the offspring. The time horizon for the measurements extends over several years to decades due to the critical population sizes, existing negative influences and late sexual maturity, especially for the anadromous species. In parallel, the restoration of the habitats especially of the longitudinal continuum not only at the Iron Gates but also at upstream migration obstacles is indispensable.

References

Bemis WE, Kynard B (1997): Sturgeon rivers: an introduction to acipenseriform biogeography and life history. Environmental Biology of Fishes, 48, 167–183. https://doi.org/10.1023/A:1007312524792

Bemis WE, Findeis EK, Grande L (1997): Part 1: Diversity and evolution of sturgeons and paddlefishes – An overview of Acipenseriformes. Environmental Biology of Fishes, 48, 25–71. papers3://publication/uuid/53114CA8-331D4F99-B921-642E4F972389

Billard R, Lecointre G (2001): Biology and conservation of sturgeon and paddlefish. Reviews in Fish Biology and Fisheries, 10, 355–392. https://doi.org/10.1023/A:1012231526151

Chebanov M, Rosenthal H, Gessner J, Van Anrooy R, Doukakis P, Pourkazemi M, Williot P (2011): Sturgeon hatchery practices and management for release. Guidelines FAO Fisheries and Aquaculture Technical Paper No. 570, Ankara, 110 pp.

Friedrich T, Eichhorn H (in prep): Durations of incubation & larval development of sterlets (A. ruthenus) in river water rearing under semi-natural conditions

Friedrich T, Ludwig A (in prep): Genetic population assessment of two sterlet populations in the Upper Danube, Austria.

Friedrich T, Schmall B, Ratschan C, Zauner G (2014): Die Störarten der Donau: Teil 3: Sterlet, „Stierl" (Acipenser ruthenus) und aktuelle Schutzprojekte im Donauraum. Österreichs Fischerei, 67, 167–183.

Friedrich T, Gessner J, Reinartz R, Striebel-Greiter B (2018): Pan-European Action Plan for Sturgeons. Strasbourg, 85 pp. https://rm.coe.int/pan-european-action-plan-for-sturgeons/16808e84f3

Hensel K, Holčík J (1997): Past and Current Status of Sturgeons in the Upper and Middle Danube River. Environmental Biology of Fishes, 48,185–200. https://doi.org/10.1007/0-306-46854-9_9

Holčík J (1989): Acipenser ruthenus (Linnaeus, 1758). In: Holčík J (Ed.): The Freshwater Fishes of Europe. Vol.1. Part II. General Introduction to Fishes – Acipenseriformes. AULA, Wiesbaden, 469pp.

IUCN (2022): https://www.iucn.org/press-release/202207/migratory-monarch-butterfly-nowendangered-iucn-red-list. Accessed: 08.08.2022

Jones O, Wang J (2010): COLONY: a program for parentage and sibship inference from multilocus genotype data. Molecular Ecology Resources, 10, 551–555.

Kendall WL (1999): Robustness of closed capture-recapture methods to violations of the closure assumption. Ecology, 80(8), 2517–2525.

Lenhardt M, Jarić I, Kalauzi A, Cvijanović G (2006): Assessment of extinction risk and reasons for dec-line in sturgeon. Biodiversity and Conservation, 15, 1967–1976. https://doi.org/10.1007/s10531-005-4317-0

Ludwig A, Lippold S, Debus L, Reinartz R (2009): First evidence of hybridization between endangered sterlets (Acipenser ruthenus) and exotic Siberian sturgeons (Acipenser baerii) in the Danube River. Biological Invasions, 11, 753–760. https://doi.org/10.1007/s10530-008-9289-z

Neuburg J, Friedrich T (in prep): First description of a remnant sterlet (Acipenser ruthenus Linnaeus, 1758) population in the eastern Austrian Danube.

Otis DL, Burnham KP, White GC, Anderson DR (1978): Statistical Inference from Capture Data on Closed Animal Populations. Wildlife Monographs, 62, 3–135.

Pollock KH (1980): Capture-Recapture Models: A Review of Current Methods, Assumptions and Experimental Design. Department of Statistics, North Carolina State University, 32pp.

Ratschan C, Zauner G, Jung M (2017): Der Sterlet im oberen Donautal – Identifikation der Laichhabitate mittels Telemetrie, Endbericht 2016. Ezb – TB Zauner GmbH, Technisches Büro Für Gewässerökologie Und Fischereiwirtschaft, 67.

