

Changes of plant diversity in riparian grassland after extreme hydrologic events

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Riparian grasslands dominate the floodplains along the River Elbe. In a monitoring project, vegetation data of a riparian grassland site were collected in three different periods over 12 years. The effects of two extreme hydrologic events, the summer flood of 2002 and the extreme low water of 2003 on plant diversity, were analysed.

Between 1999 and 2003, species richness and Shannon diversity declined in all classes while Simpson's dominance increased. In the following years and in 2009, species richness increased and reached even higher levels than before the 2002 flood and 2003 drought in wet and moist grassland. In these classes Shannon diversity and Simpson dominance reached values similar to those of 1998 and 1999.

Diversity and dominance were most strongly affected in the vegetation of flooded depressions. Due to the higher disturbance regime, even after six years, species composition remained less balanced and more dominated by single species as compared to 1999. However, it remains uncertain if the flood event of 2002 or the drought of 2003 or both led to the observed changes in vegetation. A yearly monitoring (KLIWAS project) of these sites at least until 2013 may provide further understanding of the effect of extreme hydrologic events.

First records on effect of renewed flooding of three wetlands from Belene Island (Lower Danube, Bulgarian stretch)

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Three marshes situated on Belene Island, permanently separated from the Danube River for many years started to be frequently flooded by irregular opening of installations operated by man at times of high river water level during 2009 as part of a large wetland restoration project.

To investigate possible early effects and efficiency of the new hydrological regime on the marsh status we compared several sporadic samplings for water chemistry, phytoplankton and zooplankton from 1997, 1998, 2000 and 2004 with those of 2009. Main nutrients and oxygen showed similar concentrations and large scattering of measurements before and after the restoration start. A lack of oxygen seems to be responsible for the continuing poor fish presence and occasional fish kills. Similarly, phytoplankton and zooplankton composition and abundance did not show significant changes after renewed flooding. Since the flushed water could not remove the thick anoxic layer of mud and the intense coverage of macrophytes during summer, the applied flood regime seems to have a low restoration effect on the marshes. The artificial flood regime must be improved and additional measures such as dredging of mud and/or macrophyte control may be needed.

Diversity of beetle communities from ground level to canopy in the Danube floodplain forests between Neuburg and Ingolstadt (Germany)

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In Germany, most of the flood plain forests along the Danube River lost their typical character since the 19th century due to river regulations and embankment. A remaining forest area between Neuburg and Ingolstadt will be restored by a particular flooding management starting in 2010 (see Stammel et al.). In order to get faunistic baseline data prior to changes by the water regime beetle communities were studied since 2007. Beetles were collected in four habitat classes according to the relief: (1) close to a water-bearing ditch, (2) in areas which will be flooded irregularly (0–4 times per year) depending on the Danube water level, (3) in areas expected to be flooded only once in 100 years, and (4) in special sites which are dry stands due to gravel deposits. On each site beetles were sampled from the ground layer to the canopy using a variety of automatic traps. The main objectives of the study are (1) beetle diversity in relation to soil moisture, (2) beetle diversity in relation to their vertical distribution (ground level, lower part of the trunk, tree crown), and (3) horizontal and vertical distribution of feeding guilds. The presented results characterize beetle communities typical for different hardwood forest habitat classes.

Spatial differences of the zooplankton assemblages and chemical characteristics of water in a plesiopotamal side-arm of the active floodplain at the Danube (rkm 1442–1440)

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The Gemenc floodplain and the Béda-Karapanca (Gemenc-Béda-Karapanca wetlands, Duna-Dráva National Park) represent an exceptional example of a larger old floodplain with big meanders, oxbow lakes, marshland and extended hardwood forests. Due to river regulation works in the 19th century this area has changed: the floodplain remained more or less isolated from the main channel and the length of the side-arms decreased. Detailed investigation was carried out in one of the plesiopotamal side-arms of the area to monitor phyto- and zooplankton assemblages and the chemical characteristics of the water. The Mocskos-Duna (rkm 1442–1440) is situated in the active floodplain of Karapanca area, approximately 3.4 km long, 60 m wide and shallow (average water depth 1.5 m), a side-arm with very dense macrophyte vegetation. An artificial channel connects the side-arm with the Danube. Diverse zooplankton assemblages (Cladocera, Copepoda, Rotifera) developed in the side-arm. The composition, density and taxon number of assemblages as well as the number of the macrophyte-associated species showed large variations in the different habitats. Our results demonstrate that these side-arms are important storage zones for zooplankton and play an important role in the river-floodplain system.

