




RIVER HABITAT SURVEY IN SLOVENIA

RESULTS FROM 2005

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WEB SITES

RHS: www.rhs@environment-agency.gov.uk

STAR: www.eu-star.at

LIFE IN UK RIVERS: www.riverlife.org.uk

GLOSSARY OF ACRONYMNS

CEH	Centre for Ecology and Hydrology
CEN	Committee for Standardisation
HMS	Habitat Modification Score
HMC	Habitat Modification Class
HQA	Habitat Quality Assessment
JNCC	Joint Nature Conservation Committee
LAWA	Landerarbeitsgeinshaft Wasser (German Working Group of the Federal States on water issues)
MTR	Mean Trophic Rank
PCA	Principal Component Analysis
RHS	River Habitat Survey
SLOV	Unique acronym to identify sites from 'Slovenia' on the RHS database
STAR	STAndardisation of River Classifications
WFD	Water Framework Directive

PURPOSE

Our primary objective was to undertake River Habitat Surveys (RHS)[1] on a selection of rivers in Slovenia to provide benchmarks for the technique and for inter-calibration under the EU Water Framework Directive (WFD).

Specific objectives were to:

- locate and survey near-natural examples of different river types in western and south-western Slovenia using the RHS and the Joint Nature Conservation Committee (JNCC)[2] and Mean Trophic Rank (MTR)[3] macrophyte survey methods.
- add to the database of RHS and macrophyte information for European inter-calibration purposes and inclusion on the STAndardisation of River Classifications (STAR) database (see later).
- recommend improvements to the RHS guidance manual for use on European rivers.
- demonstrate the methods to the Slovenian National Institute of Biology staff.
- discuss our experiences of river survey and evaluation in the UK with officials from the Ministry of the Environment and Spatial Planning.

BACKGROUND TO METHODS

River Habitat Survey

River Habitat Survey is a method developed in the UK to characterise and assess, in broad terms, the physical character of freshwater streams and rivers. It is carried out along a standard 500m length of river channel, with observations made at 10 equally spaced spot-checks along the channel. Other information on valley form, land-use in the river corridor etc., is also collected. Field survey follows the strict protocols given in the 2003 RHS Manual[1].

Data are entered on to the RHS database. This now contains field observations, map-derived information and photographs from more than 17,000 surveys undertaken since 1994. During 1994-96 a stratified random network of sites established a geographically representative baseline cross-section of streams and rivers across the UK[4]. RHS has been tested in several European countries and results compared with other methods[5].

The RHS database allows sites of a similar nature to be grouped together for comparative purposes. Slope, distance from source, height of source and site altitude are used to cluster RHS sample sites for so-called "context analysis" based on principal component analysis (PCA) plots[6].

Indices of habitat quality and channel modification can be derived from RHS data, and these can be used as a basis for setting physical quality objectives for rivers[7].

Habitat Quality Assessment (HQA) is an indication of overall habitat diversity provided by natural features in the channel and river corridor. Points are awarded for the presence of scoring features such as point, side and mid-channel bars, cliffs, marginal tree roots, woody debris, waterfalls, marginal reeds and floodplain wetlands. Additional points reflect the variety of substrate, flow-types, in-channel vegetation, and also the extent of trees and semi-natural land-use adjacent to the river.

Features such as vegetated mid-channel bars contribute to HQA scores

Points are added together to provide the HQA. In contrast to HMS, the higher the score, the more highly rated the site. Since the diversity and character of features at any site is influenced by natural variation and the extent of human interference, the RHS database enables the user to 'adjust' scores in line with expected values for the river type or the habitat requirements of a particular species[8]. Special surveys at known, top quality, sites provide the necessary calibration of HQA for a range of river types in the UK. This 'benchmarking' has been extended to surveys in mainland Europe, including Slovenia.

Artificial changes to channels, such as weirs are negative features in the HMS system

Habitat Modification Score (HMS) is an indication of modification to the river channel. To calculate HMS for sites, points are awarded for the presence of artificial features such as culverts, weirs, current deflectors, and bank revetments. Points are also awarded for modifications to the channel such as re-sectioned banks or heavily trampled margins. The more severe the modification, the higher the score. The cumulative points total provides the Habitat Modification Score (HMS). A Habitat Modification Class (HMC) has been developed which allocates a site into one of five modification classes, based on the total score.

The STAR (STAndardisation of River Classifications) project. The STAR project is a research project funded by the European Commission under the Fifth Framework Programme and contributes to the implementation of the Key Action "Sustainable Management and Quality of Water" within the Energy, Environment and Sustainable Development Programme. The project has a formal link to CEN and a key aim is to provide relevant CEN working groups with draft methods.

The project aims to provide standard biological assessment methods compatible with the requirements of the WFD. It will also develop a standard for determining the class boundaries of 'Ecological Status' and another one for inter-calibrating existing methods.

In STAR two 'core stream types' are recognised: (i) small, shallow, upland streams and (ii) medium-sized, deeper lowland streams. A number of 'additional stream types' were investigated to extend the range of sites at which field methods and assessment procedures are compared. RHS surveys were carried out at all 'core' stream sites and some additional stream sites. In some countries 'core' sites were chosen to reflect a gradient in habitat / morphology degradation. The countries were; Austria, The Czech Republic, Denmark, Germany and Italy.

Rivers from the UK and 12 other European countries have been surveyed in the STAR programme

Results from the STAR project will be published in a special issue of the journal *Hydrobiologia* in 2006.

Macrophyte Surveys

Two survey methods were employed. The Joint Nature Conservation Committee (JNCC) method records aquatic and marginal plants in river lengths of 500m (the same 500m as the RHS sites). Species from the main river channel, and the margins/base of the bank, are recorded separately on a three to five point scale of abundance. A check-list of species is used to aid accurate recording. Data are held on a JNCC database, and field data can be used to classification the community[2].

Marginal plants are included in the JNCC surveys

The second type of macrophyte survey carried out was the Mean Trophic Rank (MTR). This records only aquatic taxa, again using a check-list of species, within 100m sites. Each species is assigned a trophic rank of 1-10 depending on their tolerance to eutrophication (1 = tolerant; 10 = intolerant). Cover of species is estimated on a scale of one to nine, and the combination of cover values and trophic rank enables a MTR score to be derived which provides an indication of the level of enrichment of the sites surveyed[3].

Only aquatic plants are surveyed in the MTR system

SURVEY, ASSESSMENT AND ANALYSES OF SLOVENIAN RIVERS

Recommendations for the rivers to visit and survey were made by the National institute of Biology, Ljubljana and David Withrington. Final site selection on each surveyed river was made on the day. For approximate locations, see back page.

River Habitat Survey was undertaken by Paul Raven and Hugh Dawson. Nigel Holmes carried out the macrophyte surveys, using both the JNCC and MTR methods on all rivers surveyed.

Basic water chemistry samples (for pH: conductivity, calcium) were taken by Hugh Dawson to give a broad indication of this important influence on river biology (Appendix 6).

Butterflies, including marsh fritillary, were frequently observed

Ad hoc wildlife observations were made by Paul Raven and David Withrington, and could include species close to the sites surveyed, but not necessarily within them.

The RHS survey form entries were checked using digital photos taken in the field. Background information (altitude, geology, land use, water quality, climatic and hydrological regime), were derived from various publications (see references) and 1:50,000 maps (Appendix 2).

Peter Scarlett, at the Centre for Ecology and Hydrology (CEH), determined the PCA plot. Calculation of the RHS indices HQA and HMS was done by Paul Raven, using the 2005 version of these systems. MTR scores were calculated by Nigel Holmes. The identification of unknown bryophytes, or those where there was uncertainty, was by Professor Jan Kucera.

Orchid-rich meadows were a notable feature of many sites surveyed

A complete set of RHS survey forms, a CD with digital photographs, maps showing locations, sketches and macrophyte lists for each site visited has been produced. The notes in Appendix 1 will appear in Section P of the RHS database entry. Map numbers refer to the relevant pages in the Slovenian 1:50,000 "Atlas Slovenije". The abbreviated site names, starting with 'SLOV', are unique acronyms to identify them in the RHS database.

The seven rivers visited in western and southern Slovenia in May 2005 represented a range of landscape, climatic, hydrological and management influences. A survey, using RHS alone, was carried out on a further river in the Julian Alps by Paul Raven on a second visit to Slovenia in late July 2005. In total, 14 RHS site surveys (500m lengths), and 10 MTR and JNCC macrophyte surveys, were completed. The RHS included single surveys on four rivers, two contiguous lengths (1km) on three rivers, and four lengths (2km) on one river.

