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The Danube River Basin in a changing World

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Session 1. Human Impact on Fish Migration and Current Status of Fish Populations in DRB

Plenary lecture

Sturgeon migration through the Danube Green Corridor: an application of the Sturgeon Action Plan (SAP)

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Since the Sturgeon Action Plan came into force through the Bern Convention in 2006, there is an urgent need of implementation of the 72 actions proposed. The general life traits and former distribution of the endangered sturgeon species and populations are well known, and it is clear that the Iron Gates dams are the major obstacle for sturgeon migration. But apart from overexploitation and illegal trade of caviar, there are other threats in terms of hydromorphology with concern of sturgeon migration and habitats. One of these is the heavily debated project aiming at promoting navigation in the Green Corridor in the framework of developing an European transnational navigation route.

In this paper we describe the case as it developed, and we provide the plan for the necessary ecological improvements of this project, based on sound science and state-of-the-art, i.e., updated knowledge. A thorough SEA and EIA with international standards are needed to ensure the sturgeon migration routes for reproduction and protect the unique wetlands as hot spots of biodiversity including spawning sites in river banks along the Lower Danube River.

Oral presentations

Fish ecological results from the Joint Danube Survey 2 in 2007

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More than 70 species of freshwater fish inhabit the Danube along its entire course, covering various ecological guilds. Yet, the ecology of many species is still poorly known. Although fish stocks declined and species became endangered or even extinct in the last decades, fish still are of economical importance, especially in the lower river section. The status of fish populations in rivers is one of the biological quality elements in the assessment process of the ecological status according to the EU Water Framework Directive (WFD). The Joint Danube Survey 2 took place from 13 August till 28 September 2007 and was the second scientific expedition sampling ecological data across the entire Danube from Germany to the Black Sea, this time also covering the sampling of fish data. During the six weeks expedition, scientists from almost all Danube states participated and caught 49,039 fish of 66 species in 45 sampling sites.

The Register of Man-made Barriers (RoMB) - a basis for planning the restoration of the longitudinal integrity in running waters

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In order to assess the ecological integrity of running waters and to plan proper protection devices, a Register of Man-made Barriers (RoMB) has been developed. According to the European Union Water Framework Directive all artificial migration barriers as well as the stream bank protection in an entire stream system are surveyed. The RoMB introduces a new method for the registration, characterisation and evaluation of the passability of longitudinal migration barriers, and for the assessment of the integrity of stream banks. Protection and restoration guidelines are then outlined on the basis of this register in order to restore the longitudinal integrity of the stream system.

So far, Registers of Man-made Barriers have been carried out in eleven stream systems in Upper Austria with a total of 200 investigated main and tributary streams. Apart from constructive information on all man-made obstacles it provides an evaluation of their function as migration barriers for fish and benthic invertebrates. Furthermore, the state of the stream bank alteration within the catchment area of a total of 3454.8 km² has been evaluated, which is nearly a third of the land area of Upper Austria. All in all, a total stream length of 1503.9 km has been investigated.

Contributions to the longitudinal fish migration in the Austrian Danube system - from the main river to the tributaries

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In the past decades the morphological degradation and fragmentation of streams has become the main reason for the drastic decline of fish populations. Especially rheophilic fish species are endangered because of their mostly extended migrations. The Austrian fish fauna is characterized by high species richness. The primordial fish fauna of the Austrian section of the River Danube consists of 64 different species. The sum of the recent native fish species comprises 59; five species from the family of the anadromous Acipenseridae have disappeared due to the hydropower dams at the Iron Gate.

In our studies we investigated the migration of Danube fishes through a hydromorphologically degraded sidearm into the River Naarn, a tributary in Upper Austria. In order to assess the potential for upstream migration, the fish fauna in the downstream water body was investigated by the use of longlines and electro-fishing. For studying the fish migration into the tributary, a mobile fish weir was installed. This and other recent studies have shown that population densities and species richness are a result of habitat quality and connectivity between the main stream and its backwaters and tributaries. Obstacles in the longitudinal direction within the main stream, sidearms and tributaries are scaling down the species richness and population densities.

Floodplain ecosystems – endangered habitats due to measures of hydraulic engineering

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During the last centennial the Austrian floodplain systems along the Danube river have undergone many changes. The construction of several hydroelectric power plants has altered the hydromorphological situation in the Danube heavily. Many anabranches and stagnant aquatic systems have been lost due to the development of shipping lanes and the intensification of agriculture in the catchment area. Flood waters nowadays discharge mostly through the main channels of our rivers. The former floodplains are hardly connected with their rivers anymore. The periodicity of flood waters covering and reshaping the aquatic habitats of the floodplains has declined strongly. All these alterations are reflected in drastic quantitative and qualitative changes in the ichthyofauna of the Austrian river systems. Besides the well documented decline of many rheophilic species in the Danube, the degradation of the aquatic habitats also threatens stagnophilic fish which partly depend on aquatic habitats that become connected with the main river by flood waters periodically. Sediments from the surrounding agriculturally used land accumulate in the few remaining sidearm systems in the Austrian floodplain areas. Infrequent flood waters cannot support open aquatic habitats in these ditch systems in the long run. The weatherfish (*Misgurnus fossilis*) is dependent on this type of habitats and has therefore become a rare species in Austria in the last decades.

Population viability analysis and potential of its application on Danube sturgeons

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Sturgeon species in the Danube River basin have experienced severe decline. Beside overexploitation, habitat loss and pollution, they are further endangered by lack of efficient policy and management, as well as by serious lack of knowledge about their life history. Although Population Viability Analysis (PVA) could represent an extremely valuable tool to cope with these problems, it was not so far applied on Danube populations. This paper represents an assessment of different PVA methods and models developed for sturgeon species. It analyses their results, main advantages, drawbacks and main problems encountered, and discusses on possibility of their application on sturgeon populations in the Danube River basin. Future development of PVA on Danube sturgeons should be oriented on the estimation of impacts of different life history parameters on population persistence, identification of key life history parameters on whose determination future research should be oriented, and effects of different management scenarios on population persistence and recovery.

Short-term changes of Ichthyofauna in Croatian part of Danube river

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During the year 2004 we conducted an intensive fish survey of the Croatian part of the Danube River, with the primary objective to describe the fish assemblage and population status. Fish were sampled at three sites using an electro-fishing boat and backpack electro-fisher. In 2007, we repeated sampling on the same segment of the river to determine and quantify short-term changes of ichthyofauna. Forty-two fish species were recorded with *Alburnus alburnus* being the most numerous and widespread. The species number was apparently related to habitat complexity. The Ponto-caspian gobid, *Neogobius melanostomus* was found for the first time in Croatian waters. Alteration of the fish fauna appears to be correlated mostly with proliferation of exotic species.

A long-term study (1983-2007) of fish populations in the impounded Drava River, Croatia

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The diversity, species composition and structure of the fish community were studied in the vicinity of three power plant reservoirs in the middle part of the Drava River in Croatia. Over a period of twenty five years, on a collection of 39590 fishes, 57 different fish species belonging to 15 families were recorded. The family Cyprinidae is represented by 32 species, the family Percidae by 7 species and the Salmonidae by 4 species, while the remaining families were represented by one to two species. In the whole collection dominant fish species are Bream (14,81%), Bleak (14,45%), Chub (13,78%) and Roach (13,61%), while on the other hand we recorded just one specimen of Sterlet (*Acipenser ruthenus*) and Danubian Bream (*Ballerus sapa*). Among the 10 most abundant species in the investigated period the populations of Bream, Ruffe and Perch are declining, populations of Bleak, Roach and Silver Bream are increasing while populations of Chub, Vimba, Nase and Barbel are quite stable.

The fish community of the Kupa River – peculiarities due to historical events

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The Kupa River is 296 km long karstic river located in the north-western part of Croatia. Its' spring is in the Gorski Kotar mountain area and it flows into the Sava R. by the town of Sisak. Although its ichthyofauna resembles the one in the Sava R., it has some remarkable peculiarities. The Kupa R. was suspected to be a glacial refugium for several fish species during Pleistocene glaciations and as a consequence it hosts interesting fish community. Besides the species that are distributed also in the Sava R. or wider, the ichthyofauna of the Kupa R. also comprises some species with limited and/or unusual distribution. For example, the bleak *Alburnus sarmaticus* is distributed only in lower course of the Danube, Dniepr and South Bug R. as well as in the Kupa R., but not in the biggest part of the Danube R. basin. Furthermore, molecular phylogenetic investigations have shown the existence of specific genetic lineages of some species in the Kupa R., which are different from the lineages distributed in other parts of the Danube watershed. The composition of fish community in the Kupa R., with special emphasis on its peculiarities and paths of origin, will be discussed.

Ichthyofauna of the small streams of Papuk Nature Park

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Ichthyological investigations of the streams of Mt. Papuk were carried out in February, May and October of 2006. Samples were collected using a backpack electro-fishing device. Streams are tributaries of two river systems; Sava and Drava River, and have different ichthyofauna.

In the Sava River tributaries, the total catch of 257 individuals, with a total mass of 7145.7 g, was comprised of eight fish species: *Salmo trutta*, *Alburnoides bipunctatus*, *Barbus balcanicus*, *Carassius gibelio*, *Gobio obtusirostris*, *Squalius cephalus*, *Pseudorasbora parva* and *Cottus gobio*. The value of the Shannon-Wiener index of ichthyodiversity was 1.68. The value of the reciprocal Simpson's index was 2.62. Brown Trout and Large Spot Barbel were the dominant species comprising 85.6% of the total abundance (49.4% and 36.2% respectively) and also accounted for the greatest ichthyomass, with 90.8% of the total catch (55.6 % and 35.2 % respectively).

