



▲ Line of trees • © David Allen

4. Boundary and Linear Features Broad Habitat

Summary

Length and condition

- Woody linear features (managed hedges and lines of trees and shrubs) made up an estimated 51% of the total length of the Boundary & Linear Features Broad Habitat in Wales in 2007. This compares with 53% in England and 13% in Scotland.
- In parallel with the rest of Britain, there has been a reduction in the length of managed hedgerow in Wales over the 23 years since the first survey in 1984. This long-term loss reflects a combination of removal and shift to less frequently managed or unmanaged lines of trees and shrubs. Hedge removal was much more important between 1984 and 1990^{27, 28}, and has declined since 1990. However, the trend for a reduction in hedge management and increasing recruitment to unmanaged lines of trees and shrubs has been ongoing since 1984 up to and including the 1998 to 2007 interval.

- Tree and shrub species richness in Welsh woody linear features was the highest in Britain at 4.2 species per 30m length compared with 2.2 in Scotland and 3.7 in England.
- Fences were the next most common boundary feature making up 35% of the total length in Wales.
- Walls were evenly distributed between upland and lowland zones but were much more likely to be in poor condition in the uplands.

Vegetation condition

- A small number of statistically significant changes occurred in Hedgerow and Roadside Plots but the effect sizes of these changes were all medium or small suggesting possibly minor importance in terms of shifts in population means.
- The clearest ecological pattern occurred in Roadside Plots where changes were also small in effect size but suggested an overall trend toward less disturbance and greater shade.

²⁷ Barr et al (1991) *Changes in hedgerows in Britain between 1984 and 1990*. NERC/ITE.

²⁸ Barr et al (1993) *Countryside Survey 1990: Main Report*. Department of the Environment. HMSO, London.

4.1 Introduction

This Broad Habitat comprises hedgerows, lines of trees (if less than 5m wide or of single tree width), walls, fences, stone and earth banks (**Table 4.1**)²⁹. While the Countryside Surveys of 1984, 1990, 1998 and 2007 all recorded these different features, improvements in methodology and in definitions of feature types have enabled more consistent national estimates to be made across the surveys. This has meant changing the way feature types have been defined across surveys but constrained by the number and type of attributes measured and the ways these attributes can be combined. Information in this report is provided at a general level for the six major types of feature (**Table 4.1**).

Each type of feature was given a place in a hierarchy consistent with previous Countryside Survey reporting. This ensured that there would be no double counting of a section of a linear feature that was made up of two components such as a hedge and a ditch; nor triple counting for a hedge, ditch and fence. Hedges were considered to be more ecologically important than other linear features and were given precedence in reporting when they were found alongside other features. While other features, such as banks and walls are significant in a landscape policy context, hedge condition and stock are particularly important to measure because of the requirement to report progress on their Habitat Action Plan³⁰.

Data were also collected on the structural condition of the different feature types. Because there is more work to be done in exploring the uncertainties introduced by changing definitions over the previous, and particularly earlier surveys, this report emphasises the most reliable and comparable estimates that derive from the surveys of 1998 and 2007.



▲ Mixed boundary types • © Colin Barr

▼ **Table 4.1:** Boundary and Linear Feature types.

Linear Features	Description/condition criteria
Hedge	A line of woody vegetation that has been subject to management so that trees no longer take their natural shape. Hedges may be present with any feature below including alongside ditches, tracks and roads. These are also known as managed hedgerows.
Wall	A built structure of natural stone or manufactured blocks, mostly of traditional dry stone wall construction but including mortared walls. Includes walls with fences or banks/grass strips and/or lines of trees or shrubs.
Line of trees/shrubs and relict hedge and fence	Line of trees or shrubs, in which trees/shrubs take their natural shape, including those originally planted as hedges with a fence. May also include banks/grass strips.
Line of trees/shrubs and relict hedge	Line of trees or shrubs, in which trees/shrubs take their natural shape, including those originally planted as hedges. Includes avenues of trees. May also include banks/grass strips.
Bank/grass strip	An earth or stone-faced bank or grass strip with or without a fence.
Fence	A permanent post and wire or rail structure, including wooden, concrete or metal posts without any other associated feature other than a ditch or stream. Fences made from slate pillars bound by wire in Wales are included in this category.