The Obrh River, like many in Slovenia, emerges from limestone as a sizable river

RESULTS

Context in relation to UK rivers

Superimposing both the European STAR survey sites and the Slovenian ones on the PCA plot illustrates the altitude and stream energy characteristics compared with UK sites (Figure 1). This clearly shows the greater energy of the alpine sites in Slovenia as well as a broad range of conditions at STAR sites across Europe.

Morphological character

An overview of the landscape character and quality of the rivers visited is given in Tables 1 and 2, with more details provided in Appendices 2-5.

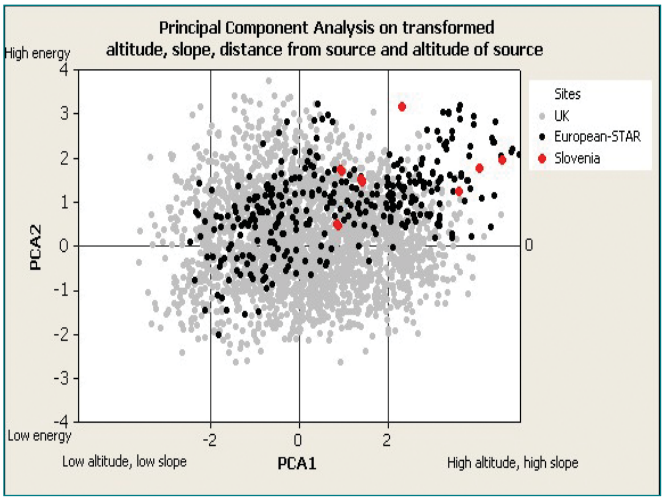


Figure 1: The RHS PCA plot showing the distribution of UK sites overlain with the STAR and Slovenian sites

TABLE 1: Basic landscape character of Slovenian river sites surveyed in 2005. Rivers are arranged in order of channel gradient († averaged for more than one site; * braided reach).

Site	River	Channel (m/km)	Water width (m)	Bankfull width (m)	Valley form	Altitude of source (m)	Distance from source (km)
2	Pišnica	58	4.0	12.0	Gorge	1450	5.0
3	Soča	44	12.0	18.0	Deep vee	1450	6.0
1	Bistrica	36	7.5	10.0	Deep vee	1050	5.5
14	Mostnice	28	6.0	15.0	Deep vee	1780	7.0
10-11	Dragonja	11	10.5†	30.0†	Deep vee	320	12.0
4-5	Soča	5	20.0	200.0*	Deep vee	1450	32.0
6-9	Obrh	2	30.0†	40.0†	Bowl	600	13.5`
12-13	Iziča	<1	25.0†	35.0†	Floodplain	660	15.0

Four sites in the Julian Alps (SLOV-1, 2, 3, 14) are typical of fast-flowing streams in steep wooded alpine valleys (Table 1).

The channel, banks and beds are dominated by bedrock, boulders and cobbles, with 'blue' water tumbling rapidly over 'white' limestone rocks. Little macrophyte growth occurs other than occasional mosses and liverworts in the main channel, and deep-rooted, scour-resistant, higher plants on the margins and banks.

Downstream of SLOV-2, on the Pišnica River, there were several metres of recently deposited sediment within its floodplain reach, representing material transported by the river derived from landslips following heavy rain.

Blue water and white rocks, a typical feature of rivers in the Julian Alps

Deep deposit of material carried by the Pišnica River

SLOV-3 was located on the River Soča where it flows alongside a major road. The river has been modified through bank protection and bed reinforcement, using local materials. Large boulders (rip-rap) have been secured with a small amount of concrete and, in the channel, iron pins. However, to the untrained eye, this would look little different to a 'natural' river.

Bed and bank stabilization on the Soča, using steel pins

A wide, braided section of the Soča River (SLOV-4, 5) near Bovec was surveyed (albeit in a cursory way given time constraints), and this illustrated the typical characteristics of a highly mobile river in the wide, flat bottom of a glaciated alpine valley.

The highly mobile, braided, section of the Soča

The Dragonja River (SLOV-10, 11), close to the Croatian border, is a bedrock-dominated river which has a diverse riparian habitat and illustrates the effects of seasonal flow in the sub-Mediterranean region of Slovenia.

Herbaceous plants and shrubs growing in mid-channel of the intermittent Dragonja River

The Obrh (SLOV-6 to 9) is a low gradient river in a karstic landscape and flows into the seasonal lake Cerkniško Jezero. It has a marked two-stage natural channel reflecting the great variation in seasonal flow. This seasonality is confirmed by the rarity of true aquatic macrophytes in the channel.

Cerkniško Jezero, the seasonal lake into which the Obrh flows

The Iziča River (SLOV-12, 13), south of Ljubljana, has a negligible gradient and flows through agricultural peatlands. Evidence suggests that the surveyed reach was recovering geomorphologically from historical over-widening and deepening, although this has yet to be confirmed. As with the Obrh, a very rich wetland flora on the floodplain is the result of low intensity hay meadow management.

Herb-rich grasslands and wetlands are a feature of the Iziča floodplain

TABLE 2: An overview of habitat and water quality at Slovenian river sites surveyed in 2005. Arranged in order of channel gradient.

Site	River	Habitat quality	MTR score	Habitat modification	Biological water quality[9]
2	Pišnica	67	68	1	1 (?)
3	Soča	70	70	4	1-2
1	Bistrica	73	71	2	1 (?)
14	Mostnice	68	N/a	2	1 (?)
10-11	Dragonja	87, 96	(60)	1	2
4-5	Soča	75-78	66	1	1-2
6-9	Obrh	43-71	(48)	1-3	2
12-13	Iziča	64, 65	36	1	2-3

Macrophytes

The occurrence of macrophytes at the sites was determined by two main factors. In the fast-flowing streams, sheer erosion power meant that very few macrophytes were present in the channel, although there was a rich flora in adjacent flushes and damp margins. In the Obrh and Dragonja Rivers, extreme seasonal fluctuations in water level meant that truly aquatic, perennial, plants were very rare in the channel. The aquatic plants that were present were all species that could either grow in terrestrial forms when the river dries up, or re-generate annually from seed when water returns.

Of special note was the presence of the aquatic moss *Cinclidotus aquaticus,* in the Mostnice, Soča and Iziča. This is a characteristic species of the calcareous areas of the Alps. It is absent from Scandinavia and the British Isles and thought to be extinct in the Czech Republic (Kucera; personal communication).

Cinclidotus aquaticus, a common species in Slovenia, but not recorded from the UK

The banks and gravel bars of most alpine rivers support rich communities of bryophytes and higher plants – *Petasites* is especially prevalent

The Pišnica River was characterized by an almost total lack of macrophytes; it was noteworthy for extensive boulders and gravel transported by floods following earthquakes and land-slips. The Alpine rivers (e.g. Bistrica and Soca) had rich flora associated with boulder bars, dominated by *Petasites* and alpine species rare or absent in the UK.

The Obrh River had an especially interesting flora that indicates periodic autumn drying and high flows in spring and summer. The growth of *Caltha palustris,* growing like water lilies, is similar to that observed from meltwater rivers in Finland.

The presence of the fine-leaved, submerged form, of *Sium latifolia* growing alongside submerged flowering *Caltha* is extremely rare and reflects both the seasonal drying and base-rich geology of the river.

Water quality

Small-scale summary maps suggest that all sites apart from SLOV-12/13, on the Iziča River, have good or very good biological water quality[9] (Table 2). This is confirmed by the MTR scores where sufficient macrophyte growth meant the derived scores can be used with confidence.

The simple analyses carried out on water collected during the surveys is summarized in Appendix 6. These were spot field determinations using a conductivity meter and test strips. The alkalinity, conductivity and calcium readings taken confirmed the nature of the predominant geology. The Iziča River showed raised levels of nitrate, confirming the evidence of nutrient enrichment from the macrophyte community recorded during 2005 and in previous surveys[11].

Caltha palustris, flowering underwater in the Obrh

DISCUSSION

The morphological character of Slovenian rivers

The total length of running waters in Slovenia is 27,000 km, and the average drainage density is 1.33m/km^2. The highlands and mountains make up 80% of the land area. Consequently, a combination of high elevation (average 550m) and very steep slopes (average in the mountains is 24.5%), mean that the streams and rivers have very high energy. Erosion can be considerable during spates and about 5 million cubic metres of sediment debris are transported each year[12].

About 10,000km of Slovenian streams and rivers have been classified on the basis of morphological character. In similar fashion to the RHS Habitat Modification Score approach, watercourses are classified in relation to the degree of modification, which in turn reflects the intensity of human interference affecting them. There are 4 classes and 3 sub-classes in the Slovenian morphological classification system, based on the overall character of river reaches (Table 3).