In the Drava River tributaries, the total catch of 229 individuals, with a total mass of 1961.2 g, was comprised of twelve fish species: *Eudontomyzon vladykovi*, *Salmo trutta*, *Sabanejewia balcanica*, *Barbatula barbatula*, *Alburnoides bipunctatus*, *Barbus balcanicus*, *Gobio obtusirostris*, *Squalius cephalus*, *Leuciscus leuciscus*, *Phoxinus phoxinus*, *Pseudorasbora parva* and *Rhodeus amarus*. The value of the Shannon-Wiener index of ichthyodiversity was 2.9. The value of the reciprocal Simpson's index was 6.14. Large Spot Barbel, Minnow and Spirlin were the dominant species, accounting for 64.1% of the total abundance (27.9%, 19.2% and 17% respectively). The most representative species in the ichthyomass were Common Chub, Brown Trout and Large Spot Barbel, accounting for 68.4% of the total catch (31.2%, 19.9% and 17.3% respectively).

Forecast of the changes in ichthyofauna of Teresva River (River Tysa Basin) with regard to hydro-construction

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The planned construction of a cascade of hydropower stations in the River Teresva would have negative consequences for the aboriginal ichthyofauna. Species of low flexibility would be reduced in abundance or even be extinct, while the number of species of high tolerance would increase and new species could be favoured. The main ecological effects of hydropower impact for aboriginal ichthyofauna are: appearance of new species in the reservoirs (*Carassius auratus gibelio*, *Cyprinus caprio*, *Salvelinus fontinalis* etc.); increasing abundance of *Salmo gairdneri*, *Esox lucius*, *Perca fluviatilis*, *Phoxinus phoxinus*, *Alburnoides bipunctatus*, *Leuciscus cephalus* etc.; reduced abundance of *Salmo trutta morpha fario* and *Thymallus thymallus*; loss of spawning and feeding areas for *Hucho hucho*; increase of *Acipenser ruthenus* abundance in the river delta is possible. On the other hand, our prediction shows that with regard to fish industry reservoir construction would increase the river's productivity.

Posters

The fish diversity of the Sava River

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The Sava River is one of the biggest tributaries of Danube and it is heavily impacted by anthropogenic influences. Middle part of the river was surveyed in order to assess species composition of the ichthyofauna and evaluate fish communities. Six stations were sampled monthly from April to October 2004 using electro-fishing gear. Based on sampling a total of 19931 fish, belonging to 37 species and 59 families, were recorded. Two families namely Cyprinidae and Perciformes constituted the dominant fish families in the Sava River. The most abundant species in samples were *Alburnus alburnus* and *Rutilus rutilus*. The most important ecological category was reophilic fishes (48,6%), followed by eurytopic (37,8%) and limnophilic species (13,8%). Fourteen species were included into the Red Data Book of Croatia, as well as protected and conserved under the Bern convention and the Habitat directive.

Ichthyofauna of the Lower Mura River

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As the largest tributary to the Drava River, the Mura River represents one of the last significant lowland river areas, particular in its lower course in Slovenia and Croatia, as the upstream reaches in Austria are burdened by hydroelectric plants. In 2007, the Mura River and part of the Drava River in Croatia were proclaimed a regional park and this park area has also been proposed for inclusion in the national ecological network as a potential NATURA 2000 site.

An ichthyological study was conducted in the lower reaches of the Mura River in Croatia in 2007 and 2008. A total of 809 specimens were captured, belonging to 27 species in 8 families. Cyprinidae, represented by 19 species dominated the ichthyofauna, accounting for 80% of all fish captured. Centrarchidae was the second most abundant family, accounting for 14% of all fish. The remaining 6 families each comprised less than 3% of all fish. Of the total ichthyofauna recorded in this survey, 13 are included on the Red List of Croatian Freshwater Fish: 6 as near threatened (NT), 6 as vulnerable (VU) and 1 as endangered (EN).

Changes in different freshwater fish feeding and reproductive groups in the Danube River near Braila (1952-2007)

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The composition of freshwater fish populations is closely linked to the environmental conditions in the Danube main channel and floodplains. The freshwater fish species from the Lower Danube River have different strategies to accomplish vital functions such as reproduction and feeding.

The freshwater fish species from the Lower Danube River are reclassified according to the place of feeding and type of food into four feeding groups: Planktivorous species (P) which feed in the water column, benthivorous species (B) which feed on the bottom, carnivorous species (C) which feed on other fish, and omnivorous species (E) which feed on both plants and animals. Another classification of freshwater fish follows reproduction criteria: Semi-migratory species (S) which live in the Danube River but reproduce in connected lakes; rheophilic species (R) which live permanently in the running water where they feed and reproduce; limnic or lentic species (L) which live and reproduce permanently in lakes or in slowly flowing rivers.

In the Danube River with its floodplain between Braila town (rkm170) and Giurgeni village (rkm 238) we investigated the changes of the trophic and reproductive structure of freshwater fish populations by analyzing the captures recorded from different bibliographic and statistic sources in 1952 – 2007.

Session 2. Restoration and conservation in DRB - plans, projects and challenges

Plenary lecture

Aquatic Macrophytes and the Water Framework Directive: implications on river floodplain restoration, the ecological potential of reservoirs, and climate change effects on biodiversity

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Aquatic macrophytes are a key Biological Quality Element (BQE) in the context of the EC/WFD and river floodplains. Results will show how attempts to restore river floodplains and to reach the “good ecological potential” in reservoirs tackle a topic with no easy solution. Additionally climate change effects could interfere with some of the strategies envisioned so far, and with the millennium goals on biodiversity. Coping with this situation and finding suitable solutions needs information rarely available today. Based on the MIDCC data set and some additional more recent information on river systems in the Danube catchment and on the main river corridor members of the IAD-EG “Macrophytes” can use their expertise to provide answers to problems rising from a changing environment.

Oral presentations

Floodplain inventories for the Danube River Basin: Approaches and first national experiences

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Floodplain inventories are relevant for the international protection of wetlands (Ramsar, EC Flora Fauna Habitat and Birds Directives with Natura 2000 areas), the EC Water Framework Directive (good ecological status of surface water ecosystems) and EC Flood Directive (flood retention areas and mitigation). Depending on the purpose, different approaches can be distinguished. Based on floodplain delineations, which can cover the whole active and morphological continuous floodplain of rivers and catchments or distinctive floodplain complexes, it is possible to balance, characterize and assess different floodplains. Parameters such as vegetation, habitats and biological indicators, land use, status of protection, anthropogenic impacts and vulnerability of habitats, and in particular hydromorphological characteristics of active and morphological floodplains allow detailed analysis concerning status, historical situation and future development of floodplains. The hydromorphological and ecological typology and assessment of different floodplains e.g. in the Danube River Basin is an important research topic and can be directly linked to reference conditions as required.

The reconstruction of the Danube's liable to floods area, a debate issue in Romania

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After a period of 30 years, the scheming of the Danube's liable to floods area within the Romanian territory for agricultural purposes proved to be an inefficient action from both the economic and ecological point of view.

Consequently, some experts consider that it is necessary to create the conditions able to support the reconstruction of the natural features specific to the liable to floods area.

There is also another opinion of those persons who sustain that the area should preserve the main attributes it was schemed for, namely the agricultural purpose. The debates regarding this issue acquired a national character and we have not reached any decision yet.

DTM through LIDAR for Danube's flood plain in Romanian sector

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The Ecological and Economical Program of reconsidering the polders from Danube Floodplain (445 000ha) was conceived and launched to assist Romanian Government in the process of long term strategies – like implementation of the Water Framework Directive and tasks regarding prevention, protection and mitigation of flooding effects, stipulated in the National Strategy for Flooding Risks Management.

The first obligatory step in strategic substantiation of the Danube's flood plains sites that serve as a defence against flooding was to develop the digital model which would facilitate the mapping of all hydro-geo-morphological units with LIDAR method.

The main objectives were (1) Reconsideration of defending lines of the localities against floods; (2) Evaluation of the economical activities within the landscape development to redimension polders as mix units (agriculture/ polders for retaining water) and (3) Recasting of some impounded areas for creating wetlands for conservation purposes.

Wetland restoration activities in the Moldavian part of the Lower Danube lakes region (Yalpugh and Cahul rivers)

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Wetland restoration activities present a great interest for local authorities as an option for improvement of water quality and development of relevant sectors of regional economy such as organic agriculture, ecological tourism, fish breeding, etc. Consultation meetings allowed identify sites for potential wetland restoration in the region and further steps for its extension.

Impacts of tunnel projects on wetlands in Alps

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Direct and indirect impacts of infrastructure projects are dealt in the Environmental Impact Assessment process. To manage the increasing transnational traffic the railway system across the Alps is renewed. In Austria there are two main tunnels projects under construction: in the western part the “Brenner section” between the Tyrol and Italy which bears a main European north – south transport route and the “Semmering-section” between Lower Austria and Styria with special importance for the connection of central Mediterranean and north-eastern Europe. In these projects the direct impact on natural systems is reduced to the short open sections and material transport routes during the building period. These sections show new challenges for the Environmental Impact Assessment to analyse the environmental conflicts. A main open question is the effect of changes to the water house hold and related biotopes and species. Due to the complex geological situation the potential indirect impacts on wetlands are discussed. Within the corridor all wetlands are mapped and evaluated concerning the expected changes of the water regime and indicator species.

