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Editorial

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Dear Readers,

This issue of Danube News highlights the topic sturgeon and possible ways of saving these flagship species of the Danube Basin, so typical in the past, but increasingly threatened by growing habitat constraints, overexploitation, and disruption of migration. Scientific and administrative efforts converge with the aim of enhancing sturgeon conservation, while technical adaptations of river flow, migration obstacles, loss of spawning habitat, and illegal fishing still impact the survival base of sturgeon in the Danube River, and in all the countries comprising the range of these fish. The contributions to this issue cover political aspects of sturgeon conservation (Cristina Sandu), programs of Sterlet restoration (Thomas Friedrich *et al.)*, challenges in sturgeon ex-situ conservation (Ralf Reinartz *et al.)*, sturgeon monitoring with telemetry and genetics (Radu Suciu *et al.)*, and the paramount issue of obstacles to sturgeon migration during the spawning period due to dams and navigation projects (Jürg Bloesch).

Thomas Hein, President of IAD

Georg Janauer, Editor of DN
Photograph: ÖWAV

Cristina Sandu, and Jürg Bloesch as Special Editor of DN 33, gain our special thanks for proposing this important topic and gathering these excellent and informative contributions.

Political support for sturgeon conservation in the Danube Region

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The public attention gained lately by Danube sturgeons is the output of the close cooperation of several governmental and non-governmental organizations active in the Danube River Basin. The adoption of the EU Strategy for the Danube Region (EUSDR) in 2011 created the frame to foster sturgeon conservation and bring this topic high on the political agenda of the Danube countries.

This issue of Danube News highlights briefly the contribution of key governmental stakeholders as well as some of the main activities devoted to sturgeons in the recent years: a restoration program for Sterlet in the Upper and Middle Danube, measures for ex-situ conservation (outside of natural habitats), monitoring of genetic diversity and migration patterns in the Lower Danube, engagement to tackle the problem of major obstacles disrupting sturgeon spawning migration, and investigation of the illegal trade with caviar.

Background

An iconic species of the Danube, inhabiting the river since ancient times, the sturgeons underwent a dramatic decline in the 20th century due to habitat loss, migration disruption, pollution, hydromorphological alterations and overexploitation. An alarm signal was raised by scientists after 2000, when the IAD and WWF brought together international sturgeon experts to discuss this critical situation. As a follow up, the Sturgeon Action Plan (SAP) was elaborated and adopted under the Bern Convention (Bloesch et al. 2005). Few supporting activities were launched in the following years by the Danube countries, such as a ban of commercial sturgeon fishery in Romania, Bulgaria, Serbia and the Ukraine, restocking activities and a dialogue to restore their spawning migration at the Iron Gate dams. However, without concerted coordination at international level, taking into account sturgeon needs during their whole life-cycle, the declining trends continued.

After 2011, the EUSDR provided an international platform for transboundary coordination of measures and integration of all the sectorial policies under one overarching goal: the harmonization of social and economic policies with the environmental needs to ensure the sustainable development of the region. To foster sturgeon conservation, key stakeholders from the Danube Region (ICPDR, IAD, WWF, WSCS) established the Danube Sturgeon Task Force in the frame of EUSDR, Priority Area 06 (PA 6), and elaborated the Program "Sturgeon 2020" based on the SAP (Sandu et al. 2013). National and international political support plays a vital role for the implementation of this program, and recent years have brought significant progress in this direction, highlighted briefly below.

The EU Strategy for the Danube Region (EUSDR)

Considering that the Danube River Basin is the most international river basin worldwide, with a high diversity of the natural and cultural heritage, and large disparities of the social and economic status, the EUSDR has a major role in the implementation by linking policy with the operational level, facilitating the dialogue of major stakeholders in the basin and ensuring the harmonization of measures. The EUSDR annual forum, as the largest event of the strategy, provides the opportunity for direct interactions of regional stakeholders with policy makers, creating the frame to develop interlinkages between different areas and projects of regional importance.

The sturgeon conservation program of the DSTF was acknowledged in the first report of the European Commission to the EU Parliament concerning the implementation of EUSDR (COM 181, 2013), as well as in the annual reports of EUSDR PA 6, where it was labeled as a flagship project. Its integrative measures require cooperation with numerous stakeholders from different fields, and hence, it is connected with all 11 Priority Areas of the EUSDR *(Figure 1)*. While with some areas such as PA 1a (Navigation), PA 3 (Tourism and culture), PA 4 (Water quality), PA 7 (Knowledge society), and PA 9 (People and skills) the cooperation has been established, these connections still need to be developed with other areas.

To raise awareness about the need to embed environmental policies into the development strategies of the other priority areas, at the 4th EUSDR annual forum in 2015 (Ulm, Germany) a workshop was organized by PA 6, focused on the connections required by the cross-cutting measures of the Program "Sturgeon 2020" with all 11 PAs, emphasizing concrete possibilities for trans-sectorial cooperation. The funding programs allocated by the EUSDR in the frame of the Technical Assistance Facility (TAF) and START programs allowed DSTF to draft several joint projects for sturgeon conservation, focused on in-situ and ex-situ conservation,