Influence of environmental factors on riparian forests and scenarios of changes in the vegetation after restoration in the Danube floodplain between Neuburg and Ingolstadt, Bavaria

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The main focus of this work is the observation of the effects of the restoration project (see abstract by Stammel et al.), especially of the ecological flooding, on alluvial forest vegetation using a system of stratified and randomly selected permanent plots. In plot selection, the following parameters were combined in a GIS:

- 1) position between the two subsequent barrages Bergheim and Ingolstadt (6 sections)
- 2) situation in the zone of projected ecological flooding (yes or no)
- 3) relative elevation above the depth contour of the projected water course ($</>1.25\text{m}$)
- 4) horizontal distance to the projected water course ($</>25\text{m}$)

Within each stratum (unique combination of parameters 1–4), three plots were placed randomly in the GIS, located in the field and sampled in 200 m² plots (in total 117 plots). The baseline survey of vegetation took place in 2008/2009 prior to the onset of restoration. Besides the study of vegetation types, we analysed relationships between site factors (soil moisture, nutrients, water storage capacity and flooding events as well as groundwater depth and flooding regime as modelled in GIS) and vegetation gradients. The resulting environment-vegetation model will serve as basis to project expected vegetation dynamics as induced by restoration measures.

1D hydrological model as a predictive tool for the assessment of aquatic habitat changes in floodplain rivers

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Predictions of future changes of floodplain habitats are essential for planners and decision-makers of river restoration programmes. In the Szigetköz section of the Danube, several alternative scenarios were proposed to improve the ecological status of the river-floodplain system impacted by the operation of the Gabčíkovo hydropower station. The rehabilitation scenarios were ranked by a preliminary quantitative benchmark system considering the areal extent and proportion of aquatic habitats, with the reference of historical habitat distribution. The typology of the aquatic habitats followed the 'functional sets' concept with minor modifications. The recent distribution of the aquatic habitats was analyzed using areal photographs and direct field observations. The future changes in structure and areal extent were predicted using results of 1D hydrological models produced by the MIKE 11 software. Discharge, flow velocity and water depth data were used for habitat typology. The results were presented on GIS habitat maps according to the rehabilitation scenarios of the river-floodplain ecosystem.

Pre-restoration analysis of soil seed bank patterns in the backwater system of the Danube floodplain between Neuburg and Ingolstadt

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In spring 2010 a new watercourse will flow through old oxbows of the Danube between Neuburg and Ingolstadt (Bavaria) to enhance fluvial dynamics in the floodplain forest (see abstract of Stammel et al.). Vegetation monitoring has already started to get exact baseline data. The aim of this study is to investigate the potential of the seed bank to contribute to the restoration of stream vegetation along the new watercourse in different parts of the Danube backwater system. These parts differ in the actual water regime (before restoration) from totally dry, over temporarily flooded to deep oxbow lakes. Approximately 350 soil samples were taken in autumn / winter 2009 and in spring 2010. Sampling plots were distributed along 22 transects across the backwater system, with transect sections stratified by geomorphology and plant communities. Seed bank samples will be concentrated (according to the Ter Heerdt method, 1996), stratified and brought to the greenhouse to germinate. The results on seed numbers and species composition will be discussed. To compare the soil seed bank with the input of hydrochoreous seeds transported by the inflowing Danube water seed traps will be installed in 2010 as soon as the water runs.

Ship-induced waves alter the macrozoobenthos community composition of the river Havel

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Ship-induced waves impact littoral invertebrates, e.g. by displacing individuals. However, the long-term effects of ship-induced waves on the littoral macrozoobenthos community composition have rarely been quantified.

Macrozoobenthos was sampled at a stretch of the river Havel between Potsdam and Brandenburg, comparing sites highly exposed to ship-induced waves with sites which are intermediately exposed and reference sites without wave disturbance. A gradient of wave exposure was verified by monitoring wave heights from April to October 2008.

At the highly exposed sites species richness and individual abundances were reduced in comparison to not exposed reference sites. However, invasive species such as *Dikerogammarus villosus* occurred in higher densities at highly exposed sites. Hence, ship-induced waves impact the community composition of littoral macrozoobenthos.

Can we find parallels between a temperate large river and a tropical small stream?

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In the framework of different projects in Austria on the end of the last century, the Austrian part of River Danube ecosystem was investigated with its structural and functional units of this ecosystem to recognize and understand its ecological functioning.

Within the framework of the cooperative project IRESA (Initiative of **R**iver **E**cology in Sri Lanka: from **S**cience to **A**pplication), two tropical low order streams in different climatic zones in Sri Lanka Island (wet and dry) were investigated, for the first time with an ecological approach. This project was a cooperation between Austria and Sri Lanka, mainly financed by Austrian Agency for Development Studies and Austrian Agency for Academic Exchange, supported by Universities in Kelaniya and Innsbruck, as well as by the Institute for Limnology Mondsee of the Austrian Academy of Sciences.

We try to present in this poster the comparison of important results, and the comparison of ecological factors influencing these ecosystems, searching for parallels and differences in temperate and tropical climatic zones, or in large and small running water ecosystems.