Methodological aspects and experiences of the Environmental Impact Assessment procedure in all stages are presented and discussed, how to deal with longterm and indirect impacts on ecological systems.

Posters

The premises of the ecological reconstruction of the Danube’s flooding area (rkm 811 – 661)

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One of the major projects regarding the reconstruction of the aquatic ecosystems in Romania refers to the Danube’s flooding area between Drobeta Turnu – Severin (rkm 811) and the mouth of the Olt River (rkm 661) that covers 100,000 hectares.

The area is characterized by a diversity of types of terrestrial and aquatic ecosystems. The terrestrial ecosystems comprise dunes, inter-dunes, meadows, forests and hayfields, while the aquatic ones include lakes, pools, brooks and marshes. The main lakes within the area are Rast, Bistreț, Nedeia, Potelu, Suhaia, as well as a series of channels that used to link the lakes to the Danube.

The essential feature of the aquatic ecosystems is the great flora and fauna diversity. Among the aquatic and marshy macrophytes we mention 18 species of great importance. Invertebrates are represented by Protozoa, Rotifera, Copepoda, Cladocera, Oligochaeta, Gastropods, Bivalves, Amphipods, Odonata and Chironomidae. 13 fish species (amongst other *Alosa pontica*, *Misgurnus fossilis*, *Huso huso*) represented the basis of the piscicultural production.

The ecological reconstruction of the area has to take into account certain actions meant to combine the ecological and economic interests. This should be the main premises of our approach.

Evaluation of suitable economical activities within Romanian Danube floodplain polders

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The Ecological and Economical Program of reconsidering the polders from Danube Floodplain (445 000ha) was conceived and launched to assist Romanian Government in the process of long term strategies – like implementation of the Water Framework Directive and tasks regarding prevention, protection and mitigation of flooding effects, stipulated in the National Strategy for Flooding Risks Management.

The purpose of this paper is to present the results of the project, which mainly consist of evaluation of the suitable economic activities within polders by various methods, like: the cost/benefit analysis, the Land and Ecosystem Accounting functional model, the Land Use and Land Cover Survey using Remote Sensing methodology, indicators for ecological potential such as indicator for land segregation and productivity indicator. The results would be used for further polder restoration programs.

The study identified three main categories of areas within Romanian Danube Floodplain: (a) 43.3 % impounded areas for agriculture; (b) 40.8 % mixed areas agriculture / polders for retaining water and (c) 15.9 % agriculture areas suitable for natural restoration.

Session 3 Biodiversity, Biotic Processes and Invasive aquatic species

Plenary lecture

Assessment of potamoplankton and primary productivity in the River Danube: A review.

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A first summary of biotic processes in the River Danube was compiled by Knöpp (1966). Contributions to the understanding of the oxygen regime and the primary production in the river have been accumulated over the years since then in numerous publications (see references). A comparative assessment of turbulent turbid systems, including the Danube, was published by Dokulil (1994) and the primary productivity of the Austrian stretch of the river has recently been summarised by Dokulil (2006). Here we present a compilation of primary production data throughout the River Danube augmented with recent measurements using Fast repetition Fluorometry (FRRF) along the entire river stretch performed during JDS2 in August and September 2007.

Oral presentations

Phytobenthos development along shorelines of a large river and their role in the carbon cycle – example from the Danube

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The aim of this study was the up-scaling of the spatial distribution of phytobenthos along different shoreline zones and the impact of future shoreline restoration on phytobenthos development. A second aim was to show the role of phytobenthos in the carbon cycle for a large river in comparison with river and floodplain phytoplankton.

An in-situ experiment consisting of the incubation of racks with artificial substrata (etched glass slides) exposed for a maximum of one month was conducted. Sampling took place in the free-flowing Danube section of the Austrian Alluvial Zone National Park at five dates in August / September 2006. Sets of etched glass plates were exposed along a water level gradient ($MW \pm 1.5m$) to investigate the development of the community. Algal biomass, species abundance and benthic algal primary production were regularly measured.

Highest phytobenthos biomass occurred in a depth of 50 cm, especially during periods of constant water levels. Shoreline reconstruction can increase production potential of benthic algae and cause higher spatial expansion. In periods with no floodplain connection phytobenthos played an important role as food source for the local biocenosis.

The understanding of the regulating processes for benthic algae will provide a scientific basis for management decisions in future, especially regarding the EU Water Framework Directive.

Limitation patterns in floodplains along the Danube River

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In Austria the Danube River is a ninth order river with a drainage basin of 104 000 km². It is characterized by an alpine flow regime with highly variable and stochastic patterns. Despite its variability, the Danube River and its floodplains have been changed to fit the needs of society for agriculture and hydro-power. Human impacts, canalization and flood protection measures reduce the retention capacity of the riverine landscape and limit the exchange of matter to short periods of high flow. Particularly, there is a significant decrease of hydrologic exchange of surface waters. The secondary channels and various water bodies within the floodplain are disconnected from the main river flow for long periods. In order to counteract these negative impacts on the floodplains, large scale restoration projects are focusing on the need to increase hydrologic exchange in slack water areas.

During the growing season of 2006 and the end of the growing season 2007, a large scale field survey was completed for two floodplains along the Danube River one of which has recently undergone restoration via reconnection to the Danube. The sampling compared the sediment nutrient concentrations and potential denitrification and respiration rates. A marked difference was observed in the potential denitrification rates between the two years along with a large change in the nutrient pools. Zones of carbon and nitrogen limitation have occurred, similar to the disconnection patterns in the floodplains, resulting in varying responses of the potential processes to pool size changes.

How important are bed-sediments in streams? Comparison in different catchments and in different climatic zones

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Bed sediments are important structures in lotic ecosystems – as space to live for many animals, as food resource, as place of physical, chemical and biological processes. In framework of projects in last years, bed sediments in temperate and tropical zone streams of Europe, Africa and Asia were studied. The investigated European streams are part of the River Danube catchment. The African streams are low order streams in the Rift Valley; the Asian streams are small catchments low order streams on different islands in Indonesia, Philippines and Sri Lanka. This presentation is based on the analysis of the availability of food resources for aquatic animals through quantitative analyses of organic matter, and biofilms in the ecosystem, measured as potential microorganismic activity. Nutrients in streambed and particulate organic matter were analysed. The amount of nutrients in sediments of tropical streams is relatively low, but of higher food quality. Temporal patterns were driven by hydrological situation in all streams. Higher nutrients concentrations are during the dry season in tropical streams. All streams taken for comparison confirm these results. The potential microorganismic activity showed higher activity during the wet season in opposite to nutrient amounts. The present study showed that bed sediments are important structures for functioning of lotic ecosystems, independent of the climatic zone.

On the specific and ecologic biodiversity of the Danube River – Black Sea Canal (DRBSC)

Gomoiu M.T., Cărauş I., Begun, T., Teaca, A. & Opreanu, P.

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The Danube River-Black Sea Canal (DRBSC), inaugurated in 1984, is a neo-ecosystem born from the Danube waters (length - 64.2 km, depth - 7 m, mean width – 80 m, water-table area – approx. 540 hectares, water volume – approx. 36 million m³). The uniqueness of the ecosystem comes from the canal environment, which, though still waters, lenitic biotope, has selected from the Danube biota the species with high ecologic plasticity, coming from the lotic community and adapted to the features of running waters. Scarcity of ecological data on DRBSC has triggered the present studies, GeoEcoMar being interested in monitoring the Romanian sector of the Danube. Here the authors present elements characteristic of DRBSC biodiversity, based on analyses of over 360 samples (phytoplankton – 116, zooplankton – 170, benthos – 92) taken in 49 stations. The researches made possible the identification of 258 phytoplankton species, 116 zooplankton species and 70 benthos taxa, which means a 2.7 fold increase as compared with the years 1986-1989, when the biodiversity of the new ecosystem was assessed. By adding these species to the ones found by researchers up to now, the total number of the forms making up DRBSC biodiversity rises to 560 species, which represents a high bio-productive potential for fishing and especially aquaculture.

Alien Species and their Evaluation according to the European Water Framework Directive (WFD)

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Neobiota in aquatic biological systems can play an important role - in flowing waters such as in waterways, in stagnant waters as well as in coastal waters. But how should one evaluate waters in which alien species are present that cannot be eliminated from their new environment again by any acceptable measure? These waters will never achieve the desired good ecological status if reference-based evaluation systems are applied. Alien species are not explicitly mentioned in the text of the WFD, although Annex II, Section 1.4 identifies pressures, including ‘other pressures’ - a category that comprises the occurrence of alien species. Annex V, Section 1.2 defines ‘high status’ for each biological quality element, and includes the statement that ‘the taxonomic composition corresponds totally or nearly totally to undisturbed conditions’. Deviation from naturalness is therefore a key criterion of the WFD, and the presence of alien species - by definition - undermines naturalness. Based on case studies of Federal waterways in Germany, the paper gives an introduction to the topic and shows also the different approaches to the WFD topic “Neobiota” in the EU.

