JOINT NATURE CONSERVATION COMMITTEE

Vegetation communities of British rivers

a revised classification

Nigel Holmes,
Alconbury Environmental Consultants,
The Almonds, Ramsey Road,
Warboys, Huntingdon,
Cambridgeshire PE17 2RW

Philip Boon,
Scottish Natural Heritage
2 Anderson Place,
Edinburgh EH9 5NP

Terry Rowell
Bryn Einon, Penfford,
Llanwenog, Llanbydder,
Dyfed SA40 9XD

Joint Nature Conservation Committee
Monkstone House, City Road
Peterborough PE1 1JY

ISBN 1 86107 458 1

Contents

List of figures and tables

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 AIa–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 AIa–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 reaggregated 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	Va	45
				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
				VIId	22
		VIII	247	VIIIa	36
				VIIIb	73
				VIIIc	44
				VIIId	39
				VIIIe	55
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

Type	*Sub-type*	*Description*
Group A: Lowland rivers with shallow gradients and rich geology		
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
	AIIa	Small 'classic' clay rivers
	AIIb	Clay rivers with diverse substrates and flow patterns
	AIIc	Clay-dominated rivers with impoverished flora
III		Chalk rivers and other base-rich rivers with stable flows
	AIIIa	'Classic' chalk rivers
	AIIIb	Chalk/oolite streams and high base-flow rivers
IV		Impoverished lowland rivers
	AIVa	Base-rich/neutral impoverished rivers, normally close to source
	AIVb	Base-poor impoverished ditch communities
	AIVc	Upland rivers with impoverished floras
Group B: Meso-eutrophic rivers flowing predominantly over sandstone and hard limestone		
V		Sandstone, mudstone and hard limestone rivers of England and Wales
	BVa	Mesotrophic, upland, hard limestone/sandstone rivers
	BVb	Small, lowland, base-rich sand rivers or winterbournes
	BVc	Small, lowland, impoverished mixed sand/clay rivers
	BVd	Western, stable rivers on sandstone and shales
	BVe	Lowland large rivers in south-west England and Wales
VI		Sandstone, mudstone and hard limestone rivers of Scotland and northern England
	BVIa	Lowland, large, mesotrophic rivers on limestone or sandstone
	BVIb	Large, lowland reaches of meso-eutrophic rivers with upland sources
	BVIc	Middle reaches of upland rivers traversing more base-rich strata
	BVId	Small, low-gradient, meso-eutrophic rivers
	BVIe	Small, basic, upland rivers
Group C: Mesotrophic and oligo-mesotrophic rivers		
VII		Mesotrophic rivers dominated by gravels, pebbles and cobbles
	CVIIa	Small, shallow, high altitude hard limestone and sandstone rivers
	CVIIb	Mesotrophic rivers with strong calcareous influence
	CVIIc	Lowland, mesotrophic rivers with acidic feeders
	CVIId	Mesotrophic upland plateau rivers
VIII		Oligo-mesotrophic rivers
	CVIIIa	Steep-gradient, low-altitude sand/shale rivers
	CVIIIb	Moderate-gradient sand/shale rivers below uplands
	CVIIIc	Base-rich mesotrophic upland rivers
	CVIIId	Large, low-gradient lowland reaches of upland rivers
	CVIIIe	Small oligo-mesotrophic reaches of upland rivers
Group D: Acid and nutrient-poor rivers		
IX		Oligotrophic low-altitude rivers
	DIXa	Lowland, low-gradient, oligotrophic rivers dominated by vascular plants
	DIXb	Hard rock 'lowland' rivers with vascular plants
	DIXc	Base-poor rivers with mixed communities
X		Ultra-oligotrophic rivers
	DXa	Upland rivers with atypically shallow gradients
	DXb	Low-altitude, bedrock rivers
	DXc	High-altitude, steep-gradient rivers rarely on base-poor rocks
	DXd	Oligotrophic rivers of the west coast of Scotland
	DXe	Small, shallow, oligotrophic rivers

Chapter 5 Physical characteristics and macrophyte communities associated with each level of the classification

5.1 Rivers in Groups A–D

First, TWINSPAN divides sites into broadly similar classes – Groups A, B, C and D. Briefly, sites with floral communities dominated by species that are typical of eutrophic lowland rivers are placed in Group A. Sites with floras typical of torrent rivers and oligotrophic waters are placed in Group D. Intermediate sites are placed into Groups B and C. Some species are more or less confined to one or other extreme of the spectrum, whilst many more are found in two or more groups, forming a continuum.

The original classification indicated that factors such as geology, channel gradient and altitude were strongly associated with different community types.

The distribution of Groups A–D in the new classification is also closely related to the same physical factors. This is clearly illustrated in Table 2, which summarises the geology, altitude, slope, substrate, flow type, width and depth of rivers in the four groups. Annex A gives details of site locations, physical features and macrophytes for each of the four groups.

Table 2 shows that from Group A to Group D there is a clear transition in terms of the altitude of sites surveyed and the altitudinal sources of the rivers. Around 85% of rivers in Group A rise at altitudes below 200 m, whereas for Group D only around 15% rise at this height; Group B is intermediate, but Group C sites have higher sources, as in Group D. There is a clear gradation of mean altitude of sites: Group B rivers are 50% higher than those in Group A, Group C rivers are 40% higher than those in Group B, and Group D rivers are 30% higher than those in Group C.

Geology is clearly a major factor in differentiating between the four groups. In Group A, calcareous clay (>29% of sites), chalk (>23%), non-calcareous clay, other soft limestones, alluvium and soft sandstone substrates predominate. In Group B, hard sandstone and soft sandstone (both >20% of sites) dominate, with hard limestone (>15%), non-calcareous shale and calcareous shales also prominent. For Group C, non-calcareous shales (>30%) are the most common substrate, with hard sandstones and hard limestones also exceeding 10%; however, a very wide range of other rock types also occur. For Group D, granite, base-rich and other igneous rocks, other metamorphic rocks and schists are all prevalent, occurring elsewhere only rarely in Group C.

Rivers in Group B were described in the original classification as characteristically having substrates of hard limestone and sandstone (including mudstone, coal measures and others); the same is evident in the revised system. Clear differences are also seen between the groups in terms of altitude and gradient. Low gradient rivers are most common in Group A, whilst steep gradient rivers prevail in Group D. Group B has a higher proportion of sites with shallow gradients than Group C, which has more sites with steep gradients than Group B.

Of the most commonly occurring taxa (Table 3) only four are represented in all groups: *Salix* spp., other trees, *Agrostis stolonifera* and *Filipendula ulmaria*. Apart from these ubiquitous plants, no common species of Group A has any affinity with Group D, and only the widespread *Phalaris arundinacea*, *Myosotis scorpioides* and *Mentha aquatica* have affinity with Group C. By contrast, seven species are common to both Group A and its nearest neighbour, Group B: *Veronica beccabunga*, *Solanura dulcamara*, *Epilobium hirsutum*, *Sparganium erectum*, *Elodea canadensis*, *Cladophora glomerata* and the algae *Vaucheria* spp.

Table 3 lists 16 taxa that are strongly associated only with Group A communities. They are all vascular plants, some submerged (e.g. *Sparganium emersum*, *Callitriche stagnalis*), some floating (e.g. *Lemna minor*, *Nuphar lutea*), some emergent (e.g. *Veronica anagallis-aquatica*, *Rorippa nasturtium-aquaticum*) and many bankside species (e.g. *Glyceria maxima*, *Lythrum salicaria*, *Carex riparia*). No bryophytes occur commonly in Group A, the only commonly-occurring non-vascular plants being the algae *Vaucheria* and *Cladophora*.

Of the less common species not listed in Table 3, some are more or less confined to Group A. *Sagittaria sagittifolia* and *Schoenoplectus lacustris* occur at least 50 times more often in Group A than in Group B, and *Berula erecta*, *Dipsacus fullonum* and *Phragmites australis* occur at least ten times more commonly.

In contrast, in Group B there are only four species (the alga *Hildenbrandia rivularis*, *Oenanthe crocata* and the mosses *Amblystegium riparium* and *Brachythecium rutabulum*) that are uniquely associated with this group, compared with 16 for Group A (Table 3). Species that commonly occur in both Group A and Group B are

Table 2 Physical characteristics of sites in Groups A–D

Group	*A*	*B*	*C*	*D*
Number of taxa				
Mean	38	38	37	31
Minimum	4	6	6	1
Maximum	67	63	70	66
Geology (% occurrence (>10%) at sites)				
Calcareous clay	29			
Non-calcareous clay	13			
Chalk	22			
Other soft limestone				
Hard limestone		17	14	10
Soft sandstone	12	24		
Hard sandstone		23	17	16
Calcareous shale				
Non-calcareous shale			30	10
Hard rock				50
Height at source (m)				
Mean	138	376	467	442
Minimum	10	30	20	10
Maximum	700	761	1,210	1,210
Altitude of site (m)				
Mean	49	74	125	160
Minimum	0	5	5	0
Maximum	213	250	425	750
Slope (km per 15 m fall)				
Mean	15	8.6	4.9	2.7
Minimum	0.3	0.1	0.2	0.1
Maximum	25	25	25	25
Substrates (% occurrence at sites)				
Silt/mud	44	11	8	13
Sand	20	11	8	8
Clay	41	6	2	2
Gravel	52	27	21	19
Pebbles	17	47	42	36
Cobbles	4	52	63	60
Boulders	0.4	26	45	56
Bedrock	0.2	9	19	33
Habitats (% occurrence at sites)				
Pools	5	9	5	13
Slacks	89	84	67	46
Riffles	5	10	14	42
Runs	40	68	71	49
Rapids	0.8	8	35	49
Width (m) (% occurrence at sites)				
<5	33	24	28	50
5–10	38	30	42	41
>10–20	36	38	37	29
>20	15	32	24	17
Depth (m) (% occurrence at sites)				
<0.25	45	75	80	73
0.25–0.5	49	52	42	52
>0.5–1	29	8	9	24
>1	30	15	11	11

Veronica beccabunga, Epilobium hirsutum, Sparganium erectum, and *Vaucheria* and *Cladophora*. Six taxa are common to both Groups B and C: the mosses *Rhynchostegium riparioides* and *Amblystegium fluviatile*, the freshwater lichens *Verrucaria* spp., the liverwort *Conocephalum conicum, Equisetum arvense* and the alga *Lemanea fluviatilis*.

Other species typical of Group B but not listed in Table 3 include other algae *Lemanea* spp., *Cladophora aegagropila*, the liverwort *Chiloscyphus polyanthos* and the mosses *Brachythecium rivulare, Fontinalis squamosa* and *Thamnobryum alopecurum*, which all occur at least ten times more often in Group B than in Group A, whilst *Myriophyllum alterniflorum* occurs at least 50 times more often.

Group B communities therefore frequently consist of a mixture of vascular and non-vascular plants, typically having some of the most widespread species of Group A present alongside the more widespread species of Group C.

Group C communities have very little affinity with those in Group A, with only the most widespread species of Group A present. Conversely, Group C often contains many species associated with the mesotrophic and upland extreme of Group B and with the low gradient sites in oligotrophic Group D.

Table 3 shows that just six taxa are uniquely associated with Group C communities. They are the liverwort *Chiloscyphus polyanthos*, the mosses *Fontinalis squamosa, Hygrohypnum ochraceum, Brachythecium rivulare* and *Schistidium alpicola* and *Angelica sylvestris* (all but the last named being bryophytes). Another six occur commonly across the Group B, C and D range, with species including the moss *Fontinalis antipyretica, Juncus effusus, Juncus acutiflorus, Glyceria fluitans* and *Caltha palustris*. Species such as the liverwort *Pellia epiphylla, Ranunculus flammula, Deschampsia cespitosa* and *Sagina procumbens* are typically found in both Groups C and D but only rarely elsewhere.

No submerged species that are typical of Group A are commonly found in Group C, but edge species such as *Phalaris arundinacea, Mentha aquatica, Filipendula ulmaria* and trees do span the range. Communities therefore reflect meso-oligotrophic conditions, with a marked prevalence of bryophytes as the main river-channel species.

Fifteen taxa are uniquely associated with Group D, compared with six taxa for Group C, four for Group B and 16 for Group A. Whilst Group A is dominated by vascular plants, including many true aquatics of eutrophic waters, Group D is dominated by bryophytes and oligotrophic moorland edge species. The most commonly occurring bryophytes in Group D are the mosses *Racomitrium aciculare, Scapania undulata, Sphagnum* spp., *Polytrichum commune* and *Bryum pseudotriquetrum*, whilst the common moorland edge species include those such as the liverwort *Nardia compressa* and *Molinia caerulea*. The most common true aquatic vascular plant is the oligotrophic indicator species *Juncus bulbosus*.

Acidophilic and oligotrophic species typify Group D communities. Species such as *Polytrichum commune, Sphagnum* spp. and *Carex nigra* occur at least ten times

Table 3 Percentage frequency of occurrence of the 30 most common taxa in each Group (A–D)

	Group					Group			
Taxon	*A*	*B*	*C*	*D*	*Taxon*	*A*	*B*	*C*	*D*
Apium nodiflorum	73				*Amblystegium fluviatile*		65	54	
Scrophularia auriculata	72				*Conocephalum conicum*		64	53	
Rorippa nasturtium-aquaticum	78				*Equisetum arvense*		58	49	
Glyceria maxima	64				*Lemanea fluviatilis*		48	54	
Callitriche stagnalis	61				*Fontinalis antipyretica*		87	80	46
Sparganium emersum	59				*Juncus acutiflorus*		68	74	59
Juncus inflexus	58				*Glyceria fluitans*		57	68	49
Lemna minor	55				*Juncus effusus*		55	71	83
Lythrum salicaria	54				Filamentous green algae		52	76	71
Polygonum amphibium	51				*Caltha palustris*		51	66	47
Lycopus europaeus	51				*Chiloscyphus polyanthos*			68	
Carex riparia	50				*Fontinalis squamosa*			57	
Veronica anagallis-aquatica	47				*Hygrohypnum ochraceum*			56	
Symphytum officinale	47				*Angelica sylvestris*			50	
Nuphar lutea	47				*Brachythecium rivulare*			49	
Carex acutiformis	47				*Schistidium alpicola*			48	
Veronica beccabunga	81	63			*Pellia epiphylla*			67	83
Solanum dulcamara	84	59			*Ranunculus flammula*			58	74
Epilobium hirsutum	92	65			Ferns			54	57
Sparganium erectum	91	77			*Deschampsia cespitosa*			51	51
Cladophora glomerata agg.	69	77			*Sagina procumbens*			46	41
Vaucheria sp(p).	68	62			*Juncus bulbosus*				78
Elodea canadensis	54	47			*Racomitrium aciculare*				72
Phalaris arundinacea	97	94	73		*Anthoxanthum odoratum*				70
Myosotis scorpioides	93	78	60		*Carex nigra*				60
Mentha aquatica	83	84	68		*Potentilla erecta*				59
Hildenbrandia rivularis		56			*Sphagnum* sp(p).				59
Oenanthe crocata		53			*Scapania undulata*				58
Amblystegium riparium		52			*Viola palustris*				57
Brachythecium rutabulum		47			*Molinia caerulea*				54
Agrostis stolonifera	96	98	95	59	*Polytrichum commune*				54
Salix sp(p).	84	86	84	61	*Nardus stricta*				47
Trees	78	89	83	53	*Galium palustre*				45
Filipendula ulmaria	66	68	67	41	*Carex demissa*				43
Rhynchostegium riparioides		89	85		*Achillea ptarmica*				41
Verrucaria sp(p).		80	71		*Bryum pseudotriquetrum*				38

more often in Group D than in Group C, whilst the liverwort *Marsupella emarginata*, the mosses *Blindia acuta* and *Dicranella palustris*, *Potentilla erecta*, *Nardus stricta* and *Potamogeton polygonifolius* occur at least five times more often.

Clearly, therefore, there is a transition of community structure from the vascular plant-dominated assemblages of Group A (which indicate eutrophic conditions) to the mixed moorland edge and bryophyte-dominated instream assemblages of Group D (which indicate oligotrophy). Of the 172 taxa listed in Table 3, over half are shown to be strongly associated with just one of the four groups. However, there is a continuum of distribution of species within the groups, so allocation of a site to a group is not clear-cut.

5.2 Rivers in types I–X

Types I–X are the groupings that are used most widely for the initial classification, comparison and assessment of the conservation value of a site. Table 4 summarises the new descriptions of types I–X, which should now be used in place of those in the *Guidelines for selection of biological SSSIs* (NCC 1989; rev. ed. Joint Nature Conservation Committee 1998). They are not markedly different in essence but they do reflect the more comprehensive geographical coverage provided by the most recent classification. Table 5 summarises the physical characteristics of sites in Groups A–D and Table 6 shows the 30 most common taxa in each group. The nearest neighbour (NN) for each type within the classification is shown to enable easy comparison.

Type I Lowland, low-gradient rivers (NN type II)

Rivers of this type are characterised by the lowest mean altitude and shallowest gradient of all the ten river community types. There is also a greater prevalence of silt substrates and the highest proportion of deep, wide and slack rivers. As would be expected from these statistics, the geology is soft, predominantly clay and chalk. Such rivers are typically located in south-east England and East Anglia. The most typical rivers are the Salisbury Avon, the Colne and the lower Wissey, Lark, Nar, Wensum and Bure. Vascular plants totally dominate the communities, with *Cladophora glomerata* and *Vaucheria* sp(p). the only commonly occurring non-flowering plants. Of the commonly occurring aquatic species, *Carex riparia*, *Sparganium emersum*, *Potamogeton pectinatus* and *Sagittaria sagittifolia* are much more likely to be found in type I, whilst among the less common species *Pulicaria dysenterica*, *Berula erecta*, *Eupatorium cannabinum*, *Oenanthe fluviatilis*, *Iris pseudacorus* and *Phragmites australis* occur in at least three times as many type I as type II sites.

Type II Lowland, clay-dominated rivers (NN type I)

Clay is the dominant geology, but, unlike in type I, soft sandstone and oolites and soft limestone are common and chalk is absent. The geographical spread of sites is much greater than in type I, the lowlands of the Cheshire Plain being the most significant outlier away from central and South-east England. A wide variety exists in terms of river widths, depths and habitats, with very gentle gradients and site altitudes invariably below 40 m, and clay is more typically a substrate than in any other type. Rivers that have the majority of their sites in this type include the Nottinghamshire river Devon and the Welland, Cherwell, Tame and Evenlode. The gross make-up of the assemblage is very similar to type I, but with greater variety, so any particular taxon is less likely to appear in type II than in type I. There are significantly more occurrences of the less common broad-leaved pondweed *Potamogeton natans* and *Juncus acutiflorus*, whilst amongst the more common taxa *Salix* sp(p)., *Cladophora glomerata* and *Vaucheria* sp(p). are slightly more prevalent.

Type III Chalk rivers and other base-rich rivers with stable flows (NN type IV)

Only base-rich geology is represented in this type. Over 60% of rivers in this type are in chalk, more than double the proportion of chalk rivers found in type I. A stable flow regime resulting from a substantial base-flow is the most common feature shared by the vast majority of sites in type III. Gravel is significantly more prevalent in this type than in any other Group A type. Rivers that best exemplify the type are those flowing from the Chalk (e.g. Piddle, Frome, Test, Itchen, Mimram, Hull and headwaters of many East Anglian rivers) and those on

Table 4 Classification of river community types found in British rivers (revised from the version previously published in the Guidelines for selection of biological SSSIs (Nature Conservancy Council 1989; rev. ed. JNCC 1998))

Group	*Type*	*General description*
A	I	Lowland rivers with minimal gradients. Predominantly in south and east England, but may occur wherever substrates are soft and chemistry enriched.
A	II	Rivers flowing in catchments dominated by clay.
A	III	Rivers flowing in catchments dominated by soft limestone such as chalk and oolite.
A	IV	Rivers with impoverished floras, usually confined to lowlands and mainly in England.
B	V	Rivers of sandstone, mudstone and hard limestone catchments in England and Wales, with similar features to those of type VI.
B	VI	Rivers predominantly in Scotland and northern England in catchments dominated by sandstone, mudstone and hard limestone; substrates usually mixed coarse gravels, sands and silts mixed with cobbles and boulders.
C	VII	Mesotrophic rivers where fine sediments occur with boulders and cobbles, so a mix of bryophytes and higher plants is typical: often downstream of type VIII communities.
C	VIII	Oligo-mesotrophic, fast-flowing rivers where boulders are common and bryophytes typify the plant assemblages; intermediate, and often found between types IX and VII.
D	IX	Oligotrophic rivers of mountains and moorlands where nutrient and base levels are low; bedrock, boulders and coarse substrates dominate.
D	X	Ultra-oligotrophic rivers in mountains, or streams flowing off acid sands; substrates similar to type IX but often more bedrock.

Table 5 Physical characteristics of sites in types I–X

	Type									
	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
Number of taxa										
Mean	46	38	42	29	35	40	31	39	31	31
Minimum	29	10	12	4	9	6	6	7	3	1
Maximum	67	61	60	50	63	60	55	70	62	66
Geology (% occurrence (>10%) at sites)										
Calcareous clay	36	34	12	29						
Non-calcareous clay	22	14		12						
Chalk	31		62	10						
Other soft limestone		16	10							
Hard limestone					12	22	25	10	11	
Soft sandstone		18		18	19	28				
Hard sandstone					34	11	20	16	16	16
Calcareous shale					11					
Non-calcareous shale							17	34		13
Hard rock									45	29
Height at source (m)										
Mean	108	158	111	158	303	447	373	496	306	496
Minimum	25	25	25	10	30	61	20	100	10	100
Maximum	229	640	229	700	655	761	810	1,210	950	1,210
Altitude of site (m)										
Mean	38	47	54	58	75	72	125	125	76	193
Minimum	0	10	15	5	5	5	5	10	0	5
Maximum	200	200	168	213	244	250	725	425	725	750
Slope (km per 15 m fall)										
Mean	20	19	11	9.8	6.6	10.5	6.1	4.5	4.7	1.9
Minimum	2.3	4.2	2.0	0.3	0.1	0.9	0.5	0.2	0.1	0.1
Maximum	>25	>25	>25	>25	>25	>25	>25	>25	>25	>25
Substrates (% occurrence at sites)										
Silt/mud	54	39	48	39	11	11	26	2	39	2
Sand	14	20	23	21	7	15	20	4	23	2
Clay	49	57	18	28	9	4	5	0.4	6	0.4
Gravel	44	42	80	52	31	24	40	16	26	17
Pebbles	20	14	14	19	48	47	46	40	34	37
Cobbles	3	5	4	4	48	57	49	67	36	70
Boulders	0	0	0	2	22	31	22	52	31	65
Bedrock	0	0	0	1	8	10	12	21	17	39
Habitats (% occurrence at sites)										
Pools	3	8	4	4	10	8	8	5	27	8
Slacks	94	93	90	77	86	83	57	70	62	40
Riffles	1	5	2	12	14	7	30	9	43	41
Runs	29	32	56	49	65	71	59	74	40	53
Rapids	1	0	1	2	8	9	9	43	26	58
Width (m) (% occurrence at sites)										
<5	7	24	27	71	36	13	41	24	50	50
5–10	13	51	46	33	37	23	38	43	34	43
>10–20	56	42	39	8	37	38	26	40	31	28
>20	37	11	12	5	17	47	18	26	20	15
Depth (m) (% occurrence at sites)										
<0.25	12	35	68	67	80	69	67	84	59	79
0.25–0.5	35	49	66	47	54	50	37	44	54	50
>0.5–1	41	34	21	19	10	6	20	6	36	19
>1	55	36	17	13	8	22	21	8	23	6

Table 6 Percentage frequency of occurrence of the 30 most common taxa in types I–X

	Type									
Taxon	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
Symphytum officinale	70									
Potamogeton pectinatus	85	68								
Sagittaria sagittifolia	79	59								
Nuphar lutea	75	70								
Schoenoplectus lacustris	69	60								
Glyceria maxima	90	66	78							
Carex riparia	88		64							
Lycopus europaeus	77		62							
Iris pseudacorus	75		78							
Sparganium emersum	91	69		32						
Apium nodiflorum	91	59	89	66						
Scrophularia auriculata	70	68	82	70						
Juncus inflexus	69		74	50						
Eupatorium cannabinum	75		72	34						
Enteromorpha sp(p).		67								
Rorippa amphibia		59								
Lythrum salicaria		56	67	35						
Alisma plantago-aquatica		52		30						
Carex acutiformis			89							
Callitriche obtusangula			87							
Ranunculus penicillatus subsp. *pseudofluitans*			86							
Veronica anagallis-aquatica			82							
Berula erecta			73							
Elodea canadensis	73	62				64				
Lemna minor	72	66		31						
Callitriche stagnalis	72	57	70	51			54			
Solanum dulcamara	93	82	90	76	74					
Vaucheria sp(p).	73	74	74	50	73	51				
Cladophora glomerata agg.	74	80	61	55	72	83				
Epilobium hirsutum	91	90	100	87	64	66				
Sparganium erectum	95	92	96	82	71	83	47			
Veronica beccabunga	90	74	88	79	57	69	47			
Rorippa nasturtium-aquaticum agg.	89	71	88	71			38			
Phalaris arundinacea	100	98	98	92	89	99	80	71		
Mentha aquatica	94	74	99	72	77	91	66	69		
Myosotis scorpioides	96	92	97	90	62	93	70	57	44	
Agrostis stolonifera	98	97	91	98	98	99	93	96	64	58
Salix sp(p).	83	87	88	76	88	84	78	86	58	62
Trees	75	76	83	77	97	81	68	88	46	56
Polygonum amphibium		68		32		55				
Filipendula ulmaria		54	88	68	67	69	71	66	56	
Juncus acutiflorus					63	72	58	79	47	64
Fontinalis antipyretica			67		84	90	66	85	48	45
Juncus effusus				62	49	60	82	68	88	81
Glyceria fluitans				48	58	55	79	64	78	
Amblystegium riparium				45	65					
Filamentous green algae				44		63	58	81	58	77
Angelica sylvestris				41			61		54	
Equisetum arvense				31	47	69		54		
Rhynchostegium riparioides					92	87	57	94		
Oenanthe crocata					74					
Pellia endiviifolia					60					
Lunularia cruciata					55					
Brachythecium rutabulum					46					
Hildenbrandia rivularis					49	63				
Verrucaria sp(p).					77	82		84		
Conocephalum conicum					74	54		65		

Table 6 *(continued)*

	Type									
Taxon	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*
Amblystegium fluviatile					61	69		64		
Chiloscyphus polyanthos					53			80		
Mimulus guttatus						73				
Rorippa sylvestris						52				
Cinclidotus fontinaloides						52				
Caltha palustris						66	71	64	70	
Deschampsia cespitosa							57	49	46	53
Ranunculus flammula							53	59	84	69
Pellia epiphylla							45	74	69	89
Stachys palustris							43			
Senecio aquaticus							38			
Callitriche hamulata							38			
Equisetum fluviatile							43		63	
Galium palustre							42		61	
Myriophyllum alterniflorum							41		59	
Sagina procumbens							40			47
Ferns							37	60	54	58
Lemanea fluviatilis					45	50		69		
Hygrohypnum ochraceum								68		
Fontinalis squamosa								68		
Schistidium alpicola								59		
Brachythecium rivulare								58		
Thamnobryum alopecurum								54		
Scapania undulata								56		71
Juncus bulbosus									84	75
Carex nigra									76	54
Eleocharis palustris									58	
Juncus articulatus									57	
Carex rostrata									53	
Potamogeton polygonifolius									48	
Potamogeton natans									48	
Viola palustris									58	57
Molinia caerulea									50	56
Sphagnum sp(p).									50	63
Anthoxanthum odoratum									49	79
Racomitrium aciculare										83
Potentilla erecta										66
Polytrichum commune										65
Nardus stricta										61
Hyocomium armoricum										47
Bryum pseudotriquetrum										46
Carex demissa										46
Brachythecium plumosum										45
Marsupella emarginata										45
Achillea ptarmica										41
Jungermannia atrovirens agg.										40
% occurrence of 30th most common taxon	69	52	61	30	45	50	37	49	44	40

the Oolite of the Cotswolds (e.g. Coln and Windrush). Whilst the plant assemblages have many of the species found typically in type I and type II, *Carex acutiformis*, *Callitriche obtusangula*, *Ranunculus penicillatus* subsp. *pseudofluitans*, *Berula erecta* and the moss *Fontinalis antipyretica* are particularly characteristic. Of the less commonly occurring species, *Hippuris vulgaris* and *Carex paniculata* are especially characteristic, whilst *Groenlandia densa*, *Phragmites australis* and *Rumex hydrolapathum* are more common than in any other types.

Type IV Impoverished lowland rivers (NN type III)

A wide variety of soft geology prevails with sites generally at lower altitudes than in types within Groups B–D but slightly higher than in the three other types within Group A. The prevalence of narrow rivers is greater than for any other types. The over-riding character of the majority of the sites is the degradation of the physical environment through land drainage and flood defence activities. Others suffer from depleted flows or pollution problems. Because of these key factors, mean numbers of species per site are less than 75% of other Group A types. Sites are widely distributed in the lowland areas of Great Britain but with a higher proportion found on rivers with stream order 2 (Strahler 1959). The most typical species are all emergent or marginal species, none of the common submerged aquatics of the other Group A types occurring in more than 35% of sites.

Type V Sandstone, mudstone and hard limestone rivers of England and Wales (NN type VI)

As in type VI, the geology is predominantly sandstone and hard limestone, but the latter is much more, and the former less, important. Calcareous shales are also more likely to be found within this type too. Typical rivers include the Tamar, Torridge, Exe, Teifi, Monnow, Lugg and Dove, with few sites north of the Mersey. Substrates are dominated by pebbles and cobbles, with much less of the finer material so characteristic of types I–IV. In total contrast to these latter types, no submerged aquatics occur in more than half the type V sites, and *Sparganium erectum* is the only emergent to do so. Submerged habitats are often dominated by mosses, the most important being *Rhynchostegium riparioides*, *Fontinalis antipyretica* and *Amblystegium* sp(p). Of the common species found in both types IV and V, *Oenanthe crocata*, *Solanum dulcamara*, *Conocephalum conicum* and *Vaucheria* sp(p). are significantly more frequent in type V, whilst of the less common taxa *Apium nodiflorum*, *Eupatorium cannabinum*, *Lythrum salicaria* and *Carex remota* are more than three times more frequent.

Type VI Sandstone, mudstone and hard limestone rivers of Scotland and northern England (NN type V)

Sandstone and hard limestone geology prevails, as in type V. The altitude of sites is similar in both types but gradient is significantly steeper in type V. Despite this, the various substrates occur in broadly similar proportions, dominated by pebbles and cobbles and with much less of the finer material so characteristic of types I–IV. Geographical location appears to be very significant, with hard limestone and sandstone catchments north of the Mersey invariably having type VI communities. Typical examples are the Ribble, Wharfe, Eden, Tweed, Lunan Water and Ythan; outliers are the Usk and Teme. Of the common species encountered in both type V and type VI, *Myosotis scorpioides*, *Mentha aquatica*, *Mimulus guttatus*, *Equisetum arvense*, *Caltha palustris*, *Elodea canadensis* and filamentous algae are much more prevalent in type VI. This also applies to less commonly occurring species such as *Myriophyllum spicatum*, *Polygonum amphibium*, the moss *Schistidium alpicola*, *Ranunculus fluitans* and *Eleocharis palustris*, which all occur at least three times more frequently in type VI than in type V.

Type VII Mesotrophic rivers dominated by gravels, pebbles and cobbles (NN type VIII)

Shales, hard limestone and hard sandstone dominate the geology of both type VII and type VIII. However, type VII has double the proportion of sites on hard limestone and less than half the proportion on non-calcareous shales than does type VIII. Typical site altitudes are similar, but gradients are shallower in type VII, and there is a far greater proportion of fine substrates, ranging from silts to sands and gravels. Sites are well scattered around the country, most typically in catchments of more basic geology than type VIII or with relatively stable flows. Wetland edge species characterise the assemblage, with fewer bryophytes than in either Group B or in neighbouring type VIII (reflecting finer sediments). Of the common species in both type VII and type VIII, *Phalaris arudinacea* and *Myosotis scorpioides* are more common in type VII, whilst of the less common species the following are also far more prevalent in type VII: *Callitriche stagnalis*, *C. hamulata*, *Equisetum fluviatile*, *Myriophyllum alterniflorum*, *Juncus articulatus*, *Potamogeton natans* and *Rorippa nasturtium-aquaticum*.

Type VIII Oligo-mesotrophic rivers (NN type VII)

Shales, hard limestone and hard sandstone dominate the geology, but compared with type VII, type VIII has half the proportion of sites on hard limestone and double the proportion on non-calcareous shales. Gradients are steeper in type VIII, and it has a vastly higher proportion of coarse substrates, ranging from cobbles to boulders and bedrock, than does type VII. Typically sites are downstream of high land and base- and nutrient-poor (oligotrophic), with rivers such as the lower Findhorn, Spey, Dee and Esk in Scotland and mid-reaches of rivers flowing from the Pennines (e.g. Ure), the highlands of the Lake District (e.g. Derwent) and the highlands of Wales (e.g. Conwy, Dee, Cothi) and Exmoor (e.g. Barle) exemplifying this type. The higher proportion of rocky substrate and their less base-rich nature result in a wide variety of bryophytes being typical. Species that are far more common in type VIII than in type VII include: *Rhynchostegium riparioides*, *Chiloscyphus polyanthos*, *Pellia epiphylla*, *Hygrohypnum ochraceum*, *Amblystegium fluviatile*, *Thamnobryum alopecurum*, *Scapania undulata* and *Schistidium alpicola*. Many less common bryophytes and lichens occur more than five times more frequently in type VIII than in type

VII; these include *Dermatocarpon fluviatile, Hyocomium armoricum, Dichodontium pellucidum* and *D. flavescens.*

Type IX Oligotrophic, low-altitude rivers (NN type X)

Rivers of this type have macrophyte assemblages that indicate nutrient-poor chemistry that is usually base-poor too. They have much gentler gradients than rivers in type X and are located at much lower altitudes. These factors give rise to a much greater abundance of silts and sands as substrates and at least 50% less of cobbles, boulders and bedrock. Solid geology is broadly similar to that for rivers of type X, but the absence of sites on non-calcareous shales and the presence of hard limestone gives the type a slightly less oligotrophic nature. The contrasting gradient and substrate characteristics are reflected in the plant assemblages dominated by oligotrophic vascular plants. Because of the relative scarcity of rocks, *Fontinalis antipyretica* (typically a more lowland species) and *Sphagnum* sp(p). are the only mosses among the top 30 common species, yet the aquatic vascular plants *Juncus bulbosus, Equisetum fluviatile, Myriophyllum alterniflorum, Potamogeton polygonifolius* and *P. natans* all are much more common than in type X. No single large rivers epitomise this type, with the assemblage distributed from the English lowland acid heaths of the New Forest to the Scottish Flow Country and the Western Isles. It is on the lowlands of the Western Isles that the greatest density of the type, and most typical communities, occur.

Type X Ultra-oligotrophic rivers (NN type IX)

Macrophyte assemblages in type X rivers indicate both oligotrophic chemistry and the common presence of rocks, which enable bryophytes to thrive. Sites with type X communities are found on rivers with steeper gradients than in type IX and that are located at much higher altitudes. These factors give rise to a much greater abundance of cobbles, boulders and bedrock. Typically, sites are found on all rivers rising at high altitudes on base-poor rock and/or where blanket bog or acid heath dominates the catchment upstream. Thus, rivers with stream order 1 or 2, such as those on, for example, Dartmoor, Exmoor, the Brecon Beacons, Plynlimon, Snowdonia, the Pennines, the North York Moors, the Cairngorms or the north-west Highlands, are all likely to be dominated by type X communities. In contrast to type IX, bryophytes are a major component of the flora and are very dominant in submerged habitats; the following species are noteworthy as common: *Pellia epiphylla, Racomitrium aciculare, Scapania undulata, Hyocomium armoricum, Bryum pseudotriquetrum, Marsupella emarginata* and *Jungermannia atrovirens.* Several of these species are at least ten times more common in type X than in type IX, as are the less frequently recorded *Nardia compressa, Hygrohypnum ochraceum* and *Schistidium alpicola.* Of 18 species that occur at least three times more commonly in type X than type IX, 16 are bryophytes.

5.3 Rivers in Group A: sub-types AIa–AIVc

Types I to IV in Group A are further sub-divided into 11 sub-types. Table 7 summarises the physical characteristics of sites in sub-types AIa–AIVc and Table 8 shows the 30 most common taxa in each sub-type of Group A. The nearest neighbour (NN) for each sub-type within the classification is shown to enable easy comparison.

Type I Lowland, low-gradient rivers

AIa Large, lowland rivers with high base-flow (NN sub-types AIb/AIc)

AIa sites belong to a geographically distinct sub-type that is exemplified by the lower reaches of the Dorset Stour and Hampshire Avon, where these rivers traverse a mixed geology below predominantly groundwater-fed reaches. Geology is always either clay or chalk, and sites are invariably more than 20 m wide. Sites are typically very species-rich. Many of the most commonly occurring species listed in Table 8 for sub-type AIa are also typical of AIb and AIc, but *Myriophyllum spicatum, Nuphar lutea, Potamogeton perfoliatus, Butomus umbellatus* and *Phragmites* are more prevalent. *Azolla filiculoides* and *Juncus articulatus* are more than ten times as prevalent, whilst *Bidens cernua, Galium palustre, Rorippa palustris, R. sylvestris, Oenanthe crocata, Carex hirta* and *Juncus acutiflorus* are more than three times as commonly occurring. In contrast, *Ranunculus circinatus, Rorippa amphibia* and *Potamogeton berchtoldii* are more than ten times as common in AIb and AIc than in AIa.

AIb Fast-flowing, coarse-bedded lowland rivers of low gradient (NN sub-type AIc)

In sites of the AIb sub-type, geology is very similar to AIa sites, with clay and chalk dominant and sites geographically confined to south and west of Watford. Typical sites include faster-flowing reaches on the lower Hampshire Avon and Coln. Sites are often species-rich, but less so than AIa sites, and dominant and commonly occurring species have much in common with AIa and AIc. Of these taxa, *Vaucheria* sp(p). and *Elodea canadensis* are less common than in AIc, whilst *Ranunculus penicillatus* subsp. *pseudofluitans, Sagittaria sagittaria, Lemna minor* and *Salix* sp(p). and other trees are more prevalent. Of the less common taxa, *Myosoton aquaticum* is more than ten times as likely to be found in AIb than in AIc, *Bidens tripartitas* and *Lemna polyrhiza* are more than five times as common and *Impatiens capensis* more than three times as common.

AIc Lowland, very low-gradient rivers with fine substrates (NN sub-type AIb)

These lowland rivers differ only slightly from sites classified as sub-type AIb, differing more in their geographical distribution than in their community assemblage. Sites are typified by fen and East Anglian rivers such as the Lark, Stour, Waveney and Wissey and other rivers with very low gradient (e.g. rivers in the Somerset Levels). Alluvium and calcareous clay dominate the geology, with fine sediments more prevalent than in other sub-types. The flora is totally dominated by vascular plants, but the algae *Vaucheria* sp(p). and *Cladophora glomerata* are also important. The low gradient, which results in fine sediments and sluggish flows, is reflected by a ten-times greater occurrence in sub-type AIc than in AIb sites of species such as *Ranunculus circinatus, Ceratophyllum demersum, Potamogeton berchtoldii, P. lucens* and *Lemna gibba*, and a three times greater occurrence of *Veronica catenata, Phragmites australis* and *Zannichellia palustris*.

Type II Lowland, clay-dominated rivers

AIIa Small 'classic' clay rivers (NN sub-types AIIb/AIIc)

This sub-type is very characteristic of classic clay rivers, where both the catchment geology and the underlying substrates are clay. Gravels and pebbles mixed with clay are therefore less common than in the AIIb and AIIc sub-stypes, and sites are typically less than 10 m wide. As for all type II rivers, vascular plants totally dominate the assemblage, and of the lower plants only the algae *Enteromorpha* spp. and *Cladophora glomerata* are important. Of the species that are common in all type II rivers, *Nuphar lutea, Sagittaria sagittifolia, Glyceria maxima, Schoenoplectus lacustris* and *Sparganium emersum* are particularly characteristic of AIIa sites. Of the less common species, *Galium palustre, Scutellaria galericulata* and *Veronica catenata* are all more than three times as prevalent in AIIa than in AIIb or AIIc, whilst the opposite is true for *Zannichellia palustris, Ranunculus penicillatus* subsp. *pseudofluitans* and *Potamogeton pectinatus*.

AIIb Clay rivers with diverse substrates and flow patterns (NN sub-type AIIc)

The geology of sites of this sub-type is a mixture of soft sandstones, soft limestone and clays, with a diverse mixture of substrates also typical, with silt, sand, clay, gravel and pebbles expected in more than 25% of sites. The sub-type has, therefore, no close affinity to a single rock type or substrate category. Species that are typical of clay rivers in general predominate, with *Sparganium erectum, Sagittaria sagittifolia, Schoenoplectus lacustris* and *Ranunculus penicillatus* subsp. *pseudofluitans* more common than is typical for clay rivers in general, and trees, *Salix* sp(p). and *Nuphar lutea* particularly prevalent. As is typical for all Group A communities, vascular plants dominate, except for the algae *Cladophora glomerata, Vaucheria* sp(p). and *Enteromorpha* sp(p).; an exception is the relatively common occurrence of the moss *Amblystegium riparium*. Of the less commonly occurring species, *Eupatorium cannabinum, Lycopus europaeus, Lythrum salicaria, Symphytum officinale* and *Carex acutiformis* all occur more than three times as commonly on banks of sub-type AIIb rivers than in communities of sub-type AIIc, and the same is true for *Fontinalis antipyretica, Rhynchostegium riparioides* and *Callitriche obtusangula* in mid-stream.

