study of the natural resources of the UK countryside. The survey has been carried out at intervals since 1978 with the latest survey in 2007. The countryside is sampled and studied using rigorous scientific methods, so that the results from the 2007 survey can be compared with those from previous years. In this way the gradual and subtle changes that occur in the UK countryside can be studied over time.

Countryside Survey provides scientifically reliable evidence about many aspects of the state of the UK countryside today. The results from 2007 can be compared with the findings of the previous surveys in 1998, 1990, 1984 and 1978 to measure and analyse change. This evidence can be used to review and develop policies that influence the management of the countryside.

There are two main elements to Countryside Survey: the Land Cover Map and the field surveys. The Land Cover Map uses data from satellites to form a digital map of the different types of land cover across the UK and will be published in 2009. The field surveys involve an in-depth study of a sample of nearly 600 1km x 1km squares across Great Britain and 285 0.5km x 0.5km survey squares in Northern Ireland. The two field surveys are undertaken separately but the results are brought together where possible in this report for the UK.

Individual survey squares were selected at random so that they represent variations in climate and geology across the UK. All widespread terrestrial habitat types are sufficiently well represented to enable robust and reliable statistical analyses. The locations of the survey squares are not disclosed to avoid any deliberate influences that could affect them or the features within them. In this way the survey squares will remain representative of changes in the wider countryside and will continue to provide a reliable comparison for future surveys. Vegetation, freshwaters and other landscape features were studied in detail within each square (using various types of sampling 'plots') and compared with findings from previous Countryside Surveys, enabling identification of change in the countryside.

The results presented here focus on changes in the nine years since the last Countryside Survey in 1998 and, where possible and relevant, they are set within the longer timescale from the first survey carried out in 1978. Changes are only described and discussed where they are statistically significant (where they could only occur by chance in less than 5% of cases).

The overarching objectives of Countryside Survey in 2007 were:

- To record and report on the amount and condition of widespread habitats, landscape features, vegetation, land cover, soils and freshwaters.
- To assess changes in the countryside and improve our understanding of the causes and processes of change, by comparison with data from earlier surveys.
- To collect, store and analyse data in ways that optimise the integration of Countryside Survey data through time and make it compatible with other data sources.
- To provide access to data and interpreted results that underpin a range of policy and science needs for major environmental zones and landscape types in the UK, Great Britain, England, Scotland, Wales and Northern Ireland.
- To contribute to the development of an integrated assessment of the drivers and pressures of change and better understand their effects on the UK countryside and their implications for ecosystem goods and services.

▲ Field Surveyors, N. Ireland • © *N. Ireland Environment Agency*

▲ Surveying, England • © *NERC*

The findings will be used...

The findings will be used for a range of scientific *(Box 1)* and policy *(Box 2)* applications.

Box 1. Scientific applications of Countryside Survey

Areas of research underpinned by data from the 2007 Survey will include:

- Further analysis and interpretation of stock and change estimates;
- Attribution of ecological change to pressures and drivers, e.g. land management, climate and air pollution;
- Mechanisms and inter-dependencies between soils, vegetation and water quality, underpinning ecosystem models linking biodiversity and biogeochemical cycling;
- Development of indicators of environmental benefits (ecosystem services);
- Linking observations to experimental evidence and models, to assess past changes and test future policy scenarios.

The longer-term scientific aim is to deliver an integrated analysis of selected environmental benefits, drawing on vegetation, freshwater and soils data from Countryside Survey in 2007, from previous Surveys and other relevant datasets.

Reports from Countryside Survey

The findings of Countryside Survey at the UK level are published in two reports: this summary report 'Countryside Survey : UK Headline Messages from 2007' and a main report 'Countryside Survey : UK Results from 2007'.

The 'UK Headline Messages' use the results from 2007 to answer selected questions that have arisen from previous Countryside Surveys or have been prompted by recent policy developments. The Headline Messages are not intended to cover all of the results from Countryside Survey, nor are they systematic in addressing key habitats or policy issues; they are simply intended to present key findings as an introduction to the main results and subsequent reports.

▲ Surveyor at work, England • © *NERC*

Box 2. Policy applications of Countryside Survey

The UK Sustainable Development Strategy 'Securing the Future' (2005) committed the Government to undertake a new Countryside Survey in 2007 to assess the status of natural resources in the UK countryside. Countryside Survey has many potential policy applications:

- Biodiversity: assessment of status and trends in Broad and Priority Habitats, measuring progress towards the 2010 target of halting biodiversity loss;
- Natural environment: measurement and improved understanding of ecosystem goods and services;
- Sustainable agriculture and agri-environment schemes: understanding effects of agricultural policy on the natural environment, including assessment of farmland habitats such as grasslands, hedges and cereal field margins;
- Water resources: context and baseline assessment for the EU Water Framework Directive, especially for headwater streams and ponds;
- Soil protection: measurement of long term trends in soil quality, including soil carbon;
- Sustainable forestry: information on isolated trees and plant diversity within woodlands, to supplement the National Inventory of Woodlands and Trees;
- Urban development: estimates of areas of habitat affected by urban development;
- Air quality: assessment of impacts of air pollution on terrestrial habitats, soils and headwater streams;
- Climate change: provide information to help estimate carbon emissions from land cover change and soils, and to detect impacts of climate change in the countryside.

▲ Brambles • © *Sue Wallis*

1. Which plant species are increasing and decreasing the most?

Common plant species that have become more abundant since 1998 were Stinging Nettle, Hawthorn and Bramble, which all benefit from reduced management. Climbing species and species of unmanaged land were more frequent, species of wetland edges and short turf less frequent. Four of the most common non-native species became more frequent between 1998 and 2007.

Rye grass is consistently the most common species recorded in Countryside Survey. The list of the top ten most abundant species of Great Britain shows that the countryside has tended to become more strongly dominated by shrubs like Hawthorn, Bramble and Blackthorn and tall herbs like Stinging Nettle, which moved up the ranking list *(Table 1)*. All these species thrive where management of the land is reduced. In contrast, several grass species of managed land have moved down the ranking list. The list below is based on the percentage cover that each species occupied within the sampling plots, including many alongside linear features.

▼ **Table 1:** Changes in the ranking of the top 10 most abundant plant species recorded in Countryside Survey sampling plots in Great Britain between 1990 and 2007.

Names		Rank		
		2007	1998	1990
Lolium perenne	Rye Grass	1	1	1
Holcus lanatus	Yorkshire Fog (Grass)	2	3	3
Arrhenatherum elatius	False-oat (Grass)	3	2	5
Urtica dioica	Stinging Nettle	4	6	11
Crataegus monogyna	Hawthorn	5	8	9
Agrostis stolonifera	Creeping Bent (Grass)	6	4	2
Rubus fruticosus agg.	Bramble	7	13	14
Dactylis glomerata	Cocksfoot (Grass)	8	10	8
Agrostis capillaris	Common Bent (Grass)	9	5	4
Festuca rubra agg.	Red Fescue (Grass)	10	9	7
Calluna vulgaris	Heather	11	7	10
Elytrigia repens	Couch (Grass)	17	11	6

▼ **Table 2:** Plant species in rank order showing the largest increase and decrease in frequency of occurrence in Countryside Survey sampling plots in Great Britain between 1998 and 2007.