Invasive algae, plant, mollusc and crustacean species along the Hungarian Danube section: arrival time, colonisation characteristics, relative importance

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Besides causing agricultural, health economical problems globally, invasive species are also the second greatest threat to global biodiversity. Consequently, their study is of utmost importance not only from an economical but also from a nature conservation viewpoint especially along important corridors such as the River Danube. Some species predominant at several sites along the river in the floodplain are present in Hungary since the XIX century (e.g. *Elodea canadensis*), others (e.g. *Didymosphenia geminata*) just occurred. Though the presence of a large number of invasive species was often only recorded at the very end of the XX century, several rapid expansions were described along the Hungarian Danube section since then. The mussel, *Corbicula fluminea*, for example, became one of the most abundant mussel species in less than a decade. Certain groups are only represented by alien species; in others the individual number of non-indigenous species is much larger than that of the indigenous species. The number of mysid species, for example, has recently risen to three owing to the invasion of two additional species (*Katamysis warpachowskyi* and *Hemimysis anomala*) which joined the earlier invader *Limnomysis benedeni*, while among decapods *Orconectes limosus* has become the predominant species in the Hungarian Danube stretch.

Posters

The influence of some abiotic factors on phytoplankton development and biotic processes in Prut river ecosystems

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The functioning of freshwater ecosystems is a multidimensional process, influenced by different factors, including the relationships between the abiotic and biotic parameters and the development of primary (aquatic plants) and secondary (plankton invertebrates) producers.

The study presents the results of the long-term hydrochemical, hydrobiological and ecotoxicological research of aquatic ecosystems in Prut River catchment. The relationships between transparency, nutrients content and phytoplankton biomass were emphasized, as well as the influence of trace elements on biotic processes. A significant negative correlation between the suspended matter content and phytoplankton biomass was noticed, as a consequence of the functioning patterns of eutrophic freshwater ecosystems. As nitrogen compounds play an important role in phytoplankton development, the significant positive correlation between nitrates, nitrites dynamics and phytoplankton biomass was recorded, as expected. Since nitrogen is an important component of algal biomass, the algal decay leads to secondary water pollution with organic nitrogen compounds. A positive linear correlation between mineral nitrogen content and phytoplankton biomass was found, while negative correlation was identified between nitrogen organic compounds and phytoplankton biomass. In the end, the influence of copper, zinc, nickel and lead on biotic processes is also discussed.

Energy flow pathways in Musura Lagoon in 2005 - 2007 interval

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Located at the interface of Danube Delta with Black Sea, Musura Lagoon underwent significant changes in the last century. Formerly a gulf with maritime characteristics, due to the active alluvial deposition of Sulina and Chilia arms and the formation of a sandbank at its mouth, together with the limited access of marine water and the continuous inflow of Danube's freshwater, it gradually changed into a freshwater lagoon, the structural and functional parameters of its biocenoses changing accordingly.

This paper presents the main characteristics of the energy flow in Musura Lagoon between 2005-2007. The main energy input in the ecosystem was realized by the phytoplankton (amounting up to 91%). Other trophic levels had a low contribution to the energy flow: bacterioplankton 7.4%, zooplankton 1.6%; due to the sandy substrata and the reduced amount of organic matter in the sediment, the benthic communities were poorly developed and contributed in a smaller extent as well. The main energetic transfer occurred through the phytoplankton-zooplankton channel, as revealed by the significant linear correlation ($r = 0.65$, $p < 0.001$, $n = 34$) between phytoplankton primary production and the secondary production of zooplankton. An inverse relationship between the amount of energy contained by plankton and benthic biomass (4% for plankton and 23% for benthic biomass) and their contribution to the energy flow through the ecosystem (95% for plankton and 5% for benthic productivity) was revealed.

Life cycle, secondary production and feeding habits of *Dina punctata* (Erpobdellidae, Hirudinea) in the small stream Vydrice (Slovakia, the Western Carpathians)

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The leech *Dina punctata* inhabits various types of running waters. It is a species, which appeared in Slovakia probably after the first Rhine-Main-Danube channel was built. Because little is known about its ecology, the aim of our work was to analyze seasonal changes in the size structure of the population, food composition and reproductive activity of *D. punctata* in the Vydrice brook. Samples were taken mainly each month from April 2003 to November 2004 from the stones covering whole width of stream. We used the criterion of presence or absence of a clitellum as an indicator of reproductive status. In the area of Vydrice brook *D. punctata* has biennial life cycle. Population is created by three-, two- seasonal and newly hatched leeches. Breeding begins in April and finishes in September. Annual production of population was 34, 9 g/m² (2003) a 28, 6 g/m² (2004). Annual P/B coefficient is 5, 4. The major food items were chironomid larvae and *Gammarus fossarum*.

Longitudinal distribution of mussel fauna in the water system of River Danube

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In this work we examined the spatial pattern of mussel fauna along a second order (Hosszúvölgyi-stream) and third order stream (Börzsönyi-stream) – medium-sized river (Ipoly) – large river (Danube) continuum in the water system of River Danube. Investigations were performed at 15 sampling sites in April of 2007. A total of 1662 individuals belonging to 21 species were collected. One species was protected, three of them were rare and four species were invasive in Hungary. The introduced *Corbicula fluminea* was the most wide-spread species in the whole water system. Based on both species composition and abundance water types can be distinguished. The highest number of species and individuals were found in River Ipoly and in the side-arms of River Danube characterized with medium-sized water discharge, while the lowest number of species and individuals were observed in the second order

Hosszúvölgyi-stream. *Pisidium casertanum*, which is a characteristic species of hypocrenon-epirhitron, was abundant in streams. *P. subtruncatum*, *P. henslowanum*, *Sphaerium corneum*, which are adhered to hyporhitron-epipotamon, were detected with a high density in River Ipoly and in the side-arms of River Danube. The study was supported by the Hungarian Scientific Fund (OTKA) under the contract No. T/046180.

Hydra oligactis (Pallas, 1766.) in submerged *Myriophyllum spicatum* L. stands in Lake Gornjogradsko in Osijek, Croatia

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The study on composition of invertebrates with special overview on the abundance of brown hydra, in association with submerged species Eurasian water milfoil (*Myriophyllum spicatum*) was conducted in Lake Gornjogradsko in Osijek, Croatia during spring 2007. Recorded physical and chemical water parameters (conductivity, pH, dissolved oxygen concentration and saturation) within *M. spicatum* stands corresponded with the sampling period and indicated eutrophication. Hydrozoa, Cladocera, Copepoda, Chironomidae larvae and Nematoda were recorded during the investigation. The relationship between the density of brown hydra (*Hydra oligactis*) and the size of macrophyte stems, macrophyte biomass, periphyton biomass and total biomass (macrophyte + periphyton biomass) was analyzed. The highest statistical correlation was found between the density of brown hydra and the size of macrophyte stems: $r=0.75$, $df=33$, $p<0.001$. Smaller correlation was recorded between the density of brown hydra and total biomass ($r=0.66$, $df=33$, $p<0.001$). Between brown hydra density and macrophyte biomass statistically significant correlation ($r=0.62$, $df=33$, $p<0.001$) was also found. The lowest, but still significant correlation was found between the density of brown hydra and the periphyton biomass ($r=0.32$, $df=33$, $p=0.05$). *M. spicatum* with its dissected leaves serves as a favourable microhabitat for hydras because it provides periphyton as available food resource and at the same time is shelter against predators.

Present state of benthic ecosystem in Razelm-Sinoie Lagoon Complex (RSLC)

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The Razelm-Sinoie Lagoon Complex (RSLC), situated south of the Danube Delta, was known as one of the most bio-productive basins of the Black Sea, supporting rich commercial fisheries. Studies concerning ecosystems were performed mostly before 1980, and then research studies became scarce. During researches in 2002-2004, the authors collected 200 benthos samples from RSLC and registered 87 benthos taxa, in comparison with 35 recorded in the 1950s; only 17 of them present in both periods. Changes in water salinity affected benthic fauna; variations in salinity regime, the tendency towards water freshening in the last years, caused by reduction of marine influence (partial closing of natural links with the sea) and the increasing amount of Danube freshwater, marked the structure of benthic populations. Before the 1970s, 70% of the zoobenthic species consisted of Ponto-Caspian relicts and 30% freshwater and brackish water forms; during 2002 – 2004, freshwater forms represented 80%, Ponto-Caspian relicts 7% and brackish and marine elements 13%. The most important changes occurred in the molluscs populations: euryhaline species (*Cardiidae*, *Abra*, *Hydrobia*) and the most sensitive freshwater forms (*Theodoxus*) disappeared, replaced by the new freshwater stenobiontic forms (*Anodonta cygnaea*, *Corbicula fluminalis*, *Unio pictorum* etc.). Therefore, the transition from a marine to a lacustrine environment allowed the ecological succession of species in an ecosystem consisting mainly of freshwater species.

Diversity of eucaryotic micro-organisms (algae, protozoa, rotifers and micro-crustacea) in the River Danube at Göd (Hungary)

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The lack of information regarding the integrative investigation of eucaryotic microorganisms in a large river made us initiate more researches on this subject. This study presents the preliminary results of the investigations done in June 2008 in Danube River, upstream Budapest, the sampling being carried simultaneously in the main arm and a small branch. Plankton and periphyton samples were investigated in order to assess the biodiversity of algae, protozoa, Rotatoria, Cladocera and Copepoda communities. 169 algal species were identified in the plankton of the main arm and 139 in the branch. 71 diatom species were recorded in the periphyton of the main arm and 79 in the branch. 118 protozoa species were registered in the plankton and 33 in the periphyton. 19 Rotatoria species were identified in the main arm and 23 in the branch; only 11 species occurred in the periphyton. Cladocera group was represented by few species, but only juvenile forms of Copepoda were found.

