▲ Welsh landscape • © *Michael D Smith*

8. The National Picture

Summary

Broad Habitat Area

- Most Broad Habitats did not change significantly in area between 1998 and 2007 when averaged across Wales as a whole.
- Within the two environmental zones a number of statistically significant changes in area were detected between 1998 and 2007. In the lowland zone Broadleaved, Mixed & Yew Woodland increased. In the uplands, Arable & Horticultural land increased, Neutral Grassland decreased and Acid Grassland increased. The possible drivers of these changes and their uncertainties require further research.
- Land dominated by bracken was estimated to have decreased by 55%. Since the Bracken Broad Habitat is defined as having >=95% cover of bracken present, many areas no longer classified as Bracken Broad Habitat nevertheless still support high bracken cover and the change in status reflects the high cover threshold included in the definition. Possible reasons for reduced bracken cover in the 2007 survey include the impact of very high rainfall and its debilitating effect during the growing season of 2007, as well as local managed reduction. Differences in date of survey between years did not appear to be implicated in the change.
- The area of the Built-up areas & Gardens Broad Habitat increased by 13% between 1998 and 2007. This resulted from small increases in the area of buildings within survey squares and spread across many squares rather than few, large increases.

Vegetation condition

- Plant species richness declined between 1998 and 2007, and over the longer period between 1990 and 2007. This particularly impacted richness of butterfly larval food plants. Species richness per sample plot declined significantly in all landscape locations sampled: fields and larger areas of common habitat; on linear features including road verges, field boundaries, streamsides and hedgerows, and also in small habitat fragments.

- Non-native plant species were uncommon in vegetation plots in 2007 (on average, one in every six plots) and average non-native richness declined alongside native species richness between 1978 and 2007. A very small subset of such species are known to be invasive but assessment of their location and recent change awaits further analysis.

- Changes in vegetation character indicated a successional trend toward more shaded vegetation with fewer species of open ground and larger numbers of taller, more competitive species including trees and shrubs. The importance of this trend varied, the strongest being on linear features.

- Most changes in vegetation indices were small when evaluated against the amount of variability in the sampled vegetation. This was especially so in the combined analysis of all habitats, reflecting the high variability in the data as a result of aggregation across habitat types. But this pattern of relatively small changes is consistent with that seen in individual habitats. This suggests that, whilst ecological patterns are often clearly detectable, no large step-change in ecological condition has occurred. Further analysis is required to determine whether these relatively small changes are of ecological significance.

Boundary and Linear features

- In common with the rest of Britain, managed hedgerow reduced in length between 1998 and 2007, continuing a trend seen since the first survey in 1984. Rather than resulting from loss of the woody linear feature altogether, this was more likely to reflect a reduction in management and consequent increase in unmanaged lines of trees and shrubs.

Soils

- When averaged across all Broad Habitats the pH of the soil (0-15cm) did not change between 1998 and 2007 despite an overall increase between the first survey in 1978 and the latest in 2007. Soil pH did however increase in Improved Grassland and Neutral Grassland between 1998 and 2007.

- The only significant change detected in soil carbon concentration (0-15cm) was a reduction in Coniferous Woodland between 1998 and 2007.

- The mean soil (0-15cm) carbon stock in 2007 was highest for Dwarf Shrub Heath but too few samples were available for analysis of the other peat-dominated Broad Habitats.

Headwater streams and ponds

- The number of ponds increased by 18% between 1998 and 2007 but only 5% of ponds in 2007 were in ecological good condition.

- On river and stream banks, a clear ongoing successional trend was observed, consistent with a marked increase in cover of trees and shrubs and continuing reductions in species richness especially of butterfly larval food plants.

- Species richness within sampled watercourses did not change between 1998 and 2007 whilst the physical characteristics of the watercourse improved.

8.1 Introduction

In this chapter, results are drawn together to give a national overview of changes seen across Wales between Countryside Surveys. Changes in vegetation condition are also presented based on analyses combining plots in all Broad Habitats to give a summarised picture of the key ecological changes between 1998 and 2007, set within the longer 17 year timescale from 1990 to 2007. Results are also summarised for soils and freshwaters. Information is presented on:

- estimated areas of Broad Habitats, and changes in those areas;

- changes in vegetation condition in fields and larger areas of habitat, small habitat fragments and alongside boundaries, hedges, roads and streams;

- changes in linear landscape features;

- changes in headwater streams and ponds;

- changes in soil (0-15cm) characteristics;

The emphasis here and in all chapters is on the estimates from the 2007 survey since these are based on an increase in the number of sample squares. This increase provides greater statistical power for quantifying change in area and condition among habitats, soils, vegetation and landscape features for the future and provides the most precise baseline for the present. Because of the historically small sample size in Wales and the way in which the sample has gradually increased from the 1978 survey onwards, estimates of change in area and length of Broad Habitats focus on the 1998 to 2007 interval. Reference is made to previous surveys where the results are particularly clear and helpful in understanding longer term trends in Wales and the rest of the UK. A similar approach is taken when describing changes in vegetation characteristics. Occasionally, as in this chapter, enough plots can be combined to produce robust analyses back to 1978. However, because of the marked increase in sample size and numbers of plot types in the 1990 survey and the lack of Broad Habitat information for 1978, the main emphasis in the vegetation change results is on the 17 year period covering the 1990, 1998 and 2007 surveys.