	Increasing		Decreasing	
Rank	Species	Name	Species	Name
1	*Tamus communis*	Black Bryony	*Epilobium montanum*	Broad-leaved Willowherb
2	*Geum urbanum*	Wood Avens	*Drosera intermedia*	Oblong-leaved Sundew
3	*Hedera helix*	Ivy	*Alopecurus geniculatus*	Marsh Foxtail
4	*Crepis capillaris*	Smooth Hawks-beard	*Valeriana dioica*	Marsh Valerian
5	*Sonchus asper*	Prickly Sow Thistle	*Salix aurita*	Eared Willow
6	*Fraxinus excelsior*	Ash	*Fragaria vesca*	Wild Strawberry
7	*Senecio vulgaris*	Groundsel	*Carex dioica*	Dioecious Sedge
8	*Picris echioides*	Bristly Oxtongue	*Campanula rotundifolia*	Harebell
9	*Alopecurus myosuroides*	Black Grass	*Myosotis scorpioides*	Water Forget-me-not
10	*Calystegia sepium*	Hedge Bindweed	*Koeleria macrantha*	Crested Hair-grass

A similar message about the effects of reduced management emerges from the list of plant species that showed the largest increases and decreases in frequency (the number of sampling plots in which a species was recorded) since 1998 *(Table 2)*.

The ten plant species that showed the greatest increase in frequency of occurrence in sampling plots are most often associated with reduced management of lowland habitats. Half of these are tall plants that occur in places like road verges and field corners. The others include hedgerow vines and creepers such as Black Bryony, Hedge Bindweed and Ivy. Four of the increasing species (Smooth Hawks-beard, Prickly Sow Thistle, Groundsel and Bristly Oxtongue) are commonly found on wasteland and other disturbed areas.

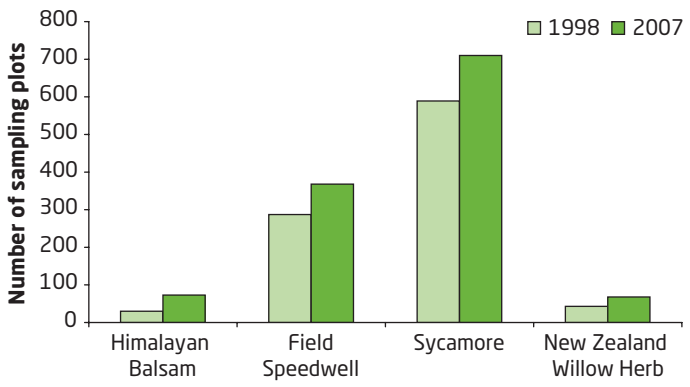
Nine of the ten decreasing species are low growing plants, sensitive to competition from more vigorous plants. Oblong-leaved Sundew, Marsh Foxtail, Marsh Valerian, Dioecious Sedge, Water Forget-me-not and Eared Willow are plants found on the edges of bogs, fens and other wet places.

The number of non-native or 'alien' plant species recorded in Great Britain has increased greatly in the past sixty years. Most non-native species remain relatively scarce in the Countryside Survey sampling plots (over 14,000 in this analysis), although locally they can be very abundant e.g. Rhododendron and Japanese Knotweed. Together, non-native species now account for nearly 2% of the vegetation cover of the British countryside.

Between 1998 and 2007 four non-native species showed larger increases in the number of plots occupied within Countryside Survey than others. Himalayan Balsam, New Zealand Willow Herb and Common Field Speedwell increased in local abundance *(Fig.1)*. Sycamore is a common tree species which continues to increase. Lack of disturbance on stream sides favours Himalayan Balsam, while less intensive arable field margin management encourages the spread of Common Field Speedwell. New Zealand Willow Herb has increased continuously since 1978 in its favoured sites on bare, damp soil along upland streams and flushes.

▲ Himalayan Balsam • © *Natural England*

▼ **Figure 1:** Changes in the number of sampling plots in which four common non-native plant species were recorded in Great Britain between 1998 and 2007.



▲ Glen Nevis, Scotland • © *NERC*

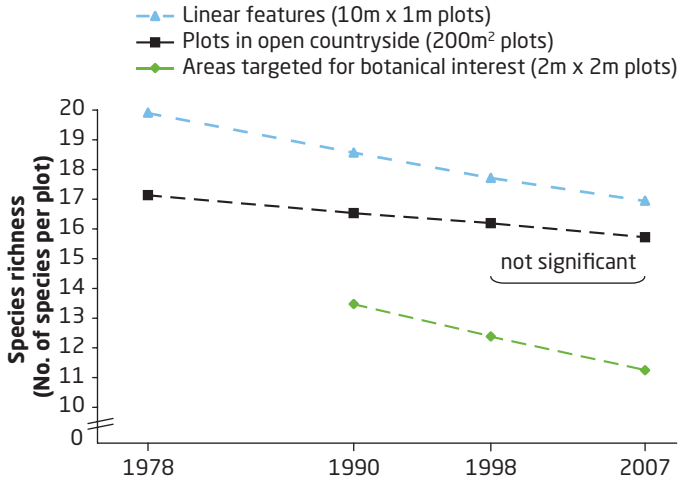
2. Has botanical diversity in the countryside changed?

The species richness of plants growing in fields, woods, heaths and moors decreased by 8% in Great Britain between 1978 and 2007, but there was no decrease between 1998 and 2007. There was a greater decrease alongside linear features and in areas targeted because of their botanical interest, which continued from 1998 to 2007.

The Countryside Surveys of 1990 and 1998 reported decreases in plant species richness *(defined in Box 3)* in the most common habitats of Great Britain. In each survey, vegetation was recorded in three different sampling plot types: in the open countryside (fields, woods, heaths and moors); alongside linear features; and in areas targeted by Countryside Survey for their botanical interest.

Over 2000 vegetation sampling plots, randomly located in open countryside, were tracked from 1978. At the outset these plots contained 17.1 different plant species but by 2007 they contained on average 1.4 fewer species, an 8% decline in species richness. However, no change was detected between 1998 and 2007 *(Fig. 2)*.

▼ **Figure 2:** Average species richness of vegetation in plots in the open countryside (fields, woods, heaths and moors), linear features and areas targeted for their botanical interest in Great Britain, between 1978 and 2007. All changes between years are statistically significant apart from the change in open countryside plots between 1998 and 2007.



Box 3. Species richness and vegetation condition

Species richness is the number of different species found in a given area (a site, habitat or region). It is an expression of the variety of species found, not of their abundance. In Countryside Survey, species richness is the number of vascular plant species recorded in the sampling plots. A small number of pairs or groups of species that are very difficult to distinguish consistently from one another are removed from the analyses to remove bias between surveyors and survey years.

Vegetation condition was analysed using different measures. The system developed by *Ellenberg* provides a score for the vegetation based on the environmental conditions that species growing in it prefer on a scale from 0-9. For example, a Fertility Score of 9 would mean the vegetation was made up of species that prefer very fertile soils. A decrease in the value of the Light Score shows that species casting or preferring shade have become more prominent. The Competitor Score is based on the system developed by *Grime*. Other scores were used but not mentioned in this report.

