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The Development of the Danube Region within the European Union – Importance and Usefulness

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The Danube crosses the heart of the continent and connects many countries and cultures. We remember the Danube Waltz, but on political, economic and social level we give very little reference to this fact. This is not only true for the ecological situation of the river, but especially also for transport, port infrastructure, energy production etc. Just tourism discovered the Danube.

What are the difficulties? Firstly the fact that there is a Danube Commission - although it is not very effective – and that the necessary investments in infrastructure are missing, even though transport on the Danube would be much cheaper than the construction of highways. Highways are not substituted, but a distribution of the burden definitely takes place. There is the „Danube Cooperation Process“ where besides Romania, the „European Commission“ and the „Stability Pact for South Eastern Europe“ also Austria is represented in the chairmanship. Presently programs are under development to mobilise the capacities, but also to set up an agency on European level to deal with inland navigation.

The types of problems are very divers. Obviously it is navigation, because the use of the Danube for the transport of goods is not only practical, but also right from an ecological point of view. Truly it is a huge topic for water management that again will be of high importance for the future development of the Region. It meets questions of water quality as well as „Waste Water Treatment“ in neighbouring regions. The list could be added in any way, but it has to be mentioned that important connections between the countries are created by this. We have areas where bridges are lacking, ports are underdeveloped and lastly it is the common ground of culture that offers an appropriate future.

Karl Markus Gauss once said „The Danube is an experiment that influences the whole world – what fails here, may fail everywhere, what is successful here, gives hope to every other place in the world.“ Ambitiously said. There is nothing to add.

Keywords: Danube Region, Infrastructure Development, Navigation, International Cooperation

Macrophyte highlights: recent advances in aquatic plant ecology

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In our knowledge there is an important progress on the ecology of aquatic macrophyte vegetation in the recent past, in the Danube Countries. Many of these contributions have been provided directly by the members of the IAD Expert Group Macrophytes. Topics cover the relationship of environment and plants, there is also information focused on connectivity aspects and an increasing knowledge on biodiversity, which is a consistent co-product in many studies. But there is a growing information also on invasive species and long-term/short-term changes based on surveys which include results pointing at the influence of climate changes. Of course, this broader knowledge widens the view on topics connected with the implementation of the EU Water Framework Directive and – in the context of restoration, as well as flood management – the possible compatibility, or incompatibility, of its goals with respect to the Habitats Directive as a part of the future development in river corridors.

EUSDR: an EU framework to harmonize development and ecosystem dynamics of the Danube Macroregion for a living and prospering region

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The EU Strategy for the Danube Region is a macroregional strategy covering a broad scope of 11 priority areas from transportation to traditional security. Although it covers 14 countries and several sectors the reference for Danube is not only symbolic in the strategy: the macroregion is defined by the functional region of the catchment basin of the Danube River. With the goal of harmonizing efforts in all priority areas and Danube Region countries for a living and prospering region the EU Danube Region Strategy presents an unprecedented opportunity to integrate criteria of sustainability to human use of ecosystem services and natural resources of the river basin and to optimize their use for the long term development. It is essential that such efforts are based on sound science, monitoring and practical experience. IAD members' findings and future research are therefore invaluable for the strategy.

This integrated approach is well reflected in the action plan of the EUSDR: sectoral priority areas build development strategies on maintaining or restoring natural and cultural heritage, it aims to upgrade or change current river use for energy or agriculture if necessary to utilize sustainable techniques or to integrate water retention and ecosystem restoration to flood protection.

Keywords: Danube Region, macro-regional strategy, integrated policies, management of natural resources

Drinking water abstraction from the Danube

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The Danube and his tributaries serve as an important drinking water recourse for approx. 10 million people. There are 3 solution for the supply. Bank filtration without treatment (linz Budapest), bak filtration with treatment (Bratislava, Novi Sad, Beograd) and direct intake from the river with treatment(Leipheim Water for Stuttgart region, Turnu Severin, Tulcea).

Over the 120 years of the bank filtering history, this procedure has become dominant in the Hungarian public utility water supply systems. The largest producing facilities (Győr, Vác, Budapest, Dunaújváros, Baja) were established beside the River Danube, supplying one third of the total Hungarian population with good quality water that can be produced in a very economical manner. Great care needs to be bestowed upon this treasure, as an irreplaceable condition for living beside the Danube, both nationally and internationally, not only in the present, but also in the near, farther and the remote future. The Danube strategy is most likely going to be not only the pledge of preserving and improving the water quality of the large river, but through monitoring the living space of the bank section ensuring the protection of the water base and the quality assurance as well, which is also of key importance in the long run.

Keywords: Danube, bank filtering, water supply, drinking-water catchments

Have sturgeons a future in the Danube River?

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Stocks of sturgeons spawning in the Danube River (DR) declined dramatically during the past century and this trend has persisted also during the last decade. Identifying and protecting essential wintering, spawning and nursery habitats for sturgeons in the Lower and Middle Danube River are priorities of ongoing research in the DR. Improving in understanding the spawning ecology of sturgeons in the Lower Danube River (LDR) enabled the implementation of regional monitoring of recruitment from natural spawning. Mitigating impact of migration barriers for sturgeons in the Lower and Middle DR by adequate fish passages is now considered as one of the keys for restoring sturgeons in the Middle and Upper DR. To solve the potential impact of ongoing navigation project on the LDR on sturgeons, their movements and ecology are monitored along with progress in construction works. Supportive stocking programmes threaten to affect the long-term conservation of genetic diversity of populations. Only the joint effort of all stakeholders in the Danube River basin, including fishermen communities, can ensure a future for the sturgeons of the DR.

Keywords: sturgeons, historical evolution of stocks, essential habitats, migration barriers, genetic variability and supportive stocking

Lectures

Topic 1

Ecological processes in riverine conditions
(dynamics and interactions between the environmental conditions and the living communities)

Patterns in EPT and fish assemblages structure in the Târnava Watershed (Romania) and implications in sustainable management of rivers

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This study presents the structure and diversity analysis of Ephemeroptera, Plecoptera and Trichoptera (EPT) larvae and fish communities of the Târnava Basin (6157 km²), in correlation with biotope characteristics and models the biotope-biodiversity relations.

The results are based on quantitative benthic macroinvertebrates and fish samples of 18 stations.

The Kruskal Wallis ANOVA non-parametric test and correspondence analysis (CA) revealed that the high diversity of mayflies and stoneflies is conditioned by lithologic substrate, ligneous riverine vegetation and banks natural dynamic. Low mayflies, stoneflies and caddisflies diversity is associated with embanked, without vegetation banks and coarse sand substrates. The fish high diversity is associated with alternating pools and runs sectors, river bed high depth and width, banks with natural dynamic and ligneous riverine vegetation.

The Pearson correlation reveals the fact that the high diversity of stoneflies and mayflies is correlating with water oxygenation and low biochemical and chemical oxygen demand.

A hierarchical typology of the studied rivers EPT and fish assemblages was obtained using clustering method. Each assemblage of the typology was analysed in correlation with 15 biotope variables.

Mathematical models were developed to forecast the EPT and fish communities' structures and dynamics in the conditions of the biotope variables changing induced by human activities impact, and to be watershed management tools.

Keywords: Ephemeroptera, Plecoptera and Trichoptera, fish, assemblages structure patterns, Târnava Basin, Romania.

Trophic structure of the ichthyofauna of the Danubes ripal zone and three adjacent wetlands in Bulgaria

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A comparative analysis was made about the basic trophic features of fishes in the ripal zone along the Bulgarian section of Lower Danube and in three adjacent wetlands – the Orsoya marshland and the lakes Malak Preslavets and Srebarna.

Complex of trophic attributes were used for revealing the interrelationship among the ichthyocenoses in each studied site. Models of the food web were built using PowerPlay software for qualitative modelling of trophic webs (Loop analysis). Statistic software packages “PAST” and “PRIMER v.6” were used for data processing.

In total 69 food items were identified in the diet of 24 fish species. Four trophic groups constituting the food web of fish community were distinguished through the food items' volumetric contribution in the analysed guts – piscivores, herbivores (feeding on phytoplankton, benthic algae and/or macrophytes), zoobenthivores and omnivores. Unlike the common literature data, in the riparian zone the Bleak *Alburnus alburnus* was identified as zoobenthivorous and the Nase *Chondrostoma nasus* as herbivorous species.

Fish community in the Danube ripal zone was characterized with relatively simpler trophic structure than in the adjacent wetlands, most probably because of the less diverse trophic resources.

Keywords: food webs, loop analysis, diet composition, trophic resources

Life table model of the Pontic shad (*Alosa immaculata* Bennet, 1835) from the River Danube and the Black Sea

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Pontic shad (*Alosa immaculata*) in the Lower Danube Region (LDR) still represents an economically valuable fish species, despite habitat fragmentation, pollution and exploitation. Except few scientific investigations within LDR countries, detailed analysis of this species and stock monitoring are still not properly introduced. Annual landings in Romania exhibit large fluctuations, with several years characterized by an increased population abundance being followed by several with low ones. We developed a simple life stage model of the Pontic shad population in the Danube and Black Sea, to assess the state of its population in this region. While such deterministic model makes a simplification of the population dynamics and makes a number of assumptions that are rarely met in nature, it is nevertheless useful as a preliminary tool for the population assessment, based on the limited available data. The model provided the evaluation of the population sensitivity to changes in different life history parameters, as well as the determination of the maximum sustainable fishery pressures. Obtained results could be helpful as an evaluation tool for the Pontic shad fishery management activities within the region.

Keywords: Danube, Black Sea, Pontic shad, life stage model

Heavy metal accumulation in tissues of pikeperch (*Sander lucioperca*), European catfish (*Silurus glanis*) and carp (*Cyprinus carpio*) from the Danube River

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The „*Fish as bioindicators of Serbian open water quality*“ Project includes testing of heavy metal accumulation in tissues (muscle, liver) of several fish species, from several trophic levels, in the middle Danube section. Samples of economically important species: pikeperch (*Sander lucioperca*), European catfish (*Silurus glanis*) and carp (*Cyprinus carpio*) were collected at the 1170 river kilometer of Danube River (Belgrade section), where a strong influence of communal and industrial wastewater exists.

We compared differences among these species and their analysed tissues: liver and muscle, in regard to the concentration of 8 elements: As, Cd, Cu, Fe, Hg, Mn, Se and Zn. Statistical tests showed the significant influence of fish species, different tissues, as well as their mutual interaction on concentration of all 8 elements in tissues. The fish species was a factor inducing significant changes in concentration of these elements in tissues. The other test showed the very significant influence of fish tissues in concentration of the following elements: Cu, Fe, Mn, Se, Zn and Cd. Their interaction between fish species and tissues was significant in respect of the concentration of all elements, except for Mn and Se. Post-hoc data comparison between concentrations of elements in tissues of these species were also evaluated.

Keywords: Danube, heavy metal, accumulation, trophic levels

Small-scale variation of phosphate in the River Danube and its ecological implications

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Phosphorus is known as the nutrient element limiting the growth of algae and macrophytes in most freshwaters. Many studies on phosphorus-limited growth have focused on effects of large phosphate additions that can well explain ecosystem changes caused by eutrophication and its exhaustion during re-oligotrophication. The importance of small-scale phosphate sources for ecosystems, however, is not well understood. In the present study, we analysed the range of diurnal variations of phosphate concentrations from hourly measurements in the River Danube in comparison to a lake. Furthermore, we analysed literature data of phosphate point sources by animal excretion in rivers compared to other marine and freshwater systems. Finally, we discuss the ecological implications of such small-scale phosphate sources. We present data from experiments and calculations, which support the idea that algae, in principle, is able to utilize small and short-lived phosphate sources supplied during the day-night cycles and zooplankton point excretion.

Keywords: Danube, nutrient uptake, algae, zooplankton, fish

Topic 2

Longitudinal, vertical and lateral connectivity in riverine landscapes (*in the main channel, side arms and active river-floodplain systems, effects of water regime*)

Small lentic backwaters of the Danube floodplain in Linz as refuges for rare macrophytes

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Aquatic macrophyte distribution was surveyed four times a year during the vegetation periods in 2001 and 2002 in the Danube floodplain at Linz (Upper Austria).

