



▲ Coed Cymerau • © Clive Hurford

7. Freshwaters: Standing Waters and Canals, Rivers, Streams and Ponds

Summary

Broad Habitat area

- The area of Standing Waters & Canals, and Rivers & Streams remained stable between 1998 and 2007.

Ponds

- The number of ponds increased by 18% Wales 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. Only 5% of ponds were in good condition.

Vegetation condition on watercourse banks

- Plant species richness of streambanks, in particular the richness of butterfly larval food plant species, decreased in Wales between 1990 and 2007. Over time there has been a successional process with vegetation becoming taller, particularly in lowland areas. This trend has also been seen across the whole of Britain since 1978.

- None of the significant changes between 1990, 1998 and 2007 seen on streambanks was based on large standardized effect sizes. However, the size of the change in species richness between plots recorded in the first survey in 1978 and 2007 was a large effect size with an estimated 36% reduction in mean richness from 22 species per plot to 14 species per plot.

Condition of headwater streams

- Plant species richness in streams remained stable between 1998 and 2007 though there was considerable turnover of species.
- The physical characteristics of streams improved between 1998 and 2007.

Note to readers of Chapter 7:

- The methodology for sampling these freshwater habitats differs substantially from the terrestrial habitats. See the **2007 UK Report** for further details at www.countrysidesurvey.org.uk

7.1 Introduction

This chapter presents the results for the two freshwater Broad Habitats: Standing Waters & Canals; and Rivers & Streams. Both habitats are important features of the Welsh landscape, as they collect and move water, sediment, nutrients and pollutants through the countryside and also add aesthetic character. When in good condition, these freshwater habitats can support a wide range of plants and animals, many of which are listed in the UK Biodiversity Action Plan. Particular types of freshwater habitat are also listed as Priority Habitats e.g. ponds, rivers and lakes. Freshwater habitats also provide a valuable economic and recreational resource for people.

The Standing Waters & Canals Broad Habitat includes ponds, lakes, canals, ditches and reservoirs. The Rivers & Streams Broad Habitat includes running watercourses ranging from small headwater streams to large rivers. Both these Broad Habitats include the open water itself and the vegetation along the water's edge. They can be extremely variable in character depending on the size of the water body and the nature of the local terrain.

In 2007, Countryside Survey estimated the current area of both Broad Habitats in Wales and the changes from previous surveys. For the first time, Countryside Survey also reported the estimated number and changing number of ponds across Wales.



▲ Upland lake, north Wales • © CEH

The condition of certain water body types within these Broad Habitats was assessed by recording the composition of the plants and animal communities they supported.

7.2. Area of Habitat

The area covered by the two Broad Habitats is relatively small, together representing about 1.2% of Wales. No change in the extent of either habitat was detected over the past decade, even though there are some apparently substantial changes in the estimated areas (**Table 7.1**). These area estimates have changed primarily because they have become more precise (as indicated by the 95% confidence limits around each estimate), due to the increased number of squares surveyed in successive surveys. This means that the 2007 estimates are currently the most reliable.

7.2.1 Number of Ponds

The number of ponds increased in Wales between 1998 and 2007. This change was most pronounced in the lowlands with no significant change in the uplands (**Table 7.2**).



▲ New pond, Wales • © CEH

7.3 Habitat Condition

7.3.1 Biological condition of Ponds

The 2007 data provide a baseline describing the condition of ponds across Wales, based on their plant communities. However, being based on only 29 surveyed ponds, care must be taken when interpreting the findings. There were not sufficient ponds surveyed to reliably report on plant species richness separately for the lowland and upland environmental zones.

In 2007, ponds supported an average of 10.7 (± 2.2 95%CI) wetland plant species per pond. Across the 29 ponds surveyed, 102 different species were recorded; 12 were submerged species, 5 were floating-leaved species and 85 were species associated with the pond margins.