626 sampling plots have also been recorded in each survey alongside linear features such as field boundaries, streamsides and road verges, which can act as refuges for species that cannot exist in intensively managed land. Although these plots are smaller they generally contained more species, but the 15% decrease in species richness between 1978 and 2007 was more acute than in the open countryside. In this case the decrease was also detected between 1998 and 2007. There was an increase in the cover of trees and shrubs leading to a more shaded, taller type of vegetation.

The greatest decrease (17%) in species richness between 1990 and 2007 was found in approximately 2500 sampling plots, in areas targeted by Countryside Survey for their botanical interest in 1990 *(Fig. 2)*.

The long-term decrease in plant species richness coincided with the decline in abundance of farmland birds and butterflies over the same period.

The overall figures for all sampling plots across Great Britain conceal some significant differences between countries and habitat types. For example, plant species richness increased in arable land in England between 1990 and 2007, but not in Scotland or Wales.

There are many reasons for the decrease in plant species richness, and they affect different habitats to varying degrees in different parts of the country. The majority of the plots included in Countryside Survey are subject to some form of agricultural management, ranging from intensive cropping to extensive grazing; others occur within commercial forests or amenity land, so land management is clearly a critical factor. In some cases, especially for linear features, it is changes in management that contribute to the decrease in abundance of some low growing plants, as shrubs and trees become more dominant. The sampling plots are also influenced by factors such as air pollution and climate change.

▲ Species rich grassland • © *Ian Simpson*

▲ Dark Green Fritillary • © *Ian Simpson*

▲ Arable farmland, England • © *Andrew Stott*

3. Has the biodiversity of arable land changed?

The area of arable land decreased by 9.1% in the UK between 1998 and 2007, mostly through conversion to grassland. Since 1998 plant species richness has increased in arable land by 30% in Great Britain, often associated with set-aside.

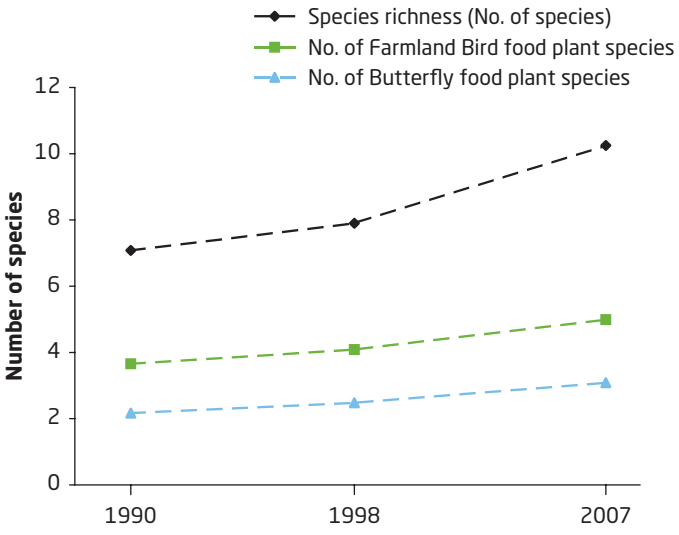
In 2007, arable and horticultural crops covered an estimated 4.7 million ha of the UK. As well as being intensively farmed for food production, arable land also includes land under set-aside or under horticulture and temporary grass. Arable fields form part of a mosaic of other farmland habitats and field boundaries which provide important habitats for wildlife, including UK Biodiversity Action Plan 'Priority Species' e.g. Pheasant's Eye, Grey Partridge and Brown Hare, for which conservation targets have been agreed.

Following a fairly stable period between 1984 and 1998 during which the total arable area changed relatively little, the period from 1998 to 2007 showed a major shift away from arable crops towards grassland. Grassland typically has greater plant species richness than arable land and the existence of patches of grassland within otherwise arable areas provides a patchwork of habitats that is beneficial to a wide variety of wildlife.

▲ Arable weeds in cereal crop • © *Ian Simpson*

▲ Oilseed rape field, England • © *Sue Wallis*

▼ **Figure 3:** Changes in the average species richness, number of Farmland Bird food plants, and the number of Butterfly food plants in sampling plots in arable land in Great Britain between 1990 and 2007.



Countryside Survey reported previously a decrease in plant species richness in arable fields of 29% in Great Britain between 1978 and 1990. Between 1998 and 2007 the average of 7.9 plant species per sampling plot increased to 10.3 reversing the previous decline *(Fig. 3)*.

The diversity and abundance of species of wild plants are important in their own right and because they provide food and shelter for animals in a wide range of habitats. In Countryside Survey, food plants for farmland birds and butterflies are used as examples to explore the potential of habitats to support a wide range of biodiversity.

The numbers of farmland bird and butterfly food plant species in arable fields increased by 22% and 24% respectively between 1998 and 2007. However, the number of species of plants is not directly related to the quantity of food available to farmland birds and butterflies and additional information can be gained by investigating the proportion of ground covered by plants.

▲ Arable margins, England • © *Natural England*

The proportion of ground covered by common species used as food by butterflies or birds has increased in arable land between 1998 and 2007 but was still less than 1% of the cropped land.

Since the late 1990s farmers have been encouraged to create arable margins under agri-environment schemes, usually sown with varying mixtures of grasses and wild flower species. Arable margins introduced a higher level of diversity to the arable landscape and Countryside Survey found they had more than twice as many species as crops and a much higher percentage cover of plants.

Between 1978 and 1990 there was a decline in biodiversity of arable land (as represented by plant species richness), but the most recent Countryside Survey showed that this biodiversity has recovered. Arable landscapes became more diverse due to conversion to grassland, set-aside and the introduction of arable margins. These changes are likely to benefit farmland birds, butterflies and other animal species and further investigations to understand these relationships are continuing. These gains in the biodiversity of arable habitats will be very susceptible to future market prices and policy changes, including the removal of compulsory set-aside in 2008.

▲ Calcareous grassland, England • © *Peter Carey*

4. Has the area and condition of lowland agricultural grassland changed?

The area of agriculturally improved and neutral grasslands increased (by 5.4% and 6.0% respectively) in the UK between 1998 and 2007. In Great Britain, between 1998 and 2007, there was no change in plant species richness but there was a relative increase in taller species or those species that prefer shadier and/or wetter conditions.

In 2007, Countryside Survey estimated that intensively managed, improved grassland covered about 5.1 million ha, over a fifth of the land area of UK, an increase of 5.4% since 1998. This grassland is the most important for livestock production but generally has low levels of plant diversity, although it provides a widespread habitat for farmland birds and other animals.

The area of neutral grassland was 2.4 million ha in 2007, about 10% of the land area of the UK and an estimated increase of 6% since 1998. The area of chalk and limestone grassland was much smaller, around 59,000 ha in 2007, about 0.2% of UK. Less intensively managed neutral and calcareous grasslands are important habitats for farmland biodiversity, including several UK Biodiversity Action Plan 'Priority Habitats' and their associated species. They include wildflower meadows and chalk downlands with high botanical diversity. Newly created neutral grassland, although not usually of special conservation value, is likely to benefit farmland biodiversity generally, including wild birds.

▲ Lowland grassland, England • © *Natural England*

▲ Cattle on improved grassland, England • © *Sue Wallis*

Previous Countryside Surveys in 1990 and 1998 reported decreases in the species richness of grasslands. The current survey shows that in improved grasslands, there was a small decrease in species richness in Great Britain between 1990 and 2007, though no significant change was detected between 1998 and 2007. The less intensively managed neutral grassland also showed no significant change in species richness. Countryside Survey did not detect a change in the condition of chalk grasslands (which because of their rarity are not adequately represented in the sampling strategy).