Although the approach is similar to HMS, the main difference is the larger scale of evaluated reaches compared with the RHS 500m sample length.

TABLE 3: The Slovenian morphological classification system for rivers[10].

Description	Modifications within river reach	Category
Naturally preserved	Pristine	Class 1
Insignificantly disturbed	Morphologically well preserved. Minor aesthetic modification. No disruption to natural river processes.	Subclass 1-2
Interference evident	But alterations not "technical" including over-deepening, sustainable bank protection, low barriers, thinned riverine vegetation.	Class 2
Intermediate disruption	Some bank stabilisation and channel straightening.	Subclass 2-3
Heavily affected	Canalisation is characteristic	Class 3
Completely altered	Rivers are drainage channels	Subclass 3-4
Covered	Culverted	Class 4

Overall comparison with Germany and UK river character

A rough comparison of the national figures for Slovenia, the UK, and Germany is attempted in Table 4.

About 46% of Slovenia river-length is classified morphologically natural or near-natural (classes 1 and 1-2). Figures for broadly comparable categories in Germany (LAWA classes 1 and 2) and the UK (HMS class 1) are 10% and 33% respectively. In both Germany and the UK the amount of pristine river-length is 2% or less, but in Slovenia the figure is 20%.

TABLE 4: Extent of channel modification of rivers in Slovenia, the UK and Germany[13]: percentage river lengths in national class divisions.

Slovenia classes	UK HMS classes	German (LAWA) classes
(1) 20		**2**
(1-2) 26	**(1) 33**	**8**
(2) 23	**(2) 21**	**11**
(2-3) 12	**(3) 20**	**19**
(3) 16	**(4) 23**	**27**
(3-4) 2	**(5) 3**	**23**
(4) 1		**10**

The proportion of heavily or completely modified river-length (classes 3, 3-4 and 4) in Slovenia is 19%, mainly associated with intensive agriculture and urban development. The broadly comparable figures are 33% in Germany (LAWA classes 6 and 7) and 26% in the UK (HMS classes 4 and 5).

This favourable picture of river habitats in Slovenia, compared with Germany and the UK, is probably linked to the lower population density (98 per km^2) and the steep, uncultivated (and hence wooded) valleys in the uplands and mountains. To support this, figures for the UK, with an average population of 340 per km^2, shows a distinct relationship between land use, river modification and predominant valley form (Table 5).

TABLE 5: Selected land use, modifications and habitat features occurring extensively (more than one third of channel-length) at RHS sites in four different valley shapes in the UK. Sites are the 1996 sub-set of nationally representative sites. (Figures are percentages; *these features need not be extensive at a site to be included.)

	PREDOMINANT VALLEY FORM			
Land Use	**Deep vee**	**Bowl**	**Shallow vee**	**Floodplain**
Woodland	48	27	22	16
Wetland	4	4	4	4
Pasture	23	47	55	61
Arable fields	2	8	25	36
Towns	9	6	9	19
Modifications				
Reprofiled banks	5	14	30	44
Protected banks	5	8	7	8
Embankments	0	3	4	12
Impounded water	1	2	2	6
Features				
Bankside trees	62	39	30	28
Shingle bars*	89	83	69	54
Woody debris*	58	46	46	33
Number of sites	**331**	**339**	**635**	**779**

Slovenia has also undergone significant land-use change in the last 100 years resulting in a more heavily wooded landscape. Woodland area has increased from 40.9% in 1900 to 60.3% in 2000 as a result of traditional meadows being abandoned[12,14]. The effects of overgrazing are now virtually non-existent – a major contrast to upland Britain where this is a major problem.

Further landscape and morphological change is likely as the effects of climate change begin to take shape. Melting glaciers and an increased frequency of storm and drought events may well have a major impact in the future.

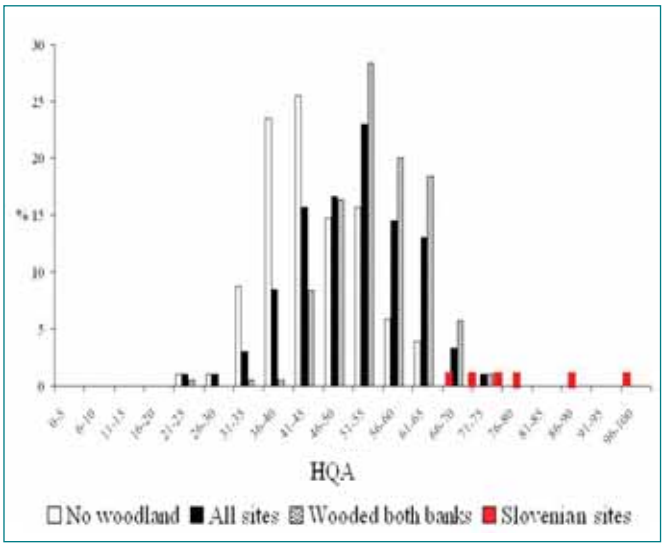
There was no time for detailed comparative analysis for this report, but some general observations can be made. For instance, compared with typical British rivers, the Slovenian rivers visited differed in the following ways:

- Much higher valley relief;
- Much more stream energy;
- Composite bank profiles;
- Less canalization of rivers in U-shaped valleys;
- Very little flow regulation;
- Much more extensive, distinctive, and more natural riparian habitats;
- Richer meadow flora;
- Little, or abandoned, arable land-use in floodplains;
- Different hydrological regimes;
- In the karstic and sub-Mediterranean regions visited, the rivers have very seasonal flow and as a result support less truly aquatic vegetation.

Site-level observations

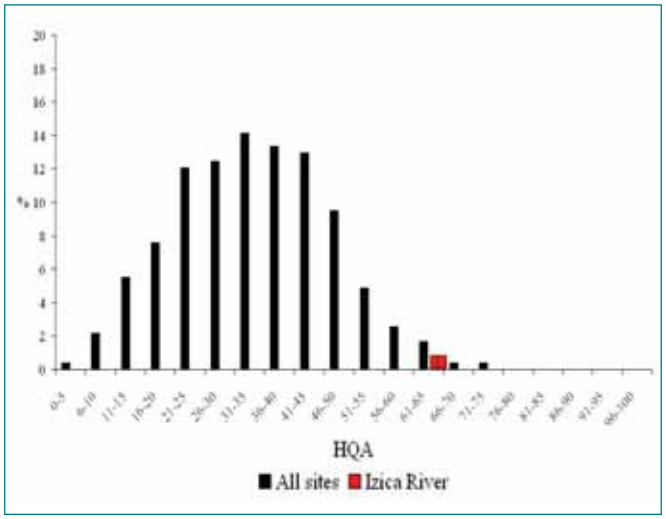
Comparing sites in similar valley shapes, the HQA scores of Slovenian sites visited in 2005 compare favourably with those in Britain (Figure 2). This is to be expected because the Slovenian sites were selected for their near-natural character. Indeed, the comparison with top quality 'benchmark' sites in the UK and elsewhere in Europe is more relevant. The heavily modified river reaches in the Pannonian plains of Slovenia would have much lower HQA scores and high HMS scores, in similar fashion to much of lowland Britain.

Figure 2 HQA scores for deep-vee valleys in the UK, showing the importance of woodland land-use. Slovenian sites are shown for comparsion.



The fast-flowing alpine streams (SLOV-1, 2, 3, 14) are very similar to torrents in wooded valleys in upland Britain, the difference being that there are far more of them in Slovenia. This is because native broad-leaved and coniferous woodland cover less than 5% of uplands in Britain but 60% of Slovenia is near-natural or lightly managed beech-fir woodland.

Figure 3 HQA scores for UK sites with floodplains. Izica River sites shown for comparison



The braided Soča near Bovec (SLOV-4, 5) compares favourably with the River Feshie at its confluence with the River Spey in Scotland, the last remaining truly braided stretch of river left in Britain. Even in the Alps however, unmodified braided rivers are less than 5% of their former distribution (www.tiroler-lech.at).

The DeLank River in S-W England is typical of upland, wooded, valleys; the lower gradient and altitude results in more bryophyte growth

There are examples of bedrock-dominated rivers in Britain such as the Wye at Erwood, and the Eden in N-W England, but none have the associated complex channel form and distinctive riparian habitat of the Dragonja River (SLOV-10, 11).

