

# *Meanders*

*Newsletter of the SIL Working Group on the  
Conservation and Management of Running Waters*

*No. 13, July 2006*

*Editor: Professor Philip J. Boon, Scottish Natural Heritage, Edinburgh, United Kingdom*

## A Note from the Editor

In these days of information overload, perhaps the last thing you want is another newsletter. However, there is no compulsion for Working Group members to read it, and the view generally expressed at our meetings at each SIL Congress is that most people feel that the newsletter still fulfils a useful role. Those of you who have been associated with the Working Group in recent years will know that we have published occasional issues of *Meanders* since the Group was first formed at the Munich meeting in 1989. Seventeen years later we are still in business, and I am grateful to those who have sent articles for this latest issue. Now, of course, we have our own pages on the SIL web-site, and this has made distribution of the newsletter far easier. In case you have not yet looked at what is there, some of the information has been reproduced at the end of this newsletter.

Yesterday the third volume of the SIL proceedings landed with its usual heavy thud in my in-tray – a rare influx of paper in these days when almost every communication seems to arrive electronically. It reminded me that the next SIL Congress is not that far away – scheduled for 12-18 August 2007 in Montreal, Canada. It has been customary for the Working Group on the Conservation and Management of Running Waters to meet during the Congress, to discuss business items and to have a short technical session on a relevant topic. It has also become standard practice for those members arranging that session to write up a short paper for publication in the Proceedings. The last four meetings have produced the following:

Campbell, I. C., **Boon**, P. J., Madsen, B. L. and Cummins, K. W. 1998. 'Objectives and approaches in lotic and riparian restoration projects'. *Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie*, **26**, 1295-1302.

Boulton, A. J., **Boon**, P. J., Muhar, S. and Gislason, G. M. 2000. Making river conservation work: integrating science, legislative policy, and public attitudes. *Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie*, **27**, 661-668.

**Boon**, P. J., Gislason, G. M., Lake, P. S., Ellis, B. K., Frank, C. and Boulton, A. J. 2002. Competition for water: international case studies of river management and conflict resolution. *Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie*, **28**, 1581-1587.

Madsen, B. L., **Boon**, P. J., Lake, P. S., Bunn, S. E., Dahm, C. N., Langford T. E. and Zalewski, M. (in press) Ecological principles and stream restoration. *Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie*.

I see no reason for us to cease this practice, so I would like to invite you to send me any suggestions for next year's meeting, and in particular the scientific or technical topic that you would like the Group to discuss. You should include a title for the session, and a brief description of the sort of content that might be included. If you know of SIL colleagues who might be interested in making a short presentation, please pass on their details to me as well. Remember that these Working Group meetings are evening sessions, so there is limited time available for talks and discussion. Of course, if there is sufficient interest, we might consider arranging a rather longer workshop, but this requires far more organization – and volunteers to do that are often in short supply.

Please send me your ideas and suggestions by 30<sup>th</sup> September 2006. I will compile another issue of the newsletter next spring, and this will contain further information on the next meeting of the Working Group.

Phil Boon

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### **Project ‘Forelle 2010’ - Stream Restoration**

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In Hamburg, Germany, the project ‘Forelle 2010’ (Trout 2010) enables engaged citizens to participate in stream restoration. Starting a bit like a joke about the programmes ‘Salmon 2000’ in the late 1990s, (if you want to have salmon, you not only have to enhance the migration route within the watercourses, but have to restore the vast stretches of former spawning and nursery grounds . . .), we tried to restore the characteristic salmonid region in urban Wandse Beck with a lot of adopt-a-brook groups. And this project has been successful. Self-reproducing brown trout and stone loach as well as increasing numbers of typical caddis-flies (for example) show the success of this project in the middle of an urban metropolitan area. If you want to read more, go to <http://www.forelle.hamburg.de/> where you will find not only texts in German, but also flags (links) which provide information in English, French, Spanish, Russian and Swedish.