Comparative assessment of the ecological state of sediments in the Ukrainian part of the Danube Delta, Dnipro and Boh Estuary

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This study focuses on identifying impaired and unimpaired areas within the Ukrainian part of the Danube Delta, Dnipro and Boh Estuary using recently developed environmental diagnostic approaches and tools. To characterize the state of these areas, a triad approach was used including (1) chemical analysis of priority contaminants in sediments (e.g., heavy metals, PCBs, DDTs, PAHs), (2) toxicity tests on whole sediments and water-sediment elutriates, and (3) assessment of zoo- and phytobenthos community characteristics. Sediment samples were collected in September/October 2006–2008 at the same stations across the delta and estuary (31 stations with three replicates at each station).

Moderate sediment contamination reflected adverse biological effects of toxicity tests. As expected, increased contamination and toxicity were often related to urban development while undeveloped areas were less impacted. However, a direct relationship between contamination, toxicity and benthic community structure was not always identified. The large spatial and temporal scale data set provided a comprehensive comparative assessment of the ecological state of sediments in two important Ukrainian water bodies. The study will be extended for several years.

The study was carried-out by several dedicated Ukrainian scientists with financial and technical support from the United States Department of State and Environment Protection Agency.

Benthic organic matter dynamics along a stream–middle size river–large river continuum

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After investigations performed at lower spatial scale (i.e. riverbank section, river section) we determined the organic matter content of the sediment along a stream, middle size river, large river continuum. Samplings were carried out in a second and third order stream (Hosszúvölgyi, Börzsöny), in a medium size river (River Ipoly) and in a large river (River Danube) 7 times during 2007–2008 (altogether 12 sampling sites). Bed sediment samples were collected by core sampler (4 cm in diameter) to the depth of 5 cm. Samples were washed through a series of sieves to separate fractions as follows: coarse (2360–710 μm), fine (710–250 μm), very fine (250–63 μm) and ultra fine (63–0.45 μm). Benthic organic matter was analysed in each fraction by loss on ignition (550 Co, 4 hrs).

During the investigation period average organic matter content was 1973 ± 651 (streams), 2087 ± 700 (River Ipoly), 1480 ± 1082 (River Danube) g AFDWm⁻².

Similarly to results of our earlier studies, lowest organic matter content occurred at high current velocity sites of the river, highest organic matter content was recorded at deposition zones characterized by low current velocity, where silt and clay dominated in the sediment.

Topic 5

**Water quality, new emerging pollutants,
biomonitoring, ecotoxicology**

The dragonfly *Gomphus flavipes* and mayfly *Palingenia longicauda* as indicators of the Danube River basin

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Till now, altogether 50 species of dragonflies were found in the Danube River and its arms in Slovakia. One of the most important indicator species is *Gomphus flavipes*, its occurrence in Slovakia was confirmed in the past and present. Today, large populations of *Gomphus flavipes* are found in the Malý Dunaj River called Danube's "inland delta". In 2007–2008 sampling of dragonflies in the Danube Delta (Romania) demonstrated another large population of this species.

The Gabčíkovo power plant (in operation since 1992) represents a significant impact on the functioning of the Danube ecosystem. Since 1994, we perform a long-term monitoring of dragonflies aiming at evaluating the influence of the dam on biota. During this monitoring we found only one larva of *Gomphus flavipes* at the site downstream of the dam.

In 2009 we observed emergence of giant mayfly *Palingenia longicauda* in the Danube Delta in Romania. This species disappeared totally in the 1930s from many European rivers.

In suitable conditions indicator species are more resistant to disturbances as well as to climatic changes. This study was carried out within the project 2/0059/09.

The influence of pH and temperature on the enzymatic activity of acidophilic heterotrophic microorganisms of the genus *Acidiphilium*

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Acidophilic heterotrophic bacteria are one important component of the biodiversity in extreme environmental conditions and have a high biotechnological potential: they contribute to the biogeochemical cycling of elements, preventing the accumulation of environmental contaminants and, thus, creating the potential for the restoration of affected sites (former mining areas, decontamination of galvanic wastes or animal farms wastewater, etc.). Although they are adapted to grow in acidic conditions, their enzymatic activity is highly dependent on environmental parameters.

This study presents the influence of pH and temperature on starch hydrolysis of mesophilic and acidophilic *Acidiphilium* strains isolated from mining effluents of Ilba area (Maramureş, Romania).

Growth experiments were carried out at different temperatures (15°C, 28°C, 37°C, 42°C) and pH values (1.5, 2.0, 2.5, 3.0, 3.5), at different starch concentrations. The optimum substrate concentration was 0.1 %; at higher concentrations growth was inhibited. The highest metabolic activity was found at 28°C and pH 2.5, meaning that these would be the best conditions in the natural environment for maximum decomposing activity of the bacteria. In comparison with the regular laboratory cultures, the isolated strains proved to be more active due to their adaptation to the acidic conditions of the mine.

