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Tributaries of the Danube III: Tisza – Floods: The oppressed beauty

Editorial

Dear Reader

Meandering of rivers is a fascinating, wonderful feature that can be seen in clear weather from airplanes. The active and dead meanders display the great dynamics of floodplains over centuries behind the spectacular hydromorphological process. The Tisza River is just one fine example *(Figure 1).* But, we also can see significant man-made river straightening and degradation. To understand ecosystems, it is sometimes good to have a broader perspective of a birds view than just to stand on the river banks and see what is close.

The Tisza concludes the trilogy of major tributaries in the Middle Danube. As the largest left-side confluence and flowing through the Pannonian Plains, the Tisza, fed by the water-rich headwaters of Ukraine, was once a majestic meandering river that was severely "domesticated" during the 19th century. Flooding was always a major issue in these lowlands, as resident farmers and settlements were strongly affected. Today, the middle part of the Tisza with its many oxbows and the Tisza Lakes offer a great restoration potential that, however, is in strong contrast to the many infrastructure projects planned for the future. Once more, "sustainability" is on debate and the ecological problems can only be solved by a sound river basin management including land use, headwaters and tributaries. Therefore, maintaining and fostering ecosystem services of the Tisza and considering public participation is in the hands of Ukraine, Slovakia, Romania, Hungary and Serbia, jointly united in the Tisza Group of the ICPDR.

In 2000, the Tisza gained an European-wide poor reputation via the two mine spills of Baia Mare and Baia Borsa. Although the ecological disaster killed numerous fish, invertebrates and birds, the riverine ecosystem recovered rather rapidly. Although mining management and early warning systems were partly improved, and when considering increasing floods promoted by climate change, accidental pollution with hazardous substances remains an important concern for integrated water management of the Tisza River.

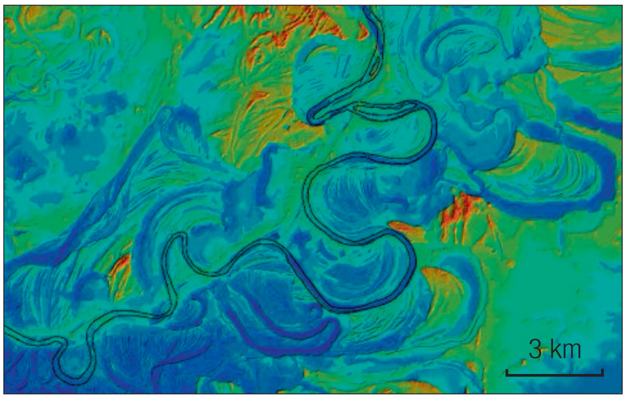

Figure 1. Signs of the westward drift of the Tisza River around the locality of Tiszacsege on a digital elevation model. Elevation ranges from 87 m (dark blue) via green and yellow to 95 m (red). Black lines indicate the pre-regulation channel of the river. Large cut-off meanders, open to the rivers, are located east of the river. Adapted from Timár et al. (2005), Late Quaternary dynamics of the Tisza River: Evidence of climatic and tectonic controls, Tectonophysics 410, 97–110. Credit: Gábor Timár

With Danube News 26, my term as editor ends. I was intrinsically tied to Danube News from the very first issue in 1999 by supporting my predecessor Thomas Tittizer to launch and substantiate his idea for a basin-wide IAD Bulletin, and from 2006 by taking over editing and further developing the structure and layout to what it is today an important and appreciated product of IAD to raise public awareness and to promote Danube River protection and restoration. I wish to thank all the readers for their continuous interest in IAD work and Danube News, and all success for my successor as Danube News editor, Georg Janauer.

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The Tisza River Basin at a glance – natural values and risks

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The ICPDR Tisza Group experts as well as observers from the five countries of the Tisza River Basin have contributed to the development of the documents serving as the basis of the present article

The Tisza River (966 km) is the longest tributary of the Danube River, which flows through five countries: Ukraine, Romania, Slovakia, Hungary and Serbia. The drainage area of the Tisza River Basin (TRB) is 157 186 km^2, and it is the largest sub-basin of the Danube River Basin (801 463 km^2). It is home to approximately 14 million people. At its confluence with the Danube the average flow of the Tisza is slightly over 800 m^3/s. The TRB is blessed with rich biodiversity but also faces significant risks due to human pressures as well as floods, drought and climate change.

Geographical and hydrological features

The Tisza River rises in the Carpathian Mountains of Ukraine and is formed by the confluence of the White and Black Tisza Rivers. The Tisza River Basin (TRB) can be divided into two main parts with different geographical characteristics *(Figure 1):*

- The mountainous Upper Tisza and its tributaries in Ukraine, Romania and the eastern part of Slovakia;
- The lowland parts, mainly in Hungary (the Great Hungarian Plain-Alföld) and in Serbia, surrounded by the East-Slovak Plain, the Transcarpathian lowland (Ukraine), and the plains on the western fringes of Romania.

The Tisza River itself consists of three main sections:

- The Upper Tisza, upstream of the mouth of the Someş/Szamos River;
- The Middle Tisza in the Hungarian Great Plain, which receives significant right- and left-side tributaries from the Carpathian Mountains in Slovakia and Ukraine, the Hungarian Mátra and Bükk Mountains, and Transylvania in Romania;
- The Lower Tisza, downstream of the mouth of the Mureş/Maros River, where it receives the Bega/Begej River and other tributaries indirectly via the Danube-Tisza-Danube Canal System.

The drainage basins of the Tisza tributaries differ in topography, soil composition, land use and hydrological characteristics (ICPDR 2007). The 1800–2500 m high ridge of the Carpathian Mountains forms in a semi-circle the northern, eastern and southeastern boundary of the Tisza catchment. The western-southwestern reach of the watershed is comparatively low in some places – on its Hungarian and Serbian parts it is almost flat.

The area is divided roughly along the centreline by the Carpathian Mountains, east of which lies the 400–600 m high plateau of the Transylvanian Basin, and the plains to the west. The river basin is varied and rich in eye-catching geographical formations. The highest summits reach 1948 m in the Low Tatras (Král'ova hol'a), 2061 m in the Chornogora Mountains (Hoverla), 2303 m in the Rodna Mountains (Pietrosul Rodnei) and are even higher in the Retezat Mountains of the Southern Carpathians (Peleaga, 2509 m). Areas higher than 1600 m make up only 1 % of the total; 46 % of the basin lie below 200 m.

Following the confluence of the White and Black Tisza Rivers further headwaters rise in the eastern mountains of Slovakia, two of them in the Narodny (National) Park. The Uzh/Uh and Latorytsa/Latorica tributaries flow from Ukraine into Slovakia where they, together with Ondava, Topl'a and Laborec Rivers, form the Bodrog River before it enters Hungary. Further, the Slaná/Sajó and Hornád/Hernád Rivers collect waters from the Carpathian Mountains in Slovakia and Ukraine. The Someş/Szamos and the Mureş/Maros rise in the Romanian Carpa-