### **The Houting Project - The Second Largest Nature Restoration Project in Denmark**

*Hans Ole Hansen, Danish Forest and Nature Agency, Denmark*

In Europe numerous species of plants and animals have disappeared over the centuries. In addition there are a large number of species that are now rare or endangered.

The salmonid fish called the houting *Coregonus oxyrhynchus* definitely belongs amongst the rarest of species - estimates say there are only about 7,000 individuals remaining. Once it was common and widespread throughout the entire Wadden Sea region - from the Netherlands in the south to Denmark in the north. Today, it only lives in the Danish sector of the Wadden Sea area, and natural reproduction only occurs in the watercourses of south-west Denmark. It has completely disappeared from Germany and the Netherlands (Figure 1).



Figure 1. Previous (light blue) and current (dark blue) distribution of the houting.

The presence even of small obstacles in rivers is one of the main impediments to successful reproduction, as the houting is unable to pass weirs and fish ladders. Furthermore, juvenile houting require large areas of reed beds or flooded meadows, where they forage for several months prior to migration to the sea – a habitat that considerably declined in numbers during the last century. Previous restocking attempts in Denmark were unsuccessful because they were not followed up by habitat restoration.

To save this fish species from complete extinction the ‘Houting Project’ was initiated in 2005. The project is the second largest river restoration project carried out in Denmark. As the survival of the houting is a matter of considerable international interest the EU Life fund has granted 8 million euros of a total project budget of 13.4 million euros.

### The houting

The houting *Coregonus oxyrhynchus* is a salmonid closely related to the common whitefish *Coregonus lavaretus*. The houting, however, grows longer and heavier than the whitefish, and can tolerate waters with higher concentrations of salt. The houting lives and matures in the high saline Wadden Sea, whereas the whitefish mainly stays in freshwater lakes or fjords with low salinity. The most striking visual difference between a whitefish and a houting is the pointed “snout” of the latter (Figure 2).



Figure 2. Adult female houting.

In early winter the houting ascends the larger watercourses to spawn. Only those streams which allow totally free passage can be used for spawning as even small falls and dams effectively block the passage of the houting to the spawning grounds - and it will not use fish ladders. The only form of fish passage which the houting can certainly clear are low gradient riffles with relatively high flows.

The houting spawns where the stream bed is about 4-6 metres wide, with a good current, a firm bed and evergreen aquatic plants. The spawning period only lasts for 2-3 weeks around November to December. The adhesive eggs are spawned freely into the water where they attach themselves to aquatic plants, stones or gravel. A single female houting has 20,000-30,000 eggs per kg body weight, whereas, by comparison, a sea trout has 2,000-3,000. The adult houting may return to spawn in the streams several times during its 10 year lifespan.

The eggs hatch in February–March. At that stage the approximately 1-cm-long fry cannot survive salinity levels as found in the Wadden Sea. As the newly hatched fry cannot swim against the water current, its survival depends crucially on being carried into areas with static water, such as flooded meadows, smaller lakes, large river bends and similar areas which constitute the natural rearing grounds. The fry reaches a length of 3-4 cm after about 2 months in these areas. Its physiology changes so it can withstand the move from fresh water to salt water and the fry reach the Wadden Sea in April to May.

### **Houting Project objectives**

The most important causes of the decline of the houting are found in the reproductive stage of the life-cycle. Obstacles blocking access to spawning grounds, siltation of spawning grounds, heavy-handed stream maintenance, canalization and drainage have all brought the houting near to extinction. However, today we know the conditions needed for the houting once again to become a common fish in the Wadden Sea. This is what the Houting project will achieve.

The overall project objective is to restore and maintain favourable conservation status for the houting in four Danish river systems. Weirs and dams in the four river systems will be removed and riffles or meanders constructed in order to facilitate upstream migration. Two hydroelectric power plants and a number of fish farms will be decommissioned. River sections will be re-meandered and restored with gravel and stone, creating new spawning grounds, and a combination of changes to hydrology and construction works will create new flooded nursery areas for fry adjacent to the river.