Monitoring the ichthyofauna in Nature Park Kopački rit (Croatia) in 2008

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Nature Park Kopački rit is one of the largest natural areas for spawning and breeding of freshwater fishes in Europe. The ichthyofauna was monitored at 8 sites in June and October 2008 by using fishing nets and electro-fishing gear. The total catch of fish was 371 individuals, classified in 6 families and 12 species. Total biomass was 468 kg. The most diverse family was Cyprinidae with 7 species. Prussian carp dominated in abundance and biomass with 47 %, followed by Common carp (30 %), and predatory fishes, such as Pike and Catfish (16 % each). Beside fish, 3 individuals of crayfish *Astacus astacus* were recorded. The American crayfish (*Orconectes limosus*) was not found, although its occurrence in Kopački rit was confirmed. Absence of fishes in size up to 20 cm and weight up to 300 g was noticeable in the catch, caused by direct impact of the predating Great Cormorant's colonies. A comparison between abundance and biomass indicated that fish communities in Kopački rit are under moderate stress.

β -HCH sediment eco-toxicity for crustacean *Gammarus fossarum* – chemical analyses and risk assessment in the Elbe River

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β -HCH as a waste isomer of the Lindane production is a pollutant in the Elbe River catchment for a long time. Presently, this pollutant still remains a concern, although the insecticide production was stopped more than two decades ago. In a laboratory experiment crustacean *Gammarus fossarum* was exposed to natural sediment spiked with different β -HCH concentrations (0, 1, 10, 100, 1000 $\mu\text{g}\cdot\text{kg}^{-1}$) for two weeks. *Gammaridean* amphipods are common epibenthic invertebrates in European inland waters and are known to be sensitive to a wide range of pollutants. This research addresses linkages between laboratory findings and results found in Elbe River and tributaries in our previous study. Results should lead to significant improvements in understanding the possible environmental stress factor on the lower trophic level and potentially for the fish community. At the endpoint of sub-chronic exposition the mortality of males and females are discussed. Selected chemical biomarkers of organochlorine pesticides will be established: glutathione-S-transferase (GST) activity and (EROD).

Monitoring of algal blooms and eutrophication processes in the River Danube

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In Bavaria two monitoring stations control the water quality of the River Danube. One of the near-continuous automated stations is located near Regensburg at Bad Abbach (rkm 2400). Raw river water is analysed and subsamples are treated immediately by continuous filtration (mesh size 30 µm and 20 nm) to remove suspended matter for further analysis. The online monitoring emphasizes 9 chemical and physical sensors including chlorophyll and nutrients. Online-biomonitors detect the presence of toxic substances.

Biomass of phytoplankton is quantified by measurement of chlorophyll-a using delayed fluorescence. Algal blooms are indicated by a maximum of chlorophyll-a concentration of about 100 µg/L as well as by high amplitudes of chlorophyll due to the light dependent diurnal rhythm of algal growth affecting the balance of, e.g., oxygen, pH-value, nutrients and suspended solids. In the German stretch of the Danube phytoplankton growth is often limited by the availability of phosphorus, a crucial nutrient for water plants. In general algal blooms in the Upper Danube are controlled by (1) phosphorus, (2) an abrupt decrease of light intensity as a consequence of adverse weather, (3) rising discharge caused by torrential rain, or (4) water temperatures above 20 °C with respect to the diatoms.

Monitoring of selected drugs in surface waters of the Vltava River Basin

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For the first time contamination of active ingredients of OTC medicines such as NSAIDs (ibuprofen, diclofenac), anticonvulsants (carbamazepine), antibiotics (erythromycin, sulfamethoxazole) and contrast agents (iopromide and iopamidol) was investigated in the Vltava River Basin. Sources of these chemicals are municipal waste water treatment plants (WWTP). Selected drugs were included to the monitoring in January 2009. Samples were collected at monthly intervals at 28 sites of the Vltava River Basin and analyzed by LC-MS/MS with direct injection of large volume water sample. Data were statistically processed (average, minimum and maximum concentration) and compiled in a map of pollution. Most of the measured concentrations were below analytical detection limits; however, in some cases, concentrations greater than 1000 ng/l were found. This situation can occur when waste water from municipal WWTP in big cities discharges into small rivers with insufficient dilution of pollutants (for example Rakovník city – Rakovník stream, Kladno city – Zakolany stream, Píbram city – Píbram stream etc.). At present, maximal limits of drugs in surface water are not yet established in the Czech Republic. Increased concentrations of these substances are the reason for continued monitoring focusing on sites with permanent pollution especially in highly populated regions or in regions with specific industrial production.

Riverine Transport and Sources of Polyfluoroalkyl Compounds (PFCs) along the Rivers Elbe and Rhine

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Polyfluoroalkyl compounds (PFCs) are currently one of the most elucidated emerging pollutants due to their extreme persistence in the environment, high bioaccumulation potential and several adverse effects on humans and animals. They have been detected in various environmental compartments including air, water, sediment and biota. Sources of PFCs in surface waters are, e.g., industrial effluents, release of treated wastewater and diffuse sources like precipitation.

The purpose of this study is to understand the riverine transport behaviour of PFCs and to identify sources discharging PFCs into the Elbe and Rhine river basins. Surface water samples were taken along the River Elbe and from the German Bight in 2007. A comparative sampling campaign took place along the River Rhine and the Dutch Coast in 2008.