Abundance of 46 aquatic species was assessed in 136 contiguous survey units (SUs) in a chain of lentic water bodies representing a cut-off Danube side-channel.

For each SU length, sediment type, water temperature (bottom and surface), macrophyte rooting depth and the percent of shading by trees were measured.

An Indicator Species Analysis proved the following species in at least one water body as significant and with high indicator values: *Potamogeton lucens* (100), *Glyceria maxima* (100), *Stratiotes aloides* (99.9), *Rumex hydrolapathum* (96.0), *Potamogeton berchtoldii* (88.2), *Fontinalis antipyretica* (87.5), *Nitella opaca* (86.9), *Utricularia vulgaris* (76.2) and *Chara globularis* (74.9).

Pairwise comparison by Multi-Response Permutation Procedures showed significant differences between all water bodies ($p < 0.005$).

A Detrended Correspondence Analysis (DCA) was calculated for illustrating, how environmental parameters relate to the macrophyte distribution.

Our results indicate that with cutting off this Danube side arm from the main channel, individual character of these small water bodies was mainly influenced by local environmental parameters, enabling a local individual flora to establish.

Keywords: Natura 2000, floodplain restoration, aquatic plant diversity, floodplain ecology, Red List species

Potamoplankton primary productivity in side-arms, floodplains and major tributaries of the Danube

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Data on composition, biomass, photosynthetic rates and primary productivity of the algal plankton in the Danube, its side-arms, floodplains and major tributaries as well as from impoundments and delta lakes have been collected from the literature and own observations.

The results are analysed with respect to the longitudinal, vertical and lateral connectivity and evaluated in the context of common river concepts.

Differences and similarities in the composition, productivity and relation to submerged vegetation of the algal plankton are described for different regions along the entire Danube. Results are compared to investigations in other large rivers of the world.

Keywords: Danube, floodplain, potamoplankton, productivity

Morphological, topographical and physicochemical characteristics of River Danube wetlands in Bulgaria

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We presented several morphological, topographical and physicochemical characteristics of aquatic bodies of eight wetlands (Orsoya, Pischin, Murtvo blato, Dyulova bara, Brushlen-Kalimok, Maluk Preslavets and Srebarna) and river branches close to Belene village, all located on Bulgarian territory of the River Danube's flood area in spring, summer and autumn 2011.

The results includes data about wetland locations, their bedrock and soil components, area and depth of water bodies and a kind of connectivity to the river, percentage of water surface covered by macrophytes, water column transparency, temperature, conductivity, oxygen saturation, pH, as well as concentrations of main nutrient soluble compounds (ammonium, nitrite, nitrate and phosphate).

We compared the wetland characteristics with water level variations of the River Danube and drew conclusions for the river's influence on the events in wetlands during a year of pronounced low water regime. We also classified the wetlands in groups reflecting the differences caused by locations and seasons, had been obtained by cluster and other multiple analyses.

Reasons for recent wetland situation and possibilities for ecological status improvement are discussed.

Keywords: Lower Danube, wetlands, environmental characteristics

Composition and short-term dynamics of zooplankton and macrozoobenthos communities in two wetlands on the Bulgarian Danube floodplain

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Spatial distribution and temporal changes in the composition of both the zooplankton and the macrozoobenthos communities were studied in two model wetlands adjacent to the Danube.

Different hydrological regime characterizes the wetlands. The Malak Preslavets Marsh, fed only by inland waters, keeps constant water level and it is regarded as unaffected by the hydrological regime of the Danube River. Contrariwise, the Orsoya Marshland is characterized by periodic flooding at high Danube waters. At low waters large variations in the water level of different water bodies within the marshland can occur until a complete drying of some of them.

Quantitative zooplankton and macrozoobenthos samples were collected seasonally from spring to autumn in 2010 and 2011. Comparative analysis (PAST data analysis package and Primer software) of the quantitative parameters of the species composition was made.

In the lake of Malak Preslavets the zooplankton is characterized with higher species richness than the macrozoobenthos while in the Orsoya Marshland both communities are equally well represented.

As a whole, higher species richness of both zooplankton and macrozoobenthos communities occurred in Orsoya Marshland than in the Malak Preslavets, corresponding to the higher diversity of microhabitats formed under variable hydrological regime.

Keywords: Danube, flooding regime, zooplankton, macrozoobenthos, species richness, habitat diversity

The distribution and abundance of genus *Potamogeton* in Slovenian rivers

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This contribution presents the genus *Potamogeton*, which is the most abundant genus in the studied Slovenian watercourses, presenting nearly 20% of total macrophyte biomass. For the purpose of this study, 40 rivers divided into 1228 stretches were examined. We determined 8 different *Potamogeton* taxa, among which *P. nodosus* was the most abundant having the highest RPM value, followed by *P. pecinatus* and *P. natans*. Three hybrids were also found, namely *P. x salicifolius*, *P. x cooperi* and *P. x zizi*. Each one of them was found at one location only. Species of the genus can be found in slow, as well as in fast flowing waters with wide range of ecological status. Five species found in studied watercourses are listed on the Slovenian Red list. *P. berchtoldii*, *P. lucens*, *P. nodosus* and *P. perfoliatus* are classified as vulnerable, *P. trichoides* as endangered. Indicator values of *Potamogeton* species are also discussed.

Keywords: *Potamogeton*, rivers, distribution

Effect of hydrological connectivity on nutrient availability and primary production patterns in Danube floodplains

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Aquatic primary production is a key issue for the ecological integrity of riverine wetlands. Autochthonous organic matter derived from primary production is commonly more labile and easier to assimilate than allochthonous carbon from the catchment and it is expected to be a crucial carbon source for riverine food webs. As a consequence aquatic primary production is of high importance in nutrient retention and self-purification processes of the river. In the Lobau, an urban riverine wetland within the borders of Vienna, Austria, nutrient availability is determined by external and internal processes. The wetland is a back-flooded lake system, where the hydrological connection with the main channel is established up to 137 days/year in the lower parts of the Lobau. It comes along with high nutrient input, which, combined with still sufficient light availability, can provide optimum conditions for algal primary production. As a consequence, phytoplankton is dominating aquatic production and the nutrient retention potential is high. In isolated or low connected parts of the wetland, macrophytes become more important. Connection is established only during floods and nutrient inputs via the river are rare. Internal processes like anoxic phosphorus released by the sediments are of some importance for algal primary production.

Keywords: Danube, nutrient-cycling, modelling

Topic 3

Changes in biodiversity (*interactions of metapopulations, invasive species, the Danube as ecological corridor, status of nature conservation*)

Topic 3: Changes in biodiversity

Life history of invasive Ponto-Caspian mysids (Crustacea: Mysida) in the River Danube, Hungary

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The Ponto-Caspian mysids *Limnomysis benedeni* Czerniavsky, 1882, *Hemimysis anomala* G. O. Sars, 1907 and *Katamysis warpachowskyi* G. O. Sars, 1893 performed remarkable range expansions in the past decades. To reveal their life history patterns, samples were taken with an approximately weekly frequency in an artificial embayment of the Hungarian Danube section in Budapest (river km 1640), where the three species coexist. The relatively large (up to 10.8 mm total length) *L. benedeni* had five generations per year and produced comparatively low numbers of young, while the similar sized (up to 11.2 mm) *H. anomala* completed only four generations, but compensated for this with a higher fecundity. The smaller sized (up to 8.6 mm) *K. warpachowskyi* was able to produce more than five generations per year owing to its short maturation time and attained brood sizes close to those of *L. benedeni*. The populations of every one of the three species in the present study appear to feature with smaller individuals than those in or close to their native ranges, whilst their fecundity is higher considering their sizes. The evaluation of the role of potential factors, responsible for this pattern (i.e. life history adaptation, genetic differences, environmental variables), requires further studies in different regions and environments.

Keywords: *Hemimysis anomala*, *Katamysis warpachowskyi*, *Limnomysis benedeni*, number of generations per year, reproduction

Changes in dragonfly diversity in the Slovakian Danube inundation area after Gabčíkovo – The beginning of Hydropower Structures's operation

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From the start of the hydropower structures's in 1992, the changes in the structure of dragonfly assemblages have been monitored so far. Since 1995 dragonflies have been surveyed regularly at 6 localities, which belong to 4 channel types (epipotamal, parapotamal, plesiopotamal and palaeopotamal). Three localities are situated above the dam and three localities below the dam. During the long-term research α diversity showed only small changes at the parapotamal arm, declined at the plesiopotamal arm and had low values at epipotamal. Altogether there has been found out 37 species of dragonflies. Only one species: *Sympetrum pedemontanum* has disappeared from the plesiopotamal arm since 1992. One of the suggested arrangements for preventing dragonfly diversity loss is the periodic flooding of the arms, which are not more connected with the Danube.

Keywords: dragonfly diversity, epi-, para-, plesio- and palaeopotamal arms

Historical distribution, current situation and future potential of sturgeons in Austrian Rivers

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Worldwide, the family of sturgeons is close to extinction. Reasons are different human factors like energy production in rivers with the interruption of the river continuum, the pollution of water bodies and overfishing because of the valuable caviar.

The Danube has five native sturgeon species, which partially used to migrate up to the Bavarian Danube for spawning. The exact distribution of the various species within the Danube remains still unclear. In the Austrian part of the Danube only small quantities of the starlet (*A. ruthenus*) can be found, which are threatened with extinction. In the last years sturgeon stocking (accidentally and on purpose) and catches increased throughout Austria. Unfortunately many of these fishes are of allochthonous sturgeon species. It is imminent to undertake steps for protection and support of the remaining population of sterlet and to evaluate other stretches regarding their potential of supporting a viable sterlet population. Measures for reintroduction have to be closely monitored, as stocking programmes in the past didn't have a significant impact on catches.

The objective of this study was to summarize all available data about sturgeons in Austrian waters to get a picture of their historical and current distribution and to use the gained data to evaluate the potential of Austrian rivers for sturgeons.

Keywords: sturgeons, sterlet, Austria, alien, Danube

Genetic diversity of adult sturgeons captured in the Lower River Danube between 1998 and 2011

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The present study aimed to assess the genetic variability within the cohorts of stellate sturgeons (*Acipenser stellatus*), which migrated for spawning in the Lower River Danube (LDR) between 1998-2011 and to establish a correlation between stellate sturgeon groups (spring / fall migrants) and young-of-the-year (YOY) stellate sturgeons captured in 2009 and 2010.

Screening of the genetic variability using PCR RFLP of mtDNA in the *D-loop region*, considerable genetic variability was found supporting the hypothesis of reproductively isolated groups / subpopulations within the stellate sturgeons spawning in the LDR. This demonstrates the existence of successive spawning events of stellate sturgeon in the LDR.

Keywords: stellate sturgeon, genetic variability, natural spawning

Acoustic telemetry study of adult sturgeons of movements in the Lower River Danube (rkm 375 –175) in 2011

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We present the results of the first year (2011) of monitoring the impact on sturgeons by ongoing constructions made for the improvement of conditions for navigation on the Lower Danube River (LDR) between Braila and Călărași (rkm 175 - 375). To improve navigation on this sector of the LDR, the branches Caleia and Bala will be partially closed by bottom sills. Between June – December 2011, 38 adult sturgeons (25 belugas, 11 stellate, 1 Russian sturgeon and 1 sterlet) were implanted with acoustic transmitters with depth and temperature sensors. The array of 18 submerged data-logging receivers covered 250 km of the LDR provided data about the movements, swimming depth and temperature preference of 25 out of 38 tagged sturgeons. 13 specimens could not be recorded. Recorded migration ground speed for stellate sturgeon was 1.09 km/d (local movement, upstream), for beluga between 24 km/d (downstream) and 9.14 km/d (upstream). The range of swimming depth was between 1.36 and 24 m below the water surface and the temperature preference in wintering habitats was 5.8 – 3.8 °C. To our knowledge these are the first swimming depth data recorded of adult sturgeons in the River Danube, which may have a significant contribution in understanding and predicting their behaviour in relation with the construction of bottom sills.