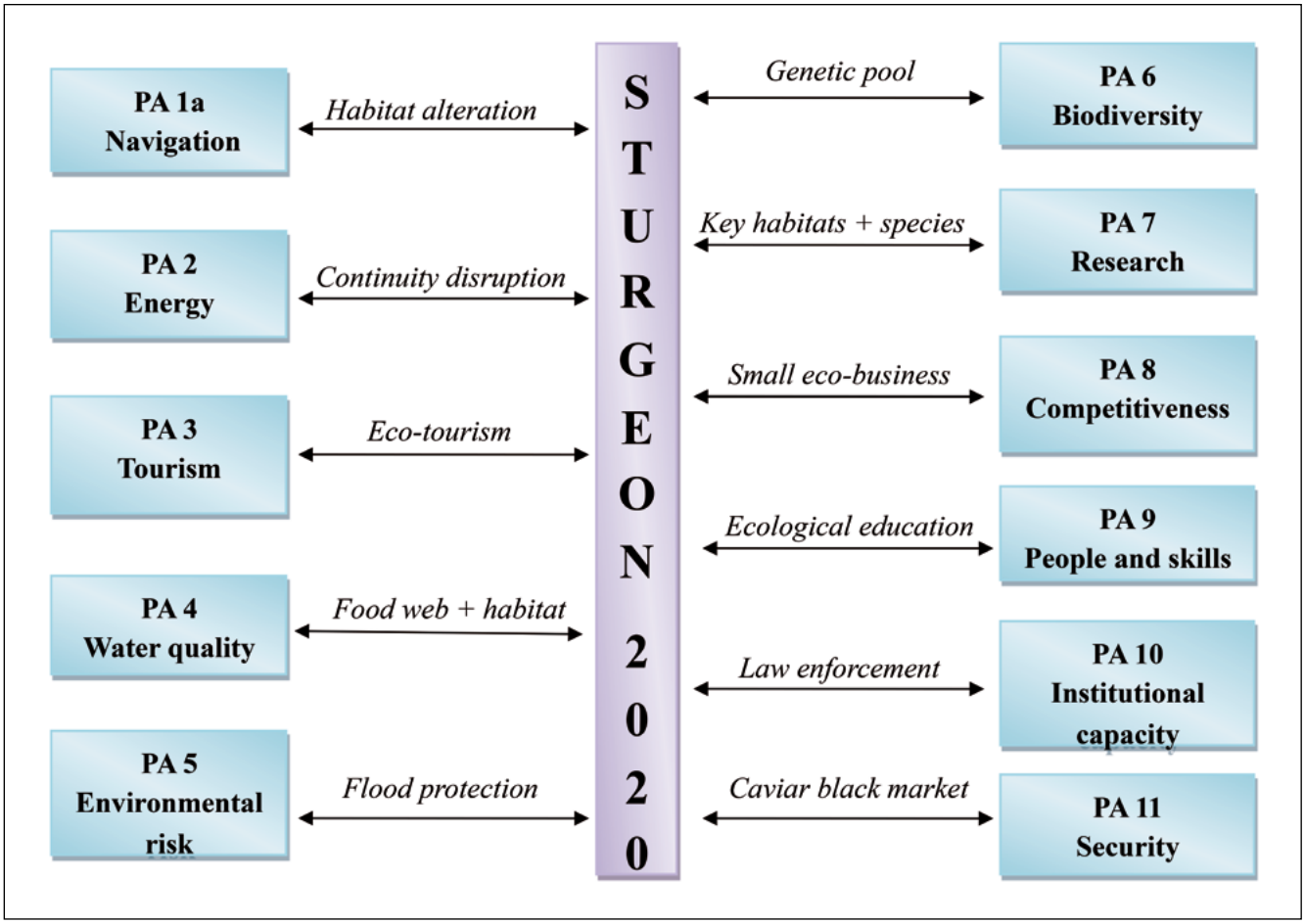

Figure 1. Interlinkage of the Program "Sturgeon 2020" with the 11 Priority Areas of EUSDR

eco-tourism and communication, and to establish a roadmap for ex-situ conservation measures in the Middle and Lower Danube, where the surviving populations of wild migratory sturgeons need urgent protection measures to avoid further loss of species and genetic diversity.

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

Established in 1998 with the aim to implement the Danube River Protection Convention, the ICPDR coordinates the implementation of the Water Framework Directive (WFD, EC/60/2000) and Floods Directive (FD, EC/60/2007) in the Danube River Basin by working closely with water management authorities of the Danube countries.

Besides being a valuable natural, cultural and economic asset, and flagship species of the Danube Region, sturgeons have also an important role as top predators in the aquatic food webs: the status of their populations is a good indicator of the river's "good ecological status" requested by the WFD. For this reason, several supportive measures were included in the Danube River Basin Management Plan (ICPDR 2015) and will be implemented in the next years (e.g. pollution reduction, habitat protection and restoration, support to restore migration at the Iron Gates dams, etc.). Moreover, the ex-situ conservation program is supported by the Water Directors of the Danube countries, i.e. a strengthened cooperation will be launched in the following years between the Water, Fishery and CITES authorities and sturgeon stakeholders in the Middle and Lower Danube to secure the genetic diversity of Danube sturgeons and initiate joint restocking programs. A communication strategy was recently elaborated by the ICPDR, in line with DSTF and EUSDR PA 6 goals, aiming to increase the visibility of sturgeons as flagship species of basin wide importance and raise public awareness on their critically endangered status. The long distance migratory sturgeons, living in the Black Sea and migrating upstream the Danube River for spawning, require monitoring and protection measures in both habitats, and hence, intensive cooperation of relevant authorities implementing WFD, MSFD and HBD. The recent Danube declaration of the environmental ministries of the Danube countries offers further support for the implementation of "Sturgeon 2020", especially in areas where ICPDR has key competences (ICPDR 2016).

Fishery and CITES authorities

The EUSDR START project "Ex-situ survey to preserve sturgeon genetic diversity in the Middle and Lower Danube" (STURGENE) provided the opportunity to establish contacts with the Fishery and CITES authorities from the Middle and Lower Danube. In a joint meeting with representatives of EC DG ENV, water management authorities and environmental NGOs the roadmap for ex-situ conservation was presented, and agreement was reached on future measures for sturgeon conservation, such as the extension of the fishery ban for a period of 5 years. However, to increase its efficiency, it was recommended that this time the measure should be accompanied by compensatory measures for sturgeon fishermen, enforced control of illegal fishery, a coordinated transnational in-situ monitoring program of sturgeons and a feasibility study to re-establish migration at the Iron Gate dams.

Several other key actions were highlighted, such as: (1) establishment of an international consortium, with governmental representatives and scientists, to lead the ex-situ conservation program, (2) elaboration of coordinated National Action Plans for Sturgeon Conservation in all the Danube countries, (3) launching a feasibility study for in-situ conservation, as a basis for the ex-situ conservation program, (4) a genetic inventory of captive sturgeons to select suitable candidates for future restocking programs, (5) establish a pilot facility for migratory species and secure most valuable sturgeons, (6) launch an urgent rescue program for Russian sturgeon (on the brink of extinction – nearly no natural reproduction). The joint implementation of the roadmap for ex-situ conservation could pave the way for further concerted actions of fishery authorities from the Middle and Lower Danube countries in the benefit of sturgeons.

European Investment Bank (EIB)

The interest of the EIB to support the implementation of EC environmental directives requiring restoration of river connectivity resulted in funding a preliminary study downstream of the Iron Gate II dam aiming to observe sturgeon behavior to identify possible locations and designs for functional fish passes allowing sturgeon upstream and downstream migration. After selecting the best methods and training Romanian, Serbian and Bulgarian teams in tagging and telemetry, a second project is envisaged for 2016, focusing on sturgeon monitoring that will help scientists and engineers understand fish behavior at the dams and design tailor made solutions to allow their passage.

The role of EIB is increasingly important for EUSDR, as in 2015 the European Commission and the bank have established an European Investment Advisory Hub as a joint initiative under the Investment Plan for Europe (EIB 2015). The aim of this HUB is to provide technical guidance and support to project promoters, public authorities and investors to develop projects. In this context, the DSTF addressed to the HUB a request for support to develop "Sturgeon 2020" into bankable projects and identify funding sources to ensure the implementation of the conservation measures. The output is expected soon, and will hopefully burst the development of new sturgeon projects in the Danube Region.

Conclusion

The numerous connections of "Sturgeon 2020" with the other Priority Areas call for the development of joint projects

and a constructive dialogue with various stakeholders from the Danube Region to mitigate the impact on sturgeons and their habitats. Such intensified cooperation between different organizations involved in sturgeon conservation may be strengthened by the ongoing political integration of the EU WFD, EU Floods Directive and EU Habitats Directive (Sundseth 2015). Acquiring increasing support of decision makers will have a vital role for the implementation of measures and the success of this program.