In addition to the recording of structural features and measurement of overall length, fixed vegetation plots have been used to record the plant species composition of vegetation associated with linear features, such as that occurring on road verges, track sides and in hedge bottoms. These data are used to explore the current ecological condition of such vegetation, and how it has changed since 1990.

Hedge Diversity Plots were introduced in 1998 to measure the number of woody species in each hedge. In 2007 these were extended to other kinds of ‘woody linear feature’ such as lines of trees. The Hedge Diversity Plots span the width of the woody linear feature and are 30m long. In addition to species information, other data on the dimensions and condition of the feature were collected as was information on the presence and width of adjacent buffer strips. These attributes contribute to an assessment of condition that allows progress to be measured against the UK Habitat Action Plan for hedgerows.

4.2 Length of Boundary and Linear Features

In 2007, woody linear features (unmanaged and managed) made up 51% of the total length of boundary features in Wales (**Table 4.2**). A further 35% of the total was fences, and the remainder was made up of walls (6%) and banks/grass strips (8%) (**Table 4.2**). While most lengths of linear feature did not change

²⁹ Jackson, D.L (2000) *Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other classifications*. Online at: www.jncc.gov.uk

³⁰ See www.ukbap.org.uk

▼ **Table 4.2:** The length ('000s km) and change in length of Boundary and Linear Features in Wales and Welsh Environmental Zones between 1998 and 2007. Arrows denote significant change ($p < 0.05$) in the direction shown. Standard errors (SE) are shown for each length estimate.

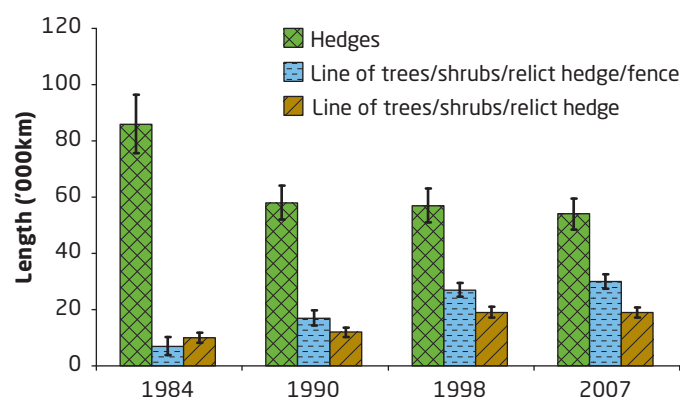
	Country and zone	1998		2007		1998-2007
		Length ('000s km)	SE	Length ('000s km)	SE	Direction of significant changes
Total woody Linear Features	Wales	107	8.0	106	7.9	
	Lowland	68	4.9	70	5.2	
	Upland	40	6.0	37	5.8	↓
Hedges	Wales	57	6.0	54	5.6	↓
	Lowland	36	4.2	36	4.0	
	Upland	21	4.0	18	3.7	↓
Line of trees/ shrubs/relict hedge/fence	Wales	27	2.4	30	2.5	↑
	Lowland	17	2.0	20	2.0	↑
	Upland	10	1.4	10	1.5	
Line of trees/shrubs/relict hedge	Wales	19	1.9	19	1.8	
	Lowland	13	1.6	14	1.5	
	Upland	6	1.1	5	0.9	
Wall	Wales	13	2.8	13	2.8	
	Lowland	7	2.4	7	2.2	
	Upland	6	1.6	6	1.6	
Bank/grass strip	Wales	16	1.8	16	1.7	
	Lowland	10	1.4	10	1.4	
	Upland	6	1.0	6	0.9	
Fence	Wales	74	4.3	74	4.5	
	Lowland	40	2.8	40	2.8	
	Upland	34	3.3	34	3.4	

type between 1998 and 2007, a significant 7.5% decline in total length of woody linear features was detected in the Welsh upland zone. The confidence interval of this change was large however: 1,500 to 4,000 km. Across Wales as a whole, managed hedges also declined significantly by an estimated 3,200km in length between 1998 and 2007 but again with a large confidence interval (95% CI; -700 km to -5,800 km). In the same period, a net significant increase of 2,700 km (95% CI; 1,200 km to 3,900 km) was estimated for the category 'Line of trees/shrubs/relict hedge/fence' associated with a lack of recent management and where trees and shrubs have regained their natural shape (*Table 4.2*).