Furthermore the houting project will have a profound positive effect on all other components of the river ecosystems. Many other rare species in these rivers will benefit considerably from the project initiatives – species such as salmon, sea and river lamprey, otter, white stork, freshwater pearl mussel and many more. Many of these are on the Danish “red list” of species in acute danger, and on the EU list of species requiring special protection.

The project is supported by the EU Life Fund and implemented by the Danish Forest and Nature Agency and the counties of Ribe and Southern Jutland in broad cooperation with a number of stakeholders including local authorities, land and fish-farm owners, regional angling societies, and owners of hydrological installations.

### **Expected results of the Houting Project:**

- Access to an additional 120 km of river habitats by removing 13 man-made obstacles in four river systems.
- 470 ha of new nursery areas.
- 21 km of heavily modified stretches of watercourse re-meandered into 28 km of naturally meandering river with good ecological status.
- Mortality in fish farms of drifting fry from 75 km of spawning habitat will be eliminated
- Supportive breeding with hatchery-reared houting will secure the total gene pool and viable populations
- A video about the project with a focus on the conservation of houting.

### **Literature and internet pages**

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The Houting Project homepage: [www.houting.dk](http://www.houting.dk) (English), [www.snaebel.dk](http://www.snaebel.dk) (Danish)

### **Ochre - a Danish Stream Problem We Can Deal With**

*Bent Lauge Madsen, (Danish Agency of Forest and Nature, retired), Denmark*

Ochre poses an environmental problem in many watercourses in western and southern parts of the Danish peninsula of Jutland. The red ochre makes the water turbid in streams and brooks. It covers the bed and smothers the plants and, more seriously, it starts with acidic water and invisible and toxic iron that washes out into the watercourses. Neither fish nor macroinvertebrates can live in such water. The problem is particularly great in those areas where there is insufficient limestone in the soil to neutralize acidic water following the oxidation of pyrite. They are areas which were not glaciated during the last ice age. The pyrite is oxidized when the water table is lowered after reclamation of meadows and bogs. In Ribe County alone, half of the watercourses that should naturally contain a rich fish and macroinvertebrate fauna are affected by ochre. Of these, half are so polluted by iron and ochre that neither fish nor macroinvertebrates can live there. The situation is not much different in Ringkjøbing County and in the west-bound watercourses in Sønderjylland County.

There are two different ways of combating ochre pollution. We can prevent it, or we can deal with the consequences. As with disease, it can be cured, or it can be kept under control with drugs that treat the symptoms, but do not eliminate the cause.

The most effective cure to combat ochre pollution is to prevent oxidation of the pyrite. It needs to be sealed inside the soil again so that the oxygen cannot reach it. In practice this is done by raising the water table, e.g. by re-meandering the regulated stream, so that the pyrite-rich meadows become waterlogged again. Additional measures can be taken to eliminate drains and ditches so that the water flows out into the watercourse more slowly. This can be combined advantageously with cessation or limitation of weed clearance in the

stream. This has proved a realistic solution in the case of areas that are of little value for cultivation. However, it can be expensive or perhaps unrealistic if it encompasses large areas of cultivated land. The price of arable land is prohibitive.