Keywords: sturgeon, Lower Danube River, acoustic telemetry, bottom sill, navigation

The conservation status of plants in the Kopački rit Nature Park (Croatia)

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Within the implementation of the action plan for conservation of the aquatic and wetland habitats, floristic field research has been carried in the area of Kopački rit Nature Park between 2010-2011. Result is an updated inventory list of vascular plants recorded in various terrestrial, aquatic and wetland habitats of the Kopački rit, comprising in total 446 taxa, which makes 8,3% related to 5,347 taxa of vascular flora of Croatia. Rufous Bulrush (*Scirpus pendulus*) has been found, which is the first record of this adventive species for the Croatian flora. Such plant diversity is typical for the riverine wetlands.

An assessment of the conservation status of plants has been made. The number of rare, endangered or protected plants is 112 species or 25% of total flora and many of these were found at new localities. Red Book of Vascular Flora of Croatia includes 38 plant taxa, among which 5 as critically endangered, 7 as endangered and 12 as vulnerable. Additional 14 species are listed under the near threatened or data deficient categories. Causes for changes in biodiversity in Kopački rit Nature Park are: increased fluctuations in flooding intensity of the Danube River, prolongation of a dry season, accumulation of bedloads and natural succession of the marshland.

Keywords: Kopački rit, Croatia, plant, biodiversity, conservation

Spatial and temporal patterns of weed-bed fauna diversity in different habitats of Sfântu Gheorghe arm of the River Danube (Romania)

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“The impact of hydrotechnical changes on the ecological systems of the Sfântu Gheorghe arm in the wider context of the sustainable development” - a project of the Romanian Academy - focuses on the lotic water bodies with different hydrological characteristics. During 2008-2010, detailed water chemical and biological surveys were conducted at 7 sampling stations, placed between rkm 7 and 92 along the Danube River arm. Three hydromorphologically different segments/ habitats were sampled: i) the free-flowing sections (reference), ii) the meanders cut by canals and iii) the newly built canals (between meanders in order to short the way). The analyses of the weed-bed fauna communities revealed a total of 16 taxa, as well as spatial and temporal patterns of their distribution. The highest diversity was generally recorded in summer and in the natural sections and cut meanders. In the newly built canals, the taxa were less abundant but the values of equitability were higher. Diversity indices and statistical relationships are presented and discussed. The variability patterns could be explained by the differences of hydrological regime, other abiotic characteristics of the ecological systems and by the seasonal changes as well.

Keywords: Danube River, lotic systems, weed-bed fauna, diversity, spatial and temporal variability

Sturgeon conservation in the River Danube Basin: How to implement the Sturgeon Action Plan 2005

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A recent analysis of the “*Sturgeon Action Plan (SAP) 2005*” under the Bern Convention revealed changes in the status of different sturgeon species and new threats such as invasive species and climate change. The review of current information, however, makes clear that several main issues such as reference conditions, current status of sturgeon species (life cycle), key habitats, migration patterns and ex situ brood stock to sustain sturgeon populations remain largely unknown. The analysis of the post SAP period shows little progress in sturgeon protection and management, although it is supported by ICPDR documents and the new EU Danube Strategy. In particular, the lack of public awareness and governmental involvement to implement legal requirements and coordinated measures is evident. Such public and political commitment is crucial, otherwise the catch bans in Romania and Bulgaria may not be effective. While research must be intensified and coordinated, a key role is given to the harmonization of national legislation, control of poaching and the domestic caviar market, management of hatcheries, and economic incentives for local communities. An outlook provides the realistic possibilities to fasten and improve the SAP implementation and strengthen sturgeon protection and conservation in the Danube River Basin and the Black Sea.

Keywords: EU Danube Strategy, sturgeon policy, public awareness, scientific state-of-the-art, conservation measures

The diversity of Hydrophytes in Lower Tisza River

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The Lower Tisa is a 150 river km long part of the river that runs through Serbia. The survey of aquatic plants in the Lower Tisa was undertaken during the time period 2004-2010. The methodology applied in the survey is in accordance to the WFD EC. The main aim of the survey was to list the plant species and to estimate their abundance according to the five-level descriptive scale, in each river km - survey unit. The list of recorded plant species and their estimated abundance in survey unit was the base for calculation of: species richness, Shannon diversity index, and Evenness, in each survey unit. The next step in the study was the spatial analyses of diversity parameters. Since the survey units are the continual sections along the river, it was possible to observe the longitudinal (upstream-downstream) trends in diversity. The studied plants belong to the ecological group that contains limited number of species in the given eco-region. The main aim of the study was to test the indicative capacity of their diversity parameters. Analyses of the aquatic plant species diversity showed that the species diversity parameters have the great potential to indicate the hydrological conditions of the river.

Keywords: aquatic macrophytes, Serbia, distribution, impoundment

Topic 5

Danube as drinking water resource
(hydroecological aspects of water resources protection, soil as filter for pollutants)

Topic 5: Danube as drinking water resource

Calculation of the transit time and the portion of river water in riverbank filtration systems – effects of the Danube water quality in the production wells (Szentendre Island, Hungary)

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In riverbank filtration systems, water quality in production wells largely depends on the water quality of the river. This process is governed by e.g. the composition of the colmatation layer, the transit time and the dispersion. Here the latter two are addressed.

We give the mathematical description of the lumped parameter approach, which is used for the quantitative interpretation of environmental tracer data. A typical application of stable oxygen isotope ($\delta^{18}\text{O}$) measurements is shown at Szentendre Island aquifer. The input (Danube) is very close to the output (multiple collector well), thus the method can only be used to analyze single oxygen isotopic peaks in a six-month (long) time series. We point out the cases when the method cannot be used, i.e. when difference between the input and the output oxygen isotopic composition is small. The method helped to define the transit time of the water from the Danube to the collector well, although the water level of the Danube changed in time.

Keywords: riverbank filtration, lumped parameter model

Microbiological pollution and anthropogenic faecal impact in the Danube River basin

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Microbiological contamination from faecal pollution by anthropogenic sources is considered to be a crucial problem throughout the Danube river basin. Thus, detailed knowledge on the extent and the origin of microbiological pollution is essential for watershed management and various types of water use, i.e. recreational activities, irrigation and especially for drinking water production purposes.

As a first step of this study we draw a clear picture of the microbiological pollution patterns along the whole longitudinal profile of the Danube by combining data on faecal indicator concentrations taken along the Danube and its major tributaries during two whole-river surveys and at 16 permanent stations. By including a variety of environmental variables in statistical analysis, an integrative picture of faecal pollution in the Danube river basin is evolved (Kirschner et al. 2009: Water Research 43: 3673). Moreover, a new concept, using human associated faecal markers as source tracking tool, was tested and implemented for this large river system (Reischer et al. 2008: Large Rivers 18: 117).

The analysed data indicate that the planned implementation of new wastewater treatment plants and wastewater treatment measures according to the European Union urban wastewater directive will have the potential to further reduce faecal pollution levels. As a consequence, the water quality will improve with regard to the Danube as a resource for drinking water production.

Keywords: microbiological pollution, Joint Danube Survey, Transnational Monitoring Network, tributaries, microbial source tracking

Carbon dynamics in soil and vegetation of riparian forests of the Danube River (1910 – 1889 rkm, Austria)

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Carbon stocks in soil and vegetation of riparian forests may be altered significantly by human activities such as dike constructions. We studied carbon pools in river sediments, aboveground biomass and fine-root biomass of riparian forests along spatial gradients at 96 sampling sites in Donau-Auen National Park, comparing both sides of the Marchfeld dike. Additionally, soil carbon increments were assessed using dendrogeomorphological methods on 48 study plots. Historic carbon sedimentation rates of soil in diked floodplain forests ($1.5 \text{ t ha}^{-1} \text{ a}^{-1}$) were significantly lower than in recent floodplain forests ($2.9 \text{ t ha}^{-1} \text{ a}^{-1}$). However, soil carbon pool of diked floodplain (264.4 t ha^{-1}) is significantly higher than in recent floodplain (199.7 t ha^{-1}). Aboveground biomass was similar on both side of the dike, but we found significantly higher C pools of fine-root biomass in inactive floodplain forests (4.0 t ha^{-1}) compared to recent floodplain forest (2.3 t ha^{-1}). Our models show that dike construction loses its predictive power, if spatial parameters are considered (relative influence 33-82%). We conclude that dike construction had forests within a time range of 150 years. River engineering and restoration measures should be re-evaluated considering carbon sequestration as relevant ecosystem service.

Keywords: fine root, riparian forest, carbon dynamic, soil, vegetation,

Topic 7

Environment and the implementation of the EU WFD: rehabilitation or sustenance of ecological function, good ecological status according to WFD, good conservation status of *NATURA2000 sites, monitoring*

Hydromorphological assessment of rivers in the Upper Tisa Basin

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Hydromorphological assessment was implemented in the River Tisa (from the confluence of the Chorna Tisa and the Bila Tisa to Tyachiv city) and in its tributaries. The methodology was based on the Slovakian approaches related to the EU WFD and the local peculiarities of hydromorphological conditions were also taken into account.

In the Tisa two water bodies were identified: one of both from the confluence of the Chorna and the Bila Tisa to the mouth of the river Visheu; the other from the river Visheu mouth to Tyachiv city. Hydromorphological assessment diagnosticated II (good) hydromorphological status in both water bodies. Hydromorphological assessment stated worse status in the River Bilyi and in the first order tributaries (Visheu, Kosivska, Shopurka, Iza, Apshytsa, Sepynza, Teresva, Tyachivets). II (good) hydromorphological state was established in two cases from nine (Iza, Tyachivets), III (moderate) state was determined in three cases (Visheu, Kosivska, Shopurka) and IV (poor) state was established in four cases (rivers Bilyi, Apshytsa, Sepynza and Teresva).

Bank, riparian zone and floodplain were the most altered from the four assessment objectives. It was caused by significant human pressures and river engineering.

Substrate analysis and evaluation of channel forming processes are proposed for hydromorphological assessment. Active river channel deformations were identified as an increase of vertical channel distortion caused by continuous bank revetment. Several types of river sections (with developed and not developed alluvium forms, meandering and braided) have been changed by natural drivers (disastrous floods) and human interventions (bank protection, etc.).

A hydromorphological monitoring system was developed. Preservation, improvement and rehabilitation of hydromorphological state of rivers in the Upper Tisa Basin are recommended.

Keywords: Upper Tisa Basin, hydromorphological assessment, ecological state, river channel processes, substrate.

Topic 8

Technical aspects and the implementation of the EU WFD: ecological effects of water engineering facilities (*barrages, object of flood protections and bed regulations*), **navigation**, **hydro-power** (*direct and indirect effects, short and long term observations*)

Virtual reality training of plant mass estimation

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The assessment of aquatic macrophytes in running and still waters by estimating the plant mass is a widely accepted method with regard to the Water Framework Directive/EU. Although the method itself is easily applied, a training of the experts is necessary to get comparable results. We use a game development tool to train experts in a three dimensional virtual reality. The experts can do their estimates on different scenarios (running and still water) which can be generated with different plants in a randomized environment. The situation and the plant mass estimates worked out by the trainees can be stored, used for evaluation of the results and can be compared, validated and discussed to improve the assessment skills of the trainees. The development of the tool is a co-operation between the TGM, Höhere Lehranstalt für Informationstechnologie, Vienna and the University of Vienna, Department of Limnology.

Keywords: virtual reality, aquatic macrophytes, water framework directive, training tool

A novel hydro-acoustic approach on assessing aquatic macrophyte biomass data

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We developed a method using a conventional fishery sonar to map submersed macrophytes in surface of water bodies and to distinguish between solid ground, muddy sediment and the “plant canopy” of submerse vegetation. As the hydro-acoustic signal is stored together with GPS coordinates this information can be used for developing a three dimensional model which provides a basis for assessing the biomass of the aquatic macrophytes. The method reduces the assessment of aquatic macrophyte biomass to echosounding the water body, mapping the shorelines and sampling the species distribution, on which the biomass can be calculated.