Sandu C, Reinartz R, Bloesch J (2013): Sturgeon 2020—A program for the protection and rehabilitation of Danube sturgeons. Danube Sturgeon Task Force (DSTF) & EU Strategy for the Danube River (EUSDR) Priority Area (PA) 6—Biodiversity, 24pp.

Schwarz CJ, Bailey RE, Irvine JR, Dalziel FC (1993): Estimating salmon spawning escapement using capture-recapture methods. Canadian Journal of Fisheries and Aquatic Sciences, 50, 1181–1197. https://doi.org/10.1139/f93-135

Wolfram G, Mikschi E (2007). Rote Liste der Fische (Pisces) Österreichs. Rote Liste gefährdeter Tiere Österreichs, Teil 2. Grüne Reihe des BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft 138.

Further literature

Friedrich T (2018): Danube Sturgeons: Past and Future. In Schmutz S, Sendzimir J (Eds): Riverine Ecosystem Management, Aquatic Ecology Series 8, 507- 518. https://doi.org/10.1007/978-3-319-73250-3_26507

Development perspectives and management options for the ecology of the urban floodplain Lower Lobau

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Abstract

The Lower Lobau is an urban floodplain system, which was disconnected from the main channel of the Danube in the 1880s. In its present state, the area is dominated by groundwater-fed and back-flooded successional floodplain water bodies hosting a high biodiversity. The main threat for the system is that strong terrestrialization processes are prevailing, significantly accelerated by ongoing hydrologic alterations. To stop the ongoing loss of aquatic habitats and their associated community, different management concepts for a step-wise rehabilitation have been developed. In this article, we give an overview of the prognosis of these different management options and development perspectives for the system.

Introduction

Terrestrialization, or hydrarch succession, is a plant succession that starts in shallow water bodies and culminates in a forest. In natural floodplain water bodies, it is countered by rejuvenation due to dynamic geomorphic processes (scouring floods, channel migration; Ward et al. 2001). In regulated rivers, terrestrialization often remains the only ongoing geomorphic process and therefore floodplain management and restoration aim to reverse this trend of decreasing waterbody area (Schiemer et al. 1999). Successional communities are complex and diverse commu-

