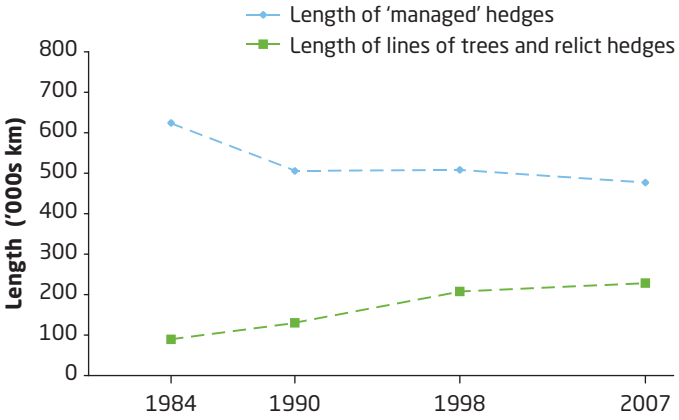
In 1984 there was an estimated length of 624,000 km of 'managed' hedge in Great Britain, which decreased rapidly to 506,000 km by 1990 *(Fig.4)*. The estimate of 508,000 km in 1998 showed the decrease had been halted. In 2007 the estimated length decreased to 477,000 km. Since 1984, many 'managed' hedges 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*

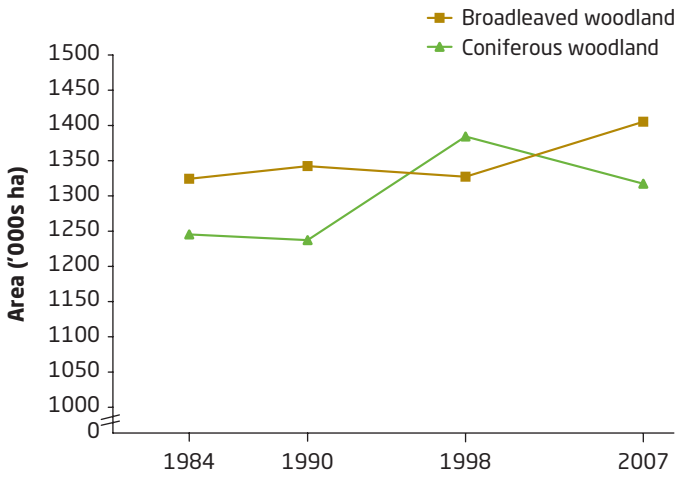
# 6. Has the area and condition of woodland changed?

**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.

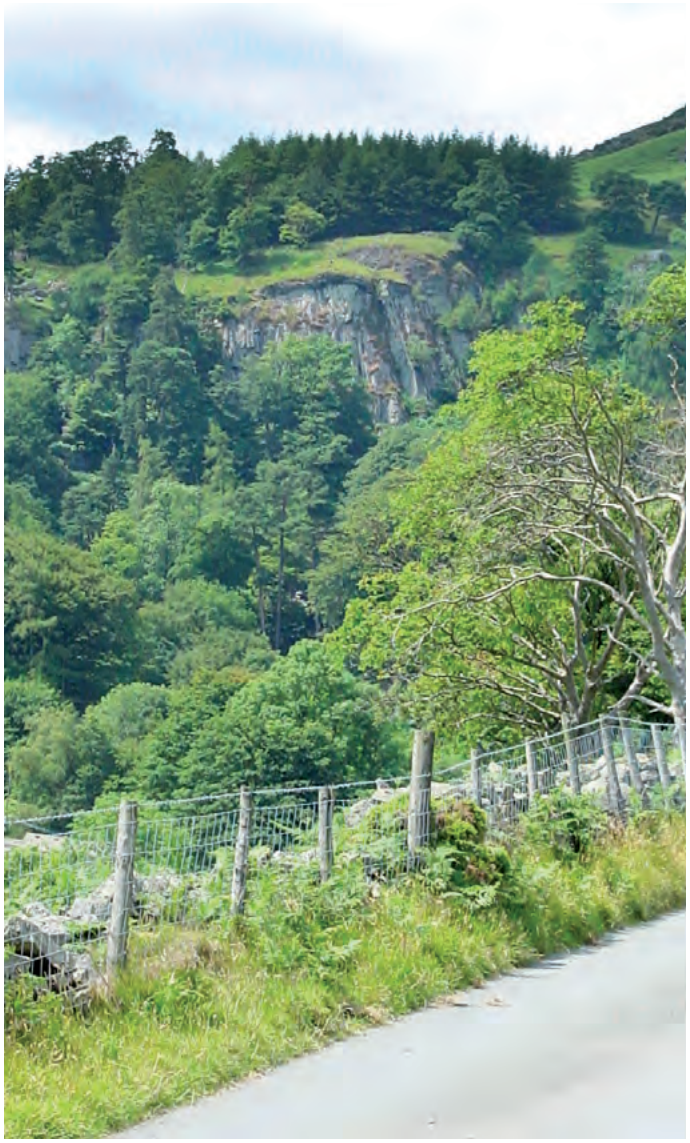
▼ **Figure 5:** Changes in the area of broadleaved and coniferous woodland ('000s ha) in Great Britain between 1984 and 2007.



