BME DEPARTMENT OF HYDRAULIC AND WATER RESOURCES ENGINEERING

Assessment of restoration measures to mitigate river bed erosion in the Drava River (between rkm 0-236)

LIFE17NAT/HU/000577, in the framework of the ”Wise water management for the conservation of alluvial forest habitats along River Drava” (Bölcs vízgazdálkodás a Dráva mentén az ártéri erdők megőrzése érdekében) project

English summary

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Executive Summary

Present study was ordered by the South-Transdanubian Water Management Directorate and prepared by the Budapest University of Technology and Economics Department of Hydraulic and Water Resources Engineering, in the framework of the LIFE17NAT/HU/000577, ”Wise water management for the conservation of alluvial forest habitats along River Drava” (Bölcs vízgazdálkodás a Dráva mentén az ártéri erdők megőrzése érdekében) project. This study is strongly linked to a previous technical document, where the past morphological changes of the Drava River were revealed, discussing the analysing effects, such as river regulation works carried out for flood protection, industrial dredging, Croatian hydropower plants as well as tectonic effects, and their contribution to the erosion processes (BME, 2020). The referred document presented that the morphology of the river, between the Hungarian-Croatian shared section to its confluence zone at the Danube River, had significantly changed, however, according to the low water level analysis, the bed incision processes have mitigated, and the lateral changes are becoming more relevant. On a larger time scale, the riverbed in the investigated section had strongly incised along its whole length, resulting in unfavourable hydromorphological conditions at several shorter sections, hence the need for river restoration has emerged, where the sediment transport and through that, the bed morphological conditions could be improved.

In this study, a review of recently finalized international projects has been performed, which specifically focused on the improvement of sediment balance in the Danube River Basin, and the recommendations of those projects were outlined. Furthermore, good practices towards improving sediment conditions from Hungarian and foreign examples were taken into account, mainly those focusing on river sections with erosion, such as the Drava itself, in order to improve their conditions. Both local- and reach-scale methods were identified and discussed to stabilize the riverbed, while also resulting in positive impacts on the ecological conditions, for instance, cutting through existing groynes near the river bank intensifies the near-shore flows and improves the habitat conditions for fishes (Figure 1).

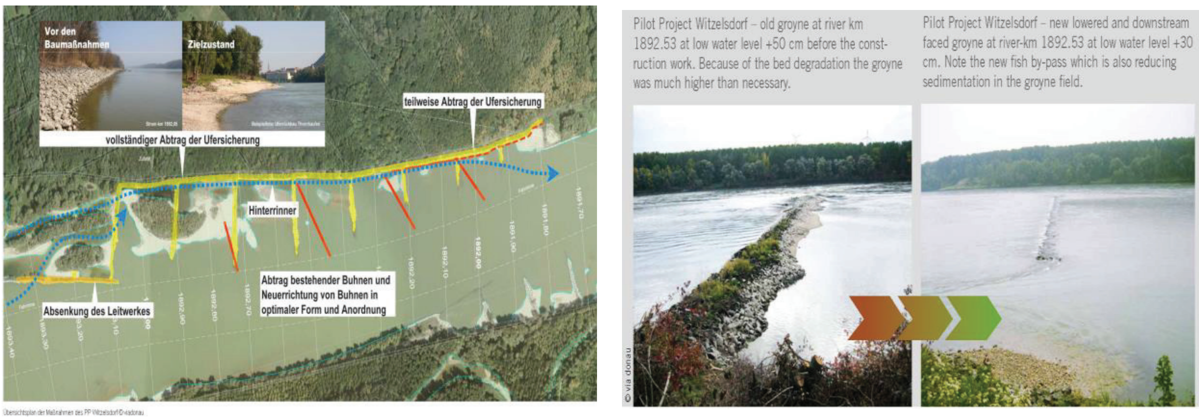

Figure 1: Reconstruction of existing groynes, while creating a cut-off at the bank. Austrian example from the Danube River, east of Vienna. Example for local-scale measure (Habersack et al., 2019).

In the study we introduced several reach-scale measure type as well. A group of these methods is aiming to widen the channel width, resulting in decreased sediment transport capacity, hence mitigating the erosion effects. Another important method is to revitalise the side branches and so to decrease the bed shear stress in the main channel (Figure 2). This subgroup also provides significant, direct ecological benefits for the restored river section. Methods where the composition of the riverbed surface is directly manipulated are also discussed, e.g. smart dredging or break-up of the armoured layer.

Figure 2: Restoration of Szabadság-island in the Danube River. Example for reconnecting side branches. reach scale measures. (source: https://wwf.hu/hireink/vizeselohelyek/ujra-vizi-paradicsom-a-szabadsag-sziget/)

Impacts of hydropeaking of the hydropower plants (HPPs) are also reviewed, since the upper section of the Hungarian section of the Dráva River is strongly affected by the Croatian HPPs (see the example of water level variations at Őrtilos station in Figure 3). It could be stated that, in general, the hydropeaking decreases the biodiversity, moreover there can be studies found introducing methods and indexing to describe the ecological impacts, however, to understand how HPPs affect the hydrological, morphological as well as sediment transport processes, further measurements and monitoring is necessary. It is also important to look at all the above mentioned aspects as a whole and complex system, since all of its elements are interconnected.