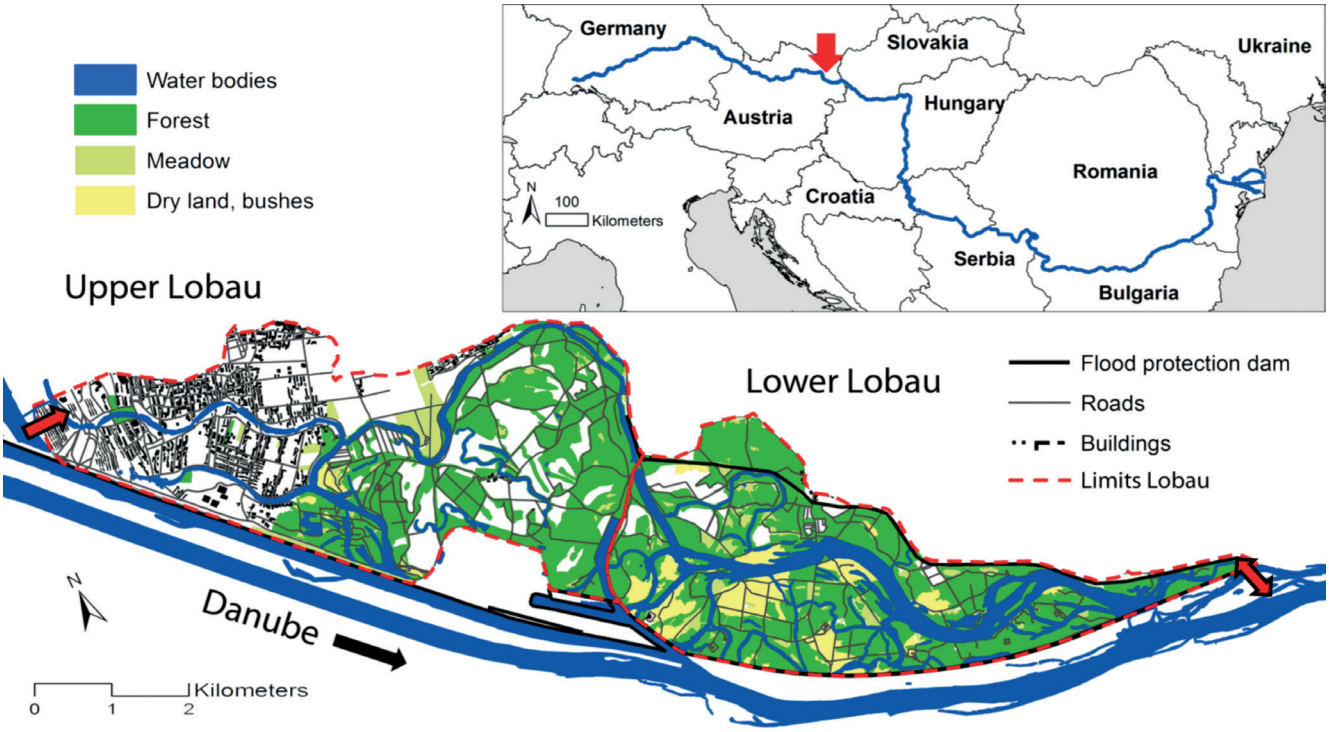

Figure 1. The floodplain system of the Lobau. Red arrows indicate the inflow/outflow area in the Lower Lobau and the inflow area of the water enhancement scheme of the Upper Lobau in its present state.

nities in transition and therefore, manipulations of succession require detailed planning based on scientific knowledge (Prach et al. 2007).

The Lower Lobau is an example of such a complex successional floodplain system. The former dynamic system was disconnected from the main channel of the Danube River by the construction of a flood protection dam in the early 1880s and thereafter, creating a system of groundwater-fed and back-flooded successional floodplain water bodies. These water bodies host a high biodiversity, including many species and habitat types protected by the Habitat Directive or Bern Convention, which led to the designation of the Lobau as a site of European and International importance (NATURA 2000, UNESCO Men and Biosphere Reserve, RAMSAR; Funk et al. 2013). Protection status was mainly designated for successional communities including a variety of macrophyte assemblages hosting many rare and endangered aquatic and semi-aquatic species (Barta et al. 2009). The main threat for the system in its present state is that the ongoing terrestrialization process is significantly accelerated by ongoing hydrologic alteration, a decrease in groundwater and surface water levels due to river bed incision of the main river and climate change related increase of periods with low precipitation and low water tables of the main river and the ground water. Enhanced inorganic sedimentation due to the impact of back-flooding of the system in combination with the lack of erosion further enhance the terrestrialzation process (Hohensinner et al. 2022; Reckendorfer et al. 2013).

This development was already recognized in the 1990s and since then, various management concepts for a step-wise rehabilitation of the Lobau floodplain have been developed (Trauner et al. 2016; Weigelhofer et al. 2013). In this article, we discuss the different development perspectives and management options targeting to reduce, stop or even partially reverse the enhanced terrestrialization prozesses in the system.

Past development and current state

The Lobau floodplain (*fig. 1*) is situated along the Austrian Danube, with large parts within the city borders of Vienna, and it is part of the 'Donau-Auen' Nationalpark. During the major river engineering phase between 1870 and 1885, this former dynamic floodplain was disconnected from the main channel by the construction of a flood protection levee. Nowadays, the floodplain can be separated into two subareas that differ considerably in their conditions. The upstream section, the 'Upper Lobau', is completely disconnected from flood events and is integrated into the settlement area of the City of Vienna. The downstream section, called 'Lower Lobau', is still affected by the flood regime of the Danube River by a downstream opening and has a widely natural land cover (Preiner et al. 2018).

Biodiversity and conservation

The Lower Lobau is of outstanding ecological value for its diverse macrophyte community and its associated animal communities (Barta et al. 2009; Janauer 2005). A total of 156 macrophyte species have been identified so far, 82 of them have a protection status according to the Austrian Red Lists (Weigelhofer et al. 2014). Particularly the smaller

floodplain water bodies, separated from the larger oxbows, represent biodiversity hotspots hosting many rare and endangered aquatic species (Barta et al. 2009). These types of water bodies in the Lower Lobau are also of outstanding ecological value for rare and threatened amphibian species (Waringer-Löschenkohl et al. 2013; 1986). Within the national park, the isolated water bodies of the Lobau with sufficiently long permanence (water from March to at least August) are of special importance for the reproduction of important amphibian species such as Danube crested newt (*Triturus dobrogicus*), fire-bellied toad (*Bombina bombina*) or European common spadefoot (*Pelobates fuscus*). Furthermore, the late successional waterbody type is important for protected macroinvertebrate species including important protected dragonfly species (e.g., *Leucorrhinia pectoralis,* protected according to Habitats Directive; Weigelhofer et al. 2014). Rare, endangered and protected stagnophilic fish species can be found in less frequently connected (European bitterling, *Rhodeus amarus*) or completely isolated (e.g., weatherfish, *Misgurnus fossilis*) waterbodies (Funk et al. 2013; Schabuss & Reckendorfer 2006).