Competitive species, tall or shade tolerant species and species preferring wetter conditions increased in improved and neutral grasslands, whilst species of open ground and those that prefer more fertile conditions decreased *(Table 3)*.

▼ **Table 3:** Changes in the condition of vegetation in improved and neutral grasslands in sampling plots in Great Britain between 1998 and 2007. Up arrows indicate a significant increase and down arrows a significant decrease.

	Improved Grassland			Neutral Grassland		
	1998	2007	Change	1998	2007	Change
Competitor Score	2.71	2.74		2.75	2.81	↑
Light Score	7.09	7.05	↓	7.01	6.98	↓
Moisture Score	5.35	5.38	↑	5.45	5.52	↑

▲ Bailing hay, England • © *Sue Wallis*

Lowland grasslands are the mainstay of the UK livestock industry supporting 10 million cattle, 35 million sheep and over 1 million horses. Numbers of cattle decreased by 10% and sheep by 20% between 1998 and 2007, following a sharp rise in sheep numbers between 1983 and 1990. The outbreak of Foot and Mouth Disease in 2001 had a major impact on UK livestock production. The findings of Countryside Survey are consistent with a reduced intensity of grassland management reflecting an overall decrease of grazing pressure. Previous decreases in species richness of widespread lowland grasslands appear to have slowed or halted, and the increased area of neutral grassland represents a gain for farmland biodiversity between 1998 and 2007.

▲ Hedgerows, Wales • © *NERC*

5. Has the length and condition of hedges changed?

The total length of 'managed' hedges[1] decreased by 6% between 1998 and 2007 in Great Britain, following a sharp decline from 1984 to 1990 and a period of stability from 1990 to 1998. The length of lines of trees increased between 1998 and 2007. Slightly less than half (48%) of 'managed' hedges in Great Britain were classified as being in good structural condition in 2007.

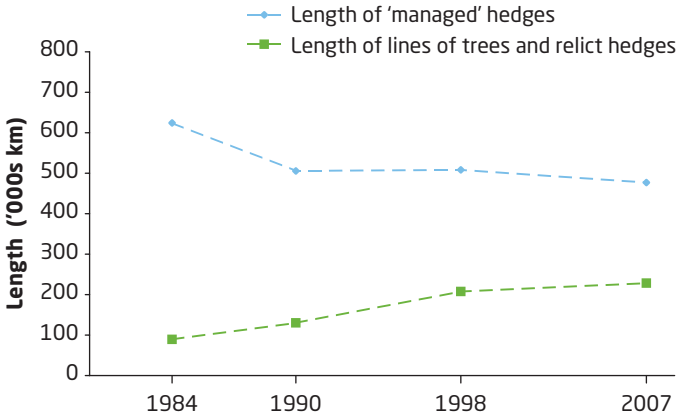
Hedgerows are characteristic features of the UK countryside. They are important for the habitats they provide, the connections they make between habitats and their contribution to the landscape. Since 1997, the Hedgerow Regulations have severely restricted the removal of hedgerows in England and Wales; this halted the reduction in hedge length recorded between 1984 and 1990. The biggest threats now to the stock of hedgerows are neglect and over-management.

▲ Managed hedgerow, England • © *Ian Simpson*

[1] This does not include relict hedges or lines of trees/shrubs

In 1984 there was an estimated length of 624,000 km of 'managed' hedge in Great Britain, which decreased rapidly to 506,000 km by 1990 *(Fig.4)*. The estimate of 508,000 km in 1998 showed the decrease had been halted. In 2007 the estimated length decreased to 477,000 km. Since 1984, many 'managed' hedges have become lines of trees and/or relict hedges, the length of which has increased from 89,000 to 228,000 km. Data for Northern Ireland are not yet available.

▼ **Figure 4:** Changes in the length of 'managed' hedges and lines of trees and relict hedges in Great Britain between 1984 and 2007.



In 2007, Countryside Survey data were used to assess the condition of hedgerows against a set of agreed criteria. Slightly less than half of the 'managed' hedgerows (48%) in Great Britain were classified as being in good structural condition. The remainder were too 'gappy', too narrow, or the base of the canopy was too high off the ground. Hedgerow condition also depends on a number of other factors including the width of undisturbed ground from the centre of the hedge; taking this into account alongside structural information, 31% of hedgerows would then meet condition criteria.

All agri-environment schemes now operating in the UK provide support and advice for the management of hedgerows and the land adjacent to them. Over the past decade, agri-environment schemes have encouraged farmers to restore, re-create and manage hedgerows sympathetically. Since 2005, hedges have been afforded additional protection through cross-compliance within the Common Agricultural Policy. For example, this includes the requirement to leave an uncultivated strip between the hedge and the crop.

▲ Relict hedgerow, England • © *Colin Barr*

▲ Hedgerow with uncultivated strip, England • © *Sue Wallis*

▲ Coniferous woodland, Scotland • © *NERC*

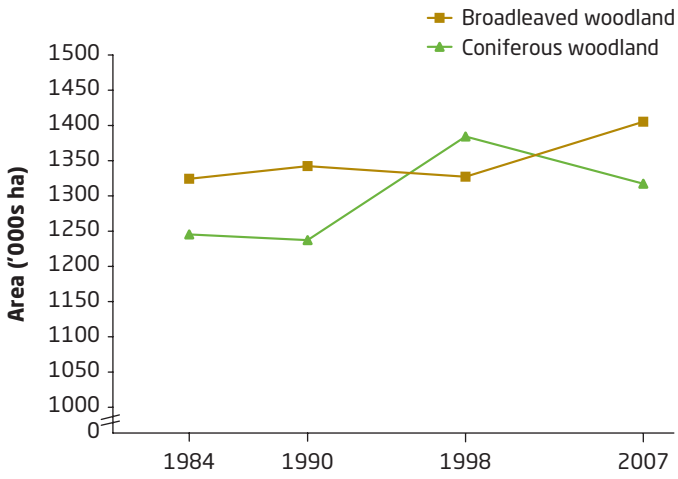
6. Has the area and condition of woodland changed?

The area of broadleaved woodland increased by 6.9% and there was no significant change in the area of coniferous woodland in the UK between 1998 and 2007. Plant species richness of the woodland ground flora in broadleaved woodlands in Great Britain did not change between 1998 and 2007, but a longer-term decrease of 7% was detected between 1990 and 2007.

Countryside Survey estimated a 6.9% increase in broadleaved woodland in the UK between 1998 and 2007 *(Fig. 5)*. At the same time coniferous woodland decreased by a similar amount, though the change was only statistically significant in Scotland.

The plant species richness of the broadleaved woodland flora decreased by 7% in random sampling plots and by 18% in areas targeted by Countryside Survey for their special botanical interest in Great Britain between 1990 and 2007. No decrease was detected in the random sampling plots between 1998 and 2007. The changes in the sampling plots suggest that woodlands are generally becoming more mature, with less evidence of disturbance, but with increased grazing by deer. No changes were detected in the vegetation of the woodland flora within conifer plantations.