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*

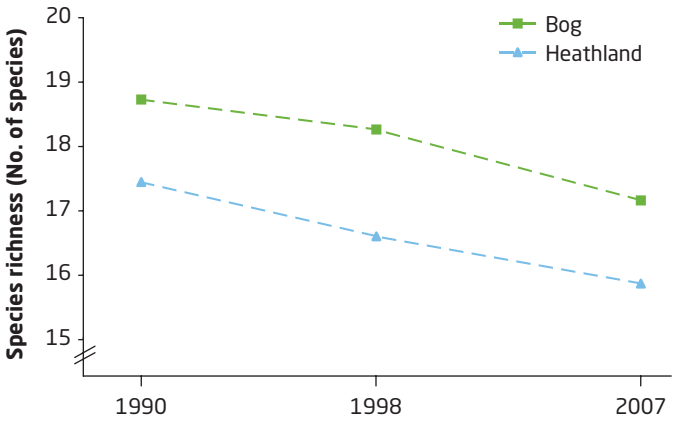
▲ Mereside pools, England • © *Sue Wallis*

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.**

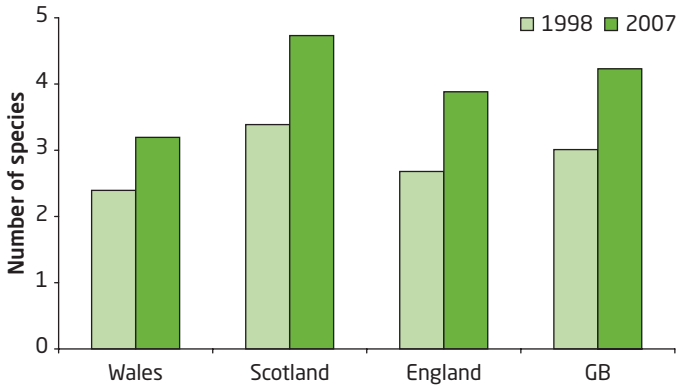
Headwater streams and ponds support a large variety of animals and plants. The small size of streams and ponds means that they are strongly affected by their surroundings and are therefore highly sensitive to any changes in the management of land around them.

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.

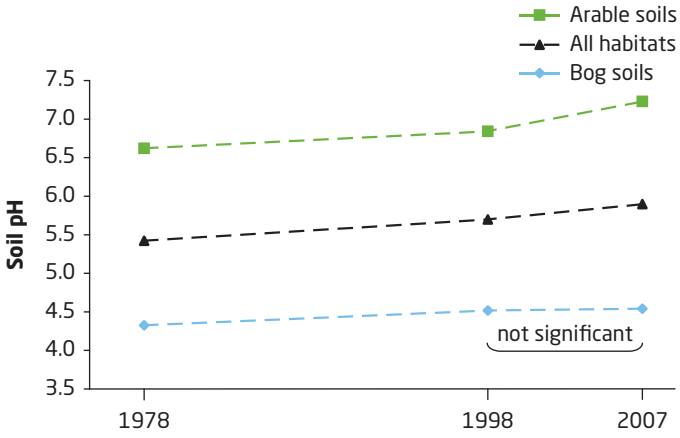
The reasons for the opposing trends in different habitats are under investigation.

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.