Aspects regarding the distribution and biodiversity of aquatic and semiaquatic Heteroptera from Maramureş Mountains Natural Park

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This paper is part of a study made in order to establish the quality of water resources from the Maramureş Mountains Natural Park in northern Romania. The aim was to inventory the habitats of aquatic and semiaquatic Heteroptera (inventory that will regard the number and quality of those habitats, and also the human intervention in the area), and to establish the biodiversity degree, using various indexes that estimate both α - and β -biodiversity. In order to reach that, we took samples from 15 sampling stations on three hydrographic basins from the Natural Park (Vişeu, Ruscova and Frumuşeaua). The results show the presence of 7 species in the study area, most of them eurivalent ones, the exception being *Gerris (Aquarius) paludum* Fabricius 1794 (species with rare sightings in Romanian fauna). The biodiversity analysis reveals relatively low values for each sampling station, counterbalanced by higher values if we relate to hydrographic basins or to the entire area; this fact is in correlation with β -biodiversity results, which are showing high variation along the gradient (in this case altitude). Similitude analysis is showing the same species distribution for suchlike habitat conditions.

Remarks on the diversity of recent Ostracoda fauna from the Razelm – Sinoe lagoon

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Though until now it was given relatively little attention to Ostracoda group, this community represents an important component of the benthic communities in Danube Delta, both in terms of abundance and diversity.

Based on 186 samples collected between 2002 and 2004, the paper presents some observations on the recent Ostracoda fauna from the Razelm – Sinoe lagoon. A total of 22 Ostracoda species belonging to 15 genera were identified. The highest diversity (15 species) was noted in Razelm Lake.

Out of the total number of species, only few were characterized by a higher frequency and abundance: e.g. *Darwinula stevensoni*, *Cypria ophthalmica* and *Cyprideis littoralis*, which are ubiquitous species.

A brackish association with euryhaline species such as *Cyprideis littoralis*, (both varieties were present - smooth and noded valves), *Cytheromorpha fuscata*, *Leptocythere histriana* and *Tyrrhenocythere donetziensis* was present. Within the same association, the species *Cytheroidea cepa*, *Leptocythere nitida* and *Xestoleberis decipiens* appeared only accidentally.

The presence of some Ponto-Caspian relict Ostracoda species (*Loxoconcha lepida*, *Leptocythere cymbula*, *Leptocythere quinquetuberculata*) is mentioned for the first time in the Razelm-Sinoe lakes.

Molecular studies on immigration of *Dikerogammarus villosus* – an alien species in Lake Constance (Bodensee) in Germany

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Dikerogammarus villosus is an invasive alien arthropod in German rivers and lakes. The Neozoon is larger and much more aggressive than the driven out *Gammarus roeseli*, former the common benthic inhabitant. Its zoogeographical home is the Ponto-Caspian Area. DNA of individual animals were extracted, PCR-products using different microsatellite-DNA-Primers (Wattier et al. 2006) were run on horizontal agarose-gel. Size of DNA fragments are determined by fluorescence using ethidiumbromide comparing to standard-length-DNA. The results of the molecular studies are different types of genetic patterns in different animals and sampling sites. The Data are analysed by statistical methods preferably cluster analysis. In addition the comparison of the DNA of animals from different geographical sources indicates the evidential pathway of immigration and colonisation of Lake Constance (Bodensee).

Aquatic resources and conservation of ecosystems in the Republic of Moldova

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The Republic of Moldova is located in South-East Europe and plays an important role in the conservation of biological diversity. The territory of Moldova is placed at the interference of those three biogeographic regions (the region of European leafy forests, that of Mediterranean forests and Euro-Asiatic steppes), near the Black Sea, in the Danube River Basin and the Carpathian Mountains.

Aquatic and paludous ecosystems (i.e., rivers, lakes and other wetlands) cover 95 000 ha (2.8% of the country). The hydrographic network consists of 3260 rivers and rivulets with a total length of more than 16 000 km. The most important are the Danube, Nistru and Prut rivers. There are 3532 lakes and water reservoirs with a total area of 332 km² and an accumulation volume of 1.8 km³.

The most important internal aquatic ecosystems are Beley and Manta lakes, Iagorlac bay from Dubasari dam lake which serve as an important habitat for the reproduction of fresh water fish. During the reproduction period, big populations of migratory and semi-migratory fish are concentrated in sectors from downstream Dubasari and Costesti-Stanca dam lakes.

Areas with significant vegetal and faunistic communities need special attention, their protection being monitored at national, regional and international levels.

Session 4. Environmental/Ecological Monitoring: scientific concepts, policy and practice

Plenary lecture

Ecotoxicology in the Danube River Basin: current state and future challenges

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The talk aims at giving a broad overview of current state of ecotoxicological research within the Danube Rivers Basin, but more importantly, to discuss some major (out of the many) challenges faced by environmental toxicologists and ecotoxicologists of DRB today.

While priority pollutants still present a problem in middle and down Danube countries, mainly due to insufficient wastewater treatment and consequently, quite a number of hot spots of severe pollution, upstream countries already focused on emerging substances. Still, many aspects, like for example, toxicity of complex mixtures, bioavailability of toxic substances and ecosystem respond to toxic pollution still remain common and unsolved.

Modern approach to environmental risk assessment stipulated with REACH and partly by WFD, once fully transposed into national legal systems throughout the DRB would certainly give additional stimulus to research activities in ecotoxicology. To catch up with trends in risk assessment, scientific community of DRB should get prepared for the latest challenge – introduction of alternative methods to completely replace animal testing. Since ecotoxicogenomic as a discipline is likely to offer some solutions, the talk will elucidate some of the advantages and disadvantages of introduction of “omic” techniques (genomic, metabolomics, proteomics) into a wide field of ecotoxicology and environmental risk assessment.

Oral presentations

Assessment of the ecological status of Teresva River (River Tysa Basin) with regard to hydro-construction

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The actual ecological status of Teresva River in the context of planned hydropower stations was investigated. 119 macro-zoobenthos taxa of 21 groups, 36 zooplankton taxa, and 18 fish species were registered. According to WFD classification based on the composition of aquatic communities the Teresva River system showed class 1–3. The tributaries (Luzhanka and Mokrianka Rivers) had high ecological status. Upper and middle sections of the Teresva River had good status and the lower section showed moderate status. Our forecast shows that the development of hydro-technical constructions would decrease the ecological quality of the Teresva River Basin. In general, the response of the planktonic organisms to the first stage of regulation (filling the reservoirs) would be an increase of abundance and a change of species composition. The impoundments would change the bottom fauna from rheophilic to lotic as larvae and nymphs of rheophilic insects would be eliminated and the species number of Plecoptera, Ephemeroptera and Trichoptera would decrease from 10–18 to 3–5. Species richness of Chironomidae and Oligochaeta would increase. River regulation would disrupt the drift of organisms, which is an important mechanism to maintain stable bottom communities.

Benthic macroinvertebrates of altered and man-made habitats in the Drava River

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Benthic macroinvertebrates were collected seasonally during 2004-2007, in altered and man-made habitats of the hydro-electric power plant system in the Drava River. All sampled habitats (reservoirs, drainage ditches, tailrace canals and old river channels) are greatly influenced by hydro-technical management. The species richness of macrozoobenthos was highest at old Drava riverbed sites. Čakovec HEPP old river channel receives insufficiently treated waste water from the City of Varaždin, and as a consequence pollution tolerant species were most abundant. Oligochaetes constituted the bulk of macrozoobenthos in the investigated reservoirs. *Limnodrilus hoffmeisteri* was a dominant species in the Varaždin HEPP reservoir, while in the Čakovec and Dubrava HEPP reservoirs *Branchyura sowewrby* also showed high densities. Chironomids were found with higher densities in the shallow parts of the Čakovec and Dubrava reservoirs. Around the reservoirs ditches were constructed, and they received seeping water from power plant reservoirs. The fauna was composed of a large number of pollution intolerant taxa, with dominance of insects and crustaceans.

Isotopic composition of river water in the Danube Basin – results from IDS2 (Joint Danube Survey 2, Aug. 13 – Sept. 27, 2007)

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Isotope ratios of river water are indicators for hydrological processes in the catchment, for interactions between river water and ground-water, for mixing processes, for travel time and dispersion of short-term pulses as well as for hydroclimatic changes in the drainage area. Such applications require a good knowledge of the “isotopic environment”. Since there have existed only very few environmental isotope data especially from the lower part of the Danube Basin, the JDS2 was a welcome opportunity to improve the data base for environmental isotopes in this region.

The $\delta^{18}\text{O}$ record along the Danube shows three significant changes in the isotopic composition: firstly, at the confluence of Upper Danube and R. Inn (alpine river, low $\delta^{18}\text{O}$ values). The second step is caused by the inflow of the rivers Tisa and Sava with their higher ^{18}O content. The third significant change in stable isotope ratios occurred in the region of the Iron Gate as a consequence of an extreme precipitation event in Central Europe during Sept. 5 – 7. - If we compare the stable isotope results from IDS2 with those from the Danube Expedition 1988, there is clear evidence for an increase of the content of heavy isotopes as a consequence of the increase of environmental temperature.