Another widely used way to combat ochre pollution is to remove the iron by treating the water in an ochre pond. This is the cheapest solution in the short term, but one that rarely solves all the problems. The process is long term, the pond has to be looked after, and it has to be emptied when it becomes full of ochre, usually at 5-year intervals. The results are rapid, however, and the method gives considerable environmental benefit in return for the investment. In order that the dissolved iron can be oxidized the pond needs to contain many aquatic plants. These have to be able to tolerate ochre, and they must have a large surface area, i.e. many leaves, such as water crowfoot. When the iron-rich water comes into contact with the aquatic plants, the iron is oxidized to ochre. Here, very close to the plants, oxygen is present, and the acidic water is neutralized. In addition, the plants filter the precipitated ochre out of the water so that it is not flushed out with the flow. Plants have to be present throughout the pond, and it is very important that the water is evenly distributed and does not take a shortcut through channels between the plants. The ochre pond can also be followed by a deeper outflow basin where ochre formed in the pond is deposited. Up to 95% of the dissolved iron can be precipitated and retained as ochre in the pond.

A third approach is the 'winter ponds'. Many meadows alongside watercourses are used for grazing in the summer months and hence have to be dry at that time. In the winter, however, when the cattle are not present, the meadow can help remove ochre if it is flooded by the stream. In such 'winter ponds' the dissolved iron is oxidized and the ochre is left deposited on the meadow when the winter pond disappears in the spring. Winter ponds are a step along the path to solving the ochre problem in nature's own way. The winter ponds turn the meadows back into the natural ochre treatment plants that they have been for thousands of years. A winter pond can be constructed by damming the stream, making it smaller or re-meandering it so that the water flows away more slowly. Winter ponds can be combined with ordinary ochre ponds in order to take the pressure off the latter in the winter time, when the ochre level in the water is highest.

More than 10 years practical experience and results in ochre abatement are published on <http://www.okker.dk/>. One of the publications: 'Ochre: A watercourse problem we can deal with', is published in English and German and both are available on the internet. Printed copies can also be obtained free from Bent Lauge Madsen, via the following e-mail address: [bent@laugemadsen.dk](mailto:bent@laugemadsen.dk)

# **Possible Climate Change Impacts on the Benthic Macroinvertebrate Fauna of Büyük Menderes River in the Mediterranean Climate Region of Turkey**

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Global climate change will cause significant alterations in temperature regimes and precipitation patterns over the next 100 years. The global surface climate is expected to warm by 1.4 to 5.8°C by 2100 owing to the emissions of greenhouse gases (Harrison *et al.*, 2003). But temperature increases will be higher in Mediterranean climate regions. Such changes in global climate will seriously affect inland freshwater ecosystems (lakes, running waters, wetlands) and coastal wetlands in these regions.

The Mediterranean climate type is characterized by dry summers and cool humid winters. The following regions have Mediterranean climate: Mediterranean itself (60% of the world's Mediterranean climate), and the other four regions from largest to smallest, respectively, are South and Western Australia (22%), California (10%), Chile (5%) and South Africa (3%).

In Europe, the Mediterranean climate was formed during the Pliocene. Climatic changes and the oscillation of ice masses in the Pleistocene then shaped the distribution of animals and plants in Mediterranean climate regions. The heat and drought during the dry summers, the frequent hard frost periods and characteristic winds are hazardous for aquatic ecosystems in Mediterranean climate regions. Storms, prolonged droughts, floods due to sudden heavy rain and high transpiration rates due to wind make the Mediterranean climate regions extremely sensitive to global climate change (Blondel and Aronson, 1999).

The biodiversity of Turkey is very rich like Spain and Italy in the Mediterranean Basin. Aquatic ecosystems are an important component of global biodiversity but they have been threatened by human activities besides climate change. In Turkey, two factors are important in defining its present rich biodiversity and the endemism of aquatic organisms and habitats. First, its geographic structure is complex with mountains eroded by river systems causing isolation of aquatic habitats. Second, Turkey provided refuge areas during glacial periods; the faunal elements from the north migrated to the south and settled in refuges. Turkey offered two refugia, one in West Anatolia and the other in East Anatolia. During the postglacial period many of the 'immigrant' species reoccupied the northern areas but some of them had adapted to higher temperatures and did not resettle in the north. Many species that originated from this time constitute important elements of Turkish fauna. The speciation of the isolated populations of northern immigrants in these refuges diversified the species composition in the Mediterranean climate region (Kazancı *et al.*, 1995).