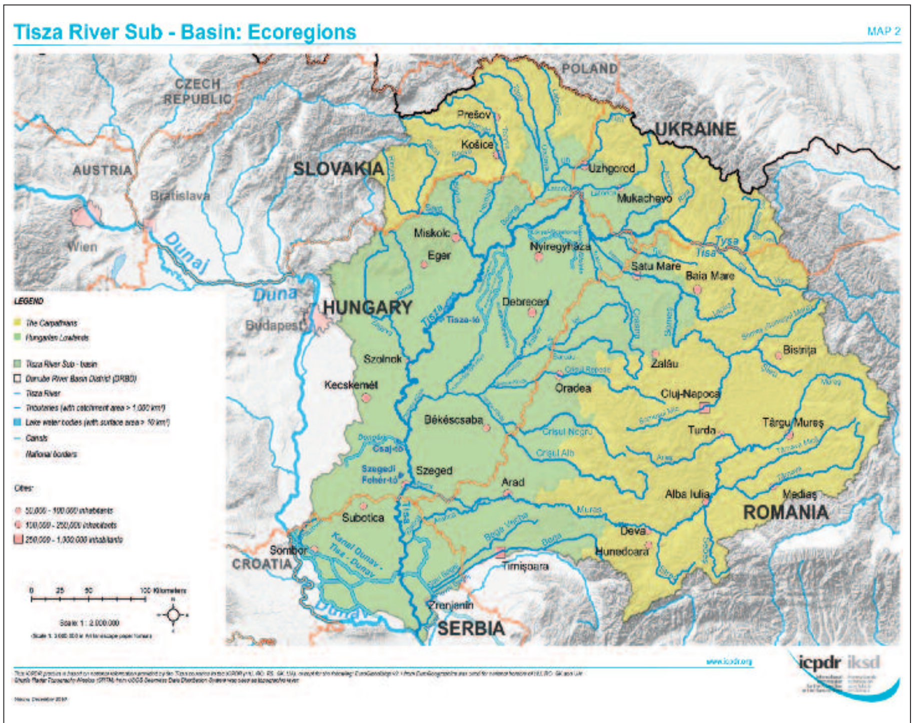

Figure 1. Map of the Tisza River Basin with eco-regions. Further maps with thematic managerial topics can be downloaded from http://www.icpdr.org/main/activities-projects/towards-itrmb-plan-component-1

thians, while the rivers forming the Cris/Körös system rise in the Apuseni Mountains. The TRB in Slovakia is predominantly hilly area and the highest mountain peaks in Král'ova hol'a, in the Low Tatras Mountain Range at 1948 m. The lowland area lies in the south, forming the northern edge of the Hungarian Lowland. The lowest point in Slovakia is the village of Streda nad Bodrogom in the eastern Slovak lowland (96 m) in the Bodrog River Basin. The TRB in Romania is located in the northwest part of Romania and is characterized by a high relief diversity: mountain areas (with elevations above 2000 m), hilly areas (400–800 m) and plain areas (200–300 m). The Hungarian part of the TRB is a flat area bordered by small ranges of hills and mountains from the north and dominated by the Great Hungarian Plain. The Zagyva River drains the Mátra and Bükk Mountains. A small, lowland part of the Tisza watershed belongs to Serbia, with various geomorphological elements in relief elevating to 74–143 m.

Visitors who got used to the boundless view of the Great Hungarian Plain can just admire the superb peaks of the Carpathian Mountains. The Tisza River flows down with joyous haste in its steep river bed until reaching the great plain and spreading idly in its lowland parts. The dynamic water flow and the gentle form of the river bed stops the viewers for minutes and drives them to the question from where this large amount of water is coming from.

Figure 2. Hortobágy National Park – the Puszta (UNESCO World Heritage Site): View of Lake Tisza (15.8.2007). Credit: Dániel Németh

The TRB is influenced by the Atlantic, Mediterranean and Continental climates, which impact regional precipitation. About 60 % of the Upper TRB gets more than 1000 mm of precipitation annually. Warm air masses from the Mediterranean Sea and the Atlantic Ocean cause cyclones with heavy rainfall on the southern and western slopes. In general, two-thirds of the precipitation occurs in summer. Within the TRB, the multi-annual mean precipitation varies from 500 to 1600 mm/year. The lowest values (500 mm/year and less) occur in the southwestern part of the basin, close to the Tisza River. The highest values (around 1600 mm/year) occur in the northwestern Carpathians and the Apuseni Mountains. Dry spells (with less than 10 mm/month) are frequent in most areas of the TRB in February and March.

In the mountainous regions, flash floods are common in spring and summer. These are further intensified by the low infiltration capacity of the soils in the Carpathian Mountains. These floods cause enormous inundation in the lowland areas. Flooding is a natural event influencing riverine ecosystems, but it is also a significant threat to communities settled in the floodplain. Rainfall in the Carpathian Mountains can be substantial and sudden. Extensive runoff, floodplain deforestation and river canalization reduce the ability of the catchment to attenuate the flood wave. When heavy rains occur, flooding threatens human lives as water levels rise quickly without sufficient retention capacity.

Rich biodiversity

The TRB is blessed with a rich biodiversity, including many species no longer found in Western Europe. The Upper TRB is an important migration route for fish, notable Nase *(Chondrostoma nasus)*, Barbel *(Barbus barbus)* and Sterlet *(Acipenser ruthenus).* The area supports a rich wetland fauna of dragonflies (Odonata) and nesting water birds, including all eight European Heron species. The region has outstanding natural ecological values such as unique freshwater wetland ecosystems, 167 larger oxbow-lakes, more than 300 riparian wetlands and 12 Ramsar sites *(Figure 2).* The TRB provides a livelihood for many, through agriculture, forestry, pastures, mining, navigation and energy production. The past 150 years of human influence, however, have caused serious problems for the basin's waters.

River regulations alter traditional landscape

In the 19th century, river floodplains traditionally supported flood-tolerant land uses, such as forests, meadows and fishponds. Since then, land development interests have changed to modern agricultural production demanding low and tightly-regulated water levels and protection from seasonal inundation. This trend has been facilitated by the availability of arable land, crop intervention payments and grant aid for drainage, including pumped drainage within floodplains. This has led to the development of arable agriculture that demands low water levels in associated rivers. Industrial and urban building has also increased within drained floodplains lasting recent decades. In Hungary, work to drain the Tisza wetlands began in the 19th century and today some 500 000 people – 5 % of Hungary's population – live on land reclaimed from the Tisza. Efforts to reduce flood impacts by building higher dikes and continued river bed regulation have resulted in a deposit of silt within the main channel which has inadvertently increased flood risks.

Until the middle of the 19th century, the Tisza River repeatedly inundated some 2 million hectares along its course. The first survey of the river valley in Hungary was done between 1833 and 1844, and Pal Vásárhelyi issued a plan for riverbed training with 121 short-cuts along the river in 1846. This plan was declined, and a new plan with 21 short-cuts was accepted in 1847. River training works began finally after a disastrous flood in 1855, and 112 short-cuts were completed by 1875 (ICPDR 2007). The original Tisza River length of 1400 km with a strongly meandering riverbed was shortened by approximately 30 % to 966 km (for more details see the article by Fejér & Bakonyi).

The Danube-Tisza-Danube Canal

The Danube-Tisza-Danube Canal System (DTD) is situated in the Vojvodina province of Serbia. People from the ancient times made great efforts to combat floods and diseases. At the end of the 17th century, this region was covered with marshes, swamps and bogs full of mosquitoes, with 2–3 inhabitants/km^2. In the 18th and 19th century, the drainage of wetlands, protection of properties from frequent flooding, and prevention of water-related diseases started. Canals were excavated to drain swamps and enable navigation: the Bega Canal for the drainage of the Central marsh (4000 km^2), the Teresia Canal in the Banat region, and the Danube-Tisza Canal in the Backa region.

After the Second World War, the existing canals were connected into a multi-purpose water management system. Its design started in 1947 and the project was finished in 1977 with the completion of the dam on the Tisza. These developments changed Vojvodina from a swampy and uninhabited area to a densely populated and developed part of Serbia.The DTD has the following tasks: flood protection – adequate level achieved; draining excess interior waters and routing drainage waters through main channels towards the Danube and the Tisza Rivers; conveying water for irrigation of agricultural land – presently very modest; water supply for industry and fisheries; navigation; receiving and transporting wastewater respecting water quality criteria; recreation, sports and tourism.

Challenges facing water management in the Tisza River Basin

The natural values and ecosystem services such as drinking water supply of the TRB are threatened by pollution of organic substances from municipalities and urban settlements, nutrients from wastewater and farming, and hazardous substances from industry and mining, e.g. by accidental spills such as cyanide in Baia Mare and heavy metals in Baia Borsa in 2000 (see article by Zinke). The load of nutrients and contaminants influences the Danube downstream and the Black Sea. The significant hydromorphological alterations described above have not only negatively impacted aquatic communities but also led to an increasing frequency of extreme floods (from 1998 to 2006), periods of drought (particularly in Hungary and Serbia), as well as landslides and erosion in the uplands (in Ukraine and Romania). All these challenges call for a sound river basin management plan to be achieved by the Tisza Group (see concluding article by Heilmann et al.).

