

SHORT ARTICLES AND REVIEWS

**THE ROLE OF SITES OF SPECIAL SCIENTIFIC INTEREST (SSSIs)
IN THE CONSERVATION OF BRITISH RIVERS**

PHILIP J. BOON

Nature Conservancy Council, Northminster House,
Peterborough PE1 1 UA, England.

*(Dr P. J. Boon, Nature Conservancy Council for Scotland, Research and
Development, 2/5 Anderson Place, Edinburgh EH6 5NP, Scotland.)*

Introduction

River conservation, in its broadest sense, is now the concern of many. For some, such as the National Rivers Authority (NRA), it is a legal obligation, while for river users such as anglers it is a desirable goal but involves no statutory responsibilities. Public opinion polls show that the populace in general also feels it is important for rivers to be maintained in a healthy state (Green & Tunstall in press), although they are not always certain what it is they want, and their perception of what constitutes a "healthy" river may not coincide with that of an ecologist. Even nature conservationists have not always stated clearly their conservation objectives for rivers, and their efforts have often concentrated on "high profile" species such as otters, birds and dragonflies.

River systems serve multiple functions - removing waste, generating power, providing drinking water, supporting fish and wildlife. However, the statutory remit of the Nature Conservancy Council (NCC) extends only as far as identifying and protecting features of nature conservation value. The role of the NCC (reconstituted from the former Nature Conservancy in 1973) is restricted to the "conservation of wild flora and fauna, geological and physiographic features of Britain for their scientific, educational, recreational, aesthetic and inspirational value" (NCC 1984). This inevitably means conflict from time to time as no single body is responsible for the integrated management of natural resources throughout Britain. Changes to the structure of the NCC are now pending, and in April 1991 separate organizations will be set up for England, Wales and Scotland. In Wales (1991) and Scotland (1992) the NCC will be merged with the Countryside Commission thus extending its remit to landscape and amenity issues.

Boon (in press) has recently suggested that river conservation can be considered as a series of management options spaced along a gradient of decreasing conservation value. These options range from "preservation" at the natural/semi-natural end of the spectrum, through "limitation" and "mitigation" of damaging activities, to "restoration" and finally "dereliction" once a river becomes irretrievably degraded. In Britain, most river systems fall somewhere in the middle, meriting limitation or mitigation strategies, although this of course varies from region to region.

The use of terms such as "limitation" and "mitigation" implies (a) that anthropogenic activities are known to be having an adverse effect on river habitats and wildlife, (b) that there is sufficient scientific information available to define the levels at which these activities become damaging, and (c) that control is possible. The first is indisputable, based on numerous studies of rivers affected by acidification, sewage pollution, urban run-off, channelization and so on. The second - defining the levels at which certain activities should be limited for the purpose of wildlife conservation - is far more difficult, and will not be dealt with here. The third - control - is equally problematical and forms the subject of this paper.

Some impacts on riverine flora and fauna are in practice uncontrollable at a local level. This is particularly true for factors such as acid deposition which operate at a level greater than the catchment. The effects of large-scale changes in catchment land-use, such as occur with conifer afforestation (influencing flow volume and periodicity, temperature regime, pH, sedimentation, nutrient levels) are theoretically controllable, but only through an integrated catchment planning process involving considerable political will. It is at the local scale, at the level of the river corridor, impinged upon by water abstraction, dredging, clearance of bankside vegetation, sewage inflow, channelization, or dam construction that control becomes a feasible proposition.

This paper discusses the particular contribution of the SSSI system (Sites of Special Scientific Interest) as a control mechanism for rivers.

Identification and selection of rivers important for nature conservation

A programme of river protection which seeks to limit anthropogenic change first requires a system for evaluating those rivers of greatest importance for conservation. This process may be described in four stages.

(1) Standardised survey

Even though fresh water accounts for no more than 1% of the land surface of Great Britain it has been estimated that there are approximately 10,000 river systems throughout Britain with more than 190,000 associated streams (Smith & Lyle 1979). A complete biological

survey of all river corridors in Britain is clearly not practicable and thus a more selective approach is essential.

The first systematic account of the nature conservation interest of British fresh waters was produced as part of the Nature Conservation Review (NCR) (Ratcliffe 1977). This was not intended to be a final, definitive statement, but rather an assessment based on the best available knowledge in the mid-1960s. The section of the NCR covering Open Waters lists 99 sites, of which 20 are wholly or partly flowing water (Table 1). Since then, the NCC has undertaken a great deal of additional survey work which has been used both to classify rivers and to identify those especially important for conservation.