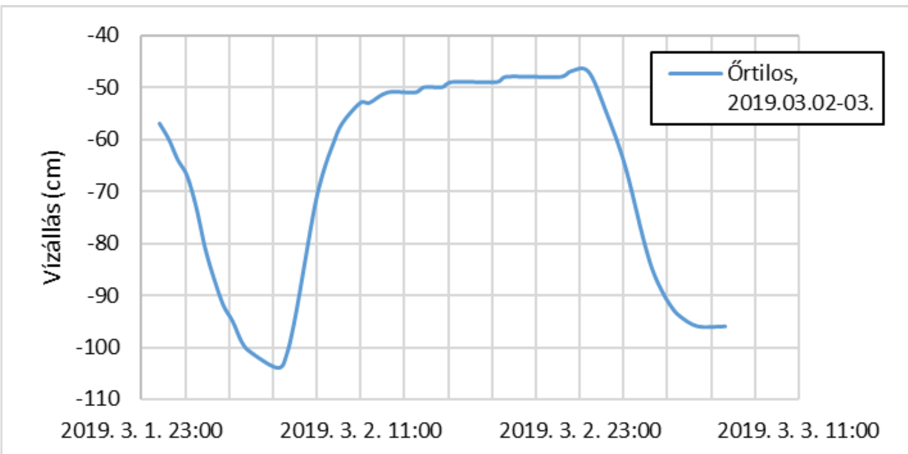

Figure 3: Typical stage fluctuation at the Őrtilos gauge in 2019. March, caused by hydropeaking at the nearby Croatian HPP (edited, based on Burián and Domány, 2019)

After discussing all the above mentioned general aspects, along with the international good examples and experiences, recommendations were made for river restoration measures along the study reach. In fact, we divided the study section into three reaches: i) from the Mura inlet to Barcs (rkm 236.0 – 154.1), ii) from Barcs to Drávaszabolcs (rkm 154.1 – 77.7) and iii) from Drávaszabolcs to the Danube confluence (rkm 154.1 – 0). These three sections were discussed separately and different measure types were suggested, considering their benefits and disadvantages. While preparing these recommendations, the focus was on conserving or improving the present hydromorphological condition of the channel. These recommendations contain actual, non-generalised measure types for shorter sections (see e.g. Figure 4), but detailed impact assessment was not carried out, since it was not the objective of this study.

Figure 4: Recommendation for side branch reconnection at Heresznye.

However, we enhanced the crucial role of performing state-of-the-art field measurements, data assessment and sophisticated numerical modelling approaches, when planning and implementing river restoration projects. Moreover, an illustrative numerical modelling study of a side branch reconnection was carried out, introducing the typical model setup steps, field data need and typical model assessment tasks through the example of the side branch at Heresznye (Figure 5 and 6).

Finally, general recommendations towards an improved sediment management of the Drava River were listed. Here, we proposed different relevant aspects of an improved, harmonized sediment monitoring methodology, highlighted the importance of cooperation between all the stakeholders, enhancing the role of river basin scale approaches in sediment management and the importance of conservation and improvement of the sediment balance.

