Monitoring *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation Communities

Conserving Natura 2000 Rivers

Monitoring Series No. 11

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Conserving Natura 2000 Rivers

This protocol for monitoring watercourses characterised by *Ranunculus fluitantis* and *Callitricho-Batrachion* vegetation communities has been produced as part of **Life in UK Rivers** – a project to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites. The project's focus has been the conservation of rivers identified as Special Areas of Conservation (SACs) and of relevant habitats and species listed in annexes I and II of the European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the Habitats Directive).

One of the main products is a set of methods for monitoring species and habitats, which complements reports containing the best available information on their ecological requirements. Each report has been compiled by ecologists who are studying these species and habitats in the UK, and has been subject to peer review, including scrutiny by a Technical Advisory Group established by the project partners. In the case of the monitoring techniques, further refinement has been accomplished by field-testing and by workshops involving experts and conservation practitioners.

Conservation strategies have also been produced for seven different SAC rivers in the UK. In these, you can see how the statutory conservation and environment agencies have developed objectives for the conservation of the habitats and species, and drawn up action plans with their local partners for achieving 'favourable conservation status'.

Life in UK Rivers is a demonstration project and, although the reports have no official status in the implementation of the directive, they are intended as a helpful source of information for organisations trying to set conservation objectives and to monitor for 'favourable conservation status' for these habitats and species. They can also be used to help assess plans and projects affecting Natura 2000 sites, as required by Article 6.3 of the directive.

Favourable conservation status

The purpose of designating and managing SACs is to maintain at, or restore to, 'favourable conservation status' the habitats and species listed on annexes I and II of the directive.

The conservation status of a natural habitat can be taken as favourable when:

- Its natural range and areas it covers within that range are stable or increasing.
- The specific structure and functions necessary for its long-term maintenance exist and are likely to exist for the foreseeable future.
- The conservation status of its typical species is favourable.

The conservation status of a species may be taken as favourable when:

- Population data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The species' natural range is neither being reduced nor is likely to be reduced for the foreseeable future.
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation status of a species or habitat has thus to be assessed across its entire natural range within the European Union, in both protected sites and the wider countryside, and over the long term.

Monitoring techniques

The Habitats Directive requires the condition of the habitats and species for which an SAC has been designated to be monitored, so that an evaluation can be made of the conservation status of these features and the effectiveness of management plans. An assessment of conservation status must, therefore, be applied at both site and network level.

Standard monitoring methods and a coherent assessment and reporting framework are essential to allow results to be both compared and aggregated within and across EU member states.

While the directive outlines the data reporting required from member states at a national level, it did not set out detailed assessment techniques for data collection at habitat and species level.

The Conserving Natura 2000 Rivers series of monitoring protocols seeks to identify monitoring methods and sampling strategies for riverine species and the *Ranunculus* habitat type that are field-tested, cost-effective, and founded on best scientific knowledge.

Titles in the monitoring and ecology series are listed inside the back cover of this report, and copies of these, together with other project publications, are available on the project website: www.riverlife.org.uk.

Contents

1 Introduction

1.1 General introduction

This protocol is applicable to monitoring of the interest feature Habitat H3260 for Special Areas of Conservation (SACs), which is defined by the *EU Interpretation Manual of European Union Habitats* (EU 1999) as 'Watercourses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses'.

The report by Hatton-Ellis *et al.* (2003) proposes a classification of the vegetation types representing the *Ranunculion fluitantis* and *Callitricho-Batrachion* communities in UK rivers. This is based on an analysis of over 250 rivers surveyed by the project partners for their plant communities and catchment geology. This report also reviews the ecological requirements of these plant communities and the factors influencing their distribution.

The monitoring methodology presented here focuses on the extent and composition of the *Ranunculion fluitantis*/*Callitricho-Batrachion* plant communities, for comparison with the characteristic communities in the classification for that river type. The presence of algae and other atypical plant species (and the absence of typical plant species) can signal impacts on the conservation status of the SAC river. It is important that this is confirmed by monitoring of physical and chemical attributes of the river in that monitoring stretch. This should enable the cause of any adverse effects to be identified and remedial action to be taken.

The dynamic nature of the *Ranunculion fluitantis*/*Callitricho-Batrachion* plant communities means that monitoring needs to be undertaken periodically over a number of years to differentiate between natural fluctuations in plant populations (for example, in response to weather) and those that result from human impacts. Background monitoring of physical and chemical attributes in the river is likely to provide a more reliable indication of adverse changes and the need for conservation action.

1.2 Steps in a monitoring strategy

1. Definition of river type (altitude, geology, flow regime, plant/animal communities).

2. Selection of monitoring units (homogenous stretches – for example, headwater tributaries, upper, middle and lower stretches of main rivers).

3. Identify attributes to be monitored (plant community, channel modifications, substrate of riverbed, flows, water quality, invasive alien species).

4. Set targets for 'favourable conservation status' for each attribute monitored (for example, extent and composition of plant community, maximum phosphorus concentrations for different river types).

5. Identify indicators of 'unfavourable' condition (for example, algal growth, presence of invasive species, high levels of modification, siltation of substrate).

6. Establish and test monitoring methodologies.

7. Develop an assessment protocol – what are the tests for a river unit to move from 'unfavourable' to 'favourable' (and vice versa)?

8. Establish a programme of monitoring frequency and standard reporting. Set up database for storage of monitoring results. Institute a validation process to ensure consistency of assessments.

1.3 Integrated monitoring on Natura 2000 rivers

It is cost-effective to integrate the monitoring of all the Annex II species with the monitoring of the *Ranunculus* vegetation Annex I habitat. This can be done by:

1. Selecting the same (or compatible) monitoring units.
2. Utilising the same environmental data (flows, water quality, physical habitat).
3. Storing the results in the same database.

By integrating Natura 2000 monitoring with monitoring for other purposes, considerable savings can be made. For instance, most rivers are already monitored for flow, chemical quality and biological quality (invertebrates). These data can be interrogated against the targets set for favourable conservation status. From 2006, monitoring of attributes such as morphology, plant communities and fish will be required under the Water Framework Directive. Co-operation may be required between the official bodies responsible for monitoring under the Habitats Directive with the bodies responsible under the Water Framework Directive to ensure that the data are collected in such a way as to allow them to be used for both purposes. It is already becoming clear that many of the targets being considered for good ecological quality for all rivers under the Water Framework Directive are unlikely to be stringent enough to secure favourable conservation status for the selected Natura 2000 rivers and the species they support. It will be important, therefore, to differentiate between the targets for each directive when making assessments.

1.4 Monitoring river macrophytes in the UK

A methodology for recording plant communities in rivers was pioneered from 1978 by the Nature Conservancy Council of Great Britain (Holmes 1983). The NCC was replaced in 1990 by English Nature, the Countryside Council for Wales and Scottish Natural Heritage. These bodies co-operate to maintain a common database of river plant surveys, which contains information on over 300 rivers, including some repeat surveys.

Analysis of this database produced a classification of rivers in Britain into 10 types according to their geology and plant communities. This was most recently updated and published in 1999 by the Joint Nature Conservation Committee (JNCC) (Holmes 1999). The best examples of each type of river have been selected as statutory Sites of Special Scientific Interest (SSSI). This network of rivers provided the basis for selecting Natura 2000 rivers, though a few were added to meet the needs of Annex II species.

The **Life in UK Rivers** project has tried to establish whether the Holmes (1983) methodology is a suitable and cost-effective way of monitoring plant communities for favourable conservation status. The methodology was designed for classifying rivers into types, entailing the survey of all plants in the river channel and on the banks, together with habitat features, in two continuous 500 m stretches at 7 km intervals along the river. The Holmes (1983) methodology is set out in Section 2.

The project also commissioned trials of a rapid-assessment methodology initially suggested by English Nature, which involves 10 m wide transects every 100 m in a 500 m stretch (Section 3). This is less time-consuming than the Holmes (1983) methodology and seeks to provide more quantified information, which could be compared at subsequent visits. It also focuses on the presence of negative indicator species (for example, those that thrive at high nutrient concentrations). However, it may not pick up important changes in the river at a reach scale, and there is as yet no national database that would allow the analysis of the information.

The project convened workshops of experts to discuss the results of the trials and how an accurate assessment methodology could be designed. There was no overall consensus on the best method, mainly in view of the variability of the plant community from one year to another, and the need for subjective judgment as to whether changes were natural or due to human impact. This is why it is important to record and assess other attributes such as water quality and siltation.

The project partners are now working under the Water Framework Directive on a scoring system for river plants. This may prove a useful tool, which could be adapted in the future for assessment of *Ranunculion fluitantis* and *Callitricho-Batrachion* plant communities.