This method has been tried in different water bodies and in a lake near Vienna, Austria, in detailed seasonal mappings over a full year.

Keywords: hydro-acoustic, biomass data, aquatic macrophytes

Narrowing of the Danube channel –morphological/sedimentary aspects and ecological consequences (1841-1822 rkm, Slovakia)

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An extensive narrowing of the Danube's channels can provide an illustration of sedimentary/morphological and ecological response to environmental changes.

The study covers a 21 km-long section of the left bank in the bypassed channel of the River Danube located down-stream at the Čunovo dam (river-km 1841-1822). It comprises seven lateral and point bars consist of the gravel with the length from 1.5 to 3 km and width about 150 m which have been emerged due to decrease in discharge since 1992, when the Danube was by-passed.

The analysis of aerial photographs of four situations (1986-before bypassing, 1996, 2003 and 2010-after bypassing) was conducted in GIS environment. Areas of main landcover types (such as bar surface, scarcely vegetated area, young willow forest) were estimated and landscape metrics have been computed in FRAGSTAT software. For the interpretation of spatial variability and changes in land cover categories, water level, geomorphological and sedimentary research across 15 cross-sections has been implemented.

Finally, the conceptual model of vegetation succession and sedimentary/geomorphic behaviour of "new floodplain" has been carried out for the study reach.

Keywords: Danube, channel, narrowing, bar, succession

Topic 9

Restoration ecology, landscape ecology, land use (*restoration needs and plans; planned and realised projects along the Danube; experiences and observations*)

Aims, needs, ecosystem service trade-offs and restoration approaches for an urban floodplain in Vienna Austria

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Floodplain ecosystems provide multiple functions and services of importance for human well being and are of strategic importance for different fields at catchment scale. Especially urban floodplains can be areas of conflicting interests ranging from different land use types, flood water retention, drinking water production and recreation to conservation of last remnants of former riverine landscape, as it is the case in Vienna in the urban floodplain of the Lobau. The structure of the Lobau has been changed due to the regulation in the 19th century, but still harbours have a high number of endangered and protected species and an overall high species diversity. As the quality of aquatic habitats is predicted to decline, restoration approaches are needed. Thus, a planning and decision making process need to rely on sound scientific analyses, but also has to involve conflicting objectives in this area, trade-offs, uncertainties and different value judgments. Multi criteria decision analysis framework provides methods and steps to integrate these different objectives that decision making can become more informed and transparent. This study implemented integrated definition of aims, needs and deficits, as well as to answer these issues ecological modelling, trade-off and multi criteria decision analyses for several management options developed for the restoration of the Lobau floodplain in Austria.

Keywords: Danube River, hydromorphological alterations, ecosystem restoration, EU Danube Strategy

Balancing Measures and Infrastructure Planning – restoration of semi-aquatic habitats

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Infrastructure development is a key task in the Danube Region and this process will last for at least one more generation, until most ideas concerning navigation, railways, roads, ports, waste water plants and hydro power plants are implemented. The EU Macro-regional Strategy for the Danube Region clearly faces the complexity of this development with its political, technical, ecological and social aspects, but the practice has to be proved in every single project. It is the implementation phase where many good ideas can fail, because single pointed and short-termed interests easily can gain influence. The instruments are “Strategic Environmental Assessments” (SEA) and “Environmental Impact Assessments” (EIA). When a SEA assesses the compatibility of a project with existing programs and plans, the EIA directly clarifies the expected impact on plants, animals and their habitats, the human environment and the natural resources water, air, soil and landscape.

What does it need to fulfil the expectations in an EIA:

The first step is an alternative assessment. Still many projects fail already in this stage.

An investigation design that includes all relevant topics. It is still important to mention that only field work can answer the questions concerning possible impacts of a project.

The conflicts arising from a project afford a detailed assessment including all aspects.

The used methods have to follow comparable guidelines. For example the huge trans-European railway net with the tunnel sections of Brenner and Semmering area have led to experience in this field.

Balancing measures are a rather modern tool to mitigate impacts. Especially the initiation of new habitats has huge chances and there is a wide range of experience in the use of measures.

Public involvement is not only a formal requisite, it is an instrument to make sure that local population has all relevant informations.

Besides investigations and the assessment process the creation of balancing measures and their implementation during the construction period are the critical factors concerning the impact of projects on the environment.

Keywords: Danube Region, Environmental Impact Assessments, Infrastructure Planning, Ecological Restoration, Habitat Protection, Species Protection, Balancing measures

Metacommunity structure in a floodplain system – implications for restoration

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The relative importance of local and regional scale processes in structuring species assemblages is determined by metapopulation and metacommunity ecology. Recent studies show that differences between species and species groups in species traits are of high importance within this framework. Using an aquatic gastropod community in a floodplain system we could show that niche breadth, as well as colonization ability of species has a strong impact on the importance of environmental vs. spatial processes for community structuring. Specialist species succeed locally due to competitiveness and risk reduction strategy via drift prevention, whereas generalists may succeed regionally due to risk spreading strategy via high reproductive output, high dispersal rates and adaptability to various habitat types, while they have a low efficiency in local habitat utilization. Our findings have far-reaching implications for river-floodplain-restoration schemes. The main technique in river-floodplain restoration is at present the enhancement of the lateral integration between the river and its floodplain by side-arm reconnections. Thereby the network structure and the habitat connectivity of the river-floodplain-system are significantly altered with subsequent effects on the relative importance of spatial and local processes in structuring metacommunities. Thus, the understanding of the spatial context for habitats within river-floodplain networks is of central interest for river management.

Keywords: wetland, metacommunity ecology, mollusc, floodplain

The ecological value of the Lower Danube islands and their importance for the conservation of biodiversity

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Due to the considerable loss of floodplains along the Lower Danube, site specific floodplain habitats and communities disappeared all the same on a large scale. Merely small strips of land with characteristic habitats that are subject to regular floods persisted on the river banks. These habitats with their site specific biodiversity are, however, also developing on the numerous Danube islands that are presently influenced by hydro-morphodynamic processes. With the formation of flood channels, sand and gravel banks, the islands offer possibilities to study and follow the evolution of habitats and their vegetation along ecological gradients, from the open banks with pioneer settlements of species to soft- and hardwood forests comprising a large variety of transition stages. Based on personal studies exemplified on chosen islands, the author presents their importance as representative for near natural floodplain habitats and their evolution processes, as home for many species and as biodiversity pools of a high conservation value. These studies demonstrate that the Lower Danube cannot be considered as a heavily modified water body, even though changes occurred in the hydrological regime over the last four decades, following the construction of the Iron Gate power plants. The protection of the islands that include habitats and species of Community interest with a high ecological value is a problem of high priority as they are endangered by transformation or loss as a consequence of modern shipping way plans. The islands and their biodiversity also serve as examples of site characteristic habitats that can be used for the restoration of transformed floodplain ecosystems on the river banks during planning processes.

Keywords: floodplain habitats, biodiversity, Lower Danube

Restoration potential in the River Danube Basin, with focus on lower river courses of the Danube, Mura and Drava

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Originally the Danube basin floodplains would cover an area of 26,500 km², which is equal to about 3.3% of the total catchment. In recent history, 80% have been cut off by dikes and dams for flood control, hydropower generation or to improve navigability. River regulation, rectification and floodplain loss changed the hydromorphological conditions for many major rivers and also caused the loss of large water retention areas, the acceleration and unfavourable superimposition of flood waves, the local increase of flood peaks and the loss of functional wetlands and their ecological services.

The aim of the studies commissioned by WWF (since 2009, three studies with increasing spatial resolution were carried out, for the whole Danube basin and for the lower Danube, Mura and Drava rivers) was the assessment and prioritisation of potential restoration areas to support national and international activities in respect to nature conservation, the ecological status improvement under WFD and flood mitigation. Aside of the review of existing and planned major restoration projects, new areas are proposed based on continuously available data sets including land use, spatial configuration, hydromorphological intactness, overlapping protected areas and different floodplain types.

For the Danube itself in total 196 areas are identified amounting to 810,228 ha in total. For an initial prioritization approach only parameters with sufficient data coverage, such as overall hydromorphological intactness, land use, protection status and area size were analysed. Of the planned and proposed areas, 33 (19%) receive a “very high” restoration potential rating, 98 (56%) a “high” and the remaining 45 (25%) only a “moderate” rating. The total proposed area would have a significant effect on flood mitigation. A total capacity volume of about 13.5 billion m³ can be estimated. Further indications of expected costs, socio-economic indicators and feasibility are assessed for selected cases only.

Keywords: Floodplain and river restoration, prioritisation

First effects of the enhanced Water Dynamic due to a Floodplain Restoration Project on the vegetation

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Since the 1970s the upper Danube has been disconnected from its floodplain by the construction of dams and barrages. Owing to this the investigation area (near Neuburg, Germany) was flooded only every 10 years. As a consequence hardly any water or sediment dynamic occurred, which resulted in a change of the vegetation (terrestrialization). To turn this development and restore the typical floodplain habitats, a project was started in 2010, which aims to bring back a new man-controlled dynamic of water, groundwater and sediment to the floodplain. The two measures of this project are the creation of a new continuous floodplain river and the diversion of water for ecological flooding, both of them with variable discharge amounts. The effects of these measures are evaluated by an intense monitoring program (hydrology, morphology, vegetation, fauna and forest economics). The results should amend the management of the diverted water amounts. In this contribution we want to present the first results of the vegetation monitoring for both the semi-aquatic habitats and the forest habitats. The effects of the changed surface water and groundwater conditions on the vegetation will be discussed regarding the different measures, the abiotic site conditions and the pre-restoration state.

Keywords: Restoration, floodplain, vegetation, monitoring, dynamic

Poster

Topic 1

Ecological processes in riverine conditions
(dynamics and interactions between the environmental conditions and the living communities)

Linking sediment mineralization processes with nutrient dynamics of a Danube oxbow (Gemenc, Hungary)

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The nutrient dynamics and the habitat conditions in river floodplain ecosystems are greatly influenced by the hydrological regime. Gemenc is a floodplain close to the natural state. There different water body types are controlled by a different hydrological regime depending on their surface water connectivity with the main arm of the Danube. This study aimed to investigate the nutrient related mineralization processes in the sediment of Nyéki-Holt-Duna oxbow of the Danube at Gemenc. For this purpose microbial activity, chemical parameters of the sediment and of the water column were analysed at two sites with a gradient in wetness. The investigations were carried out prior and at the end of the vegetation period, in 2009, which was characterised by three high flood pulses. At the end of the vegetation period the C, N concentrations of the sediment were lower, while in the water the concentrations of P, C forms and of the suspended matter were remarkable higher at both sampling sites. The C, N and LOI (loss on ignition) decreased with a higher degree in the function of sediment depth as compared to the P concentration. The microbial activity showed an exponential decrease with sediment depth and was positively correlated to the C, N, P, LOI of the sediment and negatively to the C:N molar ratio.

Keywords: microbial activity, sediment, oxbow, Danube

Nutrient dynamics in ecological systems of Sfântu Gheorghe branch (Danube Delta)

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Between 2008 and 2010, an ecological study was conducted along Sfântu Gheorghe branch of the Danube River in order to reveal the differences induced by the hydromorphological alterations consisting mainly in cutting six meanders and shortening the navigation route with 35 km. The study aimed to compare the different sections formed along the branch: the free-flowing section, the disconnected meanders and the newly formed channel.

Physico-chemical parameters, biological communities and enzymatic activity were analyzed seasonally. The channelization altered the water flow and velocity, increasing banks and river bed erosion; consequently, the depth of the newly built channel doubled in comparison with the free flowing section, while water transparency decreased. The amount of organic matter and chlorophyll-a concentration reached minimum values in the newly built channel (17.0 mg l^{-1} and respectively $9.70 \text{ } \mu\text{g l}^{-1}$), indicating a weak presence of phytoplankton community. Hence, due to the reduced up-take of nutrients from the aquatic environment, the maximum concentrations were recorded for dissolved inorganic nitrogen (1.89 mg N l^{-1}) and for total phosphorus ($92 \text{ } \mu\text{g P l}^{-1}$) in the same section. The correlations with the plankton communities were also discussed.