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History of floods and river engineering – how many Tisza floodplains and river km lost?

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History of river engineering

There is a lot of discussion both among experts and laymen about the river engineering works done on the Tisza River. Some claim that our predecessors impaired the Tisza River. It would have been better to keep the original state, let the river flow freely and continue the wetland-like floodplain farming. Although this approach seems fair there are some drawbacks as well.

The medieval and modern floodplain farming, wherever it existed along the main rivers, meant a real "living together" with the river and its regime. The marshes provided shelters for the population mainly dealing with animal husbandry and helped them to hide away from foreign and/or even home armies as the riparian people feared all kind of armed persons. The so-called "fok" systems, the floodplain farming system, rather meant survival than enriching. When ploughland corn growing became dominant the popularity of floodplain farming decreased because of the irregular flooding and thus uncertain production. It is not by chance that after an age-long struggling with the idea of river training our predecessors started the overall river engineering works of the Tisza and its tributaries in the 1840s. Of course a lot of discussion (we would call it a public debate) followed the so called Vásárhelyi concept (named after Pál Vásárhelyi, a civil engineer and conceptual designer of the river training works of the Tisza system). Vásárhelyi intended to solve the problems of the Tisza system by cutting short over developed river bends (meanders) and by constructing flood protection dykes. The discussion was about HOW to construct the flood protection and not about WHY. There was a general understanding that something should be done with water conditions of the Great Hungarian Plain to provide for economic and social development.

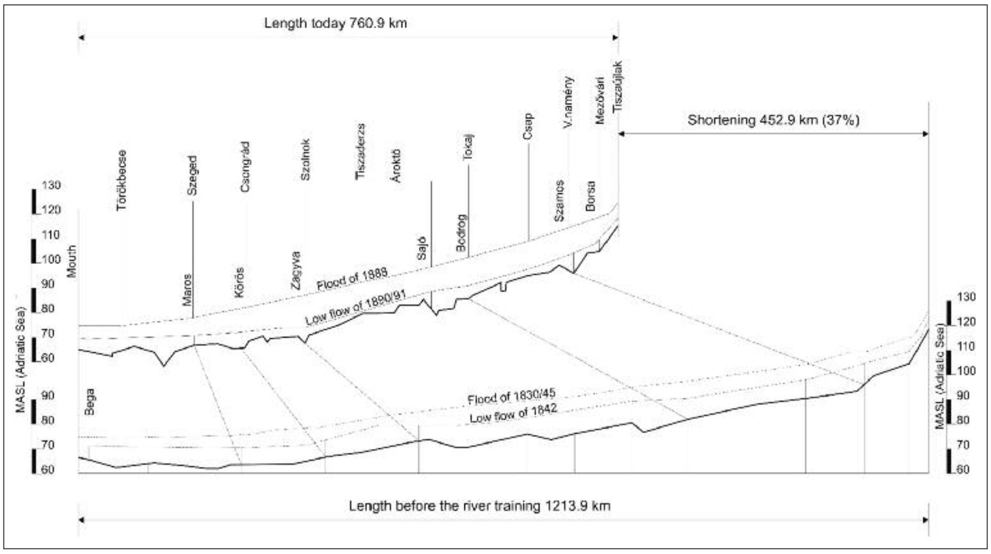

Figure 1. Longitudinal section of the Tisza before and after the river training

The hydrological survey of the Tisza and its tributaries at the beginning of the 19th century showed about thousand settlements within the floodplains. The area permanently covered with water reached 4800 km^2 while the temporarily flooded area was almost 15 000 km^2.

The Tisza River training project was driven by the interest of the large and medium size landowners. Counts Almássy, Károlyi, Lónyay and Wenckheim had enough economic power to boost the river training works. Flood Protection Associations (FPA) established by the landowners executed the constructions. This was a venture driven by the local population without any central governmental influence. During the almost half a century long construction that started in 1846 altogether 102 over developed river bends were cut off (Lászlóffy 1982). As a consequence the length of the Tisza River from Tiszaújlak down to the Danube was shortened by about 453 km while the slope doubled to about 6 cm/km *(Figure 1).* As the area of the protected floodplain increased the flood bed decreased considerably. Nowadays there is an about 2850 km long primary flood protection dyke system to avoid flooding.

Gaining arable land and prosperity – losing ecological values

As a consequence of the river training works the increase of arable land was enormous producing wealth to the landowners through corn production. A positive effect of the intervention was that roads and railways were built and large regions could latch onto the economic and social life of the country. Besides economic growth public health conditions improved a lot.

Having mentioned the positive side of the river trainings one should also present the negative side: behind the dykes on the protected floodplains large inundations arose (excess water, ground water flooding or flooding of undrained or not properly drained areas) that required extra efforts from the FPAs (Deák 1996). Drainage canals, weirs and pumping stations had to be built. The abundance of fish of the Tisza and its tributaries decreased considerably and the forced corn production led to monocultures. It became also obvious that not all of the flood protected land could be used for corn production and the salinized land was converted to fish farms. To counterbalance the lack of water irrigation systems had to be built.

The major goal of this first river engineering intervention was to fully free from flooding the Tisza region and to provide for as much agricultural land as possible. Today in the European Union the conditions and the requirements are different. First of all agricultural production is only supported where good conditions prevail. The value of wetlands, nature protection and ecosystem services increased tremendously (Fehér & Kaján 1992).

New flood protection strategy

The extreme floods of 1998–2001, four record floods in just 36 months, initiated a new thinking in flood management. One had to realize that raising the dykes is not feasible. It would create a false safety feeling and the probability of higher floods is increasing due to the ongoing climate change. The Hungarian flood management had also to consider that there is no single solution to the problem. Thus, the New Vásárhelyi Plan (VTT) is standing on three legs. First the existing dykes have to be strengthened and heightened where needed to the present standard (e.g. to withstand a hundred year flood). Second the flood conveyance capacity of the flood bed should be improved by removing obstacles and opening a “hydraulic corridor”. Last the residual risk should be mitigated by using flood retention reservoirs.

The VTT foresees the construction of 11 flood retention reservoirs with a 1.5 billion m^3 (1.5 km^3) of storage capacity *(Figure 2).* The retention areas are mainly dry and used for agriculture, but some of them allow for wetland development and some can retain water for other purposes (like irrigation, recreation etc.). It is planned that each reservoir shall be operational every 30–40 years when the damages to the landowners will be compensated by the state.

Conclusion

Tisza River has lost most of its floodplains during the 19th century river training works. This huge intervention into the life of the Tisza River opened possibilities for agriculture, social and economic development, improvement of public health, etc. However, the significant river straightening and

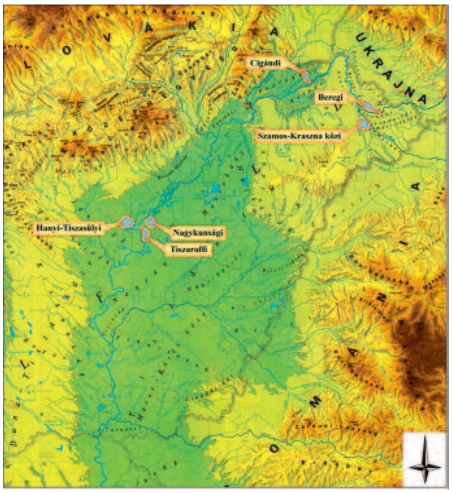

Figure 2.
Phase 1 flood retention reservoirs of the New Vásárhelyi Plan to be built by 2050.
Five additional reservoirs will follow later

the loss of floodplains accelerated the flood propagation, which in turn resulted in higher and longer flood waves on the lower part of the Tisza that cannot be efficiently combated by higher dykes. Therefore, a paradigm change in flood risk management considering the hydromorphology of a river is needed as broadly recognized worldwide. With the changes in expectations towards nature, river ecosystems, agriculture and ecosystem services, etc., the New Vásárhelyi Plan offers the use of large flood retention reservoirs that can also provide for multiple functions as wetland development, recreation, irrigation, etc. With this strategy the river hydromorphology can – to a certain extent – be restored to increase the ecological value of the Tisza River.