The total PFC concentration ranged from <1 ng/L in the open North Sea up to a few hundred ng/L in river sections with high industrial density. The Rivers Elbe and Rhine showed a different composition profile pointing to the influence of diverse sources located in the river basins. The results show that both rivers are important sources discharging PFCs into the North Sea where they are transported along the coastline via the ocean currents.

New methods in estimating biodiversity: a case study on aquatic and semi-aquatic heteroptera in the Arieş river basin (Romania)

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This paper is part of a study to assess the quality of water resources in the Arieş River Basin. The aim was to establish an inventory of habitats (number and quality) of aquatic and semi-aquatic Heteroptera considering the human intervention in the area. Further, biodiversity was investigated by using two different methods (the classical, index-based one, and a new emerging method: Jost's number equivalent) that estimate both α -, β - and γ -biodiversity. Samples were taken from 16 sampling stations along the hydrographic basin. We found at least 17 species, most of them eurivalent; however, some species were rare sightings in the Romanian fauna, such as *Gerris gibbifer* Schummel 1832, *Hebrus pusillus* (Fallén, 1807) or *Hesperocorixa sahlbergi* Fieber 1848. The α -biodiversity was low but counterbalanced by higher β -biodiversity for most of the hydrographic basin (the gradient chosen was altitude). Both methods used for diversity estimation show more or less similar results; however, Jost's method is easier to use and the results are comparable with any other area.

Assessment of Water Quality in the Upper Course of Siret river (N-E Romania)

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With a length of 599 km, Siret River is the third longest tributary of the Danube and drains a catchment area of 46289 km² (90 % belonging to Romania and 10 % to Ukraine). It encompasses different landscapes, including Eastern Carpathians, the Sub-Carpathian hilly region, the Moldavian Plateau, the Siret Meadow and Plain; all its major tributaries originate from the Eastern Carpathian Mountains.

The paper presents a water quality assessment in three sections of the Upper Siret River (upstream Siret city, Hutani, Lespezi), based on physico-chemical and biological parameters, during 2005–2009. Samples were taken monthly for physico-chemical parameters, three times a year for biological quality elements (phytoplankton, macroinvertebrates) and once every three years for fish populations.

Ammonium (0.053–0.108 mg N-NH₄/L) and total phosphorus concentrations (0.040–0.047 mg P/L) reflected category I of water quality by Romanian standard. However, nitrites showed higher concentrations equivalent to quality class II (0.017–0.024 mg N-NO₂/L).

Phytoplankton showed an average abundance between 627777 and 724722 individuals/L, and the respective Saprobic index ranged between 2.04 and 2.22. Macroinvertebrates showed low densities: 122 individuals/m² (upstream Siret), 138 individuals /m² (Hutani), 139 individuals /m² (Lespezi). The corresponding Saprobic indices were: 2.03, 2.06 and 2.16. In 2006, 77 fish specimens of 8 species were collected.

Wastewater disinfection at River Ilz to improve bacteriological water quality: effects and constraints

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Contamination with fecal bacteria often hampers the use of surface waters for bathing purposes. Different sources may deteriorate water quality including wastewater, agricultural runoff, or wildlife. If fecal input mainly results from wastewater treatment plants (WWTPs) disinfection of secondary effluents is supposed to noticeably improve hygienic water quality.

Along the River Ilz, a tributary of the Danube from the Bavarian Forest, five WWTPs between Hutthurm and Passau have recently been equipped with UV irradiation (3 WWTPs), membrane filtration (1 WWTP), and ultrasound/ozone-treatment (1 WWTP) for wastewater disinfection. Fecal indicator organisms (*E. coli*, Enterococci) were determined by cultivation-based methods to evaluate the disinfection efficiencies and monitor the effects on the microbiological quality of the Ilz. The disinfection systems mostly revealed satisfying reduction rates of the fecal indicators. Thus secondary effluents no longer account for a considerable fecal pollution in this stretch. Intense rain events, however, led to a significant impairment of bacteriological water quality possibly caused by sewer overflows or agricultural runoff. For tracing back the origin of these contaminations a quantitative MST-(microbial source tracking) method will be applied identifying genetic *Bacteroidetes* markers from the 16S rRNA gene of populations specific to human or ruminant hosts.

Bioindication and biotesting of water and bottom sediments of water bodies of the Danube Biosphere Reserve

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The transboundary Ukrainian-Romanian UNESCO Danube Delta Biosphere Reserve encompasses one of the largest wetland complexes in the world. Continuous ecological monitoring of the aquatic ecosystem includes the assessment of water and sediment toxicity.

The aim of the study was to characterize the benthic community as bioindicators of water and sediments pollution and to perform toxicity tests in water and sediments. The results allowed a comparative assessment of the state of water bodies in three main arms of the Ukrainian part of the Danube Delta. The conventional bioindication and biotesting techniques have been used. Bioindices provided information on the degree of pollution and contamination.