References

Bloesch J, Jones T, Reinartz R, Striebel B (eds) (2005): Action Plan for the conservation of sturgeons (Acipenseridae) in the Danube River Basin. Nature and Environment 144: 1–121

COM 181 (2013): Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions concerning the European Union Strategy for the Danube Region. 10 pp

EIB [European Investment Bank] (2015): Introducing the European Investment Advisory Hub. http://www.eib.org/infocentre/videotheque/introducing-the-european-investment-advisory-hub.htm

ICPDR [International Commission for the Protection of the Danube River] (2015): The Danube River Basin District Management Plan. http://www.icpdr.org/main/activities-projects/river-basin-management

ICPDR [International Commission for the Protection of the Danube River] (2016): Danube declaration. 3rd ICPDR Ministerial meeting. https://www.icpdr.org/main/mm16

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: 1–22

Sundseth K (2015): Working towards creating synergies between WFD, MSFD, and HBD: selected case studies. Compilation prepared by Ecosystems LTD /N2K GROUP – October 2015, 61 pp. http://ec.europa.eu/environment/nature/natura2000/management/docs/Compilation%20WFD%20MSFD%20HBD.pdf

Restoration programs for the Sterlet *(Acipenser ruthenus)* in the Upper and Middle Danube

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Of the five native sturgeon species in the Upper Danube, only the Sterlet is still present in a small population in the Aschach impoundment at the border between Germany and Austria. The Middle Danube sustains larger Sterlet quantities, but stocks are decreasing. At this point little is known on habitat use, population size and population dynamics of this species. Reintroductions with fish of hatchery origin in other sections of the Danube did not result in the establishment of viable populations thus far (Reinartz 2008; Friedrich 2013; Friedrich et al. 2014), questioning the success rate of conventional stocking methods. In the last years several projects were implemented to address these issues accordingly.

INTERREG – Sterlet Project in Upper Austria/Bavaria

In the border region between Upper Austria and Bavaria, several consecutive modules of a bilateral research project are running since 2013. The goal of these efforts is to acquire basic knowledge needed for the conservation and management of the local, self-sustaining Sterlet population.

A mark-recapture program has been implemented, and already more than 100 gillnet catches were examined. Photographs, morphological and meristic characteristics of the fish and DNA samples were taken, the fish were marked with PIT tags, and recaptures were identified. Preliminary calculations suggest that the local population size is in the order of a few hundred individuals, but further recapture and telemetry results are needed to confirm this rough estimate. Hybridisation with Siberian Sturgeon is a threat to this population, but fortunately the proportion of hybrids in the last years was by far lower, compared to the study by Ludwig et al. (2009).

20 Sterlets were tagged with acoustic transmitters and tracked by boat and with loggers spread over the impoundment of Aschach, but also two more impoundments downstream. Based on the patterns of catches of the fishery, it was hypothesized that the head of the impoundment would be the preferred habitat of the population (Friedrich et al. 2014). But telemetry data showed that Sterlets strongly prefer deep areas all year round. They were recorded in depths of less than 4-5 m only in very rare cases. The deepest parts, mainly in the centre of the impoundment, are used as overwintering habitats. Pressure/depth sensor data revealed astonishing patterns of vertical migrations between habitats used during day and night. Typical migration patterns in summer show sequences of long residence in restricted areas that are interpreted as "feeding habitats". These phases are interrupted by phases of fast, unidirectional migrations. In the case of upstream migrations, these phases frequently end at the power plant of Jochenstein *(Figure 1)*. Wandering downstream through turbines, several fish left the impoundment and could be tracked in the two subsequent Danube sections (Ratschan et al. 2014).

Efforts in 2016 will further focus on the discovery of key habitats, especially spawning and wintering habitats and on exchanges with neighbourly sections of the Danube and possible sub-populations. In this regard the DNA samples

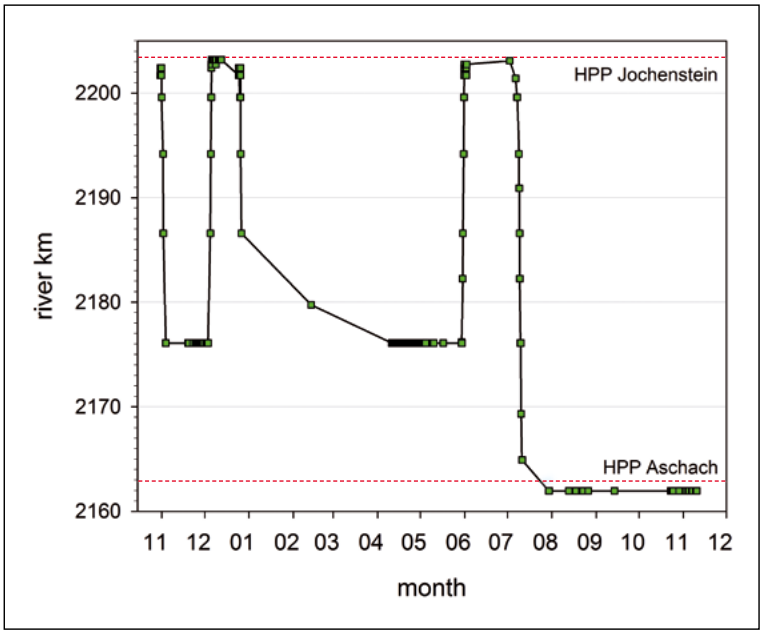

Figure 1. Example for a longitudinal migration pattern of a Sterlet (size at tagging: 470 mm) over a year. Every symbol (n=16,844) indicates that the fish was located. Red lines: Hydropower Plants (HPP)

of this local population are to be analysed and compared to other Sterlet stocks within a LIFE project.

LIFE Sterlet – Restoration of Sterlet populations in the Austrian Danube (Austria/Slovakia)

This LIFE project runs from 2015 to 2021 and was designed in compliance to "Sturgeon 2020" (Sandu et al. 2013) and the FAO guidelines on hatchery practices and release (Chebanov et al. 2011). It combines ex-situ and in-situ actions. The project team is supplied by the Institute for Hydrobiology and Aquatic Ecosystem Management of BOKU University Vienna, the Viennese governmental body for river and waters (MA45) and the Institute of Botany Bratislava of the Slovak Academy of Sciences. The project is sponsored by several partners from fisheries, governmental authorities, the National Park administration and the Waterway Directorate, and 60% co-funded through the LIFE Programme of the European Union.

The major focus is on the reestablishment of self-sustaining Sterlet populations in the Morava and two sections of the Danube, the Wachau and the National Park downstream of Vienna. A container breeding system, running with Danube water, will be established on an island in Vienna. A similar system has been in use for three years with Baltic sturgeon on the Odra River by the IGB-Berlin. The idea is to induce homing behaviour and fitness for survival with regard to natural feeding, predator avoidance and habitat use. It is planned to release 10,000 juveniles each year at the different sites, stemming from genetically autochthonous wild broodstock from the Slovakian Danube. Once established and running, it is hoped that similar systems can be implemented in the Middle and Lower Danube for all sturgeon species.

The monitoring program will focus on habitat use and behaviour of released juveniles to evaluate the success rate of restocking. A wide variety of methods will be used, including hydroacoustic telemetry, catch data of recreational fishery and different scientific sampling techniques. This should lead to the identification of sensitive habitats to provide recommendations for their conservation and to formulate a management plan for the species in the Upper Danube.

The whole project will be accompanied by a wide variety of PR actions like a public fish tank, exhibitions, excursions and workshops during the International Sturgeon Symposium (http://www.iss8.info), short films and press articles and exercises for students and pupils. For further information see: http://life-sterlet.boku.ac.at and www.facebook.com/DanubeSturgeonTaskForce/

Danube Sturgeons Management and Protection (Slovakia)

The project is financed by the Slovak Research and Development Agency under the contract No. APVV-0820-12 and intends to increase the knowledge on biology and autecology of the Sterlet in the Middle Danube downstream of the Gabčíkovo dam. In tight cooperation with the Slovak Anglers Club Union, responsible for the management of wild fish stocks in Slovakia, telemetry methods to identify key habitats and various sampling methodologies to evaluate the stocking efficiency and to record any natural spawning will be applied. The gained results and experience will be used to protect habitats and to develop stocking plans. These measures will support migratory sturgeon species when a fish passage at the Iron Gate dams will be built.