There is increasingly clear evidence of climate change impacts on the aquatic ecosystems of Turkey, especially in the Mediterranean climate region. Türkes *et al.* (2002) have considered the strong warming trends in spring and summer and annual minimum air temperatures in Mediterranean climate regions in Turkey. Climate change will have become a major threat especially in running water ecosystems by the year 2100 (Poff *et al.*, 1997). The noticeable decrease in the annual mean precipitation was observed mostly in

western and southern Turkey, as well as along the coasts of the Black Sea (Partal and Kahya in press). According to Kahya and Kalayci (2004) the flow of running waters located in western Turkey has significantly decreasing trends. Therefore lower flows can cause increases in water temperature and decreases in dissolved oxygen in the Büyük Menderes River system.

Increases in water temperature and flow regime as a result of climate change will affect ecological processes, the geographic distribution of aquatic species, extinction of species and loss of biodiversity. Climate change will alter hydrologic characteristics and water quality of running waters and will affect species composition and ecosystem functions. Floods will change the retention time of organic matter (Mulholland *et al.*, 1997). These events will reduce food availability for detritivorous macroinvertebrates and alter benthic macroinvertebrate composition. The seasonal shifts are likely to have significant impacts on benthic communities in river ecosystems. By way of an example, the possible climate change impacts on the benthic macroinvertebrate composition of the Büyük Menderes River (Figure 3) are discussed.