1.5 Recommended method for macrophyte monitoring

The view reached by **Life in UK Rivers** is that 500 m stretches of river could be chosen in each monitoring unit for repeat monitoring using the rapid assessment methodology. These could be selected in one or more of the following categories:

(a) Favourable stretch with characteristic vegetation (to see if there are adverse changes over time).

(b) Unfavourable stretch with negative indicator species (to see if the vegetation becomes more characteristic over time).

Ideally, the monitoring stretches (or 'plots') should be chosen after a continuous survey of the river using the Holmes (1983) methodology – though this could be time-consuming and expensive. Otherwise, the 'plots' would have to be chosen subjectively by an expert in river plant ecology.

By definition, baseline assessment is undertaken once at any given location. Survey timing should be standardised, based on the geographical location of the river and existing knowledge of vegetation development and phenology. Surveys should generally be undertaken between mid-June and the end of August, with subsequent monitoring visits at the same time of year. In some rivers, management activities such as weed cutting will affect survey timing. Fieldwork should be undertaken before cutting where possible. If cutting takes place before the survey, a period of at least four weeks should be allowed before survey/monitoring.

As far as possible, all macrophyte taxa should be recorded to species level, together with estimates of percentage cover of each species within each plot. Where species determinations cannot be made, samples should be taken, in clearly labelled, sealed polythene bags for later identification or specialist verification.

Recording should encompass the entire channel and immediate banksides. This requires recording of all species that are submerged or partly submerged in the river at low flow levels, and marginal species attached to or rooted on substrates that are likely to be submerged for more than 85% of the time. A checklist of aquatic species relevant to the UK is reproduced in Section 2.

Where the full width of the channel is not accessible from one bank, survey should be undertaken from both banks. Where only one bank is accessible, the monitoring plot should be extended laterally within the larger monitoring site to encompass an area comparable to a 10 m section of the whole river channel and as wide a range of microhabitats as possible.

For rapid assessment, monitoring should be undertaken without recourse to boats or other more time-consuming methods. However, in most cases, it will be necessary to enter the river by wading. Where wading is not possible, recording should be undertaken with the use of sampling grapnels.

Appropriate health and safety assessment and management should be observed before undertaking any fieldwork. The hazards and risks when working beside and within rivers are considerable, and strict adherence to safe working practices is essential. Ideally, all fieldwork should be undertaken by teams of two or more workers. Departure from this approach should be justified by clear site-specific risk assessment and management. This need not increase the overall labour requirements for a survey or monitoring programme since doubling-up often increases efficiency – especially where equipment is required, such as ranging poles, tape measures, glass-bottomed buckets, etc. All surveys should be undertaken using appropriate equipment and suitable clothing.

Special caution should be observed in relation to exposure to waterborne disease, such as Weill's disease. Appropriate health and safety guidance and risk assessment requirements should be observed on this and other working practices associated with working in and near flowing water.

2 Holmes method for surveying macrophytes and determining river community type

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. To aid future 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 survey at each site includes the entire channel and immediate banksides, with separate records being made for those macrophytes found in the river and 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 subjected 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 likely to be submerged for more than 85% of the year are included. The 'bank' can be usefully defined as the parts of the side of the river (or islands) that are submerged for more than 50% but less than 85% of the time.

In general terms, therefore, 'river' records are reserved for macrophytes occurring in the region of the river that is rarely uncovered, and shallow sections that have an upper limit that may be exposed for a maximum of 50 days in any year. 'Bank' records are for plants that occur above the limit of the 'river' plants, and are thus out of the water for more than 50 days in a year, yet will be submerged, or partially so, during average flow periods. The upper limit of the 'bank' excludes all the areas 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 different sites.

The macrophyte survey concentrates on recording the presence or absence of species on the check-list and should be limited to the channel and base of the banks. Additional species of interest are noted but not used in the classification.

Survey results are tabulated, with any species present within a 0.5 km site being denoted by a double set of numbers, either under 'R' for river or 'B' for bank (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 number (a) refers to absolute abundance or percentage cover and is a semi-objective assessment based on the percentage of the riverbed 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 at 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 envisage a dense stand of vegetation that stretches from bank to bank

and extends for 5 m downstream as covering 1% of the 500 m stretch. Similarly, an unbroken stand of 25 m represents 5%. 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%. 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, a quarter of the bed for 100 m, or that it occurs throughout the whole 500 m, but more sparsely. For a score of 3 to be given, bank taxa must conform to one of the following:

i) Be similarly abundant along both banks with a continuous fringe of 50 m.

ii) Form a co-dominant fringe of 100 m.

iii) Occur as 50 plants or colonies covering 1 metre each.

Table 1 gives an example of how data should be recorded. The first figure in each column represents the relative abundance of the species, while the second figure represents the cover value. River and bank records are made separately.

In the examples in Table 1, therefore:

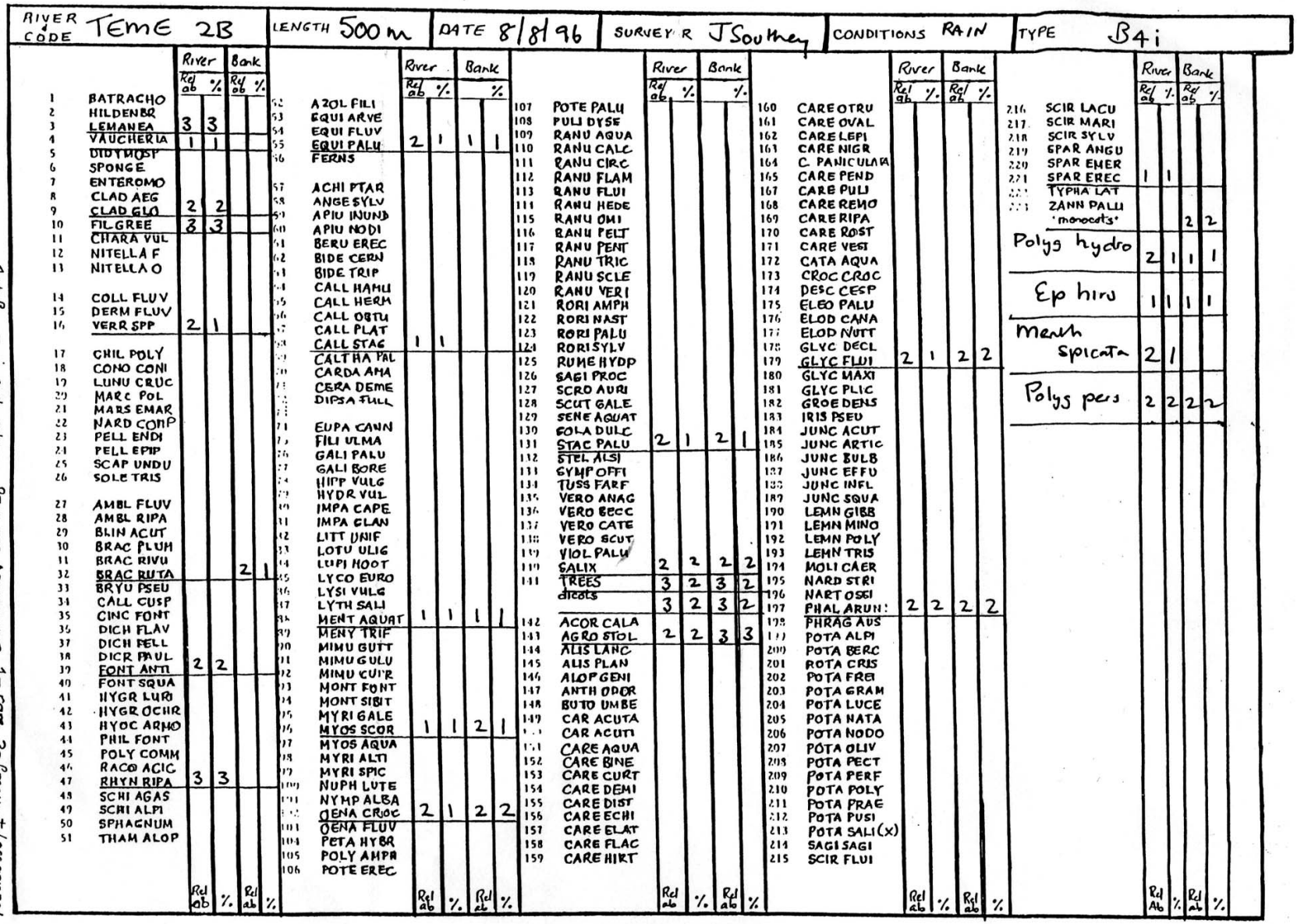
- Species A is dominant in both 0.5 km lengths of the river. It covers more than 5% of the river channel but does not occur on the banks.
- Species B is rare. It is present in both river and bank habitats in both lengths but at a cover value of less than 0.1%.
- Species C is present only in the upstream length. It is co-dominant with Species D on the banks by covering >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 it 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.

