Major obstacles for Danube sturgeon spawning migration: The Iron Gate dams and the navigation project in the Lower Danube

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Hydropower dams are disrupting the river continuum worldwide and thus threatening overall river ecosystem function. Similarly, navigation constructions and dredging activities cause significant impacts on river morphology and biota. The conflict of interest between ecosystem services and human use is obvious and should be tackled through public participation and application of the ICPDR Guidelines for developing both sustainable hydropower and navigation. This article exemplifies the problem for the Danube sturgeons that are at the brink of extinction.

Migration behaviour of animals, in general, and sturgeons, in particular, is determined genetically as part of their life cycles to naturally reproduce and maintain their populations. Sturgeons are known to show homing fidelity: i.e. they often return to the same spawning sites with characteristic features. The spawning migration of anadromous sturgeons living in the Black Sea is triggered by discharge and temperature. Migration is observed all year round with peaks in spring and fall. The fall migrants overwinter in large pool areas in the river. These essential migration patterns are still highly disturbed or disrupted by human intervention through technological river constructions and maintenance.

The Iron Gate dams

When the Iron Gate hydropower dams were constructed in 1972 and 1984 (rkm 943 and 862, *Figure 1)*, the disruption of fish migration was not an issue. After great peaks of arriving sturgeons, stopped by the first dam and harvested by fishermen in the 1970s, there was a significant decline (Reinartz & Bloesch 2006). In the late 1990s, when a general decrease of fish populations across Europe became evident, the problem of disrupted fish migration by dams received high recognition in aquatic science and river restoration, which were founded by the concepts of the river continuum, hydromorphology and sediment transport. In the Sturgeon Action Plan (Bloesch et al. 2005), where 72 actions to conserve Danube sturgeons are listed, the Iron Gate fish passage was given utmost priority. While fish passes were intensively developed to be more functional (e.g. DWA 2014, Schmalz et al. 2015), we noted that such a restoration of sturgeon migration routes would have an extremely good cost-benefit ratio: more than 800 km of Danube and lower parts of major tributaries would be available as potential spawning grounds.

With the support of ICPDR, concrete activities started in 2011 with an FAO Scoping Mission (Comoglio et al. 2011). A more detailed pre-study by a Dutch Consortium yielded first fish pass options and the proof of an overall feasibility (de Bruijne et al. 2014). Prerequisites for proper fish pass design are the measurement and modeling of flow velocity and sturgeon behavior downstream of the Iron Gate II dams. Such monitoring, performed by Suciu et al. (2015), is financially supported by the European Investment Bank (EIB). In this context, a special session "Sturgeon Fish Pas-

Figure 1. The Iron Gate Hydropower dams. While the Iron Gate I dam (left) is a single obstacle, the situation at Iron Gate II (right) is extremely complex with two hydropower stations and two ship locks (Sources: Photo Jürg Bloesch; de Bruijne et al. 2014)

sages on Large Rivers" was organized at the Fish Passage Conference during 22–25 June 2015 in Groningen NL that revealed the critical issues debated by experts (IAD Report 2015). Apart from the attracting current for finding the entrance of a fish pass, passability is a key element: i.e. the proper fish pass basin or fish lift chamber dimensions. The body length of the largest fish species must be considered. For the Iron Gates, the "design length" of sturgeon (beluga) was assumed to be 6 m. It is widely accepted that both upstream and downstream migration must be ensured, the latter separately for spent adults through a bypass and for young of the year through "fish friendly turbines". To achieve truly functional solutions of sturgeon passages is difficult, as only few experts have interdisciplinary expertise in fish pass construction, large rivers and sturgeon behavior. By all means, the engineering and biological feasibilities must be treated in a combined study.

Political implementation needs the willingness of major stakeholders: i.e. the operators of the hydropower plants and the relevant authorities both in Romania and Serbia. A feasibility study should be urgently performed, and technical as well as financial problems discussed with experts. Before sturgeon migration facilities at the next upstream hydropower plant in Gabčíkovo can be treated (de Bruijne et al. 2015), the complex situation at the Iron Gates must be clarified and these dams opened for migrating fish.

