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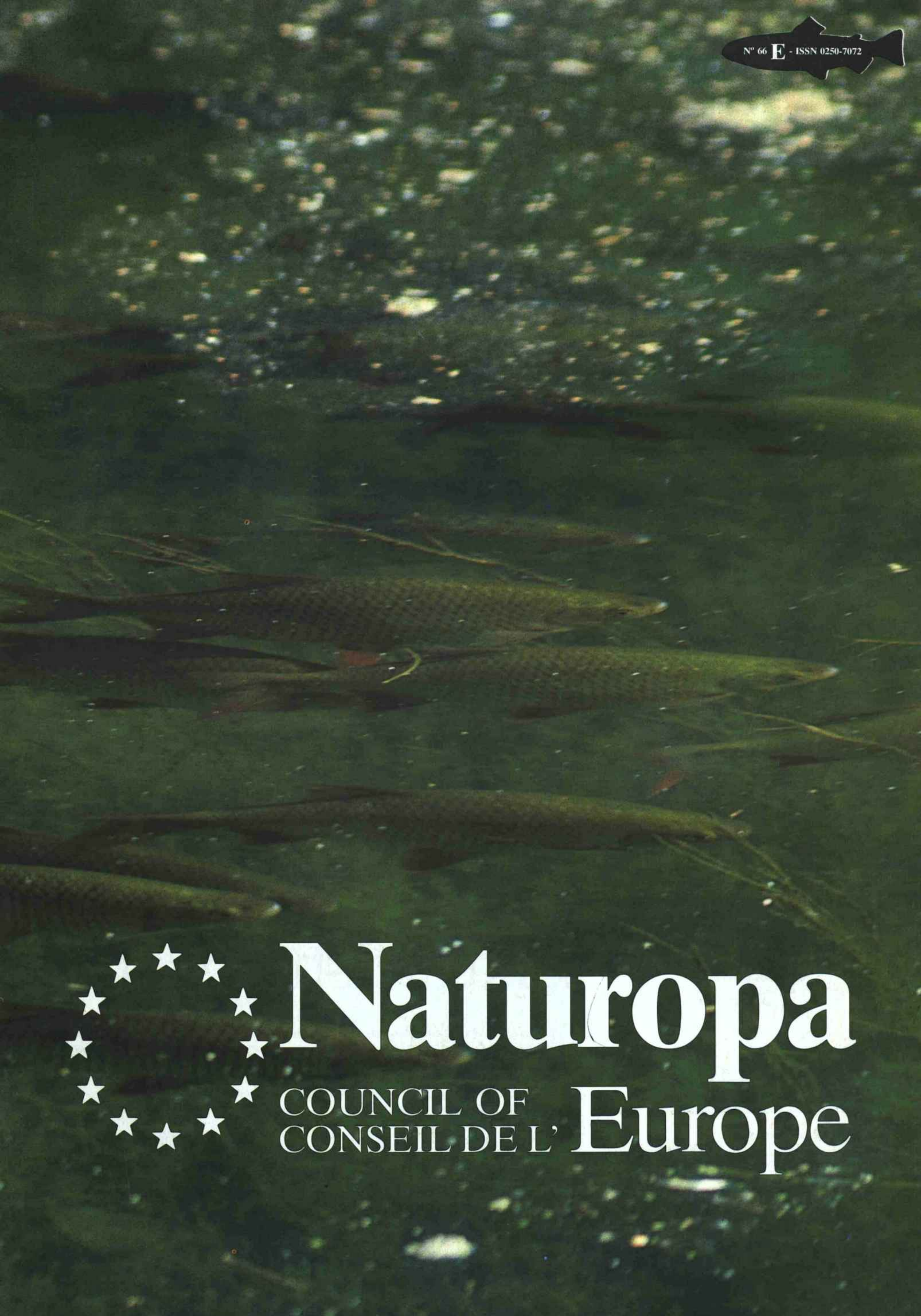

Naturopa

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Like a fish in water

An old professional fisherman in my native country, where there are large numbers of canals, rivers, streams and lakes, told me 30 years ago that "the water was diseased". Even then, he showed me blind, deformed, mycosis-infected fish. The water, which used to be drinkable, clear and refreshing, had become oily and almost viscous.

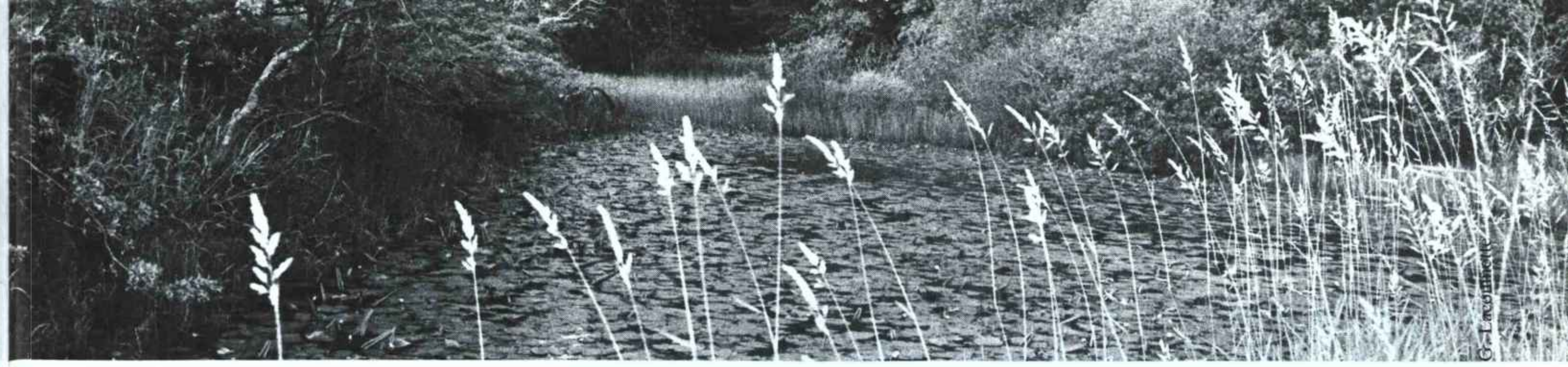
The Council of Europe's Centre Naturopa, following the example set by its friends in Switzerland, has launched a campaign to promote better knowledge and – let us hope – better protection and management of freshwater fish and also, quite naturally, the places they frequent at different stages in their life cycle. These sites are threatened or disappearing because of reclamation, drainage or cultivation, and the quality of the water has worsened alarmingly.

Through this campaign, as in all its messages, the Centre appeals to each and everyone who shares the same concern: to help put things right and re-create the beauty and diversity of nature. Practical examples can be found in the following pages or with the Centre's National Agencies. ■

H.H.H.

Cover: A. Balestreri

Pages 16–17:
Fishing with square dipping-net on the Danube
Aquarelle by Hannelore Nenning, Nussdorf (Austria)



Editorial

This year freshwater fish will attract our special attention and in many European countries special campaigns are being organised to protect freshwater fish.

There is a diversified fish fauna in our European waters. Because of the long isolation there are even endemic species. In the Nordic countries it is "only" 8,000–12,000 years since the last glaciation. Therefore no species have been able to live there longer than that. Still there are some very interesting Ice Age relics found nowhere else. A good example of these is a freshwater salmon (Salmo salar m. sebago) which is found only in the Saimaa lake system in south-eastern Finland. It never gets out of the Lake Saimaa. Although the fish stocks of many lakes in Europe are well known, there may still be possibilities of finding new species in the Council of Europe member countries.

Fish have been of great interest to the general public. All small boys, I am sure, just love to go fishing on a lovely summer day, at least here in Finland, and I think that boys are the same all over the world. Trout fishing is a kind of art and those interested in it are ready to invest almost anything in equipment and also especially to get to trout waters. In Finland every third man and woman is an amateur fisherman and everybody under 16 years of age has the right to fish almost everywhere. They certainly take advantage of this right.

Still, it is generally agreed that fish have too often been neglected in water management. My experience comes from Finland, but I think the same is also true for other European countries.

Salmon and trout migrate between the Baltic Sea and the rivers running to it. Early this century there were dozens of rivers where trout migrated to spawn and where the young lived their first period of life. Now there are very few trout rivers left. Most of these rivers lost their trout populations after being dammed during the last decades. Farming and the dispersed settlement have caused eutrophication in those rivers still left undammed. Therefore the fish stocks are not doing well. In certain cases overfishing is also a part of the picture.

Asp (Aspius aspius) is found in Finland close to its northern border. It is a species of running waters and is now an endangered species in Finland because rivers have been polluted and developed.

Over-eutrophication and pollution of lakes and rivers are common reasons why many populations have lost their habitat. In the case of species having only a limited distribution area this can be fatal for the species. Widely distributed populations can easily survive in some corners of their range. Until quite recently genetically isolated populations have been neglected when fish have been stocked from one water system to another. Certain white fish populations

Council of Europe

(Coregonus sp.) have undergone a different evolution in neighbouring lakes leading to, for example, different spawning times or habitats or feeding habits. Old fishermen knew this, but fishing instructors have too often told people to stock a lake with a population of different origin causing damage. Each river may have a trout population of its own and should not be stocked with one of another origin, as this special population is specific to its old river, its chemical, biological and physical conditions. Worst of all, some exotic species have been introduced to our European waters causing disaster to the European species.

I was once listening to a robin singing his heart out in early December next to a church in Cambridge in England. It is easy to understand why Englishmen love this bird. Perhaps it is not so easy to fall in love with a fish species, except for the trout. Still there are many reasons to have a look under the surface. This separate world displays a rich life with many species. The quality of water is not only important for man, there are many others who are dependent on it. I declare that our knowledge of fish is still insufficient. The distribution of the species of economic value is often well known since old times. Knowledge of other species is still poor. Therefore we in Finland have decided to begin work on an atlas of freshwater fish. The help of amateurs is badly needed in this project.

There are some hopes that the future of some endangered fish species will be better. It has been shown that the asp can be cultivated and it has now been restocked in some of its old habitats. In 1987 many rivers were protected thanks to the Finnish Wild River Act.

The management of water resources should not be guided only on the basis of human consumption. Freshwater fish and their wellbeing could give us good guidelines for the management of freshwater habitats for the wellbeing of all dependent of those, including Homo sapiens.

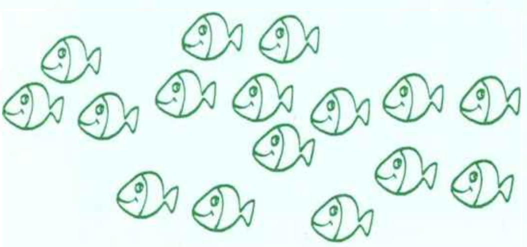
As Chairman of the Council of Europe's Steering Committee for the Conservation and Management of the Environment and Natural Habitats, I therefore wholeheartedly support the activities of the Centre Naturopa. In this particular case, and in this issue of a reborn Naturopa, dedicated to the Centre's campaign for better protection and management of Europe's freshwater fish species, I wish the Centre well. ■

A. Haapanen
Chairman of the Steering Committee for the Conservation and Management of the Environment and Natural Habitats (CDPE) of the Council of Europe

Friess-Irrmann

Indicator of the environment

S. Dumont



Stanislav Lusk

Water bodies occupy an important and, according to many, even exceptional position in the landscape. Due to the functions performed in linkage with other landscape components, the aquatic ecosystem is the most stressed by the negative consequences of human society's existence. Knowledge of the status and degree of disturbance of aquatic ecosystems is the prerequisite for their optimal management, protection and renewal. In recent times, the classical analytical methods and means for the identification and quantification of changes taking place in aquatic ecosystems have been increasingly supplemented by approaches utilising the bioindicator abilities of living organisms. Most freshwater bodies are inhabited by fishes, which can signal changes occurring not only at the present time, but also within longer periods of time.

Man's relations to fish is generally very positive and thus the public opinion responds emphatically to detriments done to fishes (and thus also waters). Mass mortality of fishes is the dramatic signal indicating that the aquatic environment is in a state of emergency, that something is happening there that may be dangerous for living creatures and thus even for man. Such a situation, which most people know or can imagine, is an extreme case in which fish act as "bioindicators" of the critical state of the aquatic environment. The capability of fish to respond sensitively to changes in the complex aquatic environment, to deviations from normal values of its various parameters, to signal even short-time anomalies or to register long-lasting but very small doses of pollution predestines fish to the bioindicative function. In this way fish can replace analyses and monitoring which otherwise would have to be made by means of complex and expensive apparatus. While this is technically possible, it is quite unreal considering the necessary extent of such operations.

Fish possess the required properties for the function of bioindicators of their living environment. Throughout their life they are bound to the aquatic environment, which they cannot abandon even temporarily. The bioindicative manifestations and signals of fishes can be studied and evaluated at the community, population or individual, and even sub-individual levels. Fish enable us to obtain objective analytical and synthetical data on changes and conditions in the aquatic environment, as discussed in greater detail below.

At fish community level

Fish communities (species diversity, quantitative parameters) present a synthesising bioindicator of the condition of aquatic environments as a whole. The species composition of a fish community is primarily determined by the quality of water, especially temperature, oxygen regimen, and also by the hydrological and morphological character of the aquatic environment. On the other hand, it is the biological properties and ecological requirements of the particular fish species that also participate in the formation of natural fish communities in given conditions. Mutual interaction of abiotic and biotic factors determines the actual species composition of the ichthyofauna in a stream, lake, pool or reservoir.

At the time when the aquatic environment was minimally affected by man's activities, the species composition of fish communities was in agreement with the determining properties of the natural aquatic environments.

The species composition of the fish community inhabiting a water body is the result of a complex of biotic and abiotic factors, including its fishery management. Changes in species diversity are a marked signal indicating that a significant and, as a rule, prolonged change in one or more factors has taken place in the aquatic ecosystem. The changes indicated by the vanishing or occurrence of certain fish species may be due to changed water quality or to hydrological or morphological changes in the stream. Since the fish communities operate as a complex and aggregative bioindicator, its signalisation must be deciphered by subsequent analyses of ichthyological, managemental, hydrological, chemical and other data in order to determine the cause or causes of the changes in the fish stock in the aquatic habitat.

The disappearance of fish species sensitive to impairment of water quality due to organic pollution (and ensuing deterioration of the oxygen regimen) is the most common phenomenon observed below numerous point sources of sewage pollution.

Similarly, a change in water temperature regimen is followed by the disappearance of species requiring high contents of dissolved oxygen (when the water temperature increases) or, on the contrary, the original cyprinid character of the fish stock may change to salmonid (when the water temperature decreases, eg below dams).