▼ **Table 7.1:** Change in the area ('000s ha) of **a) Standing Waters & Canals**, and **b) River & Streams Broad Habitats in Wales from 1990 to 2007**. Arrows denote significant change ($p<0.05$) in the direction shown. No statistically significant change was seen between survey years.

a) Standing Waters & Canals	1990			1998			2007			Change 1998-2007
	Area	95% confidence limits	%	Area	95% confidence limits	%	Area	95% confidence limits	%	
Lowland	6	(2, 10)	0.5	6	(2, 14)	0.5	3	(1, 7)	0.3	
Upland	14	(0, 41)	1.4	15	(1, 37)	1.5	15	(1, 38)	1.5	
Wales	20	(4, 48)	0.9	21	(5, 45)	1	18	(3, 42)	0.9	

b) Rivers & Streams	1990			1998			2007			Change 1998-2007
	Area	95% confidence limits	%	Area	95% confidence limits	%	Area	95% confidence limits	%	
Lowland	12	(3, 23)	1.1	9	(3, 16)	0.8	5	(3, 8)	0.5	
Upland	4	(1, 9)	0.4	3	(1, 5)	0.3	3	(2, 5)	0.3	
Wales	16	(7, 28)	0.8	12	(6, 19)	0.6	8	(5, 12)	0.4	

▼ **Table 7.2:** Change in the number of ponds ('000s) in Wales between 1998 and 2007. Arrows denote significant change ($p<0.05$) in the direction shown.

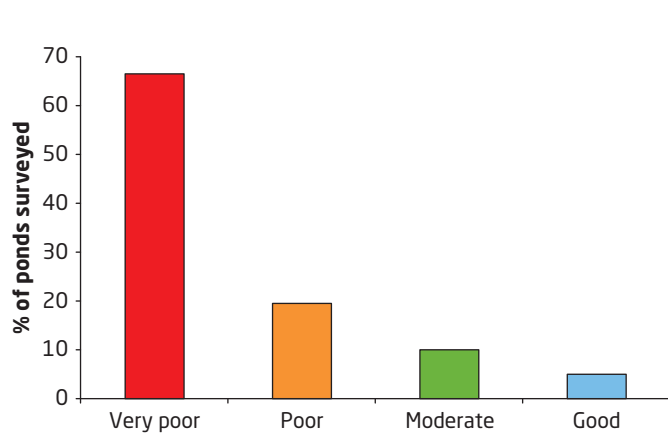
	1998 number (x 1000)	95% confidence limits	2007 number (x 1000)	95% confidence limits	Change 1998-2007
Lowland	27	(8, 56)	33	(15, 63)	↑
Upland	13	(5, 23)	14	(7, 23)	
Wales	40	(18, 70)	47	(26, 78)	↑

7.3.2 Ecological quality of Ponds

The ecological quality of the ponds was evaluated by applying the software package PSYM⁴⁰ (the Predictive SYstem for Multimetrics) to the data collected. PSYM assesses pond quality using a range of biological measures which give an indication of the level of degradation e.g. number of plant species.

Most ponds (86%) fell into one of the two lowest PSYM categories: Poor or Very Poor. Only 5% were Good quality (i.e. similar to the reference state) (**Fig 7.1**). These findings suggest that there may well be considerable and widespread stresses affecting ponds in Wales.

▼ **Figure 7.1:** The percentage of ponds falling into four PSYM quality categories in Wales in 2007.



7.4 Change in the condition of vegetation alongside Rivers and Streams

The most common species recorded in Streamside Plots are listed in **Table 7.3**.

▼ **Table 7.3:** Most frequent 15 species in 2007 in the Rivers & Streams Broad Habitat in Wales on stream and river banks (n=455).

% frequency	Mean cover (%)	Plant name
54	7	<i>Agrostis stolonifera</i>
53	6	<i>Holcus lanatus</i>
47	6	<i>Agrostis capillaris</i>
47	7	<i>Juncus effusus</i>
46	3	<i>Ranunculus repens</i>
37	4	<i>Rubus fruticosus</i> agg.
35	2	<i>Urtica dioica</i>
25	2	<i>Festuca rubra</i> agg.
25	3	<i>Hedera helix</i>
24	<1	<i>Cirsium palustre</i>
24	<1	<i>Rumex acetosa</i>
23	1	<i>Anthoxanthum odoratum</i>
23	5	<i>Fraxinus excelsior</i>
23	1	<i>Dactylis glomerata</i>
22	1	<i>Athyrium filix-femina</i>

⁴⁰ See www.pondconservation.org.uk/aboutus/ourwork/surveys/psym.htm for further details.

Species richness: All three richness measures declined significantly in the 17 year period between 1990 and 2007 but total species richness and richness of food plants for lowland farmland birds did not change in the most recent interval between 1998 and 2007. These changes in richness appeared to be more a reflection of trends in the lowlands than the uplands (**Table 7.4**). Richness of butterfly larval food plants decreased between 1998 and 2007, and 1990 and 1998, with an overall mean loss of 1 species per plot in the 17 year period. The overall change in total species richness amounted to a loss of 2 species per plot in 17 years (**Table 7.4**). While none of the standardized effect sizes were large, the total species richness change represents a 4% loss and the decline in butterfly larval food plants a 13% loss.

