

▲ Field mapping • © CEH

1. Introduction and Countryside Survey Methodology

Countryside Survey is a unique study of the natural resources of the countryside. The survey has been carried out in the UK at intervals since 1978 with the latest in 2007. The countryside is sampled and studied using rigorous scientific methods so that the results can be used to measure and analyse change based on comparisons with previous surveys. Whilst the emphasis in this report is on the 2007 data and change since 1998⁹, where possible comparisons have been made with the data from earlier surveys in 1990, 1984 and 1978. These provide valuable contextual information on the direction and strength of trends prior to the most recent interval. The evidence produced can be used to review and develop policies that influence the management of our countryside, for example by providing information on progress against the UK Biodiversity Action Plan¹⁰, Soil Action Plans¹¹ and providing an evidence base to aid the design of agri-environment schemes.

A new baseline for Wales in 2007

Countryside Survey is based on measurements made in a sample of 1 km squares across each country in Great Britain. Wales has been surveyed as part of the Countryside Survey of Great Britain since 1978 but the number of 1 km squares surveyed in Wales, prior to the 2007 survey was relatively small compared to the other countries. An outcome of devolution in 1999 was the requirement to produce estimates for Welsh habitats to an equivalent level of precision as those that could be achieved for the other larger countries. Since precision is related to sample size not just the number of samples per area, the number of survey squares in Wales needed to be increased¹². In 2007 the number of squares in Wales was therefore increased from 64 to 107 (**Fig 1.1**).

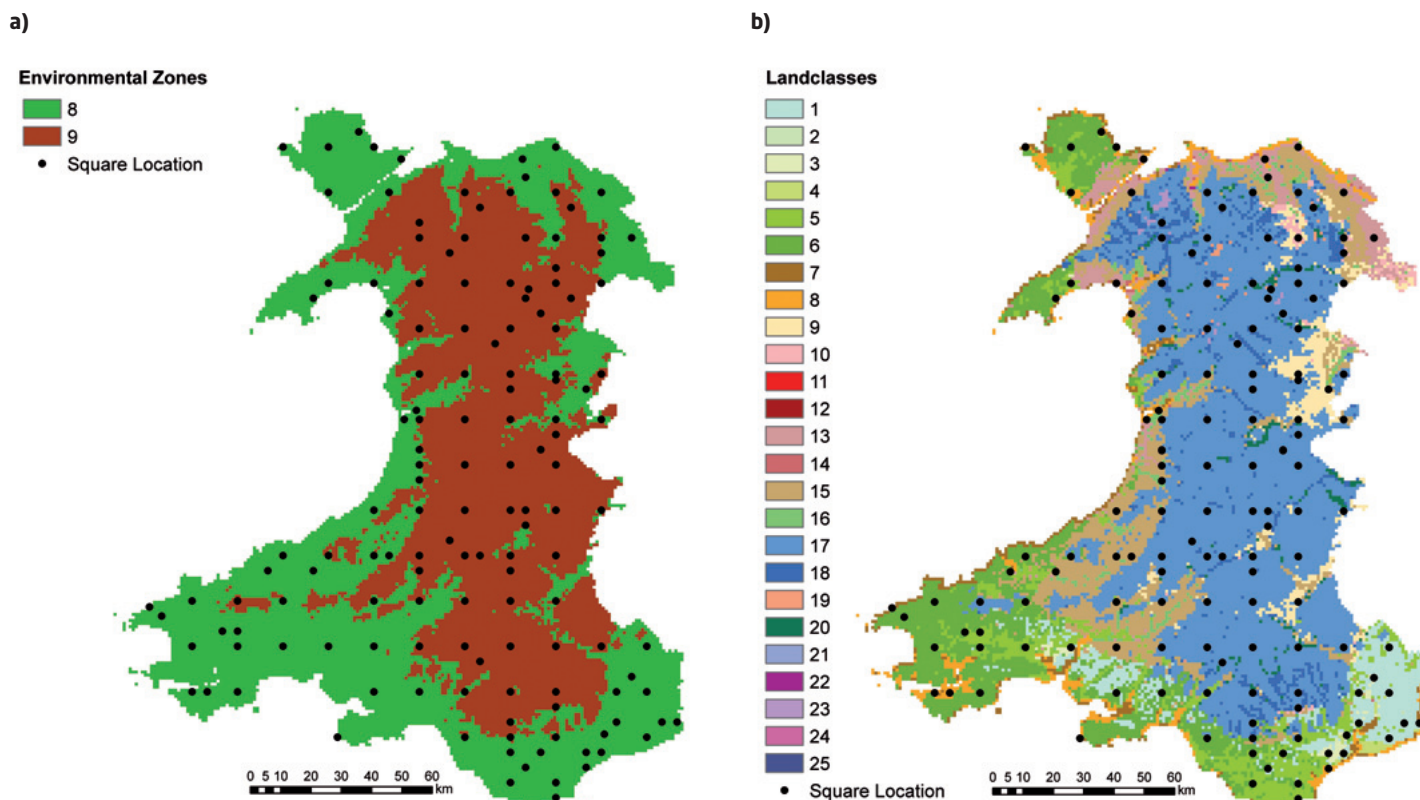
⁹ The Survey carried out in 1998 was published as: Haines-Young et al (2000). *Accounting for Nature, assessing habitats in the UK countryside, Countryside Survey 2000*. Department for the Environment, Transport and the Regions (DETR), London.