The obtained data are indicative of moderate state of benthic communities of the Danube biosphere reserve. There was a gradient of toxicity from Ochakivskyi arm (“poor”) to Bystryi arm (“moderate”) and Vostochnyi arm (“good”). These differences will be discussed. We hypothesize that sources of pollution are located mostly upstream and not in the Delta area.

Distribution of organic UV-filters in surface water of the River Elbe

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Organic UV-filters are commonly employed in sunscreens to protect the user skin against solar radiation. They are further applied as UV-stabilizer in several personal care products and in formulations of textiles, varnishes and plastics. The major input pathway of UV-filters into the aquatic environment is assumed to be the washing off from skin and clothes after superficial application in households or during swimming in lakes, rivers and the Sea. Other sources of contamination are, e.g., leaching from plastics, varnishes etc.

In this study, the most commonly used UV-filters are investigated in the surface water along the River Elbe. The analytical method was validated for the determination of UV-filter using gas chromatography and mass spectrometry (GC-MS). The extraction methods liquid-liquid-extraction with dichloromethane and solid phase extraction using PAD2-cartridges were validated. This study shows the concentration and distribution of the dissolved and particulate phase of UV-filters in the surface water along the River Elbe.

Topic 6

**Trophic relations (nutrients-bacteria-
algae-benthos-fish-birds-humans)**

Spatio-temporal changes of benthic organic matter and macroinvertebrate communities in the Danube Bend (Hungary)

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Spatio-temporal changes in benthic organic matter, composition and abundance of benthic macroinvertebrate communities and functional feeding groups were investigated on depositional and erosive riparian zones of the River Danube between river kilometres 1688 and 1668 in 2005. Depositional zones were characterised by the dominance of ultra fine and very fine sediment, while erosive zones showed a significant amount of coarse bed material. The average organic matter content was 6.3 %. The macroinvertebrate fauna was represented by 30 species within 10 higher taxonomic groups (species number in bracket): Gastropoda (8), Lamellibranchiata (15), Polychaeta (1), Oligochaeta, Isopoda (1), Amphipoda (3), Trichoptera (1), Diptera, Chironomidae, Nematomorpha (1). Bed sediment and organic matter fractions and total benthic organic matter are strongly determined by the flow velocity and grain size distribution, while species composition, taxon and functional feeding group distribution significantly differ according the depositional or erosive character of the riparian zone. The results confirm our knowledge about the discontinuity in large rivers and the phenomena of structural simultaneousness (coexistence of different spatial patterns).

Topic 7
**General limnological themes following
the IAD traditions, flora and fauna**

The actual state of relict Pontic-Caspian invertebrate fauna of the Lower Danube within the area of Ukraine

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Long-term investigations on relict Pontic-Caspian invertebrate fauna for more than a century have been reflected in the Ukrainian Danube research. Especially the Lower Danube and its tributaries serve as complex habitat for this peculiar species community, being inhabited since the tertiary period. The Pontic-Caspian Basin restricted the area of these species for a long time, but in the last decades many representatives of this group became active invaders occupying new habitats far away from their home waters.

The specified list of Pontic-Caspian macroinvertebrate fauna for the Ukrainian part of the Lower Danube is represented; ecological characteristics of some species are considered; comparative analysis with retrospective materials in relation to distribution of relict Pontic-Caspian fauna in a region is carried out.

Spatial patchiness and similarity of macrophyte assemblages along a cut-off channel of the River Danube in Linz (Austria)

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Distribution of aquatic plant assemblages along a cut-off channel of the River Danube in Linz was surveyed four times a year during the vegetation periods 2001 and 2002. To illustrate spatial changes in macrophyte communities, Bray-Curtis Similarity and species turnover rates were calculated between each pair of 17 successive stream stretches. Results of both species change measures showed a significant inverse relationship. Floristic heterogeneity was highest at the stream source, resulting in lowest Bray-Curtis similarity value (6.85 %) and highest species turnover rate (0.65). With increasing stream length, uniformity of macrophyte communities also increased resulting in the trend of raising similarity values. The similarity index, however, did not exceed values of 80 % illustrating that at least 20 % floristic change was occurring between consecutive survey units. Similarity values were associated with trends of abiotic parameters. 'Survey unit length' and 'water temperature' were positively related with similarity while 'substrate type' and 'flow velocity' showed inverse negative relationships. These trends, however, were statistically not significant and could not explain sufficiently the spatial patchiness of plant communities. Our study indicates that the establishment of macrophyte assemblages in streams could also be influenced by ecological processes such as transport of propagules to downstream sections.

Phytoplankton composition and abundance in Srebarna Lake and adjacent temporary wetlands (Bulgarian floodplain of the Lower Danube River)

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Species composition, numerical and biomass abundance of phytoplankton were determined from 15 wetland sites in the Bulgarian part of the Lower Danube floodplain. Five sampling sites were located in the aquatic area of Srebarna Lake and several other water bodies in its vicinity, representing small ponds of rather temporary than permanent character. The sampling campaign during 2004–2006 encompassed 12 visits in the vegetation period (March–October). The sampling sites were additionally characterized by their min, max and average depths, water temperature, transparency, degree of surface coverage by macrophytes, sediment type, distance from the middle of the lake, etc.