Fish communities are very good indicators of changes in their aquatic environment resulting from activities denoted as "adaptations or regulation" of streams. The impact of canalisation of minor stream beds upon their fish fauna is immediate as a rule. That this is a long-standing problem can be illustrated by quoting the description of the detrimental effect of adaptations of minor streams in the upper part of the Elbe River drainage area in the territory of Bohemia (Fric 1872): "... the banks were tidied, rocks were removed from the stream, deep scours were filled – the complete disapperarance of trout from this whole landscape was the consequence of this undertaking".

While in major streams the fish communities respond to changes in their aquatic environment more slowly than in the small ones, their bioindicative signals are also marked and unequivocal.

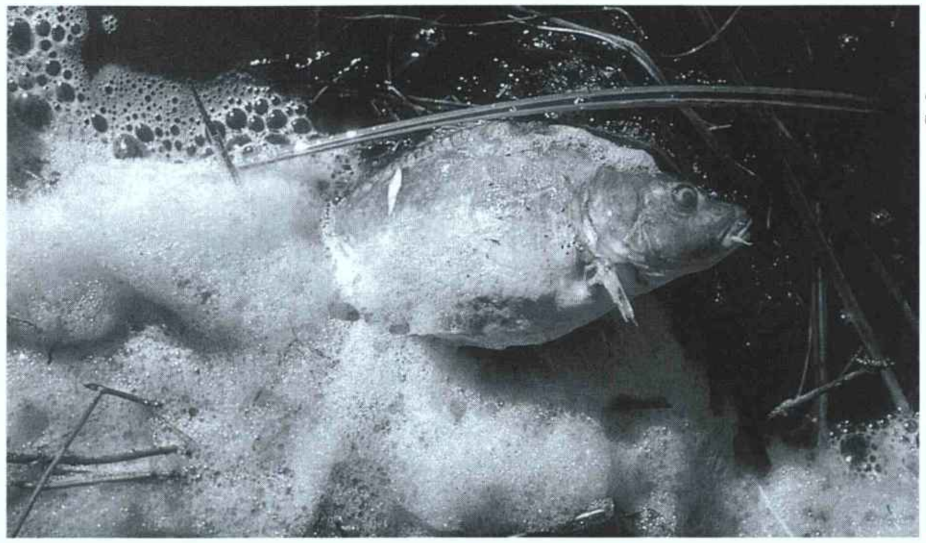
Adaptations of large streams result in both gradual disappearance of certain species and changes in the mutual ratio of the individual species. The numbers of ecologically particular but not resilient species, which are mostly important economically, are depleted and replaced by less particular and more adaptable ones. Such processes have taken place in most major European rivers whose beds have been canalised (the Danube, Rhine, Main, Elbe and other rivers).

Fishes are usually associated with the bioindication (signalisation or identification) of negative processes or negative stresses occurring in aquatic ecosystems. It is less often realised that fishes can also serve as very significant indicators of positive processes taking place in the aquatic environment. Bioindication of positive changes in water quality is exemplified by the classical and well-known case of the Thames, to which river the original fish species requiring good water quality have returned. Conditions for the occurrence of fishes are improving even in the Rhine, where sea trout begin to reappear.

Fish stock appears as a very appropriate bioindicator of revitalisation or renaturalisation adaptations of streams. Such adaptations are based on projects whose goal is to restore the original natural and ecological function and value of minor streams recently devastated by inappropriate regulations. Such endeavours, becoming a reality in Switzerland, Germany or Austria, will certainly be brought into use in the renewal of the natural character and production of minor streams devastated by senseless regulation even in other countries including Czechoslovakia. The first experiments in this line have yielded very stimulating results. Partial adaptations of minor stream beds have considerably increased the abundance and biomass of salmonids in the first place. In cases of stream renaturalisation, fish stocks appear to be suitable bioindicators of the success of ecotechnical measures taken.

At population level

Changes of population parameters of a species in an aquatic habitat are also of considerable bioindicative importance. Changes at the population level are largely the consequence of action of various influences (deviation from normal), long-term as to duration and usually not critical as to intensity in relation to fishes. Changes in numbers and biomass within a population are primarily caused by the deterioration of quality of the aquatic environment, affecting the chemical and physical properties (above all, eutrophication), hydrological characteristics as well as morphology of the river bed. The decrease in numbers of a population is primarily the result of decreased success of natural reproduction and also of increased mortality of the particular age groups in the population. As long as such changes at the population level are not slowed down and stopped (in other words, as long as the intensity of a causative factor increases), the gradual decrease in the numbers of a population may in an extreme case result in the vanishing of the species



G. Lacoumette

Often an alarm signal…

from the given habitat. The process described above is accompanied by a decrease in the average age in the population due to increased mortality and decrease in maximum longevity. Such manifestations at population level can be distinctly observed especially in populations of fish species attaining medium and high individual age.

Anomalies of the age structure of a fish population (eg missing representation of a year class) are usually due to the failure of reproduction or to catastrophic destruction of its results. This phenomemon is particularly dangerous for the maintenance of short-lived species. For example, spates after rainstorms, bearing large amounts of suspended clay particles, coming in periods of incubation, usually destroy all eggs of grayling (*Thymallus thymallus*). Similar destruction can affect even other species which spawn at one time and in limited areas, eg the nase (*Chondrostoma nasus*).

At individual or sub-individual level

At the individual level, changes in the aquatic environment become apparent, first of all, in their various consequences for the biological processes of individual fishes. To give an example: growth intensity is slowed down in response to bad oxygen conditions, to lack of food due to impaired conditions for the food organisms, or to competition for food between indigenous and introduced species. Similarly, impaired general condition of individual fishes, including confirmed manifestations of damaged health, can be observed in highly polluted waters. Impaired reproduction capacity of an individual may be another consequence of unfavourable environmental conditions.

The explosive growth of chemicalisation of almost all man's activities has resulted in a number of negative consequences whose indication and quantification in the aquatic environment would be considerably more difficult without utilising fish as bioindicators. In the aquatic ecosystems, fish are at the top of the trophic chains, and this fact is another reason for using them as bioindicators. A very valuable property of the fish organism is its capability of accumulating pollutants (chemical components) from water, thus enabling detection of short-term marked pollution (as long as they do not kill them), or even long-lasting pollution of very low levels. Such pollutants include heavy metals, pesticides, PCB compounds, radionuclides and other substances whose accumulation in the fish organism enables their successful detection.

Bioindication at the level of organs, tissues, cells and even subcellular structures has gained importance in recent times when exacting and precise research methods are applied even to fish in the fields of physiology, chemistry, bio-chemistry and genetics. Knowledge obtained on the effects of the various pollutants on enzyme systems or individual enzymes makes it possible to detect and specify water pollutions that otherwise would evade our attention due to their short duration or sub-threshold levels. For example, increased activity of certain enzymes, especially transaminases, in the blood plasma indicates intoxication of the fish organism and, above all, affection of the liver tissue by heavy metals, pesticides or nitrogen compounds. Identification of the bioindicative manifestations at individual and sub-individual levels requires perfect equipment with apparatus, knowledge of special methods and high expert skill. At the same time, the identification of the causes and their connection with the response of the fish organism are sometimes considerably difficult.

A specific form of using fish as bioindicators, to which ethical objections can be raised to some extent, is presented by toxicity tests. Such tests appear necessary in determining general toxicity and its degree in chemical preparations for general use. Fish are also used as test organisms in biological analyses of water in emergency cases (pollution). In drinking water treatment plants, fish are used as bioindicator signals indicating satisfactory water quality. Similarly, fish can be used in sewage works to check the effectiveness of the purification processes.

In conclusion, it should be noted that the aim of this article is not to present a complete list of the bioindicative use of fish, but to point out their usefulness and the importance of their existence in aquatic ecosystems. ■

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River ecology

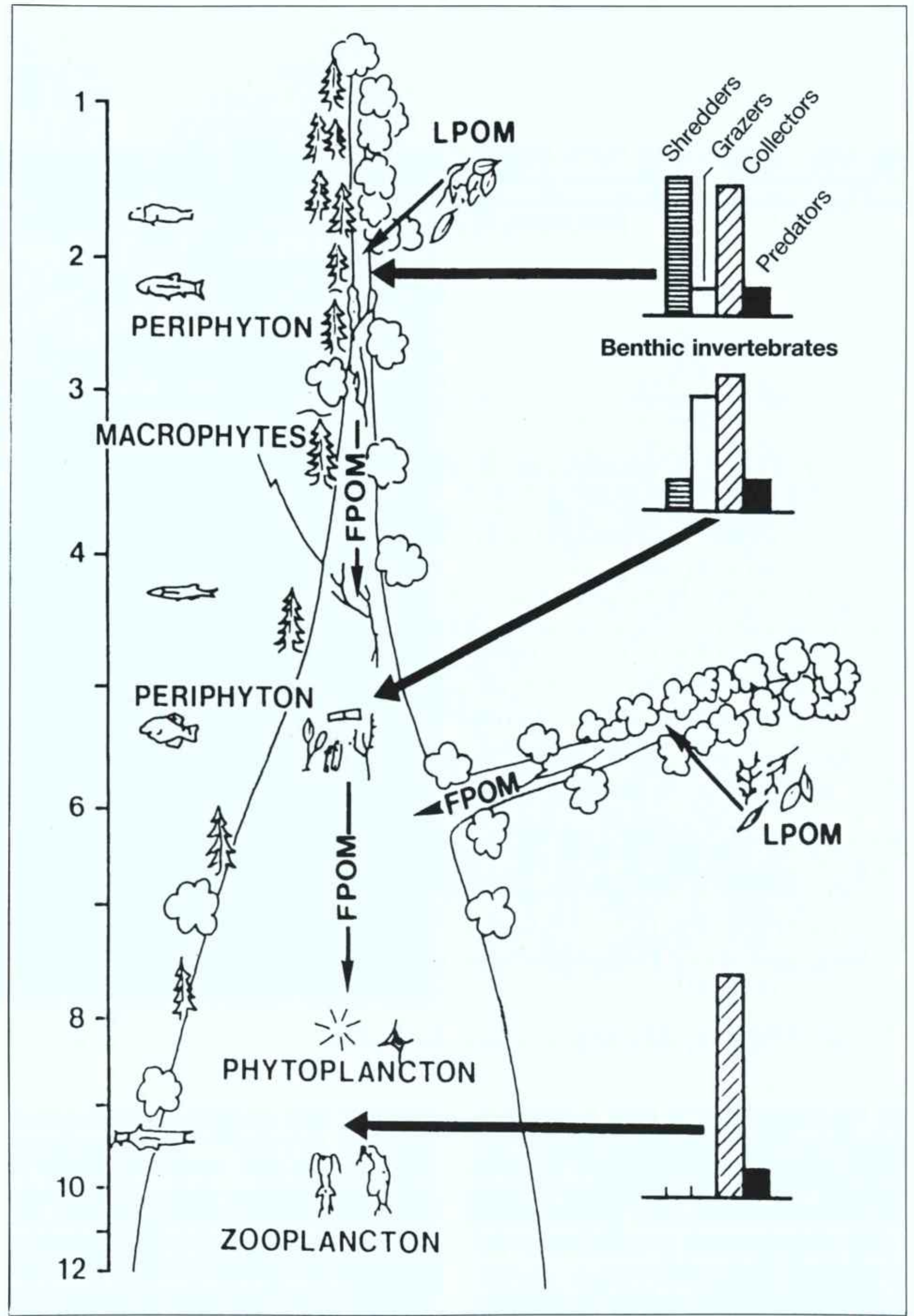
Gilles Pinay

From small streams to great rivers, many natural changes affect the running water environment. These changes in very visible properties such as flow rate and the width of secondary beds and flood plains exercise their effects from the source to the mouth on the physico-chemical and biological balance characterising hydrological networks. In many cases, harmful exploitation of water resources prevents our society nowadays from benefiting fully from the advantages of "healthy" watercourses. At present, we have to find answers to many questions concerning the operation and revitalisation of watercourses. For about 20 years now, much research has been conducted throughout the world on fluvial ecosystems. It has resulted in many publications and the development of a number of theories.

Fluvial continuum

This theory postulates that just as in line with physical characteristics, the ecological processes in watercourses change continuously from the source to the mouth. More precisely, processes in the lower reaches depend to a great degree on those which occur upstream. For example, throughout the watercourse organic material dissolved or in suspension is carried down by the water: the large organic particles from marginal woodlands upstream change gradually into fine particles downstream. The communities of living organisms adjust to these changes and succeed each other along the watercourse, tending to use available energy to the maximum. Groups of benthic invertebrates (living on the bottom or in sediment) start with shredders upstream, are replaced by grazers in the middle reaches and by collectors downstream. Similarly, fish communities change along the length of the watercourse in accordance with the classic pattern in Europe: from trout, to grayling, to barbel and to bream.

This organisation system is overlaid by a trophic scheme in which streams upstream are considered to be heterotrophic to the extent that the greater part of their food sources is provided by plant detritus from riverside trees while in the middle reaches the independent vegetation (periphyton and macrophytes) contribute significantly to the availability of nutrients. Finally, the lower reaches of the great rivers revert to heterotrophic conditions as the disturbed water lessens light penetration to the depths and hence hinders the growth of aquatic vegetation.



Biological communities adjust to physical changes along the watercourse. Riverside trees upstream provide large quantities of organic material in the form of plant detritus. But the lack of light due to these woodlands lessens the possibility of primary production.

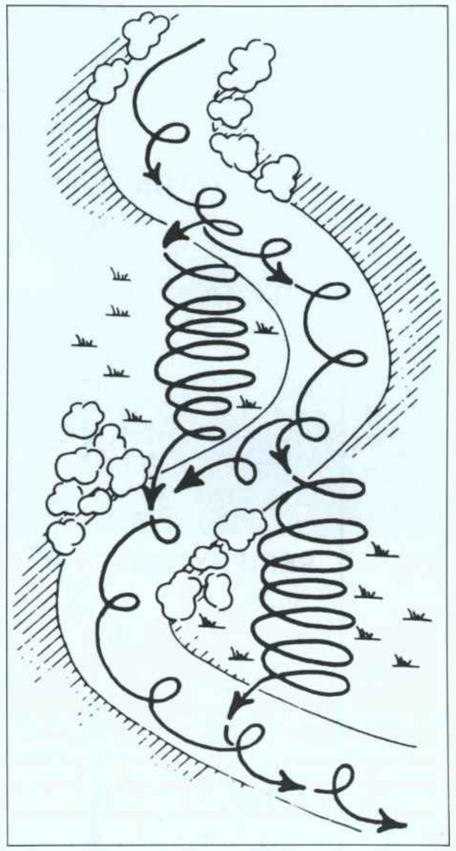
In the middle reaches, light penetrates more easily, facilitating the organic development of attached microalgae (periphyton) and tufts of rooted aquatic plants (macrophytes).