The Eden, a protected river under the Habitats Directive, combines features of the Dragonja and Mostnice

The River Narew, Poland, has many characteristics similar to the Obrh

The low gradient Obrh (SLOV-6 to 9) is broadly comparable with the River Brathey in the English Lake District, but with a distinctive, natural, two-stage channel structure and rich meadow flora. In this respect it is closer in character to the Narew River in NE Poland, surveyed in 2003. Corncrakes and marsh harriers were recorded along the Narew in 2003, as they were for the Obrh in 2005. The Obrh is distinct in naturally drying in most autumns, and therefore having a flora more akin to the winterbournes which form the headwaters of English chalk rivers.

The Iziča (SLOV-12, 13) flows through a landscape broadly similar to the peatlands of the Somerset Levels or Cambridgeshire Fens in England, albeit at an altitude 300m higher. The main difference is the distinctive riparian zone of sedge, marsh and willow scrub and adjacent rich wetland flora in the floodplain along the Iziča – this is very rarely found in Britain.

The character of the Pišnica (SLOV-2) is noteworthy because of the immense amount of new material deposited on the valley floor that now forms the bed of the river. This material has been carried in spate from upstream following huge landslides triggered by earthquakes or intense rainfall.

Pressures on rivers in Slovenia

Despite the favourable physical character and water quality of many of Slovenia's streams and rivers, there are major threats such as hydropower schemes, water and gravel abstraction, channelisation associated with land drainage and pollution. These also threaten Slovenia's wetlands[14].

The conservation of Slovenian rivers

The Ministry of Environment and Spatial Planning published a biodiversity strategy in 2002[15]. This includes specific objectives to protect biodiversity of running waters. It states that conservation objectives are incorporated into all aspects of water management, that operating priorities have a minimal impact on wildlife and that the natural dynamics of rivers are restored wherever possible.

This approach reflects the aim of the European Water Framework Directive. Valuable lessons can be learnt from EU-LIFE projects such as: (i) *"Life in UK Rivers",* which developed conservation strategies for Natura 2000 rivers and monitoring protocols for several protected species; and (ii) *"Wild River Landscape of the Tyrolean Lech",* which focused on braided alpine rivers.

The links between the Habitats Directive and the Water Framework Directive are extremely important and the experiences of the Environment Agency and English Nature should provide valuable lessons for the Ministry. This very matter was the centre of discussion between Mladen Berginc (Under Secretary for Nature Conservation), Peter Skoberne (Conservation Adviser), Paul Raven and David Withrington at the Ministry of Environment and Spatial Panning in Ljubljana on 18 May. As a result, further exchange of information will follow.

CONCLUSIONS

RHS is a suitable tool to use for surveying small to medium-sized rivers (<100m wide) in Slovenia, but not large, or braided rivers. RHS is not, at present, capable of adequately representing the geomorphological complexity of such rivers.

There are some characteristics of karstic rivers which present problems for field survey interpretation, notably the determination of "banktop" where composite or terraced bank profiles predominate. Also, the common occurrence of a distinct, and far more extensive, riparian zone needs to be better accounted for in RHS when used in mainland Europe.

Several recommendations for improvements to the RHS guidance manual text have been made as a result of the visit (Appendix 7).

There is ample opportunity for continued co-operation, building on the visit and establishing other links with technical experts and policy makers in the UK and Slovenia.

APPENDIX 1: Notes for sites surveyed in Slovenia in 2005

Many kilometres of the channel upstream of the surveyed site were dry, even in May

Bistrica River; 15 May 2005; Map 54. SLOV-1 - HQA = 73; HMS/C = 80(2) Single site.

A steep mountain stream in a spectacular alpine valley. Valley landscape of precipitous rock, scree and mixed pine/beech woodland. Dolomitic limestone geology. Several kilometres of dry channel further upstream.

Complex profile of unvegetated and vegetated side bars as herbaceous plants, shrubs and trees have colonised boulder-size deposits.

Loose sediment is released into the river from the eroding steep valley sides

Evidence of minor disturbance (boulders removal from channel) at lower end of site, plus the remains of an old wooden deflector. Of concern, some Japanese knotweed *(Reynoutria japonica)* present on the roadside.

Macrophytes very sparse in the main channel due to unstable bed and erosive power. Bryophytes only found in the boulder-strewn channel, but good bryophyte flora in adjacent flushes alongside many other higher plant species. The moss *Rhynchostegium riparioides* was the commonest species, barely covering >1% of the bed. An MTR of 71 indicates high quality but is certainly under-estimated due to sparse cover and presence of species such as *Amblystegium fluviatile* (plus *Cratoneuron* spp. and *Schistidium rivulare* – neither MTR scoring taxa) that rarely occur in high altitude, pristine-clean, rivers in the UK. These reflect the calcareous bedrock. Flushes adjacent to the margins support rich alpine/wetland communities.

Mixed boulders and cobbles dominated the bed within the site; wooded valley

A feature of the Bistrica site was the common occurrence of flushes on the river margin

Pišnica River; 15 May 2005; Map 53. SLOV-2. HQA = 67; HMS/C = 0(1) Single site.

A clear-water torrent river in a steep wooded alpine ravine. Virtually no aquatic macrophytes, presumably because of huge scouring force of meltwater, storm flows and possible effects of rock debris carried down the valley after recent earthquakes or torrential rain. Very narrow (<10m wide) gorge widens out after 250m, allowing enormous boulders to be deposited.

From torrent flows through an upstream gorge, the river gradient shallows, and the valley floor widens

Massive deposition of mixed sediment has occurred in the wider valley floor immediately downstream from site.

Following a recent landslide, huge deposition of material has taken place in the lower part of the site, and downstream

Tree cover is roughly 90% pine and 10% beech, with willow scrub.

Due to scour, as above, or being covered by recent deposits, vegetation within the river was virtually zero

Just four macrophytes were found, each covering <0.1% of the bed; all were bryophytes capable of withstanding desiccation, submergence and scour. An MTR of 68 indicates high quality but is certainly under-estimated due to sparse cover and the combined high altitude and base-rich rock not normally found in UK rivers. Most macrophytes would have been covered, or scoured, by the landslip material, so recorded species have only recently established themselves at the site.

A tributary entering the RHS also has been subject to enormous throughput of material brought down from upstream

River Soča; 16 May 2005; Map 52. SLOV-3. HQA = 70; HMS/C = 1280 (4) Single site.

A steep, clear-water, stream with a boulder-strewn bed. Upstream, the River Trenta is dry for several kilometres.

The dry River Trenta, upstream of the surveyed site

Because of the proximity of a major road, the right bank is stabilised by large boulders being concreted together in places (and consequently recorded as rip-rap). Several stanchions and pins have been placed in parts of the river channel to stabilise the boulders and form boulder groynes. A small suspension bridge for walkers is located at the downstream end. Nevertheless, the overall impact of these modifications on river ecology (migration of fish, channel and bank habitats) and landscape is likely to be minor.

Despite some stabilization measures, the overall appearance is of a very natural stream

Woodland mixture is roughly 50% pine and 50% broad-leaved trees, the latter mainly beech.

Macrophytes were less sparse, and the diversity was greater than in SLOV-1 and SLOV-2. Bryophytes were the only taxa found in the boulder-strewn channel, but a very rich mixture of bryophytes and meadow/woodland flora was present on the margins and banksides. The mosses *Rhynchostegium riparioides* and *Brachythecium rivulare* were the commonest species, covering >2.5% of the bed/margins. *Cinclidotus aquaticus,* a moss not found in the UK, was not uncommon here.

A rich marginal flora, dominated by bryophytes, was a feature of the site

The MTR of 70 indicates high quality, but under-estimated the purity of the water, again due to the unusual occurrence of *Amblystegium fluviatile* and *Cinclidotus fontinaloides* (plus *Cratoneuron* spp. and *Schistidium rivulare* – neither MTR scoring taxa) that rarely occur in high altitude, pristine-clean, rivers in the UK. Like the Bistrica River (SLOV-1), a very rich, but quite different, marginal flora.

The footbridge at the downstream end of the site

River Soča; 16 May 2005; Map 77. SLOV-4. HQA = 75, HMS/C = 0(1); SLOV-5. HQA = 78; HMS/C = 0(1) Two, back-to-back, RHS surveys (1km); Macrophyte surveys on SLOV-4 only.

A highly mobile braided reach of the River Soča. Bankfull width is more than 200m, with up to seven channels, most of them dry. Extensive floodplain woodland with relic channels, is a major feature of this morphologically active reach. The age of trees suggests major channel migration occurred within the last 50 years. Main channel is c20m wide with powerful flow and unbroken standing waves. Extensive side and mid-channel bars and large mature islands are prominent features.