Rare and protected species in the Lower Lobau are mainly associated with the (late) successional communities of floodplain systems, which are at the same time also most threatened due to the ongoing enhanced terrestrialization processes. Due to the decreasing surface and groundwater tables in the Lobau, these smaller floodplain water bodies, separated from the larger oxbows, are continuously decreasing during the last years (Barta et al. 2009). Especially the communities of submerged hydrophytes are already endangered in their existence (Janauer & Strausz 2007; Schiemer et al. 1999).

Furthermore, with its extensive reed beds, the Lower Lobau is of specific importance for the reed-breeding species of waterbirds, which reach higher densities than in other side arm systems of the Nationalpark Donau-Auen (Frühauf & Sabathy 2006). The species of particular conservation relevance are, for example, the little bittern (*Ixobrychus minutus*) and the great reed warbler (*Acrocephalus arundinaceus,* Schulze & Schütz 2013).

Additionally, the large shallow waterbodies with extensive terrestrialization zones are also highly relevant for wading birds including different species of herons (e.g. *Ardea alba*) or swimming waterbirds including protected duck species (e.g. *Anas querquedula* or *Aythya ferina;* Frühauf & Sabathy 2006). Furthermore, the Danube floodplain east of Vienna is home to the only reproducing population of the European pond turtle (*Emys orbicularis*) in Austria, with about one third of the population located in the Lobau (Schindler et al. 2012), inhabiting also the larger waterbodies of the system.

The fish community of the Lower Lobau is dominated by widely distributed eurytopic fish species. In its present state, it does not serve as habitat for endangered rheophilic species (e.g. nase, *Chondrostoma nasus* and barbel, *Barbus barbus;* Schabuss & Reckendorfer 2006). Equally, other communities of the large water bodies of the Lobau are characterized by generalists with a wide range of ecological requirements. Regarding macroinvertebrates, the Lower Lobau has a specific relevance for a high number of dragonfly species. With a total of 46 recorded dragonfly species, the Lower Lobau is the most species-rich alluvial forest area in Austria (Schulze & Schneeweihs 2013). Dragonflies include the endangered species *Sympetrum meridionale,* the critically endangered species *Somatochlora flavomaculata,* and the endangered species *Orthetrum coerulescens,* amongst others.

Provisioning and cultural Ecosystem Services

In the Lower Lobau, provisioning and cultural ecosystem services evolved over the centuries. While the Upper Lobau, which is located closer to the city, is surrounded by settlements and a sought for recreation and leisure area since about one century, the Lower Lobau is less affected by urban development and human uses (Haidvogl 2019).

After 1918, forestry was a dominating use until the late 1970s. Forestry management changed in this period because of altered hydrological conditions after the Danube channelization. The proportion of hard wood tree species increased from approximately 8% in 1850 to 50% in 1940. However, typical trees such as willows, alder or poplar still kept their importance (Haidvogl 2019).

A powerful actor entered the area in the 1950s and 1960s, when plans to tap groundwater resources for urban drinking water supply south of Vienna failed. In addition, growing agricultural production in the region Marchfeld east of Vienna increased the demand for water. In the 1950s, water extraction started with small wells supplying agriculture. In 1958, groundwater areas were identified at a depth of 12 m that appeared suitable for drinking water supply. Two years later, an area of 10 km^2 was designated as drinking water protection zone. In 1964, construction of three wells started. For about two decades, these drinking water wells contributed significantly to the supply of the Viennese districts east of the Danube and Donaukanal, respectively. Since 1988, the main purpose is to secure water supply during peak demand and in case of maintenance work on the two main Viennese water pipelines (Haidvogl 2019).

Predictions for the future and scenarios for conservation and rehabilitation

During a 70-years period since 1938, 34% of the aquatic areas of the Lower Lobau were lost due to sedimentation and terrestrialization. Digital geo-referenced orthophotos were used to visually estimate the areal extension of water bodies in the floodplain from 1938 to 2009 (supplied by Bundesamt für Eich- und Vermessungswesen BEV, Nationalpark Donau-Auen, viadonau, and MA41; Reckendorfer