Table 7 Physical characteristics of sites in sub-types of Group A: AIa–AIVc

	Sub-type										
	AIa	*AIb*	*AIc*	*AIIa*	*AIIb*	*AIIc*	*AIIIa*	*AIIIb*	*AIVa*	*AIVb*	*AIVc*
Number of taxa											
Mean	53	45	45	42	40	30	51	39	30	34	18
Minimum	44	35	29	23	18	10	41	12	7	17	4
Maximum	67	53	60	58	61	47	60	57	43	50	32
Geology (% occurrence (>10%) at sites)											
Alluvium			12			28					
Calcareous clay			60	54	30	18		16	35	18	
Non-calcareous clay	67	35		19	16				13	12	
Chalk	33	56	21				95	54	14		
Other soft limestone				15	16	13		13	15		
Hard limestone											19
Soft sandstone					23	26			12	59	
Hard sandstone											31
Calcareous shale											
Non-calcareous shale											
Hard rock											
Base-rich igneous											25
Height at source (m)											
Mean	158	100	95	139	151	195	83	118	151	102	257
Minimum	137	46	25	25	61	25	76	25	25	35	10
Maximum	200	160	229	190	640	640	107	229	640	137	700
Altitude of site (m)											
Mean	77	45	24	64	48	23	33	60	62	23	67
Minimum	2	0	15	10	10	10	15	15	5	5	5
Maximum	200	90	92	170	200	65	65	168	213	61	165
Slope (km per 15 m fall)											
Mean	19.9	17.7	21.2	19.6	17.1	20.2	11.8	10.7	9	15.4	8.3
Minimum	11.7	2.3	9.8	1.5	4.2	4.3	5.0	2.0	0.3	5.0	1.2
Maximum	23	>25	>25	>25	>25	>25	>25	>25	>25	>25	21
Substrates (% occurrence at sites)											
Silt/mud	39	44	62	35	39	41	32	52	40	24	56
Sand	0	9	21	6	28	26	11	27	22	6	31
Clay	83	30	45	87	41	44	21	17	29	47	6
Gravel	56	61	35	30	55	36	84	79	58	47	25
Pebbles	39	48	3	4	25	8	21	13	26	0	6
Cobbles	11	0	2	2	7	3	0	6	5	0	13
Boulders	0	0	0	0	0	0	0	0	0	0	13
Bedrock	0	0	0	0	0	0	0	0	0	0	6
Habitats (% occurrence at sites)											
Pools	6	0	3	7	10	5	11	3	6	0	0
Slacks	94	83	98	98	89	95	95	89	79	82	63
Riffles	0	4	0	4	6	3	0	3	9	0	44
Runs	22	44	26	24	41	26	47	58	49	59	38
Rapids	0	4	0	0	0	0	0	1	1	0	6
Width (m) (% occurrence at sites)											
<5	6	9	7	43	20	10	0	34	76	53	50
5–10	0	13	17	54	48	51	16	54	30	47	38
>10–20	6	78	62	26	52	46	84	27	7	18	0
>20	94	30	22	2	11	21	37	6	5	0	19
Depth (m) (% occurrence at sites)											
<0.25	0	4	19	33	39	36	53	72	71	59	44
0.25–0.5	17	70	28	50	51	41	63	66	50	41	44
>0.5–1	39	83	26	33	37	23	21	21	27	0	6
>1	83	26	57	33	32	44	21	16	8	24	31

Table 8 Percentage frequency of occurrence of the 30 most common taxa in sub-types of Group A: AIa–AIVc

	Sub-type										
Taxon	*AIa*	*AIb*	*AIc*	*AIIa*	*AIIb*	*AIIc*	*AIIIa*	*AIIIb*	*AIVa*	*AIVb*	*AIVc*
Stachys palustris	100										
Butomus umbellatus	89										
Schoenoplectus lacustris	83	74	62	78	62						
Sagittaria sagittifolia	83	96	71	83	61						
Myriophyllum spicatum	89		74		59	49					
Potamogeton perfoliatus	94					51					
Potamogeton pectinatus	94	87	81		85	90					
Phragmites australis	94		69				79				
Elodea canadensis	94		79	65		67	84				31
Lycopus europaeus	94	96	64		61		100				
Ranunculus penicillatus subsp. *pseudofluitans*	83	87			63		100	82			
Apium nodiflorum	94	96	88	61	65	49	100	86	79		31
Rorippa nasturtium-aquaticum	94	91	86	70	76	64	90	87	85		50
Lemna minor	83	96		70	61	67			37		
Glyceria maxima	89	91	90	82	59	51	84	76	33		25
Sparganium emersum	100	91	88	76	76	44				77	
Symphytum officinale	100	91						55		47	
Oenanthe crocata	100									88	
Sparganium erectum	100	100	91	98	99	72	100	94	83	100	56
Phalaris arundinacea	100	100	100	98	97	97	100	97	93	100	81
Mentha aquatica	100	87	95	83	80	51	100	99	77	82	38
Agrostis stolonifera	94	100	97	96	99	97	84	93	98	100	100
Salix sp(p).	94	91	76	98	94	59	84	89	79	100	31
Solanum dulcamara	94	100	90	89	89	62	95	89	86	77	
Epilobium hirsutum	89	91	91	91	100	69	100	100	94	82	63
Myosotis scorpioides	94	100	95	100	93	80	100	96	93	77	88
Nuphar lutea	94	74	69	96	72					53	
Iris pseudacorus	89	96					90	75		47	44
Veronica beccabunga	89	96	88	76	73	72		92	87	47	69
Eupatorium cannabinum	89	71	71				95	66	33	65	
Carex riparia		96	95					63			25
Scrophularia auriculata		91		82	78			86	78	71	25
Trees		87	69	83	94			90	84	88	31
Callitriche stagnalis		83	72	70		41		73	52	71	38
Cladophora glomerata		83	67	61	87	92		59	69		
Carex acutiformis		70					100	86			
Veronica anagallis-aquatica		70					84	82	35		31
Vaucheria sp(p).			90		79	82	84	72	61		
Juncus inflexus			71	63		41		75	59		38
Enteromorpha sp(p).			67	65	63	74					
Lythrum salicaria			64	65	70		95	59			
Veronica catenata				63							
Rorippa amphibia				72	59	39					
Filipendula ulmaria				76			95	86	65	94	63
Polygonum amphibium				74	62	69					44
Alisma plantago-aquatica				72						65	
Amblystegium riparium					61				58		
Potamogeton crispus						46					
Ranunculus sceleratus						46					
Elodea nuttallii						36					
Rumex hydrolapathum							95				
Zannichellia palustris							84				
Carex paniculata							79				
Impatiens capensis							90				
Fontinalis antipyretica							100	58			
Berula erecta							90	69			

Table 8 (continued)

	Sub-type										
Taxon	*AIa*	*AIb*	*AIc*	*AIIa*	*AIIb*	*AIIc*	*AIIIa*	*AIIIb*	*AIVa*	*AIVb*	*AIVc*
Callitriche platycarpa							95		40		
Juncus effusus						39			58	82	56
Callitriche obtusangula							100	83		59	
Filamentous green algae									45		56
Brachythecium rutabulum									37		
Equisetum arvense									34		
Glyceria fluitans						36			43	47	69
Angelica sylvestis									35	77	44
Lythrum salicaria										94	
Impatiens glandulifera										71	
Deschampsia cespitosa										53	
Ferns										53	
Myosoton aquaticum										47	
Lysimachia vulgaris										47	
Caltha palustris											50
Alopecurus geniculatus											31
Rorippa sylvestris											31
Potamogeton natans											25
Eleocharis palustris											25
% occurrence of the 30th most common taxon	83	70	64	61	59	36	79	55	33	47	25

AIIc Clay-dominated rivers with impoverished flora (NN sub-type AIIb)

Heavy management and relatively low numbers of species typify this sub-type, with more than 25% fewer species per site compared with other type II rivers. Only six species are present in more than 75% of the sites classified into the sub-type, compared with 17 and 15 in the other sub-types of type II rivers. Typical rivers are the enriched and heavily managed rivers of the Cheshire Plain (Dee, Weaver, Dane) and East Midland rivers such as the Welland or Devon. As the impoverished nature of the flora is the key distinguishing feature, there are no physical features or species that characterise the sub-type. In general a wide range of soft geological types are found, invariably at very low altitudes and where the slope is very gentle. The most commonly occurring and dominant species are those that are widespread along enriched banks (e.g. *Phalaris arundinacea, Agrostis stolonifera* and *Myosotis scorpioides*) or pollution-tolerant river plants (e.g. *Potamogeton pectinatus, Vaucheria* sp(p)., *Cladophora glomerata* and *Enteromorpha* sp(p).).

Type III Chalk rivers and other base-rich rivers with stable flows

AIIIa Classic chalk rivers (NN sub-type AIIIb)

Chalk is the only typical geology within the catchments of rivers classified into this sub-type. Typically rivers are 10–20 m wide (and never less than 5 m) and have more clay, gravel and pebble substrates and less silt and sand than rivers in sub-type AIIIb. The Itchen and the Test typify AIIIa. *Impatiens capensis, Lysimachia vulgaris, Lemna trisulca* and *Potamogeton lucens* are more than ten times as likely to be found in sub-type AIIIa than in AIIIb, whilst *Hippurus vulgaris, Oenanthe fluviatilis, Rumex hydrolapathum, Groenlandia densa* and several other species are more than three times as likely. Of the species common in both sub-types, *Ranunculus penicillatus* subsp. *pseudofluitans, Callitriche obtusangula, Fontinalis antipyretica, Berula erecta, Carex acutiformis* and *Zannichellia palustris* are all much more typical of AIIIa than AIIIb. Sites are typically very species-rich.

AIIIb Chalk/oolite streams and high base-flow rivers (NNI sub-type AIIa)

In common with AIIIa, chalk is the dominant geology but calcareous clay and other soft limestone (e.g. oolite) are also important. The varied geology and the greater range of river sizes within the sub-type result in a higher proportion of finer sediments being present. Sub-type AIIIa is likely wherever Chalk or Oolite has a strong influence on river flows; thus examples stretch from the Hull in Yorkshire through the Midlands and East Anglian rivers Nar, Wissey and Wensum to the more southerly rivers of Oolite (e.g. Windrush and Coln) and Chalk (e.g. Piddle, Frome, Kennet, Mimram). The core 'chalk stream' species are well represented, but they are rarely all present at the same site, as is typical in sub-type AIIIa sites. Species that are not typical of classic chalk streams are more prevalent in AIIIb, the most characteristic being *Ranunculus sceleratus, Potamogeton pectinatus, Equisetum arvense, Juncus effusus* (more than five times as many occurrences) and *Brachythecium rutabulum* and *Glyceria fluitans* (more than three times as many occurrences). Typically, AIIIb sites support only 75–80% of the number of species found in AIIIa sites.

Type IV Impoverished lowland rivers

AIVa Base-rich/neutral, impoverished rivers, normally close to source (NN sub-type AIVb)

AIVa rivers occur in a very wide geographical range, but primarily in England. A very common feature shared by the vast majority of them is a high degree of physical manipulation or degradation because of high levels of regular management or depletion of flows. Most are narrow and shallow rivers or ditches, with a low number of species expected. For instance, the most species-rich site out of 86 had fewer species than the average number expected in more than 100 sites in AIa-AIc. The 'ditch' nature of the communities is highlighted by the total dominance of the assemblage by emergent or annual wetland species, with the commonest true aquatic macrophytes not expected to be present in more than 30% of sites. *Apium nodiflorum, Cladophora glomerata* (especially), *Rorippa nasturtium-aquaticum, Juncus inflexus, Petasites hybridus, Carex riparia* and *Zannichellia palustris* are much more typical than in AIVb, whilst *Salix* sp(p). and *Juncus effusus* are much less common. This is unremarkable as the geology is generally more calcareous than in AIVb.

This is a large sub-type with many rivers represented in it. Sites are typically on heavily managed reaches of rivers where basic rock is present within the catchment. Typical examples are the Bristol Avon and Churn, on Oolite, the Darent on the North Downs, the Lark, Brett and Bure of East Anglia, the Eau and Glen of the Lincolnshire Wolds and the Gypsey Race of the Wolds in East Yorkshire.

AIVb Base-poor, impoverished ditch communities (NN sub-type AIVa)

The most significant physical difference between AIVb and AIVa is the prevalence in the former of soft sandstone geology (59% compared with 12%). Where sites are at lower altitudes and have slacker gradients, clay and gravel dominate the substrates more than in any other of the 'ditch' sub-types. The less basic nature of the geology is reflected in the assemblages, with *Impatiens glandulifera, Oenanthe crocata, Pellia epiphylla, Nuphar lutea* and several other species more than five times more likely to be found than in AIVa and *Amblystegium riparium, Rorippa nasturtium-aquaticum, Juncus inflexus, Carex riparia* and *Zannichellia palustris* usually at least five times less likely to be recorded. Sites have slightly more species than is typical for AIVa, with rivers flowing off the Hastings Beds (e.g. Beult, Teise, West Sussex and East Sussex Rother) and the New Forest (e.g. Beaulieu and Lymington) especially typical.

AIVc Upland rivers with impoverished floras (NN sub-types AIVa/AIVb)

The main features that distinguish this sub-type of Group A from the other ten is the greater altitude at source and much greater likelihood of riffle habitats. Sites are usually heavily modified by river engineering works, often leading to a high proportion of sites having silty substrates. Despite this, cobbles, boulders and bedrock are more commonly present in type AIVc than in either AIVa or AIVb, whilst pebbles and gravels are less frequently present.

The more upland sources account for the much rarer occurrence (or the absence) of species found in all other lowland sub-types (AIa–AIVb) within Group A. Good examples of such species include *Sparganium erectum, Mentha aquatica, Epilobium hirsutum, Solanum dulcamara* and *Salix* spp. The community has only three truly aquatic plants typically present: *Callitriche stagnalis, Elodea canadensis* and *Potamogeton natans*, which are all tolerant of siltation. Overall the community is dominated by plant species more commonly found in Group B; this suggests that without the physical degradation that afflicts most sites, they would be classified within Group B.

Sites are most typically found in northern England (Wansbeck, Bowmont Water) and southern Scotland (Annan, Blackadder Water), where rivers which rise in uplands flow through intensively farmed landscapes in their lower reaches.

5.4 Rivers in Group B: sub-types BVa–BVIc

Types V and VI in Group B are further sub-divided into ten sub-types. Table 9 summarises the physical characteristics of sites in sub-types BVa–BVIc and Table 10 shows the 30 most common taxa in each sub-type of Group B. The nearest neighbour (NN) for each sub-type within the classification is shown to enable easy comparison.

Type V Sandstone, mudstone and hard limestone rivers of England and Wales

BVa Mesotrophic upland hard limestone/ sandstone rivers (NN sub-types BVb/BVc)

In common with its nearest neighbours, sites of this sub-type are commonly found on hard limestone and soft sandstone. However, the more frequent occurrence of hard limestone and calcareous shales and much less frequent occurrence of clay and soft limestone distinguish BVa sites from those of BVb and BVc. Steep slope and higher altitudes are typical; altitude at source is double that of its nearest neighbour and slope is steeper than in any other sub-type of Group B. Fine sediments are rare, and bedrock, boulders and cobbles are more prevalent than is typical for the group as a whole. Generally, sites are shallow and moderately wide.

The harder rock, steeper gradients and higher altitudes result in bryophytes being much more common in this sub-type than is typical for B sub-type communities. Also, no truly aquatic vascular plant is a common component of the community. The base-rich nature of the rock is reflected in the common occurrence of bryophytes such as *Cinclidotus fontinaloides* and *Pellia endiviifolia*. Of the 12 most common taxa, eight are bryophytes; the other four are edge grasses *Agrostis stolonifera* and *Phalaris arudinacea*, together with *Salix* sp(p). and other trees. Of the less common species, the alga *Lemanea fluviatilis* and the mosses *Brachythecium rivulare* and *Dichodontium pellucidum* occur much more commonly in sub-type BVa than in BVb or BVc, whilst species such as *Lythrum salicaria, Iris pseudacorus, Glyceria plicata, Stachys palustris, Callitriche stagnalis* and *Alopecurus geniculatus* occur much less commonly.

Sites in the BVa sub-type are rarely found outside the hard limestone areas of south and north Wales, the Derbyshire Dales, the lower Pennines, the Lake District or the North York Moors; sites are also common in the upper reaches of rivers on the sandstones of Herefordshire and Worcestershire. Typical rivers from the areas cited include the Monnow, Usk, Tawe, Neath (lower), Clywedog, Elwy, Dove, Lathkill, Wharfe, Ure, Ehen, Hodder, Esk, Rye, Arrow and Lugg.

BVb Small, lowland, base-rich sand rivers or winterbournes (NN sub-type BVc)

Sites within this sub-type are very close to the mid-range character for type V rivers for attributes such as altitude and slope, with the geology typically limestone, sandstone or calcareous clay and with sites on shale and hard rock generally absent (as with sub-types BVa-BVc). Silt and sand substrates are more common than in other type V rivers; the only other difference from its nearest neighbour is the tendency for rivers to rise at slightly higher altitudes.

Of the common species, BVb communities typically contain many more algae and bryophytes than do BVc communities; examples include *Cladophora glomerata, Vaucheria sessilis, Hildenbrandia rivularis, Amblystegium riparium, A. fluviatile* and *Pellia endiviifolia*. As for BVc, but in contrast with BVa, more vascular plants are common, with *Juncus acutiflorus, Apium nodiflorum, Rorippa nasturtium-aquaticum* and *Ranunculus penicillatus* subsp. *pseudofluitans* noteworthy. The species that occur much more commonly in BVb than BVc indicate a much more calcareous and stable substrate: *Hildenbrandia rivularis* and *Ranunculus penicillatus* subsp. *pseudofluitans* occur more than ten times as commonly; *Verrucaria* sp(p)., *Symphytum officinale, Veronica anagallis-aquatica, Elodea canadensis, Glyceria plicata* and *Zannichellia palustris* are all more than five times as commonly found and many other vascular plants are more than three times as commonly found in BVb than BVc.

Sites in BVb are widely scattered in England and Wales, the sub-type most typically representing outlier sites in lowland England that are not classified into Group A. In contrast to BVc, most sites are rarely located on rivers where clay is important within the catchment. However, many sites are winterbournes (e.g. Frome, Lambourne, Moors) or the extreme upper reaches of chalk/oolite/limestone rivers (e.g. Avon, Babingly, Coln, Culm, Darent, Kit, Otter, Yarty), whilst other sites are scattered on relatively base-rich mixed geologies (often sandstones) at low altitudes (e.g. Arrow, Axe, Clwyd, Lugg, Monnow, West Sussex Rother and Trothy).

BVc Small, lowland, impoverished mixed sand/clay rivers (NN sub-type BVb)

Sites within this sub-type characteristically flow mainly over hard limestone and sandstone (typically for all BVa-BVc rivers) but are usually located on rivers that rise at much lower altitudes than is typical of sites in Group B sub-types. Sites are also typically much narrower than sites on other type V rivers.

Relatively uncommon species (e.g. *Sagina procumbens* and *Carex pendula*) and the much more commonly occurring species (e.g. the liverworts *Marchantia polymorpha, Lunularia cruciata* and *Pellia epiphylla*, the vascular plants *Deschampsia cespitosa, Scrophularia auriculata* and *Callitriche stagnalis*, ferns and filamentous green algae) are far more commonly found in this sub-type than in BVb, many reflecting the strong influence of clay within the sites. Typically these species are found on steep clay banks.

Species more associated with rock or calcareous conditions (e.g. *Hildenbrandia rivularis, Amblystegium riparium, A. fluviatile, Pellia endiviifolia, Rorippa nasturtium-aquaticum* and *Ranunculus penicillatus* subsp. *pseudofluitans*) are all rare in BVc compared with BVb.

Table 9 Physical characteristics of sites in sub-types of Group B: BVa–BVIe.

	Sub-type									
	BVa	*BVb*	*BVc*	*BVd*	*BVe*	*BVIa*	*BVIb*	*BVIc*	*BVId*	*BVIe*
Number of taxa										
Mean	33	36	30	38	39	41	42	42	42	25
Minimum	21	20	9	17	25	22	28	24	24	6
Maximum	43	54	50	52	63	60	56	55	58	36
Geology (% occurrence (>10%) at sites)										
Alluvium										
Calcareous clay		10								
Non-calcareous clay			13							
Chalk										
Other soft limestone										
Hard limestone	27	10	17			13	24	32		40
Soft sandstone	18	32	25			44	41	16	38	
Hard sandstone	18	17	21	65	81	13	14	12		30
Calcareous shale	18			19	16	19		10		
Non-calcareous shale				15			17	25		
Hard rock (base-rich)									36	25
Height at source (m)										
Mean	441	248	175	306	322	463	533	481	352	433
Minimum	183	30	35	107	198	335	76	61	61	160
Maximum	665	579	480	640	640	761	761	761	680	680
Altitude of site (m)										
Mean	107	67	60	87	51	51	57	78	76	98
Minimum	15	5	15	15	15	15	12	15	10	5
Maximum	224	244	185	183	168	215	130	229	250	270
Slope (km per 15 m fall)										
Mean	4.7	6.4	6.6	7.6	8.8	15.5	11.3	9.5	10.2	5.3
Minimum	0.1	1.5	2.0	3.1	1.5	3.0	4.0	1.5	1.0	0.9
Maximum	11	20	>25	15	15	>25	>25	>25	>25	20
Substrates (% occurrence at sites)										
Silt/mud	4	19	8	12	3	16	7	6	8	35
Sand	2	13	8	4	3	16	3	7	26	25
Clay	2	9	33	8	0	9	0	2	6	5
Gravel	13	41	63	35	7	38	10	12	40	20
Pebbles	36	58	42	73	29	47	28	53	55	30
Cobbles	76	32	25	42	65	28	69	74	47	55
Boulders	40	7	13	8	48	22	59	35	15	30
Bedrock	22	0	4	0	16	13	17	12	4	10
Habitats (% occurrence at sites)										
Pools	13	7	17	4	13	25	14	3	0	15
Slacks	84	81	88	92	94	97	90	90	79	35
Riffles	0	22	29	8	10	0	0	0	0	70
Runs	82	55	58	85	52	41	76	81	76	70
Rapids	11	4	0	4	19	9	7	12	6	10
Width (m) (% occurrence at sites)										
<5	18	52	75	31	0	3	7	3	26	35
5–10	49	42	29	46	7	6	7	21	36	45
10–20	49	29	4	50	55	59	28	46	28	15
>20	16	10	4	4	58	53	72	49	30	35
Depth (m) (% occurrence at sites)										
<0.25	93	80	75	92	55	50	55	81	81	50
0.25–0.5	56	54	58	46	58	38	66	59	40	45
0.5–1.0	2	7	25	8	16	6	10	3	2	20
>1.0	9	3	4	0	26	47	17	19	13	20

Table 10 Percentage frequency of occurrence of the 30 most common taxa in sub-types of Group B: BVa–BVIe

	Sub-type									
Taxon	*BVa*	*BVb*	*BVc*	*BVd*	*BVe*	*BVIa*	*BVIb*	*BVIc*	*BVId*	*BVIe*
Lemanea fluviatilis	73									
Thamnobryum alopecurum	51									
Marchantia polymorpha	56		54							
Amblystegium riparium	67	71	42	73						
Oenanthe crocata	58	73	54	96	100					
Chiloscyphus polyanthos	53			85	90					
Lunularia cruciata	58		54	58	65					
Pellia endiviifolia	80	57		58			62			
Vaucheria sp(p).	80	77		85	71	81	66	66		
Hildenbrandia rivularis	69	57			74		97	84		
Cinclidotus fontinaloides	51				74		86	74		
Petasites hybridus	78					72		63		
Conocephalum conicum	82	70	58	69	87	59	66	71		
Verrucaria sp(p).	96	75		89	90	69	100	99	91	
Amblystegium fluviatile	87	54			71	72	72	91	62	
Cladophora glomerata agg.	84	84			81	97	97	96	76	
Juncus acutiflorus	51	70		85	81	59	62	82	89	
Equisetum arvense	58			58		66	83	66	89	
Deschampsia cespitosa	56		54							40
Veronica beccabunga	62	84	58			78	79		76	80
Myosotis scorpioides	62	86	54			91	100	88	98	85
Filipendula ulmaria	53	62	75	85	77			79	94	80
Mentha aquatica	78	86	67	62	77	88	83	99	98	65
Epilobium hirsutum	76	91	75			94	86	72		60
Agrostis stolonifera	100	97	96	96	100	100	100	99	100	90
Rhynchostegium riparioides	100	87	71	100	100	91	100	94	85	45
Trees	96	96	96	100	100	91	83	82	79	65
Fontinalis antipyretica	91	78	63	92	94	88	97	97	93	55
Phalaris arundinacea	87	91	63	100	100	100	100	97	98	100
Salix sp(p).	84	83	88	96	97	97	66	94	81	60
Solanum dulcamara		84	88	81	71	56				
Sparganium erectum		81	75	100	65	91	86	74	100	55
Ranunculus penicillatus subsp. *pseudofluitans*		51								
Apium nodiflorum		74	42							
Ferns			58							
Pellia epiphylla			67	54						
Sparganium emersum				81						
Callitriche hamulata				77						
Lythrum salicaria				58	71					
Eupatorium cannabinum				50	74					
Scrophularia auriculata			50			59				
Fontinalis squamosa					77					
Impatiens glandulifera					58	75		66		
Brachythecium rutabulum		51	50					60		
Juncus effusus		65	54	50				59	89	80
Glyceria fluitans		62	42	89	61				70	65
Rorippa nasturtium-aquaticum		58	42						70	35
Angelica sylvestris		52	63						53	
Callitriche stagnalis			67						76	35
Filamentous green algae			58		61			81	85	55
Lemanea fluviatilis				73	77		66	74		
Myriophyllum alterniflorum				81	74				68	
Ranunculus penicillatus subsp. *penicillatus*				65						40
Caltha palustris					58		76	74	85	60
Symphytum officinale						63				

Table 10 *(continued)*

	Sub-type									
Taxon	*BVa*	*BVb*	*BVc*	*BVd*	*BVe*	*BVIa*	*BVIb*	*BVIc*	*BVId*	*BVIe*
Polygonum amphibium						72			55	60
Rorippa palustris						56				
Ranunculus fluitans						94	97			
Myriophyllum spicatum						78	69			
Potamogeton perfoliatus							59			
Rorippa sylvestris						75	83	60		35
Elodea canadensis						75	86	63	59	30
Rorippa amphibia						72			55	60
Mimulus guttatus						56	72	74	87	65
Eleocharis palustris								59		
Alopecurus geniculatus									64	
Potamogeton crispus									53	
Stachys palustris									53	
Cardamine amara										65
Iris pseudacorus										45
Sagina procumbens										45
Juncus articulatus										40
Tussilago farfara										40
Equisetum palustre										35
% occurrence of 30th most common taxon	51	51	42	50	58	56	59	59	53	30

Sites in BVc are widely scattered in England and Wales and, as with sub-type BVb, are most typically very isolated outlier sites in lowland England that are not classified into Group A. In contrast to BVb, most sites are located on rivers where clay is important within the catchment. Typical rivers include the Weald rivers on sand and clay, such as the Teise and East Sussex Rother, and the Fraw and Cefni on Anglesey. Whilst sites typically indicate more acidic catchment conditions than in BVb (e.g. New Forest Beaulieu and Uddens), very impoverished sites on calcareous clays (e.g. Burry Pill, Gypsey Race and Eau) are common.

BVd Western, stable rivers on sandstone and shales (NN sub-type BVe)

Sub-types BVd and BVe are very characteristically found on hard sandstone and shale geology (typically calcareous shale), and are absent from hard limestone and soft sandstone. Typically, sites in sub-type BVd have finer substrates than sites in BVe, being dominated by gravel and pebbles, with minimal bedrock and boulders present. Sites also tend to be narrower (usually less than 10 m wide) and are shallow, being virtually always under 0.5 m deep.

The finer sediment means that BVd communities have a high proportion of truly aquatic vascular plants. Some of the more common species include *Sparganium emersum, Callitriche hamulata, Myriophyllum alterniflorum* and *Ranunculus penicillatus* subsp. *penicillatus*. The communities also often contain a wide variety of bank species common in Group A rivers (e.g. *Eupatorium cannabinum* and *Lythrum salicaria*), and aquatics of contrasting habitat needs (e.g. *Sparganium erectum, Rhynchostegium riparioides, Amblystegium riparium* and *Chiloscyphus polyanthos*) are all invariably present alongside each other. Relatively uncommon species within the sub-type, such as *Scrophularia auriculata, Alisma lanceolatum, Galium palustre, Alopecurus geniculatus* and *Stellaria alsine*, are far more commonly found in BVd than in BVe.

Communities of sub-type BVd are confined to western Britain, typically south-west England and south-west Wales. The Torridge and Tamar, together with their more lowland tributaries, typify the sub-type in the former region and the Teifi and Western Cleddau are typical in the latter region. All examples are on rivers where some features typical of Group A are evident (e.g. lower altitudinal sources or presence of large upland plateaux giving downstream stabilisation). However, because of the coarser substrates and the sites' extreme western distribution, the communities present do not have enough species typical of lowlands and enriched conditions to be classified into Group A.

BVe Lowland, large rivers in south-west England and Wales (NN sub-type BVd)

Differences between sub-types BVe and BVd are highlighted by the much coarser substrates of the former, which is dominated much more by cobbles, bedrock and boulders. Sites also tend to be wider (usually at least 10 m wide) and deeper. Sites tend to be at lower altitudes (usually under 50 m) than is typical for most Group B communities, and the mean gradient is the slackest of any type V sub-type.

Despite the lower altitude and slacker gradients, the coarse sediment characteristics are the primary determinants of the communities. In contrast to BVd, there is a relatively low proportion of truly aquatic vascular plants present. Whilst *Myriophyllum alterniflorum, Rhynchostegium riparioides* and *Chiloscyphus polyanthos* are more-or-less as prevalent as in BVd, *Sparganium emersum, Callitriche hamulata, Ranunculus*

penicillatus subsp. *penicillatus* and *Amblystegium riparium* occur much more rarely. In contrast, species present on rock, such as *Hildenbrandia rivularis, Fontinalis squamosa, Cinclidotus fontinaloides, Schistidium alpicola* and *Cladophora aegagropila* occur much more commonly. Reflecting the lowland location of sites in the sub-type, bank communities commonly support species often found abundantly in Group A; typical species include *Impatiens glandulifera, Eupatorium cannabinum, Lythrum salicaria, Phalaris arudinacea* and *Agrostis stolonifera.*

Communities of sub-type BVe, like those in BVd, are more or less confined to western Britain, again most typically south-west England and south-west Wales. The lower (and much larger) reaches of the same rivers in which BVd communities exist upstream are most typical. The lower Torridge, Tamar and Teifi exemplify the sub-type, but sites on the Exe, Elwy and Welsh Dee indicate that more calcareous low-gradient rivers with moorland in their upper catchments are also represented.

Type VI Sandstone, mudstone and hard limestone rivers of Scotland and Northern England

BVIa Lowland, large mesotrophic rivers on limestone or sandstone (NN sub-types BVIb/ BVIc)

The majority of sites in this sub-type are found on soft sandstone, with a strong calcareous influence arising from their presence on limestone and calcareous shales. Sites commonly occur at low altitudes on rivers that rise at high altitudes (but not as high as in sub-types BVIb or BVc). Gradient is the most shallow for any Group B sub-type. Rivers are generally wide and it is extremely rare to find a site narrower than 10 m wide; sites are generally much deeper than is normal for Group B rivers.

The shallow gradient and low altitude (also common in sub-type BVIb) are reflected in the much higher proportions of species typical of lowland Group A rivers found in these two sub-types than in type B rivers generally. Examples include *Myriophyllum spicatum, Elodea canadensis* and *Vaucheria* sp(p)., with *Ranunculus fluitans, Symphytum officinale, Rorripa sylvestris* and *Rorippa amphibia* characteristic. The community typically contains a variety of truly aquatic vascular plants associated with fine sediments alongside a wide range of lower plants associated with gravels and shingle banks.

Typical rivers in this sub-type with communities well represented include the lower reaches of the Derbyshire Dove, Teme, Tweed, Wharfe and Usk. All rise at high altitude on moorland but then traverse basic hard rocks before becoming relatively big rivers with slack gradients in their lowlands.

BVIb Large, lowland reaches of meso-eutrophic rivers with upland sources (NN sub-type BVIc)

In common with BVIa, many sites are found on soft sandstone, but others are found on non-calcareous shales as well as hard sandstone and limestone. Sites commonly occur at low altitudes on rivers that rise at high altitudes (the highest mean for all Group B sub-types. Gradient is atypically shallow for a Group B sub-type, but not as extremely shallow as in BVIa.

Rivers are generally wide, normally exceeding 20 m, but no deeper than normal for the wide rivers in sub-types BVIa-BVIc. Reflecting the shallow gradient and low altitude, much higher proportions of species typical of lowland Group A rivers are present in sub-type BVIb than in BVIc. Examples include *Potamogeton perfoliatus* (occurring more than ten times as frequently), *Enteromorpha* sp(p)., *Myriophyllum spicatum, Ranunculus penicillatus* subsp. *penicillatus, Potamogeton pectinatus* (more than five times as common) and *Ranunculus fluitans, Lemna minor* and *Zannichellia palustris* (more than three times as common). The community typically contains a variety of truly aquatic vascular plants associated with fine sediments alongside a wide range of lower plants associated with rock substrates. Common examples of the latter include *Hildenbrandia rivularis, Verrucaria* sp(p)., *Cinclidotus fontinaloides, Rhynchostegium riparioides* and *Fontinalis antipyretica.*

Relatively few rivers are classified into this sub-type, the Eden and Ribble in north-west England typifying it. Both rivers, together with outliers such as the Usk and Wharfe, are characterised by having an upland source in moorland before descending into lowlands and traversing more base-rich geological strata.

BVIc Middle reaches of upland rivers traversing richer strata (NN sub-type BVId)

Sites may be located on hard limestone, soft sandstones, hard sandstone and shales. Rivers rise at high altitudes (as in sub-type BVIb), and sites are typically at higher altitudes and with a steeper gradient than is typical in the nearest-neighbour sites. In common with all sub-groups BVIa-BVIc, mixed substrates are typical, but shallower depths predominate in BVIc. The typically smaller size, higher site altitudes and steeper gradients lead to fewer aquatic vascular plants being present, unless they are species associated with more oligo-mesotrophic conditions of Group C rivers; a typical example is *Myriophyllum alterniflorum*, which occurs more than ten times as commonly in BVIc than in BVIb. Edge species such as *Equisetum palustre, Mimulus guttatus, Rorippa palustris, Tussilago farfara* and *Juncus effusus* also occur more than three times as commonly, and *Eleocharis palustris* is also more common. Many of the common algae and bryophytes of BVIb (which are much less frequent in BVIa) are also common in BVIc. Typical examples include *Hildenbrandia rivularis, Lemanea fluviatilis* and *Cinclidotus fontinaloides.*

Many more rivers are represented in this sub-type than in BVIb. Extensive middle reaches of the large rivers where BVIb is typical in the lower reaches (e.g. Eden, Ribble, Wharfe, Usk) all typically support BVIc communities. BVIc communities also occur on many smaller tributaries of these rivers (e.g. Petterill, Eamont, Hodder) and middle reaches of many larger rivers in the Pennines and Lake District (e.g. Lune, Ure, Wharfe) and where more rich geological strata are traversed by rivers below moorland (e.g. Garnock, Ithon, Tweed, Tyne).

BVId Small, low-gradient meso-eutrophic rivers (NN sub-type BVIe)

In common with its nearest neighbour BVIe, these are the only sub-types within Group B where the geology is typically base-rich hard rock. In contrast to BVIe, most of the other sites in BVId are on hard sandstone. A wide range of substrates and flow types are also represented in both sub-types, with sites being much narrower than is typical for BVIa-BVIc rivers. Gradient is slack, almost half that of BVIe, with the sources of rivers in BVId being typically at lower altitudes than in other type VI sub-types. A large number of taxa occur far more frequently in BVId than in BVIe, such as the algae *Cladophora* spp., *Vaucheria* sp(p). and *Hildenbrandia rivularis*, the lichens *Collema dichotomum*, *Dermatocarpon fluviatile* and *Verrucaria* spp. (all more than ten times as frequent), the bryophytes *Amblystegium riparium*, *A. fluviatile* and *Cinclidotus fontinaloides* (all more than ten times as frequent) and the aquatic vascular plants *Potamogeton crispus*, *Myriophyllum alterniflorum* and *Glyceria maxima*.

More than 90% of sites are in Scotland, the most typical examples being on the most productive farmland associated with the lower land and richer soils of the east coast. The Bervie Water, Dean Water, Don, Eden, Lunan Water, Ugie and Ythan typify the sub-type.

BVIe Small, basic, upland rivers (NN sub-type BVIe)

As in Group C, hard rock dominates sites in this sub-type of Group B, with hard limestone, hard sandstone and hard base-poor rocks typical. Sites are generally at higher altitudes than in other sub-types of type VI, with a mixture of wide and shallow rivers represented. In common with sub-type BVa only, gradient is atypically steep for Group B rivers, but silt and sand are more prevalent as substrates than in any other Group B sub-type. Many of the common species of other sub-types in Group B rarely occur in BVIe; the most typical are species which indicate eutrophic conditions, such as *Vaucheria*, *Cladophora* and *Amblystegium fluviatile*. The calcareous nature of the substrate is reflected in the more than ten times greater frequency of species such as *Ranunculus penicillatus*. subsp. *pseudofluitans*, *Apium nodiflorum*, *Carex riparia* and *Juncus inflexus*.

The sub-type has relatively few sites, typically found in the Borders (Annan, Blackadder Water, Coquet, Kale Water) and in the Lake District (Kent). Other outliers include the Yorkshire Dove and Clun. The vast majority of these rivers have basic rock geology at relatively high altitude.

5.5 Rivers in Group C, sub-types CVIIa–CVIIIe

Types VII and VIII in Group C are further sub-divided into ten sub-types. Table 11 summarises the physical characteristics of sites in sub-types CVIIa and CVIIIe. Table 12 shows the 30 most common taxa in each sub-type of Group C. The nearest neighbour (NN) for each sub-type within the classification is shown to enable easy comparison.

Type VII Mesotrophic rivers dominated by gravels, pebbles and cobbles

CVIIa Small, shallow, high-altitude hard limestone and sandstone rivers (NN sub-type CVIIb)

In common with nearest neighbour CVIIb, sites are invariably on hard limestone and hard sandstone with no other rock type represented by more than 10% of sites. Both CVIIa and CVIIb typically have sources at much higher altitudes than CVIIc or CVIId, with CVIIa typically occurring at much higher altitudes than other type VII river communities. Slope is also much steeper, being approximately twice that of CVIIb and four times that of CVIId. Because most CVIIa sites are in the headwaters, none is more than 20 m wide and they are typically very shallow (the narrowest and shallowest examples within Group C). However, finer sediments are more prevalent than in other Group C sub-types.

Over 25 species occur more than five times as commonly in sub-type CVIIa than in CVIIb. Many reflect the greater influence of base-rich rock in CVIIa (e.g. *Cinclidotus fontinaloides* and *Amblystegium fluviatile*), while others reflect the presence of fine sediments (e.g. *Carex vesicaria, Myriophyllum spicatum, Veronica anagallis-aquatica* and *Sparganium emersum*). Because of the stable influence of groundwater and the higher base status, several species of Groups A and B are more common in this sub-type of C than in any other. Typical examples (other than some of those mentioned above) include *Alopecurus geniculatus, Rorippa nasturtium-aquaticum* and *Veronica beccabunga*. Bryophytes are less well represented than is typical for Group C sub-types.

There are few examples in this sub-type, and sites are widely scattered in upland headwater reaches of rivers where a distinct calcareous influence to a predominantly moorland character is typical. Examples include Briggle Beck, Cowside Beck, Gordale Beck and Malham Tarn outflow in northern England and the Ythan, Wick and Loch Croispol streams in Scotland.

CVIIb Mesotrophic rivers with strong calcareous influence (NN sub-type CVIIc)

The geology of sites within CVIIb is dominated, as in CVIIa, by hard limestone and hard sandstone, but physical features are different. Site altitudes are much lower and gradients are much slacker, with a great variety of widths, depths and general habitat features. Riffles, runs and rapids over cobbles, boulders and bedrock are prevalent. Bedrock and boulders are more common than in any other CVII sub-type and fine sediments are scarce.

Marchantia polymorpha and *Montia sibirica* are more than ten times as common in CVIIb than in CVIIa, with *Ranunculus penicillatus* subsp. *penicillatus, Conocephalum conicum* and *Phalaris arundinacea* more than three times as common. The community includes some elements indicative of base-rich conditions (but less so than in CVIIa), together with more bryophytes and other vascular plants at the margins than in CVIIa. Other typical taxa include *Cardamine amara* and *Eleocharis palustris*, with trees also much more common on the banks. Sites often have unstable channels and macrophytes are primarily confined to the margins or banks or on bedrock; consequently sites are typically unproductive and very species-poor.

Sites of this sub-type are rarely found outside northern England and southern Scotland, where more-basic rocks are exposed by rivers flowing from extensive heathy uplands. Typical examples are the Annan, Whiteadder Water, Coquet, Kent and Nevern.

CVIIc Lowland, mesotrophic rivers with acidic feeders (NN sub-type CVIId)

Sites of this sub-type occur on a variety of rock types, including hard limestone, hard sandstone, soft sandstones, non-calcareous shales and base-rich hard rock. Compared with other Group C sub-types, sites of this sub-type are very typically at extremely low altitudes (i.e. under 50 m, approximately 3–5 times lower than other sub-types of CVII). Substrates vary, but silt is more common than in any other Group C sub-type. Sites in CVIIc are typically deeper than is typical for Group C and wider than is typical for type VII, reflecting the fact that they are the most lowland reaches of oligo- mesotrophic rivers.

Far more species typical of Group B occur than is typical for sub-types in Group C, reflecting the low site altitude and typically greater width and the fact that few of the rivers rise in mountains. Vascular plants, many of them truly aquatic, are more common in this sub-type than is typical for Group C sites, although bryophytes are much less common. Examples of atypically common species include *Hydrocotyle vulgaris, Impatiens glandulifera, Lythrum salicaria, Alisma plantago-aquatica, Juncus articulatus* and *Phragmites australis* (all more than ten times more frequent than in CVIId), plus *Lycopus europaeus, Apium nodiflorum, Callitriche obtusangula, Potamogeton natans, Sparganium emersum* and *Littorella uniflora*.

There are few examples of this sub-type and sites are spread throughout Great Britain, from the acid New Forest (e.g. Dockens Water and Oberwater) to Wales (e.g. Llyfni and Dysynni) and Scotland (e.g. Bladnoch and Cree).