Further downstream, the turbidity of the water lessens light penetration thus leading to conditions similar to those upstream.

Large particles (LPOM) are dominant upstream while fine particles (FPOM) are more abundant downstream. Communities of living organisms adjust constantly to these changes. Fish communities change in accordance with the classic pattern in Europe: trout-grayling-barbel-bream.

Spiralling

This close dependence between the upper and lower reaches appears again in studying the recycling of nutrients in watercourses. Once organic matter is moving in the watercourse it suffers change in which benthic micro-organisms and macro-invertebrates participate very actively. As it flows downstream, organic matter present



The nutrients (carbon, nitrogen or phosphorous) follow a spiralling course in the river. They are in turn stocked, recycled and rejected downstream, in alternate organic and inorganic forms.

The floodable river margins constitute a holding system for nutrients along watercourses by increasing the retention of these elements. They increase the river's efficiency to produce living material.

in watercourses is, in turn, ingested, rejected, oxydised and ingested again by various groups of living organisms. A single nutrient element such as carbon, nitrogen or phosphorus is found in turn in mineral form or incorporated in living matter during its journey downstream.

This spiralling theory allows identification of the distances in which a complete cycle can be produced. The shorter this distance, the more frequently the same nutrient element can be used in a given fluvial sector and the more productive the sector will be. This concept allows estimation of the stability of any particular watercourse against, for example, excess nutrient matter.

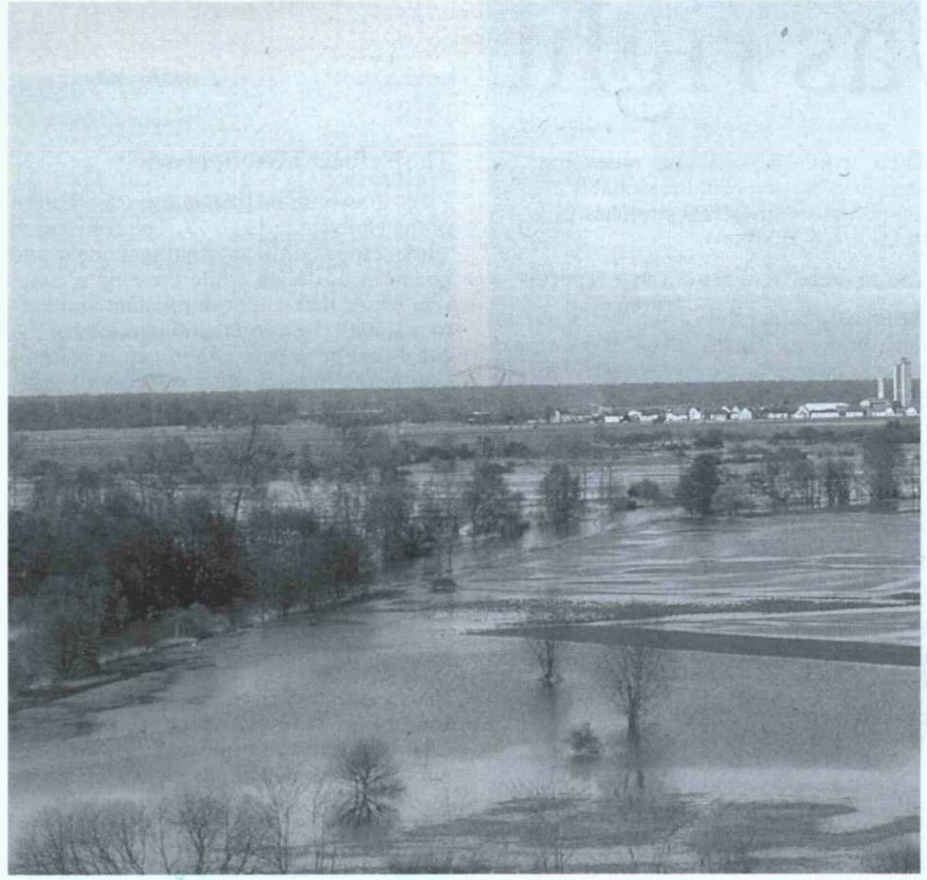
Fluvial ecotones

It is now well known that the land territory of rivers influences their ecological functioning as attested by the theories of fluvial continuum and spiralling, at least, for small watercourses. However, these two theories do not take sufficiently into account the floodable areas of large rivers. In fact, understanding of dynamic systems such as river valleys requires examination of rivers in their terrestrial context. For example, floodable river margins are an interface – known as an ecotone – prime importance between land and water ecosystems. In temperate Europe, these river margins consist naturally of willow, ash, alder, elm or oak trees according to flooding conditions. By their intermediate position, the riverbanks provide favoured transit areas between terrestrial and aquatic ecosystems which give them their own functional identity. It is now well known that alluvial forests constitute flood regulation areas by slowing down the current and allowing the banks to stabilise by reducing physical land erosion. Furthermore, riparian woods act both as a filter for diffuse nitrogeneous pollution from river basin drainage and a retention system for nutrients and carbon matter brought downstream in hydrological networks. Because of this, floodable river margins increase the productivity of river systems. For example, in large African rivers, a strong positive correlation has been found between fish harvests and the area of flood plain for a given sector of river. The nutrient elements accumulated in the dry season by vegetable and animal decomposition dissolve during the hours immediately after flooding begins and combine with the fluvial water elements to launch a veritable explosion of productivity enabling many species to feed, grow and reproduce before returning to the riverbed when the waters fall. This natural flood cycle is vital and any alteration in its intensity or frequency may change the characteristics and productivity of fish populations.

River and catchment basin

The theories of fluvial continuum, spiralling and their corollaries emphasise the close dependence of rivers on the hydrological network supplying them but also with their entire catchment basin since they are natural drains. Hence, any human activity in the fluvial corridor itself (dams, dykes, dredging, draining of floodable areas, deforestation of margins, specific pollution) and in the catchment basin (change of soil use, intensive agriculture) will have consequences for the functioning of the river.

Of course this global vision of the functioning of fluvial ecosystems raises serious problems of scale of perception when an attack is made specifically on the causes of dysfunction of a river and its consequences. To name only two, the Danube and the Rhine are good examples which give rise to political, legal and economic as well as environmental problems. Nevertheless, identification of the hierarchical structure of fluvial systems has provided the basis for a more pragmatic approach of problems to be solved in that it posits a study framework in both time and space. This theory implies



S. Cordier

Flooding permits the recycling of organic and inorganic matter. Riparian woods and meadows capture elements and purify the water which feeds the ground water.

that fluvial systems have organisation levels of defined size, one inside the other, like Russian dolls.

Each organisation level is the site for particular biological and physical processes functioning at a determined time and space level. Hence, in the micro-habitat occupying a few centimetres, the organic matter decomposition processes take place over a few days or weeks, while the erosion and sedimentation processes, for example, can be seen over parts of watercourses several kilometres long and take place annually or every few years. Furthermore, the biological and physical processes which occur at a given organisation level are controlled by the underlying organisation level. To take the example of the decomposition processes, they are controlled in particular by the type of riparian vegetation and the watercourse substratum, which are both controlled by the habitat.

The challenges

All these theories, although scientists are not unanimous on them, nevertheless provide a sound basis for understanding the functioning of lotic (that is, running water) ecosystems and their revitalisation. How can the knowledge acquired on the functioning of watercourses be used to restore fluvial ecosystems? We already know that river planning can be done only at global level. However, if managing catchment basins as a whole is the target, taking into account alluvial river areas is an important starting point for integrated management of river systems in that they control the interactions between the aquatic environment and the terrestrial environment. There are, nevertheless, many questions regarding the problems which arise.

These questions may be grouped into three great challenges which we must face:

1. The integration of river systems as functional units in the countryside is one of these challenges. In fact, it is urgent for us to try to understand how the landscape mosaic is organised and how it interacts with lotic ecosystems.

2. Another great question relates to the cumulative effects of human activity on river ecosystems. Although it is possible today to predict the direct consequences of, for example, a high phosphorous content, excessive temperatures, a slackening of flow or toxic effluents over a short period of time, we still do not know the reactions of systems as complex as lotic ecosystems to repeated disturbance or the synergetic effect of combined disturbance.

3. Finally, a third important challenge we must meet is that of revitalisation and restoration of damaged lotic ecosystems. What is a damaged ecosystem? What do we mean by restoration? What methods are used and how can we foresee their consequences?

It is now urgent to meet these challenges in order to revitalise watercourses, from small streams to large rivers. To do this, we must use as a basis the experience acquired on the functioning of river ecosystems. Revitalisation work already carried out on several European rivers plays an exemplary role as a catalyser for developing other projects in that it shows that it is not Utopian to hope for a better future for our watercourses. ■

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Nature was right

Christian Göldi

"Protection of rivers and streams cannot be confined to anti-pollution measures and biological or technical treatment of waste-water contaminated by human activity. Water protection should cover the entire water cycle. Modern civilisation with its advanced industries, intensive farming and our often irresponsible consumer society threaten water, and hence rivers and streams, on a global level.

A great effort has been made in the area of waste-water treatment. It is not sufficient, however, to concentrate on water quality. Rivers and streams are a biotope for many animals and plants. When they flow across land used for intensive farming they act as links for the increasingly marginalised areas that have remained unspoilt. Lakes, rivers and streams are also important features of our landscapes.

Along many stretches, human activity has destroyed the natural character of rivers and streams and turned them into gutters. We are not suggesting that our predecessors do not deserve credit for their flood control and clearance work. What we want today is recognition of the need for a new approach to our relationship with rivers and streams.

The redevelopment of several stretches of river in the canton of Zurich with the aim of bringing them closer to their natural state has led to significant ecological and aesthetic improvements. The present plan for the revitalisation of rivers and streams reflects a belief that water protection cannot be confined to producing clean water at the outlets from sewage plants and that one should not resign oneself to leaving rivers and streams that have been straightened, narrowed or turned into sewers in that unnatural state."

Extract from the forward to the revitalisation plan by Mr Eric Honegger, State Councillor and Head of the Public Works Department of the Canton of Zurich.

Context

In 1987, the Zurich cantonal executive instructed the Public Works Department to draw up a plan for the revitalisation of rivers and streams.

Planning was entrusted to 15 private-sector working parties, each including a civil or agricultural engineer, a landscape architect and a biologist.

Their work showed that redevelopment and revitalisation could reasonably be contemplated for over 600 stretches of water (total length 560 km).

The findings were set out in a report.

After careful scrutiny, the parliament of the canton of Zurich (Cantonal Council) approved the plan on 23 October 1989 and allocated the first funds: SF 18 million for the years 1989–93.

Technical principles

Revitalisation relies principally on the techniques of biological engineering.

Where the river or stream has a high gradient, it is advisable to consolidate its bed by controlling vertical erosion, eg by stabilising the bed with rock, creating artificial sills with rock or building dams with rock or timber. In the case of small streams, it is even conceivable to use roots for this purpose. As far as possible, the water should flow freely between the stabilising elements. If there is a risk of lateral erosion, the banks have to be reinforced. To preserve the diversity of the landscape, systematic use of the same stabilising elements is avoided, due regard being had to the risks, which vary from one instance to another.

Generally speaking, the techniques of biological engineering produce very good results.

The Nefbach in Neftenbach

Plans drawn up in 1966 led to canalisation of the Nefbach in 1972–73. The restoration work respected the original rectilinear and geometrical design while creating a coherent whole that was both resistant and easy to maintain. Because the dimensions of the canal had been very generous, its restoration to the natural state was easy to plan. The work was carried out section by section in 1983, 1986 and 1987.

The hard surface of the bed and banks was first removed by means of an excavator. As a result, the stream once again exhibits a wide variety of forms. The sub-soil laid bare by the excavation work is composed of gravel and sand, which, by fostering the development of numerous species, can help to bring the stream back to life.

Catchment area E = 30 km^2
Rate of flow Q = 57 m^3 per second
Cost of the restoration work: approximately SF 70 per metre.

The canton of Zurich has an area of 1,728 km^2 (built-up areas: 17%, farmland: 23%, meadows: 21%, woodland: 29%, lakes and rivers: 5%, miscellaneous: 5%). The canton's rivers and streams (from the Rhine to the smallest stream) probably exceed 3,500 km in length. (Annual rainfall: 800 – 1,600 mm).

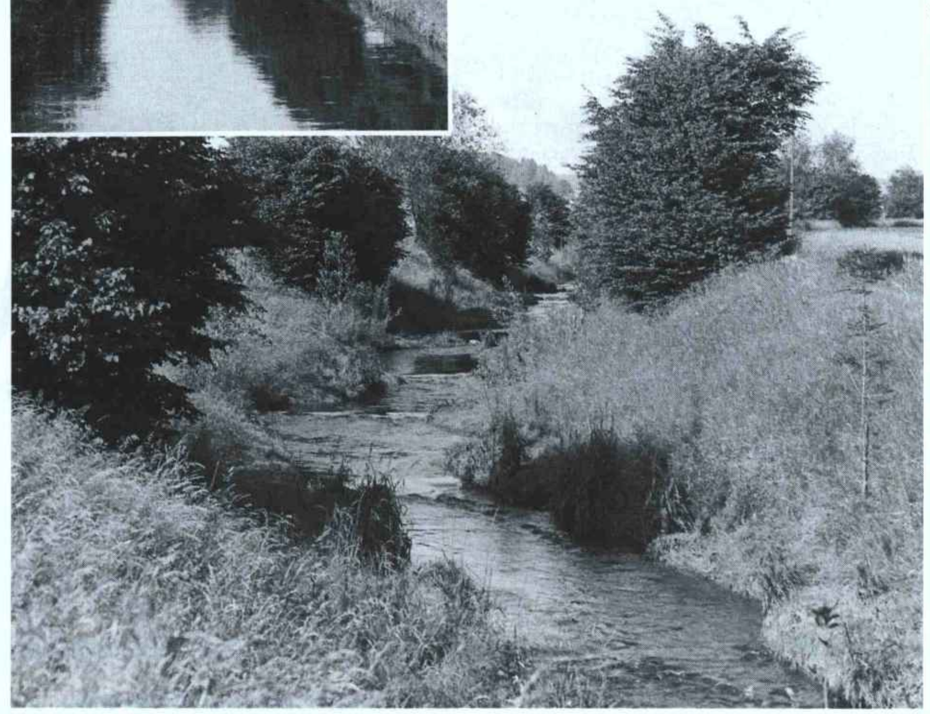
The Mülibach in Saland (municipality of Bauma) revitalised according to the principles of biological engineering.