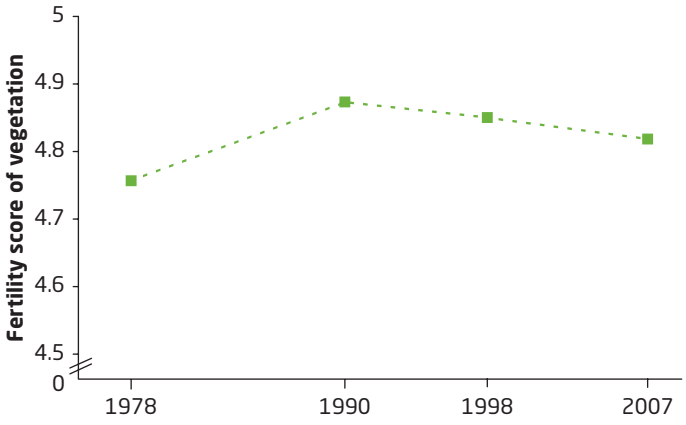
Emissions of nitrogen from sources including agriculture, transport and power plants play a role in changing the levels of nutrients in soils. An increase in fertility was observed between 1978 and 1990, and the 1998 survey found that in some habitats plant species preferring fertile conditions had become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

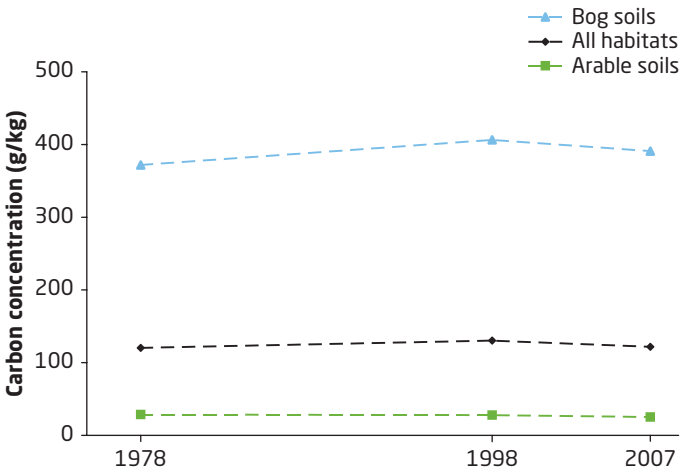
# 10. Has average carbon concentration in soils (0-15cm) changed?

**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

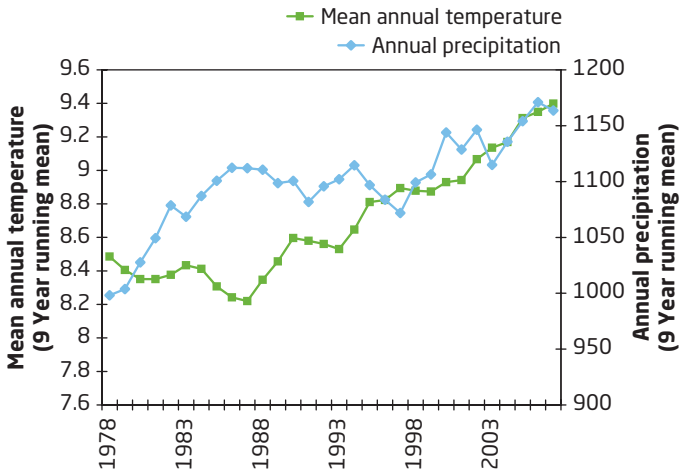
▲ Flooded fields, England • © *NERC*

# 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.

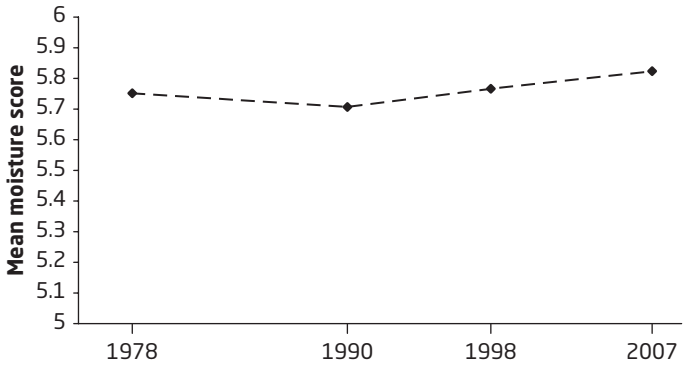
The clearest long-term climate-related signal recorded in Countryside Survey to date comes from changes in the vegetation across the countryside as a whole. Between 1990 and 1998, and again between 1998 and 2007, there was a shift in favour of taller species, those that prefer shade and those species 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).

**ISBN Number:** 978-0-9557672-7-2



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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.

# Countryside Survey

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