Table 1. The list of rivers published in the Nature Conservation Review (NCR) (Ratcliffe 1977).

ENGLAND	WALES
River Avon	Ogof Ffynon Ddu (streams in cave system)
Oberwater	(River Wye)
Moors River	
River Great Eau	SCOTLAND
River Lark	River Tweed
River Wissey (tributary)	River Endrick
River Wye	River Spey
Lathkill Dale	River Dee
Malham/Arncliffe (streams)	River Strontian
Ingleborough cave systems (streams)	River Traigill
Knock Ore Gill	River Laxford
(River Tweed)	Burn of Latheronwheel

Between 1978 and 1982 botanical and habitat surveys were carried out at 1055 sites on over 200 rivers throughout Britain, culminating in the NCC's publication "Typing British Rivers according to their Flora" (Holmes 1983). A further botanical survey programme (1988-1991) is now nearing completion, covering sites on more than 130 rivers. In addition the NCC has commissioned invertebrate surveys for more than 50 British rivers. Since 1986 this work has been carried out for the NCC by the Freshwater Biological Association and the Institute of Freshwater Ecology, using standard methodology.

(2) River classification

Rivers may be classified using a variety of techniques. For example, work carried out by the FBA and IFE over the past decade has made it possible to classify British rivers according to their invertebrate communities (Wright et al. 1989). NCC's botanical survey in the early 1980s produced a classification system exclusively derived from plant distribution data (Holmes 1983, 1989). The analysis (using TWINSPAN) defined four main

plant community groups (A-D), each divided into four sub-groups. The final classification consists of 56 distinct communities which can be amalgamated into ten River Types (Table 2), reflecting geological, physical and chemical characteristics. This classification system has enabled the NCC (a) to estimate the extent of each River Type throughout Britain, (b) to assess local, regional and national variations of the same River Type, and (c) to compare species richness at any site with the mean for that River Type (Holmes 1989).

Table 2. A botanical classification of British rivers (Holmes 1989)

Type I	Group A1	Lowland rivers with minimal gradients, in England
Type II	Group A2	Clay rivers
Type III	Group A3	Chalk and oolite rivers
Type IV	Group A4	Rivers with impoverished ditch floras, in lowland England
Type V	Groups B1 and B2	Rivers on rich geological strata in Scotland and northern England
Type VI	Groups B3 and B4	Rivers on sandstone, mudstone and hard limestone in England and Wales
Type VII	Groups C1 and C2	Mesotrophic rivers downstream from oligotrophic catchments
Type VIII	Groups C3 and C4	Oligo-mesotrophic rivers, predominantly upland
Type IX	Groups D1, D3 and D4	Oligotrophic rivers of mountains and moorlands
Type X	Group D2	Ultra-oligotrophic rivers in mountains

(3) Assessment of nature conservation value

Scientific evaluations of areas for nature conservation rely on the use of standard criteria. In some countries, assessment techniques for rivers are broad-based and cover a wide range of features. For example, O'Keeffe et al. (1987) used an "expert system" approach for South African rivers incorporating 41 attributes such as per cent canalization, number of mainstream dams, per cent natural vegetation, number of endemic fish species and invertebrate diversity. Their aim was to provide a consistent method for classifying rivers according to their conservation status, and a semi-quantitative model to simulate the effects of proposed developments on certain rivers.

Many of these specific attributes are implied in the suite of ten general nature conservation assessment criteria suggested by Ratcliffe (1977), i.e. size, diversity, naturalness, rarity, fragility, representativeness, recorded history, position in an ecological/geographical unit, potential value and intrinsic appeal. These have become widely accepted and underpin the selection of conservation sites in Britain. For rivers the most important

criteria are diversity (of habitats and species), naturalness (of catchment and corridor) and representativeness (of rivers of a certain Type). Conservation criteria may sometimes be mutually exclusive. For example, representativeness by definition places emphasis on commonplace features rather than rarities. Species diversity in nutrient-poor waters may be increased by slight enrichment (i.e. lack of naturalness). In other words, the application of nature conservation criteria cannot be made blindly but needs a degree of scientific judgement.

(4) Selection of sites for positive conservation measures

The selection of special conservation "sites" may be easily misunderstood to imply a lack of concern for the majority of the habitat outside such sites. In Britain the work of the NCC extends beyond the management of National Nature Reserves and Sites of Special Scientific Interest (SSSIs) to include advice and research on "wider countryside" matters. However, as the SSSI system is unique to the NCC and acts as a focal point for much of its work, the relevance of SSSIs to river conservation needs to be carefully considered.