CVIId Mesotrophic, upland plateau rivers (NN sub-type CVIIc)

Rock types in CVIId differ from other type VII sub-types in that they are dominated by shales and base-rich hard

Table 11 Physical characteristics of sites in sub-types of Group C: CVIIa–CVIIIe

	Sub-type								
	CVIIa	*CVIIb*	*CVIIc*	*CVIId*	*CVIIIa*	*CVIIIb*	*CVIIIc*	*CVIIId*	*CVIIIe*
Number of taxa									
Mean	36	22	30	37	27	40	36	49	42
Minimum	20	7	6	24	7	19	15	36	24
Maximum	55	43	47	50	42	56	55	70	67
Geology (% occurrence (>10%) at sites)									
Alluvium									
Calcareous clay									
Non-calcareous clay									
Chalk									
Other soft limestone									
Hard limestone	31	48	22				25		16
Soft sandstone			22					13	
Hard sandstone	31	35	17		44	18	14		
Calcareous shale				23			18		
Non-calcareous shale			11	46	17	58	21	28	29
Hard rock (base-rich)			22	27				26	
Hard rock (base-poor)								21	16
Height at source (m)									
Mean	435	417	263	379	302	464	503	598	589
Minimum	20	240	35	152	130	100	240	140	250
Maximum	696	700	810	640	853	1,210	853	1,210	1,210
Altitude of site (m)									
Mean	207	126	45	142	103	98	115	95	206
Minimum	20	18	5	10	30	15	15	15	10
Maximum	275	265	152	229	244	274	305	213	425
Slope (km per 15 m fall)									
Mean	2.5	4.3	5.7	10.6	3.2	5.7	3.6	7.3	2.4
Minimum	0.5	0.6	1.1	0.7	0.2	1.0	0.3	1.0	0.2
Maximum	8.1	21	15	>25	8.7	22	9	>25	16
Substrates (% occurrence at sites)									
Silt/mud	31	17	44	18	3	1	7	0	0
Sand	15	9	11	41	11	3	5	3	2
Clay	0	0	11	9	3	0	0	0	0
Gravel	23	22	50	59	25	22	9	21	4
Pebbles	62	35	33	59	53	45	36	44	26
Cobbles	62	61	39	36	36	67	68	74	82
Boulders	15	48	22	0	33	40	57	49	78
Bedrock	0	35	6	0	28	12	36	10	24
Habitats (% occurrence at sites)									
Pools	23	4	11	0	8	4	7	3	2
Slacks	54	17	78	82	72	78	71	82	49
Riffles	31	65	22	0	28	1	11	0	9
Runs	46	61	50	73	47	74	73	85	86
Rapids	0	26	6	0	33	37	48	39	58
Width (m) (% occurrence at sites)									
<5	62	17	56	41	50	19	11	8	36
5–10	31	61	17	36	58	43	46	28	42
10–20	15	26	33	27	19	51	55	31	35
>20	0	17	28	23	3	26	23	56	20
Depth (m) (% occurrence at sites)									
<0.25	100	48	61	73	86	74	91	80	93
0.25–0.5	23	52	33	32	53	44	46	56	29
0.5–1.0	0	26	39	9	17	3	5	8	4
>1.0	0	17	33	27	3	15	2	13	2

Table 12 Percentage frequency of occurrence of the 30 most common taxa in sub-types of Group C: CVIIa–CVIIIe

	Sub-type								
Taxon	*CVIIa*	*CVIIb*	*CVIIc*	*CVIId*	*CVIIIa*	*CVIIIb*	*CVIIIc*	*CVIIId*	*CVIIIe*
Alopecurus geniculatus	77								
Carex rostrata	46								
Carex flacca	46								
Rorippa nasturtium-aquaticum	77	30							
Veronica beccabunga	92	61							
Equisetum palustre	62	39							
Mimulus guttatus agg.	54	30							
Juncus articulatus	46	65							
Anthoxanthum odoratum	46	52							
Cardamine amara		48							
Eleocharis palustris		44							
Ranunculus penicillatus subsp. *penicillatus*		35							
Brachythecium rutabulum		30							
Stachys palustris		30	61						
Callitriche stagnalis		35	72	64					
Equisetum fluviatile	54		44	73					
Sparganium erectum	46		50	86					
Alisma plantago-aquatica			61						
Stellaria alsine			56						
Lythrum salicaria			50						
Apium nodiflorum			50						
Potamogeton natans			39						
Senecio aquaticus			61	59					
Galium palustre			56	73					
Oenanthe crocata			78		72	71			
Ferns			61	55	78	56	57	87	
Callitriche hamulata			56	86		63		82	
Angelica sylvestris	54	48	56	82	42				
Myosotis scorpioides	77	74	50	77		59	57		
Deschampsia cespitosa	62	48	72		39		57	72	
Glyceria fluitans	92	57	72	100	58	75		80	
Filipendula ulmaria	77	78	50	77	47	73	64	80	
Ranunculus flammula	69		61	73		69		97	75
Mentha aquatica	69	44	67	86		86	61	90	67
Salix sp(p).	54	78	78	91	83	95	80	90	78
Calliergon cuspidatum	69								69
Tussilago farfara	54	52					64		71
Sagina procumbens	54	52					71		71
Caltha palustris	100	70	56	68		64	59	95	67
Agrostis stolonifera	92	91	94	96	94	99	100	95	91
Fontinalis antipyretica	62	61	50	86	61	86	84	95	91
Rhynchostegium riparioides	92	44		86	89	95	98	90	98
Filamentous green algae	85	52		68	61	78	75	90	96
Juncus effusus	77	74	83	91	42	74		85	80
Carex nigra	54							72	67
Juncus acutiflorus	46		67	100	36	90	71	100	84
Phalaris arundinacea		91	83	96	67	97	64	92	
Trees		78	72	73	97	90	86	92	76
Pellia epiphylla		30	50	68	89	71	59	85	71
Myriophyllum alterniflorum				86		64		92	
Chiloscyphus polyanthos				68	86	88	80	85	
Verrucaria sp(p).				64	67	96	75	92	82
Achillea ptarmica				73				92	67
Carex remota					56				
Vaucheria sp(p).					44				
Lunularia cruciata					42				

Table 12 (*continued*)

	Sub-type								
Taxon	*CVIIa*	*CVIIb*	*CVIIc*	*CVIId*	*CVIIIa*	*CVIIIb*	*CVIIIc*	*CVIIId*	*CVIIIe*
Conocephalum conicum					75	69	89		
Thamnobryum alopecurum					69	59	66		
Dermatocarpon fluviatile						60			
Dichodontium pellucidum							66		
Cinclidotus fontinaloides							66		
Hildenbrandia rivularis							55		
Fontinalis squamosa					56	88		85	
Racomitrium aciculare					36			74	
Equisetum arvense				55			59		75
Hygrohypnum ochraceum				55	47	74		95	82
Lemanea fluviatilis					58	74	61		78
Brachythecium rivulare					47		89		84
Scapania undulata					47	51		90	66
Amblystegium fluviatile					36	75	84		67
Schistidium alpicola							57	82	82
Brachythecium plumosum							57		69
Bryum pseudotriquetrum								85	75
Jungermannia atrovirens								74	67
Philonotis fontana									71
Hygrohypnum luridum									69
% occurrence of 30th most common taxon	46	30	39	55	36	51	57	74	67

rocks and are absent on hard limestone or sandstones. Whilst the proportion of gravel, pebbles and cobbles is typical for Group C rivers, CVIId is unique in having sites that are totally devoid of boulders and bedrock, commonly having sand as substrate. Gradient is also exceptionally shallow for Group C river types.

Because of the shallow gradient and absence of rocks, vascular plants are typically much more important than in any other Group C sub-type. Examples include: *Myriophyllum alterniflorum, Callitriche hamulata, Equisetum fluviatile* and *Sparganium erectum*. Other species that are far more prevalent in CVIId than in CVIIc are *Verrucaria* spp. and *Hygrohypnum ochraceum* (more than ten times as prevalent), *Rhynchostegium riparioides, Carex aquatilis* and *C. rostrata* (more than five times as prevalent) and liverworts *Chiloscyphus polyanthos* and *Scapania undulata*.

Sites are typically associated with mesotrophic rivers that traverse upland plateaux. The classic examples are the Spey in Scotland, as it crosses Loch Insh Marshes, and the Teifi in Wales, where it crosses Tregaron Bog. Short stretches of low-gradient mesotrophic rivers may be classified as CVIId sub-type where the altitudinal source is low (Clettwr, Grannell) or where the influence of large lakes in the upper reaches exerts a stabilising influence on the flow (Dee below Bala Lake).

Type VIII Oligo-mesotrophic rivers

CVIIIa Steep-gradient, low-altitude, sand/shale rivers (NN sub-type CVIIIb)

In common with CVIIIb, hard sandstone and non-calcareous shale are the only rock types on which sites commonly occur; in contrast to CVIIIb, hard sandstone is by far the most prevalent geology. Whilst altitudinal sources are typically low, gradient is relatively steep. A diverse range of substrates are represented, with channels usually narrower and shallower than is normal for type VIII sites.

Vegetation in CVIIIa sites is often very impoverished compared with sites in other type VIII sub-types. The community is representative for the type, but the small size and steep gradient result in species such as *Achillea ptarmica, Mimulus guttatus, Ranunculus penicillatus* subsp. *penicillatus* and *Senecio aquaticus* being present comparatively rarely; they are more than ten times as likely to occur in sub-type CVIIIb. Similarly 15 other taxa (all but two being vascular plants) have a more than threefold greater frequency of occurrence in CVIIIb than in CVIIIa; typical examples are *Mentha aquatica, Myosotis scorpioides, Ranunculus flammula, Stachys palustris, Myriophyllum alterniflorum* and *Iris pseudacorus*.

Sites are scattered throughout England and Wales but are rarely encountered in Scotland. The most typical sites are in south-west England where river reaches below moorlands (Bodmin, Exmoor or Dartmoor) become enriched; examples include the Fowey, Lyd, Okement and Torridge. The communities on the acid sand rivers of Sussex as they drop steeply from their sources (e.g. Rother) are also classified as CVIIIa.

CVIIIb Moderate-gradient shale/sandstone rivers below uplands (NN sub-type CVIIIa)

In common with CVIIIa, hard sandstone and non-calcareous shale are the only rock types where sites commonly occur; in contrast to CVIIIa, non-calcareous shale is by far the most important. Sites are located at relatively low altitudes where gradient is moderate for the type. A mix of gravel, pebble, cobble and boulder bed is typical, with bedrock or fine sediments very rare.

Many species typical of type VIII occur frequently within the sub-type, but bryophytes and lichens are especially prevalent. These include *Verrucaria* spp. and *Dermatocarpon fluviatile*, with *Rhynchostegium riparioides, Fontinalis antipyretica, F. squamosa, Hygrohypnum ochraceum* and *Chiloscyphus polyanthus* especially typical. Both *Callitriche hamulata* and *Myriophyllum alterniflorum* are common, in contrast to their rare presence in CVIIIa. With a good mix of vascular and non-vascular plants commonly present, communities of CVIIIb are far more diverse than is typical for CVIIIa.

Mesotrophic rivers in the foothills of uplands in England and Wales commonly support sub-type CVIIIb communities; sites are especially typical of western England and Wales and are more rarely encountered in Scotland. Typical examples include the Barle, Exe and Fowey in south-west England, Banwy, Cledlyn, Conwy, Cothi, Dee and Dwyfach in Wales, the Derwent and Greta in the Lake District and the Spey and Ugie Water in north-east Scotland.

CVIIIc Base-rich, meso-oligotrophic, upland rivers (NN sub-types CVIIIa/CVIIIb)

In contrast to the nearest neighbours, sites are not confined to non-calcareous shales and hard sandstones but are equally likely to be found on calcareous shales and hard limestone. This makes the geology atypically calcareous for a type VIII sub-type and more like that of a type VII sub-type. Sites in sub-type CVIIIc tend to be at moderate altitude with moderate slope but often occur on rivers that rise at much higher altitudes than is typical for nearest neighbour sites of sub-types CVIIIa and CVIIIb. They are also typically wider and faster-flowing than sites in these sub-types.

The base-rich nature of the rock is highlighted by the paucity of records of acidic upland mosses such as *Fontinalis squamosa, Hygrohypnum ochraceum, Scapania undulata* and *Racomitrium aciculare* and vascular plants such as *Myriophyllum alterniflorum* and *Juncus effusus*. There is also a much greater abundance of basic indicators (typical of Group B), such as *Fontinalis antipyretica, Schistidium alpicola, Cinclidotus fontinaloides, Amblystegium fluviatile* and *Hildenbrandia rivularis*.

Sites are most typically found where the underlying rock in the uplands of northern England and southern Scotland is basic, with examples in similar situations in Wales also. The Neath, Ogwen, Aber and Clwyd are typical examples in Wales. In northern England the Seven and Hodge Beck are representatives from the North York Moors and the Wharfe and Ure are examples from the Pennines. The Esk is the most typical example from south-west Scotland.

CVIIId Large, low-gradient, lowland reaches of upland rivers (NN sub-type CVIIIe)

Hard rock is the dominant geology in this sub-type, although a small percentage of sites are found on soft sandstone. In common with CVIIIe, CVIIId sites tend to be found in the lower reaches of rivers that rise at atypically very high altitudes. Sites in CVIIId have very shallow gradients compared with other sub-types of type VIII and are often much wider too. Rapids, runs and slacks typify sites, with riffles and pools virtually absent.

Rivers represented in this sub-type are often unconstrained in their lower reaches, giving rise to the formation of gravel shoals and backwaters, where specialist vascular plants such as *Galium boreale* and *Littorella uniflora* occur more than ten times as frequently as in CVIIIe, and *Iris pseudacorus, Potamogeton polygonifolius, Sparganium erectum* and freshwater sponge are also more than five times as common. The more than threefold greater occurrence of species such as *Phalaris arundinacea, Equisetum fluviatile, Oenanthe crocata* and *Eleocharis palustris* indicate that many species associated with Group B rivers occur in this sub-type alongside the more oligotrophic indicators of Groups C and D. Typical common examples of the latter include *Myriophyllum alterniflorum, Callitriche hamulata, Fontinalis squamosa, Bryum pseudotriquetrum* and *Hygrohypnum ochraceum*. A wide range of habitats combined with some relatively stable substrates gives rise to very species-rich assemblages.

Classic examples of this sub-type occur in Scotland, with some outliers in Wales and the Lake District. The lower piedmont reaches of the Spey, Dee and Teith are typical examples in Scotland, and the meso-oligotrophic Brathay and Cocker in the Lake District are also good examples.

CVIIIe Small, oligo-mesotrophic reaches of highland rivers (NN sub-type CVIIId)

Whilst the altitude of river sources of CVIIId and CVIIIe sub-type sites are similar, the typical gradient is three times steeper in CVIIIe than it is in CVIIId, and sites typically occur at much higher altitudes. Sites are also much narrower. Underlying rock is typically hard, and sites are occasionally on hard limestone. Bedrock and boulders dominate the substrate, with gravel very rarely encountered.

The steep gradients and coarse substrates mean that aquatic vascular plants are much rarer than in CVIIIe, with mosses such as *Hygrohypnum luridum* and *Philonotis fontana* more than five times as prevalent as in CVIIId. In contrast, the vascular plants that are typical of CVIIId are rarely present, but rich bryophyte communities are characteristic, with more than ten species occurring in more than 60% of the sites classified into the sub-type.

Many rivers have their upper reaches classified into this sub-type if there is some base-rich influence on the underlying oligotrophic moorland character. Good examples are the Don, Findhorn and Tweed in Scotland.

5.6 Rivers in Group D sub-types DIXa–DXe

Types IX and X in Group D are further sub-divided into eight sub-types. Table 13 summarises the physical characteristics of sites in sub-types DIXa–DXe and Table 14 shows the 30 most common taxa in each sub-type of Group D. The nearest neighbour (NN) for each sub-type within the classification is shown to enable easy comparison.

Type IX Oligotrophic, low-altitude rivers

DIXa Lowland, low-gradient, oligotrophic rivers dominated by higher plants (NN sub-type DIXb/DIXc)

Sites assigned to this sub-type have macrophyte communities that indicate oligotrophic water, but vascular plants totally dominate the communities. The reasons for this dominance are the low altitudes of the rivers at their source and the shallow gradient of sites. This gives rise to low energy regimes, enabling sand and silt to be more common substrates in type DIXa than in any other sub-type of Group D. Typically, sites are smaller and shallower than in other sub-types of Group D, and fast flows associated with runs and rapids are rare compared with other sub-types.

The fine substrates and low energy are reflected clearly in the vegetation, with only two mosses being listed amongst the 30 most commonly recorded taxa. Instead, vascular plants, especially emergent species, totally dominate the community. The greater occurrence of species such as *Hippurus vulgaris, Rorippa nasturtium-aquaticum, Apium nodiflorum* and *Callitriche stagnalis* suggests that sites are rarely base-poor. This is confirmed by the usual absence of such indicators as *Eleogiton fluitans, Callitriche hamulata, Myriophyllum alterniflorum* and *Potamogeton polygonifolius*.

Sites are widely distributed, with examples on the Scottish islands (Benbecula), Scottish mainland (Latheronwheel and Whiteadder Water), England (Coquet) and Wales (Glaslyn).

DIXb Hard rock, 'lowland' rivers with vascular plants dominant (NN sub-type DIXc)

Typically, sites are on hard rock, more sites being significantly associated with base-poor rock than in any other sub-type. Rivers that support this sub-type generally rise at lower altitudes than rivers with other type D communities and the sites themselves are at lower altitudes. Slope, as in other type IX rivers, is more gentle than in type X rivers. Also, in common with other type IX rivers, silt and sand more commonly occur than in type X, with equal amounts of cobbles, boulders and bedrock. Slacker flow characterises sub-type DIXa, with pools and slacks much more common than runs and rapids.

Lower altitudes and slacker gradients over hard rocks lead to more frequent occurrence of many vascular plant aquatics indicative of clean, base-poor water than in other Group D sub-types. Typical species include *Myriophyllum alterniflorum, Menyanthes trifoliata, Juncus bulbosus, Littorella uniflora, Potamogeton polygonifolius, Potamogeton natans* and *Eleogiton fluitans*. Sites tend to have very few species and many are characteristic of moorland; this is exemplified by the common occurrence of *Molinia caerulea*.

The majority of sites within this sub-type are in Scotland, with rivers such as the Brora, Dunbeath Water, Langwell Water and Machrie Water typical.

DIXc Base-poor rivers with mixed communities (NN sub-type DIXb)

Physical characteristics have great similarity with partner sub-group DIXb; river sources and site altitudes are lower than other Group D sub-types and gradients are even slacker than in DIXb. Rock types are very variable, with no single type represented in more than 25% of sites; hard rocks, including hard limestone and hard sandstone, predominate. Fine sediments are far more common than in type X, with clay present in some sites and with the lowest occurrence of boulders and bedrock than in any other Group D sub-type. Slacks and pools are more frequent than runs or rapids, and sub-type DIXc is more likely to be found on wide and deep rivers than DIXb.

Plant communities are typically much richer than in DIXb, characteristically containing a mixture of bryophytes and vascular plants. Many of the species of DIXb are well represented in DIXc, but mosses and liverworts, such as *Pellia epiphylla* and *Fontinalis antipyretica*, are more common in sub-type DIXc than in DIXb and the river margins frequently support species such as *Senecio aquaticus, Myosotis scorpioides, Mentha aquatica, Agrostis stolonifera, Equisetum fluviatile, Eleocharis palustris* and *Filipendula ulmaria*, which are not common moorland plants. Banks are also much more commonly colonised by *Salix* sp(p). and other trees.

Type X Ultra-oligotrophic rivers

DXa Highland rivers with atypically shallow gradients (NN sub-type DXb)

Sites are predominantly associated with hard rock, especially those that are base-rich, but a large proportion occur on a wide variety of other hard rock types. Altitude at source and site height are typical for type X rivers but gradient is generally very much more gentle than is typical. Substrates are similar to those in other type X rivers, but bedrock is less than a third as common as in the nearest neighbour. The preponderance of slacks and pools is greater than in other type X rivers, with runs predominant.

Bryophytes are often dominant, with many species being more common in this sub-type (or DXe) than in any other; examples include *Dichodontium pellucidum, Calliergon cuspidatum, Brachythecium plumosum, Scapania undulata, Bryum pseudotriquetrum, Hygrohypnum ochraceum, Jungermania atrovirens* and *Hyocomium armoricum*. In contrast, more vascular plant species (e.g. *Caltha palustris, Ranunculus flammula, Salix* spp.,

Table 13 Physical characteristics of sites in sub-types of Group D: DIXa–DXe

	Sub-type							
	DIXa	*DIXb*	*DIXc*	*DXa*	*DXb*	*DXc*	*DXd*	*DXe*
Number of taxa								
Mean	26	24	37	44	32	19	19	28
Minimum	3	7	23	23	16	1	8	13
Maximum	44	44	62	66	47	33	33	43
Geology (% occurrence (>10%) at sites)								
Alluvium								
Calcareous clay								
Non-calcareous clay								
Chalk								
Other soft limestone								
Hard limestone	21		11			17	10	
Soft sandstone								12
Hard sandstone	26		15		41	40	10	
Calcareous shale								
Non-calcareous shale								33
Hard rock (base-rich)	11	12	24	32	27	23	33	14
Hard rock (base-poor)	37	68	22	11		11	47	12
Height at source (m)								
Mean	191	294	361	465	449	594	481	481
Minimum	10	50	30	109	100	100	130	107
Maximum	750	540	950	1,210	780	890	890	1,210
Altitude of site (m)								
Mean	98	51	79	189	110	231	129	234
Minimum	0	5	5	10	15	10	5	10
Maximum	725	300	335	490	575	750	645	474
Slope (km per 15 m fall)								
Mean	6.1	3.6	4.8	3	4.6	1.7	1.5	1.7
Minimum	0.3	0.2	0.1	0.2	1.6	1.2	1.2	1.3
Maximum	>25	>25	>25	>25	5	5	6	10
Substrates (% occurrence at sites)								
Silt/mud	58	36	33	3	5	0	3	0
Sand	32	20	22	0	0	8	0	2
Clay	0	0	11	1	0	0	0	0
Gravel	16	20	33	11	32	23	17	14
Pebbles	32	32	37	43	32	40	40	27
Cobbles	11	40	44	79	55	85	53	62
Boulders	11	40	35	57	73	79	67	60
Bedrock	11	32	11	23	77	56	47	26
Habitats (% occurrence at sites)								
Pools	5	48	24	12	9	4	10	2
Slacks	58	64	63	51	36	25	30	44
Riffles	42	60	35	21	64	69	67	19
Runs	16	32	54	76	27	44	7	67
Rapids	26	32	22	43	68	75	60	58
Width (m) (% occurrence at sites)								
<5	74	52	39	41	23	42	70	71
5–10	16	48	35	36	68	50	53	31
10–20	11	28	41	35	50	35	13	12
>20	11	16	26	27	9	21	0	6
Depth (m) (% occurrence at sites)								
<0.25	84	52	52	87	73	65	63	92
0.25–0.5	47	56	57	37	77	63	73	33
0.5–1.0	5	44	44	11	23	38	30	6
>1.0	11	16	33	1	0	17	17	0

Table 14 Percentage frequency of occurrence of the 30 most common taxa in sub-types of Group D: DIXa–DXe

	Sub-type							
Taxon	*DIXa*	*DIXb*	*DIXc*	*DXa*	*DXb*	*DXc*	*DXd*	*DXe*
Equisetum palustre	63							
Veronica beccabunga	42							
Polygonum amphibium	37							
Hippuris vulgaris	37							
Rorippa nasturtium-aquaticum agg.	42							
Apium nodiflorum	32							
Eleogiton fluitans		68						
Potamogeton natans		64						
Menyanthes trifoliata		40						
Callitriche hamulata		40						
Iris pseudacorus	37	36						
Equisetum fluviatile	42	64	72					
Eleocharis palustris	63	48	61					
Caltha palustris	80	44	80	77	64			
Angelica sylvestris	37	40	70		55			
Callitriche stagnalis	58				59			
Juncus articulatus	68	40	61		86	48		
Carex rostrata		56	65					
Myriophyllum alterniflorum		80	70				20	
Littorella uniflora		68					23	
Potamogeton polygonifolius		72					30	
Juncus bulbosus	42	100	94	80	77	48	90	83
Carex nigra	63	88	74	87	50		40	46
Ranunculus flammula	58	88	94	87	91	42	70	62
Juncus effusus	74	84	96	91	86	73	57	85
Pellia epiphylla		80	80	97	86	71	83	96
Filamentous green algae	74	76		96	64	40	80	87
Molinia caerulea		72	57			58	83	52
Sphagnum sp(p).		72			55	60	87	81
Viola palustris		68	70		86	58	53	60
Ferns		68	57	64		48	67	62
Potentilla erecta		52	65	72	59	63	77	58
Racomitrium aciculare		52	54	93	82	75	80	77
Glyceria fluitans	95	48	87	64				46
Carex demissa		48			64	44	50	
Salix sp(p).	37	48	72	81	59	50	47	58
Anthoxanthum odoratum	42	44	54	96	68	71	47	85
Deschampsia cespitosa			78	67	64	52		58
Filipendula ulmaria	47		74	72				
Galium palustre	53		83	63	55			
Achillea ptarmica			76	80		27		
Juncus acutiflorus			76	95		42	50	65
Agrostis stolonifera	90		76	79	82	42		60
Trees			70		55	56	30	73
Mentha aquatica	37		70					
Myosotis scorpioides	58		59		50			
Senecio aquaticus			57		50			
Fontinalis antipyretica	53		52	77	86	25		
Dichodontium pellucidum				64				
Calliergon cuspidatum	37			64				
Brachythecium plumosum				69		35		
Sagina procumbens	47			68	77	54	23	
Nardus stricta				71	68	54	53	54
Scapania undulata				89			73	96
Bryum pseudotriquetrum				88				54
Hygrohypnum ochraceum				77				50
Jungermannia atrovirens agg.				61				69

Table 14 *(continued)*

	Sub-type							
Taxon	*DIXa*	*DIXb*	*DIXc*	*DXa*	*DXb*	*DXc*	*DXd*	*DXe*
Hyocomium armoricum				64				87
Hygrohypnum luridum					73			
Marchantia polymorpha					64			
Montia fontana	37				55	27		
Chiloscyphus polyanthos					55			
Polytrichum commune						69	70	92
Carex echinata						38	30	50
Philonotis fontana						38		
Tussilago farfara						27		
Juncus squarrosus						25		
Narthecium ossifragum							57	
Blindia acuta							57	
Dicranella palustris							30	
Brachythecium rivulare							23	
Marsupella emarginata							57	71
Nardia compressa								60
Fontinalis squamosa								48
% occurrence of 30th most common taxon	32	44	52	61	55	27	20	46

Filipendula ulmaria and *Galium boreale*) are present in this sub-type but it lacks the species highly associated with acidic or oligotrophic waters (e.g. *Marsupella emarginata* and *Nardia compressa*). Of the less common species, *Verrucaria* spp., *Dichodontium flavescens*, *Hygrohypnum ochraceum*, *Schistidium agassizii* and *S. alpicola* have a ten times greater chance of being found in DXa than DXb. The same is true for edge species such as *Myrica gale*, *Carex panicea* and *Eleocharis palustris*, reflecting the gentler gradient.

The majority of sites within this sub-type are on the upper reaches of rivers in Scotland, with occasional isolated sites occurring elsewhere on high moorlands (e.g. Barle and Exe on Exmoor; Clwyd and Conwy on Snowdon; Derwent and Eden in the Lake District). Rivers with several sites are typically in extensive uplands and include the Carron, Dee, Findhorn, Inver, Oykel, Teith and Varrigill.

DXb Low-altitude bedrock rivers (NN sub-type DXa)

Sites of this sub-type commonly occur only on hard sandstone and base-rich hard rock – more so than for any other sub-type. Whilst rivers typically have high altitude sources, sites are more likely to be at lower altitudes than in other type X sub-types. Bedrock (especially) and boulders are collectively much more common as substrates than in other sub-types. Sites therefore differ from those in sub-type DXc in being bedrock-dominated, with steep gradients, but at lower altitudes.

Fewer upland/base-poor species (e.g. *Scapania undulata*, *Hygrohypnum ochraceum* and *Hyocomium armoricum*) are recorded, and less frequently, in this sub-type than in other type X sub-types, reflecting the lower altitude, and the bedrock dominance is reflected in the more common occurrence of bryophytes such as *Hygrohypnum luridum*, *Fontinalis antipyretica* and *Chiloscyphus polyanthos*. The lower altitude also results in *Montia fontana*, *Callitriche stagnalis* and trees being common associates, with *Brachythecium rutabulum* and *Juncus articulatus* being ten times more likely to be found than in DXc.

The communities of DXb are strongly associated with Scotland, outliers occurring only on the Aeron in Wales and Knock Ore Gill on the Pennines. The community commonly occurs in the Aros, Brora, Dunbeath Water, Langwell Water and Machrie Water.

DXc High altitude, steep gradient rivers rarely on base-poor rocks (NN sub-type DXd)

In common with DXb, many sites in this sub-type commonly occur on hard sandstone and base-rich hard rock; however, in contrast to DXb, sites also occur sporadically on hard limestone and base-poor hard rock. Rivers with this community typically rise at altitudes higher than in any other type X sub-type and with sites located at altitudes higher than in any sub-type other than DXe. The geology is much more base-rich in this sub-type, with 80% of sites on hard limestone, sandstone or base-rich hard rock, compared with 14% in sub-type DXe. In common only with DXd, a much higher proportion of deep water occurs than is typical for type X rivers. Unstable substrates – pebbles, cobbles and boulders – are collectively more common than is typical in type X.

Bed instability in hostile environments is almost certainly responsible for sites being typically very species-poor, with less than 20 taxa the norm. Despite the high altitudes, many typical species of the uplands are rarely found, owing to bed instability; these include *Nardia compressa*, *Marsupella emarginata*, *Scapania undulata*, *Fontinalis antipyretica* and *Hygrohypnum ochraceum*. The shingle bars which characterise the rivers are commonly colonised by such species as *Philonotis fontana*, *Juncus bulbosus*, *Sagina procumbens*, *Achillea ptarmica*, *Tussilago farfara*, *Montia fontana*, *Deschampsia cespitosa* and *Juncus articulatus*, the last five species being found more than ten times as commonly in DXc sites than in DXd sites.

Sites in this sub-type are scattered throughout Scotland and northern England. Typical examples where several sites occur on the same river include the Allport, Ashop, Derwent, Duddon, Orchy, Roy and Tarff; virtually all sites from source to mouth on the Roy and the Tarff are classified into this sub-type.

DXd Oligotrophic rivers of the west coast of Scotland (NN sub-typeDXc)

The low altitude of sites in this sub-type is very characteristic, even though several rivers where such communities occur have much higher-altitude sources (in common with sites in sub-type DXb). Hard rock is more prevalent than in any other type X sub-type. In common with DXc, assemblages are typically very impoverished, with just 20 taxa frequently recorded.

Characterising the typical community is difficult, since many species with contrasting substrate needs occur relatively frequently. For example, common species typical of rock habitats include *Marsupella emarginata* and *Scapania undulata*, whilst species typical of peaty or gravel substrates include *Sphagnum* spp., *Myriophyllum alterniflorum*, *Juncus bulbosus*, *Littorella uniflora* and *Potamogeton polygonifolius*. *Littorella uniflora* and *Narthecium ossifragum* are more than ten times as common in sub-type DXc as in DXc and *Scapania undulata* and *Blindia acuta* are more than three times as common. The overriding influence on the flora appears to be base-poor, nutrient-poor conditions.

The majority of sites classified within this sub-type are found on the west coast of Scotland. Many sites are located on the short rivers surveyed on the Western Isles, together with rivers such as the Coe and Ulladale.

DXe Small, shallow, oligotrophic rivers (NN sub-types DXc/DXd)

Sites supporting DXe communities are typically at higher altitudes than for most type X sub-types, although not necessarily on rivers that rise at exceptionally high altitudes. Non-calcareous shales and hard rock predominate, but there are several sites on softer sandstones. It is noteworthy that 45% of sites are on soft sandstone or shales, no other sub-type of Group D having a total exceeding 10%. Sites are typically very shallow and, in common with DXd, narrow too. Acid-tolerant species such as *Marsupella emarginata*, *Scapania undulata*, *Fontinalis squamosa*, *Hygrohypnum ochraceum*, *Sphagnum* spp. and *Nardia compressa* all have atypically high occurrences in this sub-type. Species such as *Scapania undulata*, *Fontinalis squamosa*, *Hyocomium armoricum*, *Rhynchostegium riparioides*, *Callitriche hamulata* and *Nardia compressa* all occur more than five times more frequently in DXe than in either of the nearest neighbour sub-types (DXc and DXd), with *Jungermania atrovirens*, *Bryum pseudotriquetrum*, *Hygrohypnum ochraceum* and *Lotus uliginosus* all more than ten times as common.

Sites within this sub-type are scattered throughout Great Britain, the only common factor being base-poor soils. Sites are common in England and particularly so in Wales, although they are infrequent in Scotland. Several lowland outliers occur on the acid heaths of the New Forest (e.g. Highland Water, Blackwater), with other sites in south-west England (e.g. Fowey, Lyd, Okement), Wales (e.g. Cothi, Conwy, Elan, Dysynni, Ystwyth), Lake District and northern England (e.g. Ehen, Dove, Greta) and Scotland (e.g. Machrie Water, Allt Coire Gabhail, Carron).

Chapter 6 Comparison with previous classification system

6.1 Changes in the allocation of sites using the new classification

Group A

No sites classified in the original classification into types within Groups B–C have been transferred into Group A in the new classification. In contrast, over 30 sites have been re-allocated in the new classification from Group A into Group B. All have been relocated out of either the clay type (A3) or the ditch type (A4).

Type I

Many of the sites originally classified into this type were transferred to type II (and to a lesser extent type III and type IV). Examples of such sites were the Welland, East Sussex Rother, Glen, Weaver, Cary, Devon, Smite and Kent Stour – all known to be very heavily influenced by clay. Losses to type III were mainly found on East Anglian headwaters and lower Dorset/Hants rivers – Wensum, Babingly, Nar, Waveney, Frome, Avon, Piddle and Test. This is exactly what might be expected, as all these rivers rise on chalk, or are fed by their aquifers, and type III is highly correlated with soft limestone. Losses to type IV were very clearly impoverished rivers (Glen, Darent, Weaver).

Transfers of sites into type I were limited and came from just two end-groups, containing rivers such as the Kennet, Loddon, Kent Stour, Moors and Waveney. All these rivers have sections with a similar character to the Salisbury Avon, where the influence of the (mixed) geology, substrates and groundwater is great.

The new classification clearly delimits a more well-defined lowland type I in which low gradient, enriched waters, coarse substrates where clay is not influential and a groundwater element to the flow regime are normally present.

Type II

Gains from type I were considerable but no sites were transferred from other types. Losses to type I have been described above; losses to type III were very evident only to the Loddon, Windrush, Yare, Waveney and Moors which are all rivers on chalk or oolite. Losses from type II to type IV are characterised by movement from polluted or acid sand clay rivers. Most losses to types V–VI are, therefore, from clay sites where mudstone and coarse substrate are present.

The loss of sites to other types gives the new type II an even better defined affinity with clay.

Type III

Most gains for type III are described above in types I and II. However, it is significant that six further gains were from the most calcareous sites originally classified into type IV. Only a single site was lost to another type.

The revised classification gives an even tighter definition and grouping of 'aquifer' rivers as type III.

Type IV

This type had several losses and gains, but many sites which have been lost appear much better placed than before. For example, some border-line oolite streams have been moved to type III whilst impoverished communities with species present on stones or gravel have been put into Group B. Gains have come primarily from managed and unstable rivers in type I and species-poor sites on type II (clay) rivers.

In the new classification type IV is still a 'dumping ground' type with distribution highly correlated with upper sites of Group A rivers. The term 'dumping ground' is used because most sites that have an impoverished flora (either naturally or through perturbations) and that generally lack any of the characteristics species of any of the other types are allocated to this type.

Group B

There has been considerable re-allocation of sites within Group B, the new classification giving a better transition from sub-types BVa–c to sub-types BVId–e. The former contains many winterbourne sites with much in common with Group A communities, and the latter has many sites immediately downstream of sites allocated to the more mesotrophic communities of Group C.

Type V and type VI

In terms of site groupings, there have been few changes. However, compared with the old classification, types V and VI have been 'inverted'. Thus the old type VI has become type V and vice-versa in the new classification. (In essence, TWINSPAN groups sites together and then

aligns these groups, although the group alignment is two dimensional, not straight.)

Sub-types BVId/e

These two sub-types (previously classified together as B4) are the most oligotrophic, northern and upland in character and invariably occur upstream of sub-types BVIa–c (previously classified together as B3). BVId–e gained some sites from previous classifications into Group C and gained more enriched sites from the former Group A.

Sub-types BVIa–c

These two sub-types (previously classified together as B3) are more widely distributed and more northerly than type V (previously B1 and B2), except where rivers are large (e.g. Teme, Usk, Lugg, Dove). From previously having only 30 sites allocated to it, it has become a larger collection of sites, having had many sites assigned to it in the new classification that were previously allocated to other Group B sub-types.

This new type VI forms a very tight type and in gradient is closer to type VII than type IV.

Type V

In this new type V, sub-types BVa–c and BVd–e contain many of the sites previously allocated to B3 and B4. Types BVa–c have many sites of the old B3 and B4 allocated to it, as well as 27 sites previously allocated to Group A communities. The sub-types BVd–e have the majority of their sites in the revised classification derived from the old B4, with over 40% of sites relocated from previous allocations to Group C.

Group C

A very clear transition is now evident from types CVIIa–b, which are low-nutrient but base-rich sites, to types CVIIId–e, which are low-nutrient but base-poor sites.

Type VII

The new sub-types CVIIa–b and CVIIc–d are equivalent to the old C1 and C2, but the majority of sites classified to the new sub-types CVIIa–b have been assigned from new surveys and only three of them were sites from the 1978–1982 surveys. This is because many new sites were surveyed on oligo-mesotrophic base-rich rivers flowing over hard limestone in the uplands. Communities were therefore different from those at the majority of sites in the 1978–82 survey that were allocated to Group C1 or C2, which had some commonality with Group B rivers, although less so than those of the recent surveys. All those with base-rich communities have been allocated to sub-types CVIIa–b in the new classification, which forms a clear and definable transition from Group B to Group C through sub-types CVIIa–b to sub-types CVIIc–d.

Type VIII

In the new type VIII, sub-types CVIIIa–c contain more than 125 sites from the old Group C and only two sites previously allocated outside Group C. With the new sites on limestone leading to a more distinct transition from Group B to C through type VII, many of the sites in the 1978–82 survey programme have been re-allocated from the old C1 and C2 into type VIII (old C3 and C4). The new classification provides a much more distinctive type VIII, having communities that are more enriched than at most sites in type VII but less oligotrophic than at those in Group D. Sites in sub-types CVIIIa–c invariably occur downstream of sites allocated to CVIIId–e, again providing an improved system of gradation of sites based on trophic status. This is illustrated by the re-allocation of 17 sites from the old Group D into the new types CVIIId–e.

Group D

Type IX is a good transition between the oligo-mesotrophy of Group C and the extreme oligotrophy in type X. They have a pronounced western distribution (plus Blackadder Water/Whiteadder Water of the Tweed system). Few sites within the new type IX were recorded in the original classification, and some clarification may be needed in the future to determine whether surveyor bias has had any influence on the classification within Group D.

Type IX

The new DIXa (old D1) has been created solely from sites surveyed since the original classification was completed. Thus lowland, low gradient sites from western Scotland and the Islands are assigned to this type. Sites allocated to the old D1 have been shared between sub-type DIXb and the most oligotrophic sub-types of Group C (sub-types CVIIId–e). The majority of sites in the old D2 have been placed in the new sub-types DXa–b, to reflect the more lowland nature of type IX compared with type X. This is further confirmed by only 11 of the 1978–1982 sites being assigned to sub-types DIXb–c, four from Group D and seven from Group C.

Type X

In the original system the more oligotrophic communities of D2 were separated from the rest to form type X. The new system gives a much clearer and more logical breakdown of oligotrophic sites, as a result of the greater number of Group D sites that have now been examined.

The new sub-types DXc–e are the most upland and nutrient-poor communities in the new system, whilst sub-types DXa–b usually occur either downstream of sub-types DXc–e on oligotrophic rivers such as the Dee and Spey or in uplands that are less oligotrophic or acid (i.e. Exmoor, compared with Dartmoor).

6.2 Summary

Using the original classification it was difficult confidently to assign sites to types VII or VIII within Group C, or to types IX or X in Group D. Greater confidence was felt in assigning sites to types at the more eutrophic end of the scale, with types I, II and III derived with almost complete certainty where the geology was well known. For type V and type VI, the division of Group B was not always entirely clear, but geographical location, size of river and altitude were important features in helping to predict the likely communities of a given river.

Types I, II and III are essentially unchanged, although there is a tighter definition of the 'fenland' rivers (type I) and more soft limestone systems (i.e. the Oolite) have been included in the 'chalk stream' type III. Type IV is essentially the same as before – a dumping ground for lowland systems with depleted floras, or geographically isolated Group A sites where elements of Group B or even Group C communities are well represented.

Types V and VI are even more closely correlated with sandstone/mudstone and hard limestone than before, and the north-south divide is even more distinct. The types are now the reverse of what they were (i.e. old type V = new type VI and vice versa). The system appears much better than before, with the faster-flowing southern sites of Group B placed in the northern type VI. The new type V is distinctively represented by small streams or western rivers. There is a clear gradient of decreasing trophic status from B1–B4 (types V–VI), with B1 (sub-type BVa) (including winterbournes) appearing to be most calcareous.

There is now also a clear trophic gradient through Group C, with the new C4 (sub-type CVIIIa) (especially) and C3 (sub-type CVIIIb) more oligotrophic than C2 and C1 (type VII). There has been a complete re-arrangement of the old Group C. Type VII can be regarded now as clearly more southerly and more meso-oligotrophic than type VIII, which is very 'northern' and/or genuinely oligotrophic. In many respects the types are now more clearly defined than before.

Group D (types IX and X) shows the distinct gradient to decreased trophic status from 1–4 (as in B and C) even more clearly than before. The differentiation of type IX from type X is much clearer than before, but some caution is needed; most new type IX sites have come from new surveys – a possible link to surveyor bias is possible but since their western and island locations are very evident this is unlikely. In addition to being less oligotrophic, type IX is more characteristic of lower altitudes than type X.

Figure 2 shows the allocation into types of the 1,055 sites in the original classification compared with their allocation into types in the revised classification. The tabulation shows the location of sites at the fourth division of the classification, which gives rise to types I–IV in Group A (referred to as sub-groups A1–4 in the original classification), two sub-divisions of types V and VI in Group B (previously B1–4), two subdivisions of types VII and VIII in Group C (previously C1–4) and two sub-divisions of types IX and X in Group D (previously D1–4). Figure 2 shows clearly how the new types compare very closely with those of the previous classification and also where there are significant differences. For example, the new type I (previously A1) has 59 of the previous sites in the classification re-assigned to it, with 48 from the original A1 and 11 from its nearest neighbour A2 and none from anywhere else. However, of the 110 sites previously allocated to A1,

	Subtype in the new classification to which site/s assigned															
Subgroup in the old classification from which site/s derived	*AI*	*AII*	*AIII*	*AIV*	*BV a–c*	*BV d–e*	*BVI a–c*	*BVI d–e*	*CVII a–b*	*CVII c–d*	*CVIII a–c*	*CVIII d–e*	*DIXa*	*DIX b–c*	*DX a–b*	*DX c–e*
A1	48	43	10	9												
A2	11	80	6	22	5		4	2								
A3			58	1												
A4			7	46	22			3								
B1					1	3	17	41								
B2							30									
B3					30		47	3								
B4					47	23	22									
C1					2		4	1			36	19				
C2					3	12	1	1			65	9				1
C3					2	6		2	1	25	15	9		4		1
C4						2		3	2	3	10	31		3		
D1												12			25	
D2												4			10	1
D3											2	1		1	11	36
D4														3	14	

Figure 2 Re-allocation of sites in the new classification. Vertical columns show which 1978–82 sites were assigned to the 16 sub-types in the new classification, and the horizontal columns show from which sub-groups in the previous classification they have been derived.

almost half have been re-located into the new type II (previously A2), and ten into type III and nine into type IV. In comparison, of the 59 sites previously allocated to A3, all but one are re-assigned in the new classification to type III (chalk streams), whilst 23 other sites have been transferred from other sub-types in the original classification to type III in the revised classification.