(Stabilising elements: rock; bank reinforcement: fascines, individual plants, grass).

Catchment area E = 4.3 km^2
Maximum rate of flow (50-year period) Q50 = 19 m^3 per second
Cost of improvements (1980) SF 713 per metre (without purchase of land) SF 567 per metre (with purchase of land)

C. Göldi

C. Göldi



C. Göldi

Trends in the trout population of the Nefbach

Survey of 3 August 1987, afternoon Section:	straightened	revitalised
Area fished (m^2)	150	150
Trout aged 1 year	6	14
Trout aged 2 years	5	21
Trout aged 3 years and more	7	14
Total trout	18	49
Trout/100 m^2	12	33

The Reppisch in Birmensdorf

In 1914–15 and 1931, the Reppisch was converted into a geometrical drainage channel. The wide shallow channel afforded little shelter for trout, and the sparse vegetation was hardly likely to add to the beauty of the landscape.

The idea of restoring the Reppisch to a more natural state arose in connection with the construction of a public building: a number of people were in favour of incorporating it into the plans for the exterior of the building.

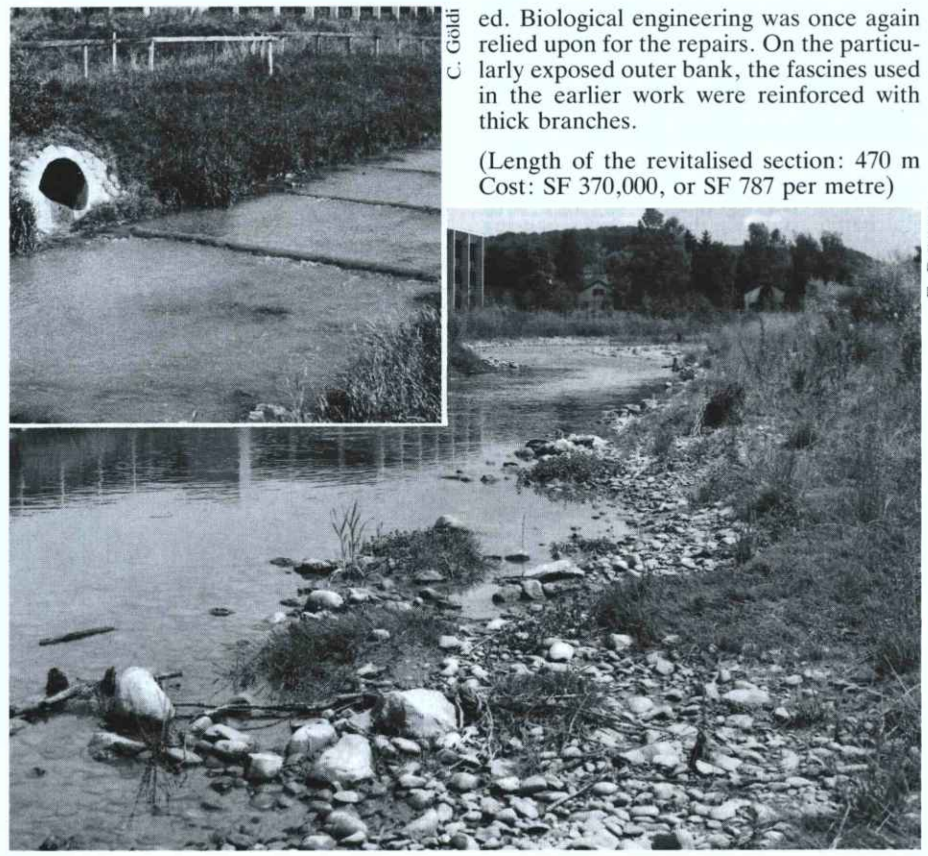
The widening of the channel made this project a solution that was close to nature, favourable to fish and aesthetically pleasing.

Technical data:

Catchment area: E = 46 km^2
Rate of flow: Q = 92 m^3/s

As far as possible, biological engineering techniques were relied upon to consolidate the banks. Fascines, groynes and geotextiles were used. The banks were restored by means of stakes and ligneous plants growing close to the water's edge. On two occasions, however, the stabilising elements were partially swept away by flood waters (Q = 30 m^3 per second and Q = 40 m^3 per second) before they had become firmly fixed. Biological engineering was once again relied upon for the repairs. On the particularly exposed outer bank, the fascines used in the earlier work were reinforced with thick branches.

(Length of the revitalised section: 470 m Cost: SF 370,000, or SF 787 per metre)



C. Göldi

E. Brügger

W. Casanova

E. Brügger

The Chämmeterbach in Dübendorf

The catchment area of the Chämmeterbach in Dübendorf is approximately 1 km, 45% of which consists of meadows, 2% woodland and 33% buildings. The highest rate of flow recorded over a period of 50 years is 5 m^3 per second. This can fall to 5 litres per second in dry weather.

Redevelopment and revitalisation of the straightened Chämmeterbach were contemplated in connection with a footpath project. The land needed for the footpath and the extensive improvements to the stream was placed at the municipality's disposal by a private landowner. This generous offer made it possible to restore a natural appearance to the stream along a 400 metre stretch.

The use of transverse sills to stabilise the bed was avoided. The bank nearest the street was protected from lateral erosion by plant cover removed from the natural bank of the stream by means of machines. The right bank was sown with a special mixture.

The planting of a number of tall trees among the bushes separated by areas of dry grassland made it possible to restore the transition between the built-up areas and the woodlands and between open and woodland biotopes.

The cost of revitalising the stream, not including the building of the path and a wooden bridge, was approximately SF 198,000, or SF 498 per metre of stream. Another SF 50,000, or SF 125 per metre of stream, was spent on the plant cover.

The Mülitobelbach in Ebmatingen

The Mülitobelbach was canalised over a distance of about 200 metres in 1945.

Because of the growing number of buildings, rainwater was no longer seeping into the ground, but flowing almost directly into the stream from the roofs, courtyards and streets. As a result, water levels rose sharply in flood periods.

As the capacity of the canalised section had become insufficient, the water sought an alternative route via the meadows, causing extensive damage in the industrial estate downstream.

The municipal council and the landowners gave their support to a plan for re-opening the stream.

The building of the new stream combined traditional techniques with those of biological engineering. Concrete and rock were used to create sills on the stream bed and dams. The major structures were linked together by stream sections whose banks had been stabilised by means of fascines of willow or other trees and bushes.

Because this method of improvement involved risks, allowance was made for the damage which might be caused by erosion. However, the vegetation grew magnificently and only a few instances of mild flooding have been recorded.

Catchment area:	$E = 0.79\ km^2$
Rate of flow:	$Q = 10\ m^3/s$
Mean gradient:	$J = 10\%$

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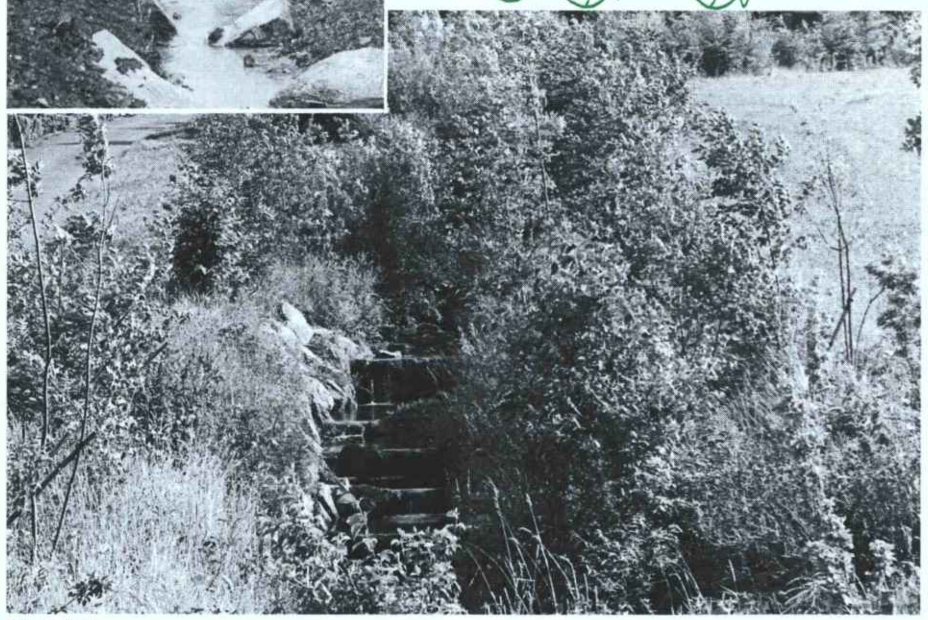

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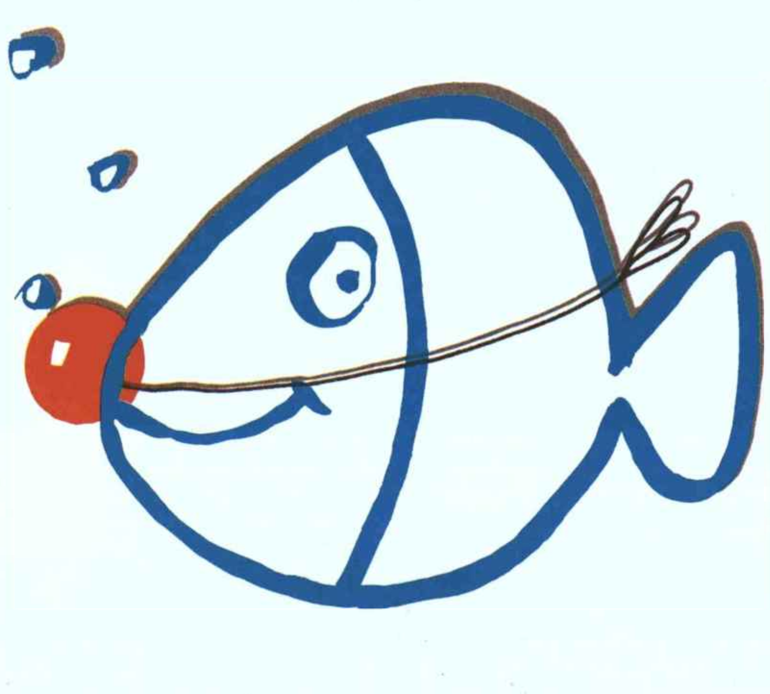
COMME UN POISSON DANS L'EAU



Conception: F. Allanic

The happy optimistic fish is the symbol of the Council of Europe's Centre Naturopa campaign for the protection of European freshwater fish and their habitats.

The Campaign: "Sell fish"

Ulrich Halder

The dire facts are well known: out of some 200 European freshwater fish species, about 51% have disappeared or are threatened with extinction. The causes of this rapid depletion are also generally well known, as indeed are the measures needed to remedy the situation. Yet action to protect fish and their biotopes is slow in coming – and understandably so, since any improvement depends on changes in present practices and, what is more, a considerable amount of expenditure. But, above all, an improvement goes hand in hand with public awareness of the need to protect fish stocks and, hence, a will to act. This is why it is so important to create among the general public an understanding of the problem and a readiness to take the necessary measures, for without such preparation and education even the best ideas and projects will remain a dead letter. Here I should like to explain how the Swiss League for the Protection of Nature (Ligue suisse pour la protection de la nature – LSPN), one of the great Swiss conservationist organisations which also acts as a National Agency for the Centre Naturopa, is trying to carry out this essential task of persuasion and education as part of the Council of Europe's "Like a Fish in Water" campaign.

The LSPN has adopted the Council of Europe's "freshwater fish" theme for its own 1990–91 campaign, combining it with that of "Rivers, a living environment", in order to demonstrate clearly that the preservation of a species is inconceivable without the protection of its biotope. For all the LSPN's campaigns, intensive use is made of the media and of publications and audio-visual material is produced in German and French for distribution to the general public through various channels, but more particularly to schools, thanks to close collaboration with the cantonal ministries of education. Numerous booklets, leaflets, teaching aids, wall charts and slides on fish and their natural habitats have been prepared in the form of a modular package which can be used in different combinations in a variety in educational and training situations.

However, an information campaign remains an abstract notion unless it is backed up by activities aimed at mobilising the various target groups. For that reason the LSPN also decided to carry out several educational projects as part of the campaign.

Everything depends on local communities

The 1991 slogan, "The local community rediscovers its rivers", is intended to encourage the authorities and other interested circles of the 3,000 municipalities of Switzerland to take an interest in the watercourses crossing their territories.

The aim is to stress the importance of watercourses that are in a near-natural state as well as the need to protect them on account of the wide variety of flora and fauna they contain, to promote the idea of restoring altered watercourses to their natural state and to propose the necessary means of support. The above-mentioned series of publications is supplemented by a guide explaining the various administrative formalities (varying from canton to canton) which have to be carried out in order to obtain the necessary authorisations and subsidies. A free telephone counselling service has also been set up: it answers dual enquiries and gives the particulars of persons to contact in order to visit watercourses already restored in an exemplary manner, as well as the names and addresses of agronomical engineers. This service is in great demand, and the first restoration schemes are under way.

Sale of "ducats"

For over 40 years now, the LSPN, in conjunction with the Swiss League of the National Heritage, has been organising a sale of chocolate "ducats" for the benefit of natural and cultural monuments under threat. In 1990, with the theme "Natural rivers", some 50,000 schoolchildren offered 850,000 of these titbits for sale in the streets. The proceeds were used to finance pilot projects for restoring watercourses to their natural state, as well as the general activities of the two organisations sponsoring the operation. Before each sale schoolchildren concerned are briefed by their teachers on the year's theme, with the help of special teaching material; their assistance is rewarded by a contribution to their class fund. In 1990 television advertising was used for the first time to back up the public information campaign.