References

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, FAO, 110 pp

Friedrich T (2013): Sturgeons in Austrian Rivers: Historic Distribution, current Status and Potential for their Restoration. World Sturgeon Conservation Society: Special Publication n°5, Books on Demand, Norderstedt

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

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. Biol. Invasions 11: 753–760

Ratschan C, Zauner G, Jung M (2014): Grundlagen für den Erhalt des Sterlets. Interreg Projekt Bayern - Österreich (J00346). Bericht Projektsphase 2014. I. A. Amt der OÖ. Landesregierung. 55 S

Reinartz R (2008): Artenhilfsprogramm Sterlet. Projekt 904, Abschlussbericht 2004-2007, I.A. des Landesfischereiverbandes Bayern e.V.

Sandu C, Reinartz R, Bloesch J (eds) (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

Ex-situ conservation for Danube River Sturgeons – concept, facts and outlook

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Introduction

The Danube River is the last refuge for populations of five sturgeon species in Europe *(Acipenser gueldenstaedtii, A. ruthenus, A. nudiventris, A. stellatus* and *Huso huso).* All of these populations are seriously endangered or threatened by extinction due to a whole complex of factors. This includes the historic burden of centuries of overexploitation, resulting in small population sizes, e.g. by the Allee effect and genetic bottlenecks, and, in combination with blocked migration routes, in the loss of subpopulations living and/or spawning in the Upper and Middle Danube River and their tributaries (Reinartz 2002; Schmall & Friedrich 2014). Populations are also still impacted by illegal, unreported and unregulated (IUU) fishing and under an increasing pressure by infrastructural development in the Danube region, resulting in a potential loss of sturgeon habitat.

The ex-situ concept

One conservation approach to counteract the extinction of wild animal populations is the implementation of ex-situ ("off-site") measures aka conservation breeding, as already envisioned by the Sturgeon Action Plan under the Bern Convention (Bloesch et al. 2005) and included in the Program "STURGEON 2020" (Sandu et al. 2013). Ex-situ measures serve two main purposes (Reinartz 2015):

- the conservation of endangered sturgeon populations or populations on the brink of extinction by establishing captive life-cycle units and ensuring the survival of adult spawners of each population entity aka conservation unit (CU)
- the stabilization of CUs by compensating for deficits in natural reproduction through the release of juveniles adapted to wild conditions (fit-for-survival) and thus ensuring viable year-classes of future wild spawners.

It is of paramount importance to maintain and protect the genetic identity and diversity, as well as the morphological and behavioural characteristics of the respective CUs in both captivity and the wild. Measures have to be in line with the existing life-cycle of CUs, synchronized with all in-situ ("on-site") activities and conducted long-term until stocks have recovered. Ex-situ operations have to be clearly distinguished from commercial aquaculture operations *(Figure 1)*, as the desired traits in produced offspring differ significantly (see also the article by Friedrich et al. in this volume).

Feasibility

Respective guidelines and studies (Chebanov et al. 2011; Reinartz 2015) deliver the following important resources for the feasibility of ex-situ measures (in alphabetical order):

1. Broodstock: Adult spawners that genetically represent the wild CUs
2. Ex-situ expertise: Necessary for establishing and running ex-situ facilities and operations
3. Funding: Short- to mid-term funding for establishing facilities and broodstock and long-term funding to cover maintenance costs
4. Knowledge and research: In-depth knowledge and research of in-situ conditions and ex-situ processes
5. Live gene bank facilities: Sites for keeping broodstock and running ex-situ operations

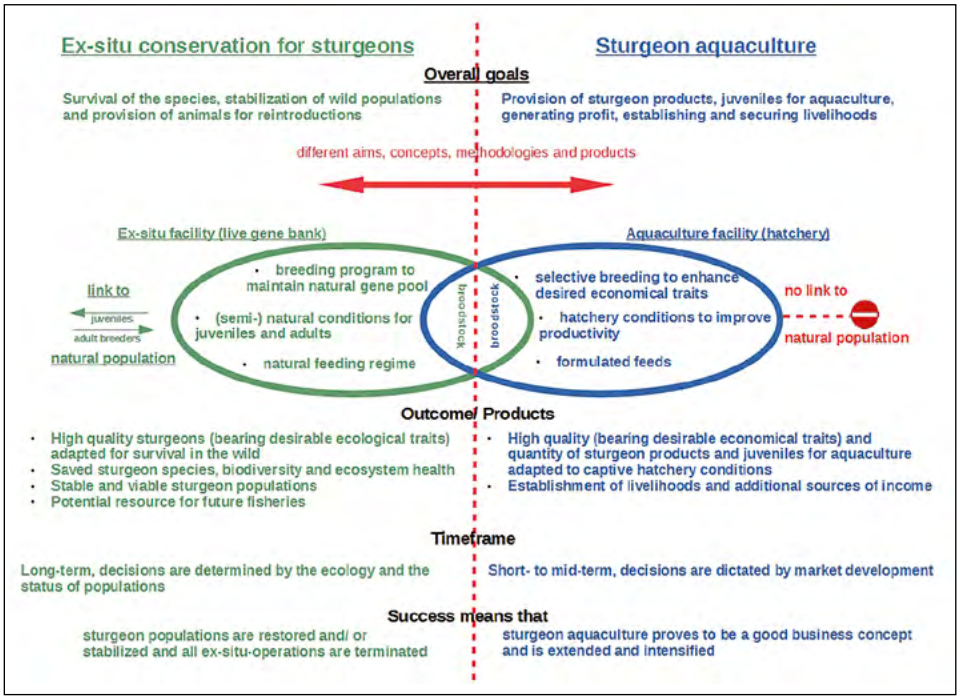

Figure 1. Main differences between ex-situ measures for sturgeons and sturgeon aquaculture (from Reinartz 2015)

6. Management: Transnational management at all levels for the goal-oriented implementation of basin-wide ex-situ measures under public coordination and control
7. Political will: Is vital for the support and long-term funding of ex-situ measures.

Ex-situ survey to preserve sturgeon genetic diversity in the Middle and Lower Danube aka STURGENE

Up to now, releases of migratory sturgeon juveniles from controlled propagation into the Danube system have been sporadic and their stocking always depended on the availability of funding and caught wild spawners (Reinartz 2002). Funded by the EUSDR START program, the project "Ex-situ survey to preserve sturgeon genetic diversity in the Middle and Lower Danube" (STURGENE) constitutes the first step towards transnational concerted ex-situ measures on a regular basis, in line with "STURGEON 2020". This project was carried out in Bulgaria, Romania, Serbia and the Ukraine, and comprised a survey of existing aquaculture facilities and captive broodstock *(Figure 2)*, as well as raising awareness with local stakeholders and high-level policy makers.