Table 1. Standard method of recording macrophyte abundance.

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

Table 2 and figures 1 and 2 show example checklists and diagrams from the River Teme.

Table 2. Example checklist from River Teme.



RIVER CODE TEME 2B | LENGTH 500 m | DATE 8/8/96 | SURVEYOR JSoutney | CONDITIONS RAIN | TYPE B4i

		River Rel ab	River %	Bank Rel ab	Bank %
1	BATRACHO				
2	HILDENBR				
3	LEMANEA	3	3		
4	VAUCHERIA	1	1		
5	DIDYMOSP				
6	SPONGE				
7	ENTEROMO				
8	CLAD AEG				
9	CLAD GLO	2	2		
10	FILGREE	3	3		
11	CHARA VUL				
12	NITELLA F				
13	NITELLA O				
14	COLL FLUV				
15	DERM FLUV				
16	VERR SPP	2	1		
17	CHIL POLY				
18	CONO CONI				
19	LUNU CRUC				
20	MARC POL				
21	MARS EMAR				
22	NARD CONP				
23	PELL ENDI				
24	PELL EPIP				
25	SCAP UNDU				
26	SOLE TRIS				
27	AMBL FLUV				
28	AMBL RIPA				
29	BLIN ACUT				
30	BRAC PLUM				
31	BRAC RIVU				
32	BRAC RUTA			2	1
33	BRYU PSEU				
34	CALL CUSP				
35	CINC FONT				
36	DICH FLAV				
37	DICH PELL				
38	DICR FAUL				
39	FONT ANTI	2	2		
40	FONT SQUA				
41	HYGR LURI				
42	HYGR OCHR				
43	HYOC ARHO				
44	PHIL FONT				
45	POLY COMM				
46	RACO ACIC				
47	RHYN RIPA	3	3		
48	SCHI AGAS				
49	SCHI ALPI				
50	SPHAGNUM				
51	THAM ALOP				
52	AZOL FILI				
53	EQUI ARVE				
54	EQUI FLUV				
55	EQUI PALU	2	1	1	1
56	FERNS				
57	ACHI PTAR				
58	ANGE SYLV				
59	APIU INUND				
60	APIU NODI				
61	BERU EREC				
62	BIDE CERN				
63	BIDE TRIP				
64	CALL HAMU				
65	CALL HERM				
66	CALL OBTU				
67	CALL PLAT				
68	CALL STAG	1	1		
69	CALTHA PAL				
70	CARDA AMA				
71	CERA DEME				
72	DIPSA FULL				
73					
74	EUPA CANN				
75	FILI ULMA				
76	GALI PALU				
77	GALI BORE				
78	HIPP VULG				
79	HYDR VUL				
80	IMPA CAPE				
81	IMPA GLAN				
82	LITT UNIF				
83	LOTU ULIG				
84	LUPI NOOT				
85	LYCO EURO				
86	LYSI VULG				
87	LYTH SALI				
88	MENT AQUAT	1	1	1	1
89	MENY TRIF				
90	MIMU GUTT				
91	MIMU GULU				
92	MIMU CUPR				
93	MONT FONT				
94	MONT SIBI				
95	MYRI GALE				
96	MYOS SCOR	1	1	2	1
97	MYOS AQUA				
98	MYRI ALTI				
99	MYRI SPIC				
100	NUPH LUTE				
101	NYMP ALBA				
102	OENA CROC	2	1	2	2
103	OENA FLUV				
104	PETA HYBR				
105	POLY AMPH				
106	POTE EREC				
107	POTE PALU				
108	PULI DYSE				
109	RANU AQUA				
110	RANU CALC				
111	RANU CIRC				
112	RANU FLAM				
113	RANU FLUI				
114	RANU HEDE				
115	RANU OMI				
116	RANU PELT				
117	RANU PENT				
118	RANU TRIC				
119	RANU SCLE				
120	RANU VERI				
121	RORI AMPH				
122	RORI NAST				
123	RORI PALU				
124	RORI SYLV				
125	RUME HYDP				
126	SAGI PROC				
127	SCRO AURI				
128	SCUT GALE				
129	SENE AQUAT				
130	SOLA DULC				
131	STAC PALU	2	1	2	1
132	STEL ALSI				
133	SYMP OFFI				
134	TUSS FARF				
135	VERO ANAG				
136	VERO BECC				
137	VERO CATE				
138	VERO SCUT				
139	VIOL PALU				
140	SALIX	2	2	2	2
141	TREES	3	2	3	2
	dicots	3	2	3	2
142	ACOR CALA				
143	AGRO STOL	2	2	3	3
144	ALIS LANC				
145	ALIS PLAN				
146	ALOP GENI				
147	ANTH ODOR				
148	BUTO UMBE				
149	CAR ACUTA				
150	CAR ACUTI				
151	CARE AQUA				
152	CARE BINE				
153	CARE CURT				
154	CARE DEMI				
155	CARE DIST				
156	CARE ECHI				
157	CARE ELAT				
158	CARE FLAC				
159	CARE HIRT				
160	CARE OTRU				
161	CARE OVAL				
162	CARE LEPI				
163	CARE NIGR				
164	C. PANICULATA				
165	CARE PEND				
167	CARE PULI				
168	CARE REMO				
169	CARE RIPA				
170	CARE ROST				
171	CARE VESI				
172	CATA AQUA				
173	CROC CROC				
174	DESC CESP				
175	ELEO PALU				
176	ELOD CANA				
177	ELOD NUTT				
178	GLYC DECL				
179	GLYC FLUI	2	1	2	2
180	GLYC MAXI				
181	GLYC PLIC				
182	GROE DENS				
183	IRIS PSEU				
184	JUNC ACUT				
185	JUNC ARTIC				
186	JUNC BULB				
187	JUNC EFFU				
188	JUNC INFL				
189	JUNC SQUA				
190	LEMN GIBB				
191	LEMN MINO				
192	LEMN POLY				
193	LEMN TRIS				
194	MOLI CAER				
195	NARD STRI				
196	NART OSSI				
197	PHAL ARUN:	2	2	2	2
198	PHRAG AUS				
199	POTA ALPI				
200	POTA BERC				
201	POTA CRIS				
202	POTA FREI				
203	POTA GRAM				
204	POTA LUCE				
205	POTA NATA				
206	POTA NODO				
207	POTA OLIV				
208	POTA PECT				
209	POTA PERF				
210	POTA POLY				
211	POTA PRAE				
212	POTA PUSI				
213	POTA SALI (x)				
214	SAGI SAGI				
215	SCIR FLUI				
216	SCIR LACU				
217	SCIR MARI				
218	SCIR SYLV				
219	SPAR ANGU				
220	SPAR EMER				
221	SPAR EREC	1	1		
222	TYPHA LAT				
223	ZANN PALU 'monoects'			2	2
	Polys hydro	2	1	1	1
	Ep hirs	1	1	1	1
	Mentha spicata	2	1		
	Polys pers	2	2	2	2

1st figure in each column RELATIVE ABUNDANCE 1 - rare, 2 - frequent/occasional & 3 dominant

2nd figure in each column % cover 1 = < 0.1%, 2 = 0.1 - 5%, 3 = > 5%

1 = <5%, 2 = 5–25%, 3 = 25–50%, 4 = >50%	**DEPTH**	
	<0.25 m	4
	0.25–0.5 m	3
	0.5–1.0 m	1
	>1.0 m	1
	WIDTH	
	<5 m	0
	5–10 m	4
	10–20 m	2
	>20 m	0
	SUBSTRATES	
	Bedrock	0
	Boulders	3
	Cobbles	3
	Pebbles	3
	Gravel	2
	Sand	0
	Silt/mud	3
	Clay	0
	HABITATS AND FLOW	
	Pool	2
	Slack	2
	Riffle	3
	Rapid	1
	Run	0
	Waterfall	0
	Exposed rock	3
	MARGINAL FRINGES	
	<1 m	3
	1–2 m	0
	>2 m	0
	TOTAL VEG AREA (%)	
	Bryophytes	20<
	Algae	60–70
	Emergents	5–10
	Submergents	<2
	Floating	0

River level very <u>low</u>. A lot of silt overlying other substrates.

Figure 1. Example habitat checklist for River Teme.