"Nature ship" – A new approach to fish

This spring, the LSPN's "Nature ship", a specially equipped cruise boat has been plying the lakes and rivers of central Switzerland in order to promote the protection of water as a living environment and stress the role of watercourses as links between human communities. For example, watercourses link together the German-speaking and French-speaking region of Switzerland, which are jointly responsible for protecting them. The LSPN's "nature ship" makes stops at the main localities along the River Aar and around the Neuchâtel. At each port of call, it offers an on-board exhibition of aquaria together with information about indigenous fish and their biotopes, a series of one- day or half-day courses on subjects connected with water, an advisory service on water and fishing trips with professional anglers, as well as poetry readings and other cultural activities. This programme is aimed at individuals, representatives of administrative bodies, groups of school children and others. Every visitor to the "Nature ship" goes away with knowing what he or she can do to protect fish and the waters in which they live. At the end of the ship's cruise, the LSPN will continue the operation until the end of the year at its Champ-Pittet information centre on the shores of the Lake of Neuchâtel.

G. Lacoumette

We must educate today's generations – tomorrow's decision-makers.

It's fun learning by the riverside

Another activity of particular importance, in my view, is the "blue ribbon river" environmental education scheme. This pilot project, financed jointly by the LSPN and the Swiss WWF and the Ecological Education Centre of the canton of Zurich, provided 30 school classes with an opportunity to study the Töss, a small hydrographical system in the canton of Zurich, in the early summer of 1990. A similar scheme took place in French-speaking Switzerland in the autumn. The two operations were so successful that the LSPN intends to repeat them virtually unchanged in other Swiss regions in 1991, provided that the necessary resources are available.

The aim here is not to dispense advanced scientific knowledge, but rather to familiarise schoolchildren with an important but threatened ecosystem as part of an exercise which is not only educational but also recreational – though by no means frivolous, as demonstrated by the programme of the activities. A one-day course in the methodology of the exercise is provided for the teachers. In addition to the well-known technique of determining water quality by the means of bio-indicator species, a new method, called "landscape ecology" is used to evaluate "rivers, a living environment" in their entirety. All chemical analysis of water is deliberately eschewed.

As far as the practical work is concerned, the first stage is the rough classification of the river in question by means of standard survey forms, which involves describing the type of landscape through which the river runs and initially identifying the flora and larger animals it contains.

Afterwards, each class carries out a topographical survey of the 40 or so metres of river bank assigned to it, noting down alteration schemes it observes and making a cross-section diagram of the river, including its bed. The main thing is that the children should learn to recognise the differences between natural and altered stretches of the river bank and identify the various kinds of constructions which impede the movement of migratory fish species.

The next stage is to determine the quality of the water by means of certain small-animal species which serve as bio-indicators. The macrobiological method (developed by Lassleben) can easily be used by schoolchildren and provides reliable results. At least ten samples are taken of the substrate of each section of the river; then one specimen of each distinguishable species is collected for identification purposes. In addition to the number of species counted, the presence of "noble" species is of decisive importance in assessing water quality. "Noble" species include, for example, the larvae of a number of varieties of trichoptera, which are found only in slightly or moderately polluted waters. The total number of species present as well as whichever observable "noble" species is most sensitive to pollution are entered on a bio-indication form, and in this way the degree of water quality can simply be read off. By collating the results concerning all the stretches of the river and its affluents which have been studied (ie by using the work of all the classes taking part in the exercise) it is possible to obtain findings that are interesting results though not perhaps very surprising to specialists. For example, it can be seen that the water quality deteriorates markedly from the beginning to the end of the river and declines sharply after any discharge of sewage. However, it may also be observed that the water quality can improve again further downstream thanks to the river's self-purifying capacity, a fact that is also instructive to schoolchildren.

Not only do these elementary ecological findings have an educational value; the same is true of the teamwork conducted, the whole experience of living together outside school and the exchange of notes among the children concerned: the links and relationships thus formed are a good illustration of the concept of "Blue ribbon river". The exercise ends with a large gathering of the participants, during which they compare their observations, present them imaginatively in graphic form and use them to mount a joint exhibition which afterwards tours the localities of the catchment area as a means of encouraging further efforts for the preservation of threatened watercourses.

This kind of education is aimed at inculcating or modifying the values which guide an individual's behaviour. It needs a lot of time, and its results are not immediately visible. It will take several years, perhaps a change of generation, before it will be possible to judge the success of all the environmental education activities initiated by the LSPN as part of the Council of Europe campaign. The question is whether the threatened flora and fauna species can wait so long. Hence the importance of taking effective short-term measures to preserve, at least provisionally, the last relics of our natural heritage. For the long-term protection of our resources, a radical change in our attitude towards nature, along the lines of greater patience, will undoubtedly be necessary, a process that will itself require patience. Perhaps our next environmental education campaign should be centred on the theme of our relationship with time! ■

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– settlement of conflicts over use and determination of simple or multiple use;

– reconciliation of types of use with respect for nature.

Six sectors were defined: the wine road, the small businesses area, the wine-growing area, the area for recreation and sport, the nature protection area and the buffer zone.

The equipment to be installed, the proximity of the sensitive nature reserve and types of recreational and sports activity which were sometimes unsuitable for the site made it necessary to subdivide the area for recreation and sport. The area for intensive recreational and sports activities is intended for active leisure pursuits and sports activities and will be fitted with facilities for resting; the area for recreation and sport of medium intensity is reserved for fishermen, while the area for recreation and sport in the broad sense is reserved for quiet leisure activities. In the last two sectors, the infrastructure will largely be restricted to a road network.

With the nature reserve, the Grand Duchy of Luxembourg would like to make its contribution to the development, preservation and maintenance of habitats for aquatic birds. A maintenance and development plan for the reserve has already been drawn up based on the establishment of the largest possible central area, the adoption of measures to encourage the formation of biotopes and a publicity campaign. Because of the rather small area of the whole site, the central area should contain the whole of the reserve and should be directed surrounded by undisturbed buffer zones. The Luxembourg Government has already begun to acquire the land earmarked for the nature protection zone; it intends to buy the whole of the area involved. In the case of the ponds, which are already public property, the first stage of development should begin shortly. This will mainly involve measures affecting the banks, the purpose of which will be threefold:

– softening the "bath tub" shape of the ponds;

– creation of a stretch of water providing more extensive views, but without linking up the ponds. The diversity of the chemical composition of the water should not be altered; the different underground water levels rule out linkage between ponds;

– creation of a greater diversity of habitats, particularly of wetlands, which will dry out on a seasonal basis.

The higher ground between ponds will be partly levelled out, shallow inlets and pools will be formed and some steep banks will be turned into normal gently sloping banks.

Once the work has been completed, some land will be left fallow (land under rotation); on other land initial planting is planned (as well as the replanting of plants previously removed and preserved).

In view of the unique character of the pond region in Luxembourg and its central situation in a future "Three Borders Nature Park", a "Moselle house" style visitor and information centre is planned, which will serve not only the reserve but also the nature park.

In putting this idea into practice, the Grand Duchy of Luxembourg would like to emphasise its wish to establish a cross-border nature park, for which it was willing to provide considerable infrastructure facilities.

The visitor and information centre will be built on the edge of the nature reserve near the village of Wintrange. The external aspect of the building will reflect the local architectural style. It is planned to provide premises for a permanent exhibition on the zoological and natural features of the pond region and the nature park as well as for temporary exhibitions; there will also be lounges and workrooms, together with a library; outside it is planned to establish a small educational trail, which will lead to certain places at the edge of the nature reserve.

Risks and conflicts

A buffer zone will be required to reduce or mitigate the negative impact on the sensitive nature sectors. This means, first, the ponds and, secondly, the nature reserve. The buffer zone will therefore have two goals to attain:

– to mitigate as far as possible the negative impact on the composition of the water, particularly that deriving from neighbouring agricultural land which is worked intensively. The aim is to reduce the amount of nutrients introduced into the ponds. A contribution should also be made by establishing protective plantations to prevent the entry of such substances or of pesticides as well as catchment ditches to drain off surface water;

– the nature reserve, which is left as it is, should be sealed off. This objective will be mainly achieved through the area of ponds situated between the area of intensive recreation and sporting activities and the reserve. Fishing will still be allowed on the southern bank, but not from boats. This sector could also be provided with an observation platform equipped with a telescope and explanatory tables from which the reserve could be observed.

The main obstacle to the establishment of the nature reserve is still the unresolved conflict with the fishermen. This is because they fish in virtually all the ponds, even where the future reserve will be. The site's potential for the protection of biotopes and species, particularly aquatic birds, is certainly much greater than is the case at present. A nature reserve of 71 hectares cannot be used simultaneously for the protection of nature and for fishing, whether as a sport or otherwise.

The future?

The discussion of other uses for the Haff Reimech region began three decades ago with the extraction of gravel; the 1985 regulation and subsequent agreements have cleared the ground for an in-depth discussion in that a number of possible uses have been permanently ruled out, eg the construction of a nuclear power station, the building of motorways/industrial estates or the establishment of a national water sports centre. But even today the demands are multiple and conflicts exist. In the case of some of these demands, the ecological conditions are not favourable; other uses could not co-exist in the same area; however, in some cases, conflicts could at least be reduced by measures to develop and/or maintain the site. Other decisions must be taken now in consultation with those involved. Haff Reimech must be considered in the regional setting of Luxembourg's Moselle Valley in the light of the great beauty of the site and hence its importance in terms of tourism, its border situation, its importance for transport (particularly the navigable channels) and the heavy burden imposed on the region by intensive agriculture (wine-growing). The pond sector is, in its own way, unique in the Grand Duchy of Luxembourg and, from the point of view of nature protection, is among the most important sites in the country. It has the potential to become a man-made paradise and could accommodate many plant and animal species which, during recent decades, have generally been forced back into smaller and smaller areas and whose survival has become doubtful in areas of intensive land use. ■

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A. Bordes

Dordogne (France)

A. Bordes

Jacques Cartier (Quebec)

Twinned rivers

Pierre Dulude
Guy Pustelnik

The Dordogne (France) and the Jacques-Cartier (Quebec): two rivers twinned for conservation

Historically, most rivers of France flowing into the Atlantic were visited annually by the Atlantic salmon (*Salmo salar*). Similarly, in Quebec, a great many of the rivers flowing into the Gulf and Saint Laurence estuary were visited by this species. Over-fishing and the deterioration of habitats required for salmon breeding along with industrialisation have resulted in a led to decrease in numbers and, in certain watercourses, the disappearance of the species. In particular, this is the case of the river Dordogne in France and the Jacques-Cartier river in Quebec, from which the salmon disappeared in the late 19th century.

Over the past two decades, France and Quebec have made great efforts to restore their aquatic environments and to build up salmon stocks. In the Dordogne and the Jacques-Cartier, it was decided in the late 1970s to conduct a revitalisation campaign.

The idea of twinning the two rivers followed on from scientific and technical co-operation carried out between the two states since the late 1970s. In 1985 a Franco-Quebec colloquy on the restoration of watercourses for migrating species culminated in the twinning idea, producing a charter rendered official in the framework of an agreement signed by the two governments on 10 December 1990.

Parts of the charter affirm the wish of governments:

- "to make the Dordogne and Jacques-Cartier rivers examples of the enhancement of such exceptional natural sites, for the enjoyment of present and future generations;
- to encourage all research likely to contribute to balanced management of the natural environment;
- to inform and sensitise local riparian authorities on the particularly fragile nature of the salmon species, its biotopes and habitats, and to encourage local people to participate in restoration activities;
- to commit their own administrations, along with associations representing the people living along the river-banks in joint action to encourage reintroduction of the Atlantic salmon".

The institutions involved: France: the Ministry of Foreign Affairs, Ministry of Environment;
Quebec: Ministry of International Affairs, Ministry of Leisure, Hunting and Fishing

For this purpose, scientific and technical exchanges and co-operation, exchange of information, exchanges of representatives of associations and residents involved in watercourse management are envisaged.

In practice

The logic and recent experience of this twinning are directly based on concepts formulated by the scientists who conceived them; studies were conducted before plans were made and the activities undertaken followed each other logically and were integrated in an action plan designed to provide motivation in keeping with the objectives of restoration on the two rivers.

Exchanges and co-operation have related successively to the following topics:

Sciences and techniques

Close co-operation, exchanges of information and methods, and work conducted jointly over several years have steered and motivated scientific approaches and more or less directed the choices made on each of the river basins. A joint comparative analysis carried out in 1990 has identified differences of approach and context, objective pinpointing of the strengths and weaknesses of each activity and is currently serving as the basis for planning of new restoration activities under the twinning:

- a French specialist is participating in the design of fishways on the Jacques-Cartier,
- Quebec technicians have contributed in environmental cartography (this work has produced joint participation in colloquies and Franco-Quebec publications).

Involvement of local people

Evaluation highlighted the lack of involvement of local people and associations on the French side in the plan for restoring the river.

A mission to the Jacques-Cartier allowed a group of fishermen to make contact with a different situation, the Quebec context where more flexible management and stricter regulation are achieving an accelerated restoration process. This has provided considerable stimulation and contacts between associations which will not fail to encourage.

Exchanges have taken place between municipal elected representatives (Quebec) and departmental elected representatives (France). These contacts have resulted in ongoing collaboration (twinning of towns and sports clubs) and particularly in new openings and dynamism resulting directly from exchanges of information and discoveries elsewhere of what it is often difficult to imagine at home.

Educational activity

To facilitate medium-termed social involvement and an increase in environmental awareness, environmental education is a valuable tool on both sides of the Atlantic. Exchanges in this domaine are particularly active:

- Quebec teachers in charge of educational developments on the Jacques-Cartier have visited France to analyse the contextual links and activities under way. Exchanges of experience with French teachers have proved fruitful and are to be expanded;
- an information visit was organised to the chief towns in the Dordogne valley with pre-release showing of a France television station FR3 film showing the two restorations, a Quebec play on the life story of the salmon and talks by two biologists, one French and one Quebecker on reintroduction of the fish. This event organised by the town authorities and associations was very successful and, in particular, allowed local people not closely connected with the river to be made aware through the Quebec people of their own assets and conservation problems. A similar visit was made in late March 1991 in the Jacques-Cartier valley for the purpose of increasing identification with the valley in people's minds, through a very thorough knowledge of the characteristics and problems of the other river.

Future

Up to now, twinning of the two rivers has resulted in an awareness, through example and comparison, in the two valleys of their respective richness. Beyond the obvious scientific value, in terms of results and methods, the twinning has already exceeded the hopes of its initiators through the recent but active involvement of the teaching fraternity, associations and elected representatives.

A high quality tool for collective motivation, a means of action, an alibi, a catalyser... whatever, on the Dordogne and the Jacques-Cartier the twinning has already served the cause of the environment in spite of – or thanks to – the differences of context.