Chapter 7 List of scientific names used in the text, with corresponding common names

Achillea ptarmica	Sneezewort
Acorus calamus	Sweet-flag
Agrostis stolonifera	Creeping bent
Alisma lanceolatum	Narrow-leaved water-plantain
Alisma plantago-aquatica	Water-plantain
Alopecurus geniculatus	Marsh foxtail
Amblystegium fluviatile	Brook-side feather-moss
Amblystegium riparium	Kneiff's feather-moss
Angelica sylvestris	Wild angelica
Anthoxanthum odoratum	Sweet vernal-grass
Apium inundatum	Lesser marshwort
Apium nodiflorum	Fool's water-cress
Azolla filiculoides	Water fern
Batrachospermum	An alga
Berula erecta	Lesser water-parsnip
Bidens cernua	Nodding bur-marigold
Bidens tripartita	Tripartite bur-marigold
Blindia acuta	Sharp-leaved blindia
Brachythecium plumosum	Rusty feather-moss
Brachythecium rivulare	River feather-moss
Brachythecium rutabulum	Rough-stalked feather-moss
Bryum pseudotriquetrum	Marsh bryum
Butomus umbellatus	Flowering-rush
Calliergon cuspidatum	Pointed spear-moss
Callitriche hamulata	Intermediate water-starwort
Callitriche hermaphroditica	Autumnal water-starwort
Callitriche obtusangula	Blunt-fruited water-starwort
Callitriche platycarpa	Various-leaved water-starwort
Callitriche stagnalis	Common water-starwort
Caltha palustris	Marsh-marigold
Cardamine amara	Large bitter-cress
Carex acuta	Slender tufted-sedge
Carex acutiformis	Lesser pond-sedge
Carex aquatilis	Water sedge
Carex binervis	Green-ribbed sedge
Carex curta	White sedge
Carex demissa	Common yellow-sedge
Carex disticha	Brown sedge
Carex echinata	Star sedge
Carex elata	Tufted sedge
Carex flacca	Glaucous sedge
Carex hirta	Hairy sedge
Carex lepidocarpa	Long-stalked yellow-sedge
Carex nigra	Common sedge
Carex otrubae	False fox-sedge
Carex ovalis	Oval sedge
Carex panicea	Carnation sedge
Carex paniculata	Greater tussock-sedge
Carex pendula	Pendulous sedge
Carex pulicaris	Flea sedge
Carex remota	Remote sedge
Carex riparia	Greater pond-sedge
Carex rostrata	Bottle sedge
Carex vesicaria	Bladder-sedge
Catabrosa aquatica	Whorl-grass
Ceratophyllum demersum	Rigid hornwort
Chara vulgaris	Common stonewort
Chiloscyphus polyanthos	St Winifrid's moss
Cinclidotus fontinaloides	Smaller lattice-moss
Cladophora aegagropila	Carpet blanketweed
Cladophora glomerata agg.	Blanket weed
Collema dichotum	River jelly-lichen
Conocephalum conicum	Great scented liverwort
Crocosmia x crocosmiiflora	Montbretia
Dermatocarpon fluviatile	A lichen
Deschampsia cespitosa	Tufted hair-grass
Dichodontium flavescens	Yellowish fork-moss
Dichodontium pellucidum	Transparent fork-moss
Dicranella palustris	Marsh forklet-moss
Didymosphenia geminata	Woolly diatom
Dipsacus fullonum	Wild teasel
Eleocharis palustris	Common spike-rush
Eleogiton fluitans	Floating club-rush
Elodea canadensis	Canadian pondweed
Elodea nuttallii	Nuttall's pondweed
Enteromorpha spp.	Tubeweed
Epilobium hirsutum	Great willowherb
Equisetum arvense	Field horsetail
Equisetum fluviatile	Water horsetail
Equisetum palustre	Marsh horsetail
Eupatorium cannabinum	Hemp-agrimony
	Ferns
	Filamentous green algae
Filipendula ulmaria	Meadowsweet
Fontinalis antipyretica	Greater water-moss
Fontinalis squamosa	Alpine water-moss
Galium boreale	Northern bedstraw
Galium palustre	Marsh bedstraw
Glyceria declinata	Small sweet-grass
Glyceria fluitans	Floating sweet-grass
Glyceria maxima	Reed sweet-grass
Glyceria plicata (notata)	Plicate sweet-grass
Groenlandia densa	Opposite-leaved pondweed
Hildenbrandia rivularis	An alga

Hippuris vulgaris	Mare's-tail
Hydrocotyle vulgaris	Marsh pennywort
Hygrohypnum luridum	Drab feather-moss
Hygrohypnum ochraceum	Yellow mountain-rill feather-moss
Hyocomium armoricum	Flagellate feather-moss
Impatiens capensis	Orange balsam
Impatiens glandulifera	Indian balsam
Iris pseudacorus	Yellow iris
Juncus acutiflorus	Sharp-flowered rush
Juncus articulatus	Jointed rush
Juncus bulbosus	Bulbous rush
Juncus effusus	Soft-rush
Juncus inflexus	Hard rush
Juncus squarrosus	Heath rush
Jungermannia atrovirens	Dark-green flapwort
Lemanea fluviatilis	An alga
Lemna gibba	Fat duckweed
Lemna minor	Common duckweed
Lemna trisulca	Ivy-leaved duckweed
Littorella uniflora	Shoreweed
Lotus uliginosus	Greater bird's-foot-trefoil
Lunularia cruciata	Crescent-cup liverwort
Lupinus nootkatensis	Nootka lupin
Lycopus europaeus	Gipsywort
Lysimachia vulgaris	Yellow loosestrife
Lythrum salicaria	Purple loosestrife
Marchantia polymorpha	Star-headed liverwort
Marsupella emarginata	Notched rustwort
Mentha aquatica	Water mint
Menyanthes trifoliata	Bogbean
Mimulus cupreus	Copper monkeyflower
Mimulus guttatus	Monkeyflower
Mimulus guttatus x *luteus*	Monkeyflower hybrid
Molinia caerulea	Purple moor-grass
Montia fontana	Blinks
Montia sibirica	Pink purslane
Myosotis scorpioides	Water forget-me-not
Myosoton aquaticum	Water chickweed
Myrica gale	Bog-myrtle
Myriophyllum alterniflorum	Alternate water-milfoil
Myriophyllum spicatum	Spiked water-milfoil
Nardia compressa	Compressed flapwort
Nardus stricta	Mat-grass
Narthecium ossifragum	Bog asphodel
Nitella flexilis	Smooth stonewort
Nitella opaca = *N. flexilis*	Smooth stonewort
Nuphar lutea	Yellow water-lily
Nymphaea alba	White water-lily
Oenanthe crocata	Hemlock water-dropwort
Oenanthe fluviatilis	River water-dropwort
Pellia endiviifolia	Endive pellia
Pellia epiphylla	Broad-leaved pellia
Petasites hybridus	Butterbur
Phalaris arundinacea	Reed canary-grass
Philonotis fontana	Fountain apple-moss
Phragmites australis	Common reed
Polygonum amphibium	Amphibious bistort
Polytrichum commune	Common haircap
Potamogeton alpinus	Red pondweed
Potamogeton berchtoldii	Small pondweed
Potamogeton crispus	Curled pondweed
Potamogeton friesii	Flat-stalked pondweed
Potamogeton gramineus	Various-leaved pondweed
Potamogeton lucens	Shining pondweed
Potamogeton natans	Broad-leaved pondweed
Potamogeton nodosus	Loddon pondweed
Potamogeton pectinatus	Fennel pondweed
Potamogeton perfoliatus	Perfoliate pondweed
Potamogeton polygonifolius	Bog pondweed
Potamogeton praelongus	Long-stalked pondweed
Potamogeton pusillus	Lesser pondweed
Potamogeton x *olivaceus*	A hybrid pondweed
Potamogeton x *salicifolius*	A hybrid pondweed
Potentilla erecta	Tormentil
Potentilla palustris	Marsh cinquefoil
Pulicaria dysenterica	Common fleabane
Racomitrium aciculare	Yellow fringe-moss
Ranunculus aquatilis	Common water-crowfoot
Ranunculus circinatus	Fan-leaved water-crowfoot
Ranunculus flammula	Lesser spearwort
Ranunculus fluitans	River water-crowfoot
Ranunculus hederaceus	Ivy-leaved crowfoot
Ranunculus omiophyllus	Round-leaved crowfoot
Ranunculus peltatus	Pond water-crowfoot
Ranunculus penicillatus subsp. *pseudofluitans*	Brook water-crowfoot
Ranunculus penicillatus subsp. *pseudofluitans* var. *vertumnus*	Brook water-crowfoot
Ranunculus sceleratus	Celery-leaved buttercup
Ranunculus trichophyllus	Thread-leaved water-crowfoot
Rhynchostegium riparioides	Long-beaked water feather-moss
Rorippa amphibia	Great yellow-cress
Rorippa nasturtium-aquaticum	Water-cress
Rorippa palustris	Marsh yellow-cress
Rorippa sylvestris	Creeping yellow-cress
Rumex hydrolapathum	Water dock
Sagina procumbens	Procumbent pearlwort
Sagittaria sagittifolia	Arrowhead
Salix spp.	Willows
Scapania undulata	Water earwort
Schistidium agassizii	Teesdale grimmia
Schistidium alpicola	Water grimmia
Schoenoplectus lacustris	Common club-rush
Scirpus maritimus	Sea club-rush
Scirpus sylvaticus	Wood club-rush
Scrophularia auriculata	Water figwort
Scutellaria galericulata	Skullcap
Senecio aquaticus	Marsh ragwort
Senecio palustris	Marsh fleawort
Solanum dulcamara	Bittersweet
Sparganium angustifolium	Floating bur-reed
Sparganium emersum	Unbranched bur-reed
Sparganium erectum	Branched bur-reed
Sphagnum spp.	Bog-moss
Spirodela (Lemna) polyrhiza	Greater duckweed
	Sponges
Stachys palustris	Marsh woundwort
Stellaria alsine	Bog stichwort
Symphytum officinale	Common comfrey
Thamnobryum alopecurum	Fox-tail feather-moss
Tussilago farfara	Colt's-foot
Typha latifolia	Bulrush

Vaucheria spp.	Mole-pelt alga
Veronica anagallis-aquatica	Blue water-speedwell
Veronica beccabunga	Brooklime
Veronica catenata	Pink water-speedwell
Veronica scutellata	Marsh speedwell
Verrucaria spp.	Freshwater lichens
Viola palustris	Marsh violet
Zannichellia palustris	Horned pondweed

Chapter 8 Acknowledgements

The authors wish to thank the many people who helped in the preparation of this publication: Kathy Dale (Waterland) and Jane Southey (Ecosurveys), who undertook the majority of new surveys under contract to the Nature Conservancy Council; Anglian, Severn-Trent, South-west and Thames Water/National Rivers Authority (NRA) (now the Environment Agency), who made available data collected by Nigel Holmes under contract to them; Dr Chris Newbold, for initiating the original work in 1978 when head of Freshwater Section of the Chief Scientist's Team of the Nature Conservancy, and for his constant encouragement since; the Joint Nature Conservation Committee, Scottish Natural Heritage, English Nature and the Countryside Council for Wales (all formerly the Nature Conservancy Council), for funding for the data collection, analysis and reporting; and the NRA, for providing funding to complete the information trawl on physical features associated with the sites surveyed, to enable comparisons of physical features of Groups, types and sub-types.

Chapter 9 References

Boon, P.J. 1995. The relevance of ecology to the statutory protection of British rivers. *In: The ecological basis for river management*, ed. by D.M. Harper and A.J.D. Ferguson, 239–250. Chichester, John Wiley.

Boon, P.J., Holmes, N.T.H., Maitland, P.S., & Rowell, T.A. 1995. *SERCON: system for evaluating rivers for conservation. Version 1 manual.* Edinburgh, Scottish Natural Heritage. (SNH Research, Survey and Monitoring Report, No. 61.)

Department of the Evironment. 1987. *Methods for the use of aquatic macrophytes for assessing water quality 1985–86. Methods for examination of waters and associated materials.* London, HMSO.

Hill, M.O. 1979. *TWINSPAN. A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes.* New York, Cornell University Department of Ecology and Systematics.

Holmes, N.T.H. 1983. *Typing British rivers according to their flora.* Peterborough, Nature Conservancy Council. (Focus on nature conservation, No 4.)

Holmes, N.T.H. 1989. British rivers, a working classification. *British Wildlife, 1*(1): 20–36.

Holmes, N.T.H., Boon. P.J., & Rowell, T.A. 1998. A revised classification system for British rivers based on their aquatic plant communities. *Aquatic Conservation, 8:* 555–578.

Nature Conservancy Council. 1989 (rev. ed. Joint Nature Conservation Committee 1998). *Guidelines for selection of biological SSSIs.* Peterborough.

Strahler, A.N. 1957. Quantitative analyses of watershed geomorphology. *Transactions of the American Geophysical Union, 38*: 913–920.

Photo 1 River Avon, Salisbury, Hampshire. Type I - lowland, low gradient rivers. The lower Avon typifies the Type, flowing in a wide and shallow valley. Higher plants totally dominate the communities, the photo showing the luxuriant growth of a diverse range of reeds and other marginal plants. Monkeyflower *Mimulus guttatus* is a common alien species present in this and other Types.

Photo 2 River Blythe, Warwickshire. Type II - lowland, clay-dominated rivers. This river is an SSSI on the outskirts of Birmingham. The photo illustrates a low-gradient section where characteristic species of the Type are prominent - yellow water-lily *Nuphar lutea*, branched bur-reed *Sparganium erectum* and common club-rush *Schoenoplectus lacustris*.

Photo 3 River Itchen, Hampshire. Type III - Chalk rivers and other base-rich rivers with stable flows. The high base status and very stable flow regime of rivers flowing mainly on chalk give rise to prolific in-channel macrophyte growth of water-crowfoot *Ranunculus* spp. and water-starwort *Callitriche* spp. and dense marginal and bank vegetation. Only in this Type is the lesser pond-sedge *Carex acutiformis* a very common component of the bank community.

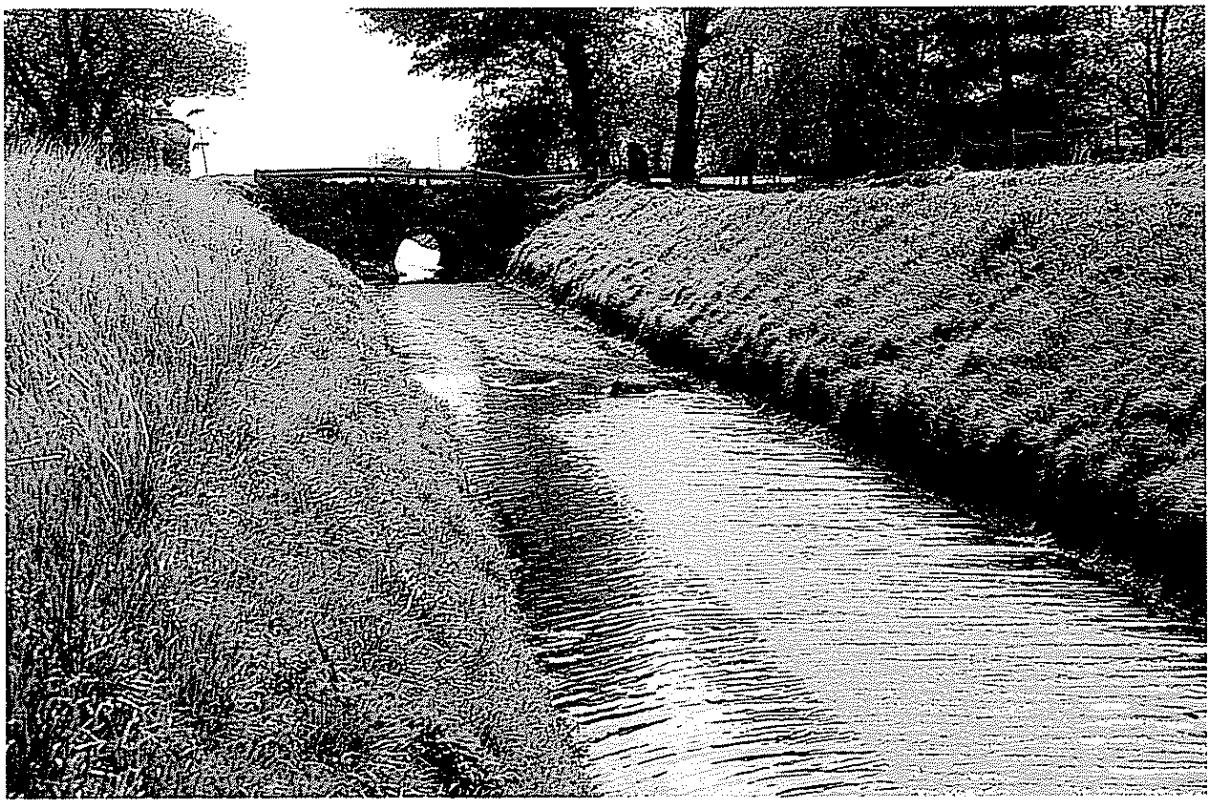


Photo 4 River Torne, Nottinghamshire. Type IV - impoverished lowland rivers. This section of the River Torne is typical of many rivers in this Type. The majority are narrower than other rivers with communities classified within Group A. The overriding character of most of the sites is the degradation of the physical environment through land drainage and flood defence activities. Others suffer from depleted flows or pollution problems.

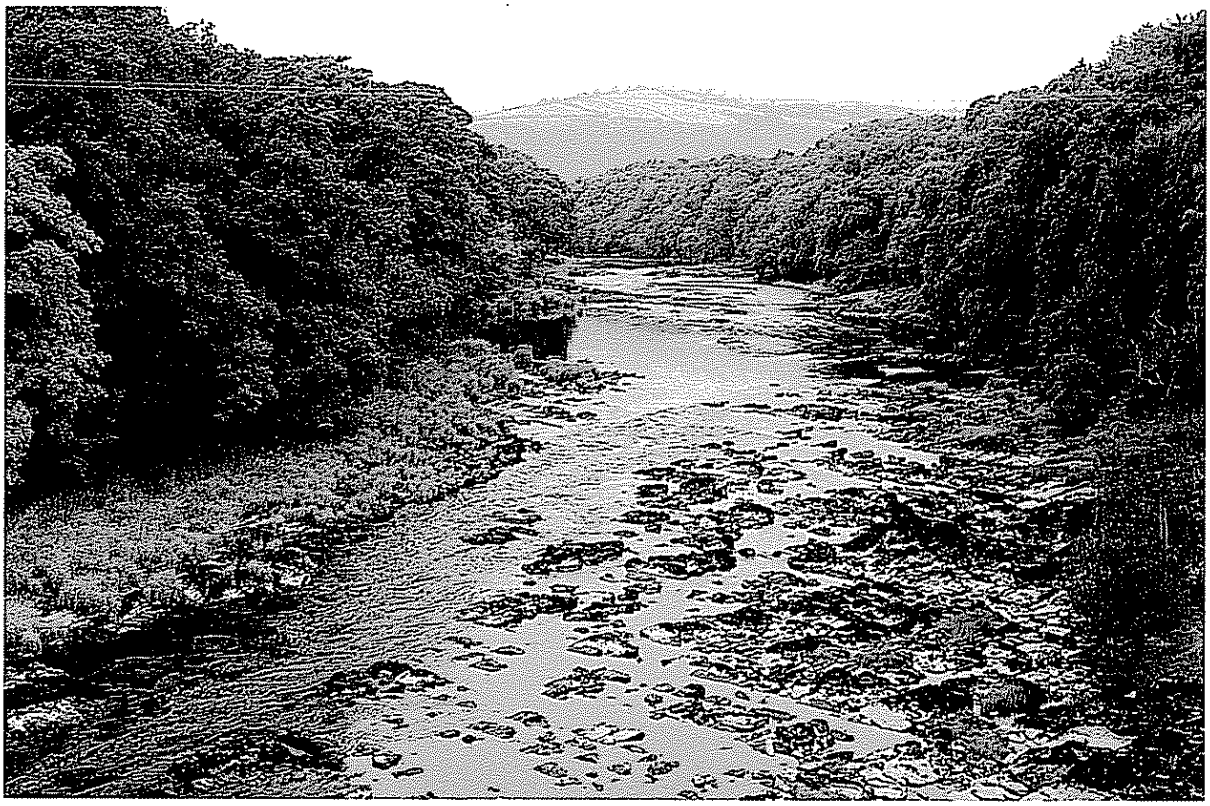


Photo 5 River Wye, Erwood Gorge, Powys. Type V - sandstone, mudstone and hard limestone rivers of England and Wales. The physical characteristics of the Type can be very variable, but where bedrock and boulders predominate, communities are totally dominated by mosses, the most common being long-beaked water feather-moss *Rhynchostegium riparioides*, water grimmia *Schistidium alpicola*, greater water-moss *Fontinalis antipyretica* and brook-side feather-moss *Amblystegium fluviatile*. The site illustrated supports a strong population of river jelly lichen *Collema dichotomum*, a Biodiversity Action Plan species found only in Type V and VI rivers.

Photo 6 River Coquet, Northumberland. Type VI - sandstone, mudstone and hard limestone rivers of Scotland and Northern England. Physical characteristics of rivers in this Type can range from the meandering and active channels illustrated to stable bedrock reaches similar to that depicted for the Wye (neighbouring Type V). In unstable conditions vegetation is very sparse in the channel, but the transient flora of the shingle shoals and margins is very important and varied.

Photo 7 River Rydal, Cumbria. Type VII - mesotrophic rivers dominated by gravels, pebbles and cobbles. Types VII and VIII are characteristic of upland catchments draining hard rocks such as shales, hard limestone and hard sandstone. The Rydal illustrates that in Type VII gradients are generally shallower than in Type VIII, with fine substrates and relatively stable flows. Wetland edge species characterise the assemblage, with far fewer bryophytes than in Type VIII.

Photo 8 River Spey, Highland. Type VIII - oligo-mesotrophic rivers. The Spey is typical of many Type VIII rivers, in which coarse substrates such as cobbles, boulders and bedrock are totally dominant. The apparently sandy banks in the picture are in fact entirely composed of cobbles. The higher proportion of rocks than in Type VII, and their less base-rich nature, results in a wide variety of bryophytes being present within the channels; cover is very limited in unstable meandering reaches (as illustrated), or dense where channels are stable.

Photo 9 DeLank River, Cornwall. Type IX - oligotrophic, low altitude rivers. Types IX and X have macrophyte assemblages that indicate nutrient and base-poor chemistry. The DeLank typifies Type IX, in which there are much gentler gradients, giving rise to a much greater abundance of silts and sands as substrates and plant assemblages often dominated by oligotrophic flowering plants. These include characteristic species such as bulbous rush *Juncus bulbosus*, alternate-flowered water-milfoil *Myriophyllum alterniflorum*, bog pondweed *Potamogeton polygonifolius* and floating clubrush *Scirpus fluitans* (pictured).

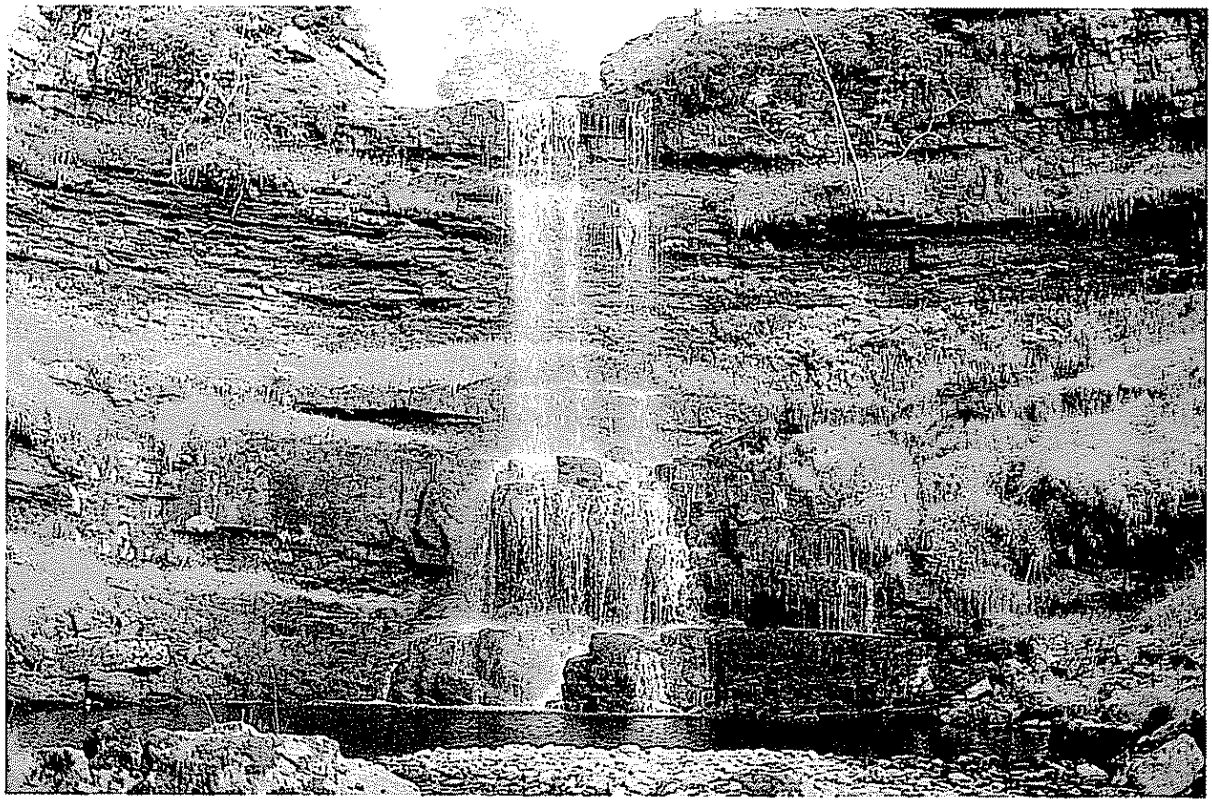


Photo 10 River Rawthey, Lancashire. Type X - ultra-oligotrophic rivers. The Rawthey, rising high in the Pennines, is typical of the Type. Characteristically, sites are found on rivers rising at high altitudes on base-poor rock or where blanket bog or acid heath dominates the catchment upstream. Mosses and liverworts are a major component of the flora and are very dominant on waterfalls and other wet rocks, where broad-leaved pellia *Pellia epiphylla*, yellow fringe-moss *Racomitrium aciculare*, water earwort *Scapania undulata* and flagellate feather-moss *Hyocomium armoricum* are common species.

Chapter 10 Annexes

Annex A Site locations, physical features and macrophytes for Groups A–D

Group A

No. of sites = 475

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	86.7
Agrostis stolonifera	82.2
Myosotis scorpioides	80.9
Epilobium hirsutum	80.9
Sparganium erectum	67.8
Mentha aquatica	66.1
Solanum dulcamara	65.0
Salix sp(p).	63.1
Rorippa nasturtium-aquaticum agg.	62.5
Veronica beccabunga	61.4
Other (non-*Salix*) tree taxa	59.1
Apium nodiflorum	56.4
Glyceria maxima	54.9
Scrophularia auriculata	50.2
Filipendula ulmaria	44.1
Carex riparia	42.8
Lythrum salicaria	41.7
Juncus inflexus	37.7
Symphytum officinale agg.	36.7
Carex acutiformis	36.4

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	96.8
Agrostis stolonifera	96.4
Myosotis scorpioides	93.2
Epilobium hirsutum	91.5
Sparganium erectum	90.7
Solanum dulcamara	84.3
Salix sp(p).	83.5
Mentha aquatica	82.6
Veronica beccabunga	81.1
Rorippa nasturtium-aquaticum agg.	78.2
Other (non-*Salix*) tree taxa	77.5
Apium nodiflorum	73.3
Scrophularia auriculata	71.6
Cladophora glomerata agg.	68.6
Vaucheria sp(p).	67.8
Filipendula ulmaria	65.9
Glyceria maxima	63.8
Callitriche stagnalis	61.0
Sparganium emersum	58.9
Juncus inflexus	58.3
Lemna minor	54.7
Elodea canadensis	54.2
Lythrum salicaria	54.0
Polygonum amphibium	51.1
Lycopus europaeus	51.1
Carex riparia	50.2
Veronica anagallis-aquatica	46.8
Symphytum officinale	46.8
Nuphar lutea	46.8
Carex acutiformis	46.6

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	38	4	67
Height at source (m)	138	10	700
Altitude of site (m)	49	0	213
Slope (km per 15 m fall)	15.3	0.25	25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	32.6	<0.25	44.7
5–10	37.5	0.25–0.5	48.7
10–20	35.6	0.5–1	29.0
>20	15.3	>1	30.3

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Calcareous clay	29.0
Non-calcareous clay	12.9
Soft sandstone	11.9
Chalk	22.2

Habitats	
Habitat	*% of sites*
Pools	5.3
Slacks	88.8
Riffles	5.3
Runs	40.0
Rapids	0.8

Substrates	
Substrate	*% of sites*
Silt/mud	43.6
Sand	19.7
Clay	40.5
Gravel	52.3
Pebbles	16.7
Cobbles	4.2
Boulders	0.4
Bedrock	0.2

Group B

No. of sites = 397

Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	89.2
Phalaris arundinacea	87.7
Other (non-*Salix*) tree taxa	75.3
Mentha aquatica	71.0
Salix sp(p).	69.8
Myosotis scorpioides	65.0
Rhynchostegium riparioides	62.0
Epilobium hirsutum	53.9
Sparganium erectum	51.6
Amblystegium fluviatile	51.6
Juncus acutiflorus	49.9
Filipendula ulmaria	47.6
Fontinalis antipyretica	43.1
Conocephalum conicum	43.1
Veronica beccabunga	42.3
Solanum dulcamara	40.3
Oenanthe crocata	40.1
Glyceria fluitans	39.5
Equisetum arvense	39.3
Amblystegium riparium	37.3

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	98.2
Phalaris arundinacea	94.0
Rhynchostegium riparioides	89.4
Other (non-*Salix*) tree taxa	88.9
Fontinalis antipyretica	86.9
Salix sp(p).	85.6
Mentha aquatica	84.1
Verrucaria sp(p).	79.6
Myosotis scorpioides	77.6
Cladophora glomerata agg.	77.3
Sparganium erectum	77.1
Filipendula ulmaria	68.0
Juncus acutiflorus	67.5
Epilobium hirsutum	65.2
Amblystegium fluviatile	64.7
Conocephalum conicum	63.5
Veronica beccabunga	63.2
Vaucheria sp(p).	61.5
Solanum dulcamara	59.2
Equisetum arvense	58.2
Glyceria fluitans	56.7
Hildenbrandia rivularis	56.2
Juncus effusus	54.7
Oenanthe crocata	52.6
Amblystegium riparium	52.1
Filamentous green algae	51.6
Caltha palustris	50.6
Lemanea fluviatilis	47.6
Brachythecium rutabulum	47.4
Elodea canadensis	46.6

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	38	6	63
Height at source (m)	376	30	761
Altitude of site (m)	74	5	250
Slope (km per 15 m fall)	8.6	0.1	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	24.2	<0.25	74.6
5–10	29.7	0.25–0.5	52.0
10–20	37.5	0.5–1	8.0
>20	32.2	>1	14.9

Geological types represented in at least 10% of sites

Rock	*% of sites*
Soft sandstone	23.7
Hard sandstone	22.7
Hard limestone	16.9

Habitats

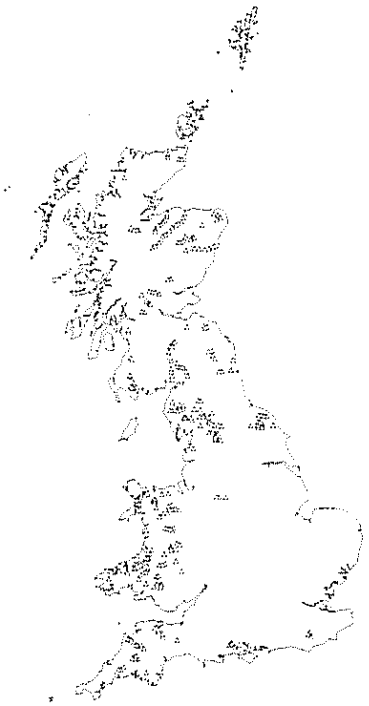
Habitat	*% of sites*
Pools	9.3
Slacks	84.4
Riffles	10.3
Runs	68.3
Rapids	8.3

Substrates

Substrate	*% of sites*
Silt/mud	10.8
Sand	11.1
Clay	6.3
Gravel	27.2
Pebbles	47.4
Cobbles	52.4
Boulders	26.4
Bedrock	9.3

Group C

No. of sites = 323



Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	81.4
Other (non-*Salix*) tree taxa	75.5
Rhynchostegium riparioides	70.3
Salix sp(p).	68.1
Juncus acutiflorus	64.7
Phalaris arundinacea	60.7
Fontinalis antipyretica	56.3
Mentha aquatica	55.7
Chiloscyphus polyanthos	54.8
Juncus effusus	54.5
Glyceria fluitans	51.4
Pellia epiphylla	51.1
Filipendula ulmaria	50.2
Myosotis scorpioides	47.4
Caltha palustris	47.4
Hygrohypnum ochraceum	44.6
Amblystegium fluviatile	44.6
Ranunculus flammula	44.3
Schistidium alpicola	39.0
Fontinalis squamosa	38.4

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	95.4
Rhynchostegium riparioides	85.4
Salix sp(p).	83.9
Other (non-*Salix*) tree taxa	83.3
Fontinalis antipyretica	80.2
Filamentous green algae	75.5
Juncus acutiflorus	74.0
Phalaris arundinacea	73.1
Juncus effusus	70.9
Verrucaria sp(p).	70.6
Mentha aquatica	68.1
Glyceria fluitans	67.5
Chiloscyphus polyanthos	67.5
Filipendula ulmaria	66.9
Pellia epiphylla	66.9
Caltha palustris	65.6
Myosotis scorpioides	60.1
Ranunculus flammula	57.6
Fontinalis squamosa	56.7
Hygrohypnum ochraceum	56.3
Ferns	54.2
Lemanea fluviatilis	54.2
Amblystegium fluviatile	53.6
Conocephalum conicum	53.3
Deschampsia cespitosa	51.1
Angelica sylvestris	49.5
Equisetum arvense	48.6
Brachythecium rivulare	48.6
Schistidium alpicola	48.3
Sagina procumbens	46.1

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	37	6	70
Height at source (m)	467	20	1,210
Altitude of site (m)	125	5	725
Slope (km per 15 m fall)	4.9	0.2	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	28.2	<0.25	79.9
5–10	41.8	0.25–0.5	42.4
10–20	36.8	0.5–1	9.3
>20	23.8	>1	10.8

Geological types represented in at least 10% of sites

Rock	*% of sites*
Non-calcareous shale	30.0
Hard sandstone	17.0
Hard limestone	13.6

Habitats

Habitat	*% of sites*
Pools	5.3
Slacks	66.9
Riffles	13.6
Runs	70.6
Rapids	35.3

Substrates

Substrate	*% of sites*
Silt/mud	7.7
Sand	7.7
Clay	1.5
Gravel	21.4
Pebbles	42.5
Cobbles	62.8
Boulders	44.9
Bedrock	18.9

Group D

No. of sites = 318

Top 20 dominant macrophytes

Taxon	*% of sites*
Pellia epiphylla	64.2
Juncus effusus	53.8
Juncus acutiflorus	50.3
Juncus bulbosus	48.4
Anthoxanthum odoratum	46.2
Racomitrium aciculare	45.9
Ranunculus flammula	45.6
Salix sp(p).	42.8
Scapania undulata	41.2
Other (non-*Salix*) tree taxa	39.9
Carex nigra	39.6
Agrostis stolonifera	38.7
Filamentous green algae	35.8
Sphagnum sp(p).	35.5
Potentilla erecta	33.6
Polytrichum commune	33.3
Molinia caerulea	32.7
Deschampsia cespitosa	32.7
Ferns	32.7
Glyceria fluitans	31.4

Top 30 macrophytes

Taxon	*% of sites*
Pellia epiphylla	83.0
Juncus effusus	82.7
Juncus bulbosus	77.7
Ranunculus flammula	73.6
Racomitrium aciculare	71.7
Filamentous green algae	71.4
Anthoxanthum odoratum	70.4
Salix sp(p).	61.0
Carex nigra	59.7
Agrostis stolonifera	59.4
Potentilla erecta	59.4
Sphagnum sp(p).	59.4
Juncus acutiflorus	58.8
Scapania undulata	57.5
Viola palustris	56.9
Ferns	56.9
Molinia caerulea	54.4
Polytrichum commune	54.1
Other (non-*Salix*) tree taxa	53.1
Deschampsia cespitosa	50.6
Glyceria fluitans	49.4
Nardus stricta	46.9
Caltha palustris	46.9
Fontinalis antipyretica	45.9
Galium palustre	44.7
Carex demissa	42.5
Achillea ptarmica	41.2
Sagina procumbens	40.6
Filipendula ulmaria	40.6
Bryum pseudotriquetrum	38.1

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	31	1	66
Height at source (m)	442	10	1,210
Altitude of site (m)	160	0	750
Slope (km per 15 m fall)	2.7	0.1	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	50.3	<0.25	73.3
5–10	40.6	0.25–0.5	51.6
10–20	28.9	0.5–1	24.4
>20	16.7	>1	11.0

Geological types represented in at least 10% of sites

Rock	*% of sites*
Non-calcareous shale	0.1
Hard sandstone	16.0
Hard limestone	10.1
Granite	11.0
Base-rich igneous	11.9
Other metamorphic	13.5
Schist	13.8

Habitats

Habitat	*% of sites*
Pools	12.9
Slacks	46.2
Riffles	41.5
Runs	49.4
Rapids	48.7

Substrates

Substrate	*% of sites*
Silt/mud	12.6
Sand	8.2
Clay	1.9
Gravel	19.2
Pebbles	36.2
Cobbles	60.4
Boulders	55.7
Bedrock	32.7

Annex B Site locations, physical features and macrophytes for Types I–X

Type I

No. of sites = 102

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	92.9
Glyceria maxima	85.9
Myosotis scorpioides	83.8
Agrostis stolonifera	80.8
Epilobium hirsutum	79.8
Carex riparia	76.8
Rorippa nasturtium-aquaticum agg.	76.8
Solanum dulcamara	72.7
Mentha aquatica	71.7
Sparganium erectum	70.7
Apium nodiflorum	69.7
Salix sp(p).	65.7
Veronica beccabunga	65.7
Eupatorium cannabinum	57.6
Lycopus europaeus	56.6
Scrophularia auriculata	54.5
Other (non-*Salix*) tree taxa	53.5
Symphytum officinale	52.5
Phragmites australis	50.5
Lythrum salicaria	47.5

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	100.0
Agrostis stolonifera	97.0
Myosotis scorpioides	96.0
Sparganium erectum	94.9
Mentha aquatica	93.9
Solanum dulcamara	92.9
Sparganium emersum	90.9
Epilobium hirsutum	90.9
Apium nodiflorum	90.9
Glyceria maxima	89.9
Veronica beccabunga	89.9
Rorippa nasturtium-aquaticum agg.	88.9
Carex riparia	87.9
Potamogeton pectinatus	84.8
Salix sp(p).	82.8
Sagittaria sagittifolia	78.8
Lycopus europaeus	76.8
Iris pseudacorus	74.7
Other (non-*Salix*) tree taxa	74.7
Nuphar lutea	74.7
Eupatorium cannabinum	74.7
Cladophora glomerata agg.	73.7
Elodea canadensis	72.7
Vaucheria sp(p).	72.7
Lemna minor	71.7
Callitriche stagnalis	71.7
Symphytum officinale	69.7
Scrophularia auriculata	69.7
Schoenoplectus lacustris	68.7
Juncus inflexus	68.7

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	46	29	67
Height at source (m)	108	25	229
Altitude (m)	38	0	200
Slope (km per 15 m fall)	20.1	2.3	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	7.1	<0.25	12.1
5–10	13.1	0.25–0.5	35.4
10–20	55.6	0.5–1	41.4
>20	37.4	>1	54.5

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Calcareous clay	36.4
Non-calcareous clay	22.2
Chalk	31.3

Habitats	
Habitat	*% of sites*
Pools	3.0
Slacks	93.9
Riffles	1.0
Runs	29.3
Rapids	1.0

Substrates	
Substrate	*% of sites*
Silt/mud	53.5
Sand	14.1
Clay	48.5
Gravel	44.4
Pebbles	20.2
Cobbles	3.0
Boulders	0.0
Bedrock	0.0

Type II

No. of sites = 164

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	87.8
Agrostis stolonifera	85.4
Epilobium hirsutum	81.7
Myosotis scorpioides	80.5
Sparganium erectum	75.6
Salix sp(p).	66.5
Veronica beccabunga	59.8
Solanum dulcamara	59.1
Mentha aquatica	58.5
Other (non-*Salix*) tree taxa	57.3
Rorippa nasturtium-aquaticum agg.	56.1
Glyceria maxima	53.7
Polygonum amphibium	51.8
Rorippa amphibia	47.6
Scrophularia auriculata	47.0
Lythrum salicaria	47.0
Nuphar lutea	44.5
Apium nodiflorum	41.5
Carex riparia	37.2
Schoenoplectus lacustris	36.0

Top 30 macrophytes

Taxon	% of sites
Phalaris arundinacea	98.2
Agrostis stolonifera	97.6
Sparganium erectum	92.1
Myosotis scorpioides	92.1
Epilobium hirsutum	90.2
Salix sp(p).	87.2
Solanum dulcamara	82.3
Cladophora glomerata agg.	79.9
Other (non-*Salix*) tree taxa	76.2
Mentha aquatica	74.4
Veronica beccabunga	73.8
Vaucheria sp(p).	73.8
Rorippa nasturtium-aquaticum agg.	71.3
Nuphar lutea	70.1
Sparganium emersum	68.9
Scrophularia auriculata	68.3
Polygonum amphibium	68.3
Potamogeton pectinatus	67.7
Enteromorpha sp(p).	67.1
Lemna minor	65.9
Glyceria maxima	65.9
Elodea canadensis	62.2
Schoenoplectus lacustris	60.4
Sagittaria sagittifolia	59.1
Apium nodiflorum	59.1
Rorippa amphibia	58.5
Callitriche stagnalis	56.7
Lythrum salicaria	56.1
Filipendula ulmaria	54.3
Alisma plantago-aquatica	51.8

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	38	10	61
Height at source (m)	158	25	640
Altitude (m)	47	10	200
Slope (km per 15 m fall)	18.7	4.2	>25

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	23.8	<0.25	35.4
5–10	51.2	0.25–0.5	48.8
10–20	42.1	0.5–1	33.5
>20	11.0	>1	35.4

Geological types represented in at least 10% of sites

Rock	% of sites
Calcareous clay	34.1
Non-calcareous clay	14.0
Soft sandstone	18.3
Other soft limestone	15.9

Habitats

Habitat	% of sites
Pools	7.9
Slacks	93.3
Riffles	4.9
Runs	31.7
Rapids	0.0

Substrates

Substrate	% of sites
Silt/mud	39.0
Sand	20.1
Clay	57.3
Gravel	42.1
Pebbles	14.0
Cobbles	4.9
Boulders	0.0
Bedrock	0.0

Type III

No. of sites = 90

Top 20 dominant macrophytes

Taxon	*% of sites*
Epilobium hirsutum	95.6
Myosotis scorpioides	92.2
Phalaris arundinacea	91.1
Mentha aquatica	87.8
Solanum dulcamara	81.1
Carex acutiformis	80.0
Agrostis stolonifera	80.0
Rorippa nasturtium-aquaticum agg.	75.6
Apium nodiflorum	75.6
Sparganium erectum	71.1
Glyceria maxima	68.9
Ranunculus penicillatus subsp. *pseudofluitans*	67.8
Salix sp(p).	66.7
Veronica beccabunga	65.6
Scrophularia auriculata	65.6
Other (non-*Salix*) tree taxa	64.4
Veronica anagallis-aquatica	64.4
Filipendula ulmaria	64.4
Iris pseudacorus	56.7
Carex riparia	56.7