The submerged sill constructed at the Bala Branch – Old Danube bifurcation

Some 550 km downstream of the Iron Gate dams an inconsistent process was started more than 10 years ago. While efforts to restore fish migration at the Iron Gate dams are now slowly promoted, the construction of a submerged sill in the Bala Branch, in contrast, will strongly hamper if not disrupt sturgeon migration *(Figure 2).*

At the end of the 6th Workshop on the Follow-up of the Joint Statement on Guiding Principles on the Development of Inland Navigation and Environmental Protection in the Danube River Basin, held 10–11 September 2015 in Vienna, Horst Schindler, Secretariat of the Danube Commission, stated that in the next Joint Statement Meeting in 2016 *"it might be interesting not only to have a look at the positive developments but also the problems and drawbacks which are happening in different projects".* One of these critical projects is the former ISPA I Project (currently DANUBE I Project) in the Lower Danube (Calarasi-Braila, rkm 375-175) in progress since 2003 and aiming to ameliorate Danube navigation. Out of the many critical points for navigation, the bifurcation of Bala Branch and Old Danube is a major problem. The Romanian authorities planned to construct a submerged sill in the Bala Branch to divert some 30 % of water into the Old Danube to increase water levels according to the ship's critical draught depth of 2.5 m. However, the Bala Branch is the migration route of sturgeons heading towards their spawning grounds, and therefore the important question is whether sturgeons could pass this obstacle or not. Science should define the flow velocity sturgeons, known as mediocre swimmers, can pass. Therefore, flow velocity measurements and flow modeling across the sill crest was a crucial part of the ongoing monitoring program. The model predicted bottom flow velocities above the full sill of 2.4–3.5 m/s (Habersack et al. 2013). The present scientific state-of-the-art represented by the NGOs is that the threshold flow velocity for any sturgeon species is in the range of 1.5 –1.7 m/s (IAD 2013). This threshold is debated by the monitoring team and the navigation authority (AFDJ). While monitoring showed that out of 315 tagged individuals, only 10 could pass the unfinished sill (Deak & Matei 2015), this is by far an insufficient number to maintain a sturgeon population. Such coincidental passages have also been documented at the Iron Gates ship locks when single specimens of beluga were recorded in the Middle Danube. Further, it took a recorded beluga male sturgeon about 14 hours to pass the sill, indicating stronger currents at the sill crest, a measurement that is still missing. We know that such delays accumulated by consecutive fish passes may result in strong bias of spawning, since the fish lose a lot of their energy and arrive too late at the spawning sites. As a result of this controversial situation, the construction of the sill has been stopped, and alternatives including decommission of misvalued built constructions are now discussed.

Figure 2. The bifurcation Bala Branch – Old Danube near Braila. The partly constructed submerged sill in the Bala Branch (red line) and the guiding wall along the left bank have increased the local flow velocity and, consequently, the erosion of the river bottom. Only few sturgeons could occasionally pass the sill and spawning migration is disrupted. Presently, alternatives are being evaluated (Source: AFDJ, Galati, WS 7 October 2015)

Lessons learned include that (1) alternatives should have been elaborated in the EIA that was of poor quality, (2) monitoring should be focused on the essential impacts of the project, (3) monitoring and construction should not take place at the same time, and (4) methodology should be transparent and based on state-of-the-art.

Conclusions

Sturgeon migration is a typical example of how aquatic biota are of important concern over large river stretches including tributaries. The same is true for abiotic processes like sediment transport, erosion and accumulation. Significant human interventions in river ecosystems always have long-term effects that are not obvious during technical constructions. This holds true not only for sturgeon habitats, but also for floodplains via discharge and groundwater table fluctuations. Therefore, predictive modeling is a necessity.

These two case studies clearly show that sturgeon conservation is an issue in river basin management (ICPDR 2015). Therefore, the ICPDR plays a key role in the implementation of sturgeon protection by persuading the stakeholders and riparian countries, in particular Romania and Serbia, to engage better in restoring fish migration at the Iron Gates and preventing disruption of sturgeon migration in the Bala Branch. Such requests are not only supported by the NGOs, but also endorsed by the Program "Sturgeon 2020", elaborated in the frame of the EU Strategy for the Danube Region (www.dstf.eu). Moreover, restoring river connectivity and free fish migration is required by three EU Directives (Habitats Directive, Water Framework Directive and Marine Strategy Framework Directive).