In Wales, evidence from all four Countryside Surveys indicates that woody linear features whose shape suggests recent management (i.e. managed hedges) have always been, and still are, more common than unmanaged woody linear features. However, since 1984, there has been a steady reduction in length of managed hedges and an increase in relict hedges (*Fig 4.1*). Spatial analyses of these patterns has shown that the small gains to the unmanaged woody linear features were largely from managed hedges, indicating a trend toward less frequent management in a small but significant proportion of the resource in Wales. The biggest reduction in managed hedge length occurred between 1984 and 1990, and slowed thereafter (*Fig 4.1*). A similar pattern occurred across Britain as a whole in the same period and also reflected a major gain in unmanaged woody linear features recruited from managed hedges.

Removal of hedgerows was a more important driver of hedgerow loss between 1984 and 1990. Since then removal has been less influential than the unchecked growth of previously managed hedges leading to reclassification as an unmanaged line of trees and shrubs although often with signs of historical management still evident³¹.

▼ **Figure 4.1:** The change in total length ('000s km) of woody linear feature types in Wales between 1984 and 2007. Error bars are the standard errors on the mean length in each survey.



³¹ Barr et al (1993) *Countryside Survey 1990. Main Report*. Department of the Environment, HMSO London, UK.



▲ Unmanaged woody linear features • © Colin Barr

4.3 The condition of vegetation associated with Boundaries & Linear Features

The most common species recorded in Roadside and Hedgerow Plots are listed in *Table 4.3*.

None of the statistically significant changes seen in vegetation measures in the Hedgerow or Roadside Plots in Wales translated into large standardized effect sizes. However, since 1978, patterns of statistically significant changes across the whole of Britain in condition measures in Hedgerow Plots, and to a lesser extent Roadside Plots, indicated greater shade, lower herbaceous species richness and a greater representation of species favouring higher fertility³². When examined, none of the changes that were significant across Britain but not statistically significant in Wales between 1990 and 2007 were based on large standardized effect sizes.

4.3.1 Condition of vegetation in Hedge Plots

Species Richness: On average the number of butterfly larval food plants per 1x10m length of hedgerow in Wales declined by 0.8 species per plot between 1990 and 2007 but the standardized effect size was small (*Table 4.4*).

Other vegetation characteristics: All other statistically significant changes were also small or medium in size and therefore probably of minor ecological importance in terms of shift in the population, although further research would be needed to confirm this. Grass:Forb ratio declined across Wales and especially in the lowland zone, while the proportion of species favouring more disturbed conditions increased between 1990 and 1998, and then declined again between 1998 and 2007 (*Table 4.4*).

4.3.2 Condition of vegetation in Roadside Plots

Species Richness: Statistically significant reductions in butterfly larval food plant richness were detected across road verges in Wales between 1990 and 2007 (0.8 species fewer on average per 1x10m length), and between 1998 and 2007, especially in the lowland zone (*Table 4.5*). However, all of these changes were either small or medium standardized effect sizes and so probably of minor ecological importance.

Other characteristics: The clearest pattern occurred in Roadside Plots between 1990 and 2007, where Ellenberg Light Score and Ruderal Score both declined, indicating an overall trend toward species favouring greater shade and less disturbance (*Table 4.5*). However, none of the statistically significant changes were large in terms of their standardized effect size and so do not convey a marked shift in sample means.

4.4 Condition of Boundary and Linear Features

4.4.1 Woody species richness of hedgerows

Tree and shrub species richness in Welsh woody linear features was the highest in Britain at 4.2 species per 30m length compared with 2.2 in Scotland and 3.7 in England.

4.4.2 Condition of hedgerows

Agreed criteria for assessment of hedgerow condition are measured by structural attributes of the hedge itself or relate to the margin immediately adjacent to the hedge (*Table 4.6*). Taking into account purely structural attributes, 44% of Welsh hedges were in good condition in 2007. This dropped to 7% when all attributes were taken into account (*Fig 4.2*). On arable land 2% were in good condition taking into account the distance to adjacent disturbed ground and only 1% were in good condition taking into account all other condition criteria including the width of perennial vegetation between the hedge and disturbed ground.