8.2 Estimated area of Broad Habitats

Wales makes up about 9% of the area of the UK. Compared to the whole of Great Britain and the UK, Wales has proportionally more Improved Grassland (34% compared to Great Britain 20% and UK 21%), more Broadleaved, Mixed & Yew Woodland (8% compared to Great Britain 6% and UK, 6%), more Acid Grassland (10% compared to Great Britain 7% and UK 7%) but much less Arable & Horticultural (3% compared to Great Britain 20% and UK 19%)[43]. It also has less urban land than England but more than Scotland and Northern Ireland.

In order, the most common Broad Habitats in 1998 and 2007 were Improved Grassland, Neutral Grassland, Acid Grassland, Broadleaved, Mixed & Yew Woodland and Built-up areas & Gardens ***(Table 8.1)***.

8.3 Change in area of Broad Habitats

As a whole, few changes in area of Broad Habitats were detected between 1998 and 2007. The area of built land increased by 12.5% ***(Table 8.1)*** while the proportion of the Boundaries & Linear Features Broad Habitat that comprised mappable areas decreased between 1998 and 2007. These areas include major roads and associated land, a proportion of which was subsumed into the new extent of Built-up areas & Gardens consistent with the definition of both Broad Habitats[44]. Across Wales the Bracken Broad Habitat decreased by 55%. This was a large change in estimated area. A possible explanation that is being investigated is that this might be a result of the sensitivity of the mapping definition (only areas >=95% bracken cover qualify) combined with the potentially debilitating impact of high rainfall on bracken growth in the very wet summer of 2007 (see ***Chapter 6*** for more details). It could also include local managed reductions but more work is required to understand the reasons for this change. In any event, the vegetation plot data indicated that many areas no longer mapped as bracken in 2007 still had a high cover of bracken although this had reduced significantly; in these areas at least, the reduction in bracken area did not mean disappearance of bracken, but a reduction below the critical 95% threshold used in Countryside Survey to define stands of Bracken Broad Habitat.

The area of the Built-up areas & Gardens Broad Habitat increased in Wales by 14,600 ha (95% CI; 5,800 ha to 24,00 ha) ***(Table 8.1)***. This reflected increases in both upland and lowland zones in Wales, neither of which were statistically significant when tested separately. The increases reflected numerous small changes (median increase 0.04 ha in repeat survey squares between 1998 and 2007) rather than a small number of very large gains. The increase was largely attributable to new or extended buildings. 40% of the new Built-up areas & Gardens was on land mapped as Improved Grassland in 1998 and 38% on Neutral Grassland. 5% was Broadleaved, Mixed & Yew Woodland in 1998 and 8% linear habitat area, which is most likely to have been a reclassification of major road and railway having been surrounded by new built land.

Changes in area of other Broad Habitats were detected within either the upland or lowland zones in Wales between 1998 and 2007. Broadleaved, Mixed & Yew Woodland was estimated to have increased by 12% across lowland Wales. In the uplands, Neutral Grassland decreased by 33,000 ha and Acid Grassland increased by 13,000 ha. Arable land also increased in the uplands by an estimated 4,000 ha with 87% of the increase having occurred on land mapped as Improved Grassland in 1998. The possible drivers of these changes and their uncertainties require further research.

▲ **Main Plot** in bracken • © *CEH*

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

[44] Jackson, DL (2000) Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other classifications. www.jncc.gov.uk/page-2433

▼ **Table 8.1:** Estimated area ('000s ha), percentage of land area and change in area of Broad Habitats in Wales from 1998 to 2007. Arrows denote significant change ($p<0.05$) in the direction shown.

	1998		2007		1998 - 2007		Direction of significant changes 1998-2007
Broad Habitats	Area	% area of Wales	Area	% area of Wales	Change in area	% area of Wales	
Broadleaved, Mixed and Yew Woodland	172	8.1	174	8.2	1.8	1.1	
Coniferous Woodland	96	4.5	106	5	10	10.4	
Linear Features[45]	54	2.5	48	2.2	-6.3	-11.6	↓
Arable and Horticulture	61	2.9	73	3.4	12	19.8	
Improved Grassland	706	33.3	730	34.4	24.2	3.4	
Neutral Grassland	287	13.5	263	12.4	-24.2	8.4	
Calcareous Grassland	1.2	0.1	1.2	0.1	-0.07	-6	
Acid Grassland	191	9	211	9.9	19.3	10.1	
Bracken	84	4	37	1.8	-46.7	-55.4	↓
Dwarf Shrub Heath	99	4.7	117	5.5	17.9	18	
Fen, Marsh, Swamp	40	1.9	36	1.7	-4.3	-10.8	
Bog	45	2.1	48	2.3	3.1	7	
Standing Open Waters	6	0.3	5	0.3	-0.6	-10.2	
Rivers and Streams	5	0.3	6	0.3	0.3	5.9	
Montane	0.1	0.006	0.1	0.004	-0.03	-26.6	
Inland Rock	8	0.4	8	0.4	-0.7	-8.4	
Built-up Areas and Gardens	117	5.5	132	6.2	14.7	12.5	↑
Other land	134	6.3	111	5.2	n/a	n/a	
Unsurveyed Urban Land	15	0.7	15	0.7	n/a	n/a	
Total	**2121**	**100**	**2121**	**100**			

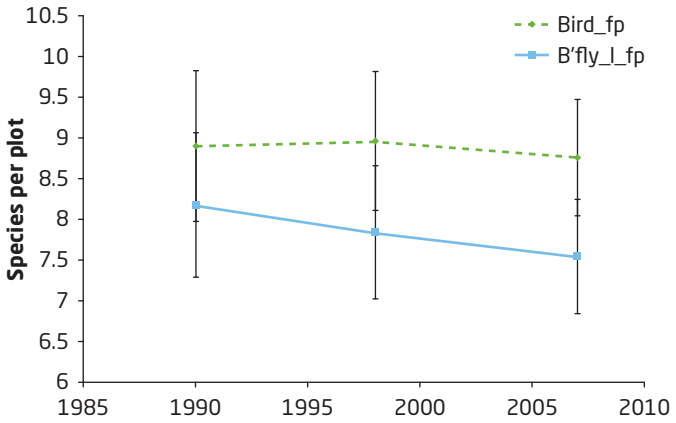
[45] Linear features were largely mapped as lengths except where >5m wide and >80m long i.e. above the Minimum Mappable Unit. Consequently, Linear Feature areas tend to comprise land occupied by larger roads and the railway network.