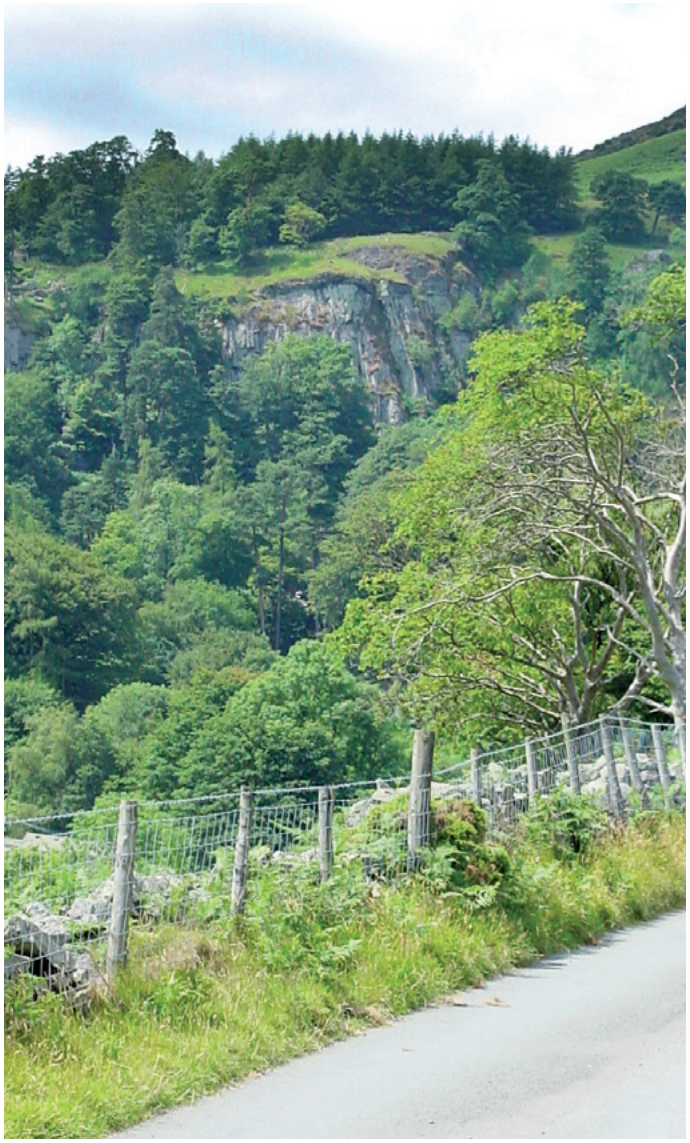
▼ **Figure 5:** Changes in the area of broadleaved and coniferous woodland ('000s ha) in Great Britain between 1984 and 2007.



Following the First World War a national policy for forestry was devised to ensure that timber would be available for use throughout the 20th Century. This was achieved by the planting of large coniferous forests, especially in upland areas. Since the end of the 1980s more emphasis has been placed on growing broadleaved native trees for amenity and conservation purposes. Each of the countries of the UK has its own forestry policy and has organisations that promote the planting of woodland. In recent years, there has been increasing recognition of the possible role of forests for storing carbon and helping to slow the rate of climate change.

The results of Countryside Survey suggest that policy objectives which favour new planting and re-planting of coniferous plantations with broadleaved trees are being effective. However, although new broadleaved woodlands have been created the management, or lack of it, in established woodlands has not favoured woodland flora.

▲ Holly in woodland, England • © *Sue Wallis*



▲ Mixed woodland, Wales • © *NERC*

▲ Woodland ground flora, England • © *Natural England*

▲ Blanket bog, Isle of Harris • © *NERC*

7. Has the area and condition of moorland, heathland and bog changed?

The estimated area of bracken decreased and acid grassland increased in the UK between 1998 and 2007. Heathland increased in England by 15% between 1998 and 2007. Competitive species, especially grasses, increased in heathland and bog in Great Britain between 1998 and 2007, suggesting a deterioration in condition.

The uplands of the UK contain our most extensive areas of semi-natural habitats, they include large areas designated for nature conservation and many of our National Parks, which are important for promoting enjoyment of the countryside. The upland areas also support hill farming, rural communities and game estates, and they are often important for the management of water resources. Lowland heaths in the UK are important for conservation at a European scale and have a high amenity value.

Previous Countryside Surveys reported that upland habitats have been affected by increasing levels of nutrient inputs and overgrazing, but there was also some evidence of recovery from the effects of acid rain.

▲ Bog Asphodel, England • © *Sue Wallis*

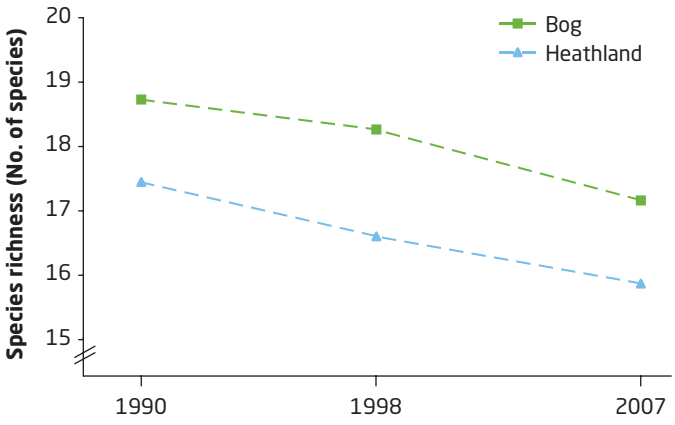
▲ Mereside pools, England • © *Sue Wallis*

Countryside Survey estimated that acid grassland, bracken, heath and bog covered about 5.6 million ha of the UK in 2007, with no overall change in extent from 1998. Within this total the estimated area of acid grassland increased by 5.5%, mostly replacing bracken, which decreased by 17%. Bracken occurs in many habitats and is only defined in Countryside Survey as an individual habitat type when it occurs densely over a continuous area. Area estimates for bracken can therefore be affected by small changes in the density of bracken cover between surveys when the density threshold is not met.

No change in the extent of heathland was detected for the UK as a whole between 1998 and 2007, but there was an increase of about 15% in England.

In heathland and bog, plant species richness decreased by 9% and 6% respectively in Great Britain between 1998 and 2007, continuing a decrease recorded between 1990 and 1998 *(Fig. 6)*. Interpretation of changes in species richness in these habitats is not straightforward.

▼ **Figure 6:** Changes in the average species richness of sampling plots in heathland and bog habitats in Great Britain between 1990 and 2007.



▲ Lowland heathland, Wales • © *Andrew Stott*

Some heathland and bog plant communities are relatively species poor so an increase in diversity is not necessarily desirable. Other changes in vegetation between 1998 and 2007, including a relative increase in competitive species and grass species suggest that the condition of heathlands and bog habitats has deteriorated. There was no evidence of changes in the levels of nutrient inputs. Further analyses of the changes in vegetation, combined with information about soil quality and land management, will be necessary to understand fully the ecological implications of these results.

▲ Mountain stream, Scotland • © *NERC*

8. Has the condition of freshwater habitats continued to improve?

The first results for freshwaters from Countryside Survey in 2007 show continued improvements in condition in headwater streams in Great Britain. The number of ponds increased by 11% but their biological condition deteriorated in Great Britain between 1996 and 2007.