Rivers as Sites of Special Scientific Interest

The SSSI system

The NCC has a statutory duty under the Wildlife and Countryside Act 1981, to notify owners and occupiers of SSSIs. These are areas of land or water containing plants, animals and geological features or landforms of special interest, and there are now 5264 throughout Great Britain (September 1990). Under the National Parks and Access to the Countryside Act 1949 these were notified to local planning authorities so that consideration could be given to their conservation (NCC 1988). However, damage could still occur to sites through activities not subject to planning control, so the 1981 Act extended the procedure. An SSSI is formally notified to the owners and occupiers of the land, the appropriate Secretary of State, the local planning authority, and (in England and Wales) to a water or drainage authority.

The notification to owners and occupiers comprises an explanatory letter, a map of the site and a statement ("citation") of the site's special interest. It also includes a list of activities (Potentially Damaging Operations - PDOs) likely to damage the interest of the site. These might include the release of animals or plants into the site, the management of aquatic and bank vegetation or the modification of watercourse structure. If owners or occupiers intend carrying out a PDO, they must give the NCC four months' notice in writing. This period allows full discussion to take place to resolve any difficulties and may entail the

NCC offering a financial settlement (a "management agreement") to protect the nature conservation interest of the site.

For river SSSIs, the NRA, water companies and internal drainage Boards in England and Wales are obliged to consult the NCC (under the Water Act 1989) on discharges, abstractions, river engineering and flood protection schemes. In addition, the NRA has a free-standing duty to promote the conservation of flora and fauna dependent upon an aquatic environment. In Scotland there are no duties on the relevant bodies to promote conservation or to consult the NCC on rivers, as are contained in Sections 8 and 9 of the Water Act.

Selecting river SSSIs and drawing their boundaries

The selection of SSSIs is not an arbitrary process and is subject to the final consideration of the NCC Council appointed by the Secretary of State, which has to consider relevant objections and representations. In 1989 the NCC published its "Guidelines for the Selection of Biological SSSIs", setting out procedures and criteria for assisting site selection. These are not intended as rules but allow scope for informed scientific opinion.

The guidelines propose that for rivers a dual selection system should be used, aimed at developing a national series. "Whole river" SSSIs, (which might ultimately comprise 20-30 rivers throughout Britain), represent the main types of river, or rivers which show classic and representative transitions down their lengths. Tributaries may also be included if their interest contrasts with, or causes transitions in, the main channel.

"Sectional" SSSIs are shorter stretches of river with high nature conservation interest. These fulfil three roles: (a) they assist in conserving parts of rivers in areas of the country where few examples of natural watercourses remain, (b) they expand the overall coverage of river SSSIs and allow adequate regional representation, and (c) they ensure that the best examples of each River Type are included in the SSSI series.

It is important to draw the lateral boundaries of a river SSSI so that they include more than just the open water. This normally means incorporating strips of riparian vegetation (important for wildlife habitat, nutrient interception, bank stabilization, temperature control, allochthonous food supply etc.), and any adjacent semi-natural wet habitat intimately linked with the river and hydrologically dependent on it (e.g. marshland, fens or wet woodland such as willow and alder carr). Non-wetland habitats adjacent to the river which are not notified as SSSIs in their own right are also included within the site boundary, provided that they contribute significantly to sustaining fauna associated with the river. This is very much a pragmatic approach which attempts to include as many

important corridor features as possible without making the task of notification unreasonably complicated.

How many river SSSIs are there in Britain ?

This is not quite such a simple question to answer as might appear at first glance. Although some rivers have been notified exclusively for their riverine interest, there are many terrestrial SSSIs containing flowing water about which very little is known. The NCC has recently classified all SSSIs with a recognised river interest, together with all other SSSIs with running waters at least 5m wide and with at least 500m present within the site (Holmes et al. 1990)

Each river length was classified using the ten River Types. For many rivers no survey data were available so classifications were predicted from map information (altitude, aspect, rock type, river slope and catchment characteristics), together with a knowledge of the typical communities in that geographical location. Each SSSI with running water was assigned to one of the following four categories:

- (i) River SSSI - where running water was the main (or one of the main) reasons for notification given in the citation.
- (ii) River valley SSSI - sites including the watercourse and the majority of its valley.
- (iii) River adds interest - where the citation clearly states that the river contributes to the biological interest of the site, substantiated with records of plants, animals or habitats of interest.
- (iv) River of incidental interest - running water not mentioned in the citation - little information available.