Top 30 macrophytes

Taxon	*% of sites*
Epilobium hirsutum	100.0
Mentha aquatica	98.9
Phalaris arundinacea	97.8
Myosotis scorpioides	96.7
Sparganium erectum	95.6
Agrostis stolonifera	91.1
Solanum dulcamara	90.0
Carex acutiformis	88.9
Apium nodiflorum	88.9
Salix sp(p).	87.8
Veronica beccabunga	87.8
Rorippa nasturtium-aquaticum agg.	87.8
Filipendula ulmaria	87.8
Callitriche obtusangula	86.7
Ranunculus penicillatus subsp. *pseudofluitans*	85.6
Other (non-*Salix*) tree taxa	83.3
Veronica anagallis-aquatica	82.2
Scrophularia auriculata	82.2
Iris pseudacorus	77.8
Glyceria maxima	77.8
Juncus inflexus	74.4
Vaucheria sp(p).	74.4
Berula erecta	73.3
Eupatorium cannabinum	72.2
Callitriche stagnalis	70.0
Lythrum salicaria	66.7
Fontinalis antipyretica	66.7
Carex riparia	64.4
Lycopus europaeus	62.2
Cladophora glomerata agg.	61.1

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	42	12	60
Height at source (m)	111	25	229
Altitude (m)	54	15	168
Slope (km per 15 m fall)	11	2	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	26.7	<0.25	67.8
5–10	45.6	0.25–0.5	65.6
10–20	38.9	0.5–1	21.1
>20	12.2	>1	16.7

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Calcareous clay	12.2
Chalk	62.2
Other soft limestone	10.0

Habitats	
Habitat	*% of sites*
Pools	4.4
Slacks	90.0
Riffles	2.2
Runs	55.6
Rapids	1.1

Substrates	
Substrate	*% of sites*
Silt/mud	47.8
Sand	23.3
Clay	17.8
Gravel	80.0
Pebbles	14.4
Cobbles	4.4
Boulders	0.0
Bedrock	0.0

Type IV

No. of sites = 119

Top 20 dominant macrophytes

Taxon	% of sites
Agrostis stolonifera	80.7
Phalaris arundinacea	76.5
Myosotis scorpioides	70.6
Epilobium hirsutum	69.7
Other (non-*Salix*) tree taxa	62.2
Veronica beccabunga	57.1
Mentha aquatica	55.5
Solanum dulcamara	54.6
Salix sp(p).	53.8
Sparganium erectum	52.1
Apium nodiflorum	51.3
Rorippa nasturtium-aquaticum agg.	49.6
Filipendula ulmaria	49.6
Scrophularia auriculata	39.5
Juncus effusus	38.7
Glyceria fluitans	31.9
Juncus inflexus	29.4
Amblystegium riparium	27.7
Lythrum salicaria	25.2
Angelica sylvestris	24.4

Top 30 macrophytes

Taxon	% of sites
Agrostis stolonifera	98.3
Phalaris arundinacea	91.6
Myosotis scorpioides	89.9
Epilobium hirsutum	87.4
Sparganium erectum	81.5
Veronica beccabunga	79.0
Other (non-*Salix*) tree taxa	77.3
Salix sp(p).	75.6
Solanum dulcamara	75.6
Mentha aquatica	72.3
Rorippa nasturtium-aquaticum agg.	71.4
Scrophularia auriculata	69.7
Filipendula ulmaria	68.1
Apium nodiflorum	66.4
Juncus effusus	62.2
Cladophora glomerata agg.	54.6
Callitriche stagnalis	51.3
Vaucheria sp(p).	50.4
Juncus inflexus	49.6
Glyceria fluitans	47.9
Amblystegium riparium	45.4
Filamentous green algae	43.7
Angelica sylvestris	41.2
Lythrum salicaria	35.3
Eupatorium cannabinum	33.6
Sparganium emersum	31.9
Polygonum amphibium	31.9
Lemna minor	31.1
Equisetum arvense	31.1
Alisma plantago-aquatica	30.3

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	29	4	50
Height at source (m)	158	10	700
Altitude (m)	58	5	213
Slope (km per 15 m fall)	9.8	0.7	25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	70.6	<0.25	67.2
5–10	32.8	0.25–0.5	47.1
10–20	7.6	0.5–1	18.5
>20	5.0	>1	13.4

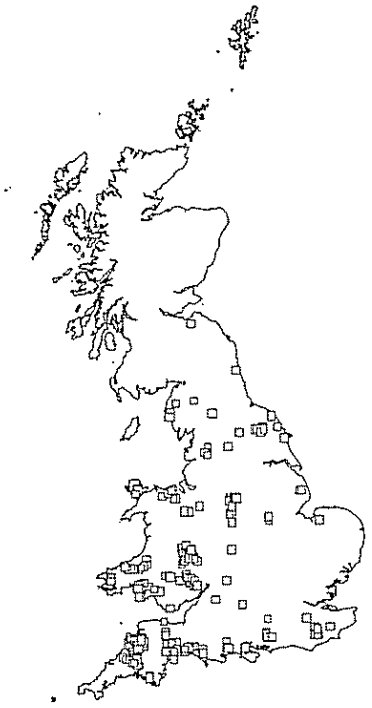
Geological types represented in at least 10% of sites	
Rock	% of sites
Calcareous clay	28.6
Non-calcareous clay	11.8
Soft sandstone	17.6
Chalk	10.1

Habitats	
Habitat	% of sites
Pools	4.2
Slacks	77.3
Riffles	11.8
Runs	48.7
Rapids	1.7

Substrates	
Substrate	% of sites
Silt/mud	38.7
Sand	21.0
Clay	27.7
Gravel	52.1
Pebbles	19.3
Cobbles	4.2
Boulders	1.7
Bedrock	0.8

Type V

No. of sites = 195



Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	85.1
Phalaris arundinacea	80.5
Other (non-*Salix*) tree taxa	80.5
Salix sp(p).	63.1
Mentha aquatica	62.6
Rhynchostegium riparioides	61.5
Oenanthe crocata	52.8
Conocephalum conicum	50.3
Solanum dulcamara	49.7
Epilobium hirsutum	49.7
Amblystegium fluviatile	47.2
Sparganium erectum	45.6
Amblystegium riparium	45.6
Myosotis scorpioides	44.6
Fontinalis antipyretica	44.1
Pellia endiviifolia	43.6
Juncus acutiflorus	40.0
Filipendula ulmaria	40.0
Glyceria fluitans	37.9
Veronica beccabunga	35.4

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	97.9
Other (non-*Salix*) tree taxa	96.9
Rhynchostegium riparioides	91.8
Phalaris arundinacea	89.2
Salix sp(p).	87.7
Fontinalis antipyretica	83.6
Mentha aquatica	76.9
Verrucaria sp(p).	76.9
Oenanthe crocata	74.4
Solanum dulcamara	73.8
Conocephalum conicum	73.8
Vaucheria sp(p).	72.8
Cladophora glomerata agg.	71.8
Sparganium erectum	70.8
Filipendula ulmaria	67.2
Amblystegium riparium	64.6
Epilobium hirsutum	64.1
Juncus acutiflorus	63.1
Myosotis scorpioides	62.1
Amblystegium fluviatile	60.5
Pellia endiviifolia	59.5
Glyceria fluitans	57.9
Veronica beccabunga	57.4
Lunularia cruciata	54.9
Chiloscyphus polyanthos	53.3
Juncus effusus	49.2
Hildenbrandia rivularis	49.2
Equisetum arvense	47.2
Brachythecium rutabulum	46.2
Lemanea fluviatilis	45.1

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	35	9	63
Height at source (m)	303	30	655
Altitude (m)	75	5	244
Slope (km per 15 m fall)	6.6	0.1	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	35.9	<0.25	80.0
5–10	36.9	0.25–0.5	54.4
10–20	37.4	0.5–1	9.7
>20	17.4	>1	7.7

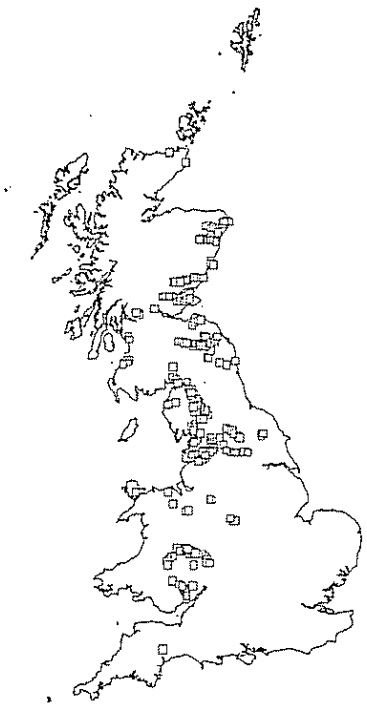
Geological types represented in at least 10% of sites	
Rock	*% of sites*
Calcareous shale	11.3
Soft sandstone	19.0
Hard sandstone	34.4
Hard limestone	11.8

Habitats	
Habitat	*% of sites*
Pools	10.3
Slacks	86.2
Riffles	13.8
Runs	65.1
Rapids	7.7

Substrates	
Substrate	*% of sites*
Silt/mud	10.8
Sand	7.2
Clay	8.7
Gravel	30.8
Pebbles	48.2
Cobbles	47.7
Boulders	22.1
Bedrock	8.2

Type VI

No. of sites = 202



Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	94.6
Agrostis stolonifera	93.1
Myosotis scorpioides	84.7
Mentha aquatica	79.2
Salix sp(p).	76.2
Other (non-*Salix*) tree taxa	70.3
Rhynchostegium riparioides	62.
Juncus acutiflorus	59.4
Epilobium hirsutum	57.9
Sparganium erectum	57.4
Amblystegium fluviatile	55.9
Mimulus guttatus	55.0
Filipendula ulmaria	55.0
Equisetum arvense	53.5
Veronica beccabunga	49.0
Juncus effusus	46.5
Rorippa sylvestris	46.0
Caltha palustris	46.0
Cinclidotus fontinaloides	43.6
Fontinalis antipyretica	42.1

Top 30 macrophytes

Taxon	% of sites
Phalaris arundinacea	98.5
Agrostis stolonifera	98.5
Myosotis scorpioides	92.6
Mentha aquatica	91.1
Fontinalis antipyretica	90.1
Rhynchostegium riparioides	87.1
Salix sp(p).	83.7
Sparganium erectum	83.2
Cladophora glomerata agg.	82.7
Verrucaria sp(p).	82.2
Other (non-*Salix*) tree taxa	81.2
Mimulus guttatus	73.3
Juncus acutiflorus	71.8
Veronica beccabunga	68.8
Filipendula ulmaria	68.8
Equisetum arvense	68.8
Amblystegium fluviatile	68.8
Epilobium hirsutum	66.3
Caltha palustris	66.3
Elodea canadensis	63.9
Filamentous green algae	62.9
Hildenbrandia rivularis	62.9
Juncus effusus	59.9
Glyceria fluitans	55.4
Polygonum amphibium	55.0
Conocephalum conicum	53.5
Rorippa sylvestris	52.0
Cinclidotus fontinaloides	52.0
Vaucheria sp(p).	50.5
Lemanea fluviatilis	50.0

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	40	6	60
Height at source (m)	447	61	761
Altitude (m)	72	5	250
Slope (km per 15 m fall)	10.5	0.9	25

Width (m)	% of sites	Depth (m)	% of sites
<5	12.9	<0.25	69.3
5–10	22.8	0.25–0.5	50.0
10–20	37.6	0.5–1	5.9
>20	46.5	>1	21.8

Geological types represented in at least 10% of sites	
Rock	% of sites
Soft sandstone	28.2
Hard sandstone	11.4
Hard limestone	21.8

Habitats	
Habitat	% of sites
Pools	8.4
Slacks	82.7
Riffles	6.9
Runs	71.3
Rapids	9.2

Substrates	
Substrate	% of sites
Silt/mud	10.9
Sand	14.9
Clay	4.0
Gravel	23.8
Pebbles	46.5
Cobbles	56.9
Boulders	30.7
Bedrock	10.4

Type VII

No. of sites = 76

Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	72.4
Juncus effusus	64.5
Glyceria fluitans	63.2
Other (non-*Salix*) tree taxa	63.2
Phalaris arundinacea	61.8
Salix sp(p).	61.8
Filipendula ulmaria	59.2
Juncus acutiflorus	52.6
Myosotis scorpioides	51.3
Mentha aquatica	48.7
Caltha palustris	40.8
Deschampsia cespitosa	35.5
Rhynchostegium riparioides	35.5
Fontinalis antipyretica	34.2
Pellia epiphylla	34.2
Sparganium erectum	31.6
Angelica sylvestris	31.6
Veronica beccabunga	30.3
Ranunculus flammula	30.3
Galium palustre	30.3

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	93.4
Juncus effusus	81.6
Phalaris arundinacea	80.3
Glyceria fluitans	78.9
Salix sp(p).	77.6
Filipendula ulmaria	71.1
Caltha palustris	71.1
Myosotis scorpioides	69.7
Other (non-*Salix*) tree taxa	68.4
Mentha aquatica	65.8
Fontinalis antipyretica	65.8
Angelica sylvestris	60.5
Juncus acutiflorus	57.9
Filamentous green algae	57.9
Deschampsia cespitosa	56.6
Rhynchostegium riparioides	56.6
Callitriche stagnalis	53.9
Ranunculus flammula	52.6
Sparganium erectum	47.4
Veronica beccabunga	47.4
Pellia epiphylla	44.7
Stachys palustris	43.4
Equisetum fluviatile	43.4
Galium palustre	42.1
Myriophyllum alterniflorum	40.8
Sagina procumbens	39.5
Senecio aquaticus	38.2
Rorippa nasturtium-aquaticum agg.	38.2
Callitriche hamulata	38.2
Ferns	36.8

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	31	6	55
Height at source (m)	373	20	810
Altitude (m)	125	5	725
Slope (km per 15 m fall)	6.1	0.5	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	40.8	<0.25	67.1
5–10	38.2	0.25–0.5	36.8
10–20	26.3	0.5–1	19.7
>20	18.4	>1	21.1

Geological types represented in at least 10% of sites

Rock	*% of sites*
Non-calcareous shale	17.1
Hard sandstone	19.7
Hard limestone	25.0

Habitats

Habitat	*% of sites*
Pools	7.9
Slacks	56.6
Riffles	30.3
Runs	59.2
Rapids	9.2

Substrates

Substrate	*% of sites*
Silt/mud	26.3
Sand	19.7
Clay	5.3
Gravel	39.5
Pebbles	46.1
Cobbles	48.7
Boulders	22.4
Bedrock	11.8

Type VIII

No. of sites = 247

Top 20 dominant macrophytes

Taxon	% of sites
Agrostis stolonifera	84.2
Rhynchostegium riparioides	81.0
Other (non-*Salix*) tree taxa	79.4
Salix sp(p).	70.0
Juncus acutiflorus	68.4
Chiloscyphus polyanthos	65.2
Fontinalis antipyretica	63.2
Phalaris arundinacea	60.3
Mentha aquatica	57.9
Pellia epiphylla	56.3
Hygrohypnum ochraceum	54.7
Amblystegium fluviatile	53.4
Juncus effusus	51.4
Caltha palustris	49.4
Ranunculus flammula	48.6
Schistidium alpicola	48.2
Glyceria fluitans	47.8
Filipendula ulmaria	47.4
Fontinalis squamosa	47.0
Myosotis scorpioides	46.2

Top 30 macrophytes

Taxon	% of sites
Agrostis stolonifera	96.0
Rhynchostegium riparioides	94.3
Other (non-*Salix*) tree taxa	87.9
Salix sp(p).	85.8
Fontinalis antipyretica	84.6
Verrucaria sp(p).	84.2
Filamentous green algae	81.0
Chiloscyphus polyanthos	79.8
Juncus acutiflorus	78.9
Pellia epiphylla	73.7
Phalaris arundinacea	70.9
Mentha aquatica	68.8
Lemanea fluviatilis	68.8
Hygrohypnum ochraceum	68.0
Juncus effusus	67.6
Fontinalis squamosa	67.6
Filipendula ulmaria	65.6
Conocephalum conicum	64.8
Amblystegium fluviatile	64.4
Glyceria fluitans	64.0
Caltha palustris	64.0
Ferns	59.5
Ranunculus flammula	59.1
Schistidium alpicola	58.7
Brachythecium rivulare	57.5
Myosotis scorpioides	57.1
Scapania undulata	55.9
Equisetum arvense	53.8
Thamnobryum alopecurum	53.8
Deschampsia cespitosa	49.4

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	39	7	70
Height at source (m)	496	100	1,210
Altitude (m)	125	10	425
Slope (km per 15 m fall)	4.5	0.2	>25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	24.3	<0.25	83.8
5–10	42.9	0.25–0.5	44.1
10–20	40.1	0.5–1	6.1
>20	25.5	>1	7.7

Geological types represented in at least 10% of sites	
Rock	% of sites
Non-calcareous shale	34.0
Hard sandstone	16.2
Hard limestone	10.1

Habitats	
Habitat	% of sites
Pools	4.5
Slacks	70.0
Riffles	8.5
Runs	74.1
Rapids	43.3

Substrates	
Substrate	% of sites
Silt/mud	2.0
Sand	4.0
Clay	0.4
Gravel	15.8
Pebbles	40.1
Cobbles	67.2
Boulders	51.8
Bedrock	21.1

Type IX

No. of sites = 90

Top 20 dominant macrophytes

Taxon	*% of sites*
Juncus effusus	53.3
Juncus bulbosus	52.2
Ranunculus flammula	51.1
Carex nigra	47.8
Glyceria fluitans	46.7
Pellia epiphylla	46.7
Juncus acutiflorus	41.1
Equisetum fluviatile	40.0
Carex rostrata	38.9
Agrostis stolonifera	37.8
Salix sp(p).	35.6
Filipendula ulmaria	35.6
Caltha palustris	34.4
Eleocharis palustris	33.3
Myriophyllum alterniflorum	31.1
Juncus articulatus	28.9
Deschampsia cespitosa	28.9
Other (non-*Salix*) tree taxa	28.9
Galium palustre	28.9
Ferns	27.8

Top 30 macrophytes

Taxon	*% of sites*
Juncus effusus	87.8
Juncus bulbosus	84.4
Ranunculus flammula	84.4
Glyceria fluitans	77.8
Carex nigra	75.6
Caltha palustris	70.0
Pellia epiphylla	68.9
Agrostis stolonifera	64.4
Equisetum fluviatile	63.3
Galium palustre	61.1
Myriophyllum alterniflorum	58.9
Eleocharis palustris	57.8
Salix sp(p).	57.8
Viola palustris	57.8
Filamentous green algae	57.8
Juncus articulatus	56.7
Filipendula ulmaria	55.6
Angelica sylvestris	54.4
Ferns	54.4
Carex rostrata	53.3
Molinia caerulea	50.0
Sphagnum sp(p).	50.0
Anthoxanthum odoratum	48.9
Potamogeton polygonifolius	47.8
Potamogeton natans	47.8
Fontinalis antipyretica	47.8
Juncus acutiflorus	46.7
Deschampsia cespitosa	45.6
Other (non-*Salix*) tree taxa	45.6
Myosotis scorpioides	44.4

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	31	3	62
Height at source (m)	306	10	950
Altitude (m)	76	0	725
Slope (km per 15 m fall)	4.7	0.1	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	50.0	<0.25	58.9
5–10	34.4	0.25–0.5	54.4
10–20	31.1	0.5–1	35.6
>20	20.0	>1	23.3

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	15.6
Hard limestone	11.1
Base-rich igneous	17.8
Other metamorphic	26.7

Habitats

Habitat	*% of sites*
Pools	26.7
Slacks	62.2
Riffles	43.3
Runs	40.0
Rapids	25.6

Substrates

Substrate	*% of sites*
Silt/mud	38.9
Sand	23.3
Clay	5.6
Gravel	25.6
Pebbles	34.4
Cobbles	35.6
Boulders	31.1
Bedrock	16.7

Type X

No. of sites = 228

Top 20 dominant macrophytes

Taxon	% of sites
Pellia epiphylla	71.1
Racomitrium aciculare	57.0
Anthoxanthum odoratum	55.7
Juncus effusus	53.9
Juncus acutiflorus	53.9
Scapania undulata	52.2
Juncus bulbosus	46.9
Salix sp(p).	45.6
Other (non-*Salix*) tree taxa	44.3
Ranunculus flammula	43.4
Polytrichum commune	41.7
Potentilla erecta	39.9
Filamentous green algae	39.5
Agrostis stolonifera	39.0
Sphagnum sp(p).	38.6
Molinia caerulea	37.7
Carex nigra	36.4
Bryum pseudotriquetrum	36.4
Nardus stricta	36.0
Ferns	34.6

Top 30 macrophytes

Taxon	% of sites
Pellia epiphylla	88.6
Racomitrium aciculare	82.5
Juncus effusus	80.7
Anthoxanthum odoratum	78.9
Filamentous green algae	76.8
Juncus bulbosus	75.0
Scapania undulata	71.1
Ranunculus flammula	69.3
Potentilla erecta	66.2
Polytrichum commune	65.4
Juncus acutiflorus	63.6
Sphagnum sp(p).	63.2
Salix sp(p).	62.3
Nardus stricta	61.0
Ferns	57.9
Agrostis stolonifera	57.5
Viola palustris	56.6
Molinia caerulea	56.1
Other (non-*Salix*) tree taxa	56.1
Carex nigra	53.5
Deschampsia cespitosa	52.6
Sagina procumbens	46.5
Hyocomium armoricum	46.5
Bryum pseudotriquetrum	46.1
Carex demissa	45.6
Fontinalis antipyretica	45.2
Brachythecium plumosum	45.2
Marsupella emarginata	45.2
Achillea ptarmica	40.8
Jungermannia atrovirens agg.	39.9

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	31	1	66
Height at source (m)	496	100	1,210
Altitude (m)	193	5	750
Slope (km per 15 m fall)	1.9	0.1	25

Width (m)	% of sites	Depth (m)	% of sites
<5	50.4	<0.25	78.9
5–10	43.0	0.25–0.5	50.4
10–20	28.1	0.5–1	18.9
>20	15.4	>1	6.1

Width and depth

Geological types represented in at least 10% of sites

Rock	% of sites
Non-calcareous shale	13.2
Hard sandstone	16.2
Granite	11.8
Schist	16.7

Habitats

Habitat	% of sites
Pools	7.5
Slacks	39.9
Riffles	40.8
Runs	53.1
Rapids	57.9

Substrates

Substrate	% of sites
Silt/mud	2.2
Sand	0.4
Clay	0.4
Gravel	16.7
Pebbles	36.8
Cobbles	70.2
Boulders	65.4
Bedrock	39.0

Annex C Site locations, physical features and macrophytes for sub-types AIa–AIVc

Sub-type AIa

No. of sites = 18

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	88.9
Glyceria maxima	88.9
Phragmites australis	83.3
Salix sp(p).	83.3
Sparganium erectum	77.8
Potamogeton pectinatus	77.8
Solanum dulcamara	77.8
Eupatorium cannabinum	77.8
Epilobium hirsutum	77.8
Rorippa nasturtium-aquaticum agg.	72.2
Myosotis scorpioides	72.2
Apium nodiflorum	72.2
Symphytum officinale	66.7
Stachys palustris	66.7
Oenanthe crocata	66.7
Lycopus europaeus	66.7
Agrostis stolonifera	61.1
Mentha aquatica	61.1
Other (non-*Salix*) tree taxa	55.6
Sparganium emersum	50.0

Top 30 macrophytes

Taxon	*% of sites*
Sparganium erectum	100.0
Sparganium emersum	100.0
Phalaris arundinacea	100.0
Symphytum officinale	100.0
Stachys palustris	100.0
Oenanthe crocata	100.0
Mentha aquatica	100.0
Potamogeton perfoliatus	94.4
Potamogeton pectinatus	94.4
Phragmites australis	94.4
Elodea canadensis	94.4
Agrostis stolonifera	94.4
Salix sp(p).	94.4
Solanum dulcamara	94.4
Rorippa nasturtium-aquaticum agg.	94.4
Nuphar lutea	94.4
Myosotis scorpioides	94.4
Lycopus europaeus	94.4
Apium nodiflorum	94.4
Iris pseudacorus	88.9
Glyceria maxima	88.9
Butomus umbellatus	88.9
Veronica beccabunga	88.9
Myriophyllum spicatum	88.9
Eupatorium cannabinum	88.9
Epilobium hirsutum	88.9
Schoenoplectus lacustris	83.3
Sagittaria sagittifolia	83.3
Lemna minor	83.3
Ranunculus penicillatus subsp. *pseudofluitans*	83.3

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	53	44	67
Height at source (m)	158	137	200
Altitude (m)	77	2	200
Slope (km per 15 m fall)	19.9	11.7	23

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	5.6	<0.25	0
5–10	0	0.25–0.5	16.7
10–20	5.6	0.5–1	38.9
>20	94.4	>1	83.3

Geological types represented in at least 10% of sites

Rock	*% of sites*
Non-calcareous clay	66.7
Chalk	33.3

Habitats

Habitat	*% of sites*
Pools	5.6
Slacks	94.4
Riffles	0
Runs	22.2
Rapids	0

Substrates

Substrate	*% of sites*
Silt/mud	38.9
Sand	0
Clay	83.3
Gravel	55.6
Pebbles	38.9
Cobbles	11.1
Boulders	0
Bedrock	0

Sub-type AIb

No. of sites = 23

Top 20 dominant macrophytes

Taxon	% of sites
Myosotis scorpioides	91.3
Sparganium erectum	87.0
Phalaris arundinacea	87.0
Carex riparia	87.0
Symphytum officinale	87.0
Rorippa nasturtium-aquaticum agg.	87.0
Lycopus europaeus	87.0
Epilobium hirsutum	87.0
Glyceria maxima	82.6
Agrostis stolonifera	82.6
Salix sp(p).	82.6
Solanum dulcamara	82.6
Veronica beccabunga	78.3
Scrophularia auriculata	73.9
Sparganium emersum	69.6
Iris pseudacorus	69.6
Mentha aquatica	69.6
Apium nodiflorum	69.6
Other (non-*Salix*) tree taxa	65.2
Veronica anagallis-aquatica	60.9

Top 30 macrophytes

Taxon	% of sites
Sparganium erectum	100.0
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Solanum dulcamara	100.0
Myosotis scorpioides	100.0
Sagittaria sagittifolia	95.7
Lemna minor	95.7
Iris pseudacorus	95.7
Carex riparia	95.7
Veronica beccabunga	95.7
Lycopus europaeus	95.7
Apium nodiflorum	95.7
Sparganium emersum	91.3
Glyceria maxima	91.3
Salix sp(p).	91.3
Symphytum officinale	91.3
Scrophularia auriculata	91.3
Rorippa nasturtium-aquaticum agg.	91.3
Epilobium hirsutum	91.3
Potamogeton pectinatus	87.0
Other (non-*Salix*) tree taxa	87.0
Ranunculus penicillatus subsp. *pseudofluitans*	87.0
Mentha aquatica	87.0
Callitriche stagnalis	82.6
Cladophora glomerata agg.	82.6
Schoenoplectus lacustris	73.9
Nuphar lutea	73.9
Eupatorium cannabinum	73.9
Carex acutiformis	69.6
Veronica anagallis-aquatica	69.6

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	45	35	53
Height at source (m)	100	46	160
Altitude (m)	45	0	90
Slope (km per 15 m fall)	17.7	2.3	>25

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	8.7	<0.25	4.3
5–10	13.0	0.25–0.5	69.6
10–20	78.3	0.5–1	82.6
>20	30.4	>1	26.1

Geological types represented in at least 10% of sites

Rock	% of sites
Non-calcareous clay	34.8
Chalk	56.0

Habitats

Habitat	% of sites
Pools	0
Slacks	82.6
Riffles	4.3
Runs	43.5
Rapids	4.3

Substrates

Substrate	% of sites
Silt/mud	43.5
Sand	8.7
Clay	30.4
Gravel	60.9
Pebbles	47.8
Cobbles	0
Boulders	0
Bedrock	0

Sub-type AIc

No. of sites = 58

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	96.6
Glyceria maxima	86.2
Agrostis stolonifera	86.2
Myosotis scorpioides	84.5
Carex riparia	82.8
Epilobium hirsutum	77.6
Mentha aquatica	75.9
Rorippa nasturtium-aquaticum agg.	74.1
Apium nodiflorum	69.0
Solanum dulcamara	67.2
Veronica beccabunga	65.5
Sparganium erectum	62.1
Juncus inflexus	53.4
Salix sp(p).	53.4
Phragmites australis	50.0
Scrophularia auriculata	50.0
Eupatorium cannabinum	50.0
Other (non-*Salix*) tree taxa	48.3
Lythrum salicaria	48.3
Carex acutiformis	43.1

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	100.0
Agrostis stolonifera	96.6
Carex riparia	94.8
Myosotis scorpioides	94.8
Mentha aquatica	94.8
Sparganium erectum	91.4
Epilobium hirsutum	91.4
Glyceria maxima	89.7
Solanum dulcamara	89.7
Vaucheria sp(p).	89.7
Sparganium emersum	87.9
Veronica beccabunga	87.9
Apium nodiflorum	87.9
Rorippa nasturtium-aquaticum agg.	86.2
Potamogeton pectinatus	81.0
Elodea canadensis	79.3
Salix sp(p).	75.9
Myriophyllum spicatum	74.1
Callitriche stagnalis	72.4
Sagittaria sagittifolia	70.7
Juncus inflexus	70.7
Eupatorium cannabinum	70.7
Phragmites australis	69.0
Other (non-*Salix*) tree taxa	69.0
Nuphar lutea	69.0
Cladophora glomerata agg.	67.2
Enteromorpha sp(p).	67.2
Lythrum salicaria	63.8
Lycopus europaeus	63.8
Schoenoplectus lacustris	62.1

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	45	29	60
Height at source (m)	95	25	229
Altitude (m)	24	15	92
Slope (km per 15 m fall)	21.2	9.8	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	6.9	<0.25	19.0
5–10	17.2	0.25–0.5	27.6
10–20	62.1	0.5–1	25.9
>20	22.4	>1	56.9

Geological types represented in at least 10% of sites

Rock	*% of sites*
Alluvium	12.1
Calcareous clay	60.3
Chalk	20.7

Habitats

Habitat	*% of sites*
Pools	3.4
Slacks	98.3
Riffles	0
Runs	25.9
Rapids	0

Substrates

Substrate	*% of sites*
Silt/mud	62.1
Sand	20.7
Clay	44.8
Gravel	34.5
Pebbles	3.4
Cobbles	1.7
Boulders	0
Bedrock	0

Sub-type AIIa

No. of sites = 54

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	90.7
Agrostis stolonifera	90.7
Myosotis scorpioides	88.9
Sparganium erectum	87.0
Salix sp(p).	85.2
Epilobium hirsutum	83.3
Other (non-*Salix*) tree taxa	75.9
Nuphar lutea	74.1
Glyceria maxima	70.4
Mentha aquatica	70.4
Veronica beccabunga	68.5
Scrophularia auriculata	68.5
Solanum dulcamara	66.7
Rorippa amphibia	61.1
Polygonum amphibium	61.1
Rorippa nasturtium-aquaticum agg.	59.3
Scirpus lacustris	55.6
Juncus effusus	55.6
Alisma plantago-aquatica	55.6
Lythrum salicaria	53.7

Top 30 macrophytes

Taxon	% of sites
Myosotis scorpioides	100.0
Sparganium erectum	98.1
Phalaris arundinacea	98.1
Salix sp(p).	98.1
Agrostis stolonifera	96.3
Nuphar lutea	96.3
Epilobium hirsutum	90.7
Solanum dulcamara	88.9
Sagittaria sagittifolia	83.3
Other (non-*Salix*) tree taxa	83.3
Mentha aquatica	83.3
Glyceria maxima	81.5
Scrophularia auriculata	81.5
Schoenoplectus lacustris	77.8
Sparganium emersum	75.9
Veronica beccabunga	75.9
Filipendula ulmaria	75.9
Polygonum amphibium	74.1
Alisma plantago-aquatica	72.2
Rorippa amphibia	72.2
Lemna minor	70.4
Rorippa nasturtium-aquaticum agg.	70.4
Callitriche stagnalis	70.4
Elodea canadensis	64.8
Lythrum salicaria	64.8
Enteromorpha sp(p).	64.8
Juncus inflexus	63.0
Veronica catenata	63.0
Apium nodiflorum	61.1
Cladophora glomerata agg.	61.1

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	42	23	58
Height at source (m)	139	25	190
Altitude (m)	64	10	170
Slope (km per 15 m fall)	19.6	1.5	>25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	42.6	<0.25	33.3
5–10	53.7	0.25–0.5	50.0
10–20	25.9	0.5–1	33.3
>20	1.9	>1	33.3

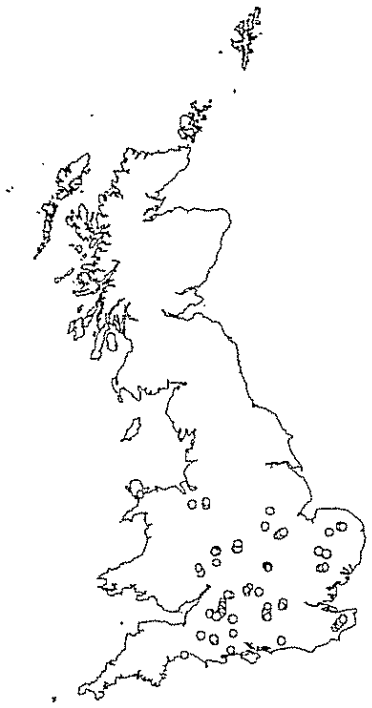
Geological types represented in at least 10% of sites	
Rock	% of sites
Calcareous clay	53.7
Non-calcareous clay	18.5
Other soft limestone	14.8

Habitats	
Habitat	% of sites
Pools	7.4
Slacks	98.1
Riffles	3.7
Runs	24.1
Rapids	0

Substrates	
Substrate	% of sites
Silt/mud	35.2
Sand	5.6
Clay	87.0
Gravel	29.6
Pebbles	3.7
Cobbles	1.9
Boulders	0
Bedrock	0

Sub-type AIIb

No. of sites = 71



Top 20 dominant macrophytes

Taxon	*% of sites*
Epilobium hirsutum	91.5
Phalaris arundinacea	83.1
Agrostis stolonifera	83.1
Myosotis scorpioides	80.3
Sparganium erectum	78.9
Salix sp(p).	66.2
Other (non-*Salix*) tree taxa	64.8
Solanum dulcamara	64.8
Lythrum salicaria	59.2
Mentha aquatica	56.3
Rorippa nasturtium-aquaticum agg.	54.9
Veronica beccabunga	53.5
Scrophularia auriculata	49.3
Polygonum amphibia	46.5
Lycopus europaeus	45.1
Glyceria maxima	43.7
Symphytum officinale	43.7
Rorippa amphibia	43.7
Apium nodiflorum	43.7
Potamogeton pectinatus	40.8

Top 30 macrophytes

Taxon	*% of sites*
Epilobium hirsutum	100.0
Sparganium erectum	98.6
Agrostis stolonifera	98.6
Phalaris arundinacea	97.2
Other (non-*Salix*) tree taxa	94.4
Salix sp(p).	94.4
Myosotis scorpioides	93.0
Solanum dulcamara	88.7
Cladophora glomerata agg.	87.3
Potamogeton pectinatus	84.5
Mentha aquatica	80.3
Vaucheria sp(p).	78.9
Scrophularia auriculata	77.5
Sparganium emersum	76.1
Rorippa nasturtium-aquaticum agg.	76.1
Veronica beccabunga	73.2
Nuphar lutea	71.8
Lythrum salicaria	70.4
Apium nodiflorum	64.8
Ranunculus penicillatus subsp. *pseudofluitans*	63.4
Enteromorpha sp(p).	63.4
Schoenoplectus lacustris	62.0
Polygonum amphibium	62.0
Sagittaria sagittifolia	60.6
Lemna minor	60.6
Lycopus europaeus	60.6
Amblystegium riparium	60.6
Glyceria maxima	59.2
Rorippa amphibia	59.2
Myriophyllum spicatum	59.2

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	40	18	61
Height at source (m)	151	61	640
Altitude (m)	48	10	200
Slope (km per 15 m fall)	17.1	4.2	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	19.7	<0.25	39.4
5–10	47.9	0.25–0.5	50.7
10–20	52.1	0.5–1	36.6
>20	11.3	>1	32.4

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous clay	29.6
Non-calcareous clay	15.5
Soft sandstone	22.5
Other soft limestone	15.5

Habitats

Habitat	*% of sites*
Pools	9.9
Slacks	88.7
Riffles	5.6
Runs	40.8
Rapids	0

Substrates

Substrate	*% of sites*
Silt/mud	39.4
Sand	28.2
Clay	40.8
Gravel	54.9
Pebbles	25.4
Cobbles	7.0
Boulders	0.0
Bedrock	0.0

Sub-type AIIc

No. of sites = 39

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	89.7
Agrostis stolonifera	82.1
Myosotis scorpioides	66.7
Veronica beccabunga	61.5
Epilobium hirsutum	59.0
Rorippa nasturtium-aquaticum agg.	53.8
Sparganium erectum	51.3
Potamogeton pectinatus	46.2
Polygonum amphibium	46.2
Glyceria maxima	43.6
Mentha aquatica	41.0
Salix sp(p).	38.5
Solanum dulcamara	35.9
Rorippa amphibia	35.9
Cladophora glomerata agg.	30.8
Alopecurus geniculatus	28.2
Apium nodiflorum	28.2
Enteromorpha sp(p).	25.6
Vaucheria sp(p).	25.6
Juncus inflexus	23.1

Top 30 macrophytes

Taxon	% of sites
Phalaris arundinacea	97.4
Agrostis stolonifera	97.4
Cladophora glomerata agg.	92.3
Potamogeton pectinatus	89.7
Vaucheria sp(p).	82.1
Myosotis scorpioides	79.5
Enteromorpha sp(p).	74.4
Sparganium erectum	71.8
Veronica beccabunga	71.8
Polygonum amphibium	69.2
Epilobium hirsutum	69.2
Lemna minor	66.7
Elodea canadensis	66.7
Rorippa nasturtium-aquaticum agg.	64.1
Solanum dulcamara	61.5
Salix sp(p).	59.0
Potamogeton perfoliatus	51.3
Glyceria maxima	51.3
Mentha aquatica	51.3
Myriophyllum spicatum	48.7
Apium nodiflorum	48.7
Potamogeton crispus	46.2
Ranunculus sceleratus	46.2
Sparganium emersum	43.6
Juncus inflexus	41.0
Callitriche stagnalis	41.0
Juncus effusus	38.5
Rorippa amphibia	38.5
Glyceria fluitans	35.9
Elodea nuttallii	35.9

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	30	10	47
Height at source (m)	195	25	640
Altitude (m)	23	10	65
Slope (km per 15 m fall)	20.2	4.3	>25

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	10.3	<0.25	35.9
5–10	51.3	0.25–0.5	41.0
10–20	46.2	0.5–1	23.1
>20	20.5	>1	43.6

Geological types represented in at least 10% of sites

Rock	% of sites
Alluvium	28.2
Calcareous clay	17.9
Soft sandstone	25.6
Other soft limestone	12.8

Habitats

Habitat	% of sites
Pools	5.1
Slacks	94.9
Riffles	2.6
Runs	25.6
Rapids	0

Substrates

Substrate	% of sites
Silt/mud	41.0
Sand	25.6
Clay	43.6
Gravel	35.9
Pebbles	7.7
Cobbles	2.6
Boulders	0
Bedrock	0

Sub-type AIIIa

No. of sites = 19

Top 20 dominant macrophytes

Taxon	*% of sites*
Carex acutiformis	100.0
Ranunculus penicillatus subsp. *pseudofluitans*	94.7
Epilobium hirsutum	94.7
Sparganium erectum	89.5
Phalaris arundinacea	89.5
Myosotis scorpioides	89.5
Mentha aquatica	89.5
Solanum dulcamara	78.9
Rorippa nasturtium-aquaticum agg.	78.9
Eupatorium cannabinum	78.9
Iris pseudacorus	73.7
Glyceria maxima	73.7
Symphytum officinale	73.7
Lythrum salicaria	73.7
Filipendula ulmaria	73.7
Apium nodiflorum	73.7
Carex paniculata	63.2
Rumex hydrolapathum	63.2
Lycopus europaeus	63.2
Impatiens capensis	63.2

Top 30 macrophytes

Taxon	*% of sites*
Sparganium erectum	100.0
Phalaris arundinacea	100.0
Carex acutiformis	100.0
Ranunculus penicillatus subsp. *pseudofluitans*	100.0
Myosotis scorpioides	100.0
Mentha aquatica	100.0
Lycopus europaeus	100.0
Epilobium hirsutum	100.0
Callitriche obtusangula	100.0
Apium nodiflorum	100.0
Fontinalis antipyretica	100.0
Solanum dulcamara	94.7
Rumex hydrolapathum	94.7
Lythrum salicaria	94.7
Filipendula ulmaria	94.7
Eupatorium cannabinum	94.7
Callitriche platycarpa	94.7
Iris pseudacorus	89.5
Rorippa nasturtium-aquaticum agg.	89.5
Impatiens capensis	89.5
Berula erecta	89.5
Zannichellia palustris	84.2
Glyceria maxima	84.2
Elodea canadensis	84.2
Agrostis stolonifera	84.2
Salix sp(p).	84.2
Veronica anagallis-aquatica	84.2
Vaucheria sp(p).	84.2
Phragmites australis	78.9
Carex paniculata	78.9

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	51	41	60
Height at source (m)	83	76	107
Altitude (m)	33	15	65
Slope (km per 15 m fall)	11.8	5	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	0	<0.25	52.6
5–10	15.8	0.25–0.5	63.2
10–20	84.2	0.5–1	21.1
>20	36.8	>1	21.1

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Chalk	94.7

Habitats	
Habitat	*% of sites*
Pools	10.5
Slacks	94.7
Riffles	0
Runs	47.4
Rapids	0

Substrates	
Substrate	*% of sites*
Silt/mud	31.6
Sand	10.5
Clay	21.1
Gravel	84.2
Pebbles	21.1
Cobbles	0
Boulders	0
Bedrock	0

Sub-type AIIIb

No. of sites = 71

Top 20 dominant macrophytes

Taxon	% of sites
Epilobium hirsutum	95.8
Myosotis scorpioides	93.0
Phalaris arundinacea	91.5
Mentha aquatica	87.3
Agrostis stolonifera	85.9
Solanum dulcamara	81.7
Apium nodiflorum	76.1
Carex acutiformis	74.6
Rorippa nasturtium-aquaticum agg.	74.6
Other (non-*Salix*) tree taxa	73.2
Scrophularia auriculata	71.8
Salix sp(p).	70.4
Veronica beccabunga	70.4
Veronica anagallis-aquatica	69.0
Glyceria maxima	67.6
Sparganium erectum	66.2
Filipendula ulmaria	62.0
Ranunculus penicillatus subsp. *pseudofluitans*	60.6
Carex riparia	56.3
Iris pseudacorus	52.1