All the visits carried out on both sides are in keeping with a clear objective, guaranteeing their success and their effectiveness to the benefit of people in general. They always aim, each in its own domaine at:

- stimulating and providing mutual support for achievement of the two restoration projects;
- understanding of contexts and measures;
- identification of the strengths and weaknesses of each activity and of the co-operation and development focus likely to be most profitable to both parties;
- establishment of a base for following up restoration and twinning activities.

For this, the organisation relies on the work of the two twinning committees (French and Quebecker) which centralise the activities proposed by the various participants, select the projects most likely to serve the collective interest and assist the project agents to prepare files, find funds and contact collaborators. These committees centralise mission reports and circulate them throughout the valley to allow the largest number to benefit from previous experience. ■

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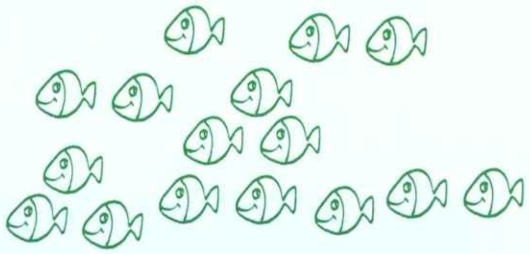

Awakening stagnant waters

Willy Delvingt
Maurice Dethioux

Bodies of stagnant water form a vast collection of highly diverse biotopes: oxbows of rivers or streams, either connected to main water courses or isolated from them; and natural or artificial lakes and ponds. The type of water supply, its quality, the depth and area of a body of water are also important parameters. This diversity and the fact that man's influence can be very far-reaching explains why it is difficult to define accurately and in few words such a complex biological reality. The study will therefore be confined to oxbows, although the results obtained may often by applied to lakes and ponds.

Plant life

Only aquatic habitats rich in nutrients (mesotrophic and eutrophic waters by far the most frequent in oxbows), will be discussed.

Oxbows are inhabited by two different types of higher plant life.

The first type is made up of aquatic species, or hydrophytes, which can grow up to 5 metres in depth if the water is sufficiently clear. Some of these hydrophytes are submerged, such as pondweed and elodea, while others float, such as duckweed.

The second type consists of semi-aquatic or amphibian species which live close to the water's edge where the water level varies. Their leaves grow on the surface of the body of water.

Littoral flora is made up of a series of more or less concentric reed beds whose distribution is determined chiefly by the depth of the water. Starting furthest from the shore, the great bulrush (*Scirpus lacustris*) grows in water 2 to 3 metres deep; water reeds (*Phragmite australis*) are most at home in water 1 to 2 metres deep; while the broad-leafed reedmace (*Typha latifolia*), reed meadow grass (*Glyceria maxima*) and bur-reed (*Sparganium erectum*) can tolerate long periods above the water level.

Reed beds annually produce 8 to 10 tonnes of dry matter per hectare but in eutrophic sites these figures can reach 10 to 20 tonnes. In such cases, decomposition remains incomplete and an excessive accumulation takes place.

Lastly, we find plants which are more terrestial than aquatic but which grow on water-logged land, such as sedge meadows, the nature of which varies according to the richness of the environment. They can produce 5 to 8 tonnes per hectare of dry matter each year.

It is generally at this level that one begins to find the first woody species in the form of a variety of willows, such as the eared sallow (*Salix aurita*), the grey sallow (*S. cinerea*) and their hybrids, which have gradually allowed the black alder (*Alnus glutinosa*) to spread.

Fauna

The rich environment allows abundant microflora to proliferate and to supply trophic networks that are very rich both in diversity of species and in number.

In particular the fish and birds of the "stagnant water" ecosystem merit special attention.

The fish living in oxbows isolated from the main watercourse, which has often been profoundly altered by man (canalisation, deepening and widening, rectifying, clearing out and so on) and which itself no longer harbours any more than a few common species, remain the only witnesses to a once abundant fish life. Alongside common species such as the roach, red-eye, carp, tench, bream, perch, pope and pike, much less-frequently found species can be seen such as the bitterling (*Rhodeus sericeus*), thunder fish (*Misgurnus fossilis*), rain bleak (*Leucaspius delineatus*) and stickleback (*Pungitius pungitius*).

The body of water attracts various species of birds looking for food or shelter: kingfishers, common herons, little grebe, ducks, swallows and so on.

The reed beds are the home of grasshopper warblers, reed warblers and sedge warblers. When willows and alders grow in the terrestrial edge of the reedbeds, warblers appear. Endangered species such as the little bittern (*Ixobrychus minutus*) and the water rail (*Rallus aquaticus*) can be found locally.

Snipes and sandpipers appear in the muddy areas where the water meets the reed bed or sedge meadow.

Such diversity inevitably attracts numerous birds of prey, such as the sparrow hawk and various types of falcon.

Threats

On account of their small size, oxbows rarely attract the attention of public authorities, or even wildlife protection associations. The disappearance of a significant number of them has taken place in almost total indifference.

S. Cordier

A sight which today is — happily — becoming rare

Some oxbows have been filled by public authorities delighted to have found sites in which to discharge their waste from cleaning-out operations, or even their rubbish.

Pollution is an ever-present threat. Nutrients find their way into the oxbows either from agricultural land surrounding the site, or from streams running into the oxbows or from polluted groundwater. From time to time drainage water or overflow from water purification plants spills into the oxbows.

G. Lacoumette

The consequences are disastrous, a proliferation of grass-green algae or blue-green algae with a substantial reduction of oxygen levels at depth and increased putrefaction. All plant and animal life ceases (eutrophisation).

When the level of nutrients supplied is not so high, the productivity of the plant life and in particular of the reed beds increases. Substantial quantities of plant matter are only incompletely recycled and accumulate on the oxbow bed. This silting-up process leads to the gradual advance over the oxbow of willows and alders and the disappearance of exposed water surface.

The anarchical occupation of the site by anglers has had a wide variety of consequences: damaged banks, crushed reeds, excessive demands on fish populations, supply of species appreciated by anglers (roach, pike, carp) which upset and grossly simplify the balance of the fish population at the site, and accelerated eutrophisation due to over-baiting.

Management

Ideally the management of oxbows of major biological and aesthetic interest should be carried out by a team comprising representatives of central government and local authorities, anglers, environmental protection organisations and scientific circles.

It is essential first of all to take stock of the current situation and in particular of the state of the biocoenosis (brief study), the water supply (nature, quality, rate of flow), pollutants entering the supply and other sources of damage. A plan of action can then be proposed to those concerned.

Among the measures to be considered are the following:

- sanitary engineering operations (diverting of pipes, upgrading water purification plants, etc);
- creating unfarmed belts of land (or farmed without the use of fertilisers) around the sites;
- planting, in a buffer zone, preferably indigenous species of trees that are capable of absorbing fertilisers (such as alder, ash and sycamore maple);
- regular cutting of reed beds, removal of cuttings and restrictions on the number of trees;
- cautious clearing if natural silting-up and matter in suspension from other sources have damaged the site;
- strict rules governing fishing.

Oxbows are an especially interesting aquatic ecosystem. They are threatened in two ways:

- natural evolution through silting up;
- external influences (various types of pollution and human activities).

These threats are especially worrying for the future of oxbows isolated from their original water course.

Management of the oxbows is vital to their preservation, must take account of the various interests involved, and should leave room for useful co-operation between public authorities, pressure groups and scientists. It is hoped that the rare examples of action currently being taken will be multiplied because the present situation is of grave concern in all the countries of Europe. ■

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Saumon 2000

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Salmon are freshwater fish at birth and spend their early lives in cool, well-oxygenated, flowing water, on gravel and pebble bottoms. where they remain for one or two years. At this stage, they are "parr" and resemble ordinary trout, though their colour and shape are slightly different.

When they are approximately 15 cm long, they undergo a radical physiological change which prepares them to enter the sea. They take on a silvery colour and are now known as "smolts". They migrate down river to the sea and make their way to a point in the North Atlantic, south of Greenland. Two to four years later, they return unwaveringly, as adult fish weighing 3–20 kilos, to their native rivers, guided by a homing instinct which is still unexplained, but infallible.

To reproduce, they find their way back to the spawning grounds in the upper reaches where their parents buried the eggs from which they themselves emerged three to six years previously. After spawning, they usually die, worn out by the long journey upstream against the current.

Various factors can interfere with this natural cycle, as we shall see in the case of the Rhine.

Loss of a heritage

Historical studies carried out in several countries have demonstrated the ecological, economic and sociological importance of salmon in the Rhine Basin. These provide us with data on distribution, catch trends, the various stages in decline of the fish and the reasons for its complete disappearance.

They tell us:

- that the salmon population used to be a large one: at the end of the 19th century, between 100,000 and 120,000 salmon were taken from the Rhine every year, with a record catch of 250,000 in 1885. Assuming an annual capture rate of between 15 and 30%, this indicates a stock of 800,000 adult fish;
- that the entire Rhine Basin (river and tributaries) contained salmon;
- that the causes of decline and eventual disappearance were:

  * morphological changes in the river and its tributaries, which reduced natural production capacities, first on the tributaries and then on the river itself;
  * prevention of migration when dams were built;
  * over-fishing;
  * severe pollution in the 1960s and 1970s;
- that the fishing authorities foresaw the decline 100 years before the fish disappeared and tried to protect and maintain stocks by using artificial reproduction techniques. All their efforts were insufficient to prevent increasing, unconsidered deterioration of the ecosystem;
- that certain changes, particularly those affecting habitats, are irreversible and can be remedied only to a limited degree;
- that pollution has been declining since the disastrous levels reached in the 1960s and 1970s, making it possible to reintroduce the sea trout from the early 1980s on.

Determined international action

The return of the sea trout was one of the first results of the policy for depollution of the Rhine launched in the wake of the Bern International Agreements of 1963, which established the International Commission for the Protection of the Rhine against Pollution (ICPRP).

It now seems both possible and advisable to take return of the symbolic and highly-prized salmon as a biological index of improved water quality.

Meeting in Strasbourg on 1 October 1987, the Environment Ministers of the Rhine riparian states called for a programme to secure return of the salmon in the year 2000, as part of the "Rhine Action Plan" for improvement of the river.

The purpose of reintroducing the salmon will thus be long-term preservation of the species, guaranteeing sound water quality for future generations.

Main features of a programme

A programme for reintroduction of the salmon has three main points of emphasis:

1. Rediscovering the spawning grounds

Once the major schemes for regularisation and channelling of the river and its tributaries has been completed, the most important thing was to find out how many of the old spawning grounds were left and salmon could still reach them.

In 1989, a research project was launched in France, Germany and Luxembourg to answer these questions and to estimate the number of salmon which could reasonably be expected to reproduce and grow in the maturing zones adjacent to these potential spawning grounds. The biologists and local fishery officials involved used historical, morphodynamic and water quality criteria to pinpoint five initial sectors: the Vieux-Rhin between Alsace and Baden-Württemberg, the Ill and its tributaries, the Kinzig and the Murg, the Sauer, which flows into the Moselle, and the Sieg, which is closest to the sea. Suitable zones (spawning grounds and habitats for young fish) covering more than 200 hectares have so far been identified, without counting the Murg and the Kinzig, which are still being studied. This is already sufficient for approximately 2,000 adult salmon to reproduce.

2. Restoring migration routes

The last ten years in Europe has seen a particularly marked improvement both in fish ladder technology and in what we know about the reactions of fish when faced with obstacles. Hydraulic simulation on small scale models and radio tracking techniques have been particularly useful here.

Fish can now to cross most dams, provided that the right steps are taken, ie that fish ladders geared both in width and intake to the river's size are constructed.

Unfortunately, this is not the case with the fish ladders at present installed on the Rhine dams. Video monitoring has confirmed their shortcomings. Solutions to the problem were considered as part of the preliminary study carried out by the Higher Fisheries Council, which drew on the experience gained by Electricité de France with the Garonne and Dordogne dams. The construction of a new ladder on every dam would make the system almost totally effective for salmon and the main migrant species (sea trout, lamprey, alosa and sturgeon).

Initially, access to the spawning grounds on the Kinzig and the Ill would be provided by constructing ladders on two major Rhine dams (Iffezheim and Gambsheim) and several small dams on the two tributaries. There are already plans to install ladders on several dams on the Ill.

On the Sieg, the four dams furthest downstream have already been modified or filled with ladders, and migrant species can now cross them.

Altogether, some 30 dams would have to be equipped on the selected pilot tributaries as part of a first project phase.

3. Restocking

To relaunch the salmon cycle in the Rhine, hundreds of thousands of fry from other rivers will have to be released over a period of several years, so that they can gradually acclimatise to their new environment: the odour of the water to guide their return, orientation at sea so that they can find the feeding grounds and then make their way

P. Roche

H. Carmie C.S.P.

Salmon in the Rhine disappeared in the middle of this century. Vast projects have been started so that this far-migrating fish may once again confront the rapids in order to regain its breeding sites (here the Old Rhine at Ottmarsheim, France)

back to the estuary, adaptation of their sexual maturing rate to match the distance they must cover to the spawning grounds, etc. Adaptation of a salmon strain to a river is a highly complex process, and this means that introducing fish from outside sources to replace vanished stock is always a long and difficult business. The return of the first adult fish is merely an encouraging sign. Several generations must return and reproduce before numbers increase to any marked extent, as adaptation improved the survival and reproduction rates.

It is safe to say that stocking with fry over a period of some 20 years is necessary for permanent reintroduction of the salmon, ie for the natural cycle to become self-perpetuating. Some one million fry will be needed every year for the five sectors already selected.

Several phases in a long-term programme

Generally speaking, a salmon restocking programme comprises three phases:

- a research phase (2–5 years): feasibility, definition of techniques and resources, consciousness raising among protagonists and public;
- a restocking phase proper (15–20 years): removal of obstacles blocking access to spawning grounds, release of salmon fry on a massive scale, artificial reproduction using returned adults, protection of the species and restoration of its habitats;
- a balancing phase: management of the stock and possible reduction by fishing, protection of the species and its habitat.

This is a long-term project, and results will not seem spectacular until several decades have passed. It calls for determination, patience and substantial resources.

Co-ordinated technical resources and regulations

Stocking the upper reaches massively with salmon fry is pointless if the adult fish are taken as soon as they enter the estuary. Resource distribution has long been an issue between Holland and the upstream countries, and the international Rhine salmon agreements concluded after 1885 detailed, among other things, the contribution which each country was to make to restocking with salmon fry.

But stocking with salmon fry would still be pointless if dams without ladders prevented adult fish from returning to the spawning grounds.

Again, the extent to which stock has been reconstituted cannot be measured without a co-ordinated international monitoring system.

An international structure is needed to pilot the "Saumon 2000" project, and this must be able to indicate the resources needed, co-ordinate initiatives and assess the results achieved by regional teams in their own areas.