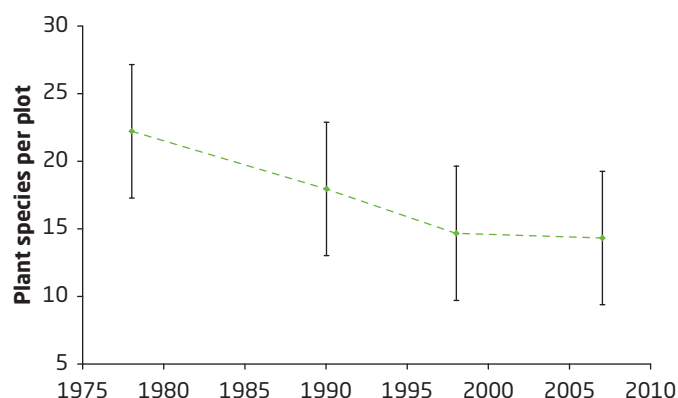
Nineteen Streamside Plots have been recorded in the same place four times: in 1978, 1990, 1998 and 2007. Despite the small sample size this is an unbiased, random sample. Over the 29 year period, species richness declined by 36% whilst the difference between 1978 and 2007 was also a large standardized effect size (**Fig 7.2**). The changes recorded between 1990 and 2007 therefore seem to be part of a more ecologically significant longer-term trend.

Other vegetation characteristics: The largest number of statistically significant changes took place on lowland streamsid es, where the Grass:Forb ratio, Ruderal, Light and Moistures Scores all decreased since 1998. Competitor Score increased between 1990 and 1998 but not between 1998 and 2007. Ruderal Score declined between the same intervals partly reflecting its negative correlation with Competitor Score (**Table 7.4**). These trends together indicate that streamside vegetation has become less managed and more overgrown, over the period 1990 to 2007. This trend is consistent with changes observed elsewhere in Britain. Evidence from the total sample of Streamside Plots indicates a Great Britain-wide successional trend toward taller, more species-poor vegetation typified by a marked increase in cover of trees and shrubs since 1978⁴¹ with the largest increase in woody cover seen in Wales. It is therefore possible that the increasing representation of stress-tolerant species in the lowland zone (**Table 7.4**) reflects increased abundance of shade-tolerant species. However, none of these changes in vegetation characteristics were based on large standardized effect sizes so even though clear trends have been detectable in Welsh streamsid es, the impact of these may have been modest compared to the spatial variability across the sample. Further research is required to confirm this whilst it seems likely that the observed changes are also correlated with aspects of the longer-term trend in species richness.



▲ Snowdonia • © Chris Evans

▼ **Figure 7.2:** Species richness change on watercourse banks (1x10m plots) between 1978 and 2007. Error bars are the 95% CI on the within-year means (n=19 repeat plots). The differences between 1978 and the years 1990, 1998 and 2007 were all significant (at least $p < 0.05$).



⁴¹ Carey et al (2008) *Countryside Survey: UK Results from 2007. Chapter 8. Rivers, Streams and Standing Waters, Figure 8.5.* www.countryside survey.org.uk/pdf/reports2007/CS-UK-2007-Ch08.pdf

▼ **Table 7.4:** Change in vegetation characteristics of vegetation in 10 x 1m Streamside Plots in the Rivers & Streams Broad Habitat 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)	20.4	19.3	18.5				↓	↓		↓	↓	
No. of Bird Food Species	7.6	7	6.8				↓	↓		↓	↓	
No. of Butterfly Food Species	7.2	6.7	6.3	↓	↓		↓			↓	↓	
Grass:Forb Ratio	0.38	0.45	0.29		↓							
Competitor Score	2.85	2.92	2.92				↑	↑	↑	↑	↑	↑
Stress Tolerator Score	2.45	2.47	2.49		↑						↑	
Ruderal Score	2.38	2.29	2.21	↓	↓		↓	↓	↓	↓	↓	↓
Light Score	6.48	6.45	6.33	↓	↓					↓	↓	
Fertility Score	4.96	4.93	4.98			↑						
Ellenberg pH Score	5.4	5.4	5.41									
Moisture Score	6.41	6.41	6.32	↓	↓	↓			↓		↓	↓

▼ **Table 7.5:** Change in the biological (as measured by the plant species richness and the Mean Trophic Rank score) and physical (as measured by the Habitat Quality Assessment score) condition of headwater streams between 1998 and 2007. Arrows denote significant change ($p<0.05$) in the direction shown.