Top 30 macrophytes

Taxon	% of sites
Epilobium hirsutum	100.0
Mentha aquatica	98.6
Phalaris arundinacea	97.2
Myosotis scorpioides	95.8
Sparganium erectum	94.4
Agrostis stolonifera	93.0
Veronica beccabunga	91.5
Other (non-*Salix*) tree taxa	90.1
Salix sp(p).	88.7
Solanum dulcamara	88.7
Rorippa nasturtium-aquaticum agg.	87.3
Carex acutiformis	85.9
Scrophularia auriculata	85.9
Filipendula ulmaria	85.9
Apium nodiflorum	85.9
Callitriche obtusangula	83.1
Veronica anagallis-aquatica	81.7
Ranunculus penicillatus subsp. *pseudofluitans*	81.7
Glyceria maxima	76.1
Juncus inflexus	74.6
Iris pseudacorus	74.6
Callitriche stagnalis	73.2
Vaucheria sp(p).	71.8
Berula erecta	69.0
Eupatorium cannabinum	66.2
Carex riparia	63.4
Lythrum salicaria	59.2
Cladophora glomerata agg.	59.2
Fontinalis antipyretica	57.7
Symphytum officinale	54.9

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	39	12	57
Height at source (m)	118	25	229
Altitude (m)	60	15	168
Slope (km per 15 m fall)	10.7	2	>25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	33.8	<0.25	71.8
5–10	53.5	0.25–0.5	66.2
10–20	26.8	0.5–1	21.1
>20	5.6	>1	15.5

Geological types represented in at least 10% of sites	
Rock	% of sites
Calcareous clay	15.5
Chalk	53.5
Other soft limestone	12.7

Habitats	
Habitat	% of sites
Pools	2.8
Slacks	88.7
Riffles	2.8
Runs	57.7
Rapids	1.4

Substrates	
Substrate	% of sites
Silt/mud	52.1
Sand	26.8
Clay	16.9
Gravel	78.9
Pebbles	12.7
Cobbles	5.6
Boulders	0
Bedrock	0

Sub-type AIVa

No. of sites = 86

Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	82.6
Myosotis scorpioides	76.7
Phalaris arundinacea	75.6
Epilobium hirsutum	75.6
Other (non-*Salix*) tree taxa	66.3
Veronica beccabunga	64.0
Solanum dulcamara	61.6
Apium nodiflorum	60.5
Rorippa nasturtium-aquaticum agg.	59.3
Mentha aquatica	59.3
Salix sp(p).	57.0
Sparganium erectum	53.5
Scrophularia auriculata	46.5
Filipendula ulmaria	46.5
Juncus inflexus	36.0
Amblystegium riparium	36.0
Juncus effusus	32.6
Cladophora glomerata agg.	32.6
Glyceria fluitans	31.4
Brachythecium rutabulum	25.6

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	97.7
Epilobium hirsutum	94.2
Phalaris arundinacea	93.0
Myosotis scorpioides	93.0
Veronica beccabunga	87.2
Solanum dulcamara	86.0
Rorippa nasturtium-aquaticum agg.	84.9
Other (non-*Salix*) tree taxa	83.7
Sparganium erectum	82.6
Salix sp(p).	79.1
Apium nodiflorum	79.1
Scrophularia auriculata	77.9
Mentha aquatica	76.7
Cladophora glomerata agg.	68.6
Filipendula ulmaria	65.1
Vaucheria sp(p).	60.5
Juncus inflexus	59.3
Juncus effusus	58.1
Amblystegium riparium	58.1
Callitriche stagnalis	52.3
Filamentous green algae	45.3
Glyceria fluitans	43.0
Callitriche platycarpa	39.5
Lemna minor	37.2
Brachythecium rutabulum	37.2
Veronica anagallis-aquatica	34.9
Angelica sylvestris	34.9
Equisetum arvense	33.7
Glyceria maxima	32.6
Eupatorium cannabinum	32.6

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	30	7	43
Height at source (m)	151	25	640
Altitude (m)	62	5	213
Slope (km per 15 m fall)	9	0.25	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	75.6	<0.25	70.9
5–10	30.2	0.25–0.5	50.0
10–20	7.0	0.5–1	26.7
>20	4.7	>1	8.1

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous clay	34.9
Non-calcareous clay	12.8
Soft sandstone	11.6
Chalk	14.0
Other soft limestone	15.1

Habitats

Habitat	*% of sites*
Pools	5.8
Slacks	79.1
Riffles	9.3
Runs	48.8
Rapids	1.2

Substrates

Substrate	*% of sites*
Silt/mud	39.5
Sand	22.1
Clay	29.1
Gravel	58.1
Pebbles	25.6
Cobbles	4.7
Boulders	0
Bedrock	0

Sub-type AIVb

No. of sites = 17

Top 20 dominant macrophytes

Taxon	% of sites
Agrostis stolonifera	94.1
Phalaris arundinacea	82.4
Salix sp(p).	82.4
Sparganium erectum	76.5
Other (non-*Salix*) tree taxa	76.5
Lythrum salicaria	76.5
Filipendula ulmaria	76.5
Juncus effusus	70.6
Mentha aquatica	70.6
Epilobium hirsutum	70.6
Solanum dulcamara	64.7
Oenanthe crocata	64.7
Impatiens glandulifera	64.7
Myosotis scorpioides	58.8
Sparganium emersum	52.9
Deschampsia cespitosa	47.1
Scrophularia auriculata	47.1
Lysimachia vulgaris	47.1
Angelica sylvestris	47.1
Alisma plantago-aquatica	41.2

Top 30 macrophytes

Taxon	% of sites
Sparganium erectum	100.0
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Salix sp(p).	100.0
Lythrum salicaria	94.1
Filipendula ulmaria	94.1
Other (non-*Salix*) tree taxa	88.2
Oenanthe crocata	88.2
Juncus effusus	82.4
Mentha aquatica	82.4
Epilobium hirsutum	82.4
Sparganium emersum	76.5
Solanum dulcamara	76.5
Myosotis scorpioides	76.5
Angelica sylvestris	76.5
Scrophularia auriculata	70.6
Impatiens glandulifera	70.6
Callitriche stagnalis	70.6
Alisma plantago-aquatica	64.7
Eupatorium cannabinum	64.7
Callitriche obtusangula	58.8
Deschampsia cespitosa	52.9
Nuphar lutea	52.9
Ferns	52.9
Iris pseudacorus	47.1
Glyceria fluitans	47.1
Veronica beccabunga	47.1
Symphytum officinale	47.1
Myosoton aquaticum	47.1
Lysimachia vulgaris	47.1

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	34	17	50
Height at source (m)	102	35	137
Altitude (m)	23	5	61
Slope (km per 15 m fall)	15.4	5	>25

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	52.9	<0.25	58.8
5–10	47.1	0.25–0.5	41.2
10–20	17.6	0.5–1	0
>20	0	>1	23.5

Geological types represented in at least 10% of sites

Rock	% of sites
Calcareous clay	17.6
Non-calcareous clay	11.8
Soft sandstone	58.8

Habitats

Habitat	% of sites
Pools	0
Slacks	82.4
Riffles	0
Runs	58.8
Rapids	0

Substrates

Substrate	% of sites
Silt/mud	23.5
Sand	5.9
Clay	47.1
Gravel	47.1
Pebbles	0
Cobbles	0
Boulders	0
Bedrock	0

Sub-type AIVc

No. of sites = 16

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	81.3
Agrostis stolonifera	56.3
Myosotis scorpioides	56.3
Filipendula ulmaria	50.0
Veronica beccabunga	43.8
Epilobium hirsutum	43.8
Juncus effusus	37.5
Caltha palustris	37.5
Juncus inflexus	31.3
Rorippa nasturtium-aquaticum agg.	31.3
Mentha aquatica	31.3
Sparganium erectum	25.0
Iris pseudacorus	25.0
Glyceria fluitans	25.0
Other (non-*Salix*) tree taxa	25.0
Enteromorpha sp(p).	25.0
Elodea canadensis	18.8
Eleocharis palustris	18.8
Carex riparia	18.8
Alopecurus geniculatus	18.8

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	100.0
Myosotis scorpioides	87.5
Phalaris arundinacea	81.3
Glyceria fluitans	68.8
Veronica beccabunga	68.8
Filipendula ulmaria	62.5
Epilobium hirsutum	62.5
Sparganium erectum	56.3
Juncus effusus	56.3
Filamentous green algae	56.3
Rorippa nasturtium-aquaticum agg.	50.0
Caltha palustris	50.0
Iris pseudacorus	43.8
Polygonum amphibium	43.8
Angelica sylvestris	43.8
Juncus inflexus	37.5
Mentha aquatica	37.5
Callitriche stagnalis	37.5
Elodea canadensis	31.3
Alopecurus geniculatus	31.3
Other (non-*Salix*) tree taxa	31.3
Salix sp(p).	31.3
Veronica anagallis-aquatica	31.3
Rorippa sylvestris	31.3
Apium nodiflorum	31.3
Potamogeton natans	25.0
Glyceria maxima	25.0
Eleocharis palustris	25.0
Carex riparia	25.0
Scrophularia auriculata	25.0

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	18	4	32
Height at source (m)	257	10	700
Altitude (m)	67	5	165
Slope (km per 15 m fall)	8.3	1.2	21

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	50.0	<0.25	43.8
5–10	37.5	0.25–0.5	43.8
10–20	0	0.5–1	6.3
>20	18.8	>1	31.3

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	31.3
Hard limestone	18.8
Base-rich igneous	25.0
Other metamorphic	12.5

Habitats

Habitat	*% of sites*
Pools	0
Slacks	62.5
Riffles	43.8
Runs	37.5
Rapids	6.3

Substrates

Substrate	*% of sites*
Silt/mud	56.3
Sand	31.3
Clay	6.3
Gravel	25.0
Pebbles	6.3
Cobbles	12.5
Boulders	12.5
Bedrock	6.3

Annex D Site locations, physical features and macrophytes for sub-types BVa–BVIe

Sub-type BVa

No. of sites = 45

Top 20 dominant macrophytes

Taxon	% of sites
Agrostis stolonifera	91.1
Rhynchostegium riparioides	88.9
Other (non-*Salix*) tree taxa	86.7
Amblystegium fluviatile	82.2
Phalaris arundinacea	80.0
Pellia endiviifolia	75.6
Conocephalum conicum	71.1
Salix sp(p).	68.9
Mentha aquatica	68.9
Epilobium hirsutum	68.9
Petasites hybridus	66.7
Fontinalis antipyretica	66.7
Myosotis scorpioides	57.8
Amblystegium riparium	53.3
Marchantia polymorpha	51.1
Oenanthe crocata	48.9
Veronica beccabunga	46.7
Deschampsia cespitosa	44.4
Lunularia cruciata	44.4
Thamnobryum alopecurum	42.2

Top 30 macrophytes

Taxon	% of sites
Agrostis stolonifera	100.0
Rhynchostegium riparioides	100.0
Other (non-*Salix*) tree taxa	95.6
Verrucaria sp(p).	95.6
Fontinalis antipyretica	91.1
Phalaris arundinacea	86.7
Amblystegium fluviatile	86.7
Salix sp(p).	84.4
Cladophora glomerata agg.	84.4
Conocephalum conicum	82.2
Pellia endiviifolia	80.0
Vaucheria sp(p).	80.0
Petasites hybridus	77.8
Mentha aquatica	77.8
Epilobium hirsutum	75.6
Lemanea fluviatilis	73.3
Hildenbrandia rivularis	68.9
Amblystegium riparium	66.7
Veronica beccabunga	62.2
Myosotis scorpioides	62.2
Oenanthe crocata	57.8
Equisetum arvense	57.8
Lunularia cruciata	57.8
Deschampsia cespitosa	55.6
Marchantia polymorpha	55.6
Filipendula ulmaria	53.3
Chiloscyphus polyanthos	53.3
Juncus acutiflorus	51.1
Thamnobryum alopecurum	51.1
Cinclidotus fontinaloides	51.1

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	33	21	43
Height at source (m)	441	183	665
Altitude (m)	107	15	224
Slope (km per 15 m fall)	4.7	0.1	11

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	17.8	<0.25	93.3
5–10	48.9	0.25–0.5	55.6
10–20	48.9	0.5–1	2.2
>20	15.6	>1	8.9

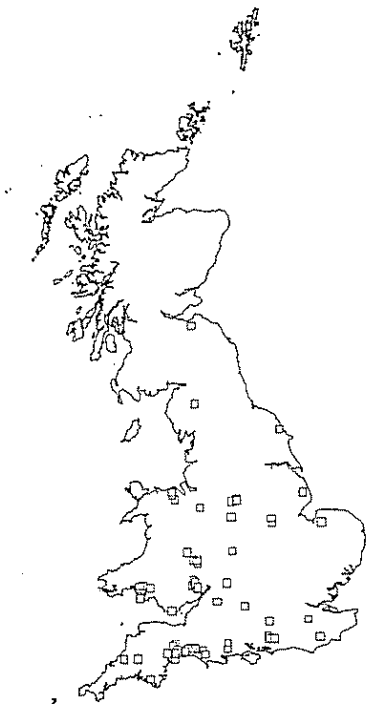
Geological types represented in at least 10% of sites	
Rock	% of sites
Calcareous shale	17.8
Soft sandstone	17.8
Hard sandstone	17.8
Hard limestone	26.7

Habitats	
Habitat	% of sites
Pools	13.3
Slacks	84.4
Riffles	0
Runs	82.2
Rapids	11.1

Substrates	
Substrate	% of sites
Silt/mud	4.4
Sand	2.2
Clay	2.2
Gravel	13.3
Pebbles	35.6
Cobbles	75.6
Boulders	40.0
Bedrock	22.2

Sub-type BVb

No. of sites = 69



Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	85.5
Phalaris arundinacea	79.7
Other (non-*Salix*) tree taxa	73.9
Epilobium hirsutum	65.2
Mentha aquatica	60.9
Sparganium erectum	58.0
Solanum dulcamara	55.1
Myosotis scorpioides	55.1
Salix sp(p).	53.6
Veronica beccabunga	50.7
Rhynchostegium riparioides	44.9
Apium nodiflorum	43.5
Oenanthe crocata	40.6
Juncus acutiflorus	39.1
Amblystegium riparium	43.5
Oenanthe crocata	40.6
Conocephalum conicum	37.7
Ranunculus penicillatus subsp. *pseudofluitans*	36.2
Amblystegium fluviatile	36.2
Glyceria fluitans	34.8
Pellia endiviifolia	34.8

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	97.1
Other (non-*Salix*) tree taxa	95.7
Phalaris arundinacea	91.3
Epilobium hirsutum	91.3
Rhynchostegium riparioides	87.0
Myosotis scorpioides	85.5
Mentha aquatica	85.5
Veronica beccabunga	84.1
Solanum dulcamara	84.0
Cladophora glomerata agg.	84.1
Salix sp(p).	82.6
Sparganium erectum	81.2
Fontinalis antipyretica	78.3
Vaucheria sp(p).	76.8
Verrucaria sp(p).	75.4
Apium nodiflorum	73.9
Oenanthe crocata	72.5
Amblystegium riparium	71.0
Juncus acutiflorus	69.6
Conocephalum conicum	69.6
Juncus effusus	65.2
Glyceria fluitans	62.3
Filipendula ulmaria	62.3
Rorippa nasturtium-aquaticum agg.	58.0
Pellia endiviifolia	56.5
Hildenbrandia rivularis	56.5
Amblystegium fluviatile	53.6
Angelica sylvestris	52.2
Ranunculus penicillatus subsp. *pseudofluitans*	50.7
Brachythecium rutabulum	50.7

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	36	20	54
Height at source (m)	248	30	579
Altitude (m)	67	5	244
Slope (km per 15 m fall)	6.4	1.5	20

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	52.2	<0.25	79.7
5–10	42.0	0.25–0.5	53.6
10–20	29.0	0.5–1	7.2
>20	10.1	>1	2.9

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Calcareous clay	10.1
Soft sandstone	31.9
Hard sandstone	17.4
Hard limestone	10.1

Habitats	
Habitat	*% of sites*
Pools	7.2
Slacks	81.2
Riffles	21.7
Runs	55.1
Rapids	4.3

Substrates	
Substrate	*% of sites*
Silt/mud	18.8
Sand	13.0
Clay	8.7
Gravel	40.6
Pebbles	58.0
Cobbles	31.9
Boulders	7.2
Bedrock	0

Sub-type BVc

No. of sites =24

Top 20 dominant macrophytes

Taxon	*% of sites*
Other (non-*Salix*) tree taxa	87.5
Agrostis stolonifera	83.3
Salix sp(p).	70.8
Solanum dulcamara	70.8
Mentha aquatica	58.3
Epilobium hirsutum	58.3
Pellia epiphylla	58.3
Phalaris arundinacea	50.0
Myosotis scorpioides	50.0
Filipendula ulmaria	50.0
Sparganium erectum	45.8
Juncus effusus	45.8
Deschampsia cespitosa	45.8
Angelica sylvestris	45.8
Scrophularia auriculata	41.7
Oenanthe crocata	41.7
Callitriche stagnalis	41.7
Ferns	41.7
Rhynchostegium riparioides	41.7
Conocephalum conicum	41.7

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	95.8
Other (non-*Salix*) tree taxa	95.8
Salix sp(p).	87.5
Solanum dulcamara	87.5
Sparganium erectum	75.0
Filipendula ulmaria	75.0
Epilobium hirsutum	75.0
Rhynchostegium riparioides	70.8
Mentha aquatica	66.7
Callitriche stagnalis	66.7
Pellia epiphylla	66.7
Phalaris arundinacea	62.5
Angelica sylvestris	62.5
Fontinalis antipyretica	62.5
Veronica beccabunga	58.3
Ferns	58.3
Conocephalum conicum	58.3
Filamentous green algae	58.3
Juncus effusus	54.2
Deschampsia cespitosa	54.2
Oenanthe crocata	54.2
Myosotis scorpioides	54.2
Marchantia polymorpha	54.2
Lunularia cruciata	54.2
Scrophularia auriculata	50.0
Brachythecium rutabulum	50.0
Glyceria fluitans	41.7
Rorippa nasturtium-aquaticum agg.	41.7
Apium nodiflorum	41.7
Amblystegium riparium	41.7

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	30	9	50
Height at source (m)	175	35	480
Altitude (m)	60	15	185
Slope (km per 15 m fall)	6.6	2.0	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	75.0	<0.25	75.0
5–10	29.2	0.25–0.5	58.3
10–20	4.2	0.5–1	25.0
>20	4.2	>1	4.2

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Non-calcareous clay	12.5
Soft sandstone	25.0
Hard sandstone	20.8
Hard limestone	16.7

Habitats	
Habitat	*% of sites*
Pools	16.7
Slacks	87.5
Riffles	29.2
Runs	58.3
Rapids	0

Substrates	
Substrate	*% of sites*
Silt/mud	8.3
Sand	8.3
Clay	33.3
Gravel	62.5
Pebbles	41.7
Cobbles	25.0
Boulders	12.5
Bedrock	4.2

Sub-type BVd

No. of sites = 26

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	92.3
Oenanthe crocata	84.6
Agrostis stolonifera	80.8
Other (non-*Salix*) tree taxa	80.8
Sparganium erectum	76.9
Glyceria fluitans	73.1
Salix sp(p).	69.2
Juncus acutiflorus	61.5
Solanum dulcamara	61.5
Rhynchostegium riparioides	61.5
Mentha aquatica	53.8
Amblystegium riparium	53.8
Conocephalum conicum	53.8
Chiloscyphus polyanthos	53.8
Filipendula ulmaria	50.0
Ranunculus penicillatus subsp. *penicillatus*	46.2
Fontinalis antipyretica	42.3
Pellia epiphylla	42.3
Pellia endiviifolia	38.5
Lunularia cruciata	38.5

Top 30 macrophytes

Taxon	*% of sites*
Sparganium erectum	100.0
Phalaris arundinacea	100.0
Other (non-*Salix*) tree taxa	100.0
Rhynchostegium riparioides	100.0
Agrostis stolonifera	96.2
Salix sp(p).	96.2
Oenanthe crocata	96.2
Fontinalis antipyretica	92.3
Glyceria fluitans	88.5
Verrucaria sp(p).	88.5
Juncus acutiflorus	84.6
Filipendula ulmaria	84.6
Chiloscyphus polyanthos	84.6
Vaucheria sp(p).	84.6
Sparganium emersum	80.8
Solanum dulcamara	80.8
Myriophyllum alterniflorum	80.8
Callitriche hamulata	76.9
Amblystegium riparium	73.1
Lemanea fluviatilis	73.1
Conocephalum conicum	69.2
Ranunculus penicillatus subsp. *penicillatus*	65.4
Mentha aquatica	61.5
Lythrum salicaria	57.7
Equisetum arvense	57.7
Pellia endiviifolia	57.7
Lunularia cruciata	57.7
Pellia epiphylla	53.8
Juncus effusus	50.0
Eupatorium cannabinum	50.0

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	38	17	52
Height at source (m)	306	107	640
Altitude (m)	87	15	183
Slope (km per 15 m fall)	7.6	3.1	15

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	30.8	<0.25	92.3
5–10	46.2	0.25–0.5	46.2
10–20	50.0	0.5–1	7.7
>20	3.8	>1	0

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous shale	19.2
Non-calcareous shale	15.4
Hard sandstone	65.4

Habitats

Habitat	*% of sites*
Pools	3.8
Slacks	92.3
Riffles	7.7
Runs	84.6
Rapids	3.8

Substrates

Substrate	*% of sites*
Silt/mud	11.5
Sand	3.8
Clay	7.7
Gravel	34.6
Pebbles	73.1
Cobbles	42.3
Boulders	7.7
Bedrock	0

Sub-type BVe

No. of sites =31

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	96.8
Agrostis stolonifera	80.6
Other (non-*Salix*) tree taxa	80.6
Rhynchostegium riparioides	74.2
Oenanthe crocata	67.7
Mentha aquatica	67.7
Salix sp(p).	64.5
Fontinalis antipyretica	64.5
Chiloscyphus polyanthos	58.1
Conocephalum conicum	51.6
Cinclidotus fontinaloides	48.4
Amblystegium fluviatile	48.4
Juncus acutiflorus	45.2
Filipendula ulmaria	45.2
Lunularia cruciata	45.2
Sparganium erectum	41.9
Fontinalis squamosa	41.9
Eupatorium cannabinum	38.7
Amblystegium riparium	38.7
Pellia endiviifolia	38.7

Top 30 macrophytes

Taxon	% of sites
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Other (non-*Salix*) tree taxa	100.0
Oenanthe crocata	100.0
Rhynchostegium riparioides	100.0
Salix sp(p).	96.8
Fontinalis antipyretica	93.5
Chiloscyphus polyanthos	90.3
Verrucaria sp(p).	90.3
Conocephalum conicum	87.1
Juncus acutiflorus	80.6
Cladophora glomerata agg.	80.6
Mentha aquatica	77.4
Filipendula ulmaria	77.4
Fontinalis squamosa	77.4
Lemanea fluviatilis	77.4
Myriophyllum alterniflorum	74.2
Eupatorium cannabinum	74.2
Cinclidotus fontinaloides	74.2
Hildenbrandia rivularis	74.2
Solanum dulcamara	71.0
Lythrum salicaria	71.0
Amblystegium fluviatile	71.0
Vaucheria sp(p).	71.0
Sparganium erectum	64.5
Lunularia cruciata	64.5
Glyceria fluitans	61.3
Filamentous green algae	61.3
Impatiens glandulifera	58.1
Caltha palustris	58.1

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	39	25	63
Height at source (m)	322	198	640
Altitude (m)	51	15	168
Slope (km per 15 m fall)	8.8	1.5	15

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	0	<0.25	54.8
5–10	6.5	0.25–0.5	58.1
10–20	54.8	0.5–1	16.1
>20	58.1	>1	25.8

Geological types represented in at least 10% of sites

Rock	% of sites
Calcareous shale	16.1
Hard sandstone	80.6

Habitats

Habitat	% of sites
Pools	12.9
Slacks	93.5
Riffles	9.7
Runs	51.6
Rapids	19.4

Substrates

Substrate	% of sites
Silt/mud	3.2
Sand	3.2
Clay	0
Gravel	6.5
Pebbles	29.0
Cobbles	64.5
Boulders	48.4
Bedrock	16.1

Sub-type BVIa

No. of sites = 32

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Salix sp(p).	96.9
Epilobium hirsutum	90.6
Myosotis scorpioides	87.5
Other (non-*Salix*) tree taxa	81.3
Mentha aquatica	81.3
Rorippa sylvestris	75.0
Ranunculus fluitans	75.0
Impatiens glandulifera	75.0
Veronica beccabunga	71.9
Petasites hybridus	68.8
Sparganium erectum	65.6
Polygonum amphibium	62.5
Juncus acutiflorus	59.4
Equisetum arvense	59.4
Amblystegium fluviatile	56.3
Symphytum officinale	53.1
Scrophularia auriculata	53.1
Rorippa palustris	53.1

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Salix sp(p).	96.9
Cladophora glomerata agg.	96.9
Ranunculus fluitans	93.8
Epilobium hirsutum	93.8
Sparganium erectum	90.6
Other (non-*Salix*) tree taxa	90.6
Myosotis scorpioides	90.6
Rhynchostegium riparioides	90.6
Mentha aquatica	87.5
Fontinalis antipyretica	87.5
Vaucheria sp(p).	81.3
Veronica beccabunga	78.1
Myriophyllum spicatum	78.1
Elodea canadensis	75.0
Rorippa sylvestris	75.0
Impatiens glandulifera	75.0
Polygonum amphibium	71.9
Petasites hybridus	71.9
Amblystegium fluviatile	71.9
Verrucaria sp(p).	68.8
Equisetum arvense	65.6
Symphytum officinale	62.5
Juncus acutiflorus	59.4
Scrophularia auriculata	59.4
Conocephalum conicum	59.4
Solanum dulcamara	56.3
Rorippa palustris	56.3
Mimulus guttatus	56.3

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	41	22	60
Height at source (m)	463	335	761
Altitude (m)	51	15	215
Slope (km per 15 m fall)	15.5	3	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	3.1	<0.25	50.0
5–10	6.3	0.25–0.5	37.5
10–20	59.4	0.5–1	6.3
>20	53.1	>1	46.9

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous shale	18.8
Soft sandstone	43.8
Hard sandstone	12.5
Hard limestone	12.5

Habitats

Habitat	*% of sites*
Pools	25.0
Slacks	96.9
Riffles	0
Runs	40.6
Rapids	9.4

Substrates

Substrate	*% of sites*
Silt/mud	15.6
Sand	15.6
Clay	9.4
Gravel	37.5
Pebbles	46.9
Cobbles	28.1
Boulders	21.9
Bedrock	12.5

Sub-type BVIb

No. of sites = 29

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Myosotis scorpioides	89.7
Other (non-*Salix*) tree taxa	82.8
Rhynchostegium riparioides	82.8
Rorippa sylvestris	79.3
Epilobium hirsutum	79.3
Mentha aquatica	72.4
Cinclidotus fontinaloides	72.4
Salix sp(p).	65.5
Cladophora glomerata agg.	58.6
Hildenbrandia rivularis	58.6
Sparganium erectum	55.2
Veronica beccabunga	55.2
Equisetum arvense	55.2
Impatiens glandulifera	51.7
Amblystegium fluviatile	51.7
Ranunculus fluitans	48.3
Fontinalis antipyretica	48.3
Eleocharis palustris	44.8

Top 30 macrophytes

Taxon	% of sites
Phalaris arundinacea	100.0
Agrostis stolonifera	100.0
Myosotis scorpioides	100.0
Rhynchostegium riparioides	100.0
Verrucaria sp(p).	100.0
Fontinalis antipyretica	96.6
Cladophora glomerata agg.	96.6
Hildenbrandia rivularis	96.6
Ranunculus fluitans	93.1
Sparganium erectum	86.2
Elodea canadensis	86.2
Epilobium hirsutum	86.2
Cinclidotus fontinaloides	86.2
Other (non-*Salix*) tree taxa	82.8
Rorippa sylvestris	82.8
Mentha aquatica	82.8
Equisetum arvense	82.8
Veronica beccabunga	79.3
Caltha palustris	75.9
Mimulus guttatus	72.4
Amblystegium fluviatile	72.4
Myriophyllum spicatum	69.0
Salix sp(p).	65.5
Impatiens glandulifera	65.5
Conocephalum conicum	65.5
Vaucheria sp(p).	65.5
Lemanea fluviatilis	65.5
Juncus acutiflorus	62.1
Pellia endiviifolia	62.1
Potamogeton perfoliatus	58.6

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	42	28	56
Height at source (m)	533	76	761
Altitude (m)	57	12	130
Slope (km per 15 m fall)	11.3	4	>25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	6.9	<0.25	55.2
5–10	6.9	0.25–0.5	65.5
10–20	27.6	0.5–1	10.3
>20	72.4	>1	17.2

Geological types represented in at least 10% of sites	
Rock	% of sites
Intermediate shale	17.2
Soft sandstone	41.4
Hard sandstone	13.8
Hard limestone	24.1

Habitats	
Habitat	% of sites
Pools	13.8
Slacks	89.7
Riffles	0
Runs	75.9
Rapids	6.9

Substrates	
Substrate	% of sites
Silt/mud	6.9
Sand	3.4
Clay	0
Gravel	10.3
Pebbles	27.6
Cobbles	69.0
Boulders	58.6
Bedrock	17.2

Sub-type BVIc

No. of sites = 68

Top 20 dominant macrophytes

Taxon	*% of sites*
Agrostis stolonifera	94.1
Phalaris arundinacea	92.6
Mentha aquatica	88.2
Salix sp(p).	80.9
Myosotis scorpioides	80.9
Rhynchostegium riparioides	79.4
Amblystegium fluviatile	79.4
Other (non-*Salix*) tree taxa	64.7
Juncus acutiflorus	63.2
Cinclidotus fontinaloides	60.3
Cladophora glomerata agg.	60.3
Filipendula ulmaria	58.8
Epilobium hirsutum	57.4
Mimulus guttatus	54.4
Equisetum arvense	54.4
Caltha palustris	51.5
Fontinalis antipyretica	51.5
Rorippa sylvestris	50.0
Conocephalum conicum	48.5
Petasites hybridus	45.6

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	98.5
Mentha aquatica	98.5
Verrucaria sp(p).	98.5
Phalaris arundinacea	97.1
Fontinalis antipyretica	97.1
Cladophora glomerata agg.	95.6
Salix sp(p).	94.1
Rhynchostegium riparioides	94.1
Amblystegium fluviatile	91.2
Myosotis scorpioides	88.2
Hildenbrandia rivularis	83.8
Juncus acutiflorus	82.4
Other (non-*Salix*) tree taxa	82.4
Filamentous green algae	80.9
Filipendula ulmaria	79.4
Sparganium erectum	73.5
Mimulus guttatus	73.5
Caltha palustris	73.5
Cinclidotus fontinaloides	73.5
Lemanea fluviatilis	73.5
Epilobium hirsutum	72.1
Conocephalum conicum	70.6
Equisetum arvense	66.2
Vaucheria sp(p).	66.2
Elodea canadensis	63.2
Petasites hybridus	63.2
Rorippa sylvestris	60.3
Brachythecium rutabulum	60.3
Juncus effusus	58.8
Eleocharis palustris	58.8

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	42	24	55
Height at source (m)	481	61	761
Altitude (m)	78	15	229
Slope (km per 15 m fall)	9.5	1.5	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	2.9	<0.25	80.9
5–10	20.6	0.25–0.5	58.8
10–20	45.6	0.5–1	2.9
>20	48.5	>1	19.1

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous shale	10.3
Non-calcareous shale	10.3
Intermediate shale	14.7
Soft sandstone	16.2
Hard sandstone	11.8
Hard limestone	32.4

Habitats

Habitat	*% of sites*
Pools	2.9
Slacks	89.7
Riffles	0
Runs	80.9
Rapids	11.8

Substrates

Substrate	*% of sites*
Silt/mud	5.9
Sand	7.4
Clay	1.5
Gravel	11.8
Pebbles	52.9
Cobbles	73.5
Boulders	35.3
Bedrock	11.8

Sub-type BVId

No. of sites = 53

Top 20 dominant macrophytes

Taxon	% of sites
Phalaris arundinacea	98.1
Agrostis stolonifera	98.1
Myosotis scorpioides	94.3
Mentha aquatica	86.8
Sparganium erectum	83.0
Filipendula ulmaria	83.0
Juncus acutiflorus	77.4
Juncus effusus	73.6
Mimulus guttatus	73.6
Salix sp(p).	71.7
Other (non-*Salix*) tree taxa	69.8
Caltha palustris	69.8
Equisetum arvense	67.9
Glyceria fluitans	58.5
Rorippa nasturtium-aquaticum agg.	56.6
Alopecurus geniculatus	54.7
Veronica beccabunga	52.8
Callitriche stagnalis	52.
Rhynchostegium riparioides	49.1
Amblystegium fluviatile	49.1

Top 30 macrophytes

Taxon	% of sites
Sparganium erectum	100.0
Agrostis stolonifera	100.0
Phalaris arundinacea	98.1
Myosotis scorpioides	98.1
Mentha aquatica	98.1
Filipendula ulmaria	94.3
Fontinalis antipyretica	92.5
Verrucaria sp(p).	90.6
Juncus effusus	88.7
Juncus acutiflorus	88.7
Equisetum arvense	88.7
Mimulus guttatus agg.	86.8
Caltha palustris	84.9
Rhynchostegium riparioides	84.9
Filamentous green algae	84.9
Salix sp(p).	81.1
Other (non-*Salix*) tree taxa	79.2
Veronica beccabunga	75.5
Callitriche stagnalis	75.5
Cladophora glomerata agg.	75.5
Glyceria fluitans	69.8
Rorippa nasturtium-aquaticum agg.	69.8
Myriophyllum alterniflorum	67.9
Alopecurus geniculatus	64.2
Amblystegium fluviatile	62.3
Elodea canadensis	58.5
Polygonum amphibium	54.7
Potamogeton crispus	52.8
Stachys palustris	52.8
Angelica sylvestris	52.8

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	42	24	58
Height at source (m)	352	61	680
Altitude (m)	76	10	250
Slope (km per 15 m fall)	10.2	1	>25

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	26.4	<0.25	81.1
5–10	35.8	0.25–0.5	39.6
10–20	28.3	0.5–1	1.9
>20	30.2	>1	13.2

Geological types represented in at least 10% of sites	
Rock	% of sites
Soft sandstone	37.7
Schist	20.8
Other metamorphic	15.1

Habitats	
Habitat	% of sites
Pools	0
Slacks	79.2
Riffles	0
Runs	75.5
Rapids	5.7

Substrates	
Substrate	% of sites
Silt/mud	7.5
Sand	26.4
Clay	5.7
Gravel	39.6
Pebbles	54.7
Cobbles	47.2
Boulders	15.1
Bedrock	3.8

Sub-type BVIe

No. of sites = 20

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	75.0
Myosotis scorpioides	60.0
Filipendula ulmaria	60.0
Agrostis stolonifera	55.0
Other (non-*Salix*) tree taxa	55.0
Salix sp(p).	55.0
Veronica beccabunga	55.0
Juncus effusus	50.0
Epilobium hirsutum	50.0
Glyceria fluitans	40.0
Mentha aquatica	35.0
Mimulus guttatus agg.	30.0
Rhynchostegium riparioides	30.0
Sparganium erectum	25.0
Juncus acutiflorus	25.0
Deschampsia cespitosa	25.0
Ranunculus penicillatus subsp. *penicillatus*	25.0
Cardamine amara	25.0
Iris pseudacorus	20.0
Eleocharis palustris	20.0

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	100.0
Agrostis stolonifera	90.0
Myosotis scorpioides	85.0
Juncus effusus	80.0
Veronica beccabunga	80.0
Filipendula ulmaria	80.0
Glyceria fluitans	65.0
Other (non-*Salix*) tree taxa	65.0
Mimulus guttatus agg.	65.0
Mentha aquatica	65.0
Cardamine amara	65.0
Salix sp(p).	60.0
Polygonum amphibium	60.0
Epilobium hirsutum	60.0
Caltha palustris	60.0
Sparganium erectum	55.0
Fontinalis antipyretica	55.0
Filamentous green algae	55.0
Iris pseudacorus	45.0
Sagina procumbens	45.0
Rhynchostegium riparioides	45.0
Juncus articulatus	40.0
Deschampsia cespitosa	40.0
Tussilago farfara	40.0
Ranunculus penicillatus subsp. *penicillatus*	40.0
Rorippa sylvestris	35.0
Rorippa nasturtium-aquaticum agg.	35.0
Callitriche stagnalis	35.0
Equisetum palustre	35.0
Elodea canadensis	30.0

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	25	6	36
Height at source (m)	433	160	680
Altitude (m)	98	5	270
Slope (km per 15 m fall)	5.3	0.9	20

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	35.0	<0.25	50.0
5–10	45.0	0.25–0.5	45.0
10–20	15.0	0.5–1	20.0
>20	35.0	>1	20.0

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	30.0
Hard limestone	40.0
Other metamorphic rock	25.0

Habitats

Habitat	*% of sites*
Pools	15.0
Slacks	35.0
Riffles	70.0
Runs	70.0
Rapids	10.0

Substrates

Substrate	*% of sites*
Silt/mud	35.0
Sand	25.0
Clay	5.0
Gravel	20.0
Pebbles	30.0
Cobbles	55.0
Boulders	30.0
Bedrock	10.0

Annex E Site locations, physical features and macrophytes for sub-types CVIIa–CVIIIe

Sub-type CVIIa

No. of sites = 13

Top 20 dominant macrophytes

Taxon	% of sites
Glyceria fluitans	84.6
Alopecurus geniculatus	76.9
Agrostis stolonifera	76.9
Veronica beccabunga	76.9
Juncus effusus	69.2
Myosotis scorpioides	69.2
Filipendula ulmaria	69.2
Caltha palustris	69.2
Rhynchostegium riparioides	69.2
Rorippa nasturtium-aquaticum agg.	61.5
Juncus acutiflorus	46.2
Mimulus guttatus agg.	46.2
Mentha aquatica	46.2
Fontinalis antipyretica	46.2
Sparganium erectum	38.5
Deschampsia cespitosa	38.5
Carex nigra	38.5
Anthoxanthum odoratum	38.5
Other (non-*Salix*) tree taxa	38.5
Salix sp(p).	38.5

Top 30 macrophytes

Taxon	% of sites
Caltha palustris	100.0
Glyceria fluitans	92.3
Agrostis stolonifera	92.3
Veronica beccabunga	92.3
Rhynchostegium riparioides	92.3
Filamentous green algae	84.6
Juncus effusus	76.9
Alopecurus geniculatus	76.9
Rorippa nasturtium-aquaticum agg.	76.9
Myosotis scorpioides	76.9
Filipendula ulmaria	76.9
Ranunculus flammula	69.2
Mentha aquatica	69.2
Calliergon cuspidatum	69.2
Deschampsia cespitosa	61.5
Equisetum palustre	61.5
Fontinalis antipyretica	61.5
Carex nigra	53.8
Salix sp(p).	53.8
Tussilago farfara	53.8
Sagina procumbens	53.8
Mimulus guttatus agg.	53.8
Angelica sylvestris	53.8
Equisetum fluviatile	53.8
Sparganium erectum	46.2
Juncus articulatus	46.2
Juncus acutiflorus	46.2
Carex rostrata	46.2
Carex flacca	46.2
Anthoxanthum odoratum	46.2

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	36	20	55
Height at source (m)	435	20	696
Altitude (m)	207	20	275
Slope (km per 15 m fall)	2.5	0.5	8.1

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	61.5	<0.25	100.0
5–10	30.8	0.25–0.5	23.1
10–20	15.4	0.5–1	0
>20	0	>1	0

Geological types represented in at least 10% of sites

Rock	% of sites
Hard sandstone	30.8
Hard limestone	30.8

Habitats

Habitat	% of sites
Pools	23.1
Slacks	53.8
Riffles	30.8
Runs	46.2
Rapids	0

Substrates

Substrate	% of sites
Silt/mud	30.8
Sand	15.4
Clay	0
Gravel	23.1
Pebbles	61.5
Cobbles	61.5
Boulders	15.4
Bedrock	0

Sub-type CVIIb

No. of sites = 23

Top 20 dominant macrophytes

Taxon	*% of sites*
Other (non-*Salix*) tree taxa	73.9
Filipendula ulmaria	65.2
Salix sp(p).	60.9
Phalaris arundinacea	52.2
Agrostis stolonifera	52.2
Myosotis scorpioides	52.2
Juncus effusus	43.5
Veronica beccabunga	30.4
Sagina procumbens	30.4
Glyceria fluitans	26.1
Eleocharis palustris	26.1
Anthoxanthum odoratum	26.1
Caltha palustris	26.1
Rhynchostegium riparioides	26.1
Tussilago farfara	21.7
Mentha aquatica	21.7
Deschampsia cespitosa	17.4
Montia sibirica	17.4
Angelica sylvestris	17.4
Potamogeton crispus	13.0

Top 30 macrophytes

Taxon	*% of sites*
Phalaris arundinacea	91.3
Agrostis stolonifera	91.3
Other (non-*Salix*) tree taxa	78.3
Salix sp(p).	78.3
Filipendula ulmaria	78.3
Juncus effusus	73.9
Myosotis scorpioides	73.9
Caltha palustris	69.6
Juncus articulatus	65.2
Veronica beccabunga	60.9
Fontinalis antipyretica	60.9
Glyceria fluitans	56.5
Anthoxanthum odoratum	52.2
Tussilago farfara	52.2
Sagina procumbens	52.2
Filamentous green algae	52.2
Deschampsia cespitosa	47.8
Cardamine amara	47.8
Angelica sylvestris	47.8
Eleocharis palustris	43.5
Mentha aquatica	43.5
Rhynchostegium riparioides	43.5
Equisetum palustre	39.1
Ranunculus penicillatus subsp. *penicillatus*	34.8
Callitriche stagnalis	34.8
Stachys palustris	30.4
Rorippa nasturtium-aquaticum agg.	30.4
Mimulus guttatus agg.	30.4
Brachythecium rutabulum	30.4
Pellia epiphylla	30.4

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	22	7	43
Height at source (m)	417	240	700
Altitude (m)	126	18	265
Slope (km per 15 m fall)	4.3	0.6	21

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	17.4	<0.25	47.8
5–10	60.9	0.25–0.5	52.2
10–20	26.1	0.5–1	26.1
>20	17.4	>1	17.4

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	34.8
Hard limestone	47.8

Habitats

Habitat	*% of sites*
Pools	4.3
Slacks	17.4
Riffles	65.2
Runs	60.9
Rapids	26.1

Substrates

Substrate	*% of sites*
Silt/mud	17.4
Sand	8.7
Clay	0
Gravel	21.7
Pebbles	34.8
Cobbles	60.9
Boulders	47.8
Bedrock	34.8

Sub-type CVIIc

No. of sites = 18

Top 20 dominant macrophytes

Taxon	% of sites
Juncus effusus	77.8
Agrostis stolonifera	77.8
Other (non-*Salix*) tree taxa	66.7
Salix sp(p).	66.7
Phalaris arundinacea	61.1
Oenanthe crocata	61.1
Juncus acutiflorus	55.6
Glyceria fluitans	55.6
Deschampsia cespitosa	55.6
Mentha aquatica	55.6
Galium palustre	55.6
Callitriche stagnalis	50.0
Angelica sylvestris	50.0
Ferns	50.0
Pellia epiphylla	44.4
Ranunculus flammula	38.9
Myosotis scorpioides	38.9
Filipendula ulmaria	38.9
Apium nodiflorum	38.9
Sparganium emersum	33.3