Financial resources

These are at present being worked out by the ICPRP's working party on migrant fish. The estimates will not be pitched too low, since this would certainly lead to failure as regional programmes lost steam before a balance had been struck.

As an indication, the building of a single fish ladder on a major Rhine dam will cost 35 million francs. The smaller ladders needed on tributaries will cost between 200,000 and 10 million francs. Stocking with fry will cost between 6 and 10 million francs a year over 20 years. To this investment expenditure must be added the cost of research, of the regional teams and of the international structure, ie approximately 5 million francs a year.

Obviously, making these financial resources available is essential to the plan's success.

At present, the feasibility studies are being financed by states and regions, by a grant from the Sandoz Rhine Fund and by various local contributions, particularly from fishermen. This preparatory phase will cost some 5 million francs.

When the implementation phase begins, several partners will have to be involved, including: states, regions, dam owners, local authorities and associations. But the scope of the plan and its international interest suggest that a European Community Programme should also be set up.

Technically possible, but hard to implement and slow in taking effect, the "Saumon 2000" scheme will apply primarily to the salmon, but also to the sea trout, the lamprey, and indeed the alosa and the sturgeon. Through shared European determination and effort, it will restore to us the heritage of our great European river. ■

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The Danube Delta

A natural monument

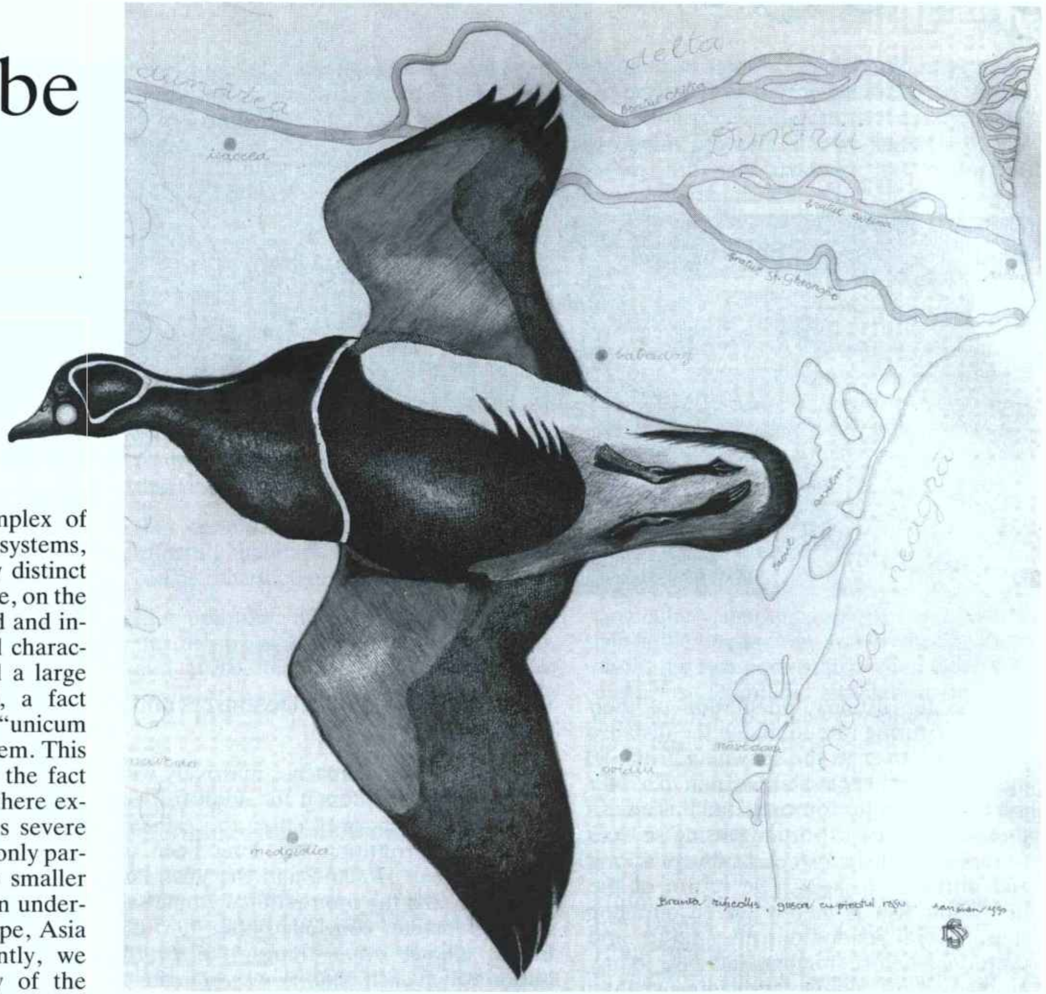
Angheluţă Vădineanu

The Danube Delta is a complex of aquatic and terrestrial ecosystems, structurally and functionally distinct in different degrees. These units are, on the whole, both tightly interconnected and interdependent, resulting in general characteristics (a certain gene pool and a large habitat and biological diversity), a fact which gives this zone the status of "unicum ecologicum" within the delta's system. This peculiarity is also emphasised by the fact that, although in the last decade there existed a programme for the delta's severe transformation, fortunately it was only partially accomplished (that is, to a smaller degree compared to what has been undertaken in other river deltas in Europe, Asia and North America). Consequently, we can now see that the specificity of the Danube Delta was preserved to a certain extent, starting from which one could initiate and develop a recovery process capable of bringing the Delta back to the 1970–75 situation.

For the time being, this ecological system includes small backwaters, marshes, ponds, lakes, floating reed islands, flooding zones, the Danube's arms and a rich network of brooks and channels (natural or man-made), through which the aquatic ecosystems are interconnected; it also includes the large sandy banks (Chilia, Letea, Ceraorman and Sfîntu Gheorghe), as well as the smaller sandy banks spread along the Danube's arms and principal channels.

I should like to point out that, until now, the planned work intended for agriculture and fish farming did not lead to the removal of some natural ecosystem categories. What has been achieved led only to the decrease of the weight of representation and to the reduction of the area of each species. This decline surely attenuated the carrying capacity over direct or indirect human pressure.

Restraining the representation rate of different categories of the Delta's natural ecosystems (especially flooding zones, marshes and lakes) within the latter's structure, large polders (about 36,000 ha) intended for intensive agriculture and fish farming ponds (about 32,000 ha) were created.



D. Sîrbu

Branta ruficolis winters around the delta

Relationship river-delta

The morphogenesis and heterogeneity of the Danube Delta, its dynamics on a restrained or large temporal scale, and consequently the structure, function and dynamics of the plant and animal communities integrated into different ecosystem categories, have always been strictly dependent on the Danube's hydrology and hydrochemistry, and on its interaction with the north-western part of the Black Sea, respectively.

But, indirectly, the rate and trend of this complex ecological system's dynamics have been, and still are, modulated by natural and anthropic factors, distributed all over the hydrographic basin of the Danube (805,300 km^2).

Out of the profound changes in the Danube's hydrographic basin made by human modifications which we consider to have played an essential part in the Danube Delta's evolution, we mention the following:

- the reduction, to a great extent, of the flooding areas along the Danube and of its main tributaries in order to control the floods and especially to increase the area intended for intensive agriculture; thus, the most efficient natural mechanism of controlling nutrients, heavy metals and pesticides in the river's water has been eliminated;
- the development of industry, agriculture and animal husbandry as well as of urban settlements, a fact that increased the direct and indirect input of sewage, industrial waste, pesticides and nutrients into the Danube's waters;
- the modification of the hydrologic regime and of the Danube's transport capacity by building dams on its middle and higher course and on the main tributaries.

Principal functions

By its components, represented by the aquatic and terrestrial ecosystems which function in a natural regime, the Danube Delta accomplishes an important productive function. It generates a large range of biological resources exploitable by traditional means, well-known to the native people. The biological resources resulting from the polders and those intended for intensive fisheries, suppose great investment and auxiliary energy expenses (special agrotechnical workings, fertilisation and stocking of fish ponds). Besides, they are generally situated – as regards productivity – much below the anticipated level and, moreover, they cannot be guaranteed on a long term, due to the exhaustion and rapid salinisation of the soils or to the degradation of the water quality.

The heterogeneity of the ecological structure and biological diversity generated grant the Danube Delta the role of an aesthetic resource and a component of the world heritage of special value.

As an unique ecological system, the Delta represents a scientific reservoir for the further development of the theoretical basis of ecology.

The Delta is the main buffer zone (chemical filter) located between the Danube with its hydrographic basin on the one hand and the north-western part of the Black Sea on the other.

By its dimensions, (5,240 km^2, of which 990 km^2 belong to the complex Razelm-Sinoe and 820 km2 to the Delta of the Chilia arm), this complex of ecological units is the most important wetland area of south-eastern Europe, having an important contribution to the regional and global water cycle.

The diversity of biotopes and of food resources, as well as its geographical position, made the Delta a junction point on birds' migration routes.

Dynamic process of the last decade

The Danube Delta's components, representing permanent aquatic ecosystems and flooding areas, were involved in a complex process of rapid and wide structural and functional changes.

For the purpose of this article, we want to point out some of the most significant structural and functional changes. The question first is about the fact that the biocenoses structure integrated into the aquatic ecosystems was simplified to a great extent by the disappearance of some taxonomical groups (biodiversity reduction) or by the reduction of the representation weight of some plant or animal populations. We also witnessed the increase in density of solar energy absorption into these ecosystems, particularly or exclusively through the phytoplankton. The excessive development of this component (50–200 mg fresh weight/l) characterises the well-known phenomena of "algal bloom".

In turn, the natural food resources of fish species were simplified and they are dominated, for the time being, by the plankton components (phyto- and microzooplankton). Thus, a deep discrepancy between natural food resources and the ichthyofauna structure appeared. Natural food resources are now strictly limited concerning transfer capacity through the benthic fauna, energy being accumulated towards the benthivorous fish species (main species of economic value: carp, bream, tench, crucian). This fact, together with the deterioration in water quality, explains the severe reduction in fish production in the Delta's lakes (frequently between 8–30 kg/ha).

Finally, the deterioration in water quality was noticed by the increase in dissolved organic matter contents (30–80 mg carbon/l), by the quantity of some toxic organic compounds and of bacterioplankton (5–20 mg wet weight/l).

The rapid eutrophication (quantity of disolved anorganic nitrogen increased by 1.5 to 3 times, and that of reacting phosphorus by 8 to 12 times) of the Delta's aquatic ecosystems and the generalisation of this process in the whole complex, represented during the last decade the driving force for all structural and functional biocenoses transformations, for the deterioration of water quality and implicitly for the quality and quantity of fish resources.

We certainly do not underestimate the fact that, during the same period of time, heavy metal and pesticide concentration levels in the Danube and within the Delta increased continuously, approaching or even exceeding freshwater standards.

To the above-mentioned changes we should also add some polders intended for intensive agriculture, detrimental to the representation rate of the ecosystems (mainly in the flooding areas).

We stress that both eutrophication, as a major driving force of the Danube Delta's dynamics, and the general process of pollution and hydrological regime respectively were induced and maintained by factors that acted at the scale of the whole hydrologic basin of the Danube river. The reduction of the flooding area (the filtering one) and the practice of intensive agriculture and fisheries within the Delta, amplified the effects induced by external factors.

Preservation and ecological reconstruction

We consider that recognition of the above statements is the strategic key to be used in order to preserve and to recover the ecological and biological diversity of the Delta, its productivity and the quality of its resources.

With this aim, the Romanian Parliament and the Government undertook the following actions:

- the adoption of the Acts according to which Romania adhered to the World Heritage Convention and the Ramsar Convention;
- the promotion of Unesco of the proposals that the Danube Delta (450,000 ha) should be included on the World Heritage List, within the international network of the Biosphere Reserves and on the list of wetlands of international importance especially for waterfowl.

In this context, we are aware that it is necessary for us to focus the efforts of all Danubian countries and of the European Community on organising and supporting a large research programme on the Danube, its Delta and the north-western part of the Black Sea, a control programme for the pollution sources and hydrotechnical works all over the Danube's basin, as well as a recovery programme, at least partially, of the ecotones within the Danube's lower sector and inside the Delta.

We hope that our present and future efforts to preserve the Delta's biodiversity will be supported even more by Unesco-MAB, IUCN, WWF and other international organisations, both by transfer of expertise and information and by financial aid.

The expense of maintaining a large number of ichthiofagous birds (cormorants and pelicans) or birds damaging winter crops (mainly geese) is estimated at more than 50 million lei for 1991. This cost is added to that agreed by the Romanian Government for this year (more than 150 million lei) in support of the complex preservation activities carried out in the Danube Delta. The financial difficulties could be overcome without negative effects on conservation activities, provided that a part of the further cost be covered by international organisations. ■

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Italian ichthyofauna

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At present the protection of freshwater fish is governed at national level by the provisions of the "Regulation on Lake and River Fishing" dating from 1914. In the course of years, with the increase in recreational anglers (over 2.7 million in 1990), in free time and, unfortunately, with changes in the aquatic environment, it became clear that the law was inadequate and needed updating. Pending a framework law to regulate this matter, a large number of Italian regions took matters into their own hands, promulgating laws applicable in their own territories. The first to do so was Liguria, in 1975 , and the most recent Latium, in December 1990.

The measures adopted for the protection of the fish population are fairly similar in all regions and essentially comprise:

– extension of the closed seasons for fishing, with the season for the Salmonidae, for instance, extended from three months to five or six months in the year, that is from October to the end of February or end of March;

– increased minimal size of the catch: for the trout, for instance, it has been raised from 18 to 20–22 cm;

– restriction on the number of catches: the introduction of this rule is extremely important since under the old national legislation no limits were imposed. Now, for each day of angling the regional laws lay down a maximum catch, per angler, of five to eight specimens of Salmonidae, ten specimens of Cyprinidae and a restricted weight for other fish species;

– the extension of the above conservation measures to other fish species, including the pike, barbel and bass, not mentioned in the 1914 regulation;

– significant increases in the fines imposed offenders.

The very recent Latium law, for instance, provides for fines of from 1 to 5 million lire on anyone caught interfering with the habitat, or fishing with the use of poisons, explosives or electric current. Anyone removing gravel or sand from spawning areas can be fined similar amounts.

Spawning sites, in fact, are given special consideration and, once identified, are to be carefully protected and preserved.