¹⁰ www.ukbap.org.uk

¹¹ new.wales.gov.uk/consultation/desh/2008/welshsoils/welshsoilscctionplan.pdf?lang=en

¹² Clarke, RT et al (2006) *Countryside Survey: Sampling for Wales – Only Reporting*. CEH Lancaster.

▼ **Figure 1.1:** *a) Division of Wales into two Environmental Zones based on aggregating Land Classes, b) The distribution of Land Classes in Wales used as the basis for stratified, random selection of 1-km survey squares.* Black dots also show the location of the sample squares in 2007 (not to scale).



Individual survey squares in Wales were randomly selected so that they are an unbiased sample of the range of variation in climate, landscape, soils and geology across the country (Fig 1.1). All widespread terrestrial habitat types are sufficiently well represented to enable robust and reliable statistical analysis. In addition, the increased number of squares also allowed estimates to be made separately in the uplands (zone 9) and lowlands (zone 8) of Wales (Fig 1.1). This enables the results to capture ecologically important differences in species and habitat composition between these two Environmental Zones (Fig 1.1a) although note that differences in the definition of upland versus lowland Environmental Zones in Wales can result in differences in estimates compared to other surveys (see Box 1). The increase in number of sample squares in Wales has had an immediate effect on improving the estimates of Broad Habitat area in 2007 and also provides a new baseline for producing improved estimates of change between 2007 and future surveys.

There are two main elements to Countryside Survey: field surveys (reported here) which focus on habitats, vegetation, soils (0-15 cm) and freshwater; and the Land Cover Map which uses vegetation data collected in the field survey and remotely sensed data from satellites to form a digital map of the land cover across the UK. The field survey provides estimates of the extent of the different Broad Habitats (see Section 1.2 UK report) and in 2007, for the

first time, some Priority Habitats¹³. The results of the field survey describe aspects of the soil and the character and condition of the different vegetation types associated with these Broad Habitats, including both land and freshwater habitats.

The UK results of the latest 2007 survey were published in November 2008 and the summary data made accessible on the Countryside Survey website¹⁴. More detailed reports on soils, freshwaters and an integrated assessment of selected ecosystem services will be produced over the coming year. This report presents further results of the analysis of Welsh data. The results are presented in chapters structured around the same Broad Habitat groupings used in the UK report. The format of the report largely follows that used in reporting results for the UK but differs in three important respects. First, each chapter, covering one or more Broad Habitats, has two parts – the first and largest part is a presentation of the results of analysis of the Welsh Countryside Survey dataset; the second part provides, in summary form, a description of the nature conservation context of the habitats included in the chapter, a comparison of Countryside Survey results with those from other key sources¹⁵, and a series of questions that are addressed in the concluding overview chapter. The second difference to the UK report is in the ordering of chapters, with the National Picture chapter following the individual habitat chapters. The third, and perhaps most important difference from the UK report format, is

¹³ Priority Habitat assessment is a topic of ongoing research work and results are not reported here.

