drivers for changes of the sediment regime on a Danube Basin level. Furthermore, agriculture and water supply (for drinking and industrial purposes) have been identified as important drivers, though the interaction of agriculture and sedimentation could only be considered on a limited basis within this project. Previous studies have shown that the influence of agriculture on quality issues of sediment is particularly high – an issue that is outside the scope of the DanubeSediment project.

Figure 9. DanubeRiver, east of Vienna, view from Braunsberg; Source: Philipp Gmeiner, IWHW-BOKU, Vienna

A sediment guidance and a stakeholder manual for the Danube River

Based on the knowledge and insights gained during the activities described above, which are flanked by an active and regular stakeholder involvement via workshops on national and international level *(fig. 5, 6)*, the project will produce a Danube Sediment Management Guidance (DSMG) and a Sediment Manual for Stakeholders (SMS).

The DSMG will be a strategic document for decision-makers that seek to improve awareness on sediment quantity-related problems. It will suggest measures for solving sediment-related problems in the Danube River Basin, such as the impacted ecological status and the increasing flood risk. The document will provide a strategy for better sediment management, such as improving the sediment continuity as well as reducing the gap between surplus and deficits of sediments, directly contributing to improved transnational water management and flood risk prevention.

The Sediment Manual for Stakeholders (SMS) will support the guidance document by providing detailed and stakeholder-oriented background information and complimenting it by concrete examples of measures. The SMS will give suggestions for the future planning of sediment management measures and describe sediment-related good practice examples. To address the key stakeholders, the manual will focus on hydropower, navigation, flood risk management and river basin management, which includes ecological issues. Stakeholders such as companies responsible for waterway maintenance, hydropower plant operators or nature protection can benefit from the recommendations made in the SMS, e. g. about new sediment management methodologies, which can be directly implemented into their operation and daily business. A specific chapter of the manual will discuss the importance of multi-stakeholder interrelation and transnational cooperation to tackle the issue of sustainable sediment management. The Danube Sediment Management Guidance and the Sediment Manual for Stakeholders will contribute to the next Danube River Basin Management Plan and the Danube Flood Risk Management Plan.

References

Hohensinner S (2015): Historical patterns along the Danube's course. Danube Watch 2/2015, p.5

ICPDR (2009): Danube River Basin Management Plan 2009

ICPDR (2015): Danube River Basin Management Plan 2015

News and Notes

Comparison between long-term monitoring survey data and "snap-shot" data from investigative monitoring of Joint Danube Surveys – Case study for nutrients along the Romanian stretch of the Danube River

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The assessment of nutrients in the Danube River has a well-known long-term history at the basin-wide level, especially in view of the link between the nutrient loads of the Danube and the eutrophication of the Black Sea. Therefore, monitoring the pressures given by nutrients in the Danube River Basin District and the extent to what the nutrient loads into the Black Sea are being reduced is one of the major objectives of the comprehensive monitoring activity carried out by the Danubian countries within the frame of Trans-National Monitoring Programme (TNMN) of the International Commission for the Protection of the Danube River (ICPDR). Tailored as a long-term surveillance monitoring, TNMN provides a general overview of the selected water quality parameters in terms of concentrations and loads, mainly in transboundary context. On the other hand, even if according to the Water Frame Direc-

tive investigative monitoring is primarily a national task, at the basin-wide level ICPDR launched the concept of Joint Danube Surveys (JDS), carried out every six years, starting from 2001. One of the specific objectives of the investigative monitoring surveys is to increase the comparability between a homogenous data set produced by a single sampling procedure and laboratory analysis (JDS measurements) and data generated by long-term surveillance type of monitoring (Trans-National Monitoring Network data) carried out by the basin-wide network of TNMN laboratories from each Danubian country.

In a case study carried out in Romania, we intend to provide a comparative view of the surveillance TNMN data and investigative data obtained during the three monitoring programmes known as Joint Danube Surveys 1, 2 and 3, carried out in 2001, 2007 and 2013 respectively. In order to have an optimal way of data comparison and given the survey timing of JDSs (August – September), the momentary results obtained during the three investigative surveys are compared with mean, median and 90-Percentiles of the TNMN data set from August – September during 2001 – 2013.

Microbial Faecal Pollution in the River Danube is Predominantly from Human Sources

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In 2013, the International Commission for the Protection of the Danube River (ICPDR) organized the 3rd Joint Danube Survey to investigate the water quality along the total length of Europe's second longest river. As part of the survey, researchers from the Interuniversity Cooperation Centre Water & Health in Austria (Technische Universität Wien, Medical University Vienna, Karl-Landsteiner-University Krems) and the University of Belgrade, monitored microbial faecal pollution levels by standard faecal indicator bacteria along a 2,580 km stretch of the Danube, as well as in the Danube´s most important tributaries. To track the origin of faecal pollution, host-associated Bacteroidetes genetic faecal marker qPCR (quantitative polymerase chain reaction) assays for different host groups were applied in concert with standard faecal indicator bacteria (SFIB). The spatial resolution analysis was complemented by a time resolution analysis of faecal pollution patterns over one year at three selected sites (downstream the cities of Vienna, Budapest and Belgrade). In this way, a comprehensive faecal pollution map of the total length of the Danube was created, combining substantiated information on both the extent and origin of microbial faecal pollution. Samples were taken midstream of the river and near its right and left banks. Midstream samples representatively depicted the microbial pollution levels at the respective river sites. However, at a few, somewhat unexpected sites (no apparent point sources or larger settlements), high pollution levels occurred in the lateral zones of the river while the midstream zone had good water quality. Using host-associated molecular markers human faecal pollution was demonstrated as the primary pollution source along the whole river, while animal faecal pollution was of minor importance. This study demonstrates that the application of host-associated genetic microbial source tracking markers in combination with the traditional concept of microbial faecal pollution monitoring based on SFIB significantly enhances the knowledge of the extent and origin of microbial faecal pollution patterns in large rivers. It constitutes a powerful tool to guide target-oriented water quality management in large river basins and is a prime example for the value of broad scientific transnational cooperation. For the upcoming Joint Danube Survey in 2019, the research team together with colleagues from the Medical University Graz plan to investigate the link between faecal pollution patterns and the distribution of antibiotic resistance in the Danube.

This mentioned study was recently published in the Journal Water Research:

Kirschner AKT, Reischer GH, Jakwerth S, Savio D, Toth E, Ixenmaier S, Sommer R, Mach RL, Linke R, Eiler A, Kolarevic S, Farnleitner AH (2017) Multiparametric monitoring of microbial faecal pollution reveals the dominance of human contamination along the whole Danube River. Water Research 124: 543–555