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The Tisza headwaters – how pristine are they?

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Geography

The Tisza River is formed by the confluence of Chorna (Black) and Bila (White) Tisza four km upstream of the town of Rakhiv. Both Tisza and its tributaries in the upper section are typical mountainous rivers with narrow valleys and precipitous slopes. Their beds are rocky-stony and the channel slope exceeds 15‰. The Tisza River Basin within Ukraine comprises 9426 rivers and streams amounting to 19 793 km total length. Four of them (Tisza, Borzhava, Uzh and Latoritsa Rivers) are more than 100 km long, 153 rivers are longer than 10 km. The density of the river net (1.7 km/km^2) is four times higher than the average for Ukraine. Sources of most rivers are located in the highland zone of the Carpathian Mountains. Geographical location and relief peculiarities condition low urbanization rate, low population density and few industrial enterprises.

The Upper Tisza sub-basin comprises two hydrological subregions – eastern and western, separated by the watershed of the Rika and Tereblia Rivers. The climate in the western subregion is warmer, rivers run mainly westward. In the eastern sub-region, which encompasses the mountainous part of the basin, the right-bank tributaries (in Ukraine) run mainly southward, while the left-bank tributaries (in Romania) run northward.

Hydrobiology

Phytoplankton in the headwaters is scarcely developed and of minor significance in the ecosystem, though 127 species, mainly Bacillariophyta were registered. Periphytic algae are quite diverse; there are some rare species, particularly *Hydrurus foetidus* (Chrysophyta), a cold-water stenotherm and indicator species of oligosaprobic zones. Special attention should be paid to the diatom *Didymosphenia geminata,* which normally occurs in all headwaters of the Tisza tributaries, however, is considered as invasive species and a potential hazard for the plain sections of the rivers (by forming extensive mats destroying food sources of fish). Higher aquatic vegetation is also rare. In the riverbeds only the aquatic moss *Fontinalis* develops, along the riparian zone single specimens of the sedge *Carex riparia, C. gracilis,* and *C. inflata* occur. The crenal and meta-rhithral river zones are characterized by the unique highland communities, particularly the thickets of the endemic *Doroniceta carpaticae.*

Zooplankton is poorly represented (only 31 species) and its abundance depends on the drift intensity. Benthos plays the key role in the considered rivers – more than 600 invertebrate species of 24 taxonomic groups were found. The most diverse groups were midges (Chironomidae – 212 species), mayflies (Ephemeroptera – 74), caddisflies (Trichoptera – 81), and stoneflies (Plecoptera – 46). Indicative and significant for the reference conditions were: *Crenobia alpina, Erpobdella monostriata, Trocheta bykowskii, Nyphargus stugius, Gammarus balcanicus, Onychogomphus forcipatus, Anax imperator, Calopteryx virgo, Perla abdominalis, Taeniopteryx auberti, T. schoenemundi, Acrynopterix* sp., *Amphinemura* sp., *Leuctra nigra, Isoperla* sp., *Chloroperla apicalis, Rhithrogena* sp., *Baetis alpinus-lutheri grs., Caenis beskidensis, Ephemera lineata, Ecdyonurus venosus, E. affinis, Rhyacophila obliterata, Hydropsyche bulbifera, Mystacides azureus, Sericostoma* sp. and *Ancylus fluviatilis*.

In the Upper Tisza River Basin 63 species and subspecies of lampreys and fishes of 16 families are present. Recently *Rutilus pigus virgo* and *Gymnocephalus baloni* were found.

The upper section is characterized by highest diversity, including 10 rare and protected species: *Eudontomyzon danfordi, Acipenser ruthenus, Leuciscus souffia agassizi, Gobio uranoscopus frici, Umbra krameri, Hucho hucho, Thymallus thymallus, Zingel zingel, Z. streber, and Gymnocephalus schraetser;* most of them are Carpathian endemics. However, over the last 80 years the number of alien fishes constantly increased *(Carassius auratus gibelio, Ictalurus nebulosus, Lepomis gibbosus, Percottus glenii, Parasalmo mykiss, Salmo fontinalis, Hypophtalmichtys molitrix, Ctenopharyngodon idella, Aristichtys nobilis, Pseudorasbora parva).*

It is worth noting that species composition of the bottom fauna and fishes in the left-bank (Vişeu, Iza, and Sepintse Rivers) and right-bank tributaries is similar, while these communities differ from those of the Borzhava, Latoritsa and Uzh Rivers, which belong to the western hydrological sub-region.

Protected areas and human impacts

Actually there are 458 reserves within the Ukrainian section of the Tisza Basin; their total area amounts to 181 400 ha – that is 13.8 % of the basin area. The reserves "Ozirniy-Brebenescul", "Atak-Borzhavs'ke", "Chorne Bagno", "Dolyna nartsyssiv" and "Pechera Druzhba" are Ramsar sites (wetlands of international importance) and new sites are planned to be listed in 2012. The total area of protected wetlands amounts to 2211.4 ha.

Water pollution by organic matter and nutrients from municipal and industrial waste waters and agriculture negatively affects rivers. For instance, in 2010 the total volume of untreated waste water discharged into Ukrainian water bodies of the considered region amounted to: industry – 1134 mio m^3, agriculture – 1510 mio m^3, municipal – 38.43 mio m^3, other – 0.051 mio m^3. Among the most notable impacts is accidental pollution by heavy metals, above all in the Vişeu River through mining, and man-induced modification and/or disturbance of the riverbed, banks and floodplains, particularly flood-protective constructions. Lumbering activities, i.e. timber transport via river valleys, lead to clogging of rivers, disturb their hydromorphological structure and exterminate biota.

Ecological status

The ecological status of the rivers of the Upper Tisza Basin was determined according to the River Quality & Biodiversity Assessment (RQBA, Afanasyev 2006), which is comparable to the EU WFD methodology. In the highland zone rivers of high ecological status still remained and are considered as reference (Potik Osa, Ozerianka, and Velykyi Balzatul Rivers, *Figure 1).* In the piedmont zone rivers mainly belong to the second quality class (good ecological status). In the sections affected by anthropogenic impacts quality decreases to moderate status (third class), e.g. the Tisza River downstream of the confluence with Vişeu, Tisa, Vicha and Latoritsa Rivers within the section of bank protection or gravel extraction. Overall, in the Ukrainian part of the Tisza Basin about 8 % of rivers are of high and 32 % of good ecological status. Poor status was registered in the lowland rivers – about 18 % of total length of the rivers (National Plan 2012). The answer to the title question is: only the upper headwaters located in remote and protected areas are pristine (reference conditions); degradation of ecological status increases gradually downstream with increasing human population density.

