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An Action Plan for the Conservation of Sturgeons (Acipenseridae) in the Danube River Basin

Aktionsplan zur Erhaltung der Donau-Störe (Acipenseridae)

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SUMMARY/KURZFASSUNG

Six species of sturgeons are native to the Danube River Basin, five are classified as either 'Endangered' or 'Critically Endangered', and one 'Vulnerable' according to the *2004 IUCN Red List of Threatened Species*. In fact, one of the five endangered species, the Atlantic sturgeon (*Acipenser sturio*), is already extinct in the Danube River Basin. The key threats to Danube sturgeons include: Over-exploitation (over-fishing linked with poaching and illegal trade), habitat loss and degradation including the disruption of spawning migrations and pollution, and potential alteration of the genetic and ecological status by the introduction of exotic species and genotypes. In December 2005, a Sturgeon Action Plan, jointly prepared by experts and stakeholders, was adopted by the Standing Committee of the Bern Convention in the frame of the Council of Europe. It puts forward a series of Objectives and associated Actions required to achieve the Plan's ultimate Goal formulated as follows: "Through national action and international cooperation, to secure viable populations of all Danube sturgeon species and forms by sustainable management and by restoration of their natural habitats and migratory movements."

Sechs Störarten kommen in der Donau natürlicherweise vor, fünf sind gemäss der IUCN Roten Liste der bedrohten Arten 2004 entweder als ‚Endangered' (‚stark gefährdet') oder ‚Critically Endangered' (‚vom Aussterben bedroht') eingestuft, und eine Art als ‚Vulnerable' (‚potentiell gefährdet'). Tatsächlich ist eine der fünf gefährdeten Arten, der Atlantische Stör (Acipenser sturio), in der Donau schon ausgestorben. Die wichtigsten Bedrohungen der Donau-Störe sind: Überfischung (in Kombination mit Wilderei und illegalem Handel), Verlust und Zerstörung von Lebensraum, die Unterbrechung der Laichwanderung, Gewässerverschmutzungen und die potenzielle Veränderung des genetischen bzw. ökologischen Status durch die Einführung exotischer Arten und Genotypen. Im Dezember 2005 wurde ein Stör-Aktionsplan, der von ExpertInnen und InteressensvertreterInnen gemeinsam vorbereitet worden war, vom Ständigen Komitee der Berner Konvention im Rahmen des Europarates angenommen. Er bringt eine Reihe von Themen und damit verbundenen Aktionen auf den Tisch, die zur Erreichung des übergeordneten Ziels des Aktionsplans nötig sind, das wie folgt lautet: „Die Erhaltung lebensfähiger Populationen aller Donaustör-Arten und -Formen durch nationale Aktionen und internationale Kooperation sowie durch nachhaltiges Management und die Revitalisierung ihrer natürlichen Habitate und Wanderbewegungen."

1. INTRODUCTION

Sturgeons are known world-wide for their caviar, and many are endangered (LELEK, 1987; BILLARD and LECOINTRE, 2001; REINARTZ et al., 2003). Recent information by trade agencies CITES (2006) alerted people that caviar has become extremely scarce (and therefore more expensive) because of exploited sturgeon stocks in the Caspian Sea (Tagesanzeiger, 2005). A ban was suggested, providing the 2006 CITES export and import quota, until caviar producing countries provide more information and proof of sustainable use of their sturgeon populations.

It has been long known that Danube sturgeons are highly threatened and near extinction in spite of their protected status under international regulations. In 2004–2005, *in situ* information from the Lower Danube River by scientists and fishermen substantiated the critical situation of sturgeon stocks. Single sturgeon catches of extremely rare species added much speculation about the existence of remaining populations. While the scientific community has comprehensively reviewed the status of Danube sturgeons and elucidated the causes of threats (e.g., HOLČÍK, 1989; HOCHLEITNER, 1996; BIRSTEIN et al., 1997; REINARTZ, 2002), the economic and political side remained obscure as legal fishery statistics are thought to be biased, and illegal trade and poaching are significant. Legal instruments are not harmonized among countries, are partly insufficient and partly not implemented. Thus, the recent dramatic decline of Danube sturgeon populations reinforces the urgent need for significantly enhanced basin-wide cooperation and action for conservation and restoration of sturgeons in the Danube River.