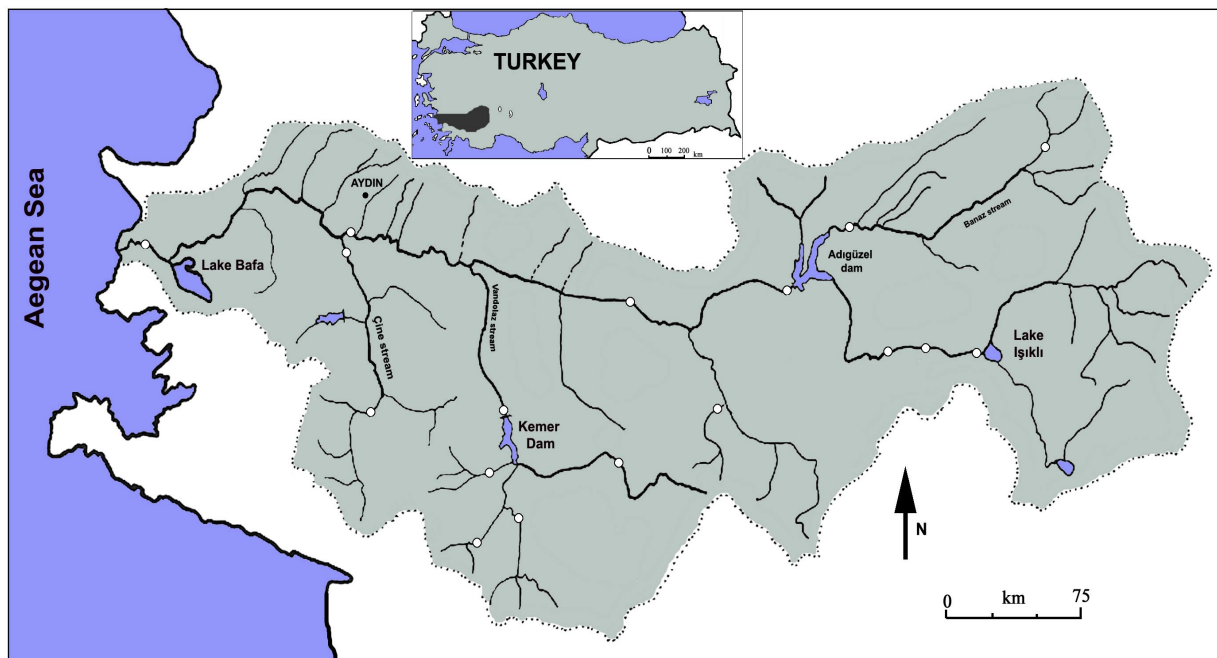


Figure 3. Map of Büyük Menderes River, south-west Turkey

The Büyük Menderes River is an important river system which includes wetland areas of the eastern Mediterranean region such as Lake Isikli, Lake Bafa, and the delta of the Büyük Menderes River. It is also a very significant river basin from a zoogeographical point of view. It was a tributary of the Aegeopotamos River which originated from the Sarmatian Sea in the Pleistocene. Aquatic taxa passed between Asia and Europe by this river and the fauna of the river now contains some extinct species of Palearctic fauna.

The Büyük Menderes River rises as springs in the limestone formations near Dinar and flows west for about 560 km, draining 24,000 km<sup>2</sup> of south-west Turkey before joining the Aegean Sea at the Büyük Menderes Delta, 115 km south of Izmir. The physicochemical characteristics, fauna, flora and problems of Bafa Lake and Delta region were outlined in Kazanci *et al.* (1999).

The river is well known for the many meanders along its course. The main tributary streams are Çine, Dipsiz, Banaz, Çürüksu, and Ak. Many of the small tributaries are dry in summer.

The delta extends approximately 16 km seawards and the Delta region is an important bird area. At the western part of the basin the maximum monthly precipitation range is 79-132.3 mm, whereas in the drier eastern regions the range is 14-80.2 mm. The annual average precipitation decreases from 999 mm in the west to 350.4 mm in the east, with an annual average of 635 mm. The average annual total evaporation is 2,122 mm. It appears that there has been a decrease in precipitation due to the increase in temperature in the basin (meteorological data from the Ministry of Environment).

The distribution of benthic macroinvertebrates in the Mediterranean region and their relationship with environmental variables are not well known in Turkey (Kazancı and Dügel 2000; Kazancı *et al.*, 2003, Dügel and Kazancı, 2004). The first detailed limno-ecological survey presenting physico-chemical characteristics, benthic macroinvertebrate fauna and relationships between physico-chemical variables and macroinvertebrates in the Büyük Menderes River was by prepared by Dügel and Kazancı (2004) using multivariate analysis. The benthic macroinvertebrate assemblages broadly reflect environmental conditions and are used as indicators of environmental degradation or restoration (Rosenberg and Resh, 1993).

The effects of climate change on community structure of benthic macroinvertebrate taxa are summarized below according to Dügel and Kazancı (2004):

Two hundred and twenty five species of benthic macroinvertebrates were identified in the river system, and the distribution of species was influenced significantly by environmental variables. Variables affecting species distribution, according to CCA, in order of importance, were: nitrite, nitrate, chloride, orthophosphate, electrical conductivity, dissolved oxygen, ammonium, total alkalinity, altitude, temperature, drainage area, flow velocity and stream order (Dügel and Kazancı, 2004).

The following taxa prefer low temperature, high dissolved oxygen and high current velocity:

Taeniopterygidae, Nemouridae, Leuctridae (Plecoptera); Oligoneuriidae, Heptageniidae, Ephemerellidae (Ephemeroptera); Aeshnidae, Gomphidae (Odonata); Rhyacophilidae, Leptoceridae and some species of Hydropsychidae (Trichoptera); Gerridae, Notonectidae (Hemiptera); Elmidae (Coleoptera); Pyraustidae (Lepidoptera); Tipulidae, Athericidae (Diptera). According to CCA results these do not tolerate climate change effects in running water ecosystems, i.e. high temperature, low dissolved oxygen and low water velocity.