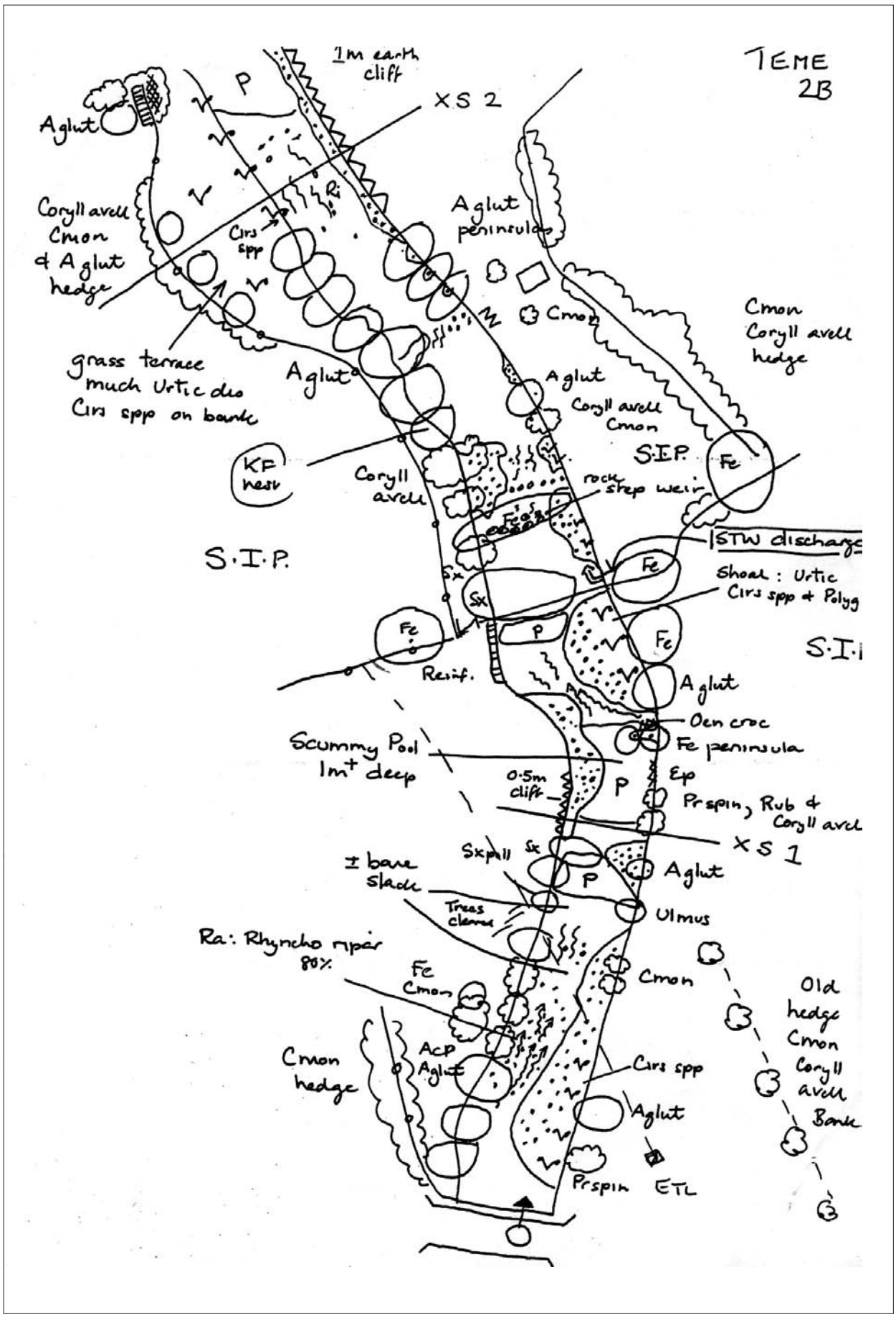


Figure 2. Example habitat diagram for River Teme.

Checklist of aquatic macrophyte species

Scientific name	Common name	Scientific name	Common name
Algae		**Mosses (continued)**	
Batrachospermum spp.	Frogspawn alga	*Hyocomium armoricum*	–
Chara spp.	Stonewort	*Isothecium holtii*	–
Cladophora aegagropila	Carpet blanketweed	*Leptodictyum riparium*	–
		Octodiceras fontanum	–
Cladophora/Rhizoclonium agg.	Blanketweed	*Orthotrichum* spp.	–
Enteromorpha spp.	Tubeweed	*Philonotis fontana*	–
Filamentous green algae (other)	–	*Polytrichum commune*	–
Hildenbrandia rivularis	–	*Racomitrium aciculare*	–
Hydrodictyon reticulatum	Netweed	*Rhynchostegium riparioides*	–
Lemanea fluviatilis	–	*Schistidium agassizii*	–
Nitella spp.	Stonewort	*Schistidium rivulare*	–
Vaucheria spp.	Mole-pelt alga	*Sphagnum* spp.	–
		Thamnobryum alopecurum	–
Lichens			
Collema dichotomum	River jelly-lichen	**Pteridophytes**	
Encrusting lichens	–	*(Azolla* spp.*)*	Water fern
Foliose lichens	–	*Equisetum fluviatile*	Water horsetail
		Equisetum palustre	Marsh horsetail
Liverworts		*Hymenophyllum* spp.	Filmy ferns
Chiloscyphus polyanthos	–	*Osmunda regalis*	Royal fern
Conocephalum conicum	–	*Other Ferns*	–
Jungermannia spp.	–		
Lunularia cruciata	–	**Dicotyledons**	
Marchantia polymorpha	–	*Achillea ptarmica*	Sneezewort
Marsupella spp.	–	*Angelica sylvestris*	Wild angelica
Nardia spp.	–	*Apium inundatum*	Lesser marshwort
Pellia endiviifolia	–	*Apium nodiflorum*	Fools' watercress
Pellia epiphylla	–	*Berula erecta*	Lesser water-parsnip
Porella spp.	–	*Bidens cernua*	Nodding bur-marigold
Riccardia spp.	–	*Bidens tripartita*	Tripartite bur-marigold
Scapania undulata	–	*Callitriche hamulata/brutia*	Intermediate water-starwort
		Callitriche hermaphroditica	Autumnal water-starwort
Mosses		*Callitriche obtusangula*	Blunt-fruited water-starwort
Amblystegium fluviatile	–	*Callitriche platycarpa*	Various-leaved water-starwort
Blindia acuta	–	*Callitriche* spp. *indeterminate*	Water-starwort
Brachythecium plumosum	–	*Callitriche stagnalis*	Common water-starwort
Brachythecium rivulare	–	*Caltha palustris*	Marsh marigold, kingcup
Brachythecium rutabulum	–	*Cardamine amara*	Large bitter-cress
Bryum pseudotriquetrum	–	*Ceratophyllum demersum*	Rigid hornwort
Calliergon cuspidatum	–	*(Crassula helmsii)*	New Zealand water stonecrop
Cinclidotus fontinaloides	–	*Dipsacus fullonum*	Teasel
Cratoneuron filicinum	–	*Epilobium hirsutum*	Great willowherb
Dichodontium pellucidum/ flavescens	–	*Eupatorium cannabinum (Fallopia japonica)*	Hemp-agrimony Japanese knotweed
Dicranella palustris	–	*Filipendula ulmaria*	Meadowsweet
Fissidens crassipes/curnovii/rufulus	–	*Galium palustre*	Marsh bedstraw
Fontinalis antipyretica	Willowmoss	*(Heracleum mantegazzianum)*	Giant hogweed
Fontinalis squamosa	–		
Hygrohypnum luridum/ ochraceum	–	*Hippuris vulgaris*	Marestail

