Moving Sediment Management Forward

River basin case studies

The Danube

The Danube River Basin is Europe's second largest river basin, covering a total area of 801,463 km². It is the world's most international river basin as it includes the territories of 19 countries: the Danube River Basin includes all of Hungary; nearly all of Austria, Romania, Slovenia, Slovakia and Serbia; significant areas of Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Moldova and Montenegro; and parts of Germany and Ukraine. Five more countries share areas of the Danube basin smaller than 2,000 km^2: Switzerland, Italy, Poland, Albania and Macedonia.

Its richness in landscape - including high Alpine zones, large plains, sand dunes, forested and marshy wetlands the Danube River Basin - highlights the tremendous diversity of habitats. Each habitat has its own inter-relationship with sediments. The ecosystems of the Danube River Basin (DRB) are highly valuable in environmental, economic, historical and social terms, but they are subject to increasing pressure and serious pollution from agriculture, industry and cities.

Fig. 1: The Danube river basin

Important water uses and services include water abstraction (industry, irrigation, household supply), drinking water supply, wastewater discharge (municipalities, industry), hydropower generation, navigation, dredging and gravel exploitation and recreation.

All Danube countries with territories >2,000 km² in the River Basin are Contracting Parties to the Danube River Protection Convention (DRPC). This Convention provides the legal, as well as political, framework for cooperation and transboundary water management in the DRB. The International Commission for the Protection of the Danube River (ICPDR) has been established to implement the DRPC and serves as the coordinating platform to compile multilateral and basin-wide issues at the "Roof level" of the DRB. The ICPDR also facilitates implementation of EU Water Framework Directive (WFD) and EU Floods Directive at this level.

Sediment balance

The first Danube River Basin Management Plan prepared to meet the requirements of the EU Water Framework Directive highlighted that, at present, the sediment balance of most large rivers within the DRB can be characterized as disturbed or severely altered. Morphological changes during the last 150 years due to river engineering works, torrent control, hydropower development and dredging, as well as the reduction of adjacent floodplains by nearly 90%, are the most significant causes of impacts.

Hydropower plants in the upper Danube catchments trap almost 80-90% of the sediment bed load. The middle Danube, due to the decreasing slope, is characterized by a transition from a gravel river into a sand river. In the lower Danube, the suspended load dominates the overall sediment transport.

Torrent control works and impoundments on the upper catchments in the Danube River Basin currently retain about one third of the suspended load. However, during floods, large quantities of sediments can be remobilized and deposited in the inundated floodplains. In the lower Danube, meanwhile, the transport of suspended load currently reaches only 30% of the original amount recorded, due to abundant anti-erosion and hydro-technical works throughout the entire Danube River Basin as well as significant settling of sediment in the Iron Gate 1 reservoir.

Sediment erosion and deposition

Downstream of torrent control works and hydropower plants, river bed degradation is very intensive due to the sediment deficit. This effect is exacerbated by river regulation (increase of slope, decrease of channel width, suppression of bank erosion).

There is an overall tendency for deepening, but incision rates vary for a variety of reasons. In Bavaria, the Danube reach from Straubing to Vilshofen has an overall incision tendency of 1.5 cm/yr. Along the Austrian Danube, in the free-flowing stretch within the Wachau, a slight deepening of 0-1 cm/yr is observed, and the stretch downstream from Vienna has a degradation of 2-4 cm/yr. Along the Hungarian-Slovak border, the channel incision downstream of the Gabcikovo power plant is 2-3 cm/yr; but it reduces downstream of Komárno to 1-2 cm/yr (including the impact of the Danube bend gorge, which is a regional erosion base). The overall riverbed incision in Hungary is estimated to be about 1-3 cm/yr. For the Serbian reach further downstream to the Iron Gate backwater (near the Tisza confluence) there is no clear evidence of a channel incision. Downstream of the Iron Gate Dams, the rate of degradation along the Romanian-Bulgarian Danube reaches an average value of 2-3 cm/yr.

Addressing the challenges in the River Basin Management Plan

The first Danube River Basin Management Plan outlined recommendations which should provide an essential basis for future decisions on sediment issues in the DRB - including decisions on actions to be taken in future river basin planning cycles. It recognized an increasing discrepancy in the DRB between sediment surplus in reservoirs and retention basins of torrent control works, and sediment deficit in the remaining free-flowing sections. In combination with river channelization, such a situation leads to river bed degradation and a loss of morphodynamic structures, with associated challenges for achieving ecological status. The DRBMP therefore proposes appropriate improvement measures which in turn require additional investigations to:

- identify the significance of sediment transport at the Danube basin-wide scale, and
- develop a sediment balance for the DRB including identification of possible consequences due to climate change.

The DRBMP reiterated that the availability of sufficient and reliable data on sediment transport is a prerequisite for any future decisions on sediment management in the DRB. River regulation works contribute to river bed degradation. River restoration is therefore of key importance for reducing degradation, improving morphodynamics and achieving good ecological status. Steps also have to be taken to ensure the sediment continuum (initiation of river type specific morphodynamics, including floodplains).

Proper functioning of the aquatic ecosystem also relies on an acceptable sediment quality. During the Joint Danube Surveys, the ICPDR regularly investigates the contamination of sediments and suspended solids to help understand the occurrence of priority substances and other pollutants.

Dialogue with other sectors

To ensure achievement of the environmental objectives of EU WFD in the most sustainable way, the ICPDR maintains close contact with the key stakeholders throughout the river basin. In October 2007, a "Joint Statement on Inland Navigation and Environmental Sustainability in the Danube River Basin" was concluded. The ICPDR linked up with the Danube Commission, and the International Commission for the Protection of the Sava River Basin to initiate an intense, cross-sectoral discussion process leading to adoption of the Joint Statement which summarizes a set of principles and criteria for environmentally sustainable inland navigation on the Danube and its tributaries, including the maintenance of existing waterways and the development of future waterway infrastructure. Following its adoption, the responsible government authorities and interest groups met again to discuss the progress achieved so far and how to improve the application of the Joint Statement in waterway projects.

Following a request by the Danube Ministerial Conference 2010, the ICPDR has become active in initiating a dialogue with representatives from the hydropower sector. As an essential step in this ongoing process, "Guiding Principles for the Sustainable Development of Hydropower in the Danube Basin" are currently being developed.

The ICPDR highlighted at its Ordinary Meeting in 2012 that a sound knowledge base on sediment issues is essential before taking decisions on future measures. It also encouraged a close cooperation with the relevant stakeholders (navigation, hydropower) working towards the elaboration of a sediment balance and identifying best practices for sustainable sediment management.

The Danube case study highlights the important inter-relationships between hydro morphology, sediment quantity and river ecological status insofar as:

- coordinated measures are required to address the disruption to natural sediment transport caused by past hydro morphological modifications which affect sediment status throughout the Danube River Basin and
- successful resolution of the various problems will depend on continued, constructive dialogue across a wide range of stakeholders in a large number of countries.

Links

International Commission for the Protection of the Danube River (ICPDR)

www.icpdr.org

June 2014