A summary of the results is presented in Table 3. Within each of the four categories the total lengths of river are (i) 976 km, (ii) 489 km, (iii) 398 km, (iv) 1961 km.

There is an uneven distribution of River Types throughout Britain. For example, 259 km of lowland Type I rivers are found within SSSIs, of which almost 50% is notified specifically for its river interest and should therefore have a high degree of protection. In contrast, less than 3% (19 km) of upland oligotrophic rivers in Type X are represented as River SSSIs out of 667 km present in SSSIs as a whole. This unevenness is partly a reflection of the geographical distribution of different River Types, but is also due to differences in notification priorities between

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Regions of the NCC. For example, there are few rivers of Types VII-X notified in England, although they are fairly widespread.

Table 3. The length of river (km) in four SSSI categories, and their classification within ten River Types listed in Table 2.*

	River Type									
	I	II	III	IV	V	VI	VII	VIII	IX	X
(i) <i>RIVER SSSIs</i>										
England	106	65	31	16	5	134	11	3	11	0
Wales	0	0	0	2	15	34	32	31	15	15
Scotland	20	0	0	0	216	22	31	83	74	4
(ii) <i>RIVER VALLEY SSSIs</i>										
England	25	1	13	4	0	19	100	13	20	0
Wales	0	0	0	3	0	13	48	7	0	0
Scotland	0	0	0	0	31	3	105	75	9	0
(iii) <i>RIVERS "ADDING INTEREST" TO SSSIs</i>										
England	65	14	16	12	2	9	55	7	28	10
Wales	0	0	0	4	0	2	19	18	25	0
Scotland	0	0	0	0	14	0	19	18	41	20
(iv) <i>RIVERS IN SSSIs WHERE INTEREST UNKNOWN/INCIDENTAL</i>										
England	43	15	7	28	0	19	134	50	181	83
Wales	1	1	0	15	0	11	33	32	131	91
Scotland	0	0	0	0	19	5	51	70	497	444

*NB: The data in this table are subject to further minor adjustments.

The overall length of river SSSIs notified to date amounts to almost 1000 km. However, of this nearly 600 km are accounted for by the rivers Wye and Tweed - both SSSIs under the 1949 Act, but not yet renotified under the 1981 Act and therefore not given the additional protection afforded by that legislation. Excluding Scotland the overall length of river SSSIs is 526 km, which is less than 2% of the 35,825 km of "main river" in England and Wales (i.e. rivers for which the NRA has direct responsibility for flood defence).

There is a huge length of river in the "unknown/incidental" category, particularly for upland oligotrophic Group D sites (Fig. 1), many of which are located in large terrestrial SSSIs in the Scottish Highlands. This points to the need for identifying and selecting the best examples of these rivers for inclusion in the SSSI series.