Scientific name	Common name	Scientific name	Common name
(Hydrocotyle ranunculoides)	Floating pennywort	*Ranunculus trichophyllus*	Thread-leaved water-crowfoot
Hydrocotyle vulgaris	Marsh pennywort		
(Impatiens capensis)	Jewelweed	*Rorippa amphibia*	Great yellow-cress
(Impatiens glandulifera)	Himalayan balsam	*Rorippa nasturtium-aquaticum/ microphyllum* agg.	Water-cress
Littorella uniflora	Shoreweed		
Lotus pedunculatus	Marsh birdsfoot-trefoil	*Rorippa palustris*	Marsh yellow-cress
Lycopus europaeus	Gypsywort	*Rorippa sylvestris*	Creeping yellow-cress
Lysimachia vulgaris	Yellow loosetrife	*Rumex hydrolapathum*	Great water-dock
Lythrum salicaria	Purple loosetrife	*Sagina procumbens*	Pearlwort
Mentha aquatica	Water-mint	*Scrophularia auriculata*	Water figwort
Menyanthes trifoliata	Bogbean	*Scutellaria galericulata*	Skullcap
(Mimulus spp.*)*	Monkeyflower	*Senecio aquaticus*	Marsh ragwort
Montia fontana	Blinks	*Solanum dulcamara*	Bittersweet, woody nightshade
(Montia sibirica)	Pink purslane		
Myosotis scorpioides	Water forget-me-not	*Stachys palustris*	Marsh woundwort
Myosoton aquaticum	Water chickweed	*Stellaria uliginosa*	Bog stitchwort
Myrica gale	Bog myrtle	*Symphytum officinale*	Comfrey
Myriophyllum alterniflorum	Alternate water-milfoil	*Tussilago farfara*	Coltsfoot
(Myriophyllum aquaticum)	Parrot's-feather	*Utricularia* spp.	Bladderwort
Myriophyllum spicatum	Spiked water-milfoil	*Valeriana officinalis*	Valerian
Nuphar lutea	Yellow water-lily	*Veronica anagallis-aquatica*	Blue water-speedwell
Nymphaea alba	White water-lily	*Veronica anagallis-aquatica/ catenata (indeterminate)*	Water-speedwell
Oenanthe crocata	Hemlock water-dropwort	*Veronica beccabunga*	Brooklime
Oenanthe fistulosa	Tubular water-dropwort	*Veronica catenata*	Pink water-speedwell
Oenanthe fluviatilis	River water-dropwort	*Veronica scutellata*	Marsh speedwell
Persicaria amphibia	Amphibious bistort	*Viola palustris*	Marsh violet
Persicaria hydropiper	Water-pepper	Other non-aquatic dicotyledons	
Petasites hybridus	Butterbur		
Potentilla erecta	Tormentil		
Potentilla palustris	Marsh cinquefoil	**Trees and shrubs**	
Pulicaria dysenterica	Fleabane	*Alnus glutinosa*	Alder
Ranunculus aquatilis	Common water-crowfoot	(*Rhododendron ponticum* agg.)	Rhododendron
		Salix spp.	Willow
Ranunculus circinatus	Fan-leaved water-crowfoot	*Conifererous trees*	–
		Other deciduous trees and shrubs	–
Ranunculus flammula	Lesser spearwort		
Ranunculus fluitans	River water-crowfoot		
Ranunculus hederaceus	Ivy-leaved crowfoot	**Monocotyledons**	
Ranunculus omiophyllus	Round-leaved crowfoot	(*Acorus calamus*)	Sweet-flag
Ranunculus peltatus	Pond water-crowfoot	*Alisma lanceolatum*	Narrow-leaved water-plantain
Ranunculus penicillatus ssp. *penicillatus*	Stream water-crowfoot	*Alisma plantago-aquatica*	Water-plantain
Ranunculus penicillatus ssp. *pseudofluitans*	Brook water-crowfoot	*Alopecurus geniculatus*	Marsh foxtail
		Bolboschoenus maritimus	Sea clubrush
Ranunculus penicillatus ssp. *pseudofluitans* var. *vertumnus*	Brook water-crowfoot	*Butomus umbellatus*	Flowering rush
		Carex acuta	Slender tufted-sedge
		Carex acutiformis	Lesser pond-sedge
Ranunculus sceleratus	Celery-leaved buttercup	*Carex aquatilis*	Water sedge
Ranunculus subgenus *Batrachium* indeterminate spp.	Water-crowfoot	*Carex curta*	White sedge
		Carex disticha	Brown sedge

Scientific name	Common name	Scientific name	Common name
Carex echinata	Star sedge	*Potamogeton berchtoldii*	Small pondweed
Carex elata	Tufted sedge	*Potamogeton broad-leaved*	Pondweed
Carex flacca	Glaucous sedge	*species (indeterminate)*	
Carex hirta	Hairy sedge	*Potamogeton crispus*	Curled pondweed
Carex nigra	Common sedge	*Potamogeton fine-leaved*	Pondweed
Carex otrubae	False fox-sedge	species (indeterminate)	
Carex ovalis	Oval sedge	*Potamogeton friesii*	Flat-stalked pondweed
Carex panicea	Carnation sedge	*Potamogeton gramineus*	Various-leaved pondweed
Carex paniculata	Greater tussock-sedge	*Potamogeton lucens*	Shining pondweed
Carex pendula	Pendulous sedge	*Potamogeton natans*	Broad-leaved pondweed
Carex pseudocyperus	Cyperus sedge	*Potamogeton nodosus*	Loddon pondweed
Carex pulicaris	Flea sedge	*Potamogeton pectinatus*	Fennel pondweed
Carex remota	Remote sedge	*Potamogeton perfoliatus*	Perfoliate pondweed
Carex riparia	Great pond-sedge	*Potamogeton polygonifolius*	Bog pondweed
Carex rostrata	Bottle sedge	*Potamogeton praelongus*	Long-stalked pondweed
Carex vesicaria	Bladder sedge	*Potamogeton pusillus*	Lesser pondweed
Carex viridula	Common yellow-sedge	*Potamogeton trichoides*	Hairlike pondweed
Catabrosa aquatica	Whorl-grass	*Potamogeton* x *olivaceus*	Hybrid pondweed
Crocosmia spp.	Montbretia	*Potamogeton* x *salicifolius*	Willow-leaved pondweed
Deschampsia	Tufted hair-grass	*Sagittaria sagittifolia*	Arrowhead
cespitosa		*Schoenoplectus lacustris*	Bulrush, clubrush
Eleocharis palustris	Common spike-rush	*Schoenoplectus*	Grey clubrush
Eleogiton fluitans	Floating club-rush	*tabernaemontani*	
(*Elodea canadensis*)	Canadian pondweed	*Scirpus sylvaticus*	Wood clubrush
(*Elodea nuttallii*)	Nuttall's water-thyme	*Sparganium angustifolium*	Floating bur-reed
Glyceria declinata	Small sweet-grass	*Sparganium emersum*	Unbranched bur-reed
Glyceria fluitans	Floating sweet-grass	*Sparganium erectum*	Branched bur-reed
Glyceria maxima	Reed sweet-grass	*Spirodela polyrhiza*	Greater duckweed
Glyceria notata	Plicate sweet-grass	*Typha angustifolia*	Lesser reedmace
Glyceria species	Sweet-grass	*Typha latifolia*	Reedmace
indeterminate		*Zannichellia palustris*	Horned pondweed
Groenlandia densa	Opposite-leaved pondweed	Other monocotyledons	–
Hydrocharis morsus-	Frogbit		
ranae			
Iris pseudacorus	Yellow flag-iris		
Juncus acutiflorus	Sharp-flowered rush		
Juncus articulatus	Jointed rush		
Juncus bulbosus	Bulbous rush		
Juncus effusus	Soft rush		
Juncus inflexus	Hard rush		
Lemna gibba	Fat duckweed		
Lemna minor	Duckweed		
(*Lemna minuscula*)	American duckweed		
Lemna trisulca	Ivy-leaved duckweed		
Luronium natans	Floating water-plantain		
Molinia caerulea	Purple moor-grass		
Nardus stricta	Mat-grass		
Narthecium	Bog asphodel		
ossifragum			
Phalaris arundinacea	Reed canary-grass		
Phragmites australis	Common reed		
Potamogeton alpinus	Red pondweed		

3 Rapid assessment method

Select a representative site. Walk the length of site observing overall character and vegetation. Record general attributes of the reach – for example, diversity and type of features and signs of impacts (see below). Choose **representative** locations for 10 m samples – well-developed macrophytes are most likely to occur in a riffle, run or glide, but sampling should aim to represent the full range of conditions present in the 500 m site. Recording the plant assemblage and physical characteristics of the channel will usually require you to enter the channel by wading unless flow conditions should prevent this.

3.1 Survey details

Record the following:

- **Details of river, tributary and site unit as appropriate**.
- **Site no./Plot no**. Site no. refers to 500 m site (may be the same as the site unit no.). Plot no. refers to 10 m sample plot.
- **Date of survey**.
- **Surveyor initials**.
- **NGR**. Grid reference to 6 or 8 figures (using GPS).

3.2 Macrophyte assessment (SECTION A)

Record the following:

- Target community from previous baseline surveys (where available).
- All macrophyte species present in 10 m sample plot.
- Taxa only from channel and bank margins considered part of the river habitat as defined in JNCC survey method (JNCC 1999).

Assign % cover values to all taxa to nearest 10%. Scarce species should be determined where possible as <5% or <1% cover.

Notes should be made where relevant on the condition of 'key' plants – for example, *Ranunculus* spp. and epiphytic algae.

In addition to noting 'negative indicator species', cover of negative indicators such as algae or *Potamogeton pectinatus* and non-native invasive species may be recorded as combined cover estimates, using River Habitat Survey (RHS) conventions for cover:

- 1 = present
- E = extensive (>33%).

Attention is drawn to the importance of negative indicators, species tolerant of eutrophic conditions and, specifically, of filamentous algae.