In this regard, a group of concerned experts and stakeholders gathered at a workshop in Petronell near Vienna in July 2005 to discuss the problem in an interdisciplinary and transboundary context, and to launch a Sturgeon Action Plan (AP 2006) under the Bern Convention of the Council of Europe (CoE). A recommendation on the AP was adopted by the Standing Committee of the Bern Convention in December 2005, and the document was published in May 2006. Together with already existing instruments, the AP may provide important tools and mechanisms for the propagation and implementation of measures and actions to avoid complete extinction of sturgeons in the Danube River and Black Sea systems. This paper provides a short overview on the Danube sturgeon's biology and threats, and discusses the measures and actions needed to protect these exciting and ancient fishes.

2. OVERVIEW OF STURGEON SPECIES AND BIOLOGY IN THE DANUBE RIVER BASIN

Sturgeons and the closely related paddlefishes belong to the class of bony fishes, Osteichthyes. The order Acipenseriformes comprises three families, of which the family Acipenseridae (sturgeons; 26 species) is represented in the Danube River Basin by six native species in two genera *Acipenser* and *Huso* (ANTIPA, 1909). All are threatened with extinction (according to the Red List of Threatened Species, IUCN, 2004).

- *Acipenser gueldenstaedti* (Danube or Russian sturgeon) – endangered
- *Acipenser nudiventris* (Fringebarbel or Ship sturgeon) – critically endangered
- *Acipenser ruthenus* (Sterlet) – vulnerable
- *Acipenser stellatus* (Stellate or Starred sturgeon) – endangered
- *Acipenser sturio* (Common or Atlantic sturgeon) – critically endan-

gered (extinct in the Danube River Basin)
- *Huso huso* (Beluga or Great sturgeon) – endangered

Other acipenseriform species and hybrids (i. e., crossings between two sturgeon species) have been introduced into pond and aquaculture systems in the Danube Basin for the production of caviar and sturgeon meat. These include *Polyodon spathula* (North American paddlefish), *Acipenser naccarii* (Adriatic sturgeon), *A. baeri* (Siberian sturgeon) and *A. ruthenus x Huso huso* (bester).

Acipenseriformes are confined to the northern hemisphere. Biogeographic analysis suggests that the order originated in Europe about 200 million years ago and that early diversification took place in Asia. The majority of species occurs in the Ponto-Caspian region, one third in North America and the remainder in East Asia and Siberia. Hence, sturgeons are considered "living fossils" and therefore their ecological value is extremely high.

The life cycle of Acipenseriformes is generally quite long with maturation occurring late in life. Sturgeons can grow up to eight meters and at ages of 60 years and more, and can reach a weight of more than one metric ton (for *H. huso*, the "giant" of the Danube). Sturgeons migrate mostly for reproduction and feeding and can travel many km in a day. Anadromous sturgeons spend most of their adult life at sea, but conduct spawning migrations into freshwater (Danube examples: *A. gueldenstaedti*, *A. stellatus*, *A. sturio*, and *H. huso* all living in the Black Sea shelf zone), potamodromous sturgeons migrate between key habitats within a freshwater riverine and/or lacustrine system (Danube examples: *A. ruthenus*, the Danube form of *A. nudiventris*, and a resident form of *A. gueldenstaedti* in the Middle Danube River), and diadromous species migrate between fresh and salt water at some point of their life cycle (Danube example: possibly a population of *A. ruthenus* in the Lower Danube River and the Danube Delta, respectively).