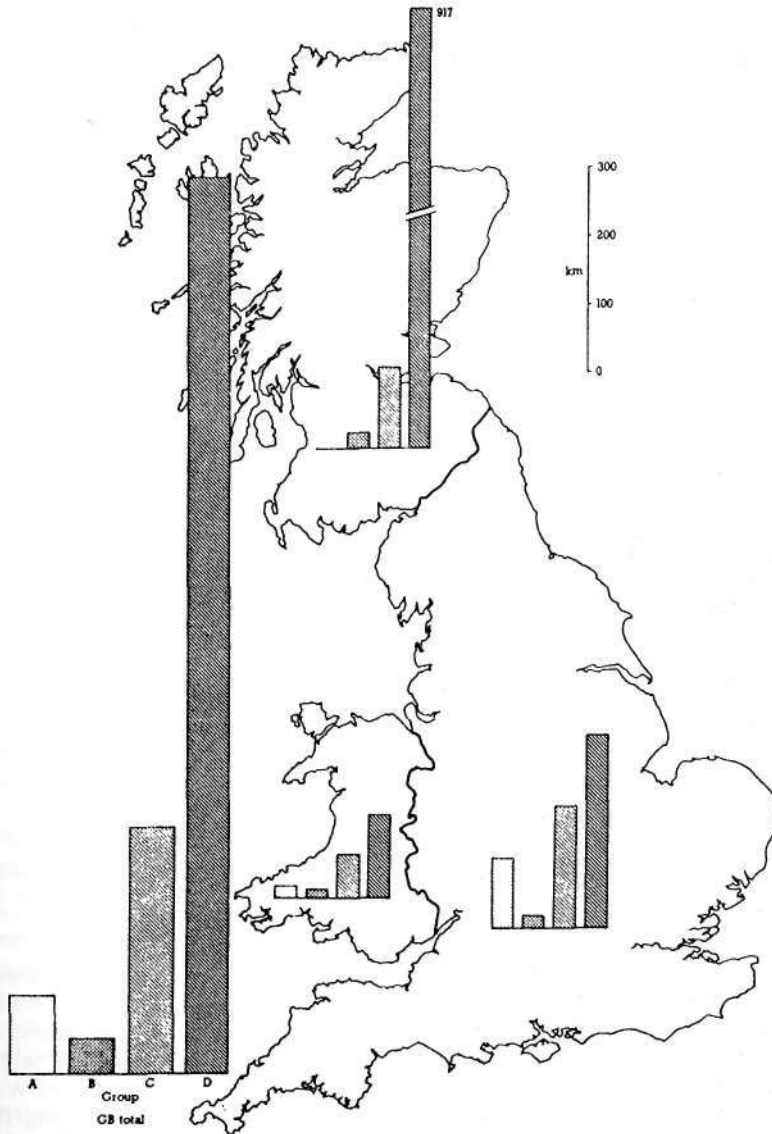


FIG 1. Lengths (km) of rivers within SSSIs where riverine interest (classified into Groups A-D) is unknown or "incidental" (category (d), see the text). Results are shown separately for England, Wales and Scotland. The total lengths of rivers for Great Britain are shown to the left of the figure.

Surveys undertaken by the NCC have now identified further rivers of SSSI quality; the eventual coverage of the river SSSI system, therefore, is likely to be rather different from that at present.

Practical experience of River SSSIs - can they aid river conservation?

Progress on river SSSI notification has lagged behind that of other habitat types. The reasons for this are both practical and conceptual.

To start with all owners and occupiers have to be identified. There must be adequate survey data, both for aquatic habitats and for adjacent areas so that lateral boundaries can be drawn in the right place. For a long river this can be time (and money) consuming. In 1986, 86 km of the River Derwent in Yorkshire were notified as an SSSI. This involved survey, boundary determinations and consultations with approximately 200 owners and occupiers, a task taking one man-year and costing roughly £15,000. There may also be added complications caused by the uniquely linear nature of a river SSSI. For example, rivers such as the Tweed or the Wye may form a geographical boundary or flow through more than one country, thus coming under the jurisdiction of several different statutory bodies.

The second main problem revolves around the effectiveness of SSSI notification as a control mechanism. It might, of course, be desirable if whole catchments could be notified. Even a "whole river" SSSI will rarely constitute more than the main channel and several tributaries, and "sectional" SSSIs may not necessarily be high up in the catchment. It would be foolish to deny that activities elsewhere in the catchment area may have a major effect on what happens to a particular stretch of river, but there are obviously many practical and political reasons why entire catchment notification is not a viable proposition.

Apart from the NCC's statutory duty under the Wildlife and Countryside Act to notify owners and occupiers of land (and water) considered to be of SSSI quality, there are five main benefits to be derived from river notification.

(1) SSSI notification places a duty upon planning authorities to consult the NCC over schemes affecting SSSIs. For river sites, these might include road or bridge construction, the construction of sewage works or pumping stations, and changing the use of premises to allow water sports. There are also additional benefits in notification connected with the recent Environmental Impact Assessment legislation following the European Communities Directive 85/337/EEC.

(2) Under the Water Act [Section 9 (3) (a)], bodies such as the National Rivers Authority are required to consult the NCC before carrying out or

authorising an operation, but only if this is likely to damage an SSSI. This would include operations such as abstraction, effluent discharge and structural modifications to the channel - all activities with the potential to affect biological communities adversely. The value of the SSSI label is further emphasised by Yorkshire NRA's abstraction strategy in which SSSIs are allocated maximum points in an arbitrary scoring system used to set river abstraction levels (Drake & Sherriff 1987).

(3) The present river classification in England and Wales, in which rivers are graded 1 A, 1 B, 2, 3, 4 in a sequence of deteriorating chemical water quality, is soon to be modified. The Government has given a commitment that the new statutory water quality objectives will include nature conservation, and these will be applied to rivers which the NCC is prepared to notify as SSSIs.