The presence of two or more negative indicator species or a high cover of such species is considered unfavourable.

3.3 Structural assessment (SECTION B)

Physical habitat assessment should follow River Habitat Survey (RHS) conventions wherever possible (Raven *et al.* 1998). Thus, bankside vegetation structure is described as follows:

Category	
U – Uniform	Predominantly one type (no scrub or trees)
S – Simple	2 or 3 vegetation types
C – Complex	4 or more vegetation types.

RHS vegetation types
Bryophytes
Short herbs/creeping grasses
Tall herbs/grasses
Scrub/brambles, etc.
Saplings and trees

The width of any riparian 'buffer' should also be recorded in the notes section of the form. Where possible, the percentage of the channel under shade should also be noted. If shade is predominantly from one or other bank, each bank may be recorded separately.

Bank and channel modifications are described as RS Re-sectioned or RI Re-inforced.

Substrate character is described using RHS codes, listed on the form as follows:

NV Not visible	**CO** Cobbles	**SA** Sand	**PE** Peat
BE Bedrock	**P** Pebbles	**SI** Silt	**EA** Earth
BO Boulders	**G** Gravel	**CL** Clay	**AR** Artificial

Bank and channel substrate should be recorded separately. In addition, substrate stability should be assessed and recorded by the addition of initial letters as follows (**S**) Stable, (**U**) Unstable and/or (**D**) Depositing.

The form also allows recording of channel bars, including mid-channel, side or point bars, indicating whether the bar is extensive – and whether or not vegetated by an initial (**V**).

Flow characteristics should be described as follows:

RAPID	An area of broken, standing waves, forming distinct whitewater conditions, normally over cobble or boulder substrates.
RIFFLE	Fast flowing, shallow water whose surface is distinctly disturbed.
RUN/GLIDE	Fast or moderate flowing, often deeper water whose surface is rarely broken or disturbed except for occasional swirls and eddies.
POOL	Discrete area of slow flowing water, relatively deeper than surrounding water, often turbulent and with back currents.
SLACK	Deep, slow flowing water, uniform in character.

Details of water depth and width should also be recorded, together with an indication of water clarity. Except where otherwise indicated on the form, the extent of physical features noted should be recorded using the simple RHS notation 1 = present; E = extensive (>33%).

3.4 Management and secondary attributes (SECTION C)

While macrophyte and physical data should be recorded for each 10 m plot, a number of attributes are likely to span greater distances and assist in characterising the general state of the stretch of river under scrutiny. Such attributes may be of importance in understanding changes in condition and any associated causes.

These characteristics should be recorded at the 500 m scale of the wider monitoring site and will be the same for all 10 m plots within the site. The convention for denoting the extent of the attribute is **1 = present**; **E = extensive** (>33%).

Alders should be recorded as either healthy or diseased (Phytophthora).

Weed cutting can be either positive (25%+ flowering *Ranunculus* spp., checkerboard pattern) or negative (encouraging domination of *Ranunculus* spp., indiscriminate, etc).

Invasive species should be named in the notes section and recorded here as present or extensive across the 500 m site.

Rehabilitation/enhancement records habitat rehabilitation and management.

3.5 Photographs

Photographs should be taken to illustrate the vegetation and physical structure at each 10 m sample plot and any impacts. Additional photographs should be taken where appropriate to illustrate the overall character of the 500 m site.

Photographs should be taken with a standard 35 mm camera and 45–50 mm, polarised lens or equivalent. All photographs should be accurately located, either by reference to 10 m sample location or by separate six- to eight-figure grid reference (using GPS wherever possible).

All photographs should be clearly labelled with River Name, Site No., Plot No. and Date.

3.6 Additional notes

The notes section of the form should be used to clarify or extend observations made elsewhere on the form. A range of prompts to memory is included at the head of the notes section to assist in making appropriate observations. Notes may cover **plant health**, including indications of general plant condition – for example, growth form, epiphytic algae, flowering, fruiting – and any apparent causes of poor plant condition.

Survey constraints should be noted and any additional habitat observations. Impacts present in the 10 m plot or in the wider 500 m site should be described more fully if possible.

A sketch map should be included if appropriate.

The presence of each Habitat Modification Score (HMS) feature should also be noted in each 10 m plot and over the 500 m site. HMS scoring features include:

Modifications in 10 m plot

- Reinforcement to banks (RI)
- Reinforcement to bed (RI/AR)
- Resectioned bank or bed
- Two-stage bank modification (BM)
- Embankment (EM)
- Culvert (CV)
- Dam, weir, ford (DA, FO)
- Bank poached by livestock (PC)

Modifications in 500 m site

- Artificial bed material
- Reinforced whole bank
- Resectioned bank
- Embankment
- Set-back embankment
- Two-stage channel
- Weed-cutting
- Bank-mowing
- Culvert
- Dam, weir, ford

Total no. in 500 m site

- Footbridge
- Roadbridge
- Enhancements, such as groynes
- Site partly or extensively (>33%) affected by flow control
- Partly or extensively (>33%) re-aligned channel

RAPID ASSESSMENT FORM

River: **Site No/Site** **Code:** **Date:**

Trib/Site: **NGR:** **Surveyor:**

A: MACROPHYTE ASSESSMENT: (5 x 10 m transects across representative section). Eutrophication-tolerant species should be marked with an asterisk. Communities predominantly composed of these species should be viewed as unfavourable.

Target community: **JNCC type**: **CB type**:

Species: estimated % cover (Use 500 m column to mark presence of additional species of note)

Plot No.	**1**	**2**	**3**	**4**	**5**	**(500 m)**

Total taxa: Negative indicators: I = present; E = extensive (>33%)

Negative indicators (500 m)

Invasive species (500 m)

RAPID ASSESSMENT FORM

River: **Site No/Site** **Code:** **Date:**

Trib/Site: **NGR:** **Surveyor:**

B. STRUCTURAL ASSESSMENT: (Add data for 500 m if different from 10 m plots)

Banks:	Left bank						Right bank					
Plot no.	**1**	**2**	**3**	**4**	**5**	**500 m**	**1**	**2**	**3**	**4**	**5**	**500 m**
Bank height (cm)												
Shading % total												
Bank-top vegetation (B/U/S/C)												
Bank-face vegetation (B/U/S/C)												
Bank modification (RS RI Other)												
Land use/buffer (500 m) (B/U/S/C)												

Substrates: (ring extensive):	NV	BE	BO	CO	P	G	SA	SI	CL	PE	EA	AR

Plot no.	**1**	**2**	**3**	**4**	**5**	**(500 m)**
Channel: add (S) stable (U) unstable (D) depositing						
Bank: add (S) stable (U) unstable						
Bars: (P) Present (V) if vegetated						

Channel modifications: I = present; E = extensive (>33%) except where indicated

Plot no.	**1**	**2**	**3**	**4**	**5**	**(500 m)**
Re-sectioned (RS)						
Re-inforced (RI)						
Other: (Define)						

Flow: I = present; E = extensive (>33%) except where indicated

Plot no.	**1**	**2**	**3**	**4**	**5**	**(500 m)**
Rapid						
Riffle						
Run/Glide						
Pool						
Slack						
Width (water) (m)						
Depth (cm)						
Photographs (Y/N)						

Notes:

RAPID ASSESSMENT FORM

River:	**Site No/Site**	**Code:**	**Date:**
Trib/Site:	**NGR:**	**Surveyor:**	

C. MANAGEMENT AND SECONDARY ATTRIBUTES

I = present; E = extensive (>33%) (Add total extent or no. for 500 m)

Plot no.	1	2	3	4	5	(500 m)
Abstraction						
Impoundment (US/DS)						
Poaching						
Invasive species						
Outfalls						
Run-off						
Tipping						
Bridges						
Swan grazing						
Weed cutting (channel)						
Mowing (banks)						
Fisheries management						
Fencing (LB)						
Fencing (RB)						
Mature Island						
Side channels						
Deflectors						
Alders (healthy-h/diseased-d)						
Leafy debris (in-channel)						
Open water (e.g. ponds)						
Wetland						
Rehabilitation/Enhancement						
Additional Photos (Y/N)						

D. ADDITIONAL NOTES

References

Grieve N, Clarke S, Caswell B & Newman J (2003). *Comparative Macrophyte Surveys on Selected Riverine SACs. English Nature*, Peterborough.

Hatton-Ellis TW, Grieve N & Newman J (2003) *Ecology of Watercourses characterised by* Ranunculion fluitantis *and* Callitricho-Batrachion *vegetation*. Conserving Natura 2000 Rivers Ecology Series No. 11, Peterborough.