Cluster and multidimensional analyses yielded different wetland site groups based on algal species, division and functional group composition. These algal groups were related to the environmental parameters mentioned above. In particular, periods of high and low lake levels depending mainly on the Danube level variations but also on man's regulation of inflow influence algal communities. The effects of interactions between main lake aquatic area and surrounding small water bodies on algal biodiversity and lake trophic status are discussed.

Recent drastic changes in the amphipod and mysid fauna (Crustacea: Malacostraca: Amphipoda, Mysida) of the Hungarian Danube stretch

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Amphipod and mysid crustaceans are among the most prominent groups of aquatic invaders. In the main arm of the River Danube in Hungary all species currently occurring are Ponto-Caspian immigrants. The rate of colonisation has undergone a drastic increase in the last two decades, which – along with the more intensive research – resulted in the doubling of the number of species in this section of the river in these groups (from six to twelve). Of the six new species five are recent invaders and one has been “rediscovered”. Within the gammaroid amphipods two species have been added to the four already present (*Dikerogammarus bispinosus*, *D. haemobaphes*, *D. villosus*, *Echinogammarus ischnus*); *Obesogammarus obesus* appeared in the early 1990s, while *Echinogammarus trichiatus* was found in 2009. Within corophioid amphipods the presence of *Chelicorophium sowinskyi* (formerly regarded as uncertain) has been proven, and *C. robustum* also appeared recently (2009), which have increased the number of species to three (with *C. curvispinum*). Similar changes have taken place within the mysids; the formerly solitary *Limnomysis benedeni* has been accompanied by two further species, *Hemimysis anomala* and *Katamysis warpachowskyi*. Colonisation patterns, current distributions, and ecological characteristics of the species are discussed.

Importance of the Danube River in spreading the infection of red deer with *Fascioloides magna* in eastern Croatia

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American giant liver fluke (*Fascioloides magna*) is an important trematode, which mainly occurs in the liver of various wild and domestic ruminants. It was recorded for the first time in eastern Croatia in January 2000, during liver examination of shot red deer from the Danube region. Introduction of the parasite severely damaged the health status of cervids. The survey was carried out during 2001–2004 by qualitative and quantitative faecal examinations of deer living in epizootic areas of the Danube region and in other hunting grounds in eastern Croatia that manage deer game. The highest number of affected deer with a prevalence of 35–60 % was recorded in forested floodplains near the Danube. Mild infections were detected in hunting grounds along the Drava River and in its flooded middle part. Considering the migration paths of red deer along the Danube and epizootic indicators, the spreading of this parasitic disease is expected on left side of the Danube in Serbia, as well as in hunting grounds on the right side of the Drava River in Croatia.

Molecular studies on the phylogeny of immigrated *Theodoxus fluviatilis*, an alien species in the Upper Danube

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Nowadays biodiversity in surface waters of central Europe is affected by the immigration of alien species. Molecular studies contribute to track the sources of the invaders and give a better understanding of the pathway of colonization.

Theodoxus danubialis (Pfeiffer, 1828) is a small aquatic gastropod mollusc of the family Neritidae. This endemic species is part of the present fauna in the Danube River Basin (DRB). In contrast, the river nerite *Theodoxus fluviatilis* (Linnaeus, 1758) is a fresh- and brackish water snail occurring in the former area of the Mesozoic Tethys Ocean. This river nerite is spread in the Rhine River Basin (RRB) but it was absent in the Upper Danube until first findings of *Th. fluviatilis* were reported in 2001 in Austria and in 2004–2005 in Bavaria (Passau, Regensburg). Immigrations into the Bavarian stretch of the Danube may originate from downstream (DRB) or from upstream (RRB) via Rhine-Main-Danube-Channel.

Molecular studies of the mitochondrial gene of cytochromoxidase are used to identify the affinity between individuals of *Th. fluviatilis* from different sites and sources. Using statistical methods a phylogenetic tree of the individuals can be generated.

Inventory of Macrophytes and Habitats along the River Danube in Croatia

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The stretch of the River Danube through Croatia is 137 km long. The Danube is a bordering river between Croatia and Serbia, and right side belongs to the Croatian territory. During 2003–2004, the inventarisation of aquatic macrophytes and assessment of habitat parameters were carried out along the right riverside of the main channel, in survey units of one river km length. In total 34 plant species were recorded, of which 11 were exclusively found in the Danube main channel. This number indicates a low macrophyte diversity similar to that in the adjacent reaches of the Danube course in Hungary and Serbia. Information on the conservation value of macrophytes is given. In the bank structure, fine inorganic material prevails (63 %), followed by stone blocks used for river regulation (30 %), and concrete embankments (5 %). Among the river sediment types, fine inorganic material is dominant (64 %); sand is present with 29 %, and gravel with 5 %. Average water transparency is 60–70 cm, and medium flow velocity is the most frequent flow class. Broad-leaved forests dominate along the riverside (86 %), agricultural area covers 3 %, and industrial and urban areas were recorded by 4 % each.