Keywords: Danube Delta, nutrients, aquatic ecosystems

Review on the ecological state of the Lower Danube River Ecosystem under anthropic pressures

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In the framework of the lower Danube monitoring program conducted by GeoEcoMar during 2009 - 2011, measurements were made and samples were collected in more than 190 sites along the Romanian section of the Danube River. The main considered aspects were the following:

Physico-chemical analyses of water samples (T, pH, O₂, nutrients etc.).

Physico-chemical and biological (phytoplankton) state of the Danube waters;

Sediment granulometry and textural parameters;

Geochemical analyses of sediment samples - CaCO₃, Fe₂O₃, TiO₂, Zr, Ba, Rb, Zn, Ni, MnO, Cr, V, Co, Pb;

Chemical analyses of sediment samples for ammonia, total organic carbon (TOC), total cyanide, organochlorine pesticides;

According to the investigations, areas of polluted from anthropogenic sources and other activities could be outlined as follows:

the stretch between rkm 1072 (Danube entry to Romania) and rkm 1039, downstream of the mining sector Moldova Veche;

sector between rkm 957- 947, near the Iron Gates I dam;

Danube - Black Sea Canal (the NPP Cernavoda zone);

Braila sector, between rkm 174 – 167 - this stretch was also affected in the past by local anthropogenic pollution;

St. George branch, which discharges about 30% of the Danube waters into the Black Sea.

On the basis of the results the authors proposed some measures to substantiate the protection of the lower Danube from the scientific point of view.

Keywords: lower Danube, aquatic ecosystem, pollution, physico-chemical analyses

Bioassessment of a heavily modified lowland river (Tamiš, Serbia) based on phytoplankton and benthic macroinvertebrate assemblages

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Assessing the ecological state of the heavily modified water bodies poses a serious challenge in freshwater monitoring due to the potential absence of reference conditions or historical information. In addition, the altered hydrology and morphology is often combined with the nutrient enrichment, as in the case of the lowland stretch of Tamiš River (Serbia).

Phytoplankton and benthic macroinvertebrates were sampled at six sites along 117 km of the lower reach of the Tamiš River with the aim to assess the ecological potential of this heavily modified water body. The evaluation based on the phytoplankton community revealed β -mesosaprobic conditions and significant moderate increase of saprobic values downstream, while the results based on benthic macroinvertebrates suggested α -mesosaprobic conditions and significant but low decrease of saprobic values towards the mouth of the river. The highly significant difference (paired t-test = -13.61, df = 17, $p < 0.001$) between the two saprobiological indices was most likely induced by the altered hydromorphological features of the river bed and flow regime upstream of weirs (Tomaševac, Opovo and Pančevo). The results demonstrate the need for integral multi-pressure and multi-indicator approach when assessing the ecological potential of heavily modified freshwaters.

Keywords: phytoplankton, benthic macroinvertebrates, altered hydromorphology

Invertebrate macrofauna bioindicators of water quality in Danube Delta Kylyia distributary

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The assessment of the water pollution within the Ukrainian sector of the Danube Delta has been carried out both in accordance with the conventional European indexes and the national ecological methodology of water quality estimation. The authors compared the results and concluded that the present ecological state of Kylyia waters is mainly ranked in II–III classes, or β' - α' -mesosaprobic, good-moderate.

An insignificant tendency of water quality worsening was registered in water reservoirs in comparison to water courses. A certain improvement of water quality as compared to the 1990s and some stabilization signs have been traced in the last decade.

Keywords: Danube Delta, water quality, saprobity.

Investigation of sediment toxicity in several water bodies of the Danube's Ukrainian part of the Kylyia branch

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The sediment's toxicity was examined in eight characteristic water bodies of the Danube's Ukrainian part of the Kylyia branch. The assays have been carried out with *Daphnia magna*, *Lemna minor* and *Allium cepa* as test-organisms using water elutriates method. Obtained results showed significant negative effect regarding daphnia growth and plant growth in several samples.

Cytotoxic effect of water elutriates of sediments has been studied by investigation of changing in mitotic index and analysis of alterations in mitosis process in cells of apical root meristem of *A. cepa*. Statistically sound changes in these indexes were not found. Thus, obtained data show that registered toxicity of water elutriates is not related with cytotoxic effect.

Keywords: the Danube delta, toxicity, sediments

A comparison between three extracellular enzymatic activities of microbial communities from Sf. Gheorghe branch, Danube Delta

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Nowadays enzymatic activity is used as a tool to evaluate the metabolic intensity of microbial communities from water and sediments, and therefore, together with other parameters, is considered useful for assessing the trophic state of the ecosystem.

The paper presents three extracellular enzymatic activities – β -glucosidase, alkaline phosphatase and α -amylase - in water and sediment samples from Sf. Gheorghe branch, Danube Delta. This branch was subject of channelization in the 80s, when six meanders were cut to shorten the navigation route; as a consequence, different types of sections were formed in the river branch: the free-flowing sector, the meanders section and the newly built channel. Between 2008-2010, the enzymatic activity, evaluated through specific substrate hydrolysis rate, was assessed together with other ecological characteristics, in order to emphasize the differences between the three sections. Over the three years of study, the highest activity was recorded at the water-sediment interface; phosphatase activity was more intense in the water column, with average values of 566 nmol p-nitro-phenol/l/h, while β -glucosidase was more intense in the sediment with average value of 4070 nmol p-nitro-phenol/g/h. Amylase activity recorded average value of 265 nmol Azure-B-chloride/l/h in water column and 751 nmol Azure-B-chloride/g/h in sediment. In general, the highest values were recorded in the meanders section. The correlations with the abiotic and biotic environment are further discussed.

Keywords: extracellular enzymes, aquatic ecosystems, Danube Delta

Topic 2

Longitudinal, vertical and lateral connectivity in riverine landscapes (*in main channel, side arms and active river-floodplain systems, effects of water regime*)

Spatial distribution of structural and functional characteristics of the benthic invertebrate communities in the rivers of the Upper Tisa basin

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Modifications in benthic invertebrates' communities (species number, diversity, abundance, biomass, trophic structure and respiration) are induced by the changes in the temperature regime, water level, granulometric composition and mobility of bottom sediments, which changes from the river source to the plain. In zone of hard substrata, at the altitude above 1000 m a. s. l. communities are formed with high species number, abundance and biomass, without clearly expressed dominants. At the altitude 600–800 m, in zone of intensive sediments' erosion the forming of stable communities is impossible – number of species sharply decreases, their combinations are occasional, the portion of certain species, adapted to constant erosion increases (particularly, mobile forms of Ephemeroptera) and a “drop” of the numerical and functional characteristics occurs. Downstream, closer to the lowland, erosion alternates with sediment accumulation, biotopic diversity increases, thus species number gradually grows and domination decreases due to “leveling” of possibilities for various forms. Values of structural-functional indexes reach maximum at the altitude about 200 m (biomass) and 300 m (species number, numbers, respiration), then they decrease. After rivers' transition to lowland processes of sediments' accumulation prevail, more dispersion of all quantitative and structural-functional characteristics is noted and at this domination due to Chironomidae or Oligochaeta (numbers) and Mollusca their increases biomass).

Keywords: structural-functional characteristics, benthic invertebrates, Tisa, altitude, bottom sediment

Support investigation of fishpass operation at Denkpál

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A fishpass was built in the Szigetköz section of the Danube at the Denkpál mouth in 1998. It provides connection between the main arm of the river and its branch system. Operation of the fishpass was investigated for three years after its construction. In the last 10 years the fishpass was damaged by floods, and reconstructed at several times.

A new survey carried out in 2011 was designed to compare its recent operation to the results of the previous observations. Sampling was made by a battery powered electrofishing equipment and a cage-like fish trap. Survey detected 22 species in 347 specimens of fish.

Good operation of the fishpass can be established according to field observations, and proposals are formulated for its future operation, and its hydro-ecology map was created.

Keywords: fish migration, longitudinal connectivity, fishpass operation

Phytoplankton in the water bodies of the Upper Tisa basin

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Over the years 2005–2009 phytoplankton (syrtion) of the Upper Tisa basin's rivers comprised of 150 algal species (161 intra-species taxa) of 6 groups. The most diverse were the Bacillariophyta – 99 (107), Chlorophyta – 27 (28), Euglenophyta – 19 (21) species. Maximal species number included genera *Nitzschia* – 18 (19), *Navicula* – 18, *Cymbella* – 9, *Pinnularia* – 8 (8), and *Diatoma* – 4. Plankton was characterized by significant portion of the periphytic algae of genera *Ceratoneis*, *Cocconeis*, *Cymbella*, *Gomphonema* and others as well. Particularly the most frequently occurred *Didymosphenia geminata*, included into the Global Invasive Species Database, and *Ceratoneis arcus*. At the altitude above 800 m only diatoms occurred in the phytoplankton, downstream its composition is composed from a single green and blue-green algae species. Their numbers only became notable at the altitude of 400–600 m. Euglenoids appear from the altitude 300–350 m. Structure of the plankton communities in all rivers becomes more complicated as the altitude decreases. Species, associated with substrata are replaced by the properly planktonic forms. Here their average numbers, biomass and species number increase almost linearly, whereas dispersion of these characteristics in the water bodies located within the altitude 200–400 m is three–four times higher than in the highland.

Keywords: algae, plankton, mountainous rivers, altitudinal distribution

Mid-term changes of planktonic rotifer assemblages in the Szigetköz floodplain of the Danube, Hungary (2003-2011)

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This study used mid-term (2003-2011, 9 years) sampling to examine the spatial distribution of planktonic rotifer assemblages on the heavily modified river-floodplain system of the Szigetköz, Danube. Samples were collected 1-3 times per year. The diversity/density patterns of the rotifers in the main river channel, the reconnected and the disconnected floodplain areas are compared and discussed with respect to the different hydrological connectivity with the main channel. Significant differences were found in rotifer density and community composition among the different habitats, but the temporal versatility was much lower than awaited. The temporal patterns were driven by seasonal changes, the diversity and density values depended on the local effects.

Despite the reconnection efforts, temporal dynamic variability of the intact river-floodplain systems - which is controlled by the water regime of the river - seems to be missing.

Characterization of planktonic rotifer assemblages provides a basis for understanding mid-term changes of this modified river-floodplain system. Examination of rotifer communities from habitats with differing hydrological characteristics provides insight into the mechanisms affecting zooplankton dynamics as well.

Keywords: Rotifer, floodplain, connectivity, diversity

Topic 3

Changes in biodiversity (*interactions of metapopulations, invasive species, the Danube as ecological corridor, status of nature conservation*)

Topic 3: Changes in biodiversity

The actual state of the benthic fauna in the Inner Danube Delta, Romania

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The benthic invertebrates are one of the most important components of the aquatic ecosystems. These systems are highly considered in research and monitoring programs dealing with the dynamics of the ecological state of the Lower Danube River System. During the period 2009-2010, field observations were implemented as to the benthic fauna of the shallow lakes from the insular and riparian zones of the Inner Danube Delta, located in Romania, between rkm 170 and rkm 365 (on the Danube River). With a seasonal periodicity the sampling program included 25 stations along a longitudinal gradient according to the water loading in the complex of ecosystems. The present work discusses the composition and structure of the benthic fauna, and compares the results with those obtained from a previous period (1993-2009) in the same area and long-term datasets (1975-2000) from the costal Danube Delta. Aquatic worms and insects, represented by *Oligochaeta* and *Chironomidae*, formed the dominant component of the bottom fauna in terms of abundance. Because the investigated area belongs to an important complex of aquatic systems remained in natural flooding regime, the hydrological regime and the trophic state have been identified as the main driving forces.

Keywords: Inner Danube Delta, natural aquatic systems, benthic fauna, structure, dynamics

Phytoplankton biodiversity state in the Romanian sector of the Danube waters in 2011

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This paper is a preliminary assessment of elements that define the qualitative and quantitative state of the Lower Danube phytoplankton; the estimation is based on data obtained in 2011 from samples collected in 70 stations distributed along the Romanian stretch between Bazias and the Danube River discharge into the Black Sea. On evidence basis, the authors present the state parameters characterizing the Danube waters, phytoplankton habitat, considering that they are within the limits of the usual dynamics.