All species reproduce in freshwater or water of low salinity. Spawning populations of Acipenseriformes show a complex multi-age structure and females do not spawn annually. Spawning migration depends on the season (there are spring and winter races), temperature (6 to 25 °C) and flow regime. Periods of high flow are an important cue for spawning migrations. The availability of suitable spawning habitat is vital for the reproductive success of Acipenseriformes. In all well-studied populations, the same spawning site(s) are frequented each year. Such site fidelity derives from the distinct characteristics of the site and from homing behaviour, especially in females. Spawning sites are characterised by hard substrates, varying in size from gravel to boulders, with many crevices and low water velocity near the bottom. These areas are typically in the mainstream of the river, or close to the banks. The water depth at spawning sites may vary from a few meters to 26 m, and the current velocity from 0.5 to 2.2 m s^{-1} in the water column, allowing for wide dispersal of fertilised eggs.

After embryogenesis, hatching and dispersing from spawning grounds, the free embryos settle to the bottom, usually on coarse substrates in low water velocity (1 to 5 cm s^{-1}) and remain until they develop into larvae that feed on both planktonic and benthic organisms. Important rearing habitats and nursery grounds of juvenile migratory sturgeons can be found in the Lower Danube River and the Danube Delta as well as in shallow areas of the continental shelf in the Black Sea. The latter is crucial for all migratory Danube River sturgeons during the marine period of their life-cycle (BACALBASA-DOBROVICI in BALON, 1997; BACALBASA-DOBROVICI and PATRICHE, 1999).

Sturgeons possess tactile barbells located at the front of the mouth, which is protactile – meaning that it can be pushed outwards and forwards – and have thickened lips. During feeding the animals show a digging behaviour with the help of the rostrum. Eyes are very small relative to the size of the fish and probably do not contribute much to the location and capture of prey. Most species feed mainly on benthic invertebrates (insects and their larvae,

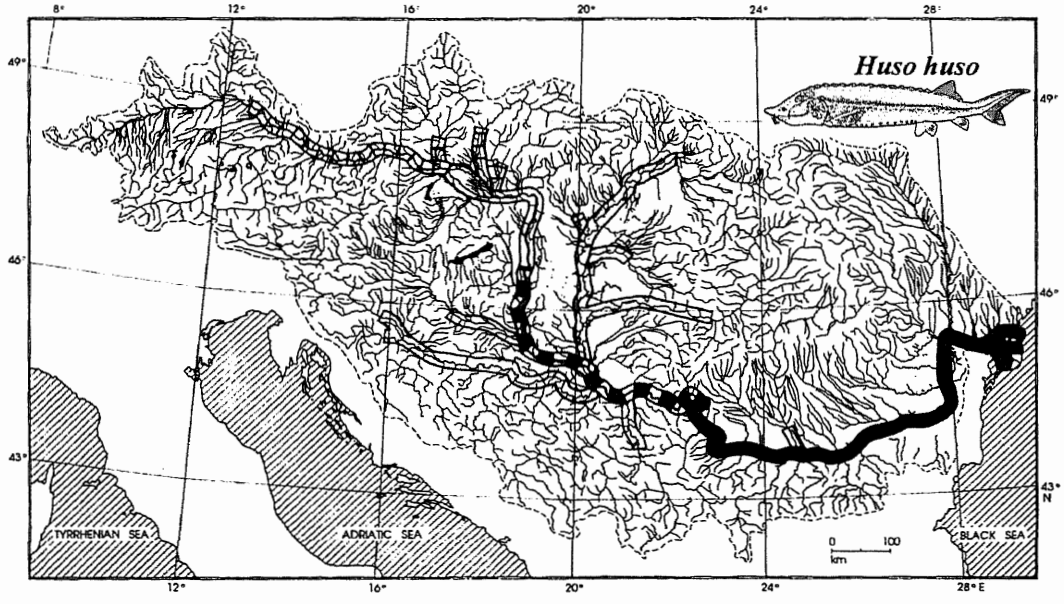

Fig. 1. Distribution of *Huso huso* (Beluga or Great Sturgeon) in the Danube drainage system. Regular (continuous black) and occasional (black and white area) occurrence at present; regular (continuous white) and occasional (striped white area) occurrence in the past (from HENSEL and HOLČÍK in BALON 1997, Original figure by K. HENSEL)

worms, mussels and snails) and also occasionally on benthic fish. Some species reduce or cease feeding during their migration in freshwater. *Huso huso* is the only true predator among the six Danube sturgeon species. In the Black Sea it preys mainly on bottom-dwelling and pelagic fish, while in the river it switches to freshwater fish (e.g. members of the cyprinid family).