Top 30 macrophytes

Taxon	% of sites
Agrostis stolonifera	94.4
Phalaris arundinacea	83.3
Juncus effusus	83.3
Salix sp(p).	77.8
Oenanthe crocata	77.8
Glyceria fluitans	72.2
Deschampsia cespitosa	72.2
Other (non-*Salix*) tree taxa	72.2
Callitriche stagnalis	72.2
Juncus acutiflorus	66.7
Mentha aquatica	66.7
Alisma plantago-aquatica	61.1
Stachys palustris	61.1
Senecio aquaticus	61.1
Ranunculus flammula	61.1
Ferns	61.1
Stellaria alsine	55.6
Galium palustre	55.6
Caltha palustris	55.6
Callitriche hamulata	55.6
Angelica sylvestris	55.6
Sparganium erectum	50.0
Myosotis scorpioides	50.0
Lythrum salicaria	50.0
Filipendula ulmaria	50.0
Apium nodiflorum	50.0
Fontinalis antipyretica	50.0
Pellia epiphylla	50.0
Equisetum fluviatile	44.4
Potamogeton natans	38.9

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	30	6	47
Height at source (m)	263	35	810
Altitude (m)	45	5	152
Slope (km per 15 m fall)	5.7	1.1	15

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	55.6	<0.25	61.1
5–10	16.7	0.25–0.5	33.3
10–20	33.3	0.5–1	38.9
>20	27.8	>1	33.3

Geological types represented in at least 10% of sites

Rock	% of sites
Non-calcareous shale	11.1
Soft sandstone	22.2
Hard sandstone	16.7
Hard limestone	22.2
Base-rich igneous	22.2

Habitats

Habitat	% of sites
Pools	11.1
Slacks	77.8
Riffles	22.2
Runs	50.0
Rapids	5.6

Substrates

Substrate	% of sites
Silt/mud	44.4
Sand	11.1
Clay	11.1
Gravel	50.0
Pebbles	33.3
Cobbles	38.9
Boulders	22.2
Bedrock	5.6

Sub-type CVIId

No. of sites = 22

Top 20 dominant macrophytes

Taxon	*% of sites*
Juncus acutiflorus	95.5
Glyceria fluitans	95.5
Phalaris arundinacea	90.9
Agrostis stolonifera	86.4
Juncus effusus	72.7
Salix sp(p).	72.7
Mentha aquatica	72.7
Other (non-*Salix*) tree taxa	63.6
Filipendula ulmaria	63.6
Sparganium erectum	59.1
Pellia epiphylla	59.1
Chiloscyphus polyanthos	59.1
Ranunculus flammula	54.5
Caltha palustris	54.5
Equisetum arvense	54.5
Fontinalis antipyretica	54.5
Senecio aquaticus	50.0
Myriophyllum alterniflorum	50.0
Myosotis scorpioides	50.0
Galium palustre	50.0

Top 30 macrophytes

Taxon	*% of sites*
Juncus acutiflorus	100.0
Glyceria fluitans	100.0
Phalaris arundinacea	95.5
Agrostis stolonifera	95.5
Juncus effusus	90.9
Salix sp(p).	90.9
Sparganium erectum	86.4
Myriophyllum alterniflorum	86.4
Mentha aquatica	86.4
Callitriche hamulata	86.4
Rhynchostegium riparioides	86.4
Fontinalis antipyretica	86.4
Angelica sylvestris	81.8
Myosotis scorpioides	77.3
Filipendula ulmaria	77.3
Other (non-*Salix*) tree taxa	72.7
Ranunculus flammula	72.7
Galium palustre	72.7
Achillea ptarmica	72.7
Equisetum fluviatile	72.7
Caltha palustris	68.2
Pellia epiphylla	68.2
Chiloscyphus polyanthos	68.2
Filamentous green algae	68.2
Callitriche stagnalis	63.6
Verrucaria sp(p).	63.6
Senecio aquaticus	59.1
Ferns	54.5
Equisetum arvense	54.5
Hygrohypnum ochraceum	54.5

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	37	24	50
Height at source (m)	379	152	640
Altitude (m)	142	10	229
Slope (km per 15 m fall)	10.6	0.7	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	40.9	<0.25	72.7
5–10	36.4	0.25–0.5	31.8
10–20	27.3	0.5–1	9.1
>20	22.7	>1	27.3

Geological types represented in at least 10% of sites

Rock	*% of sites*
Calcareous shale	22.7
Non-calcareous shale	45.5
Schist	27.3

Habitats

Habitat	*% of sites*
Pools	0
Slacks	81.8
Riffles	0
Runs	72.7
Rapids	0

Substrates

Substrate	*% of sites*
Silt/mud	18.2
Sand	40.9
Clay	9.1
Gravel	59.1
Pebbles	59.1
Cobbles	36.0
Boulders	0
Bedrock	0

Sub-type CVIIIa

No. of sites = 36

Top 20 dominant macrophytes

Taxon	% of sites
Other (non-*Salix*) tree taxa	86.1
Rhynchostegium riparioides	61.1
Pellia epiphylla	61.1
Chiloscyphus polyanthos	58.3
Agrostis stolonifera	52.8
Salix sp(p).	50.0
Oenanthe crocata	50.0
Thamnobryum alopecurum	50.0
Conocephalum conicum	50.0
Ferns	41.7
Hygrohypnum ochraceum	41.7
Fontinalis squamosa	38.9
Fontinalis antipyretica	36.1
Phalaris arundinacea	33.3
Carex remota	33.3
Angelica sylvestris	30.6
Hyocomium armoricum	30.6
Scapania undulata	30.6
Deschampsia cespitosa	25.0
Brachythecium rivulare	25.0

Top 30 macrophytes

Taxon	% of sites
Other (non-*Salix*) tree taxa	97.2
Agrostis stolonifera	94.4
Rhynchostegium riparioides	88.9
Pellia epiphylla	88.9
Chiloscyphus polyanthos	86.1
Salix sp(p).	83.3
Ferns	77.8
Conocephalum conicum	75.0
Oenanthe crocata	72.2
Thamnobryum alopecurum	69.4
Phalaris arundinacea	66.7
Verrucaria sp(p).	66.7
Fontinalis antipyretica	61.1
Filamentous green algae	61.1
Glyceria fluitans	58.3
Lemanea fluviatilis	58.3
Carex remota	55.6
Fontinalis squamosa	55.6
Filipendula ulmaria	47.2
Hygrohypnum ochraceum	47.2
Brachythecium rivulare	47.2
Scapania undulata	47.2
Vaucheria sp(p).	44.4
Juncus effusus	41.7
Angelica sylvestris	41.7
Lunularia cruciata	41.7
Deschampsia cespitosa	38.9
Juncus acutiflorus	36.1
Racomitrium aciculare	36.1
Amblystegium fluviatile	36.1

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	27	7	42
Height at source (m)	302	130	853
Altitude (m)	103	30	244
Slope (km per 15 m fall)	3.2	0.2	8.7

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	50.0	<0.25	86.1
5–10	58.3	0.25–0.5	52.8
10–20	19.4	0.5–1	16.7
>20	2.8	>1	2.8

Geological types represented in at least 10% of sites

Rock	% of sites
Non-calcareous shale	16.7
Hard sandstone	44.4

Habitats

Habitat	% of sites
Pools	8.3
Slacks	72.2
Riffles	27.8
Runs	47.2
Rapids	33.3

Substrates

Substrate	% of sites
Silt/mud	2.8
Sand	11.1
Clay	2.8
Gravel	25.0
Pebbles	52.8
Cobbles	36.1
Boulders	33.3
Bedrock	27.8

Sub-type CVIIIb

No. of sites = 73

Top 20 dominant macrophytes

Taxon	*% of sites*
Phalaris arundinacea	93.2
Agrostis stolonifera	91.8
Juncus acutiflorus	82.2
Other (non-*Salix*) tree taxa	82.2
Salix sp(p).	82.2
Mentha aquatica	78.1
Rhynchostegium riparioides	78.1
Chiloscyphus polyanthos	74.0
Fontinalis antipyretica	68.5
Fontinalis squamosa	67.1
Amblystegium fluviatile	67.1
Glyceria fluitans	63.0
Oenanthe crocata	63.0
Ranunculus flammula	58.9
Juncus effusus	57.5
Pellia epiphylla	57.5
Filipendula ulmaria	54.8
Hygrohypnum ochraceum	54.8
Conocephalum conicum	53.4
Caltha palustris	49.3

Top 30 macrophytes

Taxon	*% of sites*
Agrostis stolonifera	98.6
Phalaris arundinacea	97.3
Verrucaria sp(p).	95.9
Salix sp(p).	94.5
Rhynchostegium riparioides	94.5
Juncus acutiflorus	90.4
Other (non-*Salix*) tree taxa	90.4
Fontinalis squamosa	87.7
Chiloscyphus polyanthos	87.7
Mentha aquatica	86.3
Fontinalis antipyretica	86.3
Filamentous green algae	78.1
Glyceria fluitans	75.3
Amblystegium fluviatile	75.3
Juncus effusus	74.0
Hygrohypnum ochraceum	74.0
Lemanea fluviatilis	74.0
Filipendula ulmaria	72.6
Oenanthe crocata	71.2
Pellia epiphylla	71.2
Ranunculus flammula	68.5
Conocephalum conicum	68.5
Myriophyllum alterniflorum	64.4
Caltha palustris	64.4
Callitriche hamulata	63.0
Dermatocarpon fluviatile	60.3
Myosotis scorpioides	58.9
Thamnobryum alopecurum	58.9
Ferns	56.2
Scapania undulata	50.7

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	40	19	56
Height at source (m)	464	100	1,210
Altitude (m)	98	15	274
Slope (km per 15 m fall)	5.7	1	22

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	19.2	<0.25	74.0
5–10	42.5	0.25–0.5	43.8
10–20	50.7	0.5–1	2.7
>20	26.0	>1	15.1

Geological types represented in at least 10% of sites

Rock	*% of sites*
Non-calcareous shale	57.5
Hard sandstone	17.8

Habitats

Habitat	*% of sites*
Pools	4.1
Slacks	78.1
Riffles	1.4
Runs	74.0
Rapids	37.0

Substrates

Substrate	*% of sites*
Silt/mud	1.4
Sand	2.7
Clay	0
Gravel	21.9
Pebbles	45.2
Cobbles	67.1
Boulders	39.7
Bedrock	12.3

Sub-type CVIIIc

No. of sites = 44

Top 20 dominant macrophytes

Taxon	% of sites
Agrostis stolonifera	88.6
Rhynchostegium riparioides	88.6
Other (non-*Salix*) tree taxa	81.8
Salix sp(p).	68.2
Amblystegium fluviatile	68.2
Brachythecium rivulare	65.9
Conocephalum conicum	61.4
Chiloscyphus polyanthos	61.4
Fontinalis antipyretica	59.1
Phalaris arundinacea	54.5
Thamnobryum alopecurum	54.5
Cinclidotus fontinaloides	54.5
Juncus acutiflorus	52.3
Mentha aquatica	50.0
Equisetum arvense	50.0
Schistidium alpicola	50.0
Sagina procumbens	45.5
Caltha palustris	45.5
Tussilago farfara	43.2
Petasites hybridus	43.2

Top 30 macrophytes

Taxon	% of sites
Agrostis stolonifera	100.0
Rhynchostegium riparioides	97.7
Brachythecium rivulare	88.6
Conocephalum conicum	88.6
Other (non-*Salix*) tree taxa	86.4
Fontinalis antipyretica	84.1
Amblystegium fluviatile	84.1
Salix sp(p).	79.5
Chiloscyphus polyanthos	79.5
Verrucaria sp(p).	75.0
Filamentous green algae	75.0
Juncus acutiflorus	70.5
Sagina procumbens	70.5
Thamnobryum alopecurum	65.9
Dichodontium pellucidum	65.9
Cinclidotus fontinaloides	65.9
Phalaris arundinacea	63.6
Tussilago farfara	63.6
Filipendula ulmaria	63.6
Mentha aquatica	61.4
Lemanea fluviatilis	61.4
Caltha palustris	59.1
Equisetum arvense	59.1
Pellia epiphylla	59.1
Deschampsia cespitosa	56.8
Myosotis scorpioides	56.8
Ferns	56.8
Schistidium alpicola	56.8
Brachythecium plumosum	56.8
Hildenbrandia rivularis	54.5

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	36	15	55
Height at source (m)	503	240	853
Altitude (m)	115	15	305
Slope (km per 15 m fall)	3.6	0.3	9

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	11.4	<0.25	90.9
5–10	45.5	0.25–0.5	45.5
10–20	54.5	0.5–1	4.5
>20	22.7	>1	2.3

Geological types represented in at least 10% of sites

Rock	% of sites
Calcareous shale	18.2
Non-calcareous shale	20.5
Hard sandstone	13.6
Hard limestone	25.0

Habitats

Habitat	% of sites
Pools	6.8
Slacks	70.5
Riffles	11.4
Runs	72.7
Rapids	47.7

Substrates

Substrate	% of sites
Silt/mud	6.8
Sand	4.5
Clay	0
Gravel	9.1
Pebbles	36.4
Cobbles	68.2
Boulders	56.8
Bedrock	36.4

Sub-type CVIIId

No. of sites = 39

Top 20 dominant macrophytes

Taxon	*% of sites*
Juncus acutiflorus	97.4
Agrostis stolonifera	92.3
Ranunculus flammula	92.3
Phalaris arundinacea	87.2
Other (non-*Salix*) tree taxa	87.2
Mentha aquatica	84.6
Hygrohypnum ochraceum	84.6
Salix sp(p).	82.1
Fontinalis antipyretica	82.1
Myosotis scorpioides	79.5
Caltha palustris	79.5
Chiloscyphus polyanthos	79.5
Rhynchostegium riparioides	76.9
Achillea ptarmica	74.4
Scapania undulata	71.8
Schistidium alpicola	69.2
Pellia epiphylla	69.2
Juncus effusus	66.7
Glyceria fluitans	61.5
Filipendula ulmaria	61.5

Top 30 macrophytes

Taxon	*% of sites*
Juncus acutiflorus	100.0
Ranunculus flammula	97.4
Agrostis stolonifera	94.9
Caltha palustris	94.9
Hygrohypnum ochraceum	94.9
Fontinalis antipyretica	94.9
Phalaris arundinacea	92.3
Other (non-*Salix*) tree taxa	92.3
Myriophyllum alterniflorum	92.3
Achillea ptarmica	92.3
Verrucaria sp(p).	92.3
Salix sp(p).	89.7
Mentha aquatica	89.7
Rhynchostegium riparioides	89.7
Scapania undulata	89.7
Filamentous green algae	89.7
Myosotis scorpioides	87.2
Juncus effusus	84.6
Fontinalis squamosa	84.6
Bryum pseudotriquetrum	84.6
Pellia epiphylla	84.6
Chiloscyphus polyanthos	84.6
Callitriche hamulata	82.1
Schistidium alpicola	82.1
Glyceria fluitans	79.5
Filipendula ulmaria	79.5
Racomitrium aciculare	74.4
Jungermannia atrovirens	74.4
Deschampsia cespitosa	71.8
Carex nigra	71.8

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	49	36	70
Height at source (m)	598	140	1,210
Altitude (m)	95	15	213
Slope (km per 15 m fall)	7.3	1	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	7.7	<0.25	79.5
5–10	28.2	0.25–0.5	56.4
10–20	30.8	0.5–1	7.7
>20	56.4	>1	12.8

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Non-calcareous shale	28.2
Soft sandstone	12.8
Granite	10.3
Schist	25.6
Other igneous	10.3

Habitats	
Habitat	*% of sites*
Pools	2.6
Slacks	82.1
Riffles	0
Runs	84.6
Rapids	38.5

Substrates	
Substrate	*% of sites*
Silt/mud	0
Sand	2.6
Clay	0
Gravel	20.5
Pebbles	43.6
Cobbles	74.4
Boulders	48.7
Bedrock	10.3

Sub-type CVIIIe

No. of sites = 55

Top 20 dominant macrophytes

Taxon	% of sites
Rhynchostegium riparioides	94.5
Agrostis stolonifera	85.5
Juncus acutiflorus	78.2
Schistidium alpicola	72.7
Juncus effusus	65.5
Hygrohypnum ochraceum	65.5
Other (non-*Salix*) tree taxa	63.6
Fontinalis antipyretica	63.6
Brachythecium plumosum	63.6
Tussilago farfara	61.8
Equisetum arvense	61.8
Brachythecium rivulare	61.8
Salix sp(p).	60.0
Carex nigra	58.2
Anthoxanthum odoratum	58.2
Scapania undulata	58.2
Glyceria fluitans	56.4
Caltha palustris	56.4
Philonotis fontana	56.4
Ranunculus flammula	54.5

Top 30 macrophytes

Taxon	% of sites
Rhynchostegium riparioides	98.2
Filamentous green algae	96.4
Agrostis stolonifera	90.9
Fontinalis antipyretica	90.9
Juncus acutiflorus	83.6
Brachythecium rivulare	83.6
Schistidium alpicola	81.8
Hygrophypnum ochraceum	81.8
Verrucaria sp(p).	81.8
Juncus effusus	80.0
Salix sp(p).	78.2
Lemanea fluviatilis	78.2
Other (non-*Salix*) tree taxa	76.4
Ranunculus flammula	74.5
Equisetum arvense	74.5
Bryum pseudotriquetrum	74.5
Tussilago farfara	70.9
Sagina procumbens	70.9
Philonotis fontana	70.9
Pellia epiphylla	70.9
Hygrohypnum luridum	69.1
Calliergon cuspidatum	69.1
Brachythecium plumosum	69.1
Carex nigra	67.3
Mentha aquatica	67.3
Caltha palustris	67.3
Achillea ptarmica	67.3
Amblystegium fluviatile	67.3
Jungermannia atrovirens	67.3
Scapania undulata	65.5

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	42	24	67
Height at source (m)	589	250	1,210
Altitude (m)	206	10	425
Slope (km per 15 m fall)	2.4	0.2	16

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	36.4	<0.25	92.7
5–10	41.8	0.25–0.5	29.1
10–20	34.5	0.5–1	3.6
>20	20.0	>1	1.8

Geological types represented in at least 10% of sites	
Rock	% of sites
Non-calcareous shale	29.1
Hard limestone	16.4
Granite	16.4

Habitats	
Habitat	% of sites
Pools	1.8
Slacks	49.1
Riffles	9.1
Runs	85.5
Rapids	58.2

Substrates	
Substrate	% of sites
Silt/mud	0
Sand	1.8
Clay	0
Gravel	3.6
Pebbles	25.5
Cobbles	81.8
Boulders	78.2
Bedrock	23.6

Annex F Site locations, physical features and macrophytes for sub-types DIXa–DXe

Sub-type DIXa

No. of sites = 19

Top 20 dominant macrophytes

Taxon	*% of sites*
Glyceria fluitans	57.9
Agrostis stolonifera	57.9
Juncus effusus	52.6
Filipendula ulmaria	47.4
Eleocharis palustris	42.1
Caltha palustris	42.1
Juncus articulatus	36.8
Filamentous green algae	36.8
Iris pseudacorus	26.3
Carex nigra	26.3
Anthoxanthum odoratum	26.3
Veronica beccabunga	26.3
Ranunculus flammula	26.3
Mentha aquatica	26.3
Philonotis fontana	26.3
Sparganium erectum	21.1
Sagina procumbens	21.1
Rorippa nasturtium-aquaticum agg.	21.1
Hippuris vulgaris	21.1
Potamogeton natans	15.8

Top 30 macrophytes

Taxon	*% of sites*
Glyceria fluitans	94.7
Agrostis stolonifera	89.5
Caltha palustris	78.9
Juncus effusus	73.7
Filamentous green algae	73.7
Juncus articulatus	68.4
Eleocharis palustris	63.2
Carex nigra	63.2
Equisetum palustre	63.2
Ranunculus flammula	57.9
Myosotis scorpioides	57.9
Callitriche stagnalis	57.9
Galium palustre	52.6
Fontinalis antipyretica	52.6
Sagina procumbens	47.4
Filipendula ulmaria	47.4
Juncus bulbosus	42.1
Anthoxanthum odoratum	42.1
Veronica beccabunga	42.1
Rorippa nasturtium-aquaticum agg.	42.1
Equisetum fluviatile	42.1
Iris pseudacorus	36.8
Salix sp(p).	36.8
Polygonum amphibium	36.8
Montia fontana	36.8
Mentha aquatica	36.8
Hippuris vulgaris	36.8
Angelica sylvestris	36.8
Calliergon cuspidatum	36.8
Apium nodiflorum	31.6

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	26	3	44
Height at source (m)	191	10	750
Altitude (m)	98	0	725
Slope (km per 15 m fall)	6.1	0.3	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	73.7	<0.25	84.2
5–10	15.8	0.25–0.5	47.4
10–20	10.5	0.5–1	5.3
>20	10.5	>1	10.5

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	26.3
Hard limestone	21.1
Base-rich igneous	10.5
Other metamorphic	36.8

Habitats

Habitat	*% of sites*
Pools	5.3
Slacks	57.9
Riffles	42.1
Runs	15.8
Rapids	26.3

Substrates

Substrate	*% of sites*
Silt/mud	57.9
Sand	31.6
Clay	0
Gravel	15.8
Pebbles	31.6
Cobbles	10.5
Boulders	10.5
Bedrock	10.5

Sub-type DIXb

No. of sites = 25

Top 20 dominant macrophytes

Taxon	*% of sites*
Juncus bulbosus	76.0
Carex nigra	60.0
Ranunculus flammula	56.0
Pellia epiphylla	56.0
Juncus effusus	44.0
Filamentous green algae	44.0
Potamogeton polygonifolius	40.0
Carex rostrata	36.0
Myriophyllum alterniflorum	36.0
Sphagnum sp(p).	36.0
Viola palustris	32.0
Littorella uniflora	32.0
Equisetum fluviatile	32.0
Molinia caerulea	28.0
Salix sp(p).	28.0
Iris pseudacorus	24.0
Caltha palustris	24.0
Ferns	24.0
Potamogeton natans	20.0
Glyceria fluitans	20.0

Top 30 macrophytes

Taxon	*% of sites*
Juncus bulbosus	100.0
Carex nigra	88.0
Ranunculus flammula	88.0
Juncus effusus	84.0
Myriophyllum alterniflorum	80.0
Pellia epiphylla	80.0
Filamentous green algae	76.0
Potamogeton polygonifolius	72.0
Molinia caerulea	72.0
Sphagnum sp(p).	72.0
Eleogiton fluitans	68.0
Viola palustris	68.0
Littorella uniflora	68.0
Ferns	68.0
Potamogeton natans	64.0
Equisetum fluviatile	64.0
Carex rostrata	56.0
Potentilla erecta	52.0
Racomitrium aciculare	52.0
Glyceria fluitans	48.0
Eleocharis palustris	48.0
Carex demissa	48.0
Salix sp(p).	48.0
Anthoxanthum odoratum	44.0
Caltha palustris	44.0
Juncus articulatus	40.0
Menyanthes trifoliata	40.0
Callitriche hamulata	40.0
Angelica sylvestris	40.0
Iris pseudacorus	36.0

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	24	7	44
Height at source (m)	294	50	540
Altitude (m)	51	5	300
Slope (km per 15 m fall)	3.6	0.2	>25

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	52.0	<0.25	52.0
5–10	48.0	0.25–0.5	56.0
10–20	28.0	0.5–1	44.0
>20	16.0	>1	16.0

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Granite	12.0
Base-rich igneous	12.0
Other metamorphic	56.0

Habitats	
Habitat	*% of sites*
Pools	48.0
Slacks	64.0
Riffles	60.0
Runs	32.0
Rapids	32.0

Substrates	
Substrate	*% of sites*
Silt/mud	36.0
Sand	20.0
Clay	0
Gravel	20.0
Pebbles	32.0
Cobbles	40.0
Boulders	40.0
Bedrock	32.0

Sub-type DIXc

No. of sites = 46

Top 20 dominant macrophytes

Taxon	*% of sites*
Juncus acutiflorus	71.7
Juncus effusus	58.7
Ranunculus flammula	58.7
Juncus bulbosus	56.5
Glyceria fluitans	56.5
Equisetum fluviatile	54.3
Pellia epiphylla	54.3
Deschampsia cespitosa	50.0
Carex rostrata	50.0
Carex nigra	50.0
Salix sp(p).	47.8
Other (non-*Salix*) tree taxa	45.7
Agrostis stolonifera	43.5
Galium palustre	43.5
Eleocharis palustris	41.3
Myriophyllum alterniflorum	41.3
Filipendula ulmaria	41.3
Mentha aquatica	37.0
Caltha palustris	37.0
Ferns	37.0

Top 30 macrophytes

Taxon	*% of sites*
Juncus effusus	95.7
Juncus bulbosus	93.5
Ranunculus flammula	93.5
Glyceria fluitans	87.0
Galium palustre	82.6
Caltha palustris	80.4
Pellia epiphylla	80.4
Deschampsia cespitosa	78.3
Juncus acutiflorus	76.1
Agrostis stolonifera	76.1
Achillea ptarmica	76.1
Carex nigra	73.9
Filipendula ulmaria	73.9
Salix sp(p).	71.7
Equisetum fluviatile	71.7
Other (non-*Salix*) tree taxa	69.6
Viola palustris	69.6
Myriophyllum alterniflorum	69.6
Mentha aquatica	69.6
Angelica sylvestris	69.6
Carex rostrata	65.2
Juncus articulatus	60.9
Eleocharis palustris	60.9
Myosotis scorpioides	58.7
Molinia caerulea	56.5
Senecio aquaticus	56.5
Ferns	56.5
Anthoxanthum odoratum	54.3
Racomitrium aciculare	54.3
Fontinalis antipyretica	52.2

Physical features

Character

	Mean	*Min.*	*Max.*
No. of taxa per site	37	23	62
Height at source (m)	361	30	950
Altitude (m)	79	5	335
Slope (km per 15 m fall)	4.8	0.1	>25

Width and depth

Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	39.1	<0.25	52.2
5–10	34.8	0.25–0.5	56.5
10–20	41.3	0.5–1	43.5
>20	26.1	>1	32.6

Geological types represented in at least 10% of sites

Rock	*% of sites*
Hard sandstone	15.2
Hard limestone	10.9
Granite	10.9
Schist	10.9
Base-rich igneous	23.9

Habitats

Habitat	*% of sites*
Pools	23.9
Slacks	63.0
Riffles	34.8
Runs	54.3
Rapids	21.7

Substrates

Substrate	*% of sites*
Silt/mud	32.6
Sand	21.7
Clay	10.9
Gravel	32.6
Pebbles	37.0
Cobbles	43.5
Boulders	34.8
Bedrock	10.9

Sub-type DXa

No. of sites = 75

Top 20 dominant macrophytes

Taxon	% of sites
Juncus acutiflorus	90.7
Racomitrium aciculare	88.0
Anthoxanthum odoratum	85.3
Pellia epiphylla	84.0
Bryum pseudotriquetrum	76.0
Carex nigra	74.7
Scapania undulata	73.3
Ranunculus flammula	72.0
Juncus effusus	70.7
Agrostis stolonifera	68.0
Salix sp(p).	68.0
Juncus bulbosus	61.3
Caltha palustris	58.7
Potentilla erecta	57.3
Filamentous green algae	57.3
Nardus stricta	54.7
Hygrohypnum ochraceum	54.7
Fontinalis antipyretica	54.7
Glyceria fluitans	53.3
Achillea ptarmica	53.3

Top 30 macrophytes

Taxon	% of sites
Pellia epiphylla	97.3
Anthoxanthum odoratum	96.0
Filamentous green algae	96.0
Juncus acutiflorus	94.7
Racomitrium aciculare	93.3
Juncus effusus	90.7
Scapania undulata	89.3
Bryum pseudotriquetrum	88.0
Carex nigra	86.7
Ranunculus flammula	86.7
Salix sp(p).	81.3
Juncus bulbosus	80.0
Achillea ptarmica	80.0
Agrostis stolonifera	78.7
Caltha palustris	77.3
Hygrohypnum ochraceum	77.3
Fontinalis antipyretica	77.3
Potentilla erecta	72.0
Filipendula ulmaria	72.0
Nardus stricta	70.7
Brachythecium plumosum	69.3
Sagina procumbens	68.0
Deschampsia cespitosa	66.7
Glyceria fluitans	64.0
Ferns	64.0
Hyocomium armoricum	64.0
Dichodontium pellucidum	64.0
Calliergon cuspidatum	64.0
Galium palustre	62.7
Jungermannia atrovirens	61.3

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	44	23	66
Height at source (m)	465	109	1,210
Altitude (m)	189	10	490
Slope (km per 15 m fall)	3	0.2	>25

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	41.3	<0.25	86.7
5–10	36.0	0.25–0.5	37.3
10–20	34.7	0.5–1	10.7
>20	26.7	>1	1.3

Geological types represented in at least 10% of sites

Rock	% of sites
Non-calcareous shale	17.3
Granite	10.7
Schist	13.3
Base-rich igneous	18.7

Habitats

Habitat	% of sites
Pools	12.0
Slacks	50.7
Riffles	21.3
Runs	76.0
Rapids	42.7

Substrates

Substrate	% of sites
Silt/mud	2.7
Sand	0
Clay	1.3
Gravel	10.7
Pebbles	42.7
Cobbles	78.7
Boulders	57.3
Bedrock	22.7

Sub-type DXb

No. of sites = 22

Top 20 dominant macrophytes

Taxon	*% of sites*
Pellia epiphylla	54.5
Sagina procumbens	50.0
Hygrohypnum luridum	50.0
Other (non-*Salix*) tree taxa	40.9
Salix sp(p).	40.9
Rhynchostegium riparioides	31.8
Philonotis fontana	31.8
Juncus articulatus	27.3
Ranunculus flammula	27.3
Chiloscyphus polyanthos	27.3
Racomitrium aciculare	22.7
Fontinalis antipyretica	22.7
Calliergon cuspidatum	22.7
Bryum pseudotriquetrum	22.7
Marchantia polymorpha	22.7
Filipendula ulmaria	18.2
Juncus effusus	13.6
Juncus bulbosus	13.6
Deschampsia cespitosa	13.6
Carex demissa	13.6

Top 30 macrophytes

Taxon	*% of sites*
Ranunculus flammula	90.9
Juncus effusus	86.4
Juncus articulatus	86.4
Viola palustris	86.4
Fontinalis antipyretica	86.4
Pellia epiphylla	86.4
Agrostis stolonifera	81.8
Racomitrium aciculare	81.8
Juncus bulbosus	77.3
Sagina procumbens	77.3
Hygrohypnum luridum	72.7
Nardus stricta	68.2
Anthoxanthum odoratum	68.2
Deschampsia cespitosa	63.6
Carex demissa	63.6
Caltha palustris	63.6
Marchantia polymorpha	63.6
Filamentous green algae	63.6
Salix sp(p).	59.1
Potentilla erecta	59.1
Callitriche stagnalis	59.1
Other (non-*Salix*) tree taxa	54.5
Montia fontana	54.5
Galium palustre	54.5
Angelica sylvestris	54.5
Sphagnum sp(p).	54.5
Chiloscyphus polyanthos	54.5
Carex nigra	50.0
Senecio aquaticus	50.0
Myosotis scorpioides	50.0

Physical features

Character	*Mean*	*Min.*	*Max.*
No. of taxa per site	32	16	47
Height at source (m)	449	100	780
Altitude (m)	110	15	575
Slope (km per 15 m fall)	4.6	1.6	5

Width and depth			
Width (m)	*% of sites*	*Depth (m)*	*% of sites*
<5	22.7	<0.25	72.7
5–10	68.2	0.25–0.5	77.3
10–20	50.0	0.5–1	22.7
>20	9.1	>1	0

Geological types represented in at least 10% of sites	
Rock	*% of sites*
Hard sandstone	40.9
Schist	13.6
Base-rich igneous	13.6

Habitats	
Habitat	*% of sites*
Pools	9.1
Slacks	36.4
Riffles	63.6
Runs	27.3
Rapids	68.2

Substrates	
Substrate	*% of sites*
Silt/mud	4.5
Sand	0
Clay	0
Gravel	31.8
Pebbles	31.8
Cobbles	54.5
Boulders	72.7
Bedrock	77.3

Sub-type DXc

No. of sites = 48

Top 20 dominant macrophytes

Taxon	% of sites
Pellia epiphylla	56.3
Juncus effusus	47.9
Other (non-*Salix*) tree taxa	47.9
Polytrichum commune	41.7
Anthoxanthum odoratum	39.6
Racomitrium aciculare	39.6
Molinia caerulea	37.5
Nardus stricta	35.4
Sphagnum sp(p).	35.4
Deschampsia cespitosa	33.3
Salix sp(p).	33.3
Juncus acutiflorus	29.2
Potentilla erecta	29.2
Ferns	27.1
Philonotis fontana	27.1
Juncus bulbosus	25.0
Agrostis stolonifera	25.0
Sagina procumbens	25.0
Tussilago farfara	22.9
Juncus articulatus	20.8

Top 30 macrophytes

Taxon	% of sites
Racomitrium aciculare	75.0
Juncus effusus	72.9
Anthoxanthum odoratum	70.8
Pellia epiphylla	70.8
Polytrichum commune	68.8
Potentilla erecta	62.5
Sphagnum sp(p).	60.4
Molinia caerulea	58.3
Viola palustris	58.3
Other (non-*Salix*) tree taxa	56.3
Nardus stricta	54.2
Sagina procumbens	54.2
Deschampsia cespitosa	52.1
Salix sp(p).	50.0
Juncus bulbosus	47.9
Juncus articulatus	47.9
Ferns	47.9
Carex demissa	43.8
Juncus acutiflorus	41.7
Agrostis stolonifera	41.7
Ranunculus flammula	41.7
Filamentous green algae	39.6
Carex echinata	37.5
Philonotis fontana	37.5
Brachythecium plumosum	35.4
Tussilago farfara	27.1
Montia fontana	27.1
Achillea ptarmica	27.1
Juncus squarrosus	25.0
Fontinalis antipyretica	25.0

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	19	1	33
Height at source (m)	594	100	890
Altitude (m)	231	10	750
Slope (km per 15 m fall)	1.7	1.2	5

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	41.7	<0.25	64.6
5–10	50.0	0.25–0.5	62.5
10–20	35.4	0.5–1	37.5
>20	20.8	>1	16.7

Geological types represented in at least 10% of sites	
Rock	% of sites
Hard sandstone	39.6
Hard limestone	16.7
Granite	10.4
Schist	22.9

Habitats	
Habitat	% of sites
Pools	4.2
Slacks	25.0
Riffles	68.8
Runs	43.8
Rapids	75.0

Substrates	
Substrate	% of sites
Silt/mud	0
Sand	8.3
Clay	0
Gravel	22.9
Pebbles	39.6
Cobbles	85.4
Boulders	79.2
Bedrock	56.3

Sub-type DXd

No. of sites = 30

Top 20 dominant macrophytes

Taxon	% of sites
Molinia caerulea	56.7
Filamentous green algae	53.3
Pellia epiphylla	50.0
Juncus bulbosus	43.3
Scapania undulata	43.3
Sphagnum sp(p).	40.0
Potentilla erecta	36.7
Racomitrium aciculare	36.7
Polytrichum commune	36.7
Juncus effusus	33.3
Ranunculus flammula	33.3
Ferns	30.0
Juncus acutiflorus	26.7
Narthecium ossifragum	23.3
Carex nigra	23.3
Carex demissa	23.3
Anthoxanthum odoratum	23.3
Salix sp(p).	23.3
Other (non-*Salix*) tree taxa	16.7
Viola palustris	16.7

Top 30 macrophytes

Taxon	% of sites
Juncus bulbosus	90.0
Sphagnum sp(p).	86.7
Molinia caerulea	83.3
Pellia epiphylla	83.3
Racomitrium aciculare	80.0
Filamentous green algae	80.0
Potentilla erecta	76.7
Scapania undulata	73.3
Ranunculus flammula	70.0
Polytrichum commune	70.0
Ferns	66.7
Narthecium ossifragum	56.7
Juncus effusus	56.7
Blindia acuta	56.7
Marsupella emarginata	56.7
Nardus stricta	53.3
Viola palustris	53.3
Juncus acutiflorus	50.0
Carex demissa	50.0
Anthoxanthum odoratum	46.7
Salix sp(p).	46.7
Carex nigra	40.0
Potamogeton polygonifolius	30.0
Carex echinata	30.0
Other (non-*Salix*) tree taxa	30.0
Dicranella palustris	30.0
Sagina procumbens	23.3
Littorella uniflora	23.3
Brachythecium rivulare	23.3
Myriophyllum alterniflorum	20.0

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	19	8	33
Height at source (m)	481	130	890
Altitude (m)	129	5	645
Slope (km per 15 m fall)	1.5	1.2	6

Width and depth

Width (m)	% of sites	Depth (m)	% of sites
<5	70.0	<0.25	63.3
5–10	53.3	0.25–0.5	73.3
10–20	13.3	0.5–1	30.0
>20	0	>1	16.7

Geological types represented in at least 10% of sites

Rock	% of sites
Hard sandstone	10.0
Hard limestone	10.0
Granite	20.0
Schist	23.3
Base-rich igneous	10.0
Other metamorphic	26.7

Habitats

Habitat	% of sites
Pools	10.0
Slacks	30.0
Riffles	66.7
Runs	6.7
Rapids	60.0

Substrates

Substrate	% of sites
Silt/mud	3.3
Sand	0
Clay	0
Gravel	16.7
Pebbles	40.0
Cobbles	53.3
Boulders	66.7
Bedrock	46.7

Sub-type DXe

No. of sites = 52

Top 20 dominant macrophytes

Taxon	% of sites
Pellia epiphylla	84.6
Scapania undulata	78.8
Anthoxanthum odoratum	67.3
Polytrichum commune	67.3
Hyocomium armoricum	65.4
Juncus effusus	63.5
Juncus bulbosus	61.5
Sphagnum sp(p).	61.5
Juncus acutiflorus	57.7
Racomitrium aciculare	55.8
Marsupella emarginata	53.8
Other (non-*Salix*) tree taxa	51.9
Jungermannia atrovirens	51.9
Agrostis stolonifera	48.1
Nardia compressa	46.2
Ranunculus flammula	44.2
Ferns	44.2
Filamentous green algae	44.2
Deschampsia cespitosa	40.4
Salix sp(p).	40.4

Top 30 macrophytes

Taxon	% of sites
Scapania undulata	96.2
Pellia epiphylla	96.2
Polytrichum commune	92.3
Hyocomium armoricum	86.5
Filamentous green algae	86.5
Juncus effusus	84.6
Anthoxanthum odoratum	84.6
Juncus bulbosus	82.7
Sphagnum sp(p).	80.8
Racomitrium aciculare	76.9
Other (non-*Salix*) tree taxa	73.1
Marsupella emarginata	71.2
Jungermannia atrovirens	69.2
Juncus acutiflorus	65.4
Ranunculus flammula	61.5
Ferns	61.5
Agrostis stolonifera	59.6
Viola palustris	59.6
Nardia compressa	59.6
Deschampsia cespitosa	57.7
Salix sp(p).	57.7
Potentilla erecta	57.7
Nardus stricta	53.8
Bryum pseudotriquetrum	53.8
Molinia caerulea	51.9
Carex echinata	50.0
Hygrohypnum ochraceum	50.0
Fontinalis squamosa	48.1
Glyceria fluitans	46.2
Carex nigra	46.2

Physical features

Character	Mean	Min.	Max.
No. of taxa per site	28	13	43
Height at source (m)	481	107	1,210
Altitude (m)	234	10	474
Slope (km per 15 m fall)	1.7	1.3	10

Width and depth			
Width (m)	% of sites	Depth (m)	% of sites
<5	71.2	<0.25	92.3
5–10	30.8	0.25–0.5	32.7
10–20	11.5	0.5–1	5.8
>20	5.8	>1	0

Geological types represented in at least 10% of sites	
Rock	% of sites
Non-calcareous shale	32.7
Soft sandstone	11.5
Granite	11.5
Schist	31.5

Habitats	
Habitat	% of sites
Pools	1.9
Slacks	44.2
Riffles	19.2
Runs	67.3
Rapids	57.7

Substrates	
Substrate	% of sites
Silt/mud	0
Sand	1.9
Clay	0
Gravel	13.5
Pebbles	26.9
Cobbles	61.5
Boulders	59.6
Bedrock	25.5

Annex G Field manual (survey method, species checklist and key)

Standard method of river macrophyte survey and for determining river community type

Field survey

Ideally, sites are located every 5–7 km along a river, but this will vary depending on the size of the river and ease of access. For most rivers it has been found that sites 5 km apart reflect accurately the character of small streams, whilst sites more than 10 km apart may suffice for large rivers.

Macrophytes from two 0.5 km lengths, one upstream and one downstream of a specific grid reference, are surveyed using a check-list of species (Table A1). To aid further surveys it is important that each length is clearly identifiable by reference to an obvious feature at the site as well as to a six-figure grid reference. Where possible, recording is done by wading in the channel, but for deep and wide rivers it is necessary to walk the banks, using a grapnel for sampling, or use a boat.

The macrophyte survey concentrates on recording the presence or absence of species on the check-list and limits itself to the channel and base of the banks. Additional species of interest are noted but not used in the classification. The survey at each site includes the entire channel and immediate banksides; separate records are made for those macrophytes found in the river and for those found on the bank. This is an attempt to distinguish between species that occur more or less permanently submerged (if only their basal parts) and those that are subject to only periodic submergence. The former are referred to as 'river' records and the latter as 'bank' records.

To make the separation of these records objective the following guidelines should be observed when defining the limits of the river being surveyed. At the sides of the river all parts of the substratum are included that are likely to be submerged for more than 85% of the year. The 'bank' can be usefully defined as that part of the side of the river (or island) that is submerged for more than 50% but less than 85% of the time. In general terms, therefore, 'river' records are reserved for those macrophtyes occurring in the region of the river that is rarely uncovered and those shallow sections that have an upper limit that may be exposed for a maximum of 50 days in any year. 'Bank' records are for those plants that occur above the limit of the 'river' plants, and are thus out of the water for more than 50 days in any one year, yet will be submerged, or partially so, during mean flow periods. The upper limit of the 'bank' excludes all the areas that are submerged during the 150 days of each year when river flows are at their highest. Such estimates have to involve guesswork, but estimates of submergence levels do allow better interpretation of the data and clearer insights into the ecology of individual species and communities at difference sites.

Survey results are tabulated, with any species present within a 0.5 km site denoted by a double set of numbers, either under 'River' or 'Bank' (Table A2). (Note that in the case of marginal plants it is not uncommon for the species to be recorded in both habitats.) The two numbers are essentially estimates of abundance. The first number in each column (r) refers to the relative abundance of one species against the other species present, but does not indicate how much of the site it covers. Assessment is made on a scale of 1–3, which roughly accords to a simplified DAFOR scale.

1 = Rare

2 = Occasional or Frequent

3 = Abundant or Dominant

The second letter (a) refers to absolute abundance or percentage cover and is a semi-objective assessment based on the percentage of the river bed or bank covered by each macrophyte species. Again assessment is on a scale of 1–3:

1 = <0.1% cover of the channel (river) or its wetted margins (bank)

2 = 0.1–5.0% cover

3 = >5% cover.