▲ Traditionally laid hedge • © Colin Barr

³² Carey et al (2008) *Countryside Survey: UK results from 2007*. Online at www.countrysidesurvey.org.uk/reports2007.html

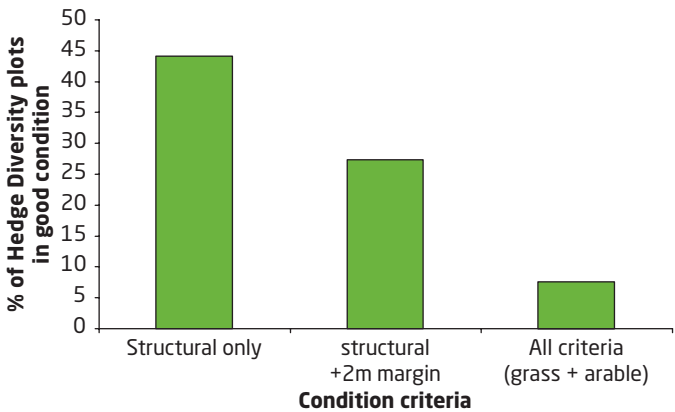
▼ **Table 4.3:** Most frequent 15 species in 2007 in the Boundaries & Linear Features Broad Habitat in Wales, comprising Roadside and Hedgerow Plots.

a) Hedgerow Plots (n=134)			b) Roadside Plots (n=403)		
% frequency	Mean cover (%)	Plant name	% frequency	Mean cover (%)	Plant name
81	24	<i>Crataegus monogyna</i>	70	7	<i>Dactylis glomerata</i>
72	8	<i>Urtica dioica</i>	65	9	<i>Holcus lanatus</i>
69	9	<i>Rubus fruticosus</i> agg.	65	2	<i>Taraxacum</i> agg.
68	6	<i>Holcus lanatus</i>	60	11	<i>Lolium perenne</i>
63	15	<i>Hedera helix</i>	59	9	<i>Agrostis stolonifera</i>
63	22	<i>Prunus spinosa</i>	53	3	<i>Poa annua</i>
57	4	<i>Dactylis glomerata</i>	50	8	<i>Agrostis capillaris</i>
54	16	<i>Corylus avellana</i>	47	7	<i>Festuca rubra</i> agg.
47	5	<i>Agrostis capillaris</i>	47	3	<i>Rubus fruticosus</i> agg.
46	2	<i>Galium aparine</i>	45	2	<i>Ranunculus repens</i>
45	4	<i>Arrhenatherum elatius</i>	43	3	<i>Trifolium repens</i>
40	3	<i>Festuca rubra</i> agg.	43	3	<i>Urtica dioica</i>
40	3	<i>Agrostis stolonifera</i>	37	5	<i>Arrhenatherum elatius</i>
34	1	<i>Digitalis purpurea</i>	31	3	<i>Hedera helix</i>
31	4	<i>Lolium perenne</i>	30	1	<i>Heracleum sphondylium</i>

▼ **Table 4.4:** Changes in the characteristics of vegetation in 10m x1m Hedge Plots across Wales between 1990 and 2007. W=Wales, Lo=Lowland zone, Up=Upland zone. Arrows denote significant change (p<0.05) in the direction shown. None of the significant changes reflected a large effect size.

Vegetation Condition Measures	Mean values (Wales)			Direction of significant changes 1998 - 2007			Direction of significant changes 1990 - 1998			Direction of significant changes 1990 - 2007		
	1990	1998	2007	W	Lo	Up	W	Lo	Up	W	Lo	Up
Species Richness (No. of Species)	19.3	18.9	18.1	NO SIGNIFICANT CHANGE			NO SIGNIFICANT CHANGE					
No. of Bird Food Species	10.1	9.8	9.4									
No. of Butterfly Food Species	9.4	8.7	8.2							↓		↓
Grass:Forb Ratio	0.65	0.25	0.04				↓	↓		↓	↓	
Competitor Score	3.18	3.13	3.17									
Stress Tolerator Score	2.28	2.29	2.29									
Ruderal Score	2.12	2.21	2.13	↓			↑	↑				
Light Score	6.14	6.14	6.13									
Fertility Score	5.78	5.77	5.75									
Ellenberg pH Score	6.06	6.06	6.06									
Moisture Score	5.48	5.48	5.52									

▼ **Figure 4.2:** The percentage of 30m long Hedge Diversity Plots in managed hedges in Wales that met condition criteria in 2007 (n=406).