The tritium (^3H) content of actual precipitation in Central Europe is about 10 TU. The samples from JDS2 showed values up to 25 TU in the Danube and up to 250 TU in the tributaries. The reasons for these higher values are obviously discontinuous releases of ^3H from local sources (mainly nuclear power plants) into the rivers

River Discharge Measurements in Romania

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In the last few years some institutions in Romania started using advanced discharge and flow measurement technology based on acoustic doppler sensors. The measuring instruments are actually used for discharge measurements in the river Danube and also for discharge measurements and flow studies in the Danube delta and in the Black Sea. The presentation gives an overview about the following topics: (1) Basic technical specifications and features of modern acoustic doppler sensors, as the acoustic doppler technology has some technical properties which have to be considered before the application to get the optimum results; (2) Sensor mounting – normally, the sensors are installed on existing measuring vehicles (measuring boats), but some issues have to be considered when designing the mounting equipment. The presentation shows the results of the developments for the Romanian institutions; (3) Practical experiences with the equipment after an operation period of about 1 year.

Dynamics of ambient phosphatase activity in oil polluted soil remediation monitoring

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In the study of oil components removal from the contaminated soil, the bioremediation based on oil biodegradation by the rhizosphaere bacterial population was estimated by the heterotrophic bacteria plate count method and ambient phosphatase enzyme activity shown in the form of categorized graphs. The soil samples contaminated with the crude oil and its derivatives were taken from an internal dump formed by excavating soil layers from several contaminated sites of the Novi Sad Oil Refinery area. *Poplars* and *Salix* inter-section hybrids were taken as young plants, where six cuttings from each genotype (6) were placed in 42 containers with soil increasingly loaded by contaminating hydrocarbons. Preliminary results of studied parameters were shown in categorized graphs. A comparison of two plants showed that phosphatase activity index (PAI) of the *Salix* rhizosphaere and those PAI of *Populus* rhizosphaere varied in its intensity and in correlation with the control. The aboveground biomass gradually decreases in *Salix* unlike in *Populus* cuttings. According to the values of soil Phosphatase Activity Index (PAI), rhizospheres of hybrids of *Populus* and *Salix* grown in the contaminated soil could be described as experimentally created environments having moderate biodegrading potential.

Floods Frequency and the Major Pollution Sources in the Prut River Basin

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Between the major factors with an evident influence on floods amplitude and frequency there are: non-homogeneous distribution of atmospheric precipitation (heavy rains) and temperature; seasonal and multi-annual modifications of the atmospheric circulations and regional climatic conditions, which occur under general influence of cyclic variations of the solar activity, as well, periodical increasing of the gravitational (tidal forces), electromagnetic and magnetic fields. In some circumstances the impact of the mentioned factors may be evidently amplified at the regional and local levels by diverse unsustainable activities like deforestation, overgrazing, excessive irrigation, intensive agriculture, mineral resources exploration, etc. The water quality in Prut River did not change significantly during the investigated period, except of evident increase of copper compounds in some samples of 2002 and 2003 at Shireutz and Cahul stations and in 2008 at the Ungheni station. Generally, the monitoring records show a moderate pollution level (water quality class III) and a slightly increasing pollution tendency from upstream to lower part of the river and from the past to present days. Due to significant reduction of use of agrochemicals in Moldova during the post soviet period this tendency become less evident and is not specific for zinc compounds and the group of prohibited pesticides. The average annual concentrations of ammonium and nitrite were well below MAC, while phenols and heavy metals frequently exceeded the MAC values. The integrated water

pollution index (WPI) – the average ratio between the concentrations of 6 selected pollutants (ammonium, nitrite, nitrate, BOD5, oil products and phenols) and their MACs – indicated an improvement in several sections. The oxygen regime was satisfactory except for a few cases during very dry summer of 2007 when dissolved oxygen in the Prut River decreased to 4.5-5.5 mgO₂/dm³.

Posters

Ecological characteristic of Danube delta water bodies

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An interdisciplinary study of a range of diverse water bodies within Ukrainian and Romanian parts of the Danube delta was carried out during 2006–2007 years. Ecological status was assessed using ARI (average rank index – following the ecological and sanitary water quality classification in force in Ukraine), various biotic indices (species richness, Shannon index, Woodiwiss index, saprobic index by Pantle-Buck), and the oil product content in water and in the bottom sediments. The results showed that the water bodies of the Sulina delta (II-III water quality class) were less polluted than those of the Kyliya delta (III-IV water quality class). The qualitative analysis of plankton, macroinvertebrates and macrophytes communities revealed 895 species; 745 species on the Romanian territory, and 603 in the younger Kyliya delta, located on the Ukrainian territory. According to the values of Woodiwiss index and acting Ukrainian classification, all water bodies of the Sulina delta and the bays of the Kyliya delta can be evaluated as «clean–fairly clean» waters, while the Bystryi and Vostochnyi arms, as well as the lake Anan'kin kut – must be regarded as «slightly polluted». ARI values and average saprobic index values varied a little among the water bodies, although the inverse trend was observed in the Bystryi and Vostochnyi arms and the bay Deliukiv kut, most probably due to the high content of the oil products.

Water regime indicated hydrobiological differences between two side arms at the Gemenc floodplain (Danube/Hungary)

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Gemenc floodplain is one of the largest floodplains in Europe with an area of 18,000 hectares (Natura 2000). It lies between river-kilometre 1498 and 1469 of the Danube and is a part of the Danube-Dráva National Park (Hungary). Various characteristic side arms and backwaters exist in different conditions. The plesiopotamal Grébeci-Holt-Duna (4.5 km long) and the parapotamal Rezéti-Holt-Duna (15 km long) side arms were chosen to demonstrate the differences in the alternation of water chemical characteristics and zooplankton assemblages, derived mainly by the water regime. The water level fluctuation in the main arm influenced the flow velocity and retention time of the water in side arms. At *extremely low water level* both side arms become lentic and remarkable differences occurred in water chemical characteristics as well as ecological parameters of zooplankton assemblages. At *mean water level* the parapotamal side arm shows permanently typical lotic conditions. In the plesiopotamal arm the retention time is longer, the flow is very low. When the Danube *water level is high*, the water chemical characteristics and zooplankton assemblages of the side arms become similar, because of the homogenizing effect of flood. The fluctuating hydrological-hydrobiological interactions highlight the high spatial-temporal variability of the floodplain.

Hydrological and physicochemical conditions of the Dobra River (Croatia) before damming

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The Dobra River is a sinking river, consisting of the upstream section Gornja Dobra, underground flow, and the downstream section Gojačka Dobra, which is a 52 km long tributary of the Kupa River. In 1958 the Gojak Hydroelectric Power Plant was built at the main spring of the Gojačka Dobra, which receives water by pipelines from the impoundments at Zagorska Mrežnica and Gornja Dobra Rivers. The first 12.6 km of the canyon part of the Gojačka Dobra will be flooded after the completion of a new 52.5 m high, deep-release dam in 2009. We analyzed hydrological and all available physicochemical data from different sites along the first 15 km of the Gojačka Dobra. After 1958, inflow of water from upstream impoundments has increased the average and maximum monthly flow of the Gojačka Dobra more than twice. Annual temperature averages and ranges increase in downstream direction, with upstream sections characterized as summer-cool (<20°C) and downstream sections as summer-warm (>20°C). Conductivity and alkalinity decrease, while pH increases in downstream direction. At the station 2.5 km downstream of the dam, most parameters monitored during seven years showed interesting seasonality and mostly indicate water quality class I or II. These data provide the baseline for prediction and mitigation of the post-damming changes.

Dynamics of the suspended particulate organic matter in the middle Danube section at Göd (1668 river km), upstream Budapest

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Total suspended matter (TSM) concentration and its chemical oxygen demand (COD) were investigated in the middle section of the Danube River in the past 5 years (2003-2007) to determine the origin and the dynamics of particulate organic matter (POM), in the river water. Samples were taken weekly at Göd (1668 river km), upstream Budapest. COD was measured both by permanganometric (COD_p) and bichromate (COD_{Cr}) method to separate the organic matter fractions by their liability. TSM concentrations increased with discharge and varied between 2–162 mg l⁻¹ in the studied period. COD_p of the TSM varied between 0.01–0.35 mg O₂ (mg SM)⁻¹ (data of 5 years), COD_{Cr} ranged between 0.01–0.26 mg O₂ (mg SM)⁻¹ (data of 3 years). The COD-TSM relationship showed a hyperbolic relation, with two distinct parts on the diagram in the years 2004, 2005, 2006, similarly to literature data (i.e. the lower the TSM concentration, the higher the organic matter content), in years 2003 and 2007 no obvious trend could be observed. Highest POM contents were measured during the vegetation period (autochthonous POM); however, high organic matter content of the TSM occurred even in winter (terrestrial or anthropogenic sources).

Zoobenthic Structure of the Valsan River

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A stretch of the Vâlsan River (a tributary of the River Argeş) represents a unique habitat of the endemic species *Romanichthys valsanicola* Dumitrescu, Bănărescu and Stoica, 1957 (sculpinperch or Romanian darter), included in the RED LIST of IUCN. This fish predominantly feeds on benthonic larvae of rheophilous insects, especially mayflies (*Rhithrogena semicolorata*) and stoneflies.

Benthos samples were taken in April – September 2005 from eight sampling sites, using a Surber-sampler. The most upstream site, located in hydro morphologically unmodified section upstream the reservoir was established as a reference site.