3. FORMER AND CURRENT DISTRIBUTION OF THE DANUBE STURGEONS – EVIDENCE OF THREATS AND THEIR VULNERABILITY TO ANTHROPOGENIC IMPACTS

Due to the many factors affecting sturgeon populations it is impossible to relate the threatened status of any sturgeon species to a single cause or change in the environment. However, since sturgeons exhibit certain traits (exemplified in the previous chapter) they are extremely susceptible to anthropogenic impacts. The two greatest current threats to sturgeons in the Danube River are over-exploitation, and habitat loss and degradation, including the disruption of spawning migrations and pollution. However, the potential alteration of the genetic status of Danube River sturgeons due to poor hatchery practices, the intentional introduction of exotic species and genotypes, and the unintentional release or escape of allochthonous specimens must also be considered as an important, though secondary, threat (TSVETNENKO, 1993; SUCIU et al., 2000).

The occurrence of *Huso huso* (that is similar to the distribution of the other species, see REINARTZ, 2002; AP 2006) is shown, for example, in Fig. 1. *H. huso* was once among the most abundant of the migratory sturgeons in the Danube Basin. During the middle ages a major fishery in the middle stretches of the Danube River was based on a large winter race that spawned as far upstream as Komarno (1 768 to 1 810 km from the sea). A significant decline in catches had already begun by the beginning of the 16th century, but exploitation continued through the 17th and 18th centuries, so that by the 19th century only a few individuals were still being caught (Table 1). The last specimen recorded in the Slovakian-Hungarian stretch of the river was a female (3.1 m/150 kg) taken near the town of Sturovo in 1925. Due to extensive river modifications carried out in recent decades (e.g. irrigation and hydropower dams, dyke construction and channelisation), the

Table 1. Important events for Danube River sturgeon species. From AP (2006).

Date	Event
200 million years ago	The order of Acipenseriformes (sturgeons and paddlefishes) appears in Europe. Early diversification takes place in Asia, from where the order spreads across the Northern Hemisphere.
65 million years ago	Dinosaurs go extinct; sturgeons live on.
5th to 6th century B.C.	Sturgeons in the Lower Danube River are fished by inhabitants of the Greek colonies in the area.
1053	*Huso huso* is mentioned as providing important rations for troops marching along the Upper Danube River in Austria.
Beginning of the 16th century	Catches in the *Huso huso* fishery of the Middle Danube River decrease rapidly, due to over-exploitation of the large winter race of this species.
18th century	Fishing of migratory sturgeons in the Austrian stretch of the Danube River is abandoned, due to their scarcity.
Beginning of the 19th century	A lack of legislation leads to over-fishing and subsequently the fishery in the Lower Danube collapses. Sturgeon fishery, however, is not seriously affected and catches remain at about 1,000 metric tons.
19th century	Occasional catches of *A. ruthenus* in the Danube between Regensburg and Passau in this part of the Upper Danube River document the remnants of a dying population.
1869	The first artificial propagation of a sturgeon species is performed in Russia.
1926	The last-known specimen of *A. stellatus* from the Slovakian section of the Danube River is caught on February 20, at Komarno.
1950	A Sturgeon Ranching Programme (SRP) is initiated in the former USSR for the Caspian/Sea of Azov, where sturgeon stocks are decreasing due to the degradation of water quality and damming of rivers.
1962	The implementation of a moratorium on commercial sturgeon fishery in the Caspian Sea provides some relief for sturgeon stocks. However, pollution and the collapse of the USSR some 30 years later resulting in a lack of law enforcement and increased poaching takes a heavy toll on sturgeon stocks, which nowadays depend largely on artificial stocking. Stabilisation of stocks has not yet been achieved.
1965	The last known specimen of *A. stellatus* from the Hungarian section of the Danube River is caught at Mohacs.
1972	Iron Gates I dam is completed, confining migratory sturgeons to the 942 kilometres of Danube River from the Black Sea to the Iron Gates gorge and cutting off important spawning sites in the Middle Danube River.
1972–1976	During the five years following the completion of the Iron Gates I dam, Serbian catches of migratory sturgeons peak significantly, below the dam.
1985	Iron Gates II is completed, further reducing the length of the Danube River that is available to migratory sturgeons to just 863 kilometres.
1987	A single *Huso huso* is caught at Paks, Hungary (300 cm in total length and 181 kg in weight; between river kms 1526–1528) on 16 May. This animal might either be considered a relict specimen or potentially documents the occasional passage of migratory sturgeons through the Iron Gates shipping locks. The catch of two specimens of the freshwater form of *A. gueldenstaedti* in the Slovakian stretch of the Danube river suggests that a relict population of this form might still persist.
1989	A second major collapse in Lower Danube River fisheries occurs, this time affecting the sturgeon fishery in particular. A sharp decline in sturgeon catches is observed. Catch of a male *A. nudiventris* from the Drava river at Heresznye: total length 147 cm, weight 20.5 kg.
1992	Catch of one specimen of *A. nudiventris* in a sidearm of the Danube at Ásvá-nyráró, Hungary.
1998	From 1 April, all Acipenseriform species are listed in the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), triggering the implementation of regulations concerning the international trade in sturgeons and sturgeon products, including a system of catch and export quotas.
1997–1999	5 subadult *A. gueldenstaedti* are caught by fishermen in the Hungarian stretch of the Danube (Dunakiliti 1997, 1999, Gönyű 1999, Ercsi 1998, Fajsz 1998). Catch of a female *A. gueldenstaedti* from the Hungarian-Slovakian stretch of the Danube at Dunakiliti: total length 123 cm, weight 11 kg in 1999.
October 2003	The catch of a male *A. nudiventris* in the Serbian stretch of the Danube River proves the continuing presence of this species in the Danube Basin.
May 2005	A further specimen of *A. nudiventris* was caught and photographed 4 km upstream from the confluence of the Mura and Drava Rivers on 23 May 2005.