▲ Cut hedge • © Colin Barr

▼ **Table 4.5:** Changes in the characteristics of vegetation in 10m x1m Roadside Plots across Wales between 1990 and 2007. W=Wales, Lo=Lowland zone, Up=Upland zone. Arrows denote significant change (p<0.05) in the direction shown. None of the significant changes reflected a large effect size.

Vegetation Condition Measures	Mean values (Wales)			Direction of significant changes 1998 - 2007			Direction of significant changes 1990 - 1998			Direction of significant changes 1990 - 2007		
	1990	1998	2007	W	Lo	Up	W	Lo	Up	W	Lo	Up
Species Richness (No. of Species)	19.2	19.1	19.0				NO SIGNIFICANT CHANGE					
No. of Bird Food Species	8.9	9.0	9.2									
No. of Butterfly Food Species	9.3	8.9	8.5	↓	↓					↓	↓	
Grass:Forb Ratio	1.15	1.21	0.87	↓	↓					↓	↓	
Competitor Score	2.77	2.79	2.86	↑		↑				↑		↑
Stress Tolerator Score	2.24	2.21	2.21									
Ruderal Score	2.76	2.80	2.68	↓	↓	↓				↓		
Light Score	6.70	6.73	6.58	↓	↓	↓				↓	↓	↓
Fertility Score	5.41	5.43	5.47									
Ellenberg pH Score	5.88	5.90	5.91									
Moisture Score	5.40	5.43	5.46				↑			↑		↑

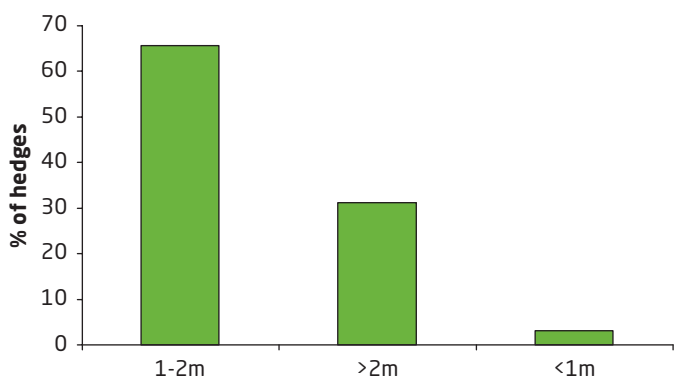
▼ **Table 4.6:** The structural and margin condition criteria assessed by surveyors in Countryside Survey 2007.

Structural Condition Criteria	Margin Condition Criteria
Height >1m	Distance between centre of hedge and disturbed ground >2m
Width >1.5m	Width of perennial vegetation 1m
Vertical gappiness <10%	
No gaps >5m	
Non-native species at >10% cover	
Height of base of canopy <0.5m	

4.4.3 Hedgerow height and management

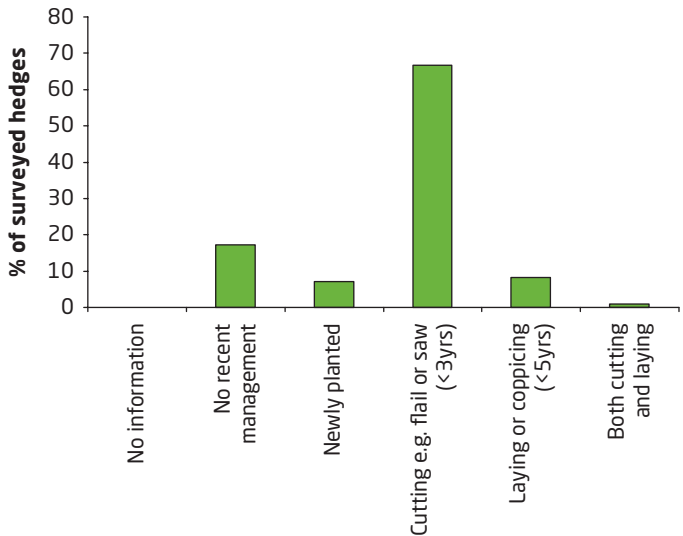
In 2007, 66% of sampled hedges were between 1m and 2m in height (*Fig 4.3*) despite a significant decrease in the proportion of hedges in this category between 1998 and 2007. No other significant changes were detected.