Multi-channels and islands are a key feature of the site. The unstable bed supports no rooted macrophytes

Very restricted visibility to the right bank so the surveys are only partly complete. Data for right bank was assessed from photographs, so this needs further verification by aerial photograph analysis (e.g. width, channels, land use). Extensive backwaters present within the site, and marshes upstream from the site.

Backwaters provide more stable, and contrasting, habitat to the majority of the site

Very difficult to determine if point bars present. No true riffles in main channel, but woody debris piled high on many bars and margins.

There is extensive woody debris deposited on the margins

Some minor in-channel movement of gravel at bottom end of SLOV-5, whilst some gravel removal evident upstream from SLOV-4. The river is used by canoeists and fly-fishermen so some minor tree branch-lopping is carried out for easy passage of canoes.

Macrophytes (surveyed in SLOV-4 only) were virtually absent in the main channel due to the extreme instability of the cobbles and pebbles. Virtually everything present was represented by scraps on the bank margins or in slightly sheltered bays protected by over-hanging trees. A cut-off relic channel (or part of braiding system) within the floodplain woodland had a rich and luxuriant flora. The moss *Fontinalis antipyretica* was dominant, with *Ranunculus* also present, as was *Caltha palustris* growing in mid-channel. An MTR of 60 was probably a good reflection of the good, but not pristine, water quality.

Obrh River; 17 May 2005; Map 77. SLOV-6. HQA = 71; HMS/C = 0(1), SLOV-7. HQA = 60; HMS/C = 0(1), SLOV-8. HQA = 58; HMS/C = 0(1), and SLOV-9. HQA – 43; HMS/C = 330(3). Four, back-to-back, RHS surveys (2km) and macrophyte surveys in SLOV-6 and SLOV-7.

A very gently flowing river which appears from the limestone rocks as a sizeable stream and then flows into a large (28km^2) seasonal lake, the Cerkniško Jezero. From there, water from the Obrh and other rivers disappears down several sinkholes, to emerge several kilometres to the north. Given the seasonality of flow there is a distinct natural two-stage channel profile, with the second stage just under water at the time of survey. The river (more than 2m deep for much of its length) often dries out in summer.

The source of the Obrh, emerging from underground rivers in the limestone

There is a distinct downstream change in character over the 2km stretch surveyed. For example, the banktop and bankface of shallow natural berms in SLOV-7, 8 and 9 reflect a 'young berm' profile (page 3.3, RHS manual), so the berm surface represents the 'bankface' for vegetation structure. Consequently, marsh on the berm is recorded in land-use sweep-up. In SLOV-6 the berm is more like a terrace, so the bankface is taken as first break in slope. (cf. SLOV-12 and 13).

The river has a substantial flow within a few metres of its source

Scrub and broadleaved woodland occur in SLOV-6 and SLOV-7, whereas SLOV –8 and 9 are in the wide floodplain which has a very herb-rich meadow, cut once or twice a year. There is a major bridge at the downstream end of SLOV-9.

Herb-rich meadows adjacent to the Obrh

Macrophytes (in SLOV-6 & 7 only) were surveyed from the bank following initial observations in a canoe. The flora was not particularly rich or varied, but of a type not present in the UK, and probably very rare in Europe too. The flora, and the growth forms of plants present, reflected the intermittent nature of flow, with expected drying in late summer in most years but submergence to up to 3m for much of the spring and early summer growth period. A feature of the site was two species that typically are marginal plants, growing as submerged macrophytes - *Caltha palustris* and *Sium latifolia* (growing with fine, dissected, rosette leaves and no emergent broad leaves at the time of survey). Mosses were not dominant. *Ranunculus* was also present, almost certainly *R. trichophyllous,* growing as it does in the UK in chalk river headwaters in ponded stretches that periodically dry (it then reproduces from seed, with the predominant growth being annual).

The wide, and rich, riparian habitat forming a two-stage channel

The MTR scores in SLOV 6 & 7 (48 and 45) were probably not a good reflection of the water quality because such a river habitat is not present in the UK, and the base-rich nature of the community lowered the score. The low gradient also resulted in taxa such as *Rorippa amphibia* and *Schoenoplectus lacustris* being present which are taxa more associated with enriched lowland rivers, and so again reduced the MTR score. The National Institute of Biology, Ljubljana, hold macrophyte data for this site; the whole system has been surveyed on several occasions, including when dry.

Dragonja River; 19 and 20 May 2005; Map 210. SLOV-10. HQA = 87; HMS/C = 10(1), and SLOV-11. HQA = 96; HMS/C = 0(1). Two, back-to-back, RHS surveys (1km) and macrophyte survey in SLOV 10 only.

A fast-flowing, small river with a very complicated terraced, and in parts multiple, channel profiles. The number of channels recorded at spot-checks. There are ancient river terraces c3m above the current water level. Very difficult to distinguish between vegetated bars, mature islands etc. Complex mixture of wetland and dense scrub on mid-channel bars and terraces provides excellent riparian habitat. Large stretches of the river dry up in summer with only pools remaining.

A huge (30m high) cliffs adjacent to the river, with massive slabs of flysch and sandstone

The cliffs provide loose material for the bed, which either get washed away or appear occasionally as discrete gravel deposits, adjacent to bedrock. This geomorphological / geological feature is one reason the river valley is a nature reserve. It is also a Special Area of Conservation under the Habitats Directive.

An unusual mixture of bedrock and cobble bars

A distinct step-like flow sequence over boulder/cobble substrate is equivalent to riffles; these were counted as such, so care is needed over interpretation. Broad-leaved and conifer woodland mixture on valley slopes (beech, hazel, oak) with alder blackthorn prevalent in the riparian scrub.

Evidence at extreme lower end of SLOV-11 of abandoned vineyards. Adjacent orchid-rich meadows are of particular interest. The area is a nature reserve and is well used by locals for picnics etc., with some kiddies weirs being constructed as well.

No truly aquatic plants recorded, but 100% of the submerged channel substrate, including bedrock, covered by thick diatom growth when terrestrial species not present.

Diatom slime covers the bed

Very unusual flora reflects the intermittent nature of flow, the very calcareous substrate, and also the need for species to be able to be submerged for long periods in the early part of the growing season, and then withstand extreme desiccation later. Even bryophytes were rare. Grasses, herbs associated with river margins, and the sedges *Carex viridula* and *C. panicea* dominated a 'green' river bed. An MTR survey was carried out, but it produced a meaningless score of 60, based on just three plant species. The flora indicates drying, and baking, of the majority of the bed for much of the summer growing period.

Scrub and sedges dominate the centre of the channel

Iziča River; 21 May 2005; Map 147. SLOV-12. HQA – 65; HMS/C – 0(1), and SLOV-13. HQA – 64; HMS/C = 0(1); Two, back-to-back, RHS surveys (1 km) and macrophyte survey in SLOV-12 only.

A meandering, very low gradient, karstic river flowing through a flat peatland landscape (Ljubljana Moor), which is a mixture of herb-rich wetland and abandoned tilled land. The channel substrate is predominantly very fine sand, mixed with clay and silt. Banks are earthy clay (recorded as earth). Natural berm on both sides is a distinct feature. These berms seem to suggest over-widening of the river in the past, presumably for agricultural drainage purposes. There are several channelised watercourses (e.g. the Želimeljščica) draining directly into the Ižica. The natural berms may therefore reflect historical widening and deepening to aid drainage followed by subsequent recovery, but this interpretation needs to be checked against old records. Where the channel widens out at the bottom of SLOV-13 there are no natural berms. A well-developed riparian zone on the berms provides good scrub/shrub and reedbed habitats.

Banktop and bankface vegetation structure and land use were recorded as for a mature berm or terrace. (See RHS Manual pages 3.3 and 3.17).

In the downstream site a silty point bar is developing in an otherwise relatively uniform channel

SLOV-12 and SLOV-13 are very similar, except that there is more scrub in the riparian zone on the left bank in SLOV-13. The best wetland is on the floodplain of the right bank, particularly in SLOV-13.

Macrophyte surveys have been undertaken by the University since 1996[11] and the flora suggests raised nutrient levels derived from agricultural land use.

As the river appears to be recovering from widening and deepening, a 'berm' is developing and a dense riparian zone of sedges and willow scrub thrives

The RHS-related macrophyte survey revealed a rich lowland macrophyte community with dense margins of *Phragmites*, and in particular, *Carex acuta* with *Carex acutiformis* also present. *Potamogeton* species included *P. crispus, lucens* (locally dominant), *natans, pectinatus* and *perfoliatus.* Ribbon-leaved taxa such as *Sparganium emersum* and *Schoenoplectus lacustris* were common also. The river had been recently in spate, so macrophyte recording was difficult. The community recorded suggests it does not dry out. The MTR site survey was confined to the lower 100m of SLOV-12 and the score of 36, derived from almost 20 species, reflects a lowland, very base-rich community that is probably enriched. By comparison the score is lower than the best base-rich chalk rivers in the UK.