▼ **Table 8.2:** Change in the characteristics of all types of vegetation in 200m² Main Plots in Wales and in each of the Environmental Zones 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.

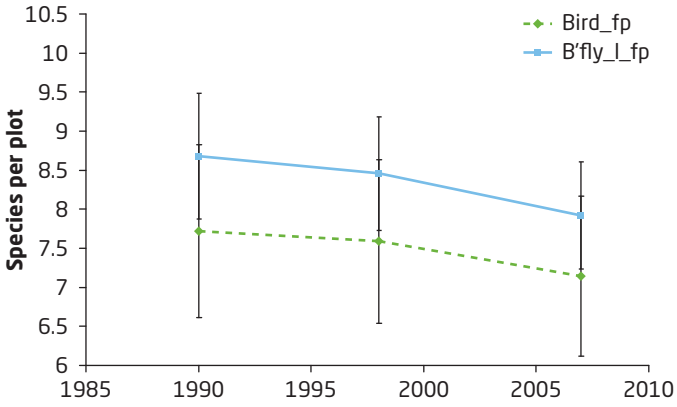
	Mean values (Wales)			Direction of significant changes 1998 - 2007			Direction of significant changes 1990 - 1998			Direction of significant changes 1990 - 2007		
Vegetation Condition Measures	1990	1998	2007	W	Lo	Up	W	Lo	Up	W	Lo	Up
Species Richness (No. of Species)	18.0	17.6	16.7	↓		↓	↓	↓		↓	↓	↓
No. of Bird Food Species	8.3	8.3	8.0			↓		↓			↓	↓
No. of Butterfly Food Species	8.4	8.2	7.7	↓		↓		↓		↓	↓	↓
Grass:Forb Ratio	1.00	1.27	1.10	↓		↑	↑	↑	↑			
Competitor Score	2.60	2.61	2.67	↑					↑	↑		↑
Stress Tolerator Score	2.46	2.45	2.42									
Ruderal Score	2.67	2.68	2.64	↓	↓			↑			↓	
Light Score	6.87	6.90	6.87	↓								
Fertility Score	4.71	4.71	4.72									
Ellenberg pH Score	5.26	5.23	5.21									
Moisture Score	5.64	5.69	5.72				↑			↑		

▼ **Figure 8.1:** Changes in number of food plants for butterfly larvae (B'fly_l_fp) and lowland farmland birds (Bird_fp) in Main Plots in Wales between 1990 and 2007 across all Broad Habitat types in the lowland zone a) and in the upland zone b). See ***Table 8.2*** for statistical significance of changes between surveys. Mean values for each year are shown (+/-95% CI).

a) lowland zone



b) upland zone



8.4 Changes in vegetation condition across all habitat types

8.4.1 Main Plots

The Main Plots (200m^2) were located at random within fields, woods and unenclosed habitats, and away from boundary and linear features. These plots therefore provide an unbiased picture of vegetation composition and characteristics in the most common habitats in Wales.

The analyses presented here address average change across all sampled habitats in Wales, and therefore they reflect the aggregation of various, sometimes habitat-specific, trends seen in individual Broad habitats (see previous chapters). These results provide a useful high-level summary but may also average out changes in different directions that occurred among different habitats.

Species richness: A progressive loss of species diversity occurred in the 17 year interval *(Table 8.2)*, which in turn meant significant reductions in food plants for butterfly larvae and lowland farmland birds *(Fig 8.1)*. However, effect sizes for changes in species richness were all small or medium indicating small magnitude change relative to the variation in the sample.

A highly significant mean loss of 2.5 butterfly larval food plant species per plot between 1978 and 2007 was detected across the much smaller sample (n=58) of repeated Main Plots first sampled in 1978. Taking into account the confidence intervals around the mean change, this amounts to a reduction of between 12% and 37% in the mean over the 29 year period. The standardized effect size was 0.62 for the 1978 to 2007 change. Although below the threshold value of 0.8 for a large effect, the sample was highly variable given that all habitat types were included hence this loss over the 29 year period should be considered potentially significant in its ecological impact on common habitats and butterflies in Wales.

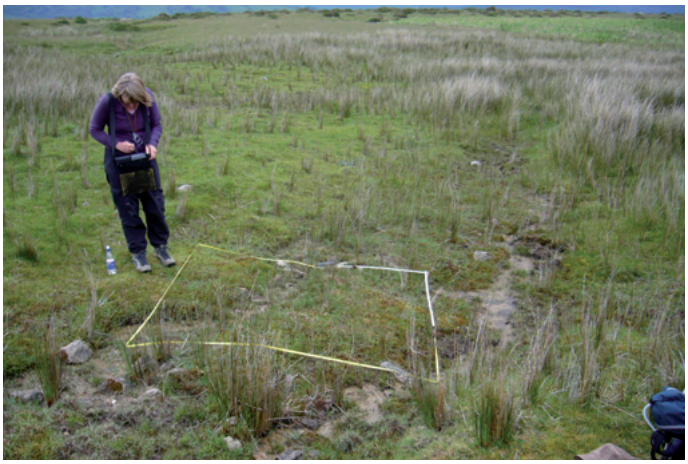
Other vegetation characteristics: None of the significant changes in the Main Plots were based on large standardized effect sizes hence ecological impacts may well be minor. The pattern of changes does not reveal any especially clear signal of movement along an ecological gradient. This is perhaps not surprising given that habitat-specific trends are here averaged across all sampled habitats. The most obvious signal was for an increase in competitive species at the expense of ruderal species of more open conditions and an increase in species preferring more moist conditions *(Table 8.2)*.