(4) Although chemical water quality is an important factor determining the presence and abundance of many aquatic species, other features of their environment, such as flow regimes and physical habitat structure, may be equally important. Activities by owners and occupiers on river banks and in river channels (e.g. cutting of bankside vegetation, dredging river channels) may therefore directly influence flora and fauna. SSSI status provides a means for regulating such activities.

(5) The SSSI status of a river helps to highlight its special interest. This opens the way for dialogue on activities occurring within the catchment but outside the SSSI boundary, where persuasion is an important element in damage limitation.

Case study - The River Blythe SSSI

The River Blythe in the West Midlands is one of the few rivers which the NCC has notified recently as an SSSI. The river flows through an area of undeveloped land between Birmingham and Coventry and joins the River Tame near Coleshill. Although the river has been diverted in some places to accommodate rail and road construction it follows a natural course for much of its length. It also retains a wide range of attractive structural features, such as shallow runs, deep pools, gravel riffles, open shallow margins for reeds, small cliffs and winding meanders.

The River Blythe was surveyed by Holmes (1983) and found to be one of the best examples of a Type II lowland clay river, with plant communities typically richer than those found in other similar rivers. Submerged vegetation includes species such as *Myriophyllum spicatum* L. (Spiked water-milfoil), *Sagittaria sagittifolia* L. (Arrow-head) and six species of *Potamogeton*, e.g. *Potamogeton crispus* L. (Curled pondweed)

and *Potamogeton perfoliatus* L. (Perfoliate pondweed). The shallow banks of many parts make it an important river for reeds and encroaching amphibious plants, while the low-lying adjacent land contains many wetland plants - common species such as *Apium nodiflorum* (L.) Lag. (Fool's water-cress) and *Mentha aquatica* L. (Water mint) together with less common species such as *Rorippa islandica* (Oeder) Borbas (Marsh yellow-cress).

The Blythe has a diverse invertebrate fauna, particularly rich in molluscs, caddisflies and dragonflies, good fish stocks including native brown trout, and varied bird life.

The notification of the River Blythe as an SSSI commenced in April 1988 and was completed in December 1989. The estimated size of the task and the costs involved are shown in Table 4.

Table 4. An approximate estimate of the exercise (in terms of size, time and money) of notifying the River Blythe as an SSSI.

Length of river notified	39 km
Area of SSSI (including adjacent semi-natural habitats)	102.2 ha
Numbers of owners and occupiers	136
Identification of owners/occupiers and pre-notification consultations	120 days
Survey of adjacent semi-natural habitats	20 days
Notification exercise (including document preparation)	28 days
Post-notification case-work	0.5-1.0 day wk ⁻¹
Cost of notification (staff salaries and overheads)	£11,625

The Blythe catchment is coming under increasing pressure from industrial and commercial development. In fact, at the time of writing the NCC is discussing various proposed construction schemes with developers in order to find suitable ways of preventing possible damage to the river. Local landowners with trout fishing interests, and the Severn Trent NRA, have welcomed SSSI notification as a helpful contribution to the maintenance of water quality.

The River Blythe SSSI is a good example of the value of notification, and also highlights the need for the participation of riparian owners and occupiers in protecting the entire river corridor.

Conclusions

Catchment planning must be placed high on the agenda if nature conservation objectives for rivers in Britain are to be achieved. However, in the absence of such an approach a pragmatic, stop-gap alternative is needed to ensure that at least the corridor (including riparian strips and floodplain habitats) is adequately protected (Petersen et al. 1987; Boon in press). The SSSI system can help although it is not the complete answer to a complex problem.

With relatively few semi-natural rivers remaining in Britain the emphasis in river conservation turns towards positive watercourse management and, where appropriate, river restoration. If this is to be based, as it should be, on good ecological science then there are several areas in fundamental scientific knowledge which will need further attention. Detailed habitat requirements of many species important for conservation are inadequately understood. The study of the resilience of rivers to man-made disturbance requires greater application to river management. For example, how much abstraction, low-level organic pollution, nutrient enrichment, fish stock management, flow regulation, recreation pressure, sediment input or vegetation removal can a river stand without deleterious effects to native animal and plant communities?

The success of the SSSI system in conserving rivers ultimately depends upon more than scientific knowledge or even its application by well-meaning managers and conservationists. It requires broad consensus, and concerted efforts by scientists, policy makers, industrialists, farmers, landowners, planners, water regulators, and, of course, the general public.

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