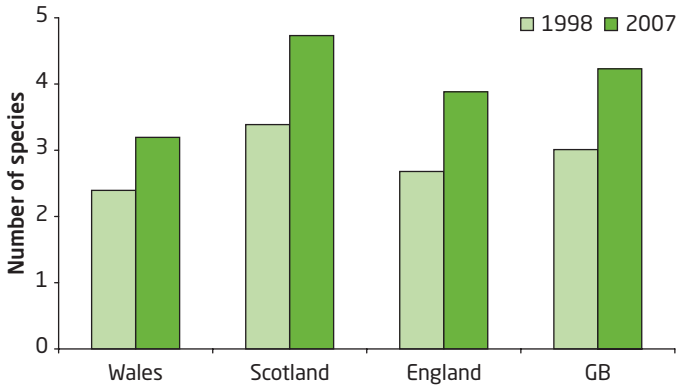
Headwater streams and ponds support a large variety of animals and plants. The small size of streams and ponds means that they are strongly affected by their surroundings and are therefore highly sensitive to any changes in the management of land around them.

Recent changes to environmental legislation have provided new obligations to protect water bodies in the UK. The EU Water Framework Directive requires that watercourses be in good condition by 2015. In 2007, ponds were listed for the first time as a 'Priority Habitat' under the UK Biodiversity Action Plan (UK BAP). Countryside Survey provides information on the condition of headwater streams and ponds in Great Britain. Headwater streams have been monitored since 1990. The biological sampling of ponds in all situations was first included in the 2007 survey, following a separate baseline survey of lowland ponds in 1996.

▲ Lowland pond, England • © *NERC*

Countryside Survey in 1990 showed that over 40% of streams across Great Britain were in good condition, by 1998 that figure had increased to around 60%. Samples of invertebrate animals that live on the streambed (collected as part of the 2007 survey) are still being analysed, but the results of the analysis of aquatic plants suggest a continued improvement in condition between 1998 and 2007 *(Fig. 7)*. The plant species richness increased, as did the abundance of species that prefer clean water.

▼ **Figure 7:** Changes in the plant species richness of headwater streams in Great Britain, England, Scotland and Wales between 1998 and 2007.



The structural conditions of streams and their banks affect the plants and animals that live in them. Results from Countryside Survey showed that the structural condition of stream habitats improved between 1998 and 2007, mainly because gravel bars, in-stream woody debris and river-side trees were more numerous.

▲ Streamside vegetation, England • © *NERC*

▲ Headwater stream, England • © *Andrew Stott*

Plant species richness in streamside vegetation decreased by 8% between 1998 and 2007 and streamsides were one of the few habitats where plant species preferring high soil fertility continued to increase. Competitive species and those preferring taller vegetation also increased, suggesting a continued reduction in the intensity of management of these habitats across Great Britain.

These first results suggest that the structural condition of headwater streams and the quality of the aquatic habitat has improved, reflecting the better control of pollution and more natural channel management. At the same time, the botanical interest of streamside vegetation has decreased because of reduced intensity of management and increased nutrient loadings.

Countryside Survey estimated that the number of ponds in Great Britain increased by 11% between 1998 and 2007, mostly in the lowlands. Based on the pond plants present, 80% of the ponds in England and Wales were classified as being in poor or very poor condition (the method cannot be applied to ponds in Scotland). In ponds that were also surveyed in 1996 as part of the Lowland Ponds Survey[2] the biological condition declined, with a decrease in the percentage of good or moderate quality ponds from 40% to 28%, partly due to an average 20% reduction in plant species richness.

Increases in the number of ponds will benefit a wide variety of wildlife, but there must be concerns about the overall poor quality of pond habitats, in particular the decline in condition of lowland ponds in England and Wales. Pollution and disturbance are possible causes of this decline and will be investigated further.

[2] Pond Action and the Institute of Terrestrial Ecology (1998) *Lowland Ponds Survey 1996 - Final Report*. DETR, London

▲ Atmospheric emissions from industry • © *Royalty-free image library*

9. Have there been detectable effects of air pollution and nutrient inputs on vegetation and soils?

Soil acidity decreased from 1978 to 2007 in Great Britain, mirroring declining emissions and deposition of sulphur. Vegetation showed only a partial recovery. Plant species that prefer higher nutrient levels increased between 1978 and 1998 but decreased between 1998 and 2007.

Sulphur (emitted from various sources including heavy industry and coal-fired power stations) can cause acidification when it is deposited on land and freshwaters, and is known as 'acid rain'. Since 1986, deposition of sulphur has decreased by 80% and Countryside Survey has investigated whether the soils and vegetation of Great Britain have shown any recovery from acidification.

From 1998 to 2007 Countryside Survey found that the mean pH of soils (0-15cm depth) across Great Britain rose significantly, becoming less acid and continuing the trend observed between 1978 and 1998 *(Fig.8)*. Different habitats responded to pH change in different ways. Arable soils and bog soils provide extreme examples. Since 1998, there has been no detectable change in the mean soil pH of normally acidic habitats such as coniferous woodland, heathland and acid grassland, despite some earlier increases between 1978 and 1998. In contrast, the pH of soils in less acidic habitats such as broadleaved woodland and neutral grassland has continued to increase. It is difficult to be sure that changes observed in soils in enclosed farmland are due to decreases in acid deposition, because lime and organic fertilisers may have been applied on farmland and subsequently affected soil pH.

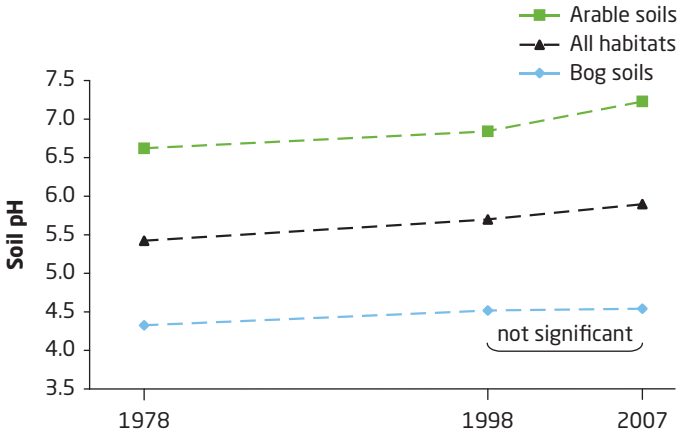
The reasons for the opposing trends in different habitats are under investigation.

As soil acidity has decreased, it might be expected that plant species that prefer less acid conditions would also increase. However, results from Countryside Survey showed an increase in these species between 1978 and 1990, followed by a decrease up to 2007. Overall, there was an increase between 1978 and 2007 and analysis shows a correlation between soil pH and vegetation. Further work is required to understand these differences more fully.