▲ Shaded **Streamside Plot** • © *CEH*

8.4.2 Linear Plots

Species richness: Total species richness, richness of food plants for lowland farmland birds and richness of butterfly larval food plants all decreased significantly over the 17 year period. Total species richness and richness of butterfly larval food plants also decreased between the two most recent surveys in 1998 and 2007 *(Fig 8.2; Table 8.3)*. None of the significant changes were based on large standardized effect sizes hence impacts on the vegetation may be modest although this can only be confirmed after further analysis.

▲ Overgrown **Hedgerow Plot** • © *CEH*



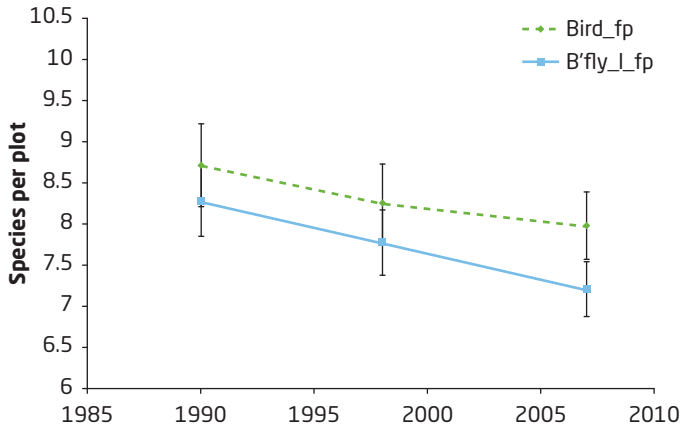
▲ Calcareous flush in **Targeted Plot** • © *CEH*

▼ **Table 8.3:** Change in the characteristics of all types of vegetation in 10m² Linear Plots (Boundary, Hedgerow and Roadverge) in Wales and in each of the Environmental Zones 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.

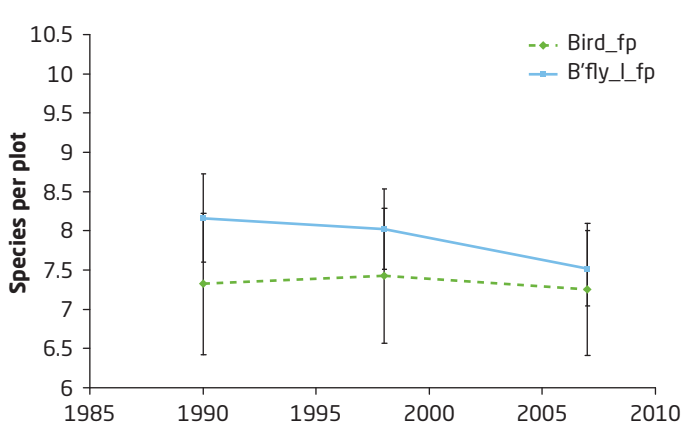
	Mean values (Wales)			Direction of significant changes 1998 - 2007			Direction of significant changes 1990 - 1998			Direction of significant changes 1990 - 2007		
Vegetation Condition Measures	**1990**	**1998**	**2007**	**W**	**Lo**	**Up**	**W**	**Lo**	**Up**	**W**	**Lo**	**Up**
Species Richness (No. of Species)	18.6	18.1	17.4	↓			↓			↓		
No. of Bird Food Species	8.1	7.9	7.6							↓		
No. of Butterfly Food Species	8.2	7.9	7.4	↓		↓	↓			↓		↓
Grass:Forb Ratio	0.99	0.99	0.72	↓	↓	↓				↓	↓	
Competitor Score	2.85	2.88	2.94	↑						↑		
Stress Tolerator Score	2.34	2.33	2.32									
Ruderal Score	2.56	2.58	2.46	↓	↓					↓		
Light Score	6.62	6.62	6.51	↓	↓					↓		
Fertility Score	5.19	5.23	5.26							↑		
Ellenberg pH Score	5.63	5.67	5.67				↑					
Moisture Score	5.43	5.52	5.56	↑			↑			↑		

▼ **Figure 8.2:** Changes in number of food plants for butterfly larvae (B'fly_l_fp) and lowland farmland birds (Bird_fp) in Linear Plots in Wales between 1990 and 2007 across all Broad Habitat types in the lowland zone a) and upland zone b). See ***Table 8.3*** for statistical significance of changes between surveys. Mean values for each year are shown (+/-95% CI).