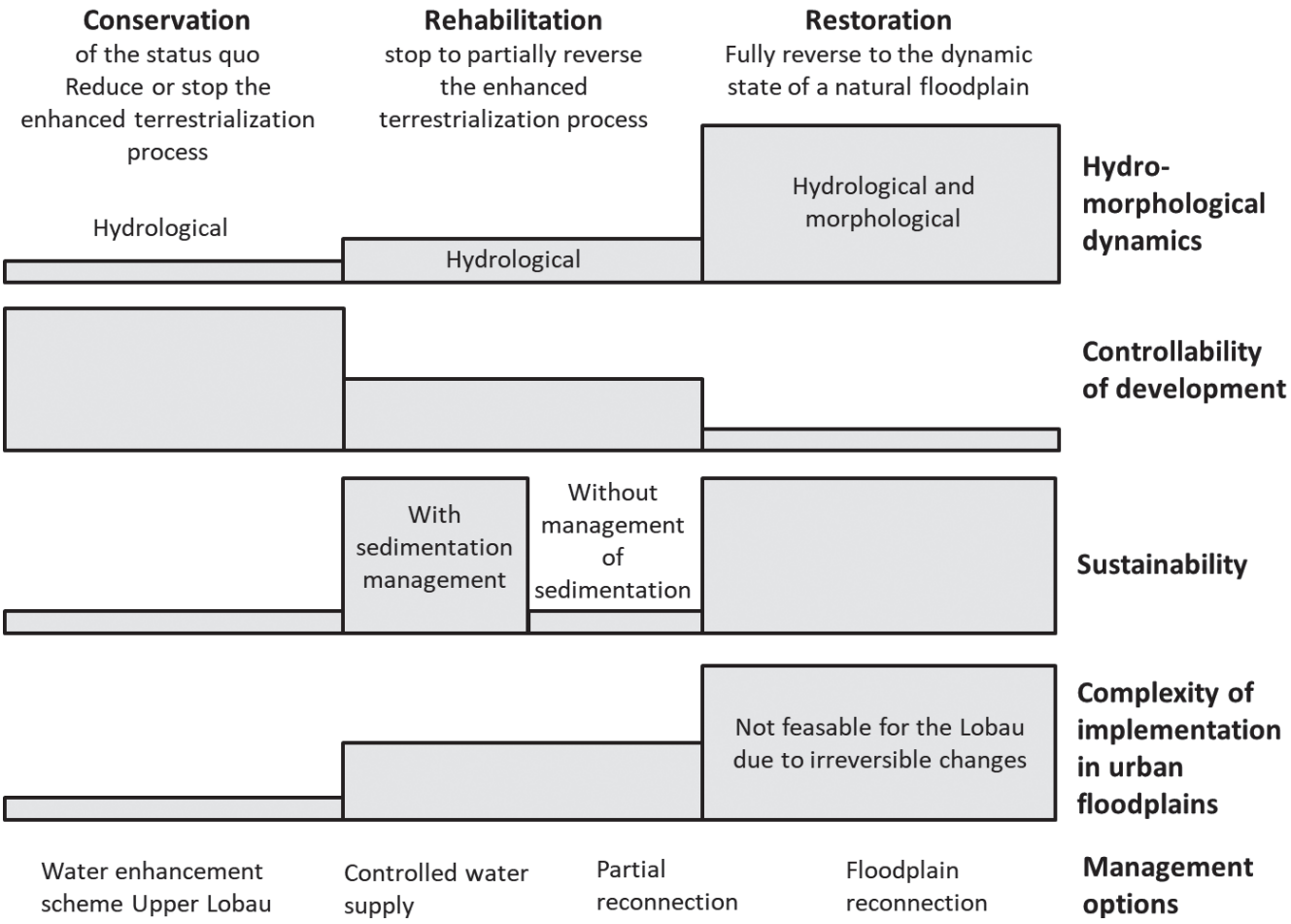

Figure 2. Overview of potential floodplain conservation, restoration and rehabilitation measures that were proposed and evaluated for the Lobau system. The size of the boxes increases with the match to the respective property (modified after Weigelhofer et al. 2013).

et al. 2011). The losses were significantly higher for small and shallow water bodies (70%) than for large and deeper parts of the side arm (30%) and they were also greater in the Upper Lobau than in the Lower Lobau. The estimated average sedimentation rates for this period ranged between 1 to 14 mm per year, with maxima of up to 28 mm per year (Reckendorfer et al. 2013). Predictions about the future development of floodplain water bodies in the Lobau are difficult. On the one hand, the incision of the Danube River, which was one major driver of the increasing terrestrialization during the last 20-30 years, was mitigated by regular gravel supply to the river channel (Habersack et al. 2013). On the other hand, more frequent low surface and subsurface water levels in the Danube and the adjacent floodplain are predicted for the future due to climate change induced shifts in the seasonal precipitation patterns (Hein et al. 2016). A sedimentation model showed high sedimentation rates of up to 46 cm of fine sediments until 2050 in shallow and low-flow water bodies near the downstream inlet of the Lower Lobau (Weigelhofer et al. 2015; Funk et al. 2014). In addition, both aquatic and terrestrial primary production will lead to further sedimentation of plant material (10-15 cm until 2050) in isolated water bodies. Thus, if no measures are taken in the future, further losses especially of small and shallow water bodies are certain to occur (Reckendorfer et al. 2013).