Spate flow conditions on 18 May (which prevented planned survey that day) show clearly the flooding of a natural berm/terrace

Mostnice River; 29 July 2005; Map 80. SLOV-14. HQA – 78; HMS/C – 100(2). Single RHS only.

A small alpine stream flowing in a deep (450m), steep-sided wooded valley. A narrow, 20m deep ravine section (spot-checks 2 and 3) opens out into a bedrock/boulder channel. The bedrock in the ravine section is extensively scoured and sculptured by the calcareous rocks being dissolved forming a series of plunge pools, some more than 3m deep, with gravel at the bottom. A marshy area with small pools adds to the habitat diversity.

Plunge pools and rock hollows, contrasting features in the bedrock dominated river

The site is a popular beauty spot on a nature trail in Triglav National Park. There are footpaths on both sides in the beech-fir woodland. A footbridge spans the ravine section, but it is 10m above the channel and does not impact the site. Crystal clear blue-coloured water, with abundant macroinvertebrates living in the submerged mosses growing on boulders and bedrock. Trout are present. Latitude/longitude and altitude estimated from 1:25,000 and 1:15,000 maps respectively.

Bedrocks and boulders darkened by growths of *Rhynchostegium & Cinclidotus*

No dedicated macrophyte surveys were carried out, but the flora was relatively sparse, but as shown in the photographs, some of the stable boulders and bedrock were colonized by good growth of the mosses *Rhynchostegium riparioides* and *Cinclidotus aquaticus.*

APPENDIX 2: Characteristics of Slovenian rivers surveyed in May 2005[12]

KEY: † excludes dry upper reaches; * trashline height (deep vee valley); ** virtually impossible to tell because of karstic geology; *** taken from summary map information; #Scores determined, but too few taxa to be confident

Physical and landscape	SLOV-1 Bistrica	SLOV-2 Pišnica	SLOV-3 Soča	SLOV-4 & 5 Soča
Geology	Alpine karst	Alpine karst	Alpine karst	Alluvium
Landscape type	Alpine mountains	Alpine mountains	Alpine mountains	Alpine mountains
Climatic regime	Mountain	Mountain	Mountain	Temperate continental
Hydrological regime	Snow-rain	Snow-rain	Snow-rain	Snow-rain
Biogeographical region	Alpine	Alpine	Alpine	Alpine
Predominant land-use	Pine-beech woodland	Pine-beech woodland	Pine-beech woodland	Woodland and meadow
Population density	0-1/km^2	0-1/km^2	0-1/km^2	10-50/km^2
Valley form	Deep vee	Gorge	Deep vee	Deep vee
Valley relief	1600m	1200m	1600m	1600m
Altitude (mid-site)	800m	880m	750m	365m
Slope (m; m/km)	18m; 36m/km	29m; 58m/km	22m; 44m/km	2,3m; 5m/km
Height of source	1050m	1750m	1450m	1450m
Mid-point distance from source†	5.5km	5.0km	6.0km	32 and 32.5km
Water width	7.5m	4.0m	12.0m	20m
Bankfull width	10.0m*	12.0m*	18.0m*	>200m
Extent of braiding	None	None	None	Extensive
Predominant channel substrate	Boulder-cobble	Boulder-cobble	Boulder	Cobble-pebble
Predominant flow type	Broken wave-chute	Chute-broken wave	Chute-broken wave	Unbroken wave
Morphological class ***	Class 1	Class 1	Class 1	Sub-class 1-2
Biological water quality***	1 (?)	1 (?)	1-2	1-2
HQA	73	67	70	75; 78
HMS (and class)	80 (2)	0 (1)	1280 (4)	0 (1); 0 (1)
MTR score	71	68	70	60
Impacts on site	Negligible	Negligible	Rip-rap; groynes; minor bridge	Negligible

Physical and landscape	SLOV-6 to 9 Obrh	SLOV-10 to 11 Dragonja	SLOV-12 to 13 Ižica	SLOV-14 Mostnice
Geology	Low Dinaric karst	Flysch	Alluvium	Alpine karst
Landscape type	Alpine corrosion plains	Mediterranean low hills	Flat lands	Alpine Mountains
Climatic regime	Temperate continental	Coastal sub-mediterranean	Temperate continental	Mountains
Hydrological regime	Rain-snow	Rain	Rain-snow	Snow-rain
Biogeographical region	Dinaric	Mediterranean	Dinaric	Alpine
Predominant land-use	Woodland and meadow	Woodland and scrub	Agriculture/ meadow	Woodland
Population density	10-50/km^2	10-50/km^2	10-50/km^2	0-1/km^2
Valley form	Concave/bowl	Deep vee	Floodplain	Deep vee
Valley relief	300m	300m	n/a	450m
Altitude (mid-site)	560m	95m	290m	585m
Slope (m; m/km)	4m,0,0,0m:2m/km	5m,6m; 11m/km	<1m;<1m; <1m/km	14m; 28m/km
Height of source	600m	320m	660m	1780 m
Mid-point distance from source **	12 to 13.5km	11.5 and 12km	15km(?)	7km
Water width	25-35m	7.5-10.5m	15-35m	6m
Bankfull width	27-55m	30m	30-39m	15m
Extend of braiding	None	Some	None	None
Predominant channel substrate	Pebble, then silt	Bedrock-boulder-cobble	Sand- silt	Bedrock-cobble
Predominant flow type	Smooth	Unbroken wave	Smooth	Chute-broken wave
Morphological class***	Sub-class 1-2	Sub-class 1-2	Class 2	Class 1
Biological water quality**	2	2	2-3(?)	1 (?)
HQA	71; 60; 58; 43	87; 96	65; 64	68
HMS (and class)	0(1); 0(1); 0(1); 330(3).	10(1); 0(1)	0(1); 0(1)	100 (2)
MTR score	48#, 45#	60#	36	n/a
Impacts on site	Road bridge at downstream end of Slov-9	Negligible	Historical widening? Agriculture	Tourist beauty spot

APPENDIX 3: HQA sub-scores and total scores for SLOV-1 to SLOV-14

(* shrub/scrub and rock/scree counted as natural vegetation)

Sub-score category	SLOV-1	SLOV-2	SLOV-3	SLOV-4	SLOV-5	SLOV-6	SLOV-7	SLOV-8	SLOV-9	SLOV-10	SLOV-11	SLOV-12	SLOV-13	SLOV-14
Flow types	9	11	10	7	7	5	4	4	4	12	12	6	7	11
Channel substrates	9	11	8	8	8	8	5	3	4	7	9	8	8	10
Channel features	8	7	11	7	7	0	0	5	0	12	13	1	0	11
Bank features	5	4	6	7	8	6	7	9	8	10	16	10	11	1
Bank vegetation structure	12	8	10	9	10	12	11	9	3	12	12	10	9	11
In-stream vegetation	3	1	3	0	0	13	11	10	11	6	5	10	9	2
Land-use	10	14*	9	14*	14*	6	6	5	4	6	6	4	4	14
Trees, etc	10	8	9	12	11	11	8	6	3	10	11	7	7	8
Special features	7	3	4	11	13	10	8	7	6	12	12	9	9	10
Total HQA	73	67	70	75	78	71	60	58	43	87	96	65	64	78

Appendix 4: HMS scores and habitat modification class for SLOV-1 to SLOV-14

Sub-score category	SLOV-1	SLOV-2	SLOV-3	SLOV-4	SLOV-5	SLOV-6	SLOV-7	SLOV-8	SLOV-9	SLOV-10	SLOV-11	SLOV-12	SLOV-13	SLOV-14
HMS	80	0	1280	0	0	0	0	0	330	10	0	0	0	100
Class	**2**	**1**	**4**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**1**	**2**

Wetland habitat - a scoring component of the HQA system

APPENDIX 5: Some habitat features and observations of wildlife along Slovenian rivers surveyed in 2005.

Habitat features formally recorded in the RHS survey are noted as 'P' if present, and 'E' if extensive (covering >33% of length); Informal wildlife observations are for the site as a whole, denoted by ✓.