a) lowland zone



b) upland zone

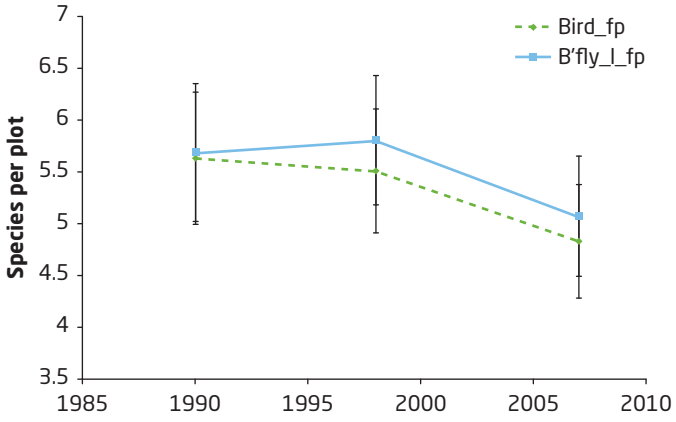


▼ **Table 8.4:** Change in the characteristics of all types of vegetation in 4m² Targeted Plots in Wales and in each of the Environmental Zones between 1990 and 2007. W=Wales, Lo=Lowland zone, Up=Upland zone. Arrows denote significant change ($p<0.05$) in the direction shown. None of the significant changes reflected a large effect size.

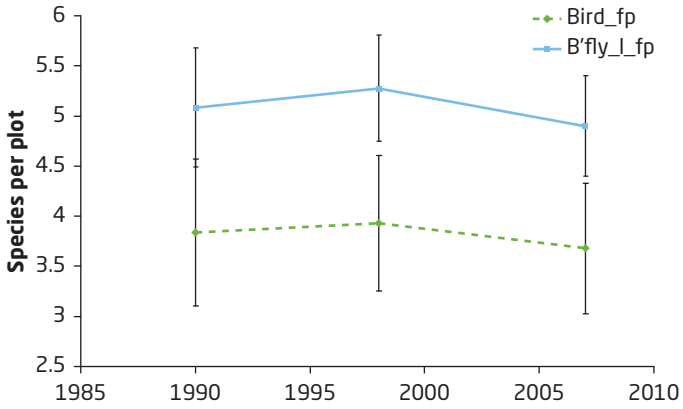
	Mean values (Wales)			Direction of significant changes 1998 - 2007			Direction of significant changes 1990 - 1998			Direction of significant changes 1990 - 2007		
Vegetation Condition Measures	**1990**	**1998**	**2007**	**W**	**Lo**	**Up**	**W**	**Lo**	**Up**	**W**	**Lo**	**Up**
Species Richness (No. of Species)	14.0	14.0	12.5	↓	↓	↓				↓	↓	
No. of Bird Food Species	4.8	4.7	4.3	↓	↓					↓		
No. of Butterfly Food Species	5.4	5.5	5.0	↓	↓							
Grass:Forb Ratio	0.64	1.06	0.68	↓			↑					
Competitor Score	2.61	2.68	2.75	↑		↑	↑	↑		↑	↑	↑
Stress Tolerator Score	2.90	2.85	2.76	↓		↓	↓		↓	↓		↓
Ruderal Score	2.20	2.22	2.19		↓	↑		↓	↑		↓	↑
Light Score	6.70	6.74	6.66	↓	↓	↓			↑	↓		
Fertility Score	4.08	4.14	4.25	↑		↑				↑		↑
Ellenberg pH Score	4.89	4.92	4.95			↑						
Moisture Score	6.24	6.31	6.27				↑					

▼ **Figure 8.3:** Changes in number of food plants for butterfly larvae (B'fly_l_fp) and lowland farmland birds (Bird_fp) in Targeted Plots in Wales across all Broad Habitat types in the lowland zone a) and upland zone b). See ***Table 8.4*** for statistical significance of changes between surveys. Mean values for each year are shown (+/-95% CI).

a) lowland zone



b) upland zone



Other vegetation characteristics: Reductions in Ruderal Score and Light Score along with increases in Competitor Score indicate a clearer pattern of ecological changes in the Linear Plots. It seems likely that species less tolerant of shade and competition for light have declined in response to more relaxed management while the increase in Fertility and Moisture Scores also indicate greater abundance of more nutrient-demanding species that prefer more moist conditions *(Table 8.3)*.

8.4.3 Targeted Plots

Targeted Plots (2m x 2m) were introduced in Countryside Survey in 1990 to sample the vegetation in areas of botanical interest not otherwise sampled by the Main or Linear Plots. These include smaller fragments of less frequently occurring habitats. The 1990 Targeted Plots have been re-sampled in 1998 and 2007. Like the Linear Plots, they provide a unique indication of ecological changes in parts of the landscape that, while often intimately associated with land under intensive management, may also act as refuges for plant species that were formerly more common in the countryside[46].

Species richness: Total species richness, richness of food plants for lowland farmland birds and richness of butterfly larval food plants decreased significantly between 1998 and 2007 particularly in the lowland zone. Total species richness and richness of food plants for lowland farmland birds decreased significantly over the 17 year period between 1990 and 2007 *(Fig 8.3; Table 8.4)*. None of the significant changes were based on large effect sizes hence ecological impacts on the vegetation may be modest.

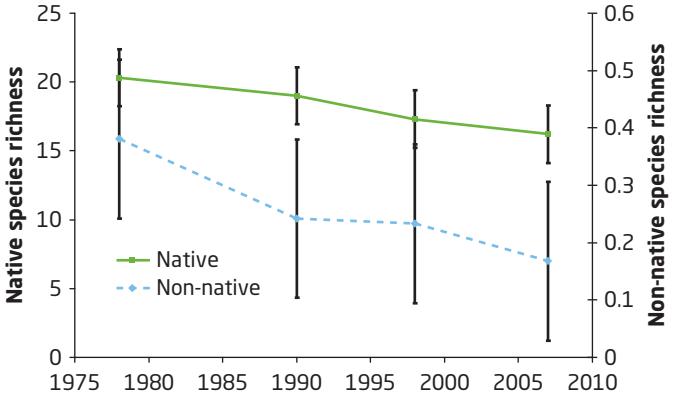
[46] Smart *et al* (2006) *J.Appl.Ecol.* **43**, 1128-1137.