In the spring of 2011, 116 phytoplankton species were identified in the surface waters of the lower Danube.

Usually, few species (10 -15) occurred in the samples and only 13 species (11.21% of total) had a frequency of over 25%. The phytoplankton abundance was relatively low (in the range between 68 - 3573 10³cel. L⁻¹ and 0.0609 - 2.4477 mg L⁻¹ dry weight). The first top 10 most abundant species of phytoplankton accounted for more than 58% of the calculated average numerical abundance for all analyzed samples.

A relatively small number of euplanktonic species were present, while the non-planktonic species made up a large proportion of the total identified forms. Concerning saprobity, both Beta- and Alfa-mesosaprobic phytoplanktonic species are mentioned in the paper.

The final conclusion is that, according to phytoplankton composition and abundance, the ecological state of the lower Danube River can be considered satisfactory.

Keywords: lower Danube River stretch, phytoplankton, specific diversity, abundance, distribution

Finding of *Rutilus virgo* (Heckel, 1852) (Pisces, Cyprinidae) in the Ukrainian section of the Upper Tisa basin

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In the Tisa River *Rutilus virgo* was firstly found in 1994 between Tivadar and Vásárosnamény within the Hungarian river section. Later it was downstream Chop, nearby mouth of the Samosh River and in the Slovak sections of the Latoriza and Bodrog Rivers. Occurrence of *R. virgo* in neighboring countries became more frequent in the last 20 years, so its finding in Ukrainian territory was quite possible. Analysis of the probable scenarios of the Tisa River outbreak into the Pannonian Lake also advantaged purposeful search for the *R. virgo* occurrence in a zone, which genetically belongs to the water area of the ancient Pannonian Sea and could avoid catastrophic flood, which totally covered the Ukrainian part of the Hungarian lowlands. In August 2010 one specimen was caught in the left side-arm of the Tisa River nearby village Petrovo in Transcarpathia, later species was found in the Tur–Batar drainage system, in tributaries within section Vilok–Vynogradiv, and in the Borzhava River.

Finding of *Rutilus virgo* in the Tisa River basin in Ukraine points out necessity of thorough revision of ichthyofauna of Transcarpathia to precise eastern borders of its areal.

Keywords: *Rutilus virgo*, Tisa, Ukraine, natural areal

Diversity and structure of zooplankton communities of water bodies of the Kiliya Danube delta (Ukraine)

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The freshwater zooplankton of the water bodies in the Kiliya Danube delta is formed mainly under the influence of the Danube's water; it is also subjected to the effect of the North-West part of the Black Sea and depends on the connection between the water bodies and the sea. Zooplankton of the model water bodies (lakes Anan'kin, Potapiv and Deliukiv) was studied over the years 2006–2010. Zooplankton was quite rich, 148 taxa of three main taxonomic groups were found, which belonged to 27 families and 63 genera. Rotatoria comprised 16 families and 25 genera, maximal species number included Brachionidae (16), Lecanidae (12), Trichocercidae (7), Synchaetidae (7), and Asplanchnidae (6). Cladocera belonged to 7 families and 22 genera, the most rich in species were Chydoridae and Daphniidae. Copepoda belonged to 4 families and 12 genera, maximal species number was of Cyclopidae. At present zooplankton communities of the considered lakes included some species not found earlier, which are characteristic for the water bodies situated along the left bank of the lower section of the Danube River. Each considered lake was characterized by a special composition of the dominating complex and the relationship between the taxonomic groups. Some species were peculiar for the certain water body. The whole zooplankton of the Kiliya Danube delta's water bodies regarding its species composition can be characterized as Copepoda–Rotatoria, by structure – as oligodominant or polydominant.

Keywords: zooplankton, diversity, communities, lakes, Kiliya Danube delta

Zooplankton monitoring in the Szigetköz floodplain of the Danube (Hungary) (1999-2011): long-term results and consequences

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The Szigetköz floodplain of the Danube is situated in the north-western part of Hungary, between 1850-1793 rkm; it consists of three sections: main arm, reconnected and disconnected floodplain areas. In the 1990ies significant hydrological and morphological changes occurred in the Szigetköz Danube stretch mainly due to the construction of the Dunakiliti dam and the regulation of the river; in consequence the natural dynamics of the river-floodplain system disappeared.

In the early nineties, after the diversion of the Danube and the operation of the Gabčíkovo River Barrage System, significant hydrological and morphological changes occurred in the Szigetköz and the natural dynamics of the river-floodplain system entirely disappeared. 1991 an intensive monitoring program was implemented in the Szigetköz to investigate the spatial and seasonal distribution of the planktonic crustaceans as well as the long-term changes of the community. Samples were collected 1-4 times per year and from 1991 to 2011 75 Cladocera, 26 Copepoda and 13 Ostracoda taxa were collected. The examined parameters (composition of the community, density, diversity pattern) differed between the three examined sections reflecting the different hydrological connectivity with the main river stretch.

This paper presents the main results for the main river channel, the reconnected and the disconnected floodplain areas for the time 1999-2011.

Keywords: Danube, Szigetköz, floodplain, zooplankton, monitoring

Comparative description of the Lower Danube macrozoobenthos

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During the last decade under the aegis of ICPDR three international surveys of Lower Danube (within the framework of JDS, JDS-2 and JDDS) were carried out, the authors of the actual report took part in the last two. Collection of benthic invertebrate fauna was executed by different samplers, subsequent treatment of materials showed certain distinctions of the used methodological approaches and evaluation criteria. On the basis of comparative analysis of species composition, indexes of development, calculated biotic indexes and other used parameters a comparison is drawn and the generalized description of the Lower Danube macrozoobenthos is presented.

Keywords: macrozoobenthos, Danbe Delta, international surveys

The intergenic spacer region between tRNA^{Thr} and tRNA^{Pro} genes in the mtDNA of *Triturus* spp. can be a good tool for the analysis of intraspecific diversity of Danube crested newt (*Triturus dobrogicus*)

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Triturus dobrogicus is a lowland newt species listed in the IUCN Red Data Book as near threatened. It occurs in floodplains, canals and ponds in the Carpathian Basin. Populations living 100 – 250 km-s away from each other in Hungary were sampled (in the least invasive way possible) to see the effect of isolation and human disturbance (e. g. pollution, road traffic, etc.).

Studies regarding the population genetics of *Triturus dobrogicus* are sporadic; this organism was involved mainly in investigations that aimed to clear the phylogenetic relationships in *Triturus* genus. The available DNA sequence data of this species are limited; most of them are segments of the mitochondrial (mt) cytochrome b (*cyt b*) gene, this marker however shows low resolution at intraspecific level.

An intergenic spacer region (IGS) with high variability (~200-500 bp length) is located between the tRNA^{Thr} and tRNA^{Pro} genes in the mtDNA of *Triturus* spp., which can give sufficient resolution for intraspecific investigations of *T. dobrogicus*. Genus-specific primers were designed to amplify this segment and the adjacent region: the complete *cyt b* gene and a part of D-loop, together providing approximately 2000 bp sequence data for each individual.

Keywords: *Triturus dobrogicus*, population genetics, mtDNA, IGS

Acknowledgement: This study was supported by the National Science Foundation of Hungary (KTIA-OTKA CNK 80140).

Do researchers have anything to do with “Danubian killermachines”? *Eriocheir sinensis* in Hungary

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The Chinese mitten crab (*Eriocheir sinensis*) is listed among the worst 100 invasive species of the world. Due to unintentional human introductions it extended its distribution range to Iran, Europe and North America in the last 100 years. Its fast growing populations cause serious environmental problems in many ecosystems. Due to the burrows it makes, this species also heavily damages dikes. In its native range, unlike the European individuals, it is a carrier of parasitic worms causing a human lung disease 22 million people presently suffer from.

In Hungary, the first *E. sinensis* individual was found in 2003. Altogether four specimens were caught since, three from the River Danube. As it was expected because of its catadromous life cycle, even if it has a global impact, it did not cause any serious impact in the country that is more than 1,400 km away from the sea.

In spite of the above summarized facts *E. sinensis* got mass media attention as the “Danubian killer machine” in Hungary. Tabloid papers were also fuelled by worried and ill-informed environmentalists. The catch of the fourth individual in a street of Budapest gave an opportunity to properly inform the general public about this animal.

Keywords: Danube, *Eriocheir sinensis*, Hungary, academic responsibility

Diversity of habitats and assemblages of macroinvertebrates of Brook Morgó (Börzsöny Mountain/Hungary)

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The investigations of low-order streams are more and more urgent. On one hand, because there are hardly any untouched streams and on the other hand, it is indispensable to know the results of the increasing human interventions. For this, we need to register the long term changes from the aspect of the environmental endowments, water chemistry and of the fauna. Our research was made along the 11 km long Morgó brook in the Börzsöny Mountain. Our aim was to investigate the hydroecological and hydrozoological conditions of Brook Morgó. The investigation began in March 2008; and has been carried out for a year now, with monthly regularity, embracing water chemical and zoological terms. The aim is to explore the different kinds of habitats, to adopt distinct ways of sampling and to compare all the results both in time and space. We have found 118 new taxa and there have been 68 new ones revealed to the brook's fauna. One of these was new to the Hungarian fauna (*Atrichops crassipes* (Meigen, 1820)), and one was new to the fauna of Börzsöny (*Oulimnius tuberculatus* (P. J. W. Müller, 1806)) as well. There are typical differences between the patterns of certain taxa diversity and density. Nevertheless, these patterns are influenced by human factors as well.

Keywords: Morgó Brook, low-order stream, macroinvertebrate, spatio-temporal pattern

Distribution of aquatic invasive alien species in the standing water bodies in the Danube River Basin, Bulgaria

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The main Danube Canal has been recognized as part of the Southern Invasion corridor in Europe linking the Black Sea basin with the North Sea basin via the Danube–Main–Rhine Canal. The adjacent standing water bodies – lakes and reservoirs have been extremely vulnerable to introduction of aquatic invasive alien species.

The goal of our study was to monitor the occurrence of invasive alien species of fish and bivalve mollusks in the reservoirs in North-West Bulgaria. A total of 19 reservoirs were sampled during the period 2006-2011. As a result, twelve alien fish species, six of which used in aquaculture and the rest introduced unintentionally were recorded in the reservoirs. Most frequently found were gibel carp (*Carassius gibelio*) and pumpkinseed (*Lepomis gibbosus*). The species topmouth gudgeon (*Pseudorasbora parva*) and pumpkinseed had the highest abundance in the littoral zone. Three invasive alien species of bivalve mollusks were reported as established in the reservoirs. Most frequently found and abundant was zebra mussel (*Dreissena polymorpha*). High values of integrated biological pollution risk index were registered in almost all studied reservoirs. The pathways of introduction of aquatic invasive alien species within the Danube River basin were discussed.

Keywords: Invasive alien fish, Invasive alien bivalve mollusks, Pathways of introduction, Reservoirs, Danube River basin management

The study was funded by the Bulgarian Science Fund, Project DO 02-283/2008.

Topic 4

Climate Change: present situation and expected effects on ecological processes (*long term changes, long term surveys*)

The effect of drying up on macroinvertebrate communities in small streams of Central Europe

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Climate change has brought remarkable changes in hydrological regime over the last decades and lack of summer precipitation causes consequent periodical drying out of small streams also in Central Europe. Insufficient data from this region lead us to conduct the studies of intermittent stream in the Czech Republic, which were focused on drought-related ecological filters affecting aquatic macroinvertebrate communities.

The extent of community impairment is related to abiotic parameters (e.g. refugia availability, water quality, frequency and regularity of desiccation etc.), as well as to biotic factors, namely individual “species traits” (recolonization capacity, aestivation, drought-resistant stages etc.). Duration and extent of drought determine the range of changes in key assemblages (e.g. EPT taxa), and the degree of dissimilarity comparing to permanent stream assemblages can indicate the extent of dry period in the history of a watercourse. Different approaches focused e.g. to species richness, density, presence/absence of indicator taxa or representation of selected species traits within community can be used to assess the drought impact. The aim of our current research is to describe basic mechanisms enabling survival of drought-resistant species in regularly dried up streams and to evaluate the applicability of some of selected characteristics to drought indication.