¹⁴ www.countryside.gov.uk/data.html

¹⁵ Comparing Countryside Survey estimates with those from other sources is not straightforward because of differences in survey design, timing of survey, and by the different definitions of habitats used. No single source can be considered definitive – but often Countryside Survey provides the most recent estimate based on recording in the field.

Box 1: Defining upland and lowland areas of Wales

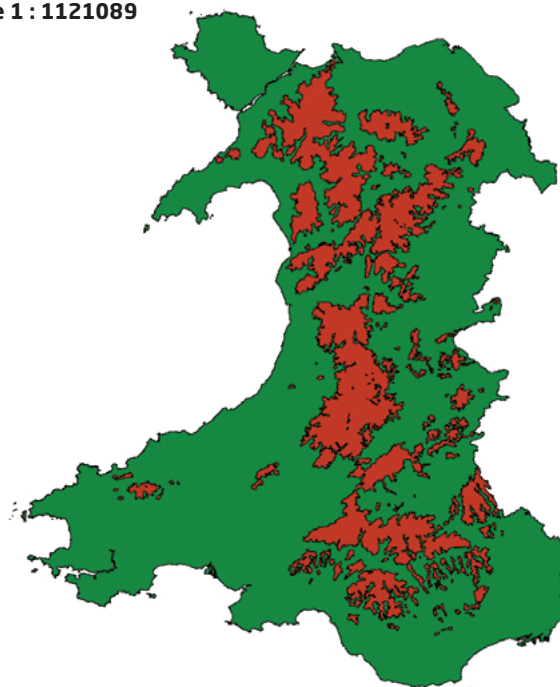
The differentiation in Countryside Survey of two environmental zones, characterised broadly as upland Wales and lowland Wales, is based on an amalgamation of the ITE Land Classes that form the basis of the survey design. These Land Classes are the product of a multivariate classification of data relating to topography, climate, geology and soil. The environmental zones formed from these classes therefore reflect an array of characteristics rather than any single characteristic. This differs from classification systems based on a single or a few characteristics. The Countryside Council for Wales for example, defines upland areas as land lying above 300m or above the limits of enclosure (**Fig B1**). These different approaches produce different pictures of the extent of upland and lowland areas, though the Countryside Council for Wales distribution based largely on altitude is clearly a subset of the Countryside Survey distribution based on a wider array of characteristics. Readers should be aware that all references in this report to upland and lowland Wales refer to the broader characterisation used by Countryside Survey (**Fig 1.1**).

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▼ **Figure B1:** The separation of upland (in red) from lowland Wales used by the Countryside Council for Wales based on the 300m contour and the limit of enclosed land.

Scale 1 : 1121089



the inclusion of an additional, concluding chapter that presents a preliminary evaluation of the significance of the results in relation to Welsh environmental policy objectives; and here the questions posed at the end of the individual habitat chapters are revisited.

The Centre for Ecology and Hydrology¹⁶ had lead responsibility for the scientific evidence presented and the project partners Countryside Council for Wales¹⁷ and Welsh Assembly Government¹⁸ for the contextual discussions. Equivalent reports are being produced in parallel for England and Scotland.

Details of the field survey methods used to collect the data for Countryside Survey in 2007 and preceding Surveys are presented in **Chapter 1 of the "UK Results from 2007"** and these are not reproduced in full in this report. However, an overview of the sampling strategy is provided below.

1.1. Methodology

Sampling design

Countryside Survey uses a sample-based design to estimate the amount and condition of habitats and landscape features in the countryside. Measurements of each component are made in a sample of 1 km squares, and statistical techniques are used to

scale up from the measured sample to the whole of Wales. This is rather different from a census, in which all parts of the countryside would be visited – a field survey based on a census design would be prohibitively expensive to carry out.

An important consideration in the design of the survey is that the sampled 1 km squares are representative of the whole of Wales. Countryside Survey aims to do this by ensuring that the sample of recorded squares includes the range of variation in soils, geology, topography and therefore in land-use and habitats, across the landscape, without bias toward any particular region or type of habitat. This is achieved by randomly selecting squares from a set of Land Classes that collectively capture the range of variation in the Welsh countryside (**Fig 1.1a**). Because only a proportion of the whole of Wales is sampled, the estimated values for the entire Welsh resource of a particular habitat or other measure include some amount of uncertainty. The degree of such imprecision is strongly influenced by the number of samples available – where more sample squares are available, as is the case for common habitats and features, estimates are more precise; where fewer samples exist, as with rare habitats, estimates are less precise. This 'uncertainty' around each estimate is conveyed in this report mainly by the use of 95% confidence intervals¹⁹ or in some cases by standard errors.