References

Bloesch J, Jones T, Reinartz R, Striebel B (2005): Action Plan for the Conservation of the Sturgeons (Acipenseridae) in the Danube River Basin. Publication of the Council of Europe (Bern Convention)

Comoglio C (2011): FAO Scoping mission at Iron Gates I and II dams (Romania and Serbia). Preliminary assessment of the feasibility for providing free passage to migratory fish species. Mission report May 2011

Déak G, Matei M (2015): Methods, techniques and monitoring results regarding the sturgeon migration on Lower Danube. http://www.afdj.ro/sites/default/files/prezentari/presentation_incdpm_deak_bern_convention_0.pdf

de Bruijne W et al. (2014): Towards a healthy Danube: Fish migration Iron Gates I & II. Part A: Project Report, Part B: Road Map by a Dutch Consortium. 20 October 2014. Client: Agentschap NL / Romanian and Serbian water authorities

de Bruijne W et al. (2015): Fish migration at the Gabčíkovo dam. Final Report by a Dutch Consortium. 2 September 2015. Client: European Investment Bank (EIB)

DWA – Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (2014): Merkblatt M-509: Fischaufstiegsanlagen und fischpassierbare Bauwerke - Gestaltung, Bemessung, Qualitätssicherung. Hennef, 334 pp

Habersack H, Tritthart M, Liedermann M, Gmeiner P (2013): Monitoring the environmental impact of works to improve conditions for navigation on the Danube between Calarasi and Braila, km 375 and km 175. 3D hydrodynamic modelling RSim3D-Critical Spots 01 and 02. PPT presentation Meeting Bucharest 25.02.2013

IAD Report (2013): ISPA 1 Navigation Project Danube – Sill on Bala Branch. IAD Analysis of the Workshop of July 1–2, 2013, and recommendations. Author: Jürg Bloesch. 21 August 2013

IAD Report (2015): Fish Passage 2015 – International Conference on River Connectivity (best practices and innovations) during June 22–25, 2015, in Groningen NL. Special Session "Sturgeon Fish Passages on Large Rivers" – Moderators: Jürg Bloesch & Boyd Kynard. 9. July 2015

ICPDR (2015): Danube River Basin Management Plan. Download from www.icpdr.org

Reinartz R, Bloesch J (2006): History and perspectives of "living fossils" (sturgeons) in the Danube River. Verh. Internat. Verein. Limnol. 29: 1703–1708

Schmalz W, Wagner F, Sonny D (2015): Arbeitshilfe zur standörtlichen Evaluierung des Fischschutzes und Fischabstieges. Forum „Fischschutz und Fischabstieg". Ecologic Institute & Umwelt Bundesamt, März 2015. 215 pp

Suciu et al. (2015): Identify potential areas for locating fish pass entrances at Iron Gates II by integrating data on fish movements and hydrodynamic numerical models. Pilot Project funded by the European Investment Bank (EIB)

Sturgeon poaching and illegal caviar trade – a problem of basin wide and international concern

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As stated in the Action Plan for the conservation of sturgeons in the Danube River Basin (Bloesch et al. 2005), overexploitation is a key threat to Danube sturgeons and the pressure by poaching and illegal trade remains intense. This holds true even after catch and trade bans were introduced for wild sturgeons in the most relevant range states. In the Ukraine and in Serbia there has been a permanent sturgeon catch ban since 2000 and 2009, respectively (http://www.sturgeons.info/generalinfo/endangering/endangering.htm), for all species except the Sterlet in Serbia. In Romania, a 10-year catch and trade moratorium for all species started in 2006, which may be prolonged, and in Bulgaria, such a ban is in place since 2011 and was recently extended for another five years (http://wwf.panda.org/wwf_news/?261670/bulgaria-extends-the-sturgeon-fishing-ban-for-another-five-years).

The caviar market in Romania and Bulgaria

A WWF and TRAFFIC survey on caviar trade (Jahrl 2013) aimed to collect reliable data and provide clear indications as to whether illegal caviar is available in Romania and Bulgaria. From April 2011 to February 2012, local surveyors visited shops, restaurants, markets, street vendors and sturgeon farms and collected a total of 30 samples (14 in Romania, 14 in Bulgaria and two of Bulgarian farmed caviar in Austria). The DNA was analysed to determine the species of origin (Ludwig et al. 2015). The key results were as follows:

- Five samples were declared by vendors to be wild-caught (and therefore illegal); four of these five samples were from the highly sought-after and endangered Beluga Sturgeon *(Huso huso).*
- Eight samples did not have mandatory CITES labels with CITES codes (excluding restaurants, where the container