Since the 1980s, various management concepts for a step-wise rehabilitation of the Lobau floodplain have been developed (Trauner et al 2016; Weigelhofer et al. 2013). As a first management measure, a water enhancement scheme was started in the area of Upper Lobau in 2001. Water from large stagnant former Danube branches within the city borders of Vienna is discharged during the vegetation period (March to October; Weigelhofer et al. 2011; 2005; Funk et al. 2009). The discharge is restricted to a maximum of 1.5 m^3/s and depends on chemical, hygienic, and hydrological thresholds. The New Danube as source of the water enhancement scheme was preferred over the Danube main channel due to the better water quality in this artificial side channel.

For the Lower Lobau, different hydrological scenarios were developed and evaluated based on different quantitative and qualitative models since 2005 (*fig. 2*; Weigelhofer et al. 2020; 2005; Trauner et al. 2016; Funk et al. 2013; Reckendofer et al. 2013; Sanon et al. 2012). Besides a business-as-usual scenario without measures, they included two types of measures:

1. A controlled water supply with increased waterflow from the Upper Lobau or from alternative sources e.g. directly from the Danube, aiming to stop and partially reverse the enhanced terrestrialization by raising the surface and

groundwater levels in the floodplain, increasing the connectivity and the surface water exchange via the main side arm. In the most recent planning phase, a scenario with a controlled water supply of 3 m³/s from the Danube main stem was evaluated (Weigelhofer et al. 2020).

2. Different levels of re-connections with the Danube, including a dynamic discharge of the river into the main side arm of the floodplain. Besides the aim to stop and partially reverse the enhanced terrestrialization, this scenario type also aims at increasing the erosion in certain stretches and reducing the effect of sedimentation at least in parts of the system (Funk et al. 2013; Sanon et al. 2012).

Opportunities and risks

All evaluated management scenarios, except the business-as-usual scenario, have the potential to improve, stop or even reverse the hydrologically driven terrestrialization process, dependent on the amount of water entering into the system, i.e., an increase of the groundwater and surface water tables that reverses or stabilizes the human driven loss of water body area in the system (e.g. Weigelhofer et al. 2020).

The different management options also come together with some risks for the biodiversity and integrity of the system.

There is a risk for a loss of the diversity of small permanent to temporal, isolated water bodies by increasing the surface connectivity with the large main waterbodies. This may initiate a loss of heterogeneity, increase in nutrient levels and productivity, trophic state and consequently, loss of the sensitive community and dominance of more eurytopic species. This is a risk of both types of restoration measures (Weigelhofer et al. 2020; Funk et al. 2013) but according to Reckendorfer et al. (2013) especially relevant for the partial re-connection type where nutrient and sediment rich surface waters enter the system widely uncontrolled. In a controlled water supply scenario, the amount and quality of surface water that is supplied can be controlled and regulated as already shown for the Upper Lobau. A potential management solution for this issue is also a creation (excavation) of small isolated groundwater-fed water bodies that can compensate a potential loss of these types (Weigelhofer et al. 2020).

Further, there is a risk related to socio-economic demands in the system. Only the controlled water supply type of scenario is expected to fully preserve important socio-economic demands in the area such as drinking water supply, recreation or agriculture. Especially a full reconnection of the system would be in conflict with the socioeconomic demands, particularly for the potential for drinking water production, as the surface water influence impacts the quality of groundwater (Sanon et al. 2012). Therefore, a partial re-connection scenario with a dynamic, permanent discharge (depending on the respective water level of the Danube) and a controlled maximum discharge of 80 m³/s was developed to reduce this risk (Weigelhofer et al. 2020).

Sedimentation processes in the system are a further issue. Ongoing sedimentation can only be reversed, if the discharge in the system is high enough to allow erosion processes; this is only predicted for the re-connection type of measures, so with a controlled water supply enhanced terrestrialisation might continue (Weigelhofer et al. 2020; Funk et al. 2013). On the other hand, these erosion processes within a reconnection type measure come also with the risk that the successional stage of parts of the system are more strongly reversed than targeted, parts of the waterbodies might lose their current stagnotopic species rich community (Weigelhofer et al. 2020; Funk et al. 2013). A potential solution to reduce the impact of sedimentation within a controlled water supply scenario could also be a targeted excavation of water bodies with high sedimentation rates to reduce the already accumulated sediments.