¹⁶ www.ceh.ac.uk

¹⁷ www.ccw.gov.uk

¹⁸ www.wales.gov.uk

¹⁹ The 95% CI for significant changes in extent of Broad Habitats are referred to in parentheses in the text alongside the estimated mean change. They are also tabulated in **Chapter 9**.



▲ Soils analysis • © CEH

The locations of the survey squares are not disclosed to avoid influencing their management in any way. This helps ensure that the survey squares remain representative of changes in the wider countryside and will continue to provide a reliable comparison for future surveys.

Recording vegetation, soil and freshwaters

The sample squares provide the basic recording units for Countryside Survey. Within these squares a range of data was collected. The area, shape and position of habitats including linear features were mapped across the whole square. In addition, lists of plant species with estimates of their percentage cover, were made in a smaller subset of fixed vegetation sampling plots. These plots varied in size and shape depending on the feature being sampled. Soil (0-15cm) samples were also collected from five plots in each square, and a stream and a pond were also sampled in many of the squares. See Carey *et al* (2008) for further information on vegetation, soil and freshwater sampling methods²⁰. The data collected enables estimation of:

- **the extent and change in area of habitats;**
- **the extent and condition of landscape features such as hedges and walls;**
- **the changing condition of vegetation in habitats;**
- **the pH, carbon concentration, carbon stock and bulk density of soils (0-15cm); and**
- **the condition of headwater streams and ponds.**

Further analysis of soils is ongoing to enable estimation of nutrient status, contaminant levels, soil biotic diversity and soil function, and will be reported in November 2009.

The recording framework within Countryside Survey makes it possible to report on both the area and the change in area for Broad Habitats using the data from the 1990, 1998 and 2007 Surveys. A modified coding system for habitat mapping was introduced in 1998 to enable reporting on Broad Habitats but, given the smaller number of 1 km squares visited in 1990, this report focuses on the 1998 to 2007 interval. The modified system has backwards compatibility to 1990 for most Broad Habitats. Similarly, the methods of recording linear features have been refined over time and so, where there has been consistency of recording over time, the length of linear landscape features and the numbers of point features including trees and ponds (and changes in those lengths and numbers) can be reported. Assessments of the condition of linear features are confined largely to more recent Countryside Surveys, in particular 1998 and 2007.

The condition of the vegetation sampled within each Broad Habitat can also be reported for the 1990, 1998 and 2007 Countryside Surveys. This is because the position of each vegetation plot is known and so the species data recorded in each plot can be referenced to a Broad Habitat. The large number of plots available in 1990 for most Broad Habitats also makes it possible to quantify change from that survey onwards. A range of 'condition measures' were produced from the species lists in each plot and these data analysed to convey aspects of change in quality e.g. change in numbers of food plants for butterfly larvae, as well as indications of species response to change in conditions such as fertility, soil pH and light. This report also includes details of individual plant species which increased and decreased the most across Wales in terms of frequency of occurrence in sample plots between 1998 and 2007.

Two issues impacted the analysis of the vegetation data and have required the application of additional methods to address them. Analysis of the Quality Assurance results for the vegetation plots surveyed in 2007 was followed by further statistical analyses of the full time-series combining Quality Assurance surveys carried out in parallel with the field surveys in 1990, 1998 and 2007. These follow-up analyses were carried out by external and internal statisticians who recommended that a correction factor should be added to the mean Ellenberg scores for 1990 when analysed together with 1998 and 2007 data. Despite the fact that the Quality Assurance analysis carried out after the 1998 survey found no change in bias between the 1990 and 1998 datasets, the simplest approach to correct for the gradual change in bias revealed by the full time-series analysis was to adjust the 1990 data. No significant change in bias was found for any of the other condition measures²¹.