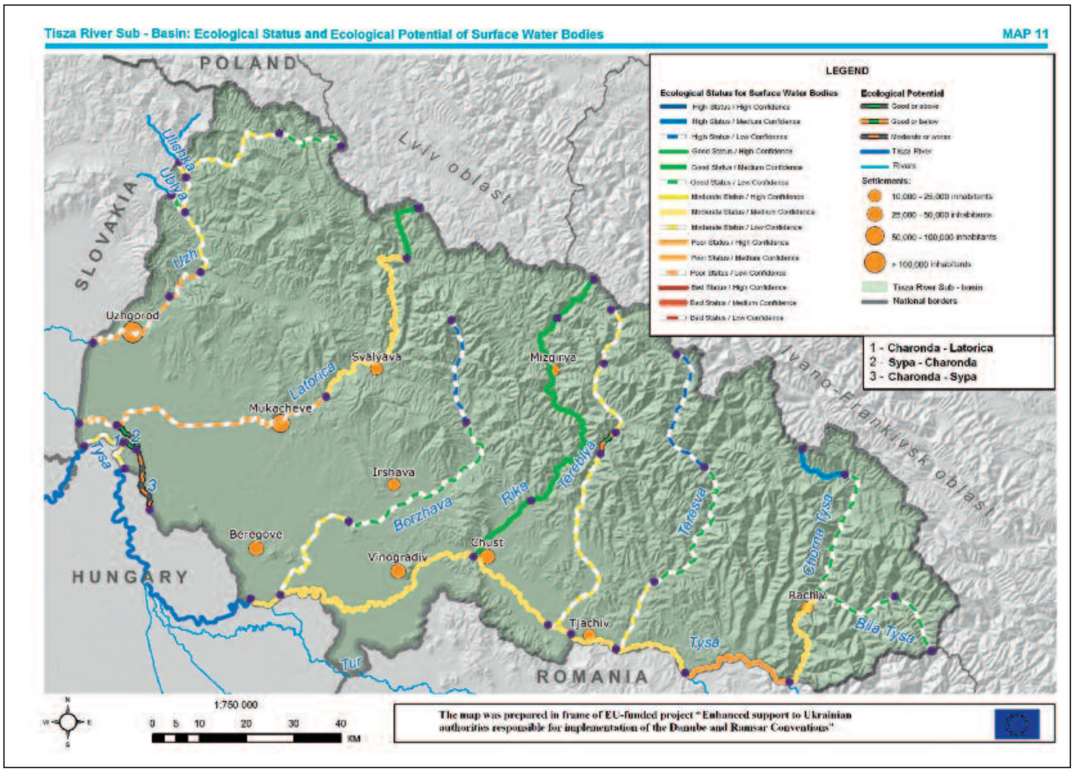

Figure 1. Map of the Upper Tisza River in Ukraine showing the ecological status of rivers

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The mine spills in Romania in 2000 – Lessons from and responses to the ecological disaster

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Risks of Mining

Mining operations are often overexploiting natural resources; many mines are high risk areas and hotspots of pollution (soil, water, air). Mining accidents (pollution spills) generally occur due to technical insufficiencies, bad management and critical weather events, or a combination thereof. Prevention is possible by applying high technical and environmental standards as well as precautionary measures but, in fact, preparedness and alarm systems in most mines in SEE are still limited.

The mining accidents in 2000

The Baia Mare and Baia Borsa (Romania) mine waste spills in early 2000 provide an illustrative example. They were caused by the overtopping of dams after heavy rainfall on snow-covered tailings which was well documented (e.g. by UNEP-OCHA, US-EPA, IAD, VITUKI, NL-RIZA, WWF-DCP, THW/GTZ). A major assessment was prepared by the *"Baia Mare Task Force"* (BMTF 2000). The environmental impacts of both accidents can be summarized as follows:

- Baia Mare: Some 100 000 m³ of wastewater contaminated with heavy metal sludge and 120 tons of cyanide were released. While the Lower Tisza remained largely unaffected due to the dilution and degradation of cyanide, in the Upper and Middle Tisza massive losses in populations of fish (some 1242 tons), benthos (bottom fauna) and plankton occurred. However, the ecosystem recovered rather rapidly, and even threatened or vulnerable species such as the fish Burbot *(Lota lota)* and Pike-perch *(Stizostedion lucioperca),* the endemic mayfly *(Palingenia longicauda),* the otter *(Lutra lutra)* and the White-tailed eagle *(Haliaeetus albicilla)* did not show long-term effects. Favourable conditions after the pollution event and the recruitment from unaffected tributaries and side arms have contributed to the re-colonisation (WWF 2002).
- Baia Borsa: About 40 000 tons of solid waste and 100 000 m³ of water with high concentrations of heavy metals were spilled. This accident received less public attention because it occurred in a remote mountain valley *(Figure 1)* and its impacts were less spectacular. While peak concentrations of heavy metals were measured in water and sediment (e.g. 0.86 mg/l Cu, and 2.9 mg/l Pb and Zn; IAD 2000), toxic effects were limited and only few dead fish washed up on foreign state river banks. However, as heavy metals accumulate in sediments, may be re-mobilized and build up in the food chain, long-term effects on the ecosystem can be significant but are hardly monitored in this mining region.

As this complex and sensitive issue has been addressed by international organizations (ICPDR, UNDP, World Bank, UNEP) and NGOs (WWF, Greenpeace, IAD), both sites were repaired and upgraded. However, regional inspections revealed many more potential risk sites across the entire Tisza and the wider Danube River Basins and the Balkan region (ZEC 2000, 2002; UNEP 2004; Peck & Zinke 2006).

Causes of chronic and accidental pollution

The Tisza Basin is known to be rich in mineral resources (ferrous and nonferrous ores such as copper, lead, zinc, gold, silver, bauxite, manganese, uranium and iron). Gold ores are concentrated in Transylvania, such as Rosia Montana (upper Aries catchment), and face a long history of mining since Roman times. The Apuseni and Banat Mountains are also highly prospective for uranium (U-238) but many deposits are now depleted.

Mining legacies in the area are serious and extensive, with risks of both national and transboundary pollution, damage of landscapes and deterioration of fauna and flora habitats (UNEP 2004). Impacts include chronic and (potentially) acute environmental pollution. Besides *background contamination* by heavy metals from natural rocks the continuous discharge of heavily contaminated acid water from tailing ponds, waste rock piles, and underground and waste dumps of abandoned (inadequately closed) and operational (poorly managed) mining sites are the major sources of *chronic pollution* with hazardous substances in the Upper Tisza region (UNEP 2005; Zobrist et al. 2008; Zinke 2010). *Acid mine drainage* (AMD) results if non-ferrous metal deposits of copper, lead and zinc sulfides are oxidized to sulfuric acid. Due to the low pH (1.5-3.0) of these waters heavy metals can be leached from the rock and mobilized. Consequently, heavy metals can enter and bio-accumulate in the natural and human food chain.

Only in few cases contaminated mine waters are collected and treated properly. The main reason is the lack of national and international financial support for proper closure, decommissioning and related modern waste water treatment (UNEP 2004). The political and economic changes after 1990 did not really improve bad mining practices (sub-standard extraction, processing and waste management; no proper aftercare and monitoring). So, as in the past, many facilities pose risks with

Figure 1. Baia Borsa-Novat dam spill: view from the dam downstream on 1 April 2000. The photo reflects the significant local destruction of riverine landscapes where the various impacts on biota were hardly monitored. Photo: A. Zinke

potentially wide impacts at limited public awareness, and accidents are much less related to "force majeure" than to largely foreseeable technical failures. The few old waste water treatment plants, operating with obsolete technologies, continued to release large volumes of toxic substances into the streams.

In the Western Carpathians, uranium mine and mill effluents containing natural radioactive elements were often above permitted concentration. In 2000, the daily release of radioactive effluents was about 14 000 m^3 with average content of 2–7 mg U/l. There is a serious problem of seepage from uranium tailings, which represent 6 million tons of accumulated wastes at risk to contaminate soils and groundwater by radio-nuclides (mainly Ra-226). Some accidental spills have occurred in the Tisza River Basin (e.g. in April 2000 at western Romanian streams and then Fekete Körös River in Hungary), but their causes and environmental/health impacts were hardly investigated (UNEP 2004).

Rehabilitation of mining sites

Beside a local workshop on accident prevention (water pollution) organized by the UNDP Country Office Romania in May 2000, a first regional inventory of potential Accidental Risk Spots (ARS), initiated by Romania and ICPDR, identified 139 risk spots, including 42 at high risk (24 in RO, 11 in HU, 6 in UA and 1 in SK) with over 50% being tailing deposits (ZEC 2000). In follow-up steps, ICPDR developed until 2007 a common methodology for ARS classification and ranking for the entire Danube Basin, including a Water Risk Index (WRI) as a quantitative indicator also for flood risk areas.

