



Vegetation communities of British rivers

a revised classification

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Executive summary

It was not until the 1980s that attempts were first made to develop a comprehensive national rivers classification for England, Wales and Scotland based on macrophytes. River surveys throughout Britain were commissioned by the Nature Conservancy Council (NCC) between 1978 and 1982, and the resulting classification system (Holmes 1983, 1989; DoE 1987) was used for various purposes, such as in selecting rivers as statutory conservation sites (NCC 1989; Boon 1995). However, it was recognised from the outset that further work was needed to examine the stability of plant communities over time, the effects on accuracy when different surveyors were used, and how community associations were affected by external environmental variables. Moreover, some parts of Britain were not well represented in the survey, and with the addition of new sites it was likely that the classification itself would need to be revised.

The premise at the outset was that if analyses of the expanded database produced similar results, the survey method and the derived classification would be

sufficiently robust for wide application by any competent surveyor and over a long time period. The new classification, developed from the enlarged database, has in fact produced results very similar to those yielded by the original classification. Minor improvements have been made, but the basic structure of the original classification remains unchanged.

The most important outputs from the revised classification include:

- ◆ a new key to Groups A–D, types I–X and the 38 sub-types Ala–DXe (Annex G);
- ◆ updated maps showing the British distribution of sites at each level of the classification (Annexes A–F);
- ◆ amended descriptions of types I–X and sub-types Ala–DXe (Chapter 5);
- ◆ tables showing the species and physical features that characterise sites at each level of the classification (Chapter 4).

Chapter 1 Introduction

Between 1978 and 1982 the Nature Conservancy Council (NCC) commissioned surveys of macrophytes in rivers throughout Britain, culminating in the establishment of a classification system based on plants (Holmes 1983, 1989; DoE 1987). This system has been widely used for classifying rivers before their selection as Sites of Special Scientific Interest (SSSIs) (NCC 1989).

Detailed information regarding the original classification is still available (DoE 1987), but *Focus on Nature Conservation No. 4* (Holmes 1983) is out of print.

Although the original classification was widely used as soon as it was available, a number of areas required clarification before it could be regarded as universally acceptable.

- ◆ The same surveyor carried out the whole of the original survey programme, covering 1,055 sites. If different surveyors each carried out part of the survey programme, would a new classification produce significantly different results?
- ◆ The original classification was based on surveys undertaken over a period of only four years. If sites were re-surveyed several years later would changes over time be detectable by movements in the original classification of sites to different types?
- ◆ a number of geographical areas and river community types were less well represented in the original survey than others. If more sites were added to the

database, would a new classification produce significantly different results?

Details of the rivers included in the original survey programme are held at the headquarters of English Nature, Scottish Natural Heritage and Countryside Council for Wales. The sites classified into the 38 sub-types are listed in alphabetical order, by sub-type, in Annex H.

The additional surveys therefore both extended the geographical distribution of sites and formed a basis for determining how accurate and robust the original classification was. The premise at the outset was that if the two classifications produced similar results, the method of survey and the derived classification would have acceptable robustness for wide application by any competent surveyor and over a wide time period. If changes in classification had occurred, it was important to determine why, and whether the system was capable of detecting changes in community type over time (either through natural change or through human activity).

This report summarises outputs from the updated classification and provides details of the distribution of each Group, type and sub-type, and information on the physical environments and species associated with them. A peer-reviewed paper summarising the new classification and outlining some of its applications has also been published (Holmes *et al.* 1998).

Chapter 2 Survey method

A new programme of river surveys was carried out between 1988 and 1991, which, together with some additional data collected by one of the authors (NTH), provided the raw material for revising the classification. Whereas the earlier survey had been undertaken by a single surveyor, the later ones were completed by at least six different people. The same method was used throughout, and this has now become a standard technique for surveying macrophytes in British rivers. Further details are given in Holmes (1983, 1989), DoE (1987) and Boon *et al.* (1996). In essence, the surveys involved recording macrophytes at sites 1 km long (formed from two contiguous 500 m reaches), situated 5–7 km apart (closer together for small rivers, further apart for larger ones). Survey was carried out by wading, walking the banks or from a boat (for deeper, wider rivers). A standard check-list was used for plant recording, containing 223 taxa (most at the species level), with the absence of a taxon as significant as its presence. Rarer aquatic plants found at the site, but not included on the check-list, were recorded but not used in the classification process.