Other vegetation characteristics: The clearest signal over the 17 year period as well as between 1998 and 2007, was an increase in the frequency of more competitive species and decreased representation of more stress-tolerant species, especially so in the uplands where also accompanied by an increase in ruderal species of more open conditions ***(Table 8.4)***. Overall, patterns of change did not compellingly indicate succession and lack of disturbance. For example, the Ruderal Score increased in the upland zone and decreased in the lowlands, while the Light Score increased significantly between 1990 and 2007. The lack of clear directional patterns may well reflect different changes among the different habitats included in the sample. A more evident trend over the 17 year period was for increased representation of more nutrient-demanding generalist species especially in the upland zone ***(Table 8.4)***. None of the significant changes were based on large standardized effect sizes hence impacts on the vegetation were minor compared to variation in the sample. The ecological impact of these changes could well be slight but further research would be required to explore this.

8.4.4 Changes in species richness since 1978

Countryside Survey began in 1978 with a sample of 256 1 km squares located across Britain. In the squares surveyed in Wales a series of vegetation plots were established and have been visited in every survey since. This time series is the longest and while based on a relatively small number of plots, the sample is large enough to show change over all landscape locations and vegetation types over the 29 year period ***(Fig 8.4)***. A significant decline in species richness was observed for both native[47] and non-native[48] species between 1978 and 2007. Non-native plant species were uncommon in vegetation plots in 2007 (on average, one in every six plots). A very small subset of such species are known to be invasive but an updated assessment of their location and recent change awaits further analysis.

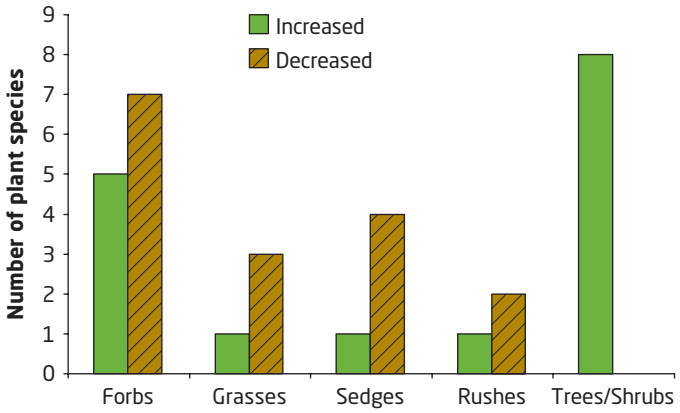
▼ **Figure 8.4:** Changes in native and non-native species richness in all Welsh repeat plots (n=115) first sampled in 1978. Error bars are 95% CI on the mean counts in each survey year. Changes in native species richness were significant ($p<0.05$) between all years except 1978-'90 and 1998-'07. Changes in non-native species richness were significant ($p<0.05$) between 1978 and all other survey years.



8.4.5 Individual species changes within plots surveyed in 1998 and 2007

To account for any variation in observer efficiency between surveys an index of relative change was calculated that conveys change in frequency for each species having averaged out any 'global' within-survey difference in species frequency. ***Table 8.5*** lists those species that had the highest and lowest change indices but excluding species that were recorded separately but whose identifications may be confused with one another. The plant species that increased or decreased the most between 1998 and 2007 segregate clearly in terms of canopy height and growth form; tall woody species tended to have increased ***(Fig 8.5)*** whilst shorter herbs decreased ***(Fig 8.6)***. These patterns are consistent with those seen among increasers and decreasers in England and Scotland. This raises the possibility of a common response to factors operating to some extent across Britain between 1998 and 2007 and continuing trends seen from 1978 especially on linear features and, since 1990, in small habitat remnants[49, 50]. They also resemble patterns of change in larger scale grid square occupancy seen among both the common and rare species in the British Flora since the 1960s[51, 52]. In addition to land-use change, weather impacts in each year of survey may also have played a role in driving the observed trend in Countryside Survey plots. Explanation of these signals in terms of land-use and other drivers is a matter for ongoing analysis.

▼ **Figure 8.5:** The species that increased or decreased the most between 1998 and 2007 are classified here by their growth form (see ***Table 8.5***).



[47] Comprises the categories Archaeophyte (alien introduced before 1500), Native (not endemic), Native (endemic) and Spontaneous hybrid between two native parents.

[48] Comprises the categories Neophyte (alien introduced after 1500) and Alien casuals (mostly crops). See PLANTATT (www.brc.ac.uk/resources.htm).

[49] Smart *et al* (2005) *Biol. Cons.* **124**, 355-371.

[50] Smart *et al* (2003) *J.Env.Man.* **67**, 239-254.

[51] Preston *et al* (2000) *Changing Flora of the UK*. DEFRA, London.

[52] Braithwaite *et al* (2006) *Change in the British Flora 1987 – 2004*. Botanical Society of the British Isles, London.