The Romanian mining company REMIN S.A., stimulated by Greenpeace and local authorities, identified priority measures for 7 mining sites to reduce water pollution in the upper Tisza River Basin and the impact risk on downstream water users (in RO, HU and UA). Investments required ranged from EUR 0.1 to 1 million per mining site (ZEC 2002). But only the listed Baia Borsa-Novat mine was repaired and upgraded with Austrian aid funds (Zinke 2005).

With support from World Bank/GEF, the RO Government agreed a closing strategy aiming from 2008 to 2020 at ecological reconstruction and post-closure activities at 77 tailing facilities, as part of a program addressing 550 mining objects. But the national company CONVERSMIN stressed in 2010 that only half of the needed budget was secured. So, although several sites in the Tisza region became less risky in recent years, the overall situation remains critical.

Lessons learned?

More than 10 years after the disasters, the accident risk in many hot spots – particularly in the upper Tisza region – was not effectively reduced. Main reasons are a low interest among international donors, the local bureaucracy, and insufficient national updates and reviews of the ARS list and attributed WRI, proving to be different from the national list and the real site status (Zinke 2010). The weakness of these lists, fully depending on provided national government information, was shown at the Ajka/Kolontár red mud accident spill in October 2010 in western Hungary whose risk was neither top-listed nor quantified, even though it was identified already in 2001. The same refers to a probably even more dangerous site: the Almásfüzitö red mud and hazardous waste dump right at the Danube east of Komárom.

In 2004 the *Environment and Security Initiative* introduced an improved risk management of mining hotspots through its new guidelines *'Mining for Closure'* (ENVSEC 2005). A follow-up workshop in March 2007 in Brestovacka Spa, Bor, Serbia, addressed innovative, cost-efficient and robust mine water treatment techniques (e.g. passive treatment) that rely on natural processes, such as bacterial activity and oxidation. These techniques, commonly used in North America, were recently adopted in Western Europe and are suitable also for SEE. They should be taken into consideration at all mining sites where conventional techniques are not feasible due to financial and technical constraints. For related documents see http://www.envsec.org/index.php?option=com_content&view=article&id=27&Itemid=52&lang=en&region=SEE&type=publications

It is hoped that such guidance is taken up and applied on time to prevent another ecological disaster of the mining legacy. A scientific database on the transport paths and depositing/accumulation patterns of pollutants in water and biological systems would help sustaining improved mining management.

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Tisza oxbows – restoration and aquatic macrophyte biodiversity

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The origin and classification of oxbow lakes

Lowland rivers show a meandering course within the limits of their natural floodplain, governed by hydrological processes and sediment properties. Erosive forces of floods along the convex side of river bends shape these bends until new short-cuts are created and the thalweg is shortened. Cut-off meanders are called oxbow lakes. In the Hungarian lowlands of the Danube and Tisza River corridors hundreds of natural oxbows were present until the second half of the 19th century.

Navigation needs and flood protection measures led to massive river regulation activities ("Széchenyi-Plan"; WR1 2012). Man-made short-cuts created artificial oxbows. Some were filled up with sediments, but most remained and are used for fishing, as water reservoirs, and for recreation. A comprehensive treatise on oxbow lakes lists 80 water bodies >4 ha along the Hungarian Tisza River corridor (Pálfai 2001), while 138 oxbows with >5 ha were reported in 1992 (Mándoki, personal communication).

Most 'active' oxbows are separated from the river during low and mean discharge but connected during floods. Flood flow patterns determined by floodplain surface properties and man-made structures (e.g. agricultural roads crossing the course of oxbows) influence oxbow bed morphology, e.g. creating deep pools. Oxbows situated outside the levees are connected to the river only by groundwater contact (Pall et al. 1996; Molnár 2011).

Ecological importance, macrophyte vegetation and present status of Tisza oxbow lakes

Oxbows are standing water habitats for most of the year, supporting an intensive development of aquatic plants ('macrophytes'). Oxbows act as breeding and foraging habitats for aquatic animal life, especially fish and amphibians (Schiemer et al. 2001; Dévai 2004). The macrophytes produce biomass, but more important, provide structural elements in the water body like shoots and leaves, and protected habitats. Many aquatic plants are protected by law, underlining their ecological value (Sârbu et al. 2011).

A survey of 15 Tisza oxbows (Janauer et al. 2006) revealed the importance of aquatic macrophytes for ecological and conservational status. While the floating-leaf plants White Waterlily *(Nymphaea alba)* and Water Chestnut *(Trapa natans)* were the most dominant species, the submersed Hornwort *(Ceratophyllum demersum)* and Milfoil *(Myriophyllum spicatum)* were

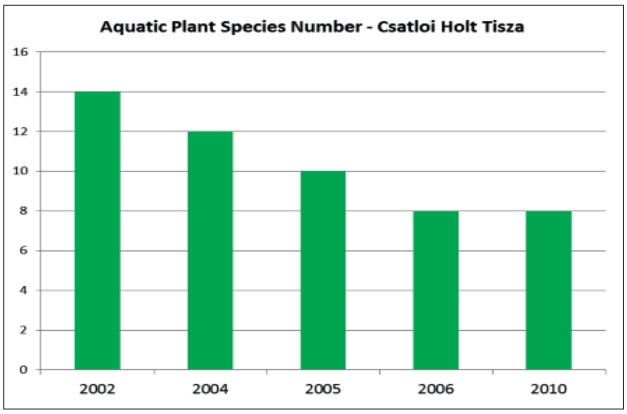

Figure 1. Number of aquatic and amphibious plant species in Csatloi Holt Tisza. Numbers do not include helophytic species, which inhabit the bank vegetation belt

dominant in five oxbows, and the two free-floating species Duck Weed *(Lemna minor)* and Water Fern *(Salvinia natans)* dominated two oxbows.

The present status of aquatic plant distribution in the 15 oxbows is not published yet, but Csatloi Holt Tisza was studied frequently between 2002 and 2012. The drastic decline of macrophyte species *(Figure 1)* is correlated with a decreasing connection period with the main Tisza channel. The progressive lowering of the water level in the oxbow during the last five years is mirrored by Tisza hydrographs. A similar loss of macrophytes may have occurred in other oxbows, too.

Integrative solutions for oxbow restoration

The European Water Framework Directive requests – amongst others – to achieve "good ecological status" for rivers. Ideally, river restoration shall enhance ecological quality to historical, 'near-natural' conditions, including oxbows as part of former river channels. However, reactivated water flow will 'wash away' the standing water community developed over more than a century (Janauer et al. 2006), creating a considerable conflict with the aims of the European Habitats Directive, the most important conservational legal instrument for EU member countries (WR2 2012). Present stakeholder interests like fishing and recreation will also be affected. Water management strategies will need to bridge the gap between divergent EU legislation, sustainable new ways of flood control, drought mitigation and ecology-sensitive care for biological diversity in the Tisza River corridor.

Two aspects beyond instant human control need to be mentioned, too: temperature increase due to climate change (DW Map 2012) and invasive plant species. Higher air temperatures will not only increase Tisza River temperature but also evapotranspiration and reduce summer discharge; hence, due to lower water levels considerable areas in some oxbows will dry out (Csatloi records, Mándoki, unpublished), annihilating most of the aquatic flora and fauna. Invasive species are not only aliens (Hussner 2012); also native, dense canopies producing species have the potential of destroying most of the aquatic biocoenosis: Water Chestnut and Water Fern excessively compete against submersed plants and even fish fauna (by depletion of oxygen under the canopy) in Csatloi oxbow (Janauer, in preparation). As this regards protected species, too, future water management needs to be based on balanced integrated strategies considering the best solution for overall ecological enhancement.

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Decapoda invasion along the River Tisza: current status and trends

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Crayfish communities

The loss of biodiversity is a key ecological process on Earth threatening biota of different geographical units and mankind as well (Rockström et al. 2009). Biological invasions, i.e. the introduction of alien species, are one of the key mechanisms of global environmental change, particularly in freshwater ecosystems. Fish and crustaceans, for example, are easily transferred for food, restocking and ornamental or aquacultural purposes. These introduced organisms are often established in the wild by reaching high densities and greatly impacting native species or ecosystems (Light 2003). In Europe, the establishment of alien aquatic species is well above the 5–20 % suggested by Williamson's "tens" rule due to multiple introductions, which indicates a higher than average threat for inland waters of the continent (García-Berthou et al. 2005).