A long-standing and regrettable feature of restocking in Italy is traditional repetitive operations, testifying to poor understanding of the fish population's complex relationships with its environment. The situation can only be improved by appropriate use of the regional "water charter" which each region proposes in its law, calling it a fundamental instrument for the proper management of the aquatic medium and the protection of the ichthyofauna. ■

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Freshwater fish in Cyprus

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Natural freshwater bodies do not exist in Cyprus, the third largest island in the Mediterranean. Drought periods are not uncommon and the increasing water needs had to be met with the construction of dams. For this reason the Government undertook a major dam building scheme which increased dam capacity from 30 million tons in 1960 to 300 million tons in 1988. Out of these, 20 dams covering an area of 1,117 ha and having a capacity of 261 million tons were stocked with fish and are used for angling. The island lacked any indigenous freshwater fish and all species had to be introduced and acclimatised to the local conditions. Now 19 species are found in the Cyprus dams.

The fish stocks are managed by the Department of Fisheries, while other departments and bodies are involved in the management of the dam water for various uses.

The introduction of new species is now slowing down. More attention is being paid to the introduction of species which could contribute to the upgrading of angling.

Some drawbacks hindering the work of dam management for angling are becoming evident with the years. The increase in the number of anglers and the resulting pressure on stocks necessitates the intensification of trout stocking. Supplementary stocking of other species, especially of those which are highly esteemed by anglers, is required in certain dams.

Generally efficient fish stock management practices were established according to the experience gained. A relevant overall policy was formulated which aims at establishing and maintaining fish stocks of suitable size and composition for angling in dams and the promotion of angling for its socio-economic values. The active participation of Cyprus in the European Inland Fisheries Advisory Commission (EIFAC) of FAO since its first years and in other similar international organisations, proved very helpful towards this end. Equally useful are the integrated programmes of the technical committees for the recreational use of dams.

Angling has been accepted as a new sport and its legal framework has been defined. The relevant research programmes and the legal and administrative measures are flexible and allow for modifications, revisions, or additions, according to the results obtained and the new needs. The co-operation and assistance of the anglers in dam management for angling has been secured and their organisation into angling clubs is being promoted. Public support is expanding. Generally the co-operation between all parties involved in the management of dam water has proved indispensable and it is expected to be strengthened, since no fishery project in dams could be successful without it. ■

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The American way of fishing

David W. McDaniel

Each year, 60 million citizens engage in recreational fishing in the United States, providing 100,000 more jobs than General Motors, the nation's largest industrial corporation. The collective angler activity (a billion days of fishing each year) generates over $ 30 billion to the American economy, an amount equal to the sales by K Mart, the 13th-ranked corporation on the Forbes 500 list. The number of anglers has more than doubled during the past 30 years, and is expected to increase by an additional 40% by the year 2030.

The growing realisation of the economic and social importance of recreational fisheries is evident not only in the United States, but worldwide. The threats from development, pollution and other economic tradeoffs must be countered if resource quality and quantity are to be maintained. The protection and conservation of recreational fishery resources are often hampered by a patchwork of management and support efforts which often fail to provide the co-ordination and co-operation necessary to defend against the forces that would convert the resources to other uses, or destroy them.

As a key federal agency with fishery resource management responsibilities, the US Fish and Wildlife Service is charged to promote optimum management and use of fishery resources for the long-range benefit of the nation. Acting within this charge, the Service launched an initiative to develop a National Recreational Fisheries Policy in April 1987. The strategy was to establish a policy developed co-operatively by a consortium of federal, state and tribal governments, along with representatives from constituency groups and the recreational fishing industry. This approach recognised that government, the public and industry share in the responsibility for the conservation and wise use of fishery resources. This multilateral effort holistically considered biological, socio-economical and managerial precepts in order to develop a unified platform of national objectives relative to recreational fisheries and the natural resources on which they depend. The platform would advance long-term goals and strategies instead of quick fix approaches to recreational fishery management problems. Through statements of national objectives and strategies, the policy would serve as a springboard from which governmental, tribal and private sector interests could, in the context of their respective responsibilities, pursue the advancement of wise recreational fishery management and use. The advantage of stepping down the Policy to meet specific goals and responsibilities helps to ensure that the sum of the efforts would blend with and support the national goals and objectives.

In June 1988, President Ronald Reagan, then Vice-President George Bush, and 65 other rule-making and administrative authorities of state, tribal, federal and local governments, and non-government private sector interests, signed the Policy. The Policy declares:

1. The nation's recreational fisheries provide substantial benefits to all Americans, to the health and welfare of our society, and to the national economy.

2. These benefits derive from achieving and maintaining healthy and robust fish populations and related habitats. A concerted and diligent effort is require to maintain, restore and increase the productivity of these populations and the habitats to provide for continuing public benefits.

3. Governments are vested with stewardship responsibilities and must work in concert with recreational fisheries constituencies and the general public to conserve, restore and enhance recreational fisheries and their habitats.

4. Constituency groups, the recreational fishing industry and individual anglers have an obligation to support natural resource stewardship, practise responsible angler ethics and actively participate in individual and co-operative fishery resource conservation efforts.

The four goals of the Policy:

1. Effect the protection and/or increase productivity of fishery resources.
2. Ensure and enhance the quality, quantity and diversity of recreational fishing opportunities.
3. Enhance partnerships between governments and the private sector for conserving and managing recreational fisheries.
4. Achieve and maintain a healthy recreational fisheries industry.

With the adoption of the Policy came speculation as to its impact on recreational fisheries. At worst, it would serve as a collection of policy statements, guiding principles, goals and objectives packaged in an attractive cover that would gather dust on the desks of bureaucrats. At best, it would provide the catalyst to unite the efforts of 60 million anglers to work through government agencies, constituency organisations, and individual efforts to launch a national campaign to promote the social and economic importance of the resource, and to take actions to further protect, conserve and enhance those resources. Fortunately, the latter has been the case. Since the Policy was adopted, major federal agencies, such as the Fish and Wildlife Service, US Forest Service, Bureau of Land Management and the National Marine Fisheries Service are all working to enhance their recreational fisheries activities. Some major recreational fisheries initiatives are all ready in place and there is increased activity by states, national and local fishing organisations, the major private conservation groups and the sport fishing industry.

The continued success of the Policy in the United States, and positive results in other countries with similar policies, points out the value of focusing national attention on recreational fisheries resources through the multilateral development of national policies which serve as rallying points for constituencies. ■

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At the Council of Europe

Water is a vital and precious resource which must be protected and managed actively, coherently and responsibly in accordance with the 12 key principles of the European Water Charter proclaimed by the Committee of Ministers of the Council of Europe (May 1968).

Wetlands, lakelands and river valleys constitute some of the most interesting environments from the point of view of ecology, but they are also those under greatest threat from various development projects. Neglected and underestimated, wetlands and fresh water have, however, been the subject of considerable activity on the part of the Council of Europe aimed at their inventorisation, rehabilitation and protection. Some examples include:

- identification and evaluation cards devised for the protection of wetlands (Recommendation No. R (79) 11);
- activities aimed at the protection of lake shores and river banks (Resolution No. (77) 8) and of inland water areas in the face of the development of sport and physical recreation (Recommendation No. R (81) 8);
- the protection of dragonflies (Odonata) and threatened freshwater fish in Europe, as well as of their biotopes (Nature and Environment Series, Nos. 18 and 38 and Recommendation No. R (87) 14). These species are valuable indicators of the quality and purity of aquatic environments;
- lastly, the Council of Europe networks of protected areas (Diploma-holding areas and the European network of biogenetic reserves) encourage and reward efforts to protect major European wetlands, such as the Camargue National Reserve (France), the Doñana National Park (Spain), the Wollmatinger Ried-Untersee-Gnadensee Nature Reserve (Germany), as well as various lakes, marshes, peat bogs, alluvial formations and coastal and inland wetlands.

The Steering Committee for the Conservation and Management of the Environment and Natural Habitats (CDPE) has instructed an expert (Mr B Lachat, Switzerland) to prepare a handbook for managers and decision-makers concerned with watercourse management. The booklet which is the result of his work describes how watercourses function and the biological riches they contain. It presents practical examples and innovative methods of maintenance, enhancement and restoration of water courses, specially by the use of rural, forestry and biological engineering. Mr T Wiederholm of Sweden has also drawn up "A study of lakes in the light of conservation problems".

These publications, in addition to the technical and scientific information they contain, will also serve to make the public and the decision-makers aware of the need to protect water – a precious heritage which must be actively managed.

The Bern Convention (in full, "Convention on the Conservation of European Wildlife and Natural Habitats") includes four species of fish in Annex II (strictly protected fauna species) and 122 species of fish in Annex III (protected fauna species).

The Convention protects these species against over-exploitation since States having ratified the Convention (most European States, plus Senegal and Burkina Faso) have undertaken to maintain populations of these fish above danger level and to prohibit use of all non-selective means of capture and killing. Furthermore, the Bern Convention protects the habitats of wild flora and fauna species and commits States to initiating measures against water pollution, thus resulting in improved quality of watercourses.

Recommandation 1128 (1990)(1) on the state of Europe's freshwater fish population

1. The Assembly is deeply concerned that almost half of the 393 registered fish species in European rivers and lakes are threatened with extinction, and that the freshwater aquatic ecosystem is in danger because of pollution, over-fishing and other human interventions (the building of dams etc.). It welcomes the Council of Europe's initiative to organise a European campaign on freshwater fish and their habitats in order to increase knowledge of and respect for the freshwater aquatic ecosystem.

2. The Assembly is aware of the importance of recreational fishing and of the fact that subsistence and commercial freshwater fisheries still are of importance for certain rural regions. It considers however that fishing practices should be employed which will reduce the suffering of fish.

3. Consequently, the Assembly recommends that the Committee of Ministers invite the governments of member States and the European Community, in co-operation with other European governments and the FAO's European Inland Fisheries Advisory Committee:

a. to work out a European policy framework for the conservation and restoration of the natural habitats of European freshwater fish and for the maintenance of healthy indigenous fish stocks in European rivers and lakes. This framework must include policy measures which will avoid water pollution and other negative effects on the aqautic fauna and ecosystem, and stop over-fishing including that of species constituting important food for other stocks. It must favour research in order to gain a better understanding of freshwater aquatic ecosystems, their restoration and management;

b. to promote better fishing ethics among anglers and professional fishermen and make the practice of fishing subject to a certification of the basic understanding of the aquatic ecosystem.

4. The Assembly recommends that the Committee of Ministers, with regard to the freshwater aquatic fauna and ecosystem:

i. strengthen the implementation of the Convention on the Conservation of European Wildlife and Natural Habitats;

ii. include the protection of fish in hatcheries and fish farms in its work on animal welfare.

(1) Text adopted by the Standing Committee, acting on behalf of the Assembly, on 3 July 1990. See Doc. 6207, report of the Committee on Agriculture, Rapporteur: Mrs Anttila.

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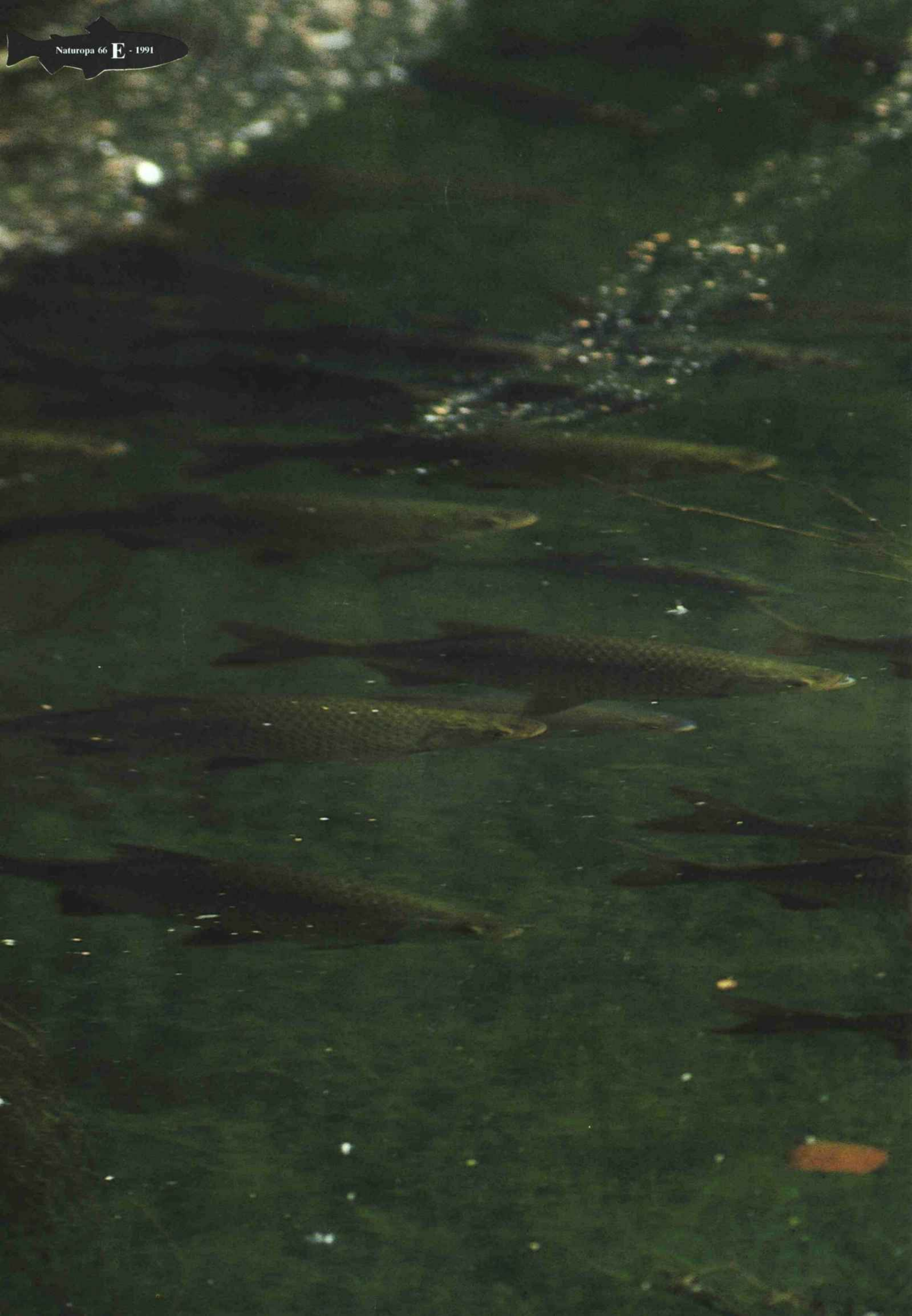

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