Keywords: drought, macroinvertebrates, small streams, Czech Republic, species traits

Isotopic composition of Danube water in the pre-delta section from the years 2009-2011

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Isotopic composition of precipitation is related mainly to air-mass source and evolution including temperature-dependent equilibrium fractionation effects. River discharge signatures provide insight into the basin-integrated hydroclimate forcing on water cycling such as precipitation variability and evaporation from the catchment. Since evaporation has only little effects on the isotopic composition of river water within the Danube Basin, the isotopic composition in Danube water reflects mainly the isotopic composition of precipitation in the whole basin and so provides an integrated isotope signal for climatic/hydrological conditions and changes in the catchment.

Investigations of the isotopic composition of Danube water in the Tulcea region were performed during 2009-2011. The aim was to establish a representative isotope monitoring of river water near the Danube Delta in order to achieve isotope-hydrological information about the entire Danube Basin. The results show that the Danube River is isotopically totally mixed at the bifurcation of the Danube Delta arms. Therefore routine sampling at only one location in the pre-delta region seems to be sufficient to get a representative isotope record for the whole Danube Basin. The seasonal variations of the $\delta^{18}\text{O}$ values of Danube water in Tulcea amount to about 1.5 ‰ between October 2009 and July.2011.

The tritium results clearly exhibit the influence of short term contaminations due to human activities. The expected tritium content of river water in central Europe would be about 10 TU, values up to 100 TU are an evidence for discontinuous releases of tritium from local sources (mainly nuclear power plants) into the rivers.

Keywords: isotope hydrology, rivers, deuterium, tritium, oxygen-18

Long-term changes of certain chemical parameters in the River Danube at Göd (1668 rkm)

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The Hungarian Danube Research Institute (earlier: Hungarian Danube Research Station of the Hungarian Academy of Sciences) has been providing water chemical data since its foundation in 1957.

In this study we have compared two eight-year time periods (1985-1992, 2003-2010), considering certain water chemical parameters which are of great hydrobiological importance: water discharge, water temperature, conductivity, concentration of suspended matter, inorganic nitrogen, phosphorus (orthophosphate), water-hardness and organic matter content (expressed as chemical oxygen demand).

Significant decrease occurred in the organic matter content (39%) and in the inorganic nitrogen concentration (20%). Phosphorus, suspended solids and water hardness decreased as well, however, the difference between the two periods was not significant.

Conductivity showed significant increase (36,2%) and also water temperature data were slightly higher, but no significant difference could be found.

Keywords: Danube, water chemical parameters, long-term changes

Long-term changes of mayfly taxocoenosis – a reflection of the Morava River catchment alterations

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The Morava River, left tributary of the Danube River, is a large river with the catchment area of about 26,580 km². The major part of its catchment is located in the Czech Republic. This area has been markedly changed concerning its land-use, river network characteristics and/or water quality of streams in the last century. Nevertheless, any exact comparison of past and present ecological status of aquatic habitats is limited by the accessibility of reliably data. Whereas several earlier abiotic characteristics is possible to read from earlier maps, information about water quality are scarce even from the middle of the 20th century. Comparison of earlier and present taxocoenoses of aquatic macroinvertebrates with the potential for bioindication (such as mayflies) can reflect changes in ecological status and help to identify main anthropogenic impacts. The research of aquatic insects realized in the former Czechoslovakia in 1955–1965 included also investigation of numerous localities in the Morava River basin. A set of thirty sites was investigated again at the beginning of the 3rd millennium to compare historical and present composition of mayfly taxocoenoses. The most important impacts and causes of species composition change were identified for the main stream types of the area.

Keywords: species composition change, bioindication, Czech Republic, Ephemeroptera

Topic 5

Danube as drinking water resource
(hydroecological aspects of water resources protection, soil as filter for pollutants)

Toxicity of the antibiotic Clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

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Antibiotics are suspicious environmental contaminants as they are biologically active substances. Drugs, which have specific modes of action, may probably cause adverse effects on terrestrial and aquatic ecosystems. Up to now, only a few eco-toxicological studies for the assessment of the environmental risk of antibiotics and their metabolites are available. In Germany, the human macrolid antibiotic clarithromycin is widespread in surface waters and has been found in concentrations up to $0.3 \mu\text{g L}^{-1}$. Some studies published eco-toxicological effects of clarithromycin on aquatic organisms. Unfortunately, most of these findings are not valid according to the “Technical guidance document on risk assessment (TGD EU-Commission)”, because of missing standardized test methods, missing analytical measurements of the exposed concentrations or else problems such as disregarding solubility in water and sorption effects. In the present study, adverse effects of clarithromycin on the green algae *Desmodesmus subspicatus* (Chlorophyta) and the blue-green algae *Anabaena flos-aquae* (Cyanobacteria) were investigated in compliance with the TGD. As *Desmodesmus subspicatus* is an established species in toxicity testing on primary producers, Cyanobacteria, a phylum of bacteria, are more and more brought into focus of risk assessment because there is some evidence that they are more susceptible organisms to antibiotics than green algae.

Keywords: Macrolid antibiotic clarithromycin, eco-toxicological effects, green algae *Desmodesmus subspicatus*, blue-green algae *Anabaena flos-aquae*

Topic 6

Environment and infrastructure in the European Strategy for the Danube Region (EUSDR): harmonization of ecological needs and effects of different water usages (*drinking water, irrigation, navigation, hydro-power, dredging, fishing, reed management, recreation*)

Irrigation water quality as a part of sustainable development of the northern part of Serbia

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In the northern part of Serbia, with 1.67 million ha of quality arable land, food production amounts to some 40% of the gross national product, whereas the primary agricultural production makes its 30%. Besides, it should be added that there is a tradition in irrigating agricultural crops. The river Danube and the hydro system Danube-Tisa-Danube, with a main canal network (MCN) of 930 km and a detailed canal network (DCN) of 19,000 km, represent the source of water irrigation for a large portion of agricultural soil in mentioned area. The appropriate quality of water for irrigation would enable production of healthy food and ensure protection of the irrigated soil from undesired effects.

The main aim of this investigation is to select the most suitable classification for irrigation water. The suitability of the analyzed water for irrigation was assessed by the following next classifications: Neugebauer's method, US Salinity Laboratory, FAO classification, and classification Miljkovic. Global estimation is that water on analyzed irrigation systems cannot be used because of its inappropriate effects to soil salinity. An analysis of suitability of the phreatic aquifer for irrigation showed their inappropriate characteristics. Only a small number of water samples could be recommended for irrigation.

Keywords: Hydro system Danube-Tisa-Danube, water quality, irrigation, classifications

Need for harmonization of contradicting efforts: development of the Danube navigation and protection of river ecosystems

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The Danube has been one of the Europe's important inland waterways for several centuries and it has formed a transport route between Eastern and Western Europe via the Rhine-Main-Danube Canal since the early 1990's. Nevertheless, transport volume on the Danube has fallen dramatically behind the competing road and rail networks. Improvement of mobility in inland waterways, particularly in the Danube is one of the priority areas of the Danube Region Strategy (DRS), however its assessment requires a multilateral approach. This study reviews some contradicting economic and environmental efforts related to the Danube navigation and considers the needs of society, as improvement of environmental quality and protection or restoration of fluvial ecosystem functions.

Keywords: river regulation, waterway improvement, navigability, landscape ecology

Topic 7

Environment and the implementation of the EU WFD: rehabilitation or sustenance of ecological function, good ecological status according to WFD, good conservation status of NATURA2000 sites, monitoring

Plants, animals and recommendations on rehabilitation of the flood land water body in the upper section of the Tisa River

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The Teplitsa Lake is a unique, large water body in the Tisa flood land, located nearby the Bochicu-Mare (Romania) at the altitude 277 m (area about 3 ha, average depth 1.8 m). In its actual appearance it was constructed in the 60s in the place of gravel extraction and is still actively used for recreation. The lake is severely eutrophic and overgrown by macrophytes. Occurrence of the water body with stagnant conditions at such altitude provided a variety of new ecological niches and peculiar biota, including 7 species of higher aquatic plants, 40 – algae, 23 – zooplankton, 73 – macrozoobenthos. We found 5 fish species, 4 birds and the muskrat. As compared with adjacent section of Tisa, the species richness and abundance of biotic communities are notably higher. The Teplitsa Lake is a refugium, where the unique species assemblage is formed, which enriches biota of the river during the floods. At the same time excess eutrophication and overgrowing by macrophytes in recent years – up to 80% of the surface, need urgent measures for its rehabilitation. Ecological and economic effects were estimated of measures for the lake biomelioration using the grass carp. This will enable to preserve lake from swamping and improve its ecological status.

Keywords: flood land water body, Tisa, biota, eutrophication, rehabilitation

Sampling requirements for monitoring long-term changes of fish fauna in the Middle Danube

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Fish are good indicators of long-term changes in fluvial ecosystems and their assessment (fish assemblages) has been incorporated in evaluation of ecological status of rivers, especially since the implementation of the EU Water Framework Directive. Some elements of long-term changes in the Danubian fish fauna and abundance of fish populations can be documented by millennia-old historical river fisheries' data. Obtaining consistent data to identify long-term changes in fish populations from the large rivers is difficult due to remarkable temporal and spatial variation in fish distribution. Electrofishing is a frequently used method in fish monitoring in rivers.

The study provides a literature review of methods for fluvial fish monitoring, with special attention to electrofishing and spatio-temporal variability of fish occurrence. Reconsidering and testing the requirements of river fish assemblages' representative sampling can contribute to further development of monitoring procedure in the Middle Danube for observation of long-term changes in fish populations.

Keywords: monitoring methods, standard sampling, fishing with electricity, diurnal changes, seasonal distribution

Topic 8

Technical aspects and the implementation of the EU WFD: ecological effects of water engineering facilities (*barrages, object of flood protections and bed regulations*), **navigation**, **hydro-power** (*direct and indirect effects, short and long term observations*)

Impact of hydropower constructions and diking on riverine ecosystems

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Hydropower constructions and dykes had a major impact that triggered radical transformations in the functioning of fluvial ecosystems. Along the Danube River with a length of 2.857 km, 62 large hydroelectric dams were built. These impoundments turned lotic stretches into lentic stretches for about 39% of the river length. Hence, planktonic and benthonic biocoenoses changed significantly in structure and function. The populations were simplified by a loss of species and biodiversity. New lentic specialist species replaced lotic species.

The construction of dykes along the river banks represents the second major impact on fluvial life. Dykes, more fragmented along the Upper and Middle Danube, are almost continuous along the Lower Danube (rkm 70-955). The dykes disconnected the Danube's and Europe's largest and most diverse floodplains in the Green Corridor. The floodplain area (more than 300,000 ha) encompasses 40% permanent lakes, 40% temporary lakes (pools), and 20% rarely flooded terrains. Thus, natural flooding was disrupted and, consequently, the structure and function of these characteristic ecosystems disappeared.

Keywords: Danube, hydro-energetic constructions, ecosystems, biodiversity

The structure and functions of the rotifers community on Sfântu Gheorghe branch (Danube Delta) impacted by hydrotechnical works

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There were hydrotechnical works performed on Sfântu Gheorghe branch of the Danube in the 80s to improve navigation. This affected the structure and functionality of rotifer communities, as a consequence the physical-chemical factors on the natural and modified sections were altered.

Samples were taken seasonally between 2008-2010, covering the natural sectors, meanders and the newly built channels. The impact was visible mainly from the species richness of rotifers: a decrease in number of species was noticed in the newly created channel - 103 species, while in the natural sectors 119 species were shown, and the highest values were found in the meanders - 135 species.