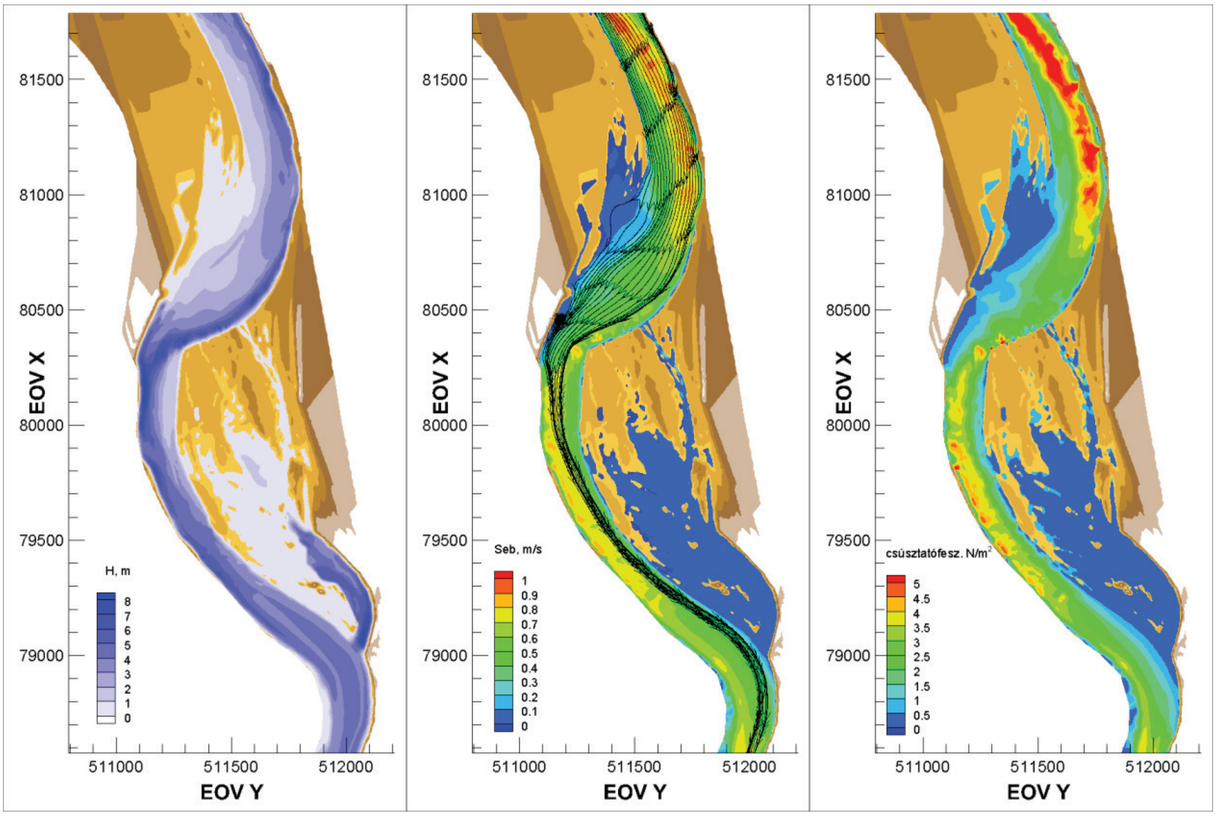

Figure 5: Simulated water depth (left), depth-averaged flow velocity (middle) and bed shear stress field for mean-water conditions, in the current situation.

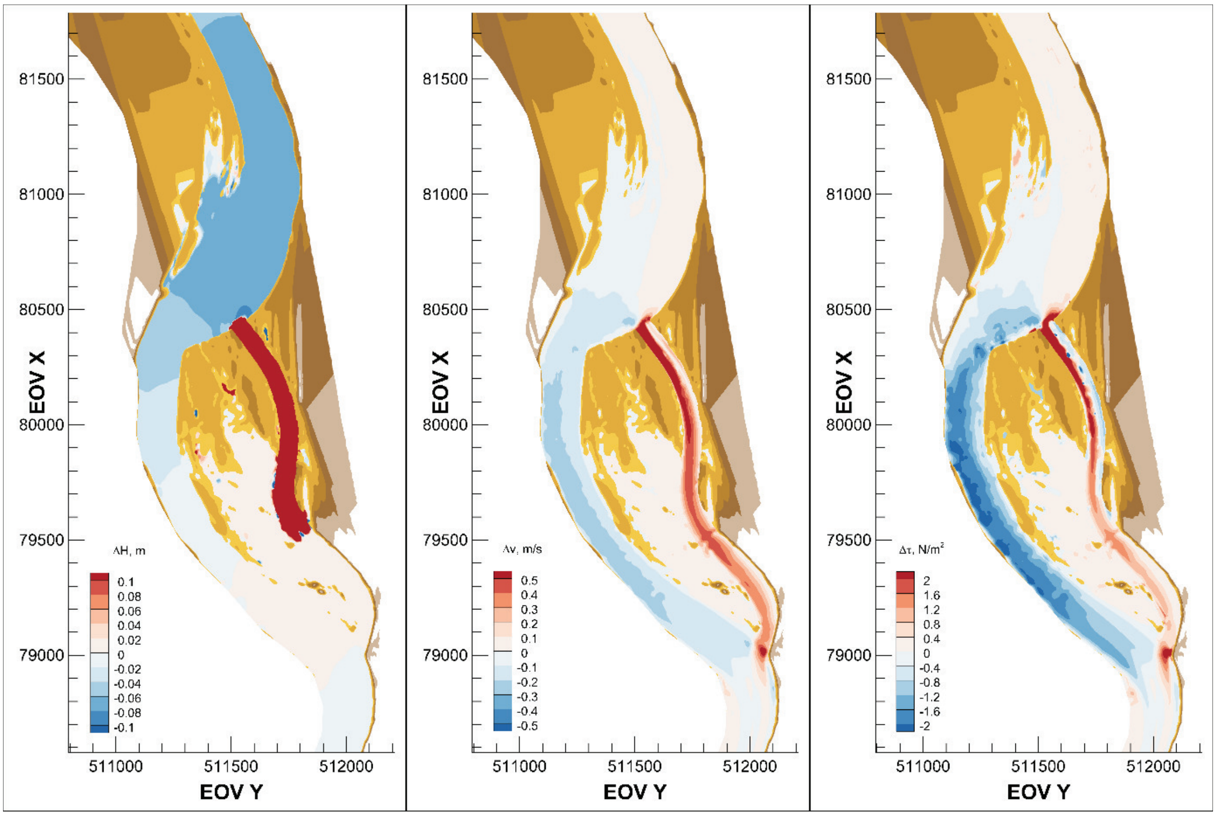

Figure 6: The simulated effects of opening a side branch. The differences in water depth (left), depth-averaged flow velocity (middle) and bed shear stress (right) compared to the original state (without restored side branch).

References

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