Advantage of a Hungarian Rotifer Database System from the aspect of the Danube research

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Our 2008–2009 results showed that rotifers contribute the highest proportion of zooplankton in the River Danube (70–95 % of the abundance and biomass). During this research period we found 92 taxa from the main arm and 83 taxa from the side arm near Göd (rkm 1669). Nowadays the collection of information in well organized databases means an effective tool for easy data access and utility. We constructed a new database system for collecting rotifers data on a country scale, which provides correct information for different water systems (lakes, ponds, canals). There are many taxon lists on the internet, which can provide current, accurate and reliable information about the species. Our database collects recordings of rotifer species in the Hungarian fauna based on scientific papers. Numerous tables facilitate easy access to actual information on valid taxon name, synonym taxon name, paper quotation (name of author(s) and journal, year of publication), date and place of sampling with GPS coordinate or by cities, habitat type, photo of the animal and a habitat map based on recent data. The database operating system functions like Google and Yahoo. The Rotifer database is flexible, expandable and the uploading is continuous.

Can reservoirs compensate oxbow disappearance? The amphibian fauna of the Rétközi reservoir and the Várközi oxbow lake

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The decline of amphibians is a global problem. In Europe it is mainly caused by the disappearance and alteration of habitats. Therefore, it is necessary to counterbalance this negative process with the protection of already existing and the creation of new amphibian habitats. Several large-scale interventions will be realised in the framework of the New Vásárhelyi Plan, a river-regulation oriented programme along the Hungarian stretch of the River Tisza including the construction of new reservoirs. Rétközi reservoir (48°16'30" N, 22°01'50" E) was built in 1990 providing a good locality to study the mid-term impacts of such constructions. Várközi oxbow lake is a nearby semi-natural habitat. Our survey started in March, 2008. Two sampling methods, visual encounter survey and sound monitoring according to the MONITOR2000 protocol were applied. *Bombina bombina*, *Bufo bufo*, *Epidale viridis*, *Hyla arborea*, *Pelophylax ridibundus*, *Pelophylax lessonae*, *Pelophylax kl. esculentus* were detected using sound monitoring. In addition, *Rana arvalis* and *Pelobates fuscus* were found during visual encounter surveys. The occurrence of species is different at the two sites. From green frogs *P. lessonae* was only detected at the oxbow, where *H. arborea* and *E. viridis* were also more abundant, while *B. bufo* was heard only at the reservoir.

Diversity of Benthic Macroinvertebrates in Relation to Environmental Parameters in Reservoirs, Danube Basin, North-West Bulgaria

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Twelve reservoirs in the Danube Basin in North-West Bulgaria were sampled in September – October 2009 to study species composition and distribution of benthic macroinvertebrates in relation to selected environmental parameters. The reservoirs, located at altitudes of 110–445 m a.s.l. and with surface areas of 10–360 ha are used for irrigation, drinking water supply, electricity production, aquaculture and recreational fishing.

The benthos fauna consisted of 40 % Oligochaeta, 3 % Gastropoda, 30 % Bivalvia (mostly *Dreissena polymorpha* and *D. bugensis*), 0.1 % Hydracarina, 0.5 % Odonata, 0.5 % Ephemeroptera, 1 % Trichoptera, and 25 % Diptera (16 % Chaoboridae, 7 % Chironomidae, 2 % Ceratopogonidae). Hirudinea, Mysidacea, Decapoda, Heteroptera and Coleoptera were found as well. Highest species diversity was recorded in reservoirs close to the Danube River and in the largest reservoir.

Physico-chemical parameters were analyzed by Principal Component Analysis (PCA). Most of the variance was explained by conductivity, Ca concentration and nutrients. Reservoirs with high values of these parameters were separated from those with low values but high transparency. The diversity of macroinvertebrates is dependent on the environmental parameters and can be used to assess the ecological status. In particular, the role of invasive *D. polymorpha* and *D. bugensis* is discussed.

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Long-term changes of fish fauna in the Hungarian section of the Ipel River

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Setting environmental objectives for rehabilitation of large rivers is hindered by a lack of knowledge of the pre-regulation or reference conditions. Our study was aimed to assess the deviation of the recent fish fauna from its reference state in the regulated lowland section of the Ipel River. Historical habitat analysis and literature study gives a chance for judgement of former fish fauna. Acceptable reports from the fishes of the Ipel River are available mainly from the 19th century and the beginning of the 20th century. The number of observed species increased over time and the occurrence of 57 fish species was reported up to now. The description of recent species composition was based on the results of fish surveys by electrofishing. The comparison of data sets yielded the disappearance of sterlet (*Acipenser ruthenus*) and bullhead (*Cottus gobio*) and increasing abundance of bream (*Abramis brama*), Prussian carp (*Carassius gibelio*) and Ponto-Caspian gobies.

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