Visualising the relative abundance of one species compared with all the others present in a 0.5 km length of river is relatively straightforward, but estimating the actual cover value is more difficult. As a general guide it is valuable to assume that a dense stand of vegetation stretching from bank to bank and extending for 5 m downstream covers 1% of the 500 m stretch. Similarly, an unbroken stand of 25 m represents 5% cover. Bank cover is best recorded from one bank in very wide rivers. In such cases a continuous fringe of a single species stretching 5 m represents 1% cover. If both banks are clearly visible and being recorded, then a continuous stand of 10 m represents 1% cover. A species with cover value 3 means, for instance, that it completely covers the stream bed for 25 m, or it covers half the bed for 50 m, or a quarter of the bed for 100 m, or it occurs throughout the whole 500 m, but more sparsely. For a score of 3 to be given, bank taxa must:

i) be similarly abundant along both banks with a continuous fringe of 50 m, or

ii) be a co-dominant fringe of 100 m, or

iii) occur as 50 plants or colonies covering a metre each.

Table A2 gives an example of how data should be recorded. The first figure in each column represents the relative abundance of the species; the second figure represents the cover value. River and bank records are made separately. In the examples in Table A2, therefore:

Table A1 Macrophyte species listed on the standard river survey field card

Batrachospermum	Alga
Hildenbrandia rivularis	Alga
Lemanea fluviatilis	Alga
Vaucheria spp.	Mole-pelt alga
Didymosphenia geminata	Woolly diatom
	Sponge spp.
Enteromorpha spp.	Tubeweed
Cladophora aegagropila	Carpet blanketweed
Cladophora glomerata	Blanketweed
	Filamentous green algae
Chara vulgaris	Charophyte
Nitella flexilis	Charophyte
Nitella opaca	Charophyte
Collema dichotomum	Lichen
Dermatocarpon fluviatile	Lichen
Verrucaria spp.	Freshwater lichen
Chiloscyphus polyanthos	Liverwort
Conocephalum conicum	Liverwort
Lunularia cruciata	Liverwort
Marchantia polymorpha	Liverwort
Marsupella emarginata	Liverwort
Nardia compressa	Liverwort
Pellia endiviifolia	Liverwort
Pellia epiphylla	Liverwort
Scapania undulata	Liverwort
Jungermannia atrovirens	Liverwort
Amblystegium fluviatile	Moss
Amblystegium riparium	Moss
Blindia acuta	Moss
Brachythecium plumosum	Moss
Brachythecium rivulare	Moss
Brachythecium rutabulum	Moss
Bryum pseudotriquetrum	Moss
Calliergon cuspidatum	Moss
Cinclidotus fontinaloides	Moss
Dichodontium flavescens	Moss
Dichodontium pellucidum	Moss
Dicranella palustris	Moss
Fontinalis antipyretica	Willowmoss
Fontinalis squamosa	Moss
Hygrohypnum luridum	Moss
Hygrohypnum ochraceum	Moss
Hyocomium armoricum	Moss
Philonotis fontana	Moss
Polytrichum commune	Moss
Racomitrium aciculare	Moss
Rhynchostegium riparioides	Moss
Schistidium agassizii	Moss
Schistidium alpicola	Moss
Sphagnum spp.	Moss
Thamnobryum alopecurum	Moss
Azolla filiculoides	Water fern
Equisetum arvense	Field horsetail
Equisetum fluviatile	Water horsetail
Equisetum palustre	Marsh horsetail
Ferns	
Achillea ptarmica	Sneezewort
Angelica sylvestris	Wild angelica
Apium inundatum	Lesser marshwort
Apium nodiflorum	Fool's water-cress
Berula erecta	Lesser water-parsnip
Bidens cernua	Nodding bur-marigold
Bidens tripartita	Tripartite bur-marigold
Callitriche hamulata	Intermediate water-starwort
Callitriche hermaphroditica	Autumnal water-starwort
Callitriche obtusangula	Blunt-fruited water-starwort
Callitriche platycarpa	Various-leaved water-starwort
Callitriche stagnalis	Common water-starwort
Caltha palustris	Marsh-marigold
Cardamine amara	Large bitter-cress
Ceratophyllum demersum	Rigid hornwort
Dipsacus fullonum	Teasel
Epilobium hirsutum	Great willowherb
Eupatorium cannabinum	Hemp-agrimony
Filipendula ulmaria	Meadowsweet
Galium palustre	Common marsh-bedstraw
Galium boreale	Northern bedstraw
Hippuris vulgaris	Mare's-tail
Hydrocotyle vulgaris	Marsh pennywort
Impatiens capensis	Orange balsam
Impatiens glandulifera	Indian balsam
Littorella uniflora	Shoreweed
Lotus uliginosus	Greater bird's-foot-trefoil
Lupinus nootkatensis	Nootka lupin
Lycopus europaeus	Gipsy-wort
Lysimachia vulgaris	Yellow loosestrife
Lythrum salicaria	Purple loosestrife
Mentha aquatica	Water mint
Menyanthes trifoliata	Bogbean
Mimulus guttatus agg.	Monkeyflower
Mimulus guttatus x luteus	Monkeyflower hybrid
Mimulus cupreus	Coppery monkeyflower
Montia fontana	Blinks
Montia sibirica	Pink purslane
Myrica gale	Bog-myrtle
Myosotis scorpioides	Water forget-me-not
Myosoton aquaticum	Water chickweed
Myriophyllum alterniflorum	Alternate water-milfoil
Myriophyllum spicatum	Spiked water-milfoil
Nuphar lutea	Yellow water-lily
Nymphaea alba	White water-lily
Oenanthe crocata	Hemlock water-dropwort
Oenanthe fluviatilis	River water-dropwort
Petasites hybridus	Butterbur
Polygonum amphibium	Amphibious bistort
Potentilla erecta	Tormentil
Potentilla palustris	Marsh cinquefoil
Pulicaria dysenterica	Common fleabane
Ranunculus aquatilis	Common water-crowfoot
R. penicillatus subsp. *pseudofluitans*	Brook water-crowfoot
Ranunculus circinatus	Fan-leaved water-crowfoot
Ranunculus flammula	Lesser spearwort
Ranunculus fluitans	River water-crowfoot
Ranunculus hederaceus	Ivy-leaved crowfoot
Ranunculus omiophyllus	Round-leaved crowfoot
Ranunculus peltatus	Pond water-crowfoot

Table A1 *(continued)*

R. penicillatus subsp. *penicillatus*	Stream water-crowfoot
Ranunculus trichophyllus	Thread-leaved water-crowfoot
Ranunculus sceleratus	Celery-leaved buttercup
Ranunculus penicillatus subsp. *pseudofluitans* var. *vertumnus*	Brook water-crowfoot
Rorippa amphibia	Great yellow-cress
Rorippa nasturtium-aquaticum	Water-cress
Rorippa palustris	Marsh yellow-cress
Rorippa sylvestris	Creeping yellow-cress
Rumex hydrolapathum	Great waterdock
Sagina procumbens	Procumbent pearlwort
Scrophularia auriculata	Water figwort
Scutellaria galericulata	Skullcap
Senecio aquaticus	Marsh ragwort
Solanum dulcamara	Bittersweet
Stachys palustris	Marsh woundwort
Stellaria alsine	Bog stitchwort
Symphytum officinalis	Common comfrey
Tussilago farfara	Colt's-foot
Veronica anagallis-aquatica	Blue water-speedwell
Veronica beccabunga	Brooklime
Veronica catenata	Pink water-speedwell
Veronica scutellata	Marsh speedwell
Viola palustris	Marsh violet
Salix spp.	Willow
Trees	
Acorus calamus	Sweet-flag
Agrostis stolonifera	Creeping-bent
Alisma lanceolatum	Narrow-leaved water-plantain
Alisma plantago-aquatica	Water-plantain
Alopecurus geniculatus	Marsh foxtail
Anthoxanthum odoratum	Sweet vernal-grass
Butomus umbellatus	Flowering-rush
Carex acuta	Slender tufted-sedge
Carex acutiformis	Lesser pond-sedge
Carex aquatilis	Water sedge
Carex binervis	Green-ribbed sedge
Carex curta	White sedge
Carex demissa	Common yellow-sedge
Carex disticha	Brown sedge
Carex echinata	Star sedge
Carex elata	Tufted sedge
Carex flacca	Glaucous sedge
Carex hirta	Hairy sedge
Carex otrubae	False fox-sedge
Carex ovalis	Oval sedge
Carex lepidocarpa	Long-stalked yellow-sedge
Carex nigra	Common sedge
Carex paniculata	Greater tussock-sedge
Carex pendula	Pendulous sedge
Carex panicea	Carnation sedge
Carex pulicaris	Flea sedge
Carex remota	Remote sedge
Carex riparia	Great pond-sedge
Carex rostrata	Bottle sedge
Carex vesicaria	Bladder sedge
Catabrosa aquatica	Whorl-grass
Crocosmia crocosmiiflora	Montbretia
Deschampsia cespitosa	Tufted hair-grass
Eleocharis palustris	Common spike-rush
Eleogiton fluitans	Floating club-rush
Elodea canadensis	Canadian pondweed
Elodea nuttalii	Nuttall's pondweed
Glyceria declinata	Small sweet-grass
Glyceria fluitans	Floating sweet-grass
Glyceria maxima	Reed sweet-grass
Glyceria plicata	Plicate sweet-grass
Groenlandia densa	Opposite-leaved pondweed
Iris pseudacorus	Yellow flag
Juncus acutiflorus	Sharp-flowered rush
Juncus articulatus	Jointed rush
Juncus bulbosus	Bulbous rush
Juncus effusus	Soft rush
Juncus inflexus	Hard rush
Juncus squarrosus	Heath rush
Lemna gibba	Fat duckweed
Lemna minor	Common duckweed
Lemna (Spirodela) polyrhiza	Great duckweed
Lemna trisulca	Ivy-leaved duckweed
Molinia caerulea	Purple moor-grass
Nardus stricta	Mat-grass
Narthecium ossifragum	Bog asphodel
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Common reed
Potamogeton alpinus	Red pondweed
Potamogeton berchtoldii	Small pondweed
Potamogeton crispus	Curled pondweed
Potamogeton friesii	Flat-stalked pondweed
Potamogeton gramineus	Various-leaved pondweed
Potamogeton lucens	Shining pondweed
Potamogeton natans	Broad-leaved pondweed
Potamogeton nodosus	Loddon pondweed
Potamogeton x *olivaceus*	Hybrid pondweed
Potamogeton pectinatus	Fennel pondweed
Potamogeton perfoliatus	Perfoliate pondweed
Potamogeton polygonifolius	Bog pondweed
Potamogeton praelongus	Long-stalked pondweed
Potamogeton pusillus	Lesser pondweed
Potamogeton x *salicifolius*	Hybrid pondweed
Sagittaria sagittifolia	Arrowhead
Schoenoplectus lacustris	Clubrush/bullrush
Scirpus maritimus	Sea club-rush
Scirpus sylvaticus	Wood club-rush
Sparganium angustifolium	Floating bur-reed
Sparganium emersum	Unbranched bur-reed
Sparganium erectum	Branched bur-reed
Typha latifolia	Greater reedmace
Zannichellia palustris	Horned pondweed

Table A2 An example of the way in which macrophyte survey data are tabulated before determination of the river community type

	Upstream 0.5 km				*Downstream 0.5 km*			
	River		*Bank*		*River*		*Bank*	
	r	*a*	*r*	*a*	*r*	*a*	*r*	*a*
Species A	3	3			3	3		
Species B	1	1	1	1	1	1	1	1
Species C	2	1	3	3				
Species D	2	2	3	3	2	1	3	3
Species E	3	3			2	2		

Note: r = relative abundance; a = cover value

Species A is dominant in both 0.5 km lengths of the river; it covers more than 5% of the river channel but does not occur on the banks;

Species B is rare; it is present in both river and bank habitats in both lengths but at a cover value of less than 0.1%;

Species C is present only in the upstream length; it is co-dominant with Species D on the banks with cover >5% and is frequent relative to other species within the river channel but covers <0.1%;

Species D is present in both upstream and downstream lengths and is the dominant species on the banks; although relative to other species it occurs at the same frequency in both river channel sites, cover is between 0.1–5% in the upstream site and <0.1% in the downstream site;

Species E is dominant in the river channel in the upstream site but is only frequent in the downstream site; cover values are >5% in the former and 0.1–5% in the latter; the species does not occur on the banks.

Key for classifying sites into Groups, river community types and sub-types

The key is used to classify macrophyte data from 500 m or 1,000 m lengths into Groups, river community types and sub-types. Score –1 for every record of a species listed followed by a (–) sign; score +1 for every record of a species listed with a (+) sign. Where a species name is followed by a '2' it is included in the keying process ONLY if it has been recorded at abundance scale 2 or above; if followed by a '3' the species must have been recorded at that abundance level to be included.

No.	*Score for species presence*	*Total score*	*Go to*
1	*Cladophora glomerata* agg. (–)	–1 or less	2
	Epilobium hirsutum (–)	0 or more	3
	Pellia epiphylla (+)		
	Racomitrium aciculare (+)		
	Ranunculus flammula (+)		
	Solanum dulcamara (–)		
	Sparganium erectum (–)		
2	*Amblystegium fluviatile* (+)	0 or less	4 (Group A)
	Apium nodiflorum (–)	1 or more	5 (Group B)
	Carex riparia (–)		
	Conocephalum conicum (+)		
	Glyceria maxima (–)		
	Rhynchostegium riparioides (+)		
	Verrucaria sp(p). (+)		
3	*Juncus bulbosus* 3 (+)	–1 or less	6 (Group C)
	Phalaris arundinacea (–)	0 or more	7 (Group D)
	Polytrichum commune (+)		
	Potentilla erecta (+)		
	Rhynchostegium riparioides (–)		
	Sphagnum sp(p). (+)		
	Verrucaria sp(p). (–)		
4 (Group A)	*Enteromorpha* sp(p). (–)	–2 or less	8 (Types I & II)
	Nuphar lutea (–)	–1 or more	9 (Types III & IV)
	Potamogeton pectinatus (–)		
	Rorippa amphibia (–)		
	Sagittaria sagittifolia (–)		
5 (Group B)	*Elodea canadensis* (+)	1 or less	10 (Type V)
	Eleocharis palustris (+)	2 or more	11 (Type VI)
	Mimulus guttatus agg. (+)		
	Myosotis scorpioides 3 (+)		
	Oenanthe crocata 3 (–)		
	Polygonum amphibium (+)		
6 (Group C)	*Chiloscyphus polyanthos* (+)	0 or less	12 (Type VII)
	Glyceria fluitans 3 (–)	1 or more	13 (Type VIII)
	Hygrohypnum ochraceum (+)		
	Lemanea fluviatilis (+)		
	Thamnobryum alopecurum (+)		
	Verrucaria sp(p). (+)		
7 (Group D)	*Eleocharis palustris* (–)	–1 or less	14 (Type IX)
	Equisetum fluviatile 3 (–)	0 or more	15 (Type X)
	Glyceria fluitans 3 (–)		
	Hyocomium armoricum (+)		
	Nardus stricta (+)		
	Scapania undulata (+)		

No.	*Score for species presence*	*Total score*	*Go to*
8 (Group A, Types I & II)	*Berula erecta* (–) *Carex riparia* (–) *Eupatorium cannabinum* (–) *Glyceria maxima* 3 (–) *Iris pseudacorus* (–) *Phragmites australis* (–) *Rorippa nasturtium-aquaticum/microphylla* agg. 3 (–)	–4 or less –3 or more	16 (Type I) 17 (Type II)
9 (Group A, Types III & IV)	*Berula erecta* (–) *Callitriche obtusangula* (–) *Carex acutiformis* (–) *Glyceria maxima* (–) *Iris pseudacorus* (–) *Ranunculus calcareus* (*penicillatus* subsp. *pseudofluitans*) 3 (–) *Veronica anagallis-aquatica* (–)	–4 or less –3 or more	18 (Type III) 19 (Type IV)
10 (Group B, Type V)	*Chiloscyphus polyanthos* (+) *Epilobium hirsutum* (–) *Fontinalis squamosa* (+) *Lythrum salicaria* (+) *Myriophyllum alterniflorum* (+) *Ranunculus penicillatus* subsp. *penicillatus* (+) *Veronica beccabunga* (–)	1 or less 2 or more	10a (Sub-types Va–c) 10c (Sub-types Vd/e)
10a	*Amblystegium fluviatile* 3 (–) *Apium nodiflorum* (+) *Lemanea fluviatilis* (–) *Petasites hybridus* (–) *Rhynchostegium riparioides* 3 (–) *Sparganium erectum* 3 (+)	–2 or less –1 or more	Sub-type Va (END) 10b (Sub-types Vb/c)
10b	*Cladophora glomerata agg.* 3 (–) *Hildenbrandia rivularis* (–) *Pellia epiphylla* (+) *Ranunculus penicillatus* subsp. *pseudofluitans* (–) *Verrucaria* sp(p). (–)	–1 or less 0 or more	Sub-type Vb (END) Sub-type Vc (END)
10c	*Callitriche hamulata* 3 (–) *Cinclidotus fontinaloides* (+) *Glyceria fluitans* 3 (–) *Hildenbrandia rivularis* (+) *Rorippa sylvestris* (+) *Sparganium emersum* (–)	–1 or less 0 or more	Sub-type Vd (END) Sub-type Ve (END)
11 (Group B, Type VI)	*Cinclidotus fontinaloides* (–) *Cladophora glomerata* agg. 3 (–) *Filipendula ulmaria* 3 (+) *Impatiens glandulifera* (–) *Ranunculus fluitans* (–) *Vaucheria* sp(p). (–)	–2 or less –1 or more	11a (Sub-types VIa–c) 11c (Sub-types VId/e)
11a	*Caltha palustris* (+) *Lemanea fluviatilis* (+) *Myriophyllum spicatum* (–) *Ranunculus fluitans* (–) *Schistidium alpicola* (+) *Verrucaria* sp(p). 3 (+)	–1 or less 0 or more	Sub-type VIa (END) 11b (Sub-types VIb/c)

No.	*Score for species presence*	*Total score*	*Go to*
11b	Filamentous green algae (+) *Myriophyllum alterniflorum* (+) *Myriophyllum spicatum* (–) *Ranunculus fluitans* (–)	–1 or less	Sub-type VIb (END)
		0 or more	Sub-type VIc (END)
11c	*Equisetum arvense* (–) *Juncus acutiflorus* (–) *Myriophyllum alterniflorum* (–) *Verrucaria* sp(p). (–)	–2 or less	Sub-type VId (END)
		–1 or more	Sub-type VIe (END)
12 (Group C, Type VII)	*Callitriche hamulata (intermedia)* (+) *Caltha palustris* 3 (–) *Juncus acutiflorus* (+) *Oenanthe crocata* (+) *Veronica beccabunga* 3 (–)	0 or less	12a (Sub-types VIIa/b)
		1 or more	12b (Sub-types VIIc/d)
12a	*Alopecurus geniculatus* 3 (–) *Calliergon cuspidatum* (–) *Equisetum arvense* (–) *Myriophyllum alterniflorum* (–) *Phalaris arundinacea* (+) *Ranunculus flammula* (–) *Salix* sp(p). 3 (+)	0 or less	Sub-type VIIa (END)
		1 or more	Sub-type VIIb (END)
12b	*Alisma plantago-aquatica* (–) *Rhynchostegium riparioides* (+) *Verrucaria* sp(p). (+)	0 or less	Sub-type VIIc (END)
		1 or more	VIId (END)
13 (Group C, Type VIII)	*Achillea ptarmica* (+) *Bryum pseudotriquetrum* (+) *Calliergon cuspidatum* (+) *Carex nigra* (+) *Juncus bulbosus* (+) *Jungermannia atrovirens* (+)	2 or less	13a (Sub-types VIIIa–c)
		3 or more	13c (Sub-types VIIId/e)
13a	*Brachythecium rivulare* (+) *Callitriche hamulata* (–) *Cladophora glomerata* agg. (+) *Dichodontium pellucidum* (+) *Fontinalis squamosa* 3 (–) *Tussilago farfara* (+)	1 or less	13b (Sub-types VIIIa/b)
		2 or more	Sub-type VIIIc (END)
13b	*Dermatocarpon fluviatile* (+) *Juncus acutiflorus* agg. (+) *Mentha aquatica* (+) *Myriophyllum alterniflorum* (+) *Phalaris arundinacea* 3 (+) *Ranunculus flammula* (+)	2 or less	Sub-type VIIIa (END)
		3 or more	Sub-type VIIIb (END)
13c	*Brachythecium rivulare* 3 (+) *Callitriche hamulata* (–) *Hygrohypnum luridum* (+) *Littorella uniflora* (–) *Myriophyllum alterniflorum* (–) *Phalaris arundinacea* (–) *Philonotis fontana* (+)	–2 or less	Sub-type VIIId (END)
		–1 or more	Sub-type VIIIe (END)

No.	*Score for species presence*	*Total score*	*Go to*
14 (Group D, Type IX)	*Juncus bulbosus 3* (+) *Littorella uniflora* (+) *Molinia caerulea* (+) *Myriophyllum alterniflorum 3* (+) Trees (non-*Salix*) (+) *Viola palustris 3* (+)	1 or less 2 or more	**Sub-type IXa (END)** **14a (Sub-types IXb/c)**
14a	*Achillea ptarmica* (+) *Deschampsia cespitosa* (+) *Mentha aquatica* (+)	0 1 or more	**Sub-type IXb (END)** **Sub-type IXc (END)**
15 (Group D, Type X)	*Achillea ptarmica* (–) *Bryum pseudotriquetrum* (–) *Calliergon cuspidatum* (–) *Caltha palustris* (–) *Filipendula ulmaria* (–) *Fontinalis antipyretica* (–)	–3 or less –2 or more	**15a (Sub-types Xa/b)** **15b (Sub-types Xc/d)**
15a	*Hygrohypnum ochraceum* (–) *Juncus acutiflorus* (–) *Juncus articulatus 3* (+)	–1 or less 0 or more	**Sub-type Xa (END)** **Sub-type Xb (END)**
15b	*Bryum pseudotriquetrum* (+) *Hygrohypnum ochraceum* (+) *Hyocomium armoricum* (+) *Jungermannia atrovirens* (+) *Lotus uliginosus* (+) *Nardia compressa* (+) *Scapania undulata* (+)	2 or less 3 or more	**15c (Sub-types Xc/d)** **Sub-type Xe (END)**
15c	*Deschampsia cespitosa* (–) Filamentous green algae 3 (+) *Juncus bulbosus 3* (+) *Narthecium ossifragum* (+) *Sagina procumbens 3* (–) *Scapania undulata* (+)	1 or less 2 or more	**Sub-type Xc (END)** **Sub-type Xd (END)**
16 (Group A, Type I)	*Azolla filiculoides* (–) *Oenanthe crocata* (–) *Phragmites australis 3* (–) *Stachys palustris 3* (–) *Vaucheria* sp(p).	–3 or less –2 or more	**Sub-type Ia (END)** **16a (Sub-types Ib/c)**
16a	*Impatiens capensis* (–) *Myosoton aquaticum* (–) *Potamogeton lucens* (+) *Ranunculus penicillatus* subsp. *pseudofluitans 3* (–) *Salix* sp(p). 3 (–)	–2 or less –1 or more	**Sub-type Ib (END)** **Sub-type Ic (END)**
17 (Group A, Type II)	*Cladophora glomerata* agg. 3 (+) *Filipendula ulmaria* (–) *Nuphar lutea 3* (–) *Potamogeton pectinatus 3* (+) *Sagittaria sagittifolia 3* (–) *Veronica catenata* (–) *Zannichellia palustris* (+)	–2 or less –1 or more	**Sub-type IIa (END)** **17a (Sub-types IIb/c)**

No.	*Score for species presence*	*Total score*	*Go to*
17a	*Epilobium hirsutum* 3 (–) *Lycopus europaeus* (–) *Lythrum salicaria* (–) *Ranunculus penicillatus* subsp. *pseudofluitans* (–) *Sparganium erectum* 3 (–) *Symphytum officinale* (–) Trees (non-*Salix*) (–)	–3 or less –2 or more	**Sub-type IIb (END)** **Sub-type IIc (END)**
18 (Group A, Type III)	*Carex paniculata* (–) *Impatiens capensis* (–) *Lemna trisulca* (–) *Mimulus guttatus agg.* (–) *Pulicaria dysenterica* (–) *Rumex hydrolapathum* (–) *Stachys palustris* (–)	–4 or less –3 or more	**Sub-type IIIa (END)** **Sub-type IIIb (END)**
19 (Group A, Type IV)	*Cladophora glomerata* agg. (–) *Solanum dulcamara* (–) *Vaucheria* sp(p). (–)	–1 or less 0	**19a (Sub-types IVa/b)** **Sub-type IVc (END)**
19a	*Apium nodiflorum* (–) *Impatiens glandulifera* (+) *Juncus inflexus* (–) *Lythrum salicaria* (+) *Oenanthe crocata* (+) *Rorippa nasturtium-aquaticum/microphylla* agg. (–) *Sparganium emersum* (+)	2 or less 3 or more	**Sub-type IVa (END)** **Sub-type IVb (END)**

Annex H List of rivers with sites within each of the 38 sub-types

Sub-type	*River*	*No. of sites*
AIa	Avon (Salisbury)	12
	Stour (Dorset)	6
AIb	Avon (Salisbury)	7
	Cherwell	1
	Colne	8
	Colne Brook	1
	Gade	1
	Loddon	1
	Nicholaston Pill	1
	Wraysbury	3
AIc	Avon (Salisbury)	8
	Brett	2
	Bure	3
	Cary	2
	Deben	3
	Eau	2
	Frome (Dorset)	1
	Hull	1
	Kennet	3
	Lark	6
	Moors	1
	Nar	2
	Stour (Suffolk)	5
	Waveney	4
	Welland	2
	Wensum (Norfolk)	4
	Windrush	1
	Wissey	5
	Yare	3
AIIa	Arun (Sussex)	3
	Avon (Warwickshire)	2
	Beult	3
	Blythe (Warwickshire)	4
	Brett	1
	Cary	2
	Cherwell	9
	Deben	1
	Evenlode (Gloucestershire and Oxfordshire)	3
	Eye	3
	Glyme	2
	Leam	5
	Ray	6
	Stour (Suffolk)	1
	Thame	7
	Tove	1
	Waveney	1
AIIb	Avon (Bristol)	8
	Avon (Salisbury)	3
	Axe	1
	Blackwater (Berkshire)	1
	Blythe (Warwickshire)	4
	Cary	1
	Cefni	1
	Churn	2
	Colne	1
	Colnebrook	2
	Dee (Clwyd)	1
	Devon	1
	Evenlode (Gloucestershire and Oxfordshire)	2
	Eye	1
	Gwash	1
	Lark	4
	Loddon	3
	Lugg	2
	Rother (West Sussex)	1
	Stour (Suffolk)	3
	Stour (Dorset)	2
	Stour (Kent)	5
	Stour (Worcestershire)	3
	Teme	1
	Thame	1
	Tove	3
	Uddens	1
	Weaver	2
	Welland	2
	Wensum (Norfolk)	2
	Whitewater	2
	Windrush	3
	Wissey	1
AIIc	Beaulieu	1
	Beult	1
	Blackwater (Berkshire)	1
	Cleddau, western	1
	Dudwell	1
	Ffraw	1
	Lymington/ Oberwater	2
	Rother (East Sussex)	4
	Rother (West Sussex)	2
	Teise	3
AIIIa	Candover	1
	Glen (Lincolnshire)	1
	Itchen	10
	Test	7
AIIIb	Avon (Salisbury)	7
	Babingley	2
	Bere	2
	Bure	2
	Cherwell	1
	Coln	4
	Darent	1
	Frome (Dorset)	5
	Hull	4
	Kelk Beck	1
	Kennet	3
	Lambourne	2
	Loddon	3
	Mimram	4
	Moors	3
	Nar	3
	Piddle	6
	Stour (Kent)	1
	Tat	1
	Test	2
	Thaw	1
	Tichbourne	1
	Waveney	1
	Wensum (Norfolk)	2
	Whitewater	2
	Windrush	5
	Wissey	1
	Yare	1
AIVa	Avon (Bristol)	2
	Avon (Salisbury)	1
	Avon (Warwickshire)	1
	Axe	2
	Bere	1
	Blythe (Warwickshire)	1

Sub-type	*River*	*No. of sites*
	Brett	3
	Bure	3
	Cary	1
	Chelt	2
	Churn	2
	Coln	1
	Culm	1
	Dane	1
	Darent	4
	Deben	1
	Dee (Clwyd)	1
	Derwent (Yorkshire)	2
	Devon	1
	Dockens Water	1
	Eau	1
	Evenlode (Gloucestershire and Oxfordshire)	3
	Eye	1
	Ffraw	1
	Forton	1
	Glen	4
	Glyme	2
	Gypsey Race	3
	Hayes Brook	1
	Kelk Beck	1
	Kennett	2
	Lark	2
	Leam	1
	Lougher	1
	Moors	1
	Nar	1
	Nicholaston Pill	1
	Otter	1
	Rye	1
	Seven	1
	Smite	1
	Stour (Suffolk)	2
	Stour (Kent)	1
	Stour, East	2
	Stour (Worcerstershire)	1
	Swarbourn	1
	Thame	1
	Tove	2
	Umbourne	1
	Waveney	1
	Weaver	3
	Welland	2
	Wensum (Norfolk)	1
	Windrush	1
	Wissey	1
	Yare	2
	Yarty	1
AIVb	Beaulieu	1
	Beult	1
	Blackwater (Berkshire)	1
	Cleddau, western	1
	Dudwell	1
	Ffraw	1
	Lymington/ Oberwater	2
	Rother (East Sussex)	4
	Rother (West Sussex)	2
	Teise	3
AIVc	Annan	2
	Berneray	1
	Blackadder	2
	Bowmont Water	1
	Colaton	1
	Dean Water	1
	Eden Water	1
	Gilpin	1
	Kirkby Pool	1
	Loch na Liana Moire	1
	Lyvennet	1
	Swarbourn	1
	Wansbeck	2
BVa	Arrow	3
	Clwydog	1
	Dove (Derbyshire)	5
	Ehen	2
	Elwy	1
	Esk (Yorkshire)	1
	Gwendraeth Fach	2
	Hodder	3
	Horner	1
	Lathkill	2
	Lugg	4
	Manifold	2
	Monnow	3
	Neath	1
	Rye	3
	Seven	1
	Tawe	1
	Teme	1
	Trothy	2
	Ure	1
	Usk	3
	Wharfe	1
BVb	Arrow	2
	Avon (Bristol)	1
	Axe	5
	Babingley	1
	Blackwater (Berkshire)	1
	Blackwater (Devon)	1
	Blythe (Warwickshire)	1
	Bradford	1
	Burry Pill	2
	Clwyd	2
	Coln	1
	Corry	1
	Culm	2
	Darent	1
	Derwent (Yorkshire)	1
	Devon	1
	Dove (Derbyshire)	2
	Eau	1
	Elwy	1
	Erme	1
	Exe	1
	Eye	1
	Frome (Dorset)	2
	Gwendraeth Fach	2
	Inny	1
	Kit	1
	Lambourne	1
	Lathkill	1
	Lougher	1
	Lugg	2
	Monnow	2
	Moors	1
	Otter	3
	Petteril	1
	Rother (East Sussex)	1
	Rother (West Sussex)	4
	Synderford	1
	Tale	1
	Teme	1
	Thaw	1
	Thrushel	1
	Trothy	4
	Tyne	1
	Uddens	1
	Weaver	1
	Wolf	1
	Yarty	1
BVc	Aeron	1
	Beaulieu	1
	Belah	1
	Beult	1
	Burry Pill	1
	Cefni	2
	Clun	2
	Dove (North Yorkshire)	1
	Dudwell	1
	Eau	1
	Ffraw	1
	Gypsey Race	1

Sub-type	*River*	*No. of sites*
	Rother (East Sussex)	3
	Rother (West Sussex)	1
	Swarbourn	1
	Tamar	1
	Teise	2
	Uddens	1
	Wansbeck	1
BVd	Cleddau, western	3
	Cocker	1
	Inny	3
	Tamar	6
	Teifi	5
	Torridge	7
	Walden Beck	1
BVe	Barle	1
	Dee (Clwyd)	2
	Elwy	1
	Exe	3
	Inny	1
	Lyd	1
	Tamar	9
	Teifi	3
	Torridge	9
	Usk	1
BVIa	Clwyd	1
	Dane	2
	Dove (Derbyshire)	3
	Eden (Cumbria)	1
	Exe	1
	Lugg	1
	Monnow	1
	Rye	1
	Teme	11
	Tweed	4
	Usk	2
	Wharfe	3
	Wyre	1
BVIb	Cefni	1
	Eden (Cumbria)	9
	Eden (Fife)	1
	Petteril	2
	Ribble	9
	Tweed	1
	Usk	4
	Wharfe	2
BVIc	Annan	3
	Barbon Beck	1
	Clwyd	1
	Dacre	1
	Dean Water	1
	Dee (Clwyd)	2
	Derwent (Cumbria)	2
	Eamont	2
	Earn	2
	Eden (Cumbria)	4
	Eden (Fife)	1
	Esk (south-west Scotland)	1
	Garnock	2
	Girvan	2
	Hodder	3
	Ithon	3
	Lowther	1
	Lunan Water	1
	Lune	6
	Petteril	1
	Ribble	3
	Seven	1
	Teme	1
	Tweed	7
	Tyne	4
	Ure	6
	Usk	1
	Wharfe	3
	Wyre	2
BVId	Bervie Water	3
	Dean Water	3
	Derwent (Cumbria)	1
	Don (Aberdeenshire)	8
	Earn	1
	Eden (Fife)	3
	Endrick Water	3
	Forss Water	1
	Girvan	1
	Irfon	1
	Ithon	2
	Lowther	1
	Lunan Burn	2
	Lunan Water	3
	Potlands	1
	Teith	1
	Teme	1
	Tweed	4
	Ugie, north	3
	Ugie, south	2
	Wharfe	1
	Wick	1
	Ythan	6
BVIe	Annan	2
	Blackadder Water	2
	Briggle Beck	1
	Clun	2
	Coquet	3
	Dove (North Yorkshire)	1
	Gilpin	1
	Helm Beck	1
	Kale Water	3
	Kent	3
	Oxnam Water	1
CVIIa	Briggle Beck	2
	Clun	1
	Cowside Beck	1
	Don	1
	Esk (south-west Scotland)	1
	Gordale Beck	1
	Helm Beck	1
	Ithon	1
	Loch Croispol streams	1
	Malham Tarn outflow	1
	Wick	1
	Ythan	1
CVIIb	Aeron	1
	Annan	5
	Bowmont Water	1
	Clun	1
	Coquet	3
	Dove (North Yorkshire)	1
	Kale Water	1
	Kent	2
	Lyvennet	1
	Nevern	2
	Wansbeck	2
	Whiteadder Water	3
CVIIc	Beaulieu	1
	Bladnoch	3
	Cree	1
	Dockens Water	2
	Dulas	1
	Dysynni	1
	Gwyrfai	1
	Kirkby Pool	1
	Linford Brook	1
	Llyfni	2
	Lymington/ Oberwater	1
	Ogwen	1
	Torridge	2
CVIId	Clettwr	1
	Cothi	1
	Dee (Clwyd)	2
	Dulas	1
	Dwyfach	1
	Grannell	2
	Hierwan	1
	Spey	4

Sub-type	River	No. of sites
	Teifi	5
	Tweed	1
	Ugie Water, north	2
	Wick	1
CVIIIa	Aber	1
	Culm	1
	Cych	2
	Dove (North Yorkshire)	1
	Dudwell	1
	Erme	1
	Esk (Yorkshire)	3
	Fowey	2
	Gwyrfai	1
	Hierwan	1
	Horner	1
	Lougher	1
	Lunan Burn	1
	Lyd	6
	Nevern	1
	Okement	1
	Rother (East Sussex)	3
	Seven	1
	Thrushel	2
	Torridge	5
CVIIIb	Banwy	3
	Barle	3
	Birk Beck	1
	Cleddau, western	1
	Cledlyn	2
	Clettwr	2
	Conway	4
	Cothi	5
	Cych	1
	Dee (Aberdeenshire)	1
	Dee (Clwyd)	5
	Derwent (Cumbria)	3
	Duar	1
	Dwyfach	2
	Dwyfawr	2
	Earn	1
	Ehen	1
	Elwy	1
	Exe	4
	Fowey	2
	Greta	3
	Groes	1
	Gwaun	3
	Irfon	2
	Lledr	1
	Llugwy	1
	Lowther	1
	Manifold	1
	Okement	1
	Seiont	1
	Spey	4
	Teifi	1
	Teith	1
	Torridge	2
	Tweed	1
	Ugie Water, north	1
	Ugie Water, south	1
	Ystwyth	2
CVIIIc	Aber	1
	Balnagown	1
	Banwy	1
	Belah	1
	Clwyd	1
	Cowside Beck	1
	Dane	1
	Derwent (Yorkshire)	1
	Elwy	1
	Endrick	1
	Esk (south-west Scotland)	4
	Esk (Yorkshire)	1
	Garnock	1
	Girvan	1
	Greta	1
	Hodge Beck	2
	Horner	1
	Ithon	1
	Lune	1
	Lyd	1
	Monnow	1
	Neath	2
	Ogwen	1
	Rawthey	1
	Rye	1
	Seven	3
	Tawe	1
	Tyne	1
	Ure	3
	Usk	1
	Wansbeck	1
	Wharfe	3
	Wyre	1
CVIIId	Banwy	1
	Brathay	3
	Cocker	2
	Conwy	1
	Cree	3
	Dee (Aberdeenshire)	6
	Derwent (Cumbria)	1
	Don (Aberdeenshire)	1
	Dwyfach	1
	Dwyfawr	1
	Earn	3
	Elan	1
	Forss Water	2
	Girvan	1
	Glass	2
	Llugwy	1
	Spey	5
	Teith	3
	Urquhart	1
CVIIIe	Arrow	1
	Balnagown	1
	Clwyd	1
	Cocker	1
	Cowside Beck	1
	Craigroy	1
	Dane	1
	Dee (Aberdeenshire)	2
	Don (Aberdeenshire)	6
	Eden (Cumbria)	2
	Endrick Water	1
	Esk (south-west Scotland)	2
	Findhorn	8
	Garnock	1
	Grannell	1
	Inver	1
	Irfon	1
	Ithon	1
	Lugg	1
	Lunan Burn	1
	Lune	1
	Neath	1
	Newlands Beck	1
	Rha	1
	Ribble	1
	Seven	1
	Tawe	2
	Tweed	3
	Ure	2
	Urquhart	2
	Usk	1
	Wharfe	2
	Ystwyth	2
DIXa	Allt na Coite/ Criche	1
	Benbecula main drain	3
	Berneray	1
	Blackadder Water	1
	Burn of Latheronwheel	2
	Colaton	1
	Coquet	1
	Gilpin	1

Sub-type	*River*	*No. of sites*
	Glaslyn	1
	Gordale Beck	1
	Gress	1
	Loch Croispol streams	1
	Loch na Liana Moire	2
	Whiteadder Water	2
DIXb	Abhainn an t-Stratha Mhoi	1
	Abhainn Ard	1
	Abhainn Ceann A'Bhaigh	1
	Abhainn Gheatry	1
	Abhainn Roag/ Glen Dorch	2
	Aeron	1
	Allt Mille nan Con	2
	Allt Ruadh	1
	Broadford	1
	Cape Wrath streams	1
	Eaval	1
	Forsa	1
	Gress	1
	Hamara	1
	Iorsa Water	2
	Kearsinish/ Marulaig	2
	Laxdale	2
	Laxford	2
	Lussa	1
DIXc	Allt na Coite/ Criche	2
	Bellart	2
	Blackwater (Hampshire)	1
	Blackwater (Sutherland)	1
	Bladnoch	4
	Brora	3
	Coladoir	1
	Conon	1
	Conwy	1
	Cree	1
	Dockens	1
	Duich/Torra	2
	Dunbeath Water	1
	Forsa	1
	Forss Water	1
	Fowey	1
	Glaslyn	1
	Glass	1
	Gwyrfai	1
	Ithon	1
	Latchmoor	1
	Leoig	1
	Lusragan Burn	3
	Lymington/ Oberwater	1
	Naver	3
	Nevern	1
	Orchy	3
	Ose	1
	Seiont	1
	Snizort	1
	Spey	1
	Strontian	1
DXa	Balnagown	1
	Barle	1
	Bervie	1
	Brathay	1
	Carron	4
	Clwyd	1
	Conon	1
	Conwy	1
	Cothi	1
	Craigroy	2
	Cree	1
	Dane	1
	Dee (Aberdeenshire)	3
	Dee (Clwyd)	1
	Derwent (Cumbria)	1
	Dove (Derbyshire)	1
	Drynoch	2
	Eden (Cumbria)	1
	Elwy	1
	Endrick Water	1
	Exe	1
	Findhorn	4
	Forss Water	1
	Girvan	2
	Glaslyn	1
	Groes	1
	Hamara	1
	Hinnisdal	2
	Horner	1
	Inver	4
	Irfon	1
	Lealt	3
	Llugwy	2
	Manifold	1
	Neath	1
	Ose	1
	Oykel	5
	Rha	1
	Snizort	2
	Spey	2
	Tawe	1
	Teith	3
	Urquhart	1
	Varragill	3
	Wick	2
	Wyre	1
DXb	Aeron	1
	Aros	2
	Bellart	1
	Brora	3
	Dunbeath Water	3
	Glen Astle Burn	1
	Knock Ore Gill	1
	Langwell Water	4
	Machrie Water	3
	Naver	2
	Strontian	1
DXc	Abhainn Gheatry	1
	Allport	2
	Allt na Muidhe	1
	Ashop	3
	Belah	1
	Blackwater (Sunderland)	1
	Blarcreen Burn	2
	Briggle Beck	1
	Cape Wrath streams	1
	Coladoir	1
	Derwent	2
	Duddon	2
	Dunbeath Water	1
	Esragan	1
	Forsa	1
	Glaslyn	1
	Glen Astle Burn	1
	Iorsa Water	2
	Kent	1
	Kirkby Pool	1
	Lussa	1
	Machrie	1
	Ogwen	1
	Orchy	3
	Ribble	1
	Roy	8
	Strontian	1
	Tarff	5
DXd	Abhainn a'Ghlinne Mheadho	1
	Abhainn an t-Stratha Mhoi	2
	Abhainn Camas Fhionnairig	1
	Abhainn Roag/ Glen Dorch	1
	Coe	4
	Coire Nan Lochan	1
	Coladoir	1
	Cravadale	2
	Duddon	1

Sub-type	*River*	*No. of sites*
	Duich/Torra	2
	Eaval	1
	Fionn Ghleann	1
	Gress	1
	Kylerhea	1
	Machrie Water	1
	Roy	1
	Sligachan	2
	Strath na Creitheach	1
	Strontian	1
	Tarff	1
	Ulladay and Housay	3
DXe	Allt Coire Gabhail	1
	Allt Coire nam Beithach	1
	Allt Lairig Eilde	1
	Banwy	1
	Blackwater (Hampshire)	1
	Brathay	1
	Carron	1
	Conwy	1
	Cothi	1
	Dee (Aberdeenshire)	2
	Derwent (Yorkshire)	1
	Dove (north Yorkshire)	2
	Duar	1
	Dwyfawr	1
	Dysynni	2
	Egnant/Mwyro	2
	Ehen	2
	Elan	3
	Erme	1
	Esk (Yorkshire)	1
	Fowey	1
	Gress	1
	Greta	1
	Highland Water	2
	Hodder	1
	Hodge Beck	2
	Irfon	1
	Llugwy	1
	Lougher	1
	Lyd	2
	Machrie Water	2
	Okement	1
	Rye	1
	Seven	1
	Spey	2
	Teifi	1
	Wyre	1
	Ystwyth	3