Surveys included the entire channel and lower slopes of the banks, with separate records being made for macrophytes that occurred more or less permanently

submerged and for those typically subject to alternate inundation and exposure with the rise and fall of river levels. At each site an estimate was made of relative macrophyte abundance (1 = rare, 2 = occasional, 3 = abundant or dominant) and cover (1 = <0.1%, 2 = 0.1–5%, 3 = >5%). Field data were gathered on other features such as river flow types, substrates, width, depth and land-use, while map-derived data on geology, altitude and gradient were assembled for studying the relationship between environmental variables and plant communities.

The standard method for river macrophyte survey and classification (Boon *et al.* 1996) is reproduced in Annex G, with an expanded key. Using this information, any site can be classified into one of the 38 sub-types. Once the site is classified, the survey data can be compared with data from comparable and neighbouring sub-types to verify the classification. Annex H lists the rivers surveyed, classified by sub-type. Tables 2–14, Chapter 5, summarise the most common species and physical characteristics for each sub-type across the Group. These tables illustrate the similarities and differences between different sub-types. These data are also provided for individual sub-types in Annexes C–F).

Chapter 3 Analysis of data

Analyses of the extended data-set were exactly the same as for the original one (DoE 1987). The highest score from either the relative or absolute abundance scale was used. As in the original analysis (Holmes 1983), it is the composition of the plant communities alone which determines the river community type, without reference to physical or habitat information.

TWINSpan (Two-Way INdicator SPecies ANalysis) (Hill 1979) was used on the complete plant data-set of

1,514 sites. This groups together sites with the greatest similarity of plant communities.

In addition to classifying sites, the TWINSpan outputs have been used to show relationships between Groups, types and sub-types and the environmental variables that are thought to affect them most. Information on site geology, slope (gradient), altitude of site, altitude of river at source, substrates, habitats, widths and depths is given.

Chapter 4 Revised classification system

In the original classification 56 sub-types were recognised (Holmes 1983; DoE 1987), but for the *Guidelines for selection of biological SSSIs* (NCC 1989; rev. ed. JNCC 1998) these were reaggreated into ten types. The new system has three levels of detail: four Groups, ten types and 38 sub-types. Figure 1 summarises the relationship between the Groups, types and sub-types, giving information on the number of sites within each grouping. The sub-division into 38 sub-types is based on evaluations of the output and make it easier to

describe geographical, physical and community differences.

Figure 1 shows that the first two major divisions of the whole dataset produce Groups A, B, C and D. Two further divisions of Group A give types I, II, III and IV, which are synonymous with sub-groups A1, A2, A3 and A4 (Holmes 1983; DoE 1987). For Groups B, C and D one further division produces types V and VI (for Group B), VII and VIII (for Group C) and IX and X (for Group D).

Group	Total no. of sites in Group	Type	Total no. of sites in type	Sub-type	Total no. of sites in sub-type
A	475	I	102	Ia	18
				Ib	23
				Ic	58
		II	164	IIa	54
				IIb	71
				IIc	39
		III	90	IIIa	19
				IIIb	71
		IV	119	IVa	86
				IVb	17
				IVc	16
		B	397	V	195
Vb	69				
Vc	24				
Vd	26				
Ve	31				
VI	202			VIa	32
				VIb	29
				VIc	68
				VId	53
				VIe	20
C	323	VII	76	VIIa	13
				VIIb	23
				VIIc	18
				VIIId	22
		VIII	247	VIIIa	36
				VIIIb	73
				VIIIc	44
				VIIIId	39
				VIIIe	55
				VIIIId	39
D	319	IX	90	IXa	19
				IXb	25
				IXc	46
		X	229	Xa	75
				Xb	22
				Xc	48
				Xd	32
				Xe	52

Figure 1 Relationships of Groups, types and sub-types, showing the nearest neighbour and balance of distribution of sites at each level of the classification.