ANOVA tests have shown significant statistical differences in the three years of study, according to the variability recorded by the physical-chemical factors and hydrological regime of Sfântu Gheorghe branch that have influenced the abundance, biomass and productivity of rotifers differently. Simple correlations and multivariate analysis of ecological parameters of rotifers and physical - chemical factors allowed the development of mathematical models describing the relationships between them. Temperature ($^{\circ}\text{C}$), pH, TOC (mg C l^{-1}), NO_2 (mg N l^{-1}), NO_3 (mg N l^{-1}), DIN (mg N l^{-1}), significantly influenced the development of rotifer communities.

These models are valid only for the studied section of the Sfântu Gheorghe branch and require further validation and integration of other biological communities that may have influenced the structural and functional parameters of rotifers, such as bacterioplankton, phytoplankton, other zooplankton groups and ichthyofauna.

Keywords: rotifers, natural and anthropogenic factors, biodiversity, Sfântu Gheorghe branch

Impact of regulations and reservoirs on ecology of rivers in the Morava River Basin in the South Moravia, Czech Republic

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Many rivers are strongly impacted by regulations and reservoirs in the Morava River Basin. Our group has studied three rivers in South Moravia – the Svratka River, the Jihlava River and the Dyje (Thaya) River – since 1968. The last studies were done on the Dyje in the Podyjí (Thayatal) National Park and on the stretch of the Dyje River downstream of the Novomlýnské reservoirs in the Biopheric protected area Dolní Morava. According to detailed studies on populations and communities of macroinvertebrates we identified main factors which changed structure of biota and which had significant impact on ecological patterns. Our results presented mainly concern the influence of modified hydrological- and temperature regimes on bottom macroinvertebrates and on hyporheos community structure. In lowland part of the Dyje River we deduced importance of impact of large shallow reservoirs and longitudinal regulations.

Keywords: Morava River Basin, river regulation, reservoirs downstream effects, ecology of rivers

Structural dynamics of phytoplankton community in Sfântu Gheorghe branch (Danube Delta). Predictive possibilities

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The hydrotechnical works for navigation improvement performed on Sfântu Gheorghe river branch in the 1980s, affected the structure and functionality of the phytoplankton community, because of the hydrogeomorphological conditions within natural and modified sections.

The samples were taken seasonally between 2008-2010, covering the natural sectors, meanders and the newly built channels. The impact was visible mainly through the richness of phytoplankton species (confirmed by Shannon diversity): a decrease of species number was noticed in the newly created channel - 102 species, compared to 136 species found in the natural sectors.

The natural sectors offered favorable conditions for phytoplankton development; hence, the recorded numerical abundance and biomass of phytoplankton showed the highest values ($216 \times 10^3 \text{ ind}^{-1}$, respectively $1.292 \text{ mg wet weight}^{-1}$), while the impacted zones had the lowest values ($193 \times 10^3 \text{ ind}^{-1}$, respectively $0.989 \text{ mg wet weight}^{-1}$).

The results were further used to develop models describing the relationships between the structural dynamics of phytoplankton and the abiotic components of the investigated system.

Keywords: phytoplankton dynamics, mathematical modeling, statistical prediction

Topic 9

Restoration ecology, landscape ecology, land use (*restoration needs and plans; planned and realised projects along the Danube; experiences and observations*)

Topic 9: Restoration ecology landscape ecology, land use

Dike relocation and ecological restoration – best practice on the Elbe River

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Combining significant flood retention with unprecedented floodplain restoration has been successfully achieved by the “Large Scale Conservation Project Lenzener Elbtalau” in the German state of Brandenburg. Between 2002 and 2011, following a decade of continuous development and lobbying of the idea, Federal and State Governments together with the executing conservation organization funded an integrated approach with pilot character. Within a larger project area, a new 6.1 km-dike was built inland to replace 7 km of a historic dike on the immediate riverbank of the Elbe River, turning back 420 hectares of land into a naturally inundated, functional floodplain. Lateral connectivity was reestablished by six 200 – 500 m long breaches in the old dike. Former pasture land has quickly turned into an ongoing process of spontaneous and partly initiated renaturalization. Planting hardwood and - to a lesser extend - softwood floodplain forest was a main goal in order to support endangered Natura 2000 habitat types. Creating a mosaic of aquatic, semi-aquatic and terrestrial habitat characterizing natural floodplains is largely left to natural processes. A number of higher flood events have almost instantly proven significant flood peak reduction as predicted by numerical and technical models. Research, tourism and regional economy benefit from the project.

Keywords: Lenzen, Elbe, dike relocation, floodplains, flood retention

Fundamental investigations for the management of the Danube flood plain in South Hungary (Danube-Drava National Park)

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The WWF-Institute for Floodplain Ecology (Rastatt, Germany) together with the Danube Research Institute of the Hungarian Academy of Science (Vácrátót, Hungary) and a number of external experts have carried out baseline investigations on conservation issues and related problems of the Danube floodplains within the Danube-Drau National Park (DDNP) in southern Hungary. Particular interest was given to the water bodies and forests of the floodplain. Scientific and technical issues were addressed as well as ecotourism and environmental education, legal aspects and the attitude of the local population. The investigations clearly state, that within the study area neither Hungarian law nor international standards for national parks are met. The still remarkable natural values (flora, fauna, vegetation, morphological features, permanent and temporary water bodies, hydrodynamical processes, high biodiversity and the determining importance stream-flow regime of the Danube with fluctuation up to 9 m) fall short of their natural potential and are largely at risk and subjected to gradual but permanent losses. Concrete suggestions are given on measures in order to improve this situation. The poster presents selected aspects of the study.

Keywords: floodplain, Danube, natural value, restauration

The impact of river regulation on the land of the white willow in the riparian softwood forest along the Bavarian Danube (Germany) - a unique modeling of the land development since 1965

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River regulation endangers the high number of biotopes and species in river-floodplain systems in general, but it highly threatens the habitat type of riparian softwood forests. Due to the intensive construction of hydropower plants in Bavaria since the 1970s the area of riparian softwood-forests along the Danube decreased significantly. Although the importance of this phenomenon is generally known, there has not yet been an overall assessment of the decline of that habitat type along the Danube in Bavaria. Therefore, we started to reconstruct the development of the distribution of White willows (*Salix alba* L.) during the last 50 years by interpreting aerial photographs.

Within forest communities white willows show distinct color – and even grey values in the aerial photographs and can therefore be identified clearly by using geographic information systems. Within a buffer-zone of one kilometer along the Danube, the area covered by White Willows will be identified in the aerial photographs of 1965, 1973, 1987, 1998 and 2010 Through this approach we will be able to calculate the changes in the area of the softwood riparian-forest since 1965 and additionally identify areas showing a high amount of land loss, which is going to be correlated to certain events (for example the construction of hydropower stations).

Keywords: Danube, riparian softwood forest, hydropower, land development

Ecological niche models for the evaluation of management options in an urban floodplain – conservation vs. restoration purposes

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The Lobau, a former dynamic floodplain area of the Danube River situated close to Vienna (Austria), was strongly affected by the river regulation in 1875. The reduced hydrological connectivity changed the conditions in the system which is nowadays groundwater-fed, back-flooded, and characterized by sedimentation and terrestrialisation processes.

On one hand the artificially created habitat types have a high conservation potential; they harbour a rich community whose habitat range has been reduced due to degradation in the cultural landscape. On the other hand restoration efforts aim to reverse the anthropogenic impact due to damming and restore the natural status of the wetland with its dynamic hydrological regime and its associated rheophilic community as far as possible.

The challenge for floodplain managers is now to develop a compromise solution that integrates restoration and conservation efforts. The potential options cover a wide range from the conservation of the present status to the restoration of the floodplain towards pristine conditions. We use a logistic regression approach (GLM) to predict the potential habitat availability with respect to hydrological connectivity, accessibility from the river, relative depth and sun exposure of the water bodies for indicator species including highly endangered and flagship species which are used for attracting public support for the conservation/restoration measures.

The results represent the actual and potential future community of the system for the management options. Based on the results we make recommendations for the selection of a best compromise for the management of the floodplain.

Keywords: urban wetland, Danube, habitat model, generalized linear model (GLM), ecological engineering

Historical review of river engineering in the Hungarian section of the Danube

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The basic terms of the natural habitat reconstruction and conservation along the Danube is to recognize the historical water-system processes - which define the present conditions - and to unravel the dynamic events from a relevant aspect of conservation. River regulation, a major human act that utilizes and alters the Danube, has a millennia long tradition. The aim of our study was to provide a review of the consequences of diversified river engineering, moreover to determine the unfavorable effects of channelization on the ecosystem through the evaluation of the Hungarian section of the Danube.

By using historical analysis of water and landscape alteration the deficits of structural and functional ecosystem can be determined (decrease of riverine habitats, intensive hydromorphological changes, changes of lateral connectivity between the river and floodplain, etc.).

It is complicated to define ecological reference conditions for the riparian system in the Hungarian section of the Danube, due to missing river stretches lacking human impacts. Therefore it is inevitable to use historical landscape analysis.

Keywords: landscape history, landscape ecology, river engineering

Danube River's morphology and revitalization – theoretical guide of management measures for the Danube River area

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The Danube River has suffered alteration processes of the ecological balance in order to development of the human society. From the existing studies it comes to the conclusion that in the alteration process of the Danube have been destroyed dominating natural systems and have created industrial structures with economical purpose (navigation, hydro-energy, agriculture, ports etc.) that is damaging the Danube river, because of losing the floodplains and morphological structures.

This paper presents a theoretical guide management measures to achieve a balance of functions (production, habitat for plant and animal species, regulation and control, information) and structure (species, associations, communities) of actual ecosystems through work of revitalization in the Danube Floodplain. In practice, the beneficiaries of these sensitive areas like the Danube Floodplain have difficulties regarding the management of the areas, especially in agricultural and fishery polders, which were created for specific purposes altering / deteriorating the balance of the individual components of the system. Thus many such areas are often unused because of fragmentation of the energy flow between components of the socio-ecological complex.

Keywords: Danube, revitalization, management measures, theoretical guide

Systematic spatial planning for an improved flood risk management in Danube's floodplain

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Last floods in Danube floodplain require European countries to come up with new and different approaches for flood risk management regarding spatial planning.

Although numerous studies show that prevention and management of flood risk depends not only on the height of dykes, but also of a systematic spatial planning, most of public authorities continue to rely on it as the only solution for disaster prevention, which is impractical for many situations.

It is considered that a unified approach to river basin has its advantages over other approaches, where spatial planning is addressed in an integrated manner, including coordination and coherence between mitigation and adaptation policies. Of course, some disclaimers may be made. First of all, changing the traditional way is not something that can be modified easily and takes time. Moreover, there remains a mismatch between the basin approach and other socio-economic processes that has to be reconciled. In order to fully use the response capabilities for both mitigation and adaptation measures should be included socio-economic processes (such as technological development, development of knowledge and, perhaps most importantly, economic development), given the definition of spatial planning, established in 1983, in the European Spatial Planning Charter.

Keywords: spatial planning; flood risk; European policies

Mining deposits in the Carpathians - Ambiguous Heritage: threat and auto-stabilization

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The mining accident of Ajka-Kolontár (western Hungary) in 2010 evidenced the precarious situation of the mining areas in the Carpathian region. It also showed that the lessons from the Baia Mare accident in NW-Romania (2000) had not been learned. Thus, the stabilization of the various spoil deposits became extremely necessary.

Background investigations on soil and soil surfaces development were conducted on two tailing ponds with different materials; one pond of siliceous material near Anies/ Rodna Mts. NW-Romania and an other one on alumina tailings near Oradea W-Romania. The Anies pond - active until 1993 - showed biological colonization and organization from algae films and moss covers to grass felts in the *Hippophae*-stands. Intensive rooting and crumbling by annelids also led to the formation of an Ah-horizon and thus to a certain stabilization of the tailings. Soil development on the Oradea pond - which was closed in 2006 - varied between mineral pellicular surfaces and algae mats of blank alumina material and an Ah-horizon on a thin silt cover over them.

These investigations show that the rapid biological colonization and soil developments on the siliceous material might be exploited to stabilize them. However, only restricted chances seem to exist for alumina tailings.

Keywords: Tisza catchment, mining deposits, accidents, stabilization processes

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