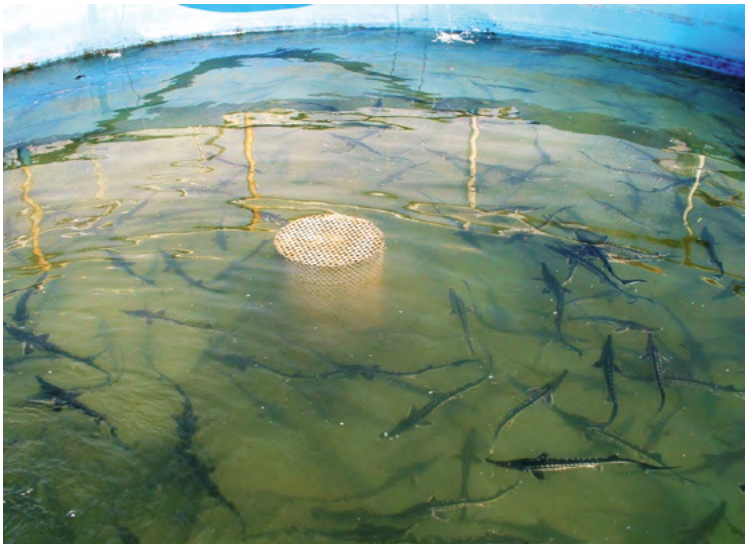

Figure 2. Sturgeon juveniles in facility at Horia, Romania during STURGENE survey (photo András Péteri)

Most of the surveyed facilities are not suitable for running integrated ex-situ operations except one, provided that minor adaptations would be implemented. However, a limited number of potential broodfish of the three anadromous species exist in facilities from Bulgaria, Romania and Ukraine and could provide future spawners, if their Danube origin and genetic suitability will be confirmed (Friedrich et al. 2015). Also, the terms and conditions for the use of these resources are not clear, as both facility and broodstock are in private hands. The stakeholder workshops and the high-level political event documented a good hands-on expertise in controlled propagation, as well as a general stakeholder and political support for ex-situ measures.

Ex-situ theory vs. reality

STURGENE results have shown that there will be no easy solutions for the implementation of basin-wide ex-situ measures, as major necessary resources still need to be established. Thus, pragmatic yet responsible solutions should be favoured to achieve the overall goal of ex-situ, which is the conservation, stabilization and restoration of original Danube sturgeon populations, as described above.

Outlook

The following activities are seen as most urgent for a further successful implementation of ex-situ measures for sturgeons in the Danube-Black Sea system (DSTF 2016):

- Establishment of an international consortium, with governmental representatives and scientists, to lead the ex-situ conservation program
- Feasibility study for in-situ conservation, as a basis for the ex-situ conservation program
- Genetic inventory of captive sturgeons to select suitable candidates for future restocking programs
- Establish a pilot facility for migratory species and secure most valuable sturgeons
- Launch a rescue program for the Russian sturgeon *(A. gueldenstaedtii)*, which is on the brink of extinction.

References

Bloesch J, Jones T, Reinartz R, Striebel B (2005): Action Plan for the conservation of sturgeons (Acipenseridae) in the Danube River Basin. Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Nature and Environment 144, 122 pp

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, FAO, 110 pp

DSTF, Danube Sturgeon Task Force (2016): Roadmap for implementation of ex-situ conservation measures for sturgeon species in the Middle and Lower Danube Region. Elaborated in the frame of EUSDR START project STURGENE, 14 pp

Friedrich T, Reinartz R, Peteri A (2015): First Screening of facilities and broodstock in captivity with regard to ex- situ conservation of Danube sturgeons – Project Report, 19 pp

Reinartz R (2002): Sturgeons in the Danube River. Literature study on behalf of Bezirk Oberpfalz, International Association for Danube Research and Landesfischereiverband Bayern e.V., 150 pp

Reinartz R (2015): Feasibility Study - Ex-situ measures for Danube River Sturgeons (Acipenseridae). Conducted on behalf of the ICPDR and BOKU within the project "Elaboration of pre-requisites for sturgeon conservation in the Danube River Basin"

Sandu C, Reinartz R, Bloesch J (eds.) (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

Schmall B, Friedrich T (2014): Das Schicksal der großen Störarten in der Oberen Donau, Denisia 33, Neue Serie 163: 423–442

Danube beluga sturgeon monitoring: genetic population structure and migration patterns

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Introduction

Monitoring so called fishery independent characteristics of sturgeon populations (Suciu 2008) in the Lower Danube River (LDR), including genetic population structure and migration of adults and young of the year (YOY), was considered crucial for making progress in understanding the life cycle of these critically endangered flagship species of the Danube (Reinartz et al. 2012). Tracking movements and migration patterns of adult sturgeons in the LDR using acoustic telemetry dates back to 1998 - 2000 (Kynard et al. 2002) and was restarted at larger scale in 2011 (Hontz et al. 2012), while systematic monitoring of downstream migration of YOY sturgeons is conducted by the Sturgeon Research Group (SRG) of the Danube Delta National Institute (DDNI) since 2000 (Paraschiv et al. 2006; Paraschiv 2011; Rosten et al. 2012). Studies of genetic population structure of endangered sturgeon species in the LDR started in 1999 (Ferguson et al. 2000) but the existence of reproductively isolated groups / sub-populations and preliminary spatial distribution in the sea and the river was first described only in 2012 (Holostenco et al. 2012, 2013; Onără et al. 2014). This article is an overview of recent work and publications of the DDNI SRG on genetic diversity and migration patterns of beluga sturgeons in the LDR.

Genetic diversity of beluga sturgeons

To study genetic diversity of downstream migrating YOY beluga sturgeons born in the LDR during 2004 – 2012 we performed PCR-RFLP screening of the mtDNA control region in 300 samples using restriction enzymes *Bsr*I and *BspH*I (Onără et al. 2014). This revealed the existence of four different haplotypes exhibiting variable frequencies *(Figure 1)* in both adults and YOY (76/44% in haplo-1, 3/9% in haplo-2, 9/24% in haplo-3, and 12/23% in haplo-4). However, no significant differences in haplotype frequencies (P = 0.5) could be distinguished among the adults while tentatively divided as spring and autumn migrants according to their capture date records.

The Neighbour Joining (NJ) tree *(Figure 2)* constructed using DISPAN programme suite based on Nei's genetic distance (DA) (Nei 1972) for mtDNA control region shows a genetic relationship between the YOY born in consecutive years (e.g. 2004–2005, 2009–2010). We explain this finding to be a consequence of gradual sexual maturation of females of the same year class spawning in successive years. This demonstrates that early life stages of beluga sturgeon migrate downstream in groups of genetically related individuals, as indicated by mean genetic distance between individuals in group YOY-04-B (D^2_{sh} = 0.000), while in the other groups of YOY this parameter shows moderate relationship between individuals as a result of some overlapping of groups.