Figure 3. View of an isolated oxbow in Untere Lobau (© Andrea Funk)

Therefore, most promising could be a stepwise adaptive management approach, closely monitoring the effects of controlled water supply, beginning with low amounts of nutrient and sediment poor water to reduce the described risks, then further increasing the supply and if the targeted reversion in succession is not achieved a partial re-connection can be implemented in a second step (Reckendorfer et al. 2013).

References

Barta V, Schmidt-Mumm U, Janauer GA (2009): Adapting floodplain connectivity conditions – a prerequisite for sustaining aquatic macrophyte diversity in the UNESCO Biosphere Reserve Lobau (Austria). Ecohydrology & Hydrobiology, 9(1), 73-81.

Frühauf J, Sabathy E (2006): Untersuchungen an Schilf- und Wasservögeln in der Unteren Lobau. Teil I: Bestände und Habitat. Studie im Auftrag der Nationalpark Donau-Auen GmbH im Rahmen des LIFE Projektes Gewässervernetzung und Lebensraummanagement Donauauen.

Funk A, Gschöpf C, Blaschke AP, Weigelhofer G, Reckendorfer W (2013): Ecological niche models for the evaluation of management options in an urban floodplain - conservation vs. restoration purposes. Environmental Science & Policy, 34, 79-91.

Funk A, Reckendorfer W, Kucera-Hirzinger V, Raab R, Schiemer F (2009): Aquatic diversity in a former floodplain: Remediation in an urban context. Ecological Engineering, 35(10), 1476-1484.

Funk A, Weigelhofer G, Feldbacher E, Hein T (2014): Nullvariante – Fachbericht Gewässervernetzung (Neue) Donau - Untere Lobau (Nationalpark Donau-Auen). Studie im Auftrag der MA 45, Wien.

Habersack H, Jäger E, Hauer C (2013): The status of the Danube River sediment regime and morphology as a basis for future basin management. International Journal of River Basin Management, 11(2), 153-166.

Haidvogl G (2019): Vom persönlichen Nutzen zur Wohlfahrtswirkung. Die Wandlungen der Lobau seit dem 18. Jahrhundert. In: Zentrum für Umweltgeschichte (Ed), Wasser Stadt Wien – Eine Umweltgeschichte. Universität für Bodenkultur Wien, Technische Universität Wien, Wien, 270-277.

Hein T, Schwarz U, Habersack H, Nichersu I, Preiner S, Willby N, Weigelhofer G (2016): Current status and restoration options for floodplains along the Danube River. Science of the Total Environment, 543, 778–790.

Hohensinner S, Grupe S, Klasz G, Payer T (2022): Long-term deposition of fine sediments in Vienna's Danube floodplain before and after channelization. Geomorphology, 398, 108038.

Janauer GA (2005): Aquatic habitats in Vienna (Austria) – integrating ecology and urban water management. Ecohydrology & Hydrobiology, 5, 279-284.

Janauer GA, Strausz V (2007): Stakeholder goals and the UNESCO Biosphere Reserve Lobau: How to make contrasting interests meet? In: Proceedings International Symposium on New Directions in Urban Water Management, 12-14 September 2007, UNESCO Paris.

Prach K, Marrs R, Pyšek P, Diggelen RV (2007): Manipulation of succession. In: Walker LR, Walker J, Hobbs RJ (eds.): Linking restoration and ecological succession. Springer, New York, 121-149.

Preiner S, Weigelhofer G, Funk A, Hohensinner S, Reckendorfer W, Schiemer F, Hein T (2018): Danube Floodplain Lobau. In: Schmutz S, Sendzimir J (eds.): Riverine Ecosystem Management. Springer, Cham, 491-506.

Reckendorfer W, Funk A, Gschöpf C, Hein T, Schiemer F (2013): Aquatic ecosystem functions of an isolated floodplain and their implications for flood retention and management. Journal of Applied Ecology, 50(1), 119-128.

Sanon S, Hein T, Douven W, Winkler P (2012): Quantifying ecosystem service trade-offs: The case of an urban floodplain in Vienna, Austria. Journal of Environmental Management 111, 159-172.