Freshwater crayfish are important components of the European aquatic fauna and can be considered as key species in the habitat they colonised: being the biggest freshwater macroinvertebrates, playing a crucial role as predators and prey, and acting as ecosystem engineers (Souty-Grosset et al. 2006). The spiny-cheek crayfish, *Orconectes limosus* (Rafinesque, 1817; *Figure 1),* was the first non-indigenous crayfish to be intentionally brought to Europe from the USA (Holdich et al. 2009). After its introduction into Germany in 1890, secondary introductions were made into other parts of Germany and into Poland and France, in an attempt to make up for losses of the economically important noble crayfish, *Astacus astacus* (L.), through crayfish plague (Souty-Grosset et al. 2006). *O. limosus* acts as a vector of crayfish plague (Vey et al. 1983), like other North American crayfish, and it is present in at least 20 European countries today (Holdich et al. 2009). Its occurrence has recently been recognised in Slovakia and Romania, and the River Danube played a key role in both cases, either as a source or as actual habitat (Jansky & Kautman 2007; Pârvulescu et al. 2009; Puky 2009). Within Hungary *O. limosus* has only recently been found in the River Tisza (Sallai & Puky 2008).

Mechanisms of spreading

Crayfish data were collected from the Hungarian stretch of the River Tisza, that is altogether 60.7 % of the total river length (966 km). Distribution and trends discussed are based on our own data and the literature published since the recording of this species from the River Tisza. *O. limosus* is present along the Hungarian stretch of the River Tisza (about 110 km) since the mid-2000s (Juhász et al. 2006; Sallai &

Figure 1. Juvenile of Orconectes limosus with a typical blue coloration of the claws; total length = 3 cm. Photo: M. Puky

Puky 2008). It was also detected in at least four tributaries and inflowing stream systems by 2011 (Szepesi & Harka 2011). The populations of *O. limosus* in the middle of the Hungarian Tisza stretch have no apparent direct contact with those living in the Serbian section of the river. Besides gradually spreading over a large area, some populations also reach high densities (Müller et al. 2009 in Szepesi & Harka 2011).

O. limosus rapidly colonised the Hungarian Danube stretch in the 1990s and early 2000s with an estimated downstream speed of 13–16 km annually (Puky & Schád 2006). It was expected to reach the River Tisza from Serbia, through canals connecting the two rivers, or deliberate or accidental introductions. The present distribution pattern, i.e. around Kisköre Reservoir – a dammed river section with a large surface, suggests one of the last two alternatives. Interestingly enough, such a colonisation pattern is not unique: the Monkey goby, *Neogobius fluviatilis,* was also first found in the reservoir in 1993, later in the River Tisza, then in tributaries (Harka et al. 2006), which may suggest a similar transport mechanism, e.g. introduction with fish stocks from other parts of the country. *O. limosus,* however, spread along the River Tisza with a greater speed.

Other invasive Decapoda species across Europe, such as *Procambrius clarkii,* or those present in the Carpathian Basin *(Pacifastacus leniusculus, Eriochier sinensis)* are not expected to occur in the River Tisza in the near future, unless deliberate introduction of *P. leniusculus* happens. At present their nearest populations inhabit the River Rába and its tributaries in the western part of Hungary. The catadromous *E. sinensis,* a rare species along the River Danube, is not expected to migrate to the middle stretch of the River Tisza. However, *O. limosus* will spread rapidly along the River Tisza as well as in streams and canals in the Great Hungarian Plain, which may diminish native *Astacus* populations fast in the region.

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Cooperation in the Tisza River Basin – achievements and future activities of the ICPDR Tisza Group

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The ICPDR Tisza Group experts as well as observers from the five countries of the Tisza River Basin have contributed to the development of the documents serving as the basis of the present article

In the Tisza River Basin (TRB) there is a long history of cooperation. In 2004, in the frame of the ICPDR, the Tisza Group was established aiming to develop and facilitate the implementation of an integrated Tisza River Basin Management Plan.

Establishment of the ICPDR Tisza Group

The Tisza countries have executed an agreement on the protection of the Tisza and its tributaries in 1986 and established the Tisza Forum in 2000 to address flood issues. They are all parties to the Danube River Protection Convention (DRPC) signed in Sofia in 1994, entered into force in 1998, the most comprehensive agreement for all Danube countries. In addition, all Tisza countries are parties to the Carpathian Convention, which was signed in Kyiv, Ukraine in 2003 and entered into force in 2006. The International Commission for the Protection of the Danube River (ICPDR) is the implementing body under the DRPC. Through the ICPDR, all Contracting Parties support the implementation of the EU Water Framework Directive (WFD) in their territories and cooperate to achieve a single, basin-wide coordinated Danube River Basin Management Plan (DRBMP).

On the basis of earlier activities and encouraged by a dialogue initiated by the EU Presidency of the ICPDR in 2004, the Tisza countries signed the Memorandum of Understanding (MoU-2004) towards an integrated river management. By this, they agreed to prepare a River Basin Management Plan for the Tisza River Basin (ITRBMP) by the end of 2009, aiming at the objectives set by the WFD. The scope for this ITRBMP is somewhat larger than that of the WFD, addressing pollution from point and non-point sources, priority substances, water quality standards, prevention of accidental pollution, flood and drought mitigation, wetland and floodplain restoration, and issues of sustainable development in the Tisza region.

The Tisza Group including all five Tisza countries was created to facilitate and coordinate the activities for the preparation and implementation of the ITRBMP. The Group jointly agrees on the necessary actions for the development of a common management strategy, identifying needs for harmonization of methods and mechanisms or reporting on the progress of implementation of the Joint Tisza Programme of Measures (JPM).

Transboundary issues not covered by the ICPDR and Tisza Group are solved at the appropriate level of cooperation such as in the frame of bilateral river committees / international agreements. Bilateral transboundary water agreements are in place between almost all states in the TRB, but not all of them were "established in order to ensure coordination" as required by WFD Annex I, 6. An exception is the Hungarian-Romanian Agreement on the cooperation aimed at protection and sustainable use of transboundary waters, signed on 19 September 2003, effective from 17 May 2004, which fully meets the provisions of the WFD.

Local issues remain a national task. Coordination efforts, conducted mainly through the respective Ministries responsible for water and environment issues, have been largely directed at inter-ministerial coordination. In this respect, the Tisza Group also serves as a platform to strengthen coordination and exchange information among the relevant international, national and regional activities in the TRB.

Achievements of the Tisza Group

The first milestone in implementing the MoU-2004 was the Tisza Analysis Report (TAR; ICPDR 2007) that includes the characterisation of surface waters and groundwater, introduces pressures and risks, addresses issues related to mining, gives an inventory of protected areas, includes an economic analysis, elaborates on activities within public participation and provides an outlook on further activities.

The TAR concluded that this region faces serious threats from pollution and structural changes as well as from floods and droughts. The 150 years of human influence – including farming, forestry, mining and river engineering, all essential to the livelihoods of people in the basin – have contributed to problems of pollution and changes of natural river morphology. Pollution in the TRB is significant and affects human health, the access to healthy fisheries, the safety of settlements and the development of a successful tourism industry. The report also showed that current water reserves are sufficient, but there is concern that increasing demands for agricultural irrigation, together with a changing climate, may require additional efforts to manage water resources in a fair way.

In 2010 the Tisza Group introduced the ITRBMP, which has been approved by Ministers and high representatives of the TRB countries in April 2011 (ICPDR/UNDP/GEF 2011).

Integrated management in the Tisza River Basin

A key conclusion of the TAR is that water quantity is a relevant water management issue and integration of water quality and quantity in land and water planning is essential for the ITRBMP. At the Danube River Basin District level four significant water management issues (SWMI) were identified that impact water quality of surface and groundwater: organic pollution, nutrient pollution, hazardous substances pollution and hydromorphological alterations. The ITRBMP addresses the same SWMI but the assessments are targeted to specific elements for the Tisza.