These preliminary results of genetic variability of the YOY beluga sturgeons suggest abandoning the hypothesis that the beluga sturgeon population spawns in the LDR as a

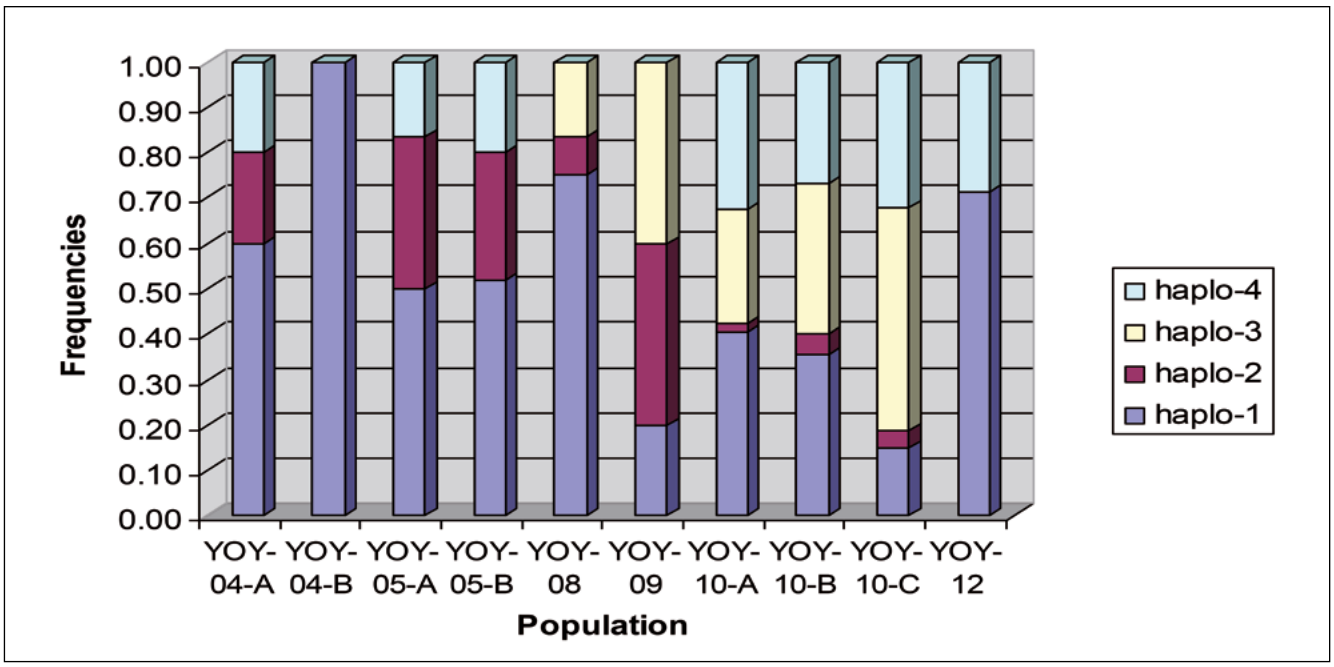

Figure 1. Haplotype frequencies of 10 beluga sturgeons YOY groups sampled in the LDR during 2004–2012 (Onără et al. 2014)

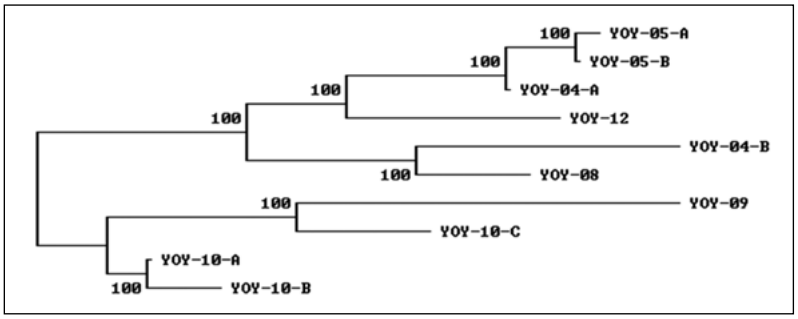

Figure 2. NJ dendrogram based on Nei's genetic distance (DA) (Nei 1972) of control region haplotypes in all 10 beluga sturgeon YOY groups. Bootstrap values are given at each node (Onără et al. 2014)

panmictic unit (Onără et al. 2014). Recently, by sequencing the enlarged control region of mtDNA in 300 YOY beluga sturgeons sampled during 2004–2015, we succeeded to demonstrate, with the cooperation of young geneticists of the University of Ferrara guided by Leonardo Congiu, that after 2006 the catch moratorium enabled a growing number of females to access spawning grounds in the LDR producing offspring. These findings at mtDNA level need to be confirmed by currently ongoing analyses at nuclear level, and if validated, they will indirectly show the positive effect of conservation measures implemented since 2006.

Migration patterns of adult and YOY sturgeons in the river

During ongoing acoustic telemetry studies of movements and behaviour of sturgeons arriving downstream of the Iron Gate 2 dams (rkm 863), we detected several beluga sturgeons carrying acoustic transmitters (Vemco, Canada) implanted by us (2012) and INCDPM (2013). Observations on three exemplary beluga sturgeon males, systematically dropping back after being tagged in the Borcea branch, show the extraordinary swimming capacity of these fish *(Table 1).*

Beluga male No.1 developed a ground speed of 41.5 km/day over a distance of 747 km, at a water temperature of 6.3 – 8 °C, needing only about 20 days from mid-March to early April to complete the journey from the sea to arrive at the Iron Gate 2 dams just in time for the spawning season.

So far we do not have a valid explanation for the behaviour of beluga male No. 2 which was recorded at Isaccea (rkm 100) in December 2013. It moved to the sea and returned two years later being recorded by the automatic receiver installed at Ruse (rkm 500) in November 2015. Then it completed the journey to the Iron Gate 2 dam in only 8 days moving upstream with a ground speed of 45.1 km/day, at a slowly decreasing water temperature of 10.6 to 8.6 °C. Finally, it returned slowly downstream (ground speed only 28 km/day) to the Borcea branch being recorded on December 14 by our receiver installed at km 15.

Beluga male No.3 was returning from upstream after the spring spawning season (late April – early May 2012). After being tagged on May 24, 2012 in the Borcea branch at a water temperature of 18.5 °C, it moved further downstream, in the beginning slowly (35 km/day) to the entrance of the Caleia branch (rkm 195), and then very fast (87.7 km/day), being recorded after 26 hours at Isaccea (rkm 100), on 29 May 2012. It returned to the river two years later during the fall migration being recorded at rkm 100 on 1 November 2014 and 8 days later at km 9.8 on Bala branch, upstream of the submerged sill (Déak & Matei 2015). It then stayed over winter somewhere upstream of the entrance to the Bala branch (rkm 345) and arrived next year for the spawning season (7–26 April 2015) in the vicinity of the Iron Gate 2 dams, being recorded by our automatic receiver installed

Species (fish code)	sex	Date of tagging	Location of releasing	History of recordings	Short description of u/s and d/s migration	Dist. [km]	Average ground speed [km/day]
1.Huso huso (13730/31)	male	Nov. 2013**	Borcea Branch≈ Danube River km 300	rkm 100 18 Nov. 2013 rkm 100 15 Mar. 2014 rkm 847 02 April 2014 rkm 860 05 April 2014 rkm 847 08 April 2014 rkm 100 26 April 2014	Moved d/s after tagging; returned next year in the spring; moved 747 km u/s in 18 days; moved d/s (747 km in 18 days) after spawning	747 23 23 747	u/s 41.5 u/s 7.7 d/s 7.6 d/s 41.5
2.Huso huso (13682/83)	male	Nov. 26, 2013*	Borcea Branch≈ Danube River km 300	rkm 100 01 Dec. 2013 B km 9.8 12 Nov. 2015* rkm 500 15 Nov. 2015 rkm 861 23 Nov. 2015 B km 15 14 Dec. 2015	After tagging moved d/s rkm 100; returned u/s in fall 2015 and arrived at Iron Gate 2 in Nov.; returned d/s in Dec.	361 588	u/s 45.1 d/s 28.0
3.Huso huso (14335/36)	male	May 24, 2012*	Borcea Branch≈ Danube River km 300	rkm 300 25 May 2012 rkm 195 28 May 2012 rkm 100 29 May 2012 rkm 100 01 Nov. 2014 B km 9.8 08 Nov 2014* rkm 847 07 Apr. 2015 rkm 847 26 Apr. 2015	Moved d/s after tagging and left the Danube River; returned to the river in fall of 2014; passed on Bala* branch and was wintering in the River u/s rkm 345; continued migration during 2015; arrived at rkm 847	95 219	d/s 87.7 u/s 27.5