Holmes NTH, Boon P & Rowell T (1999). *Vegetation communities of British rivers: a revised classification*. Joint Nature Conservation Committee, Peterborough.

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JNCC (1999). *Statement On Common Standards For Monitoring Designated Sites*. Joint Nature Conservation Committee, Peterborough.

Raven PJ, Holmes NTH, Dawson FH, Fox PJA, Everard M, Fozzard IR & Rouen KJ (1998). *River Habitat Quality – the physical character of rivers and streams in the UK and Isle of Man*. River Habitat Survey, Report No. 2. Environment Agency, Bristol.

Appendix A: Case studies

A1 River Wensum

The Centre for Aquatic Plant Management (CAPM) was commissioned by English Nature to characterise the macrophyte communities of the River Wensum SAC. A summary of the results of the survey (Grieve *et al.* 2003) is given below.

Forty-one km of the River Wensum were surveyed in sections between East Raynham and New Cotessey, as well as a 4 km section of the River Tatt directly upstream of the confluence with the Wensum. These sections of river were surveyed in 500 m sites using a new transect method (Section 3), developed as a rapid baseline assessment of the composition and abundance of the macrophyte community along the river length.

In addition, five 1 km sites down the river were surveyed using the Holmes (1983) macrophyte survey method.

The channel macrophyte community was generally dominated by *Sparganium emersum*, *Potamogeton pectinatus* and *Potamogeton perfoliatus*, with a high frequency of occurrence and relatively high cover of filamentous algae.

Plants important on a local or national scale that were found on the river during this survey were as follows:

- *Oenanthe fluviatilis* (a nationally scarce species)
- *Ranunculus penicillatus* subsp. *pseudofluitans*
- *Berula erecta*
- *Butomus umbellatus*
- *Catabrosa aquatica* (important species in a regional context).

Two species of regional importance previously found on the river, *Groenlandia densa* and *Hippuris vulgaris*, were not detected during this survey.

The substrate of the channel was found to be predominately silty, with few clean gravel pebble stretches present, except immediately downstream of mills. Increasing siltation was a major impact on the habitat quality of the river.

Land adjacent to the river was mostly grassland, usually managed by grazing. A significant amount of this grazing land was unmanaged or abandoned, resulting in undisturbed habitat provided by meadows and wet pastures. The riparian strip was generally unmanaged, usually with tall herbs dominated by nettles, but some woodland, wet woodland and wetland areas were also seen, especially above Fakenham and on the River Tat.

The river types (Holmes 1999) found from the five 1 km sites surveyed were types AIIIb and AIVa at the site upstream of Fakenham, and types AIIb, AIIc, and AIVa at the four sites below Fakenham. These types represent chalk/oolite streams and high base-flow rivers (IIIb), lowland, clay-dominated rivers (IIb/c), and base-rich/neutral impoverished rivers, normally close to source (Iva)

Using the Favourable Condition Table (Generic Attributes) (see Appendix B) to assess the conservation status of Habitat 3260 (Watercourses of plain to montane levels with the *Ranunculion fluitanitis* and *Callitricho-Batrachion* vegetation), the survey results raise concerns about the following attributes:

Composition (typical species, habitat extent)
Large stretches of the river do not have the plant community associated with this habitat (the description of the habitat does not include river type II).

Where the community does occur, characteristic species such as *Ranunculus* spp. are missing, and negative indicators, such as *Potamogeton pectinatus*, are often dominant.

River morphology (habitat structure and functions)
Much of the Wensum has been modified by mills and impoundments, while flood defence and land drainage works have straightened, overwidened and overdeepened the river. This loss of the natural dynamics of the river is considered an indicator of unfavourable condition.

River substrate (habitat structure and functions)
The channel should be dominated by clean gravels. The level of siltation in the Wensum is also an indicator of unfavourable condition.

Overall it would be difficult for the Wensum to achieve favourable conservation status for this habitat under present conditions/management.

An example of the details provided for a site is given below.

Site number	**River**	**NGR**	**Date**	**Surveyor**
1	Tat	TF851288	11/7/02	SC

Summary
Resectioned channel (small ditch-like) through rough pasture/wetland. Extensive patches of clean gravel pebble substrate but some silty sections. Channel plants dominated by *Callitriche* spp. and emergent herbs with a 10% fringe of grasses (predominately *Glyceria maxima*).

Substrate (% cover of bed) : Silt: 70 Gravel/pebble: 30

Macrophytes	**Relative abundance**	**% Cover**
Callitriche spp.	3	10
Glyceria maxima	3	10
Myosotis scorpioides	3	10
Phalaris arundinacea	3	10
Rorippa nasturtium-aquaticum	3	10
Veronica anagallis-aquatica	3	5
Mentha aquatica	2	1
Veronica beccabunga	2	1
Berula erecta	1	1
Epilobium hirsutum	1	1
Filipendula ulmaria	1	1
Juncus spp.	1	1
Lemna spp.	1	1
Sparganium emersum	1	1
Sparganium erectum	1	1
Veronica anagallis-aquatica x catenata	1	1
Zannichellia palustris	1	1

A2 River Lambourn

A2.1 Objectives

The primary objective was to characterise the botanical communities of the river and compare plant survey methodologies. While the focus was on the plant community, broad data were also collected for other species of interest – for example, bullhead and brook lamprey habitat – together with observations of some of the key attributes, such as substrate, adjacent wetland and coarse woody debris (CWD). This was to provide additional information for the sustainable management of the watercourse and identify issues relevant to attaining the conservation objectives.

A2.2 Summary

2002 was a good year to survey the vegetation (with two previous years of good groundwater recharge), and the records are considered to provide a sound baseline for the system. A series of scientific investigations into the ecology and dynamics of macrophytes in the Lambourn have been undertaken (Ham *et al.* 1981, Ham *et al.* 1982, Wright *et al.* 1982) and a more recent follow-up study in the late 1990s (Wright *et al.* 2002).

The importance of climate (rainfall and discharge) has also been recognised in the studies on the river Lambourn (Ham *et al.* 1982, Wright *et al.* 1987). Years of prolonged low flows alter conditions in the river with increased siltation, a reduction in *Ranunculus* and increase in marginal herbs (*Rorippa nasturtium aquaticum*, *Apium nodiflorum*) and increased *Callitriche* spp.

Annual variations in climate drive the processes in the channel, and the effects of natural dynamics in determining community composition and river conditions needs to recognised, in addition to management and human impacts. It should also be borne in mind that the data collected during the survey represents a single point in time, and that the system is in a continuous state of change relating to a hierarchy of processes (for example, geology, climate, geomorphology, community ecology, and sediment interactions).

Example of plant distribution in River Lambourn in 2002

RIVER LAMBOURN SITE No. L11 NGR SU357769 DATE 3-9-02

SUMMARY

Predominantly shady with more mosses than previous sections, and *Ranunculus peltatus* in open sections.

Long riffles, with a clean substrate and good flow. (Good habitat for bullhead, *Cottus gobio*).

CWD and tree roots occur frequently.

Banks are steep (modified in the past) and tree-lined.

Plant name	% cover
Ranunculus peltatus	40
Callitriche stagnalis	1
Veronica anagillis-aquatica	5
Amblystegium fluviatile	1
Fontinalis antipyretica	20
Apium nodiflorum	1
Mentha aquatica	10
Myosotis scorpioides	1
Rorippa nasturtium-aquaticum	1
Iris pseudacorus	1

Appendix B: Draft Favourable Condition Table

Prepared for the JNCC by English Nature, Countryside Council for Wales and Scottish Natural Heritage (May 2003). Note: Attempting to assess the sustainability of the habitat is important when using this guidance, as this is an integral part of the concept of favourable conservation status (FCS). For habitats, the key components used for assessing FCS include habitat extent, habitat structure and functioning, and typical species. The appropriate FCS component is included in parentheses below each attribute.