The Tisza countries defined that management issues related to water quantity needed special attention and are therefore treated as an additional relevant water management issue. Water scarcity and droughts, as well as floods and excess water are a major challenge in the TRB. Climate change is expected to further influence the water cycle. Floods and droughts impact biodiversity and water quality and, hence, exacerbate previously existing problems.

In the ITRBMP the following priority pressures and impacts playing a role in two or more Tisza countries were identified in connection to Integrated Water Resources Management (IWRM) in the TRB:

- Hydromorphological pressures from flood protection measures
- Accidental pollution due to flooding
- Loss of wetlands
- Solid waste disposal in riparian areas and groundwater zones
- Groundwater depletion because of over-use
- Increased irrigation and related surface water abstraction
- Impacts of climate change on low water flow

The principles of IWRM promote the coordinated development and management of water, land and related resources, to maximise the resultant aquatic ecosystem health as well as economic and social welfare in an equitable and sustainable

Country	Barriers 2009	Passable by fish 2009	River continuity interruptions 2009	Fish migration aids to be constructed	River continuity interruptions 2015	Exemptions according to WFD Article 4(4)	Exemptions according to WFD Article 4(5)	No measures indicated yet
Ukraine	1	0	1	0	1	0	0	1
Romania	100	13	87	1	86	23	0	66 [a)]
Slovakia	60	5	55	13	42	42	0	0
Hungary	55	11	44	25	19	19	0	0
Serbia	12	0	12	0	12	0	0	12
Total	**228**	**29**	**199**	**39**	**160**	**84**	**0**	**76**

Table 1. Overview for each Tisza country on the number of river continuity interruption in 2009 and 2015, as well as on restoration measures and exemptions according to WFD Article 4(4) and 4(5)

[a)] For 44 sites with one or more interruptions the environmental objectives, i.e. good ecological status and potential (for HMWB) are achieved according to the Romanian competent authorities

manner (GWP 2000). The JPM is based on the national programmes of measures, operational by December 2012, and describes the expected improvements of water status by 2015.

Managing floods

Floods in the TRB can develop at any season as a result of rainstorm, snowmelt or the combination of both. Snowmelt without rainfall rarely occurs in the Tisza Basin and respective floods account for no more than 10–12% of total flooding. A rise in temperature is almost always accompanied or introduced by rain, and therefore large flood waves are generated more frequently in late winter and early spring. The TAR provided an overview on historical floods from 1879 to 2006, and indicated 24 extreme events with serious damage in the TRB.

Hydromorphological pressures from flood protection measures are significant in all Tisza countries. Flood protection is one of the key driving forces causing river and habitat continuity interruption for 25% of the TRB. Out of the 228 listed barriers *(Table 1)* flood protection is the primary use for 58 barriers.

As part of flood action plans for the Tisza countries, Ukraine and Romania will implement measures for technical flood defence (construction of new dikes and consolidation of the banks along the Tisza River and its tributaries). New flood protection measures with possible effects on the Tisza aquatic ecosystems are also underway in Hungary, and reconstruction of levees/dikes in Serbia is almost finished. Some 91% of future infrastructure projects (FIP) are intended to improve the flood protection systems in the TRB countries. Some FIP lead to Heavily Modified Water Bodies (HMWB) and are subject to an assessment according to WFD Article 4(7) and/or Strategic Environmental Assessment (SEA) / Environmental Impact Assessment (EIA). The proposed measures aim to reduce flood damage and risk, but they cause severe hydromorphological alterations that must be prevented or mitigated.

Public participation and preservation of natural resources

During the preparation of the TAR public participation, particularly by observers from NGOs relevant for the TRB, was closely linked with ICPDR activities. The TAR was uploaded to the public website of the ICPDR (www.icpdr.org) and available for six months for comments. Also the draft ITRBMP was submitted to the public participation process, and the final draft was approved by the ICPDR Tisza Countries Heads of Delegation in December 2010. In April 2011, in the frame of the Tisza Ministerial Meeting, the countries updated the Memorandum of Understanding to express their commitment to the implementation of the ITRBMP.

Some tributaries and the Tisza River itself in the upper section of the basin run free of dams and other significant human impacts, contributing to the values of this natural heritage which is considered unique in Europe. Conservation of these natural areas is of common interest and the implementation of future infrastructure projects has to be managed so as to preserve these natural assets.

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39th IAD Conference in Szentendre, August 21–24, 2012
Conference Summary

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The topic "For the living Danube – Integrating human use and ecosystem function for a sustainable development" was in focus at the 39th IAD Conference in Szentendre, Hungary. This reflects the increased efforts of IAD to bridge the gap between science and management, and to strengthen political implementation of measures for water protection.

Actual scientific topics that are debated in Environmental Ministries in all Danube countries were addressed in oral and poster presentations, such as aquatic ecosystem services and function (ecological processes, longitudinal and lateral connectivity, biodiversity-invasive species, climate change effects and restoration), water use and pollution (e.g. drinking water supply of Budapest through bank filtration), and ecological effects of water engineering (hydromorphological alterations). The latter was impressively demonstrated in the Danube Museum in Esztergom visited during the post-conference excursion, exhibiting the great Tisza River regulation by Pál Vásárhelyi and others. A comprehensive set of contributions focused on the highly endangered Danube-Black Sea sturgeons, a problem that is intensively discussed by NGOs (IAD, WWF, WSCS) and governments (through ICPDR). As a result the Danube Sturgeon Task Force (DSTF) was founded in January 2012 (www.dstf.eu) within the framework of the EU Strategy for the Danube Region (EUSDR).

The link to the EUSDR with 11 Priority Areas and EC DG-REGIO policy was in focus with regard to EU WFD implementation. "Sustainable development" can only be achieved if policy finds the balance between economy, social affairs and ecology, and the "business as usual" approach of economic growth is abandoned. Invited honorary keynote speaker Dr Erhard Busek, Austrian politician and president of the Institute for the Danube Region and Central Europe in Vienna (Institut für den Donauraum und Mitteleuropa), stressed the importance and usefulness of the development of the Danube region within the EU policy. He pointed out that we need to understand the Danube countries' history and culture, and to overcome national borders to find common and sustainable solutions of problems concerning water policy. With respect to development, his plea is clearly in favour of expanding navigation along the Danube River corridor and across Europe. Yet the hydromorphological river alterations pose a much stronger pressure on aquatic ecosystems than pollution and drinking water use as exemplified by the ongoing navigation projects (ISPA I and II) in the "Green Corridor", Romania, and the planned hydropower chain in the Sava River, Croatia, upstream of Zagreb.

A resolution based on the results of the conference was approved by the General Assembly (www.iad.gs). It stresses the concern of IAD about the economic drive of the EUSDR and planned development of navigation, hydropower and future infrastructure projects in the Danube River Basin. Moreover, IAD members and conference participants discussed between the sessions of how to make the association more attractive for young scientists, the future generation. Enhanced exchange between IAD officers and students seems to be a key element. The conference has been a good opportunity to make friends and project partners, and to promote IAD as scientific organization in coming EU research Programmes.

Some 103 scientists from 14 countries attended the conference. The output of the conference is available in two printed documents: 80 short abstracts for oral and poster presentations are published in the Conference Book of Abstracts and 33 extended abstracts are published in the Conference Proceedings. (Both can be downloaded on www.iad.gs). The conference organization by emeritus Prof Árpád Berczik, Dr Mária Dinka and their team from the Danube Research Institute of the HAS supported by the IAD Organizing and Scientific Committees, is greatly acknowledged. Árpád Berczik was honoured for his long-term IAD membership (since 1957/58) and IAD Board activities (Country Representative since 1974).

Figure 1. The IAD Board of Country Representatives and Expert Group Leaders held another work meeting in Szentendre to ensure the prosperity of our association. Their decisions were unanimously approved by the General Assembly during the conference. Photo Fritz Kohmann

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Hydrological catchment of the River Danube

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