**Déak & Matei (2015); ** INCDPM (2013)*

Table 1. *Upstream (u/s) and downstream (d/s) migration of adult sturgeons recorded with acoustic telemetry (a few representative fish)*

Origin	N	Age (month)	TW (g)	SL (cm)	Distance (km/days)	Ground speed (km/day ; m/sec)	Route
Wild	20	1.5	27	13.5	165/2	82.5 ; 0.95	Reni (rkm 123) → St. George (km 5)
Stocked / aquaculture	26	3.5	131	24	327/5	65.4 ; 0.75	Stelnica (rkm 300) → St. George (km 5)
Stocked / aquaculture		3.5	154	26	144/2	72.0 ; 0.83	Isaccea (rkm 102) → Sf. George (km 5)
Stocked / aquaculture *	100	18	460	48	655/10	65.5 ; 0.75	Ercsi / downstream of Budapest (rkm 1615) → Tekija / Serbia (rkm 960)

** Data by courtesy of Miklos Pannonhalmi / Water Directorate Győr, Hungary and Mirjana Lenhardt / IMSI Belgrade / Serbia*

Table 2. Downstream migration swimming speed of wild and stocked YOY beluga sturgeon (Huso huso) as recorded by Vemco acoustic telemetry transmitters and receivers (Rosten et al. 2011)

Origin	Releasing location	N	Chilia Branch (%)	St. George Branch (%)	Unknown (%)	Total
Wild	Reni rkm 123	20	2.2	26.1	15.2	43.5
Stocked	Borcea Branch km 40	13	15.2	4.4	8.7	28.3
Stocked	Isaccea rkm 102	13	23.9	2.2	2.2	28.3
		46	41.3	32.6	26.1	100

Table 3. Route taken by YOY beluga sturgeons as recorded by acoustic telemetry transmitters (June – August 2010) (Rosten et al. 2011)

at Pristol (rkm 847), while arriving, and 19 day later, passing downstream.

All three beluga sturgeons recorded by us arriving at Iron Gate 2 dams belong to the group of fall migrants. The migration pattern of these few fish confirms the hypothesis that beluga sturgeon males which enter the river during the fall migration season are long distance migrants. They stay over winter in the river (downstream of rkm 100 or upstream of rkm 345) and continue their migration in spring to the Iron Gate 2 dam.

Characteristics of downstream migration and route taken on the delta branches by YOY beluga sturgeons of wild (N = 34) and aquaculture (N = 26) origin was investigated during June – August 2010. After tagging with small acoustic transmitters (Thelma Biotel, Norway) they were released to the river at the monitoring site of rkm 123 / Reni (the wild YOY), on Borcea branch at km 40 / Stelnica, and rkm 102 / Isaccea (the YOY stocked from aquaculture). Average ground speed developed by YOY beluga varied from 82.5 km/day in the fish of wild origin to 65.4 – 72 km/day in those of aquaculture origin *(Table 2)*. Noteworthy is the finding that most (26%) of tagged wild YOY moved downstream on the St. George branch, while most of the stocked YOY released from Borcea km 40 (15%) and Isaccea rkm 102 (24%) moved on the Chilia branch *(Table 3)*.

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References

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

Ferguson A, Suciu R, Prodöhl P, Hynes R (2000): Genetic population structure of endangered sturgeon species of Lower Danube. Royal Society Joint Projects with Central / Eastern Europe and the former Soviet Union, Final report, August 2000: 15 pp

Holostenco D, Onara D, Taflan E, Suciu R (2012): Genetic diversity of adult stellate sturgeons captured in the Lower Danube River during 1998–2011. Book of Abstracts, 39th IAD Conference. Szentendre, Hungary: 44

Holostenco D, Onără D, Suciu R, Honț S, Paraschiv M (2013): Distribution and genetic diversity of sturgeons feeding in the marine area of the Danube Delta Biosphere Reserve, Romania. Scientific Annals of the Danube Delta Institute vol. 19: 25–34

Hontz S, Iani M, Paraschiv M, Cristea A, Tănase B, Bâdiliță A M, Deák G, Suciu R (2012): Acoustic telemetry study of movements of adult sturgeon in the Lower Danube River (Km 175 – 375) during 2011. Book of Abstracts, 39th IAD Conference, Szentendre, Hungary: 45

INCDPM (2013): Monitoring of Environmental Impact of the Works for Improvement of the Navigation Conditions on the Danube between Călăraşi and Braila, km 375 - km 175. http://afdj.ro/en/content/romomed

Kynard B, Suciu R, Horgan M (2002): Migration and habitats of diadromous Danube River sturgeons in Romania: 1998–2000. Journal of Applied Ichthyology 18: 529–535

Nei M (1972): Genetic distance between populations. American Naturalist 106: 283–292

Onără D, Holostenco D, Paraschiv M, Suciu R (2014): Preliminary genetic variability of Lower Danube River young of the year (YOY) beluga sturgeon *Huso huso* (Linnaeus, 1758) using mtDNA markers. Journal of Applied Ichthyology 30: 1286–1289

Paraschiv M, Suciu R, Suciu M (2006): Present state of sturgeon stocks in the lower Danube River, Romania. In: Proceedings 36th International Conference of IAD, Vienna: 152 – 158

Paraschiv M (2011): Downstream migration of young of the year (YOY) of sturgeons in the Lower Danube River. PhD thesis, Lower Danube University of Galatz: 115 pp

Reinartz R, Bloesch J, Sandu C, Suciu R, Lenhardt M, Guti G, Jahrl J (2012): Sturgeon conservation in the Danube River Basin: How to implement the Sturgeon Action Plan 2005. Limnological Reports 39, Proceedings of 39th IAD Conference, Szentendre, Hungary: 101–107

Rosten C, Suciu R, Hawley K, Holostenco D, Onara D, Paraschiv M, Iani M, Kristensen T, Taflan E (2011): Downstream movement of YOY beluga sturgeons in the Lower Danube River. International Conference on Conservation, Recovery and Sustainable use of Danube River Sturgeons March 29–April 2, 2011, Tulcea, Romania, (PP oral presentation, 17 slides)

Rosten CM, Onara D, Hawley K, Suciu R (2012): The status of Danube beluga sturgeon (Huso huso): Past, present and future. Vann, Oslo, 04: 523–534

Suciu R (2008): Sturgeons of the NW Black Sea and the Lower Danube River Countries. Case study, International Expert Workshop on CITES Non-Detriment Findings, Cancun / Mexico, November 17–22, 2008, 27 pp

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

with the label is not expected to be on display); two of these were in fact caviar from sturgeon (both of which were said to be wild-caught), six samples proved to be fake (from Lumpfish or produced artificially).