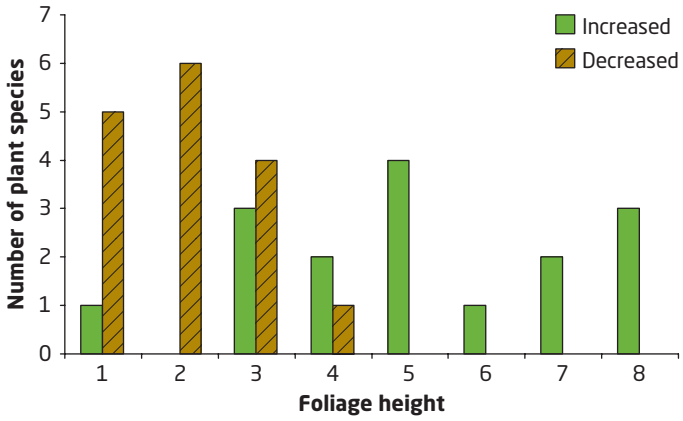
▼ **Table 8.5:** Plant species whose indices of change between 1998 and 2007 were in the top 16 or bottom 16 of all species ordered firstly by change in numbers of plots occupied and then by Change Index calculated using an adaptation of the method presented in the New Atlas of the British and Irish Flora (see ***Chapter 1***). Growth form: w = woody; f = forb; g = grass, s= sedge, m=rush. Excludes species pairs that were likely to have shown patterns of correlated change linked to identification bias between surveys.

Latin name	Growth form	Number of records in 1998	Change index
Crataegus monogyna	w	349	0.55
Fraxinus excelsior	w	161	0.56
Galium palustre	f	117	0.59
Equisetum arvense	f	17	0.6
Juncus effusus	m	342	0.6
Corylus avellana	w	228	0.62
Tamus communis	w	18	0.64
Sonchus asper	f	12	0.67
Blechnum spicant	f	33	0.68
Dryopteris dilatata/carthusiana	f	78	0.74
Hedera helix	w	188	0.81
Salix cinerea	w	17	0.82
Quercus robur/petraea	w	114	0.88
Carex seedling/sp	s	70	0.91
Aira caryophyllea	g	4	0.94
Rubus fruticosus agg.	w	315	0.99
Cerastium glomeratum	f	39	-1.8
Eleocharis palustris	m	32	-1.69
Ranunculus ficaria	f	43	-1.08
Carex flacca	s	51	-0.96
Carex nigra	s	120	-0.75
Juncus bulbosus	m	73	-0.73
Poa pratensis sens.lat.	g	328	-0.69
Elytrigia repens	g	125	-0.43
Potentilla anserina	f	95	-0.29
Phleum pratense sens.lat.	g	116	-0.22
Carex pilulifera	s	95	-0.19
Trifolium pratense	f	94	-0.16
Sagina sp.	f	177	-0.08
Leontodon autumnalis	f	165	-0.07
Carex echinata	s	109	-0.05
Apium nodiflorum.	f	47	-0.72

8.5 Changes in landscape features

Woody linear features (managed hedges and lines of trees and shrubs) made up an estimated 51% of the total length of boundary and linear features in Wales in 2007 compared with 53% in England and 13% in Scotland, where unenclosed land is a much more common component of the landscape. In parallel with the rest of Britain, there was a reduction in the length of managed hedgerow in Wales over the 23 years since the first survey in 1984.

▼ **Figure 8.6:** Increasing and decreasing species in ***Table 8.5*** classified by average foliage height as follows: ***1,*** <100mm; ***2,*** 101-299mm; ***3,*** 300-599mm; ***4,*** 600-999mm; ***5,*** 1.0-3.0m; ***6,*** 3.1-6.0m; ***7,*** 6.1-15m; ***8,*** >15m.



Rather than removal of the feature, which was a more important process between 1984 and 1990, the loss between 1998 and 2007 reflected a shift to less frequently or even unmanaged lines of trees and shrubs.

Fences were the next most common boundary feature, making up 35% of the total length. Walls were evenly distributed between upland and lowland zones but were much more likely to be in poor condition in the uplands.

8.6 Changes in soils (0-15cm) in all habitats

8.6.1 Introduction

Soil samples (0-15cm) were collected in Main Plots in 1978, 1998 and 2007 for chemical and physical measurements. Initial results for soil (0-15cm) pH, carbon concentration, bulk density and stock of carbon are presented here for habitat types for which sufficient samples were available *(Table 8.6)*.

▲ Soil cores • © *CEH*

▼ **Table 8.6:** Changes in the pH and carbon concentration of soils (0-15cm depth) within all vegetation types and in Broad Habitats across Wales. Arrows denote a significant change ($p<0.05$) in the direction shown. Grey cells with diagonal strikethrough indicate insufficient data for analysis.

	Mean pH		Mean carbon concentration (g/kg)		Direction of significant changes 1998 - 2007		Direction of significant changes 1978 - 1998		Direction of significant changes 1978 - 2007	
Broad Habitat	1998	2007	1998	2007	pH	Carbon Conc.	pH	Carbon Conc.	pH	Carbon Conc.
Broadleaved, Mixed and Yew Woodland	5.24	5.40	68.40	78.95			↑		↑	
Coniferous Woodland	4.22	4.14	197.81	144.01		↓				
Arable and Horticulture		6.48		20.93						
Improved Grassland	5.74	5.94	60.67	55.07			↑		↑	
Neutral Grassland	5.85	5.82	49.24	56.73			↑		↑	
Acid Grassland	4.41	4.74	179.77	186.26						
Bracken										
Dwarf Shrub Heath	4.53	4.40	243.48	240.92						
Fen, Marsh and Swamp										
Bog										
All vegetation types	5.43	5.56	99.54	98.58			↑		↑	

8.6.2 Soil (0-15cm) pH

The pH of soil (0–15 cm) averaged across all Broad Habitats increased significantly from a mean pH of 5.00 to 5.56 between 1978 and 2007 but did not change between 1998 and 2007 *(Table 8.6)*. When broken down by Broad Habitat no significant changes in soil pH were seen between 1998 and 2007 but pH did increase between 1978 and 1998 and between 1978 and 2007 in Broadleaved, Mixed & Yew Woodland, Improved Grassland and Neutral Grassland *(Table 8.6)*.