	1998		2007		Direction of significant changes 1990 - 2007
		95% confidence limits		95% confidence limits	
Mean plant richness	2.4	(1.7, 3.1)	3.2	(2.3, 4.1)	
Pooled plant richness	51		48		
Mean Trophic Rank score	56.8	(46.1, 67.9)	63.2	(54.7, 72.3)	
Habitat Quality Assessment score	42.3	(38.8, 46.0)	49.2	(43.8, 54.6)	↑

7.5 Changes in the vegetation and physical quality of streams

The diversity and cover of aquatic (within the river) plants were recorded over a 100m length of stream channel at 33 sample squares in both 1998 and 2007. This is a relatively small number of sites to reliably report on the condition of headwater streams therefore care must be taken when interpreting the findings. Furthermore, due to insufficient replication it has not been possible to reliably report on the biological and physical condition of streams separately for either of the two environmental zones.

7.5.1 Vegetation of Headwater streams

There was no significant change in headwater stream plant richness between 1998 and 2007 (**Table 7.5**), though there was a suggestion of an increasing trend; with greater replication it may have been possible to detect a significant trend. Pooled plant species richness also did not change between 1998 and 2007 (**Table 7.5**).

There was considerable variation in recorded plant species composition between the two surveys. Only 50% of the 66 aquatic plant taxa encountered were recorded in both years. Of the 33 persistent taxa, 15 had increased in frequency across Wales since 1998, while only 5 decreased in frequency; none of which had substantial declines. It was the predominantly emergent vascular plants such as Creeping Bent grass (*Agrostis stolonifera*) and Hemlock Water Dropwort (*Oenanthe crocata*) that became more prevalent between the two Surveys. The Common Feather Moss (*Eurhynchium praelongum*), Fennel Pondweed (*Potamogeton pectinatus*) and River Water-crowfoot (*Ranunculus penicillatus* var. *penicillatus*) were among the 15 species newly-recorded at Countryside Survey stream sites in 2007. The between-survey variability inevitably reflects sampling error⁴² as well as a component of true turnover related to the dynamic nature of the habitat which could be a combination of both its inherent characteristics and the changes brought about in the quality of the water and the physical structure of streams.

There was no change in biological condition of headwater streams, as assessed by the Mean Trophic Rank score (**Table 7.5**), indicating that the degree to which such small watercourses are impacted by nutrient enrichment has neither decreased nor increased over the past decade.

⁴² See the *Freshwaters Survey QA report* online at: www.countryside-survey.org.uk/pdf/QA_FRESHWATER.pdf

7.5.2 Headwater stream Physical Habitat Diversity

A River Habitat Survey (RHS) was included in Countryside Survey for the first time in 1998; the repeat survey in 2007 provided the first comparison over time. The Habitat Quality Assessment (HQA) score, derived from the recorded RHS data, provides a measure of the diversity and 'naturalness' of the physical structure of the stream.

The significant improvements in habitat quality of headwater streams (*Table 7.5*) were driven by an increased occurrence of in-stream and bank-side gravel bars, river-side trees and a greater diversity of natural features e.g. fallen trees and debris dams.

7.6 Results in context

This chapter has considered the two Broad Habitats that include all standing and running waters. Countryside Survey focuses, in particular, on headwater streams and ponds, the latter recognised as a Priority Habitat in the UK Biodiversity Action Plan. This focus reflects the lesser coverage of these types of water body in other surveys, and no comparative estimates are available. No comparative estimates of the extent of the larger Welsh resource of standing and running waters is available.

Key results and follow-up questions:

- **An increase in the number of ponds but mostly of poor quality - how much progress does this represent towards achievement of biodiversity objectives?**
- **A decrease in plant species richness and changes in other characteristics of streamside vegetation - a wholly negative change or a consequence of work to deliver other environmental benefits through the creation of streamside corridors?**
- **An improvement in the physical characteristics of streams - how much of this was deliberate amelioration or an indirect effect of waterside succession?**
- **No change in Mean Trophic Rank score of headwater streams - to what extent does this convey either lack of improvement of poorer condition watercourses or maintenance of good condition?**

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

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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