²⁰ Carey *et al* (2008) *Countryside Survey: UK results from 2007*. Online at www.countryside-survey.org.uk/reports2007.html

²¹ The full vegetation plot Quality Assurance results and analysis can be viewed at www.countryside-survey.org.uk/tech_reports.html



▲ Southern Marsh Orchids • © Richard Evans

Potentially important ecological impacts are highlighted by referring to these effect sizes. Large effect sizes indicate that the size of the change in the sample mean was substantial relative to the amount of variation in the sample. Smaller effect sizes could still be important especially as they may capture part of a longer, ongoing trend. However, smaller effects could also be driven by factors such as weather impacts in each year of survey, which shift condition measures significantly but still within the range of variability typical of the vegetation type.

Where changes in species richness are discussed, the importance of the size of the change is more easily evaluated since the units (species) have more meaning. In these cases, the size and therefore importance of the observed change is discussed alongside the calculated effect size.

The possibility of variation in recording efficiency between 1998 and 2007 also required a precautionary approach to the analysis of change in individual plant species. A relative change index was calculated from the paired species frequency data for individual taxa in 1998 and 2007. This method expresses the relative change in number of plots occupied having taken account of any overall tendency for more or less species to have been recorded in plots. The approach was a modification of the one applied to calculate change in occupancy of 10km grid squares in the New Atlas of the Flora of the British Isles²². Species with the largest change in both numbers of plots occupied and change index are more likely to have shown a real change in abundance between surveys.



▲ Grazed pasture • © CEH

Highlighting the ecological importance of statistically significant changes

Variation in the numbers of samples available for analysis can influence the probability of a particular size of change being declared statistically significant. With a relatively large sample size, quite small changes can be significant whilst with small sample numbers a major change in the mean between two samples may not be significant. Hence, statistical significance alone may incompletely represent the potential importance of observed changes. In terms of their ecological impact, statistically significant but small changes may be of little consequence. Conversely, large changes may reflect more profound ecological effects. But our ability to detect large changes is somewhat constrained by small sample sizes, especially in earlier surveys. To address this, the analysis presented here has, in addition to looking at statistical significance, examined the magnitude of changes between surveys. In addition to directly comparing the value of a measure in one year with its value in another year (an approach largely restricted here to comparisons of species richness), an approach based on the calculation of standardized effect sizes has been used (see [Appendix 1](#)).

²² Telfer *et al* (2002) *Biol. Cons.* **107**, 99-109.

Further information and future analysis

More details of the methodology, analyses and results from Countryside Survey can be found in other companion reports and data resources available from the Countryside Survey website.

This report for Wales is one of a suite of reports that have either already been published or are scheduled for publication in the next year or two. The UK results of Countryside Survey were published in November 2008, and this report is one of several country reports that are being produced in summer 2009.

More detailed analysis of particular components of the survey – soils, streams and ponds – will be reported later in 2009 in separate themed reports. A detailed, integrated assessment of Countryside Survey data alongside other datasets, exploring what the results mean for provision of selected ecosystem goods and services, will be reported in 2010. While these reports will make use of the fuller Countryside Survey dataset, rather than a single country dataset, the results will have considerable relevance for Wales. Rather than marking the end of our evaluation of what Countryside Survey results mean for the Welsh countryside, this current report only marks the beginning.

Reports:

- UK Headline Messages – *published November 2008*
- UK Results from 2007 – *published November 2008*
- Detailed Northern Ireland Countryside Survey results – *published 2010*
- England Results from 2007 – *due to be published August 2009*
- Scotland Results from 2007 – *published 25th June 2009*
- Ponds – *due to be published Summer 2009*
- Streams – *due to be published October 2009*
- Soils – *due to be published November 2009*
- Integrated Assessment – *due to be published 2010*

Data resources:

- Web access to **summary data** – a systematic summary of the results used to inform the UK and country level reports – *launched in November 2008 and updated in January 2009*
- Web access to the **actual data** – data from individual survey squares used to generate all the results presented in Countryside Survey reports from the 2007 survey – *licensed access available from June 2009*
- The UK Land Cover Map for 2007 – *September 2009*

The data generated by Countryside Survey will continue to be investigated in conjunction with other information such as climate, pollution and agricultural statistics. It is anticipated that future analysis of Countryside Survey data will lead to many scientific journal articles over the coming years. These investigations will improve understanding about the possible causes of the changes detected in the countryside and, for example, provide an opportunity to explore the results for Priority Habitats in more detail.

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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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