▼ **Figure 4.3:** Percentage of length of hedgerows in different height categories across Wales in 2007.



Recorded evidence of management indicated that most woody linear features (67% of sampled hedges) had been cut in the last 3 years, 7% had been newly planted and 17% showed no sign of recent management (*Fig 4.4*).

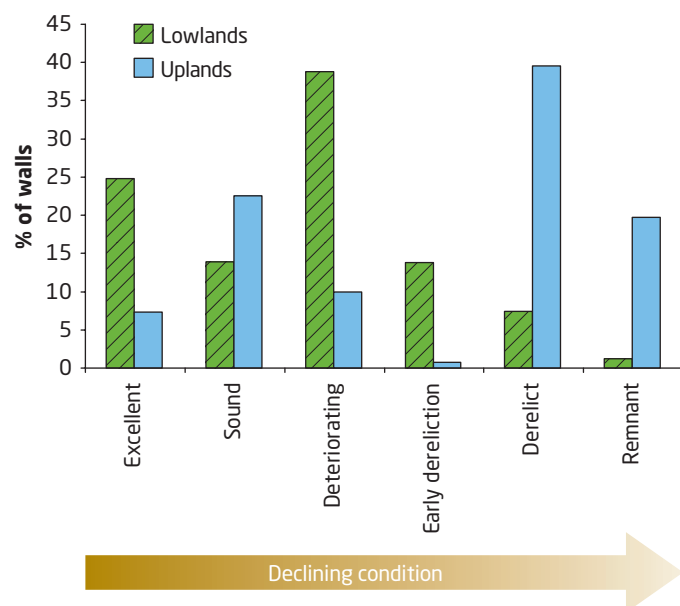
▼ **Figure 4.4:** Management practices in 2007 in Welsh hedges.



4.4.4 Structural condition of walls

In 2007, the estimated total length of walls in Wales was 13,000 km, evenly split between the upland and lowland zones (*Table 4.2*). Marked differences in condition were seen between these two zones. Walls in the uplands were much more likely to be in poor condition (derelict or remnant) than in the lowlands where more importance probably attaches to the maintenance of stockproofing. In the lowlands a higher proportion of walls were deemed either in excellent condition or deteriorating (*Fig 4.5*). The results suggest relatively more walls in lowland Wales were in good condition but a substantial proportion seem to be moving toward increasing disrepair. Nevertheless, far fewer lowland walls were in the worst possible condition categories.

▼ **Figure 4.5:** The percentage of the total length of walls in different structural condition categories across Wales in 2007.



▲ Stone walls, Gwynedd • © Richard Evans

4.5 The results in context

This chapter has considered the Broad Habitat that includes hedgerows, lines of trees, walls, fences, stone and earth banks. Some, though not all, of these provide habitats for animals and plants. But all are additionally important as components of the Welsh landscape, and the presence, relative abundance and state of different types contributes to the landscape character of particular areas. Hedgerows are recognised as a Priority Habitat within the UK Biodiversity Action Plan³³, and hedges generally provide habitats for birds, mammals, and other animal species. Hedges may be additionally important in providing connectivity between otherwise fragmented habitats.

No comparative estimates of the extent of these habitats are available from other sources. Countryside Survey is therefore a key source of information about the state of these features.

Key results and follow-up questions:

- **A reduction in the length of managed hedges and corresponding increase in lines of trees - are they consistent with biodiversity, landscape and/or agri-environment objectives?**
- **Very few hedges in good condition - what does it mean for biodiversity?**

These questions, together with those identified in each of the other habitat chapters, are considered further in *Chapter 9*.

³³ www.ukbap.org.uk

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.

Contacts

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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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