Schabuss M, Reckendorfer W (2006): Die Hydrologie als Schlüsselparameter für die Verteilung der Adult- und Jungfischfauna im Altarmsystem der Unteren Lobau. Studie im Auftrag von Nationalpark Donauauen GmbH, Wissenschaftliche Reihe 12.

Schiemer F, Baumgartner C, Tockner K (1999): Restoration of floodplain rivers: The Danube Restoration Project. Regulated Rivers: Research and Management, 15, 231-244

Schindler M, Schmidt M, Reckendorfer W (2012): Erhebung der Europäischen Sumpfschildkröte, Bericht des Projekts Gewässervernetzung (Neue) Donau – Untere Lobau (Nationalpark Donau-Auen). Studie im Auftrag der MA 45, Wien.

Schulze CH, Schneeweihs S (2013): Wissenschaftliche Beweissicherung Lausgrund: Erhebung der Libellen 2012. Bericht im Auftrag der MA 45, Wien.

Schulze CH, Schütz C (2013): Wissenschaftliche Beweissicherung Lausgrund: Erhebung der Brutvögel mit Gewässerbindung 2012. Bericht des Projekts Gewässervernetzung (Neue) Donau - Untere Lobau (Nationalpark Donau-Auen). Studie im Auftrag der MA 45, Wien.

Trauner D, Funk A, Pölz EM, Feldbacher E, Weigelhofer G, Reckendorfer W, Hein T (2016): Integrierte gewässerökologische Modellansätze zur Beurteilung von Gewässervernetzungsvarianten am Beispiel der Unteren Lobau. Österreichische Wasser- und Abfallwirtschaft, 68(7), 301-307.

Ward JV, Tockner K, Uehlinger U, Malard F (2001): Understanding natural patterns and processes in river corridors as the basis for effective river restoration. Regulated Rivers: Research & Management, 17(4-5), 311-323.

Waringer-Löschenkohl A, Csarmann E, Ruzek S, Reckendorfer W (2013): Erhebung der Amphibien 2012, Studie im Auftrag der MA 45, Wien.

Waringer-Löschenkohl A, Lengauer R, Schweiger E, Slapa C (1986): Aufnahme der Amphibienfauna in den Donauauen bei Schönau (Niederösterreich). Verh. Zool.-Bot. Ges. Österreich, 124, 115-120.

Weigelhofer G, Feldbacher E, Trauner D, Pölz E, Hein T, Funk A (2020): Integrating conflicting goals of the EC water framework directive and the EC habitats directives into floodplain restoration schemes. Frontiers in Environmental Science, 8, 538139.

Weigelhofer G, Hein T, Kucera-Hirzinger V, Zornig H, Schiemer F (2011) Hydrological improvement of a former floodplain in an urban area: potential and limits. Ecol Eng 37:1507–1514.

Weigelhofer G, Janac P, Hein T (2005): Erkenntnisse zur Ökologie aus dem Wasserwirtschaftlichen Versuch „Dotation Obere Lobau, Wien" für eine nachhaltige Entwicklung urbaner Augewässer. Österreichische Wasser- und Abfallwirtschaft, 57(9), 16-19.

Weigelhofer G, Pall K, Pölz EM, Funk A, Trauner D, Mayerhofer V, Mayerhofer S, Hein T (2014): Ökologie Naturschutz - Bericht zum Projekt Gewässervernetzung (Neue) Donau – Untere Lobau (Nationalpark Donau-Auen). Im Auftrag der MA 45, Wien, 124 Seiten.

Weigelhofer G, Preiner S, Funk A, Bondar-Kunze E, Hein T (2015): The hydrochemical response of small and shallow floodplain water bodies to temporary surface water connections with the main river. Freshwater Biology, 60(4), 781-793.

Weigelhofer G, Reckendorfer W, Funk A, Hein T (2013): Auenrevitalisierung – Potenzial und Grenzen am Beispiel der Lobau, Nationalpark Donau-Auen. Österreichische Wasser- und Abfallwirtschaft, 65(11), 400-407.

Danube Landscapes – history, diversity, conflicts, identity, but no lobby!

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The International Association for Danube Research (IAD) is in many ways actively contributing to both the International Commission for the Protection of the Danube River (ICPDR) and European Macro-Regional Strategy for the Danube Region (EUSDR). The Sturgeon Action Plan after 2005 set the fundament for all further networks and has been established in a Danube Sturgeon Task Force (DSTF). The Danube Invasive Alien Species Network (DIAS) has been developed since 2014. Continuous cooperations between the Working Community of the Danube Region, the European Land and Soil Alliance (ELSA) and the IAD expert group Sustainable Development and Public Participation (IAD EG