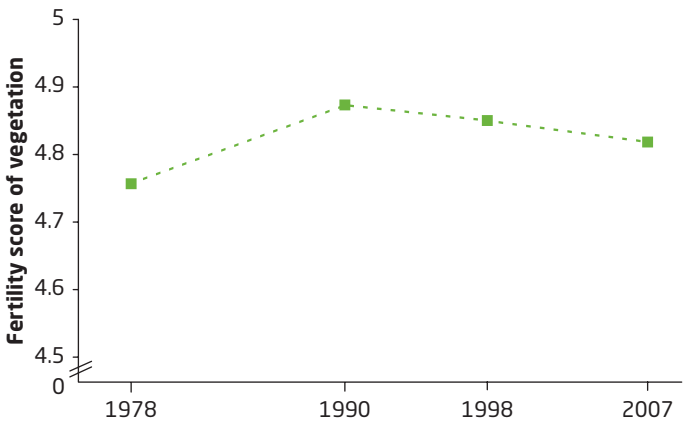
Emissions of nitrogen from sources including agriculture, transport and power plants play a role in changing the levels of nutrients in soils. An increase in fertility was observed between 1978 and 1990, and the 1998 survey found that in some habitats plant species preferring fertile conditions had become more dominant.

▲ Atmosphere and land interface • © *Royalty-free image library*

▼ **Figure 8:** Changes in the average pH of soils (0-15cm) from sampling plots in all habitats in Great Britain between 1978 and 2007. Data from arable and bog soils are shown as extreme examples. All changes between years are significant for all three lines apart from bog soils between 1998 and 2007.



▼ **Figure 9:** Changes in mean fertility score of the vegetation in sample plots in open countryside (fields, woods, heaths and moors) in Great Britain between 1978 and 2007. All changes between years are significant.



In the uplands, increased sheep grazing and deposition of atmospheric nitrogen were considered to be important drivers of this change. In the lowlands, increasing fertility was attributed to exposure to agricultural fertiliser and reductions in the intensity of management on road verges, field boundaries and streamsides.

Between 1998 and 2007, despite no change in levels of nitrogen deposition, there was an overall decrease in the plant species preferring fertile conditions *(Fig. 9)*. Other factors such as reduced and/or better managed agricultural inputs from fertilizer or changing livestock numbers may have affected the overall trend in Great Britain. Further research is required to assess regional variations and effects on sensitive habitats.

It's difficult to discriminate the effects of reduced deposition of sulphur and continued high levels of nitrogen deposition on soils and vegetation, from the effects of other changes in agricultural management and weather patterns. There is evidence that soils (0-15cm) are recovering from acid rain, but more analysis is required to assess impacts of atmospheric pollution on the condition of different habitats. There is, as yet, no clear evidence of widespread impacts of nutrient inputs.

▲ Blanket bog, England • © *NERC*

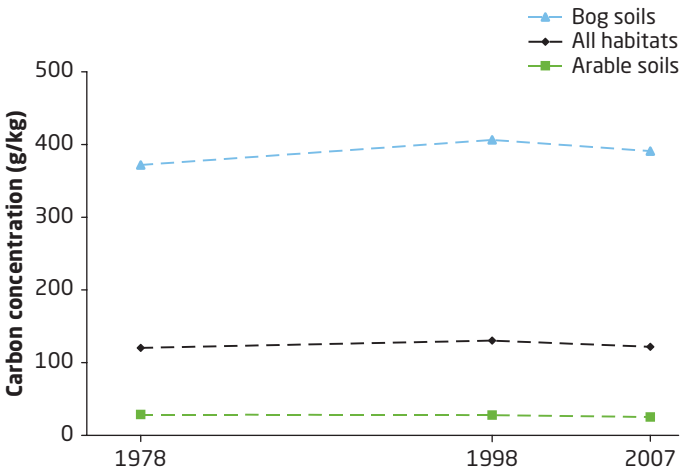
10. Has average carbon concentration in soils (0-15cm) changed?

Countryside Survey found no overall change in average carbon concentration in soils (0-15cm) in Great Britain since 1978, contrasting with a previous study in England and Wales. Changes in carbon concentration in soils are important as losses could contribute to climate change.

Soils take up and release carbon dioxide through exchange with the atmosphere. Many soils store large amounts of carbon, but it is uncertain whether human activities are causing this carbon to be released into the atmosphere. A release of soil carbon to the atmosphere could contribute to climate change, whilst a net uptake by soils of carbon dioxide could have the opposite effect.

Between 1998 and 2007, Countryside Survey found that there was a decrease in the average carbon concentration of the soil (0-15cm depth) across Great Britain. This followed an increase from 1978 to 1998. Overall, Countryside Survey found no significant change in carbon concentration in soils (0-15cm) between 1978 and 2007. These average values represent all habitats sampled in Great Britain, but there were large differences between habitats, ranging from arable fields to peat bogs *(Fig. 10)*.

▼ **Figure 10:** Changes in the carbon concentration of soils (0-15cm) from sampling plots in all habitats in Great Britain between 1978 and 2007. Data from arable soils and bog soils are shown as examples.

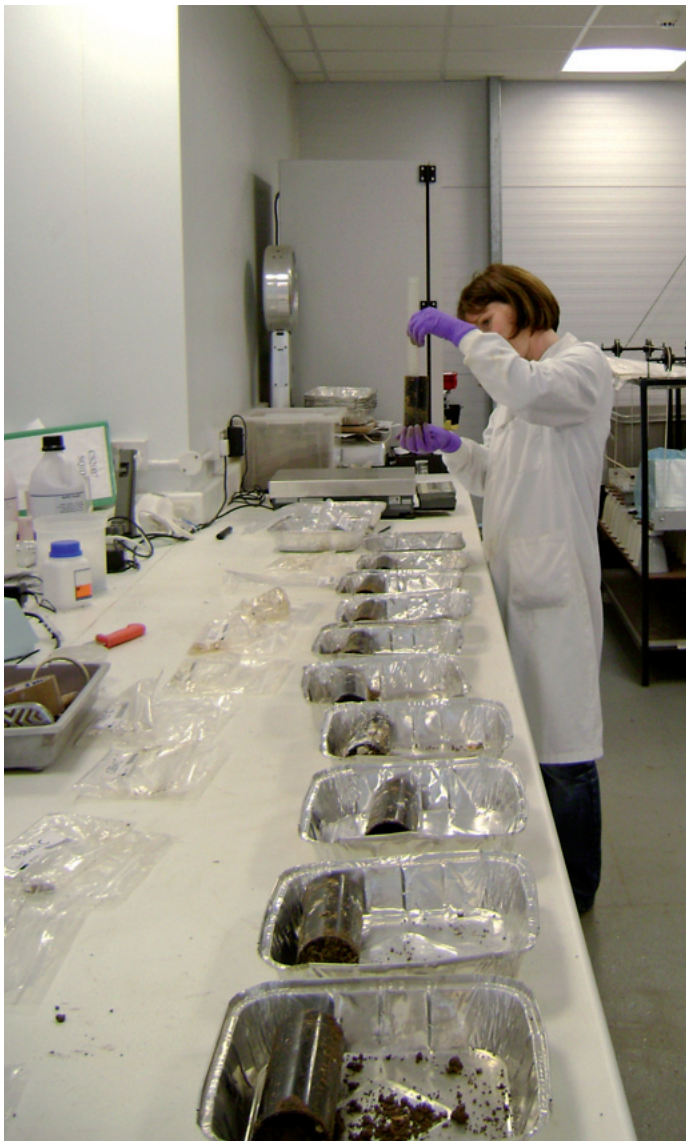


▲ Soil profile, Wales • © *Ian Rugg, Welsh Assembly Government*

The Countryside Survey results do not match the large decrease in soil carbon concentration reported by the National Soils Inventory monitoring programme in England and Wales between 1978 and 2003[3]. These differences will need to be investigated and they illustrate the difficulties of making national estimates of changes in soil carbon.