The broadest level of classification therefore comprises Groups A, B, C and D, the intermediate level types I–X, and the finest level of refinement sub-types AIa–DXe.

Table 1 provides a summary description of each level of the classification.

Table 1. Summary description of rivers at each level of the classification

<i>Type</i>	<i>Sub-type</i>	<i>Description</i>
<i>Group A: Lowland rivers with shallow gradients and rich geology</i>		
I		Lowland, low-gradient rivers
	AIa	Large lowland rivers with high base-flow
	AIb	Fast-flowing, coarse-bedded lowland rivers of low gradient
	AIc	Lowland, very low-gradient rivers with fine substrates
II		Lowland, clay-dominated rivers
	AIIfa	Small 'classic' clay rivers
	AIIfb	Clay rivers with diverse substrates and flow patterns
	AIIfc	Clay-dominated rivers with impoverished flora
III		Chalk rivers and other base-rich rivers with stable flows
	AIIfa	'Classic' chalk rivers
	AIIfb	Chalk/oolite streams and high base-flow rivers
IV		Impoverished lowland rivers
	AIIVa	Base-rich/neutral impoverished rivers, normally close to source
	AIIVb	Base-poor impoverished ditch communities
	AIIVc	Upland rivers with impoverished floras
<i>Group B: Meso-eutrophic rivers flowing predominantly over sandstone and hard limestone</i>		
V		Sandstone, mudstone and hard limestone rivers of England and Wales
	BV a	Mesotrophic, upland, hard limestone/sandstone rivers
	BV b	Small, lowland, base-rich sand rivers or winterbournes
	BV c	Small, lowland, impoverished mixed sand/clay rivers
	BV d	Western, stable rivers on sandstone and shales
	BV e	Lowland large rivers in south-west England and Wales
VI		Sandstone, mudstone and hard limestone rivers of Scotland and northern England
	BVI a	Lowland, large, mesotrophic rivers on limestone or sandstone
	BVI b	Large, lowland reaches of meso-eutrophic rivers with upland sources
	BVI c	Middle reaches of upland rivers traversing more base-rich strata
	BVI d	Small, low-gradient, meso-eutrophic rivers
	BVI e	Small, basic, upland rivers
<i>Group C: Mesotrophic and oligo-mesotrophic rivers</i>		
VII		Mesotrophic rivers dominated by gravels, pebbles and cobbles
	CVII a	Small, shallow, high altitude hard limestone and sandstone rivers
	CVII b	Mesotrophic rivers with strong calcareous influence
	CVII c	Lowland, mesotrophic rivers with acidic feeders
	CVII d	Mesotrophic upland plateau rivers
VIII		Oligo-mesotrophic rivers
	CVIII a	Steep-gradient, low-altitude sand/shale rivers
	CVIII b	Moderate-gradient sand/shale rivers below uplands
	CVIII c	Base-rich mesotrophic upland rivers
	CVIII d	Large, low-gradient lowland reaches of upland rivers
	CVIII e	Small oligo-mesotrophic reaches of upland rivers
<i>Group D: Acid and nutrient-poor rivers</i>		
IX		Oligotrophic low-altitude rivers
	DIX a	Lowland, low-gradient, oligotrophic rivers dominated by vascular plants
	DIX b	Hard rock 'lowland' rivers with vascular plants
	DIX c	Base-poor rivers with mixed communities
X		Ultra-oligotrophic rivers
	DX a	Upland rivers with atypically shallow gradients
	DX b	Low-altitude, bedrock rivers
	DX c	High-altitude, steep-gradient rivers rarely on base-poor rocks
	DX d	Oligotrophic rivers of the west coast of Scotland
	DX e	Small, shallow, oligotrophic rivers