Habitat features	SLOV-1 Bistrica	SLOV-2 Pišnica	SLOV-3 Soča	SLOV-4/5 Soča	SLOV-6/9 Obrh	SLOV-10/11 Dragonja	SLOV-12/13 Iziča	SLOV-14 Mostnice
Unvegetated bars	P	P	P	E	P	E		P
Vegetated bars/islands	P		P	E	P	E	P	
Riparian zone habitat	P		P	E	P	E	E	
Flushes	E							E
Side and back channels				E		E		
Natural berms					E		E	
Floodplain woodland				E				
Herb-rich meadows					E		E	
Orchid-rich meadows					P	P		
Wildlife observations								
Otter (footprints/slides)					✓		✓	
Common sandpiper			✓	✓				
Dipper			✓					
Grey wagtail	✓					✓		
White wagtail				✓				
Yellow wagtail					✓		✓	
Sedge warbler					✓		✓	
Marsh warbler							✓	
Corncrake					✓			
Garganey					✓			
Marsh harrier					✓			
Montagu's harrier							✓	
Nightingale						✓	✓	
Golden oriole							✓	
Nightjar						✓		

APPENDIX 6: INDICATIVE VALUES FOR WATER CHEMISTRY FOR SITES SURVEYED IN SLOVENIA IN MAY 2005.

These are spot field determinations using a conductivity meter and test strips. Key: nn = not analysed in field; tr = trace; Total Hardness scale – low = 90-180 mg/l; medium = 180 - 270 mg/l; high 270-360 mg/l.

Indicative Water Chemistry, determinand and range					
Site	conductivity ± 10 (µS m^{-1})	Water temperature at collection (± 0.1 °C)	Total hardness (Ca & Mg) (± 40 mg/l $CaCO^3$)	Acidity (± 0.1 pH units)	Nitrate (mg/l NO^3)
SLOV-1 Bistrica	-	-	-	-	-
SLOV-2 Pišnica	220	8.5	low	7.5	0
Source of Soča	275	9.1	low	7.5	0
SLOV-3 Soča	192	8.8	low	6.7	0
SLOV-4 & 5 Soča	224	11.2	low	6.7	0
SLOV-6/9 Obrh	353	8.7	medium-high	6.7	0
SLOV-10 Dragonja	(485)	(20.0)	high	8.0	tr
SLOV-11 Dragonja	492	13.3	high	-	tr
Source of Iziča at Ig	410	10	medium-high	7.5	tr
SLOV -12 & 13 Iziča	393	12.2	-	-	-

APPENDIX 7: Recommended amendments to the RHS manual text

Unbroken standing waves flow. Strong flow often results in ridgeback surface (i.e. unbroken waves, but travelling downstream). Given the stream power, it is recommended that the manual text explicitly includes the statement that these unbroken waves can be large and moving downstream.

Coniferous woodland (CW). The current wording should be changed to reflect the mixture of trees more accurately. For instance, "BL" is described as "predominantly broad-leaved", whilst CW just indicates "native conifers". It is recommended that the text is amended so that CW refers to "predominantly native conifers". It would also be useful to encourage surveyors to record the approximate mix (e.g. % pine, larch, spruce, birch, beech, etc.) in their notes.

More clarity is required when recording native conifer woodland

Natural berm (NB). This is a common feature of many European rivers. The terraced, composite, bank form makes "bankface" and "bankfull" very difficult to determine. We need to clarify when the berm becomes a terrace because this will influence vegetation structure and land-use records for spot-checks (see section E on form). It is recommended that similar differentiation is used as for mature island, where vegetation on terraces (as opposed to low-level berms) will include shrubs and saplings. At this stage the feature becomes a terrace and the shrubs etc become the banktop land-use. A terrace profile could be added to the form.

Natural berm on a large river in Finland

For low-level **berms** there will not normally be shrubs or trees, but marsh, wetland, or reedbed. Given that this will be recorded as "bankface" there is a potential anomaly because the land-use sweep-up (section H) indicates from banktop to 50m. This means that any marsh etc on the berms (i.e. bankface) would not be included. It is recommended that in these instances riparian vegetation from the water's edge is included in the land-use in the sweep-up.

Although rare in Britain, the recovery of over-widened rivers will produce some good riparian habitat which needs to be recorded. [See pages 3.3 and 3.17 of 2003 RHS Manual].

Determining banktop and bankface boundaries is difficult in V shaped valleys

Banktop in deep vee valleys. More clarity is needed on the approach to recording bankface and banktop vegetation in deep vee valleys. Basically, the notch or strandline height needs to be directly or indirectly inferred by observation. Surveyors should be confident that they are making a common sense judgement – otherwise the whole valley side is counted as "bankface" which is plainly nonsense. It also means that gorge really does mean bedrock cliffs/walls at 80° or more. It is recommended that wording reflects this more explicitly.

Riparian zone. This should be recorded in the special features section given its importance. Clear distinction is needed, because it must be restricted to habitat (largely wetland or scrub) that occupies the composite/terraced bank, characteristic of many European rivers. It is recommended that clear descriptive examples are used for UK purposes (e.g. braided channels with wet woodland).

The Sava River has a distinct riparian zone of wet woodland

Banktop. Difficulty in determining banktop can be caused by composite bank form. It is recommended that clear illustrated guidance is developed.

GPS measurements. Latitude and longitude taken from GPS are usually very reliable and accurate. Our experience from Slovenia and the UK is that absolute height data are not reliable. It is recommended that 1:25,000 or 1:50,000 scale map contours are used to verify height above sea-level.

HQA scoring – land use within 50m. Currently a score of 7 is allocated if broadleaved woodland, coniferous woodland or wetland, alone or together, are the only categories recorded for a bank. It is recommended that when scrub and shrubs (SH), or rock, scree or sand dunes (RD), are obviously part of the natural riparian zone, they are added to the scoring list. For SLOV-2, which is completely semi-natural, under the current scoring system HQA sub-score for land use would be 4; for the recommended version, and one used in this report, it is 14.

Rock and scree needs to be able to contribute to the 'land-use' scoring section of HQA

HQA scoring – special features.
It is recommended that the following categories are added: riparian zone; herb-rich meadows. For the purposes of this study, they were included in the HQA score.

Herb Rich grasslands need to be added to the 'special features' section of the HQA scoring system

APPENDIX 8: Results of MTR Surveys of Slovenian rivers in May 2005.

STR = Species Trophic Rank; SCV = Species Cover Value (one scale 1-9); CVS = Cover Value Score (STRxSCV); recorded in University Surveys[11] but not in 2005.

Site References (SLOV)		1		2		3		4		6		7		10		12	
Species Name of MTR Cheklist taxa\Cover Code	**STR**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**	**SCV**	**CVS**
Cladophora/Rhizoclonium agg.	1		0		0		0		0		0		0		0	1	1
Vaucheria agg.	1		0		0		0		0		0		0		0	1	1
Jungermannia sp(p).	8	1	8	1	8		0		0		0		0		0		0
Amblystegium fluviatile	5	2	10	1	5	2	10	1	5		0		0	1	5		0
Brachythecium rivulare	8	1	8		0	4	32	1	8		0		0		0		0
Brachythecium plumosum	9		0		0	1	9		0		0		0		0		0
Bryum pseudotriquetrum	9	1	9	1	9	2	18	1	9		0		0		0		0
Calliergon cuspidatum	8		0		0		0		0		0	1	8		0		0
Cinclidotus fontinaloides	5		0		0	2	10		0	1	5		0		0		0
Dichodontium pellucidum	9	1	9		0	1	9		0		0		0		0		0
Dicranella palustris	10	1	10		0		0		0		0		0		0		0
Fontinalis antipyretica	5		0		0		0	1	5	1	5		0		0		0
Hygrohypnum luridum	9		0		0	2	18	1	9		0		0		0		0
Philonotis fontana	9		0		0	1	9	1	9		0		0		0		0
Rhynchostegium riparioides	5	3	15	1	5	4	20	1	5		0		0		0		0
Equisetum fluviatile	5		0		0		0		0	1	5	3	15		0		0
Equisetum palustre/hybrid	5		0		0	1	5	1	5		0		0	1	5		0
Apium nodiflorum	4		0		0		0		0		0		0		0	1	4
Berula erecta	5		0		0		0		0		0		0		0	1	5
Hippurus vulgaris	4		0		0		0		0		0		0		0	7	28
Lotus uliginosum	8		0		0		0		0		0		0	1	8		0
Myriophyllum spicatum	3		0		0		0		0		0		0		0	✓	0
Oenanthe crocata	7		0		0		0		0	1	7	1	7		0		0
Potentilla erecta	9	1	9		0		0		0		0		0		0		0
Persicaria amphibia	4		0		0		0		0		0	1	4		0		0
Ranunculus trichophyllous	6		0		0		0		0	1	6		0		0		0
Rorippa amphibia	3		0		0		0		0	1	3	2	6		0		0
Veronica anagallis-aquatica	4		0		0		0		0	1	4	1	4		0	1	4
Alisma plantago-aquatica	3		0		0		0		0	1	3	1	3		0	1	3
Carex acutiformis	3		0		0		0		0		0		0		0		0
Carex acuta	5		0		0		0		0		0		0		0	3	15
Eleocharis palustris	6		0		0		0	1	6		0		0		0	1	6
Glyceria maxima	3		0		0		0		0		0		0		0	1	3
Phragmites australis	4		0		0		0		0		0		0		0	2	8
Potamogeton lucens	3		0		0		0		0		0		0		0	3	9
Potamogeton natans	5		0		0		0		0		0		0		0	2	10
Potamogeton perfoliatus	4		0		0		0		0		0		0		0	2	8
Potamogeton pectinatus	1		0		0		0		0		0		0		0	1	1
Schoenoplectus lacustris	3		0		0		0		0		0	1	3		0	4	12
Sparganium emersum	3		0		0		0		0		0		0		0	3	9
Sparganium erectum	3		0		0		0	1	3		0		0		0	1	3
Typha latifolia	2		0		0		0	1	2		0		0		0		0
SCV and CVS Totals		11	78	4	27	20	140	11	66	8	38	11	50	3	18	36	130
MTR SCORE		71		68		70		60		48		45		60		36	
Non MTR checklist Taxa																	
Filamentous algae				1						1				1		1	
Phormidium				1		1											
Red alga chantransia						1											
Diatom film														7			
Cinclidotus aquaticus						2											
Cratoneuron commutatum		2		1		1											
Cratoneuron filicinum		1		1													
Schistidium rivulare		1				1											
Pohlia wahlenberghii																	