– Three samples had CITES labels, but DNA analyses suggested they originated from species or hybrids other than those declared on the label; two of these mislabelled samples were Bulgarian farmed caviar bought in Vienna *(Figure 1).*

These cases demonstrate clear contraventions of CITES labelling provisions and EU Wildlife Trade Regulations. In addition, they suggest that caviar of wild sturgeons – reportedly from the Danube – is offered for sale, which indicates that sturgeons are still being poached. Local fishermen told surveyors that modern equipment such as sonar and GPS as well as forbidden traditional hook lines ('carmacs') are used to catch wild sturgeon. In supposedly illegal caviar trade, surveyors found that vendors tended to only sell to people they trusted. The result is a covert chain of custody from poachers to customers.

An article published in the German magazine DER SPIEGEL on 24 December 2015 (http://www.spiegel.de/spiegel/print/d-140604239.html) described two cases of Beluga caviar labelled as from Bulgarian aquaculture. However, results of isotope analysis excluded Bulgarian origin almost certainly and considered the Caspian Sea as source region. It seems likely that caviar from poached Caspian sturgeons was "white-washed" as Bulgarian aquaculture product.

These findings underline how crucial effective law enforcement is, especially in sturgeon range states but also in consumer countries. This should include strong interagency and transborder coordination and application of modern technology such as DNA or isotope analysis. The issue of illegal sturgeon fishing and caviar trade deserves more attention and also firm political support to achieve success in wild sturgeon protection, particularly in the Danube.

Awareness raising and capacity building among key stakeholder groups

To stress the problem of illegal fishing and trade, the LIFE Information and Communication project "Joint actions to raise awareness on overexploitation of Danube sturgeons in Romania and Bulgaria" was conducted by WWF Austria, Bulgaria and Romania from June 2012 to September 2015. The project focused on the groups with highest impact on and responsibility for the protection of sturgeons from poaching and illegal trade in Bulgaria and Romania:

– local fishing communities
– law enforcement agencies
– decision makers
– companies that breed sturgeons or trade/process/export caviar.

Fishermen, who traditionally relied on the Danube for sustenance, have found themselves beyond the law with regards to sturgeon fishing *(Figure 2)*. Existential needs of local communities have not been adequately addressed after the national sturgeon fishing bans were imposed and no form of compensation or other support to prevent poaching has been offered. Consequently, illegal fishing is still happening in communities and many fishermen have rather negative attitudes to conservation measures.

For these reasons, fishermen were strongly involved in the project. WWF "Sturgeon Advocates" regularly visited villages where sturgeons used to be fished. They informed fishermen about the threats to sturgeons and the impact of fishing; on the other hand, they learned about the living and working conditions of fishermen and their attitudes, experiences and suggestions with regard to sturgeons. This raised the understanding of sturgeon conservation needs and protection measures in fishing communities but also achieved a far better comprehension of the situation and motives of fishermen.

In addition, fishing communities were supported in identifying alternatives to generate income that could fill the gaps caused by the sturgeon fishing bans. In workshops, possible sources of revenue were discussed and potential funding options presented. In some villages, fishermen had very clear ideas of investments that could help them increase profits, improve services or set up small local businesses (e.g. in tourism, manufacturing of local products, fish processing and marketing), while in others, no alternative options were yet seen. A successful showcase activity was the training of fishermen in sturgeon monitoring. In the Bulgarian fishing village of Vetren, experts qualified fishermen in techniques applied in scientific monitoring of sturgeon populations. Interest has already been signalled by state agencies to employ these fishermen in future sturgeon monitoring. Moreover, the personal involvement of fishermen in sturgeon conservation resulted in increased motivation to protect sturgeons, while at the same time they acquired practical skills that can be marketed to research and conservation institutions.

Law enforcement agencies in charge of controlling all aspects relevant for sturgeon conservation – fishing, aqua-

Figure 1. Mislabelled caviar bought in Vienna: species of origin should be Beluga according to CITES code but was determined as Russian or Siberian Sturgeon by DNA analysis

Figure 2. Danube fishermen in Bulgaria, key players between sturgeon conservation and poaching

culture and trade – need sufficient capacities and knowledge to fight illegal activities. Workshops and practical training courses with national and international experts were held to enhance expertise on status of sturgeons, aquaculture production, caviar trade, fraud and smuggling techniques, legislation and enforcement. This also facilitated the crucial cooperation between national agencies and with responsible authorities in neighbouring countries. In addition, a comprehensive handbook was produced, compiling all necessary information to support the work of law enforcement agencies. Increased enforcement resulted e.g. in a large police operation in Romania in May 2014, leading to seizures of 80 kg of sturgeon caviar and 4 tons of sturgeon meat. These figures show the amounts of questionable products still in circulation.

Enterprises breeding sturgeons or trading, processing or exporting caviar pose a potential threat to wild sturgeons if not operating fully according to CITES and EU regulations, especially in range states. It must be ensured that sturgeon breeders do not illegally and unsustainably take brood stock from the wild or introduce non-native sturgeon species or populations to the wild. Moreover, the companies should refrain from introducing caviar that is illegally obtained from wild sturgeons into the market, e.g. mislabelled as legal, "captive bred" caviar.

To include the industry in sturgeon conservation, a Code of Conduct was set up, explaining these threats and listing appropriate measures. By signing this, four companies in Romania and four companies in Bulgaria officially declared compliance with relevant regulations and transparency in their business conduct to avoid any threat to wild sturgeons. This is a first important step to ensure a sustainable regional sturgeon aquaculture industry that will benefit wild sturgeons and regional economy alike.

It is also essential that the caviar industry in consumer countries understands the critical status of sturgeons and the importance of legal requirements for caviar trade, especially the mandatory CITES labelling to determine the origin of the product and to distinguish legal from illegal caviar. Therefore, information material in different languages was distributed to companies in Romania and Bulgaria as well as to international producers and traders at information stands at the Global Seafood Expo in Brussels, the worldwide largest fair for fish and seafood products.

More on the project, all information material as well as a project synthesis, recommendations and long-term strategic directions for conservation of sturgeons in the Lower Danube from illegal fishing and trade are available on the project website: danube-sturgeons.org

References

Bloesch J, Jones T, Reinartz R, Striebel B (2005): Action Plan for the conservation of sturgeons (Acipenseridae) in the Danube River Basin. Nature and environment, No. 144, Council of Europe Publishing, 112 pp; http://www.iad.gs/docs/reports/SAP.pdf?PHPSESSID=708652a79156332ebc5be9657f0d43b6

Jahrl J (2013): Illegal caviar trade in Bulgaria and Romania - Results of a market survey on trade in caviar from sturgeons (Acipenseridae). WWF Austria & TRAFFIC, Vienna, Austria, 50 pp; http://awsassets.panda.org/downloads/illegal_caviar_trade_in_bulgaria_and_romania.pdf

Ludwig A, Lieckfeldt D, Jahrl J (2015): Mislabelled and counterfeit sturgeon caviar from Bulgaria and Romania. Journal of Applied Ichthyology 31: 587–591

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Hydrological catchment of the River Danube

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