17 species of Ephemeroptera were identified along the section, yet we observed negative longitudinal gradient of species richness, which could most probably be associated with the negative impact of hydro constructions. According to the results of quantitative and qualitative analysis of zoobenthos, with special emphasis on mayfly species richness, biodiversity and abundance of bottom fauna increased in comparison to 1992. These findings counter the hypothesis that disturbed bottom fauna led to decrease of *Romanichthys valsanicola* population as a consequence of insufficient food supply. On the contrary, *Rhithrogena semicolorata*, which accounts to Romanian darter's diet with over 50%, is truly abundant along the whole section.

Comparative assessment of phytoplankton communities in lakes of Kyliya Delta (Ukraine)

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The phytoplankton communities from three lakes located in the Ukrainian part of the Danube delta (Kyliya delta) were investigated during 2006–2007: Anankin, Potapiv and Deliukiv. 232 species of algae belonging to 8 groups were identified. The highest species richness was recorded for Bacillariophyta, Chlorophyta and Euglenophyta groups: 91, 70 and respectively 30 species. Cyanophyta and Chrysophyta groups were represented by 18, respective 15 species; the other groups were represented by a very low number of species.

The highest number of species was recorded in Anankin Lake (177 species), followed by Potapiv (141) and Deliukiv Lake (110). According to the seasonal succession, the number of species varied in wide limits – from 21 to 75.

In general, Chlorophyta and Bacillariophyta were dominant in terms of abundance and biomass, but Cyanophyta and Euglenophyta had also a significant development; for instance, in autumn, Euglenophyta dominated in terms of biomass in Anankin Lake.

Distribution of diatoms in the assessment of ecological potential of the Danube-Tisa-Danube (DTD) canal system in Banat Region (Serbia)

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The seasonal dynamics of diatom species from water samples taken from DTD canal system in Serbian part of Banat is interpreted by the box-plot analyses. The statistical extremes occurred in low biodiversity area. Hence, it was estimated that the occurrence of extreme algal abundance is important contributing factor in water alkalization processes. SEM micrographs proved that *Cymbella* species attributed to the secretion and adhesion processes, and on the other hand on phosphorus concentration. Accordingly, phosphatase activity detected in different pH conditions could contribute to maintain the effective concentration of its physiologically important nutrients. Actively migrating forms, mobile algae such as *Nitzschia* and also attached algae, *Rhoicosphenia* and *Cymbella*, with their salinity tolerance, concerning this particular canal water condition were found in all samples. The occurrence of *Rhoicosphenia abbreviata* was detected at the confluences of transboundary rivers Old Begey, Navigable Begey, Tamish into DTD canal, and in southern sector of the canal Banatska Palanka-Novı Bechey. In detailed canal network, the pennate diatoms *Bacillaria paradoxa*, small *Cymbella* species and *Entomoneis paludosa* prevail in late summer when the blooming of *Cyclotella meneghiniana* in Banatian hydrosystem was found.

Seasonal dynamics of phytoplankton and bacterioplankton of the part of protected areas: The Moracha River, the Scutari Lake and the Boyana River

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The paper presents the results of phytoplankton and bacterioplankton analysis of the short term research of The Lake Scutari (Serbian: Skadarsko jezero, Albanian: Liqeni i Shkodrës) (2004-2005) protected areas. The water quality of Scutari Lake and two rivers, The Moracha – inlet, and The Boyana – outlet, was described using physical-chemical parameters and bacteria plate count method. The obtained plankton data which considered the abundance of bacteria pointed out the seasonal dynamics of organotrophs (heterotrophic and facultative oligotrophic bacteria), cyanobacteria, total coliforms (Enterobacteriaceae group) and their biodegrading activities (FO/H index, Pantle-Buck index, abundance of lipolytic, proteolytic and amylolytic bacteria). The cyanobacteria ecological potential has been detected on the Station 3, in littoral lake water in early summer and late autumn (in the course of June-July 2005, and September–November 2004), and for bacterioplankton growth in the May, June and September 2005, respectively. Nevertheless, the oligotrophic bacteria count appeared to be moderately changed in the outlet Boyana with detected faecal pollution when comparing to results of The Moracha River. The SEM analyses proved the occurrence of *Cymbella* species with *Thalassiora bramaputrae* in The Lake Scutari.

Evaluation of metabolic intensity of benthic microbial communities from Musura Bay using dehydrogenase activity method

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The hydromorphological changes occurred along the Lower Danube River Basin in the last century have affected the sediment deposition at the confluence of river branches with the Black Sea. As a consequence, Musura Bay, located at the mouths of Sulina and Chilia branches, underwent a significant shift of abiotic parameters, influencing the structure and functions of the aquatic communities.

This paper presents selected results of a larger research project carried out 2005-2007 in Musura Bay. The metabolic activity of benthic microbial communities from the oxic (0-4 cm) and anoxic (4-10 cm) layers was estimated using dehydrogenase method; three sites were investigated in order to reveal the different influence of the inflows of Sulina and Chilia branches and of the marine environment.

The highest activity was recorded at the site located under the influence of Chilia arm, the multiannual average value reaching 189 mg formazan/g.d.s/24h in the oxic layer and 217 mg formazan/g.d.s/24h in the anoxic layer; the site located in the area of marine influence exhibited the lowest activity (69 mg formazan/g.d.s/24h in the oxic layer and 78 mg formazan/g.d.s/24h in the anoxic layer).

Possible use of this method in the evaluation of trophic state of ecosystems is further discussed.

A comparison of methods for measuring denitrification

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Nitrogen cycling, being a proxy parameter used to evaluate ecosystem health, plays an important role in the environment. This makes detailed knowledge about those cycles crucial for an effective management of wetlands. The area of research is located east of Vienna and comprises sampling points with a high level of connectivity to the Danube (Hanselgrund, Lobau) to points with a low level of connectivity (Orth). The Danube Floodplain National Park area has been chosen because it offers a gradient of connection between water bodies within the floodplains and the Danube. In 2008, sediment has been sampled from three locations within the floodplains along the connection gradient. The potential rates of denitrification were measured and compared with rates measured using the isotope pairing technique. First results will be presented comparing the measurement of denitrification by these two methods. The comparison of those results allows for a better understanding of limiting factors for denitrification and shows the effectiveness of the cycling of nitrogen in different connection areas.

Assessment of sediment contamination, toxicity and benthic community composition in Ukrainian part of Danube delta

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This study focuses on identifying impaired and unimpaired areas (i.e., reference) within the Ukrainian part of the Danube delta using modern environmental diagnostic approaches and tools. The Danube delta is affected by several factors including abiotic ones like currents as well as anthropogenic pollution. Samples were collected in September-October 2006 from the main branches of the delta (15 sampling sites, three replicates per site). Concentrations of priority toxicants (i.e., heavy metals, PCBs, DDT, PAHs) in the sediments were measured. Toxicity assays were performed in whole sediment and water elutriate samples, using the battery of plant and animal tests, including the newly developed sediment toxicity test using a freshwater midge. Samples were also evaluated for abundance, biomass and composition of the zoo- and phytobenthos assemblages. Commonly used indices of benthic condition (e.g., species and higher taxon richness, Shannon's diversity) were applied to assess benthic community responses to stress. The results of chemical analyses and toxicity testing revealed moderate level of sediment contamination and adverse biological effects. A direct relationship between pollution levels and benthic community structure was not found. Apparently, changes in benthic communities at several sites in the Delta could be associated with the combined effect of toxic and abiotic factors.

The changes of some physiological parameters in Prussian carp under the action of the propiconazole fungicide

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Lately, the new plant protection products are emerging so fast that it becomes rather difficult to conduct research on their efficiency, let alone to assess the risk on integrity of natural environment. In this paper we study the action of the Tilt fungicide (the active substance is the propiconazole), under different concentration (0.265, 0.53, 1.06, 2.12 and 4.14 mg /l water) on some physiological parameters (oxygen consumption, breathing frequency, glycaemia and the number of erythrocytes) on Prussian carp (*Carassius auratus gibelio* Bloch). The propiconazole had an inhibitory effect on oxygen consumption and breathing frequency for the Prussian carp. In the concentration of 1.06mg/l, the propiconazole produces, after seven days of immersion, an increase of the glycaemia values and the number of erythrocytes.

Histological and physiological changes in *Rana ridibunda* exposed to Carbetox insecticide

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Carbetox is one of the most commonly used organophosphate insecticides in mosquitoes and other flying insects' control. This systemic, latest generation insecticide has a wide spectrum of action. The aim of this study was to assess the toxicity of Carbetox to a non-target organism, *Rana ridibunda*, using histological and physiological biomarkers, in frog skin and liver, respectively.

Two experimental (0.01 and 0.1 ml/l Carbetox) and one control group of animals were kept unfed in acuaterrarios for 5 weeks, in static renewal system, with daily change of the medium.

Hypertrophy of mucose gland of the tegument, an increased volume of hepatocytes, increased reserve of lipofuscin; a decrease in a number of erythrocytes as well as glycaemia indices were observed in both experimental treatments in comparison to the control.

Session 5. Sustainable development and infrastructure projects

Plenary lecture

Sustainable development in the Danube Region – why we need to realize a multidisciplinary approach and intensify implementation

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The paper gives the broad overview of research activities of the Institute of hydrobiology on hidroecology of the River Danube. Present ecological status and trends (impairment during 1990-ties and recent improvement), as a consequence of past and ongoing developments in the delta region are discussed. The main emphasis are put on the decrease of the Danube herring catches in 1950-ties, regulation of the lower section during the 1960-ties, organization of the reserve in the Kiliya Danube delta in the 1970-ties, project of the inter-basin water transfer from the Danube to the Dnieper basin during 1980-90-ties, construction of the deep-water navigational way on the Bystryi branch in the beginning of the 21 century. In the end, the main directions of future activities are outlined: implementation of the European principles and approaches to the actual aquatic ecosystems' status assessment, protection of the natural biodiversity, conservation of the unique flora and fauna of the Danube region.