APPENDIX 9: Results of the JNCC Macrophyte Surveys.

Figures (scale 1-5) are relative, and absolute, estimates of cover within the river channel (first two figures) and the second two are estimates for the margin. For more details, see[2]. 'p' = not recorded in this survey, but reported as present in previous surveys[11].

JNCC Check-list taxa\Sites (SLOV)	1	2	3	4	6	7	10	11	12	13
JNCC Check-list taxa\Sites (SLOV)	1	2	3	4	6	7	10	11	12	13
Filamentous green algae (other)	1100	3100	1100	2100			1100	1100	1100	1100
Cladophora/Rhizoclonium agg									1100	1100
Vaucheria agg.									2200	1100
Chara sp(p)					1100					
Encrusting lichens							1122	1111		
Jungermannia sp(p).	1111	1111								
Marchantia polymorpha				11						
Conocephalum conicum	11		11	11						
Amblystegium fluviatile	4242	1111	3232	2121			1111	1111		
Brachythecium plumosum			1111							
Brachythecium rivulare	2142		4354	1121						
Bryum pseudotriquetrum	1121	1121	1132	1121						
Calliergon cuspidatum						11				
Cinclidotus fontinaloides			3232		11	11				
Cratoneuron filicinum	2132		11				1111			
Dichodontium pellucidum/flavescens	1111		1111							
Dicranella palustris	1121									
Fontinalis antipyretica				1111	11				1111	1111
Hygrohypnum luridum			3232	2111						
Leptodictyum riparium									1111	1111
Orthotrichum cupulatum			21							
Philonotis fontana			11	3131						
Rhynchostegium riparioides	5232	2111	5332	2131					1111	
Schistidium rivulare	1121					11	11			
Equisetum fluviatile					1111	3333			2222	1111
Equisetum palustre/hybrid			11	11			1111	1111	1122	1122
Angelica sylvestris						11	11	11	1122	11
Berula erecta									1100	1111
Caltha palustris				2121	3232	3344			11	11
Cardamine amara	11			1111					11	
Epilobium hirsutum									22	11
Eupatorium cannibinum				11			1133	2222	1133	1122
Filipendula u;lmaria					1121	1122			44	1144
Galium palustris					1111	1111	1111	1111		
Hippurus vulgaris									4400	5500
Lotus uliginosum							1122	1111		
Lycopus europaeus				1121	1111	1122			1122	1122
Lysimachai vulgaris						1122	2233	1122	1122	1122
Lythrum salicaria				1111	1111	3333	2233	2233	1122	1122
Mentha aquatica				1121	3232	3333	2222	2233	1122	1111
Myosotis scorpioides					4232	3333			1111	1111
Myriophyllum spicatum									p	p
Nuphar lutea									3300	3300
Oenanthe crocata					11	11				
Potentilla erecta	1111									
Persicaria amphibia						11				
Persicaria hydropiper									11	11
Ranunculus trichophyllous					1100					
Rorippa amphibia					1111	2211				
Rorippa palustris					11					
Rorippa nasturtium-aquaticum agg.									1100	1100
Scrophularia auriculata									22	1122
Solanum dulcamara									1111	1111
Tussilago farfara				2121						
Valeriana officinalis					11	11			22	22
Veronica anagallis-aquatica					1111	1111			1111	1111
other dicotyledons	32	41	21	21	11	1122	1122	1133	22	22
Alnus glutinosa				1121	1111	1122				
Salix sp(p.)	1132	41	1132	5155	5255	2244	3355	4455	2244	2244
other deciduous trees	21	31	32	1131	1122	1122	2244	3344	1122	1122
Coniferous trees	11	51	21				11	11		
Alisma plantago-aquatica					1100	1100			1111	1111
Carex acutiformis									1122	1122
Carex acuta									1155	1155
Carex curta	11									
Carex nigra	11									
Carex panicea	11	11		11			4444	4455		
Carex pendula							11			

APPENDIX 9: Continued

JNCC Check-list taxa\Sites (SLOV)	1	2	3	4	6	7	10	11	12	13
Carex viridula							2233	2233		
Deschampsia cespitosa			1121	1121	11	11			11	
Eleocharis palustris				1111					1111	1111
Elodea canadensis									1100	1100
Glyceria fluitans					5243	5544			11	
Glyceria maxima									1111	1122
Iris pseudacorus									1122	1111
Juncus articulatus							1111	1111		
Juncus acutiflorus				1121			1111	1122	11	
Juncus effusus							11			
Juncus inflexus								1111		
Molinea caerulea		11								
Phalaris arundinacea				1111	3232	2244	11		1111	
Phragmites australis									2244	2244
Potamogeton crispus									1100	1100
Potamogeton lucens									5500	3300
Potamogeton natans									3300	4400
Potamogeton pectinatus									2200	1100
Potamogeton perfoliatus									4400	3300
Schoenoplectus lacustris						2200			3300	4400
Sparganium emersum									1100	3300
Sparganium erectum				1100					2200	2200
Typha latifolia				1100						
other monocotyledons	32	41	21	11	1132	2233	1122	2222	1122	1122
Non-JNCC Database Check-list British Taxa										
Blue Green Algae tufts							2200	2200		
Phormidium mats	1100	5100	2100				1100	1100		
Diatom films							5500	5500		
Nostoc						1100				
Rhodophyte genus			1100							
Cinclidotus aquaticus			32						1111	
Cratoneuron commutatum	3232	5141	1111	1111			1111			
Didymodon spadiceus	11		21							
Mnium hornum			21	31						
Plagiomnium rostratum	21		11	21		11				
Pohlia wahlenberghii	11	1121	11							
Rhizomnium punctatum	11		11	11						
Equisetum arvense				11						
Dryas octapetala	11									
Galium mollugo								11		
Jasione montana								11		
Juncus alpino-articulatus					2211	3333				
Leucojeum aestivum						11				
Ononis repens		11								
Plantago lanceolata							1111	2222		
Polygonatum oderatum				11						
Rhamnus sp.							2222	1122		
Sium latifolia					2100	3311				
Non-native Non-MTR species										
Alchimilla sp(p)	11									
Anenome sp.	11									
Angelica sp.							1122	1122		
Bulboschoenus sp.							11	11		
Callitriche cophocarpa?									1100	
Cardamine pentaphyllum	11									
Clematis alpina			11							
Crucifera (unknown)			11							
Helleborus sp.	11									
Lathyrus sp.							1122	11		
Paederata lutea			11							
Pinguicula alpina	11									
Petasites sp.	2153	41	1132	1121			3333	4444	1122	11
Polygala sp(p)	21									
Pinus mugo		51								
Ranunculus hybridus			11							
Spergula sp.?	1121		21	11						
Senecio paludosa						1111				
Tozzia alpina	11		11							
Valeriana sp(p)	32									
Viola sp.			11							
TAXA IN RED = TRULY AQUATIC										

APPROXIMATE LOCATIONS OF SITES SURVEYED

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