Attribute	Targets	Method of assessment	Comments
Flow [Habitat structure and functioning]	Flow regime should be characteristic of the river. Ecological flow criteria already laid down for the river (e.g. for passage of migrating salmon) should also be complied with. No obvious problems with water availability within the monitoring unit.	Data and expert opinion from relevant environment agency. Field observations.	River flow affects a range of habitat factors of critical importance to characteristic flora and fauna, including current velocity, water depth, wetted area, substrate quality, dissolved oxygen levels and water temperature. The maintenance of both flushing flows and seasonal base flows, based on natural hydrological processes, is vital. Detailed investigations of habitat-flow relationships may indicate that a more or less stringent threshold may be appropriate for a specified reach; however, a precautionary approach would need to be taken to the use of less stringent values. As a guideline, at least 90% of the naturalised daily flow should remain available to the river throughout the year. Naturalised flow is defined as the flow in the absence of abstractions and discharges. This may be modified according to the specific sensitivity of the river type, with regulated rivers having somewhat lower sensitivity than unregulated ones. However, any relaxation of the guideline figure should relate to the desirability and ecological sustainability of regulating structures. The availability and reliability of data is patchy - long-term gauged data can be used until adequate naturalised data become available, although the impact of abstractions on historical flow records should be considered.
Water quality [Habitat structure and functioning]	Biological GQA Class: a/A or b/B, depending on reach type. In addition, no drop in class from existing situation. Chemical GQA Class: a/A or b/B, depending on reach type. In addition, no drop in class from existing situation. Water Quality Class: A1 or A2 depending on reach type. In addition, no drop in class from existing situation.	England, Wales and NI only (Environment Agency and Environmental Protection standard monitoring protocol). England, Wales and NI only (Environment Agency and Environmental Protection monitoring protocol) Scotland only (SEPA standard monitoring protocol)	A wide range of water quality parameters can affect the status of interest features, but standard biological monitoring techniques provide a reasonably integrated picture in relation to many parameters. The chemical module of the GQA scheme sets standards for dissolved oxygen, biochemical oxygen demand and total ammonia. It therefore covers a number of water quality parameters which commonly cause problems within river systems. The system in Scotland differs from that used elsewhere in the UK. A scale of five water quality classes are used (A1, A2, B, C, D) for assessing water chemistry, biology, nutrients, aesthetic condition, and toxic substances. The overall classification of a water is given by the lowest class derived from these values. All classified reaches within the site that contain, or should contain, Atlantic salmon should comply with the targets given.

Draft Favourable Condition Table (continued)

Attribute	Targets	Method of assessment	Comments
Water quality (contd.)	Precautionary target No unnaturally high loads of suspended solids	Un-ionised ammonia (95-percentile) Field observations	The un-ionised form of ammonia is highly toxic to freshwater fauna. As a guide, a target of <0.025 mg l^{-1} should be used, based on the Freshwater Fish Directive. Many characteristic species of different river types are susceptible to elevated solids levels, through reduced light availability (for photosynthesis), the clogging of respiratory structures, impaired visibility or siltation of coarse substrates. Lowland clay and alluvial river sections are more depositional in character and resident biota are generally more tolerant. As an approximate guide, a target of 25 mg l^{-1} can be used, based on the Freshwater Fish Directive – a more precautionary target of 10mg l^{-1} is proposed for most river reaches. A yet more stringent target may be appropriate for some river sections where solids levels are currently very low (such as chalk streams through the growing season) - an analysis of available data is suggested to verify target selection. Most of the monitoring unit should have clear water (except where natural peat staining occurs) - as an approximate guide, this should occur in at least 90% of the length of river observed.
	Soluble reactive phosphorus: <0.02, 0.04, 0.06 or 0.1 mg l^{-1}, depending on reach type.	Annual mean	Elevated phosphorus levels interfere with competitive interactions between plant species, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). The respiration of artificially large growths of benthic algae may generate poor substrate conditions (reduced oxygen availability and increased siltation) for fish and invertebrate species.
Substrate [Habitat structure and functioning]	No excessive siltation. No evidence of excessive algal cover.	Field observations	Most river SSSIs/ ASSIs do not extend to the entire catchment. Some species or life-cycle stages (e.g. juvenile pearl mussels, salmon eggs and fry) are potentially susceptible to damage from siltation, the source of which may lie elsewhere in the catchment outside the site boundary. Sources of silt include run-off from arable land and land trampled by livestock, sewage and industrial discharges. Where there is a perceived risk of damage occurring, or where the designated species is already believed to be in decline, a fluvial audit of the catchment is recommended. This is a relatively new approach developed by fluvial geomorphologists in the UK; further guidance should be sought from the appropriate freshwater specialists in the country conservation agencies. The level of siltation that occurs naturally in a reach varies depending upon the hydrodynamic regime; as a general guide, it should not exceed 10% of the length of the river observed. As an approximate guide, the cover of filamentous and epiphytic algae should not exceed a mean of 10% for the length of river observed.

Attribute	Targets	Method of assessment	Comments
Habitat structure [Habitat structure and functioning]	Channel form should be generally characteristic of river type with predominantly unmodified planform and profile. Bank and riparian zone vegetation structure should be near-natural. No or minimal impact on river flow from instream structures.	Assess river morphology using River Habitat Survey (see Section 3).	The river should support all of the habitat features necessary for designated interest features to thrive, in characteristic proportions*. RHS provides a general indicator of habitat diversity and character. Widening or deepening of channels, and extensive artificial reinforcement of banks, are indicators of unfavourable condition. Headwater sections are particularly vulnerable to reprofiling.
Plant community [Typical species]	Presence of characteristic plant species; absence of indicators of unfavourable condition. Full details of targets are given in the river SSSI protocol.	Survey of representative stretches at intervals of about 5 km (see Section 2).	In-channel vegetation of the river should be dominated by characteristic species.
Non-native/ introduced species [Typical species]	No impact on native biota from non-native or introduced species	Aquatic macrophytes – method as above. Other organisms – expert judgement on the basis of external reports.	Non-native species constitute a major threat to many river systems. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage and the introduction of crayfish plague.

* Techniques for assessing whether habitat features are characteristic of the river are under development by the Environment Agency.

Objective	Specified assessment method (if appropriate)	Comment
No artificial barriers significantly impairing characteristic migratory species from essential life-cycle movements.		Barriers may take the form of weirs, barrages or intakes/off-takes that entrain characteristic species.
Fish introductions should not interfere with the ability of the river to support self-sustaining populations of characteristic species.	Use stocking consents	Many priority species can be affected by fish introductions, through increased predation, competition or genetic introgression, or through disease transfer. Stocking is undesirable within SSSIs/ASSIs unless undertaken as an agreed emergency interim measure for priority species while underlying adverse environmental factors are resolved.
Exploitation should not interfere with the ability of the river to support self-sustaining populations of characteristic species.	Assessed through recorded exploitation and status of target species	Key interest features under threat are Atlantic salmon, brown trout, and sea and river lampreys. Exploitation should be licensed at sustainable levels.

Tentative classification of river reaches

Dominant catchment geology	River Size		
	1	2	3
A Hard upland geologies (all land over 330 metres) – impermeable poor geologies.	Headwater	River	Large river
B Other Cambrian-Devonian geologies – hard mudstones and sandstones.	Headwater	River	Large river
C Jurassic and Cretaceous limestones – soft limestone and chalk.	Headwater	River	Large river
D Triassic sandstones and mudstones – soft sandstones and mudstones in lowland areas.	Headwater	River	Large river
E Mesozoic clay vales and Tertiary clays – impermeable rich geologies.	Headwater	River	Large river

River size to be determined from Environment Agency flow categories.

Conserving Natura 2000 Rivers

Ecology Series

1 Ecology of the White-clawed Crayfish, *Austropotamobius pallipes*
2 Ecology of the Freshwater Pearl Mussel, *Margaritifera margaritifera*
3 Ecology of the Allis and Twaite Shad, *Alosa alosa* and *A. fallax*
4 Ecology of the Bullhead, *Cottus gobio*
5 Ecology of the River, Brook and Sea Lamprey, *Lampetra fluviatilis*, *L. planeri* and *Petromyzon marinus*
6 Ecology of Desmoulin's Whorl Snail, *Vertigo moulinsiana*
7 Ecology of the Atlantic Salmon, *Salmo salar*
8 Ecology of the Southern Damselfly, *Coenagrion mercuriale*
9 Ecology of the Floating Water-plantain, *Luronium natans*
10 Ecology of the European Otter, *Lutra lutra*
11 Ecology of Watercourses Characterised by *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation

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These publications can be obtained from:

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They can also be downloaded from the project website: www.riverlife.org.uk

The Life in UK Rivers project was established to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites.

Set up by the UK statutory conservation bodies and the European Commission's LIFE Nature programme, the project has sought to identify the ecological requirements of key plants and animals supported by river Special Areas of Conservation.

In addition, monitoring techniques and conservation strategies have been developed as practical tools for assessing and maintaining these internationally important species and habitats.

River plant diversity is declining across Europe due to nutrient enrichment, siltation, over-abstraction and damaging management practices.

Ranunculion fluitantis and *Callitricho-Batrachion* vegetation communities form an important aquatic habitat type that is protected by European legislation. They have a key role in influencing flow, nutrient and sediment dynamics in river systems, and provide important habitat for invertebrates and fish.

This report suggests monitoring methods that can be used to assess the conservation status of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation communities, and what conservation action is necessary for their survival.

Information on Conserving Natura 2000 Rivers and the Life in UK Rivers project can be found at **www.riverlife.org.uk**

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