Oral presentations

Towards an environmental history of the Danube: long-term socio-ecological research of an European watershed

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Current discussions on the effects of global change on river basins are focusing on present and future conditions. If at all, historical developments are taken into account only in a short-term perspective. But riverine landscapes have undergone fundamental changes for millennia. They are the result of a long lasting co-evolution of nature and society. Historical legacies like species extinction or dam building are essential to understand the presence and influence future options. Recognizing the need for a historically informed planning based on a longer time perspective, the “Danube Environmental History Initiative” (DEHI) was established recently. This network aims at merging existing knowledge, enhancing interdisciplinary research on past nature-society interactions and identifying major trajectories for ongoing socio-economic, political and ecological problems. Research will be based on the concept of Long-Term Socio-Ecological Research, utilizing data and methods from sciences and humanities and bringing together studies on social metabolism, land use and cover change, governance, communication and knowledge.

The presentation introduces major research issues addressed by DEHI, discusses potentials and limitations of a research on the Danube river basin that brings together sciences and humanities, and is an invitation to the audience of the IAD conference to engage in future exchange and collaboration.

Hydroecological investigations of the Danube River in Ukraine, history, present time, prospects.

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The paper gives the broad overview of research activities of the Institute of hydrobiology on hydroecology of the River Danube. Present ecological status and trends (impairment during 1990-ties and recent improvement), as a consequence of past and ongoing developments in the delta region are discussed. The main emphasis are put on the decrease of the Danube herring catches in 1950-ties, regulation of the lower section during the 1960-ties, organization of the reserve in the Kiliya Danube delta in the 1970-ties, project of the inter-basin water transfer from the Danube to the Dnieper basin during 1980-90-ties, construction of the deep-water navigational way on the Bystryi branch in the beginning of the 21 century. In the end, the main directions of future activities are outlined: implementation of the European principles and approaches to the actual aquatic ecosystems’ status assessment, protection of the natural biodiversity, conservation of the unique flora and fauna of the Danube region.

Pressures from above, below, and aside: a genealogy of policies for the Danube Delta and the need for spatial planning

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In our presentation, we focus on the formation of knowledge and policy regarding the Danube Delta, next on the question of implementation. The more actors involved in policy- making, the harder the coordination becomes.

In the case of the Danube, tensions are unavoidable. In the case of the Danube Delta, they are unavoidably higher, given the impact of events and policies upstream. Therefore, the quality of policymaking and implementation upstream is crucial to the qualities of the Delta, and the decision- making for the Delta itself tends to become highly complex, if the tasks at hand are taken seriously.

Spatial planning, we argue, is the best tool, the most comprehensive one, to integrate various existing and new policies, international, national and regional policies and goals into a site- specific package.

Currently, there is in Romania a high degree of awareness of the special tasks the Delta poses the government. Yet, many issues still remain. We will try to analyze some of the issues of policy coordination and implementation specific to the Delta and its institutional arrangement. Theoretically, Michel Foucault informs us in the analysis of the interweaving of knowledge, policies and power.

Developing a Management Plan for a small scale river basin: Fizeş River (Romania)

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Fizeş river basin, covering an area of approximately 560 km², belongs to the category of small scale river basins. However the specific characteristics of this river basin (geography marked by hills with low slopes, presence of small ponds, diffuse pollution caused by agriculture and so on), makes this basin a difficult one to be managed in compliance with Water Framework Directive (WFD) .

By using an integrated approach, we propose a general management plan and most importantly, a set of measures, specific for this small scale basin, always keeping in mind the services offered by ecosystems. The most important stages in the development of a management plan were: (1) the general characterization of the basin, (2) the identification and evaluation of problems, while in the third phase we proposed measures in order to maintain the quality of ecosystem services.

In the second stage an important step was to evaluate the impact and importance of pollution sources by using mass balance modelling, the same models being used also in the final stage in order to estimate the impact of measures on the quality of the water environment.

Nature and Landscape – What kind of Importance for Danube Cycle Tourists?

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Danube with its section between Passau and Vienna has served as a pacemaker for the new cycle tourism coming up in the eighties. Meanwhile the Danube cycle route is presumed to be number one worldwide with a frequency of 80.000 cycle tourists yearly in Austria. Hungary, Serbia, Romania and Bulgaria register growing demand. Bike guests becoming more and more globalised, cycling along the Danube is often considered to discover “untrodden Europe”. By assessing the concrete interests and utilisations by bike tourists of nature sites and protected areas it’s advantageous to distinguish the clientele by the psychographic approach of Sinus-milieus. The pacemakers in cycle tourism along the Danube in the eighties can be identified as “experimentalists” regarding nature ambience as very central and less interests in well prepared nature services. “Postmaterialists” represented by the “third generation” of cycle tourists nowadays are highly interested in experiencing visitor services, combined with expected culinary and culture experience. This contribution will give an overview on different combinations of bike guest-milieus and nature interests and services based on some practical experiences on the Danube cycle route in Romania, Serbia, Hungary, Austria and Germany for identifying some key factors in addressing biking guests.

Legislative Aspects of EIA - Current & Development Trends in the Danube Basin

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The paper deals with the current legal regimes on EIA, applicable in the Danube Basin area. The Espoo Convention is a specific multilateral legal framework aimed at prevention, reducing, and control of significant adverse transboundary environmental impacts. Wishing to implement the provisions of the Espoo Convention in detail, the seven South-East European countries, not all being parties to the Espoo Convention, have signed a sub-regional treaty, popularly called “Small Espoo” on May 20th, 2008. That treaty adds new rules to the several existing legal regimes on EIA. Such situation deserves specific attention, particularly because of doubts that it would enable less transparent realisation of the major transboundary projects than before its signing. Further in depth research of details would highlight all aspects of this new international initiative.

Posters

Ecohydrological aspects of navigable channel „Danube–Black Sea“ in Ukraine

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In 2002 two projects of marine vessel passage through the Ukrainian section of the Danube River delta were criticized by the specialists of the Institute of Hydrobiology of the National Academy of Sciences of Ukraine.

Another solution of this problem was proposed – the passway, including the Solomonov branch of the Danube River – the artificial canal with the sluice – the Sasyk reservoir – the Black Sea. This passway does not cross the main part of the International Danube Biosphere Reserve.

It has been found that the realization of the project will not influence the water balance, runoff, and water level of the Danube River. In this case, hydrological characteristics of the waters and bottom sediments will remain unchanged.

It has been found that 9.5 thousand tons of suspended matter per year will be removed due to the artificial canal with the sluice. Its contribution to the total amount of suspended matter of the river, on the whole, will be 0.02 %.

Thus, hydrological regime of the Ukrainian part of the Danube River delta will remain unchanged. This will be responsible for the conservation of the ecological state of the river, and also of the adjacent part of the Sea.

Assessment and modelling of Carpathian lotic systems for sustainable management - a case study of the Vișeu River Basin

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This study highlights the importance of quantifying biodiversity in lotic systems to assess the degree of homeostasis and the support capacity within these systems. The study also tests the utility of mathematical models that reflect the interactions between biodiversity and biotope factors and their use in predicting the way such systems evolve.

This work on the Vișeu Basin was based on macroinvertebrates and fish, and biotope factors (river slope, water flow, bank stability, bank vegetation, substratum, water physico-chemical characteristics, etc.). Five indices of ecological integrity were used to describe the status of the river i.e. Belgian Biotic Index, Hilsenhof Biotic Index, EPT Index, EPT-C Index and Fish Integrity Index. Factorial analysis was used to develop mathematical models that demonstrated not only variation in the diversity of benthic macroinvertebrates and fish but also the relationship between the biotic integrity indices and variation in biotope factors. The variables used were the biotope factors, the diversity of benthic macroinvertebrates and fish and the results expressed through both biotic integrity indices and biodiversity indices i.e. Margalef, Shannon-Wiener and equitability.

The mathematical models obtained allowed prediction of the biodiversity and variation in the biotic in-

tegrity indices with estimates of probability. The models were also used to predict the condition of some biotope parameters and their modification, and were applied to establish a sustainable management programme for the studied rivers.

Ecological education - a perspective for the sustainable development in Danube River Basin

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According to the actual conceptual frame of global sustainable development process, the Danubian countries should act together to increase the support of rapid changes in the Danube River Basin socio-ecological system. Considering its' tight relation with the natural component, the socio-economical system was acknowledged as one of the targets of the integrated management plan. Ecological education plays a key role in helping the population to achieve skills, knowledge and values that promote behaviour in support of nature conservation. The education approach should be considered horizontally, in local populations of all the Danube countries and in the same time on a vertical scale, directed to different age groups and social categories.

This study presents the results of an experimental test run in a Romanian school on two groups of pupils with similar age (10-11 years old), between 2006-2008. The target group was involved in an optional ecological program for 2 years (presentations, films, workshops, experiments, field trips), while the control group received only few ecological information, included in other disciplines (biology, geography, civic education), according to the regular program.

The final survey has shown an increased environmental protection attitude in the target group, the children developing skills to understand the cause-effect relationships and to identify solutions for the problems occurred, emphasizing also the importance of adopting an environmentally oriented education at younger ages.