8.6.3 Soil (0-15cm) carbon concentration

The only significant change detected was a reduction in soil (0-15cm) carbon concentration in Coniferous Woodland between 1998 and 2007 *(Table 8.6)*.

8.6.4 Soil (0-15cm) bulk density and carbon stock (0-15cm)

Bulk density of soil (0-15cm) was measured for the first time in 2007. This is a critical property of the soil and needs to be taken into account when calculating total carbon stock because differing soil density yields a different mass for the same unit volume. Measurements showed that the densest soils were those in the intensively managed Improved Grassland and Arable Broad Habitats typically associated with lower organic matter content. The more organic matter rich Acid Grassland and Dwarf Shrub Heath had the least dense soils *(Table 8.7)*.

The least dense soils tend to be richer in carbon but also have a lower mass of carbon for the same volume. To some extent these differences in bulk density even out the differences in carbon stock in the top 15cm although Dwarf Shrub Heath and Acid Grassland still emerged as having the highest estimated stock *(Fig 8.7)*.

▼ **Table 8.7:** Bulk density in soils (0-15cm) in Broad Habitats in Wales in 2007. Grey cells with diagonal strikethrough indicate insufficient data for analysis.

Broad Habitat	Mean bulk density g/cubic cm
Broadleaved, Mixed and Yew Woodland	0.72
Coniferous Woodland	0.44
Arable and Horticulture	1.07
Improved Grassland	0.92
Neutral Grassland	0.86
Acid Grassland	0.48
Bracken	
Dwarf Shrub Heath	0.34
Fen, Marsh and Swamp	
Bog	
All vegetation types	0.76

▲ Grassland soil structure • © *Ian Rugg, Welsh Assembly Government*

▲ Upland soil profile • © *Ian Rugg, Welsh Assembly Government*

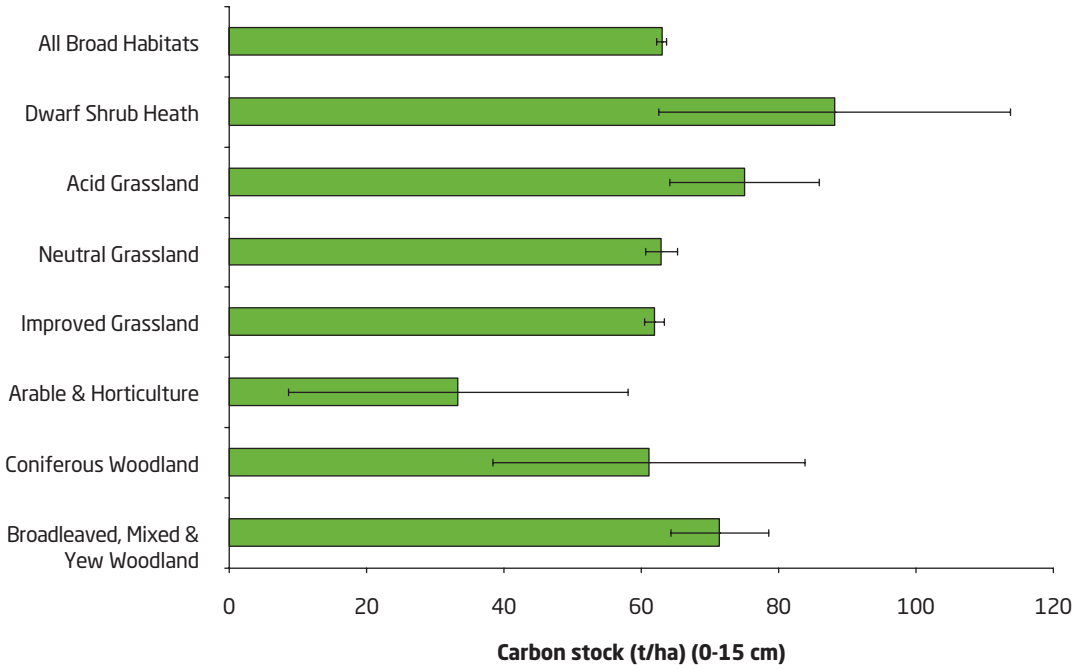
8.7 Changes in condition of headwater streams and ponds

The area of Standing Waters & Canals, and Rivers & Streams remained stable between 1998 and 2007. The number of ponds increased by 18% between 1998 and 2007, with most of the increase taking place in the lowlands. In 2007, ponds supported an average of 10.7 wetland plant species per pond yet only 5% of ponds were in good ecological condition.

On streamsides and riverbanks, plant species richness, and in particular the richness of butterfly larval food plant species, decreased between 1990 and 2007. Over time there has been a clearly identifiable successional process with vegetation becoming taller and more dominated by trees and shrubs.

In the stream channel itself, plant species richness remained stable between 1998 and 2007. Lastly, evidence from the surveyed stream lengths in each square indicated that the physical characteristics of streams improved between 1998 and 2007 whilst the nutrient status of streams, as inferred from the macrophyte species recorded, did not change.

▼ **Figure 8.7:** Carbon stock (tonnes per hectare) in the top 0-15cm of soil in Welsh Broad Habitats in 2007. Means are shown (+/-95% CI). Too few samples were collected for analysis of other Broad Habitats.



Countryside Survey

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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