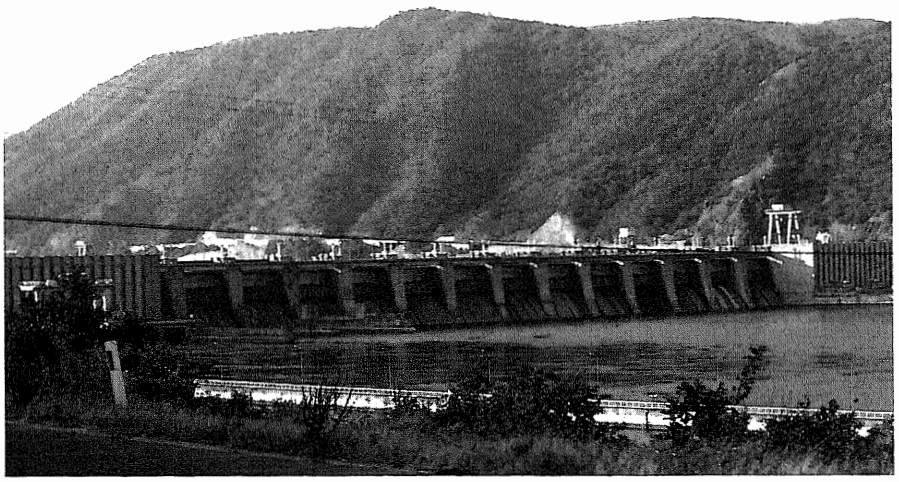

Fig. 2. The transboundary Iron Gate I dam at rkm 942, together with Iron Gate II dam at rkm 863, are impassable for sturgeons since 1972 and 1985, respectively. To make them "sturgeon gates" the Action Plan suggests an *in situ* feasibility study to investigate possible technical solutions for the construction of a sturgeon passage. Such a study is estimated to last 2–3 years and cost about 300 000 Euros. Foto: Jürg BLOESCH

species has suffered further population decline and range restriction, with its migratory movements now confined by many dams in the Danube River up to Regensburg and in the lower sections of major tributaries such as the Rivers Sava, Tisza and Drava. Today, *H. huso* only reaches the first obstacle in the Danube River, Iron Gates dam II, 863 km from the Black Sea.