The following taxa can tolerate high temperature, low dissolved oxygen and low current velocity:

Valvatidae, Bithyniidae, Planorbidae (Gastropoda); Coenagrionidae (Odonata); Unionidae, Sphaeriidae (Lamellibranchiata); Dytiscidae (Coleoptera); Lumbricidae, Tubificidae, Naididae (Oligochaeta); Glossiphoniidae (Hirudinea); Platycnemididae, Calopterygidae (Odonata); Sciomyzidae, Muscidae, Chironomidae (Diptera). These can tolerate high temperature and climate change effects on the Büyük Menderes River ecosystem (Dügel and Kazancı, 2004).

Benthic macroinvertebrate communities present different assemblages along the Büyük Menderes River related to the existence of slight, moderate or heavy organic pollution. The Büyük Menderes River Basin is an important wetland area for biological richness in the Eastern Mediterranean Region. In spite of its importance this river receives high inputs of organic and industrial wastes. The increasing temperature, reduced dissolved oxygen and lower flows brought about by climate change will also affect water quality negatively.

In conclusion, the rivers in the Mediterranean climate region are in urgent need of protection and restoration.

### **Acknowledgement**

This research was part of ‘Modelling for Climate Change Effects in the Gediz and Büyük Menderes River Basins’, part of the UNDP-GEF Project: Enabling Activities for the Preparation of Turkey’s Initial National Communication to the UNFCCC.

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## **Working Group Page on the SIL Web-site**

The SIL Working Group on the Conservation and Management of Running Waters now has a designated page on the SIL web-site. The following text is an extract from this web page which can be found at: <http://www.limnology.org/workgroups/conservation.html>

### **Background**

Rivers are used by human societies for a wide variety of purposes: for irrigation, drinking water supply, fish production, power generation, waste disposal, and a range of recreational pursuits. Unfortunately, use and abuse often go hand in hand, and the natural processes of rivers that form and maintain aquatic habitats and their associated species are frequently disrupted.

For example, streams draining agricultural catchments have frequently been deepened and straightened to remove water more efficiently. This results in faster flow of water from the land and allows farmers to plough closer to the stream channel. However, it also minimizes the biological value of the stream, reduces its self-cleaning ability, and eliminates stream-side vegetation which provides shade, habitat, and wetland areas important for nutrient removal and retention. Tackling problems such as this may require fundamental changes in land-use patterns, regulatory mechanisms, and agricultural practices, and in the way that society views and values streams.

Limnologists have a vital role to play in providing technical guidance to those who have responsibility for catchment planning and watercourse management. The SIL Working Group on the Conservation and Management of Running Waters was formed in 1989 so that limnologists in SIL could share information relevant to practical river management, and pass this on in a form that decision-makers can use.

## **Aims of the Working Group**

The group is chaired by Professor Phil Boon, Principal Freshwater Adviser, Scottish Natural Heritage, Edinburgh, UK.

The overall aim of the group is to increase communication between limnologists working on the conservation and management of running waters, and to address the following:

1. To promote river basins as fundamental units in conservation and management.
2. To encourage integrated management of river corridors - river channels, riparian zones and floodplains - and to recognise the essential links between each part.
3. To promote river restoration and rehabilitation projects as ways of benefiting aquatic habitats and human communities.
4. To explore new methods for the conservation and management of running waters.
5. To exchange information on ways of assessing the conservation value of running waters.
6. To ensure that the wide range of geographical perspectives on river conservation (e.g. differences in approach between first- and third-world economies) are adequately addressed in Working Group discussions.
7. To find ways of making modern stream management practices available more widely to society, such as through the production of practical handbooks and conservation guidelines.
8. To hold regular meetings of the Working Group at the triennial SIL Congresses, and to encourage other workshops and events on an ad hoc basis.

## **Joining the Working Group**

Are you already a member? If so, but your contact details have changed since you first joined, please send us the correct version. If you are not a member of the Working Group and would like to join, send us your name, postal and e-mail addresses, and contact telephone and fax numbers, and we will add you to our membership list. Information should be sent to:

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