Possible factors that may have contributed to changes in soil carbon concentration (0-15cm) since 1978 include: changes in land management; changes in atmospheric pollution; and responses to changing weather patterns.

▲ Collecting soil samples, England • © *NERC*



▲ Soil analysis in progress • © *NERC*

[3] Bellamy et al (2005). Nature **437**, 245-248

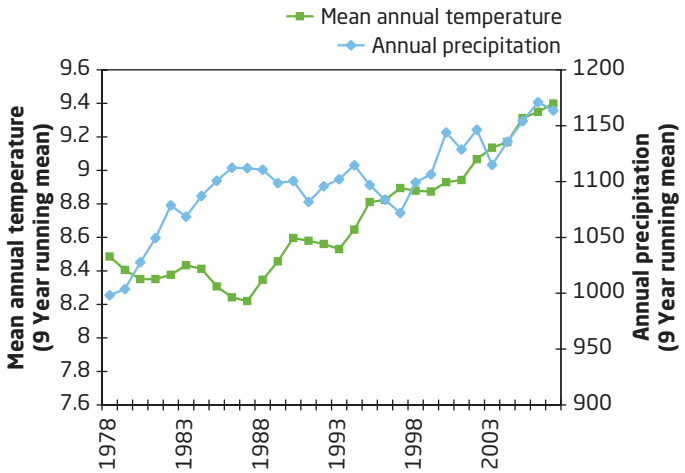
▲ Flooded fields, England • © *NERC*

11. Have climate change impacts been detected in the UK countryside?

Since 1978, Countryside Survey has detected no changes in plant distribution or abundance that appear consistent with climate change. As the weather has generally become warmer and wetter since 1978, taller plant species and those preferring wetter conditions have become more abundant across Great Britain. No direct cause-and-effect relationship has yet been established.

Long-term climate changes and year-to-year variations in weather are amongst the many factors which influence changes in the countryside. Impacts can be either direct, such as drought, or indirect through changes in policy or the way in which people use and manage natural resources. In the UK, climate change is predicted to lead to hotter, drier summers, milder wetter winters, higher sea levels and an increased flood risk (as summarised by UKCIP). However, the recent trend *(Fig. 11)* has been towards warmer and wetter summers. Changes in climate and policy may affect the profitability of different crops, making it worthwhile to grow different crops (e.g. vines and biofuels) and to use different crop management practices which may themselves alter the nature of the countryside and its biodiversity. Climate change could also affect biodiversity more directly, by changing the distribution and

▼ **Figure 11:** The 9-year running mean annual temperature and precipitation for the UK between 1978 and 2007. Data from UK Met Office.



abundance of native plant and animal populations, or by favouring the growth of competitive non-native species.

Climate change impacts are complex and it is difficult to be specific about whether the changes reported by Countryside Survey are due to climate change rather than other factors; so far only a preliminary investigation of the data has been possible. Previous surveys have not reported a definite signal of long-term climate change.

A number of plant species reach the northern limit of their distribution in the south of Great Britain and some of these species have been expected to spread northwards as the climate warms. Countryside Survey has not detected changes in the distribution and abundance of any individual species that might be expected to increase or decrease as a result of a warmer climate.

A better understanding of the effects of climate change is complicated by weather patterns during the years in which surveys were undertaken. The survey seasons of 1978 and 1990 were drier than average and 1998 wetter than average *(Table 4)*. There are also variations between different regions of the UK: although the spring and summer of 2007 were exceptionally wet in England and Wales it was not so in Scotland. Further analysis, with data from other sources, is required to determine if there are direct and long-term effects of climate change evident from Countryside Survey data.

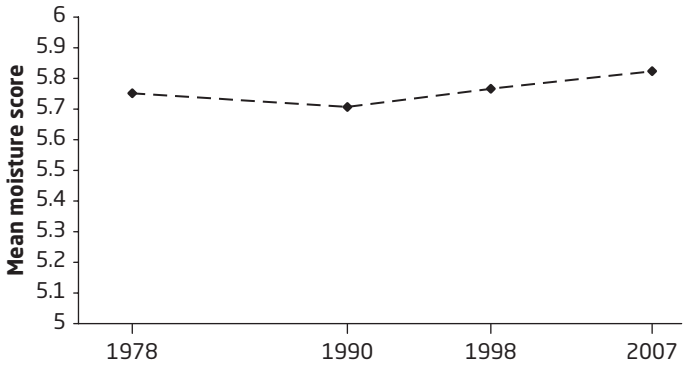
The clearest long-term climate-related signal recorded in Countryside Survey to date comes from changes in the vegetation across the countryside as a whole. Between 1990 and 1998, and again between 1998 and 2007, there was a shift in favour of taller species, those that prefer shade and those species which prefer wetter conditions *(Fig.12)*. These changes occurred at the same time as increases in mean annual precipitation and temperature across the United Kingdom. In Countryside Survey, no direct cause-and-effect relationship has yet been established between changing weather, climate and plant distribution.

▲ Habitats will respond to wetter conditions • © *Ian Simpson*

▼ **Table 4:** The precipitation in the UK during the surveying seasons when Countryside Surveys were carried out compared to the average between 1970 and 2007.

Year	Precipitation			
	Spring	% of average	Summer	% of average
Average 1970-2007	224		223	
1978	196	87	217	97
1990	185	95	209	96
1998	260	141	285	137
2007	229	88	357	125

▼ **Figure 12:** Changes in mean moisture score for plant species in sampling plots in open countryside (fields, woods, heaths and moors) in Great Britain between 1978 and 2007. All changes between consecutive sampling dates are significant.



▲ Diversity in the landscape, England • © *Andrew Stott*

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The project Partners would like to thank all the landowners, farmers, and other land managers who gave permission for the field surveyors to collect data and samples from their land. Without such cooperation, scientific field studies like Countryside Survey would not be possible.

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More information

More details of the methods, analyses and results from Countryside Survey that led to the Headline Messages presented in this report can be found in the accompanying report: "Countryside Survey: UK Results from 2007" available for download from the Countryside Survey website at www.countrysidesurvey.org.uk

A systematic summary of the results used to inform the "UK Results from 2007" is also available from the website in graphical format.

The Countryside Survey data used to generate the results will be accessible under licence following the launch of the country-level reports for England, Scotland and Wales.

The data generated by Countryside Survey will continue to be investigated in conjunction with other information such as climate, pollution and agricultural statistics. These investigations will improve understanding about the possible causes of the changes detected in the countryside of the UK.

Forthcoming Countryside Survey outputs:

2008: Detailed Northern Ireland Countryside Survey results.

2009: Country-level reports for England, Scotland and Wales.

The UK Land Cover Map for 2007.

Freshwater Habitats report.

Soils report.

2010: Integrated Assessment report.

Northern Ireland Countryside Survey report (habitat condition).

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The Countryside Survey partnership has endeavoured to ensure that the results presented in this report are quality assured and accurate. Data has been collected to estimate the stock, change, extent and/or quality of the reported parameters. However, the complex nature of the experimental design means that results can not necessarily be extrapolated and/or interpolated beyond their intended use without reference to the original data.

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