Based on the former occurrence of migratory sturgeons in the Danube River system, it has to be assumed that traditional spawning sites for anadromous species were situated in the Middle Danube River as well as along some major tributaries, such as the Tisza, Sava and Drava Rivers (Fig. 1; HENSEL and HOLČÍK in BALON, 1997). Due to the blocking of migration routes by the Iron Gates dams I and II, constructed in 1972 and 1985, respectively, these upstream spawning sites can no longer be reached by migratory sturgeons (Fig. 2). The sporadic capture of migratory sturgeons upstream of the Iron Gates simply proves that very few individuals manage to negotiate these locks used by shipping. It has been reported that catches of *H. huso* and *A. gueldenstaedti* reached a peak following completion of Iron Gates I due to the mass of migrating sturgeons trapped below the dam. During the five-year period 1972 to 1976, 115.7 metric tons of *H. huso* and *A. gueldenstaedti* (combined) were caught, representing an almost 25 % increase over the five years prior to dam construction. Catches began to fall after 1976, dropping to only 37.3 metric tons for the five-year period 1980 to 1984 during construction of Iron Gates II (JANKOVIĆ, 1993).

Hydrological alterations, such as water level fluctuations, due to flow management by hydropower stations, can have negative effects on spawning and reproduction success of adults and dispersal of early life intervals. Any reduction in river discharge during the period of migratory activity of sturgeons diminishes the attractiveness of the river, and thus reduces the number of anadromous spawners entering the main river from pre-estuarine regions or moving upstream into tributaries.

Apart from the disruption of sturgeon migration by dams and siltation in the reservoirs, loss of habitats is caused mainly by channelisation and bank constructions, the disconnection of rivers from their floodplains, and sand and gravel exploitation. For example, gravel extraction for construction purposes destroyed sturgeon spawning sites near Calarasi (river km 373) (BACALBASA-DOBROVICI in BALON, 1997). The plans of the Danube Navigation Commission in the frame of the Trans-European Transport Networks Project (EU-TEN-T) to remove the "bottlenecks" along the Danube, and dredging shipping canals in the delta are threats to other potential sturgeon spawning habitats (Fig. 3; WWF, 2002).

Pollution due to excessive organic substances and nutrients are also detrimental for sturgeons, especially in

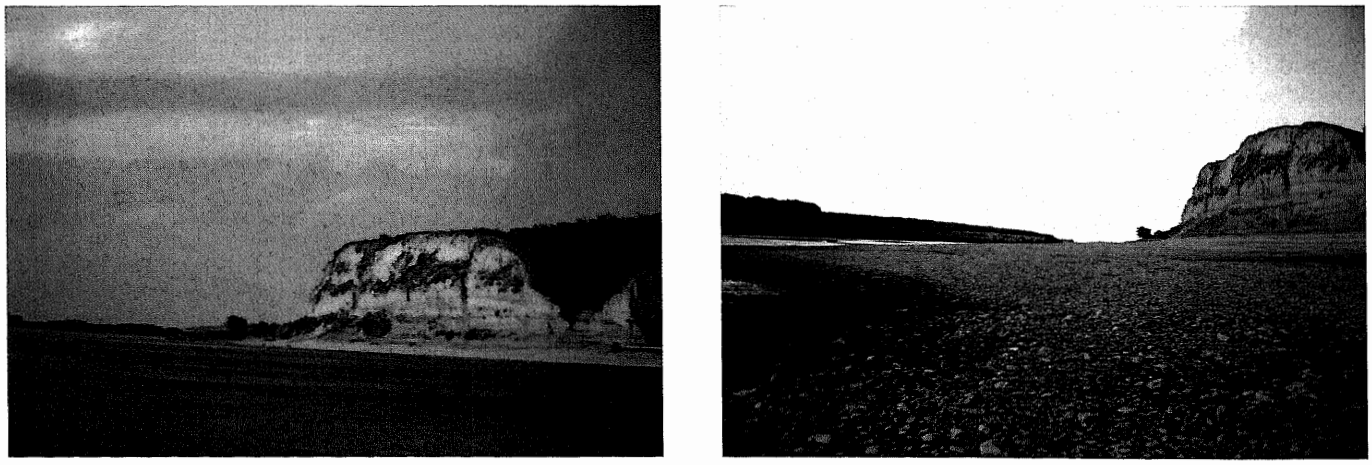

Fig. 3. This rocky site with gravel banks at high (left) and low (right) water levels has been found as beluga (*H. huso*) spawning site in the Lower Danube, upstream of Galati. Such "bottlenecks" are highly threatened by gravel excavation planned for the trans-European water way for navigation. Foto: Radu SUCIU

the Lower Danube (DANUBS, 2004; ICPDR, 2004; ZESSNER et al., 2006). A further threat to sturgeon populations is the potential for alteration of the tissues and physiology of fish and especially the reproductive capability of populations due to the accumulation of toxic and harmful substances such as heavy metals, endocrine disruptors, hormone active substances (HAS) and persistent organic chemicals (PCPs and PAHs) in sediments, and subsequent up-take through the food-chain (AKIMOVA and RUBAN, 1996; BICKHAM et al., 1998).

Fishing is a traditional and important commercial activity in the Danube River Basin. However, over-exploitation of sturgeon stocks has significantly increased in the past decade. Migratory sturgeons have suffered from over-fishing in the Danube River as documented by the decline of stocks in the Upper and Middle Danube even before the construction of the Iron Gates dams in the 1970s and 1980s (BILLARD and LECOINTRE, 2001). Nowadays, there is ample evidence of over-exploitation of sturgeons in the Lower Danube River, such as the use of non-selective fishing methods and gear (by-catch), increase in fishing effort, and decrease in catch size, fish age and length (BACALBASA-DOBROVICI in BALON, 1997; NAVODARU et al., 1999; CEAPA et al., 2002). Stocks in the Lower Danube River have also been decreasing dramatically due to ambiguous fisheries legislation and the lack of fishing regulations as well as an unknown but presumably high extent of poaching.

At present, it is difficult to provide accurate figures for the size of Lower Danube River sturgeon catches since different databases are quoted and data are claimed to be inaccurate. BILLARD and LECOINTRE (2001) even suspect that governments often provide overestimates of exploitable populations to the CITES authorities, to increase their export quotas for sturgeon products and especially caviar. Official data showed that sturgeon catches had decreased dramatically in the past: in Romania from about 1144 tons in 1940 to less than 8 tons in 1995; in Ukraine from 114 tons in 1952 to no sturgeon catch recorded since 1994; in former Yugoslavia the catch declined from 39 tons in 1975 to 5 tons in 1986. Comparative analysis of the statistical data from sturgeon catches in different riparian countries showed that *Huso huso* catches in the period 1981–1986 were 10.7 times lower than that for the period 1931 to 1940. Corresponding figures for *Acipenser gueldenstaedti* and *A. stellatus* were 7.2 times lower and 21.5 times lower, respectively. Catch-size estimates from key areas surveyed in 1997–1998 confirmed, however, that a major sturgeon fishery still existed at the time of the survey, with an important yield in the 20th century of between 300–400 tons per year on average (NAVODARU et al., 1999). From an economic point of view, sturgeon products, especially caviar, becoming scarce experience increased demand from end-users and high prices through trade and flourishing black markets, thus adding pressure not only to the local fishermen, but also to sturgeon populations (Fig. 4).

Fig. 4. Caviar, the feast of snobs and wealthy people. For how long? If the Action Plan, in line with existing legal instruments, cannot quickly stop illegal catch, poaching and the black market, sturgeons may soon go extinct. Only truly sustainable sturgeon management can conserve the Danube sturgeon populations in the long term for the benefit of local fishermen and all stakeholders

4. RECENT CONSERVATION MEASURES ARE NOT SUFFICIENT TO CONSERVE DANUBE STURGEONS

Continuous scientific research must provide a detailed basis for concrete restoration and conservation measures and specific sustainable management programmes.

Methods for the artificial propagation of sturgeons have been widely established throughout the world and in the Danube River Basin, and complete guidelines are available for many species on the basis of hatchery research. Despite a considerable hatchery routine, there still are gaps in knowledge concerning the successful breeding and rearing as well as successful management strategies of exploited populations (WILLIOT et al., 2002). In the Upper and Middle Danube River, recent efforts have focused on *Acipenser ruthenus*. Stocking has included attempts to reintroduce the species in river stretches where it is extinct, as well as supportive stocking of existing populations (REINARTZ, 2002). In the Lower Danube River artificial propagation and stocking have been carried out in Bulgaria and Romania for *Acipenser gueldenstaedti*, *A. nudiventris*, *A. ruthenus*, *A. stellatus* and *Huso huso* (BACALBASA–DOBROVICI and PATRICHE, 1999). Research is also underway with the aim of providing high-quality caviar from aquaculture sources, thereby developing an important new economic niche for aquaculture as well as potentially reducing fishing pressure on wild sturgeon stocks.

In the past decade, several national and regional attempts have been undertaken to combat sturgeon stock decrease and implement sustainable management practices, such as a regional strategy by Bulgaria, Romania, Serbia & Montenegro and Ukraine in November 2003, a conservation programme for *Acipenser ruthenus* by Germany (Bavaria) in March 2005, and a National Action Plan for migratory sturgeons by Serbia & Montenegro (LENHARDT et al., 2005). Also NGOs such as WWF Hungary have provided valuable input and concrete actions for sturgeon conservation.

Though CITES quotas have been introduced, both legal catches and a high percentage of unknown illegal catches continue to diminish sturgeon populations, and some countries are now unable to fulfil their quotas. The issues involved in exploitation of sturgeon stocks are complex and achieving sustainable management must be considered as a long-term but urgent endeavour, as illustrated by WILLIOT et al. (2002). This clearly reinforces the need for the current Action Plan that is over and above existing conservation measures.

Although there is a considerable body of scientific and technical information on sturgeons in general, and on Danube River species in particular, important gaps of knowledge still exist (KYNARD and SUCIU, technical workshop contributions, AP 2006). There are open questions about the reference situation for Danube River sturgeons concerning their life-cycle, the current status of populations and exploitation, their key habitats and migration patterns, and biological background information for sturgeon husbandry and stocking. Last but not

least, the remaining ultimate question is: What are the most effective and realistic measures and indicators of success (and/or failure) in conserving Danube sturgeons, suitable for monitoring timely and effective implementation of the Action Plan?

5. THE STURGEON ACTION PLAN UNDER THE FRAME OF THE BERN CONVENTION

The Goal of the Action Plan is:

Through national action and international cooperation, to secure viable populations of all Danube sturgeon species and forms by sustainable management and by restoration of their natural habitats and migratory movements.

Such action for the conservation of sturgeons in the Danube River Basin is vital and urgent, because:

- all Danube sturgeon species are threatened, with some critically endangered;
- the current generation has a clear social, economic and ethical responsibility, within the framework of sustainable use, to keep this unique group of fishes alive for future generations;
- many livelihoods in the Lower Danube River and its Delta depend on the commercial use of sturgeons but these livelihoods are under threat due to unsustainable management of fisheries, including severe over-exploitation (NAVODARU et al., 2001);
- sturgeons are excellent indicators of river health and achieving the goal of this Action Plan would constitute an important contribution to reaching 'good ecological status' of the Danube River Basin by 2015, as required under the European Union's Water Framework Directive.

The Action Plan is based around 12 objectives, containing in total 72 actions, and are grouped under four general headings:

5.1 Basin-wide coordination of sturgeon policy and best-practice management (Objectives 1–2)

The EU Water Framework Directive is founded on the principle that river basins (or sub-basins) – i. e. geographical and hydrological units determined by natural boundaries – should form the basis for integrated water resource management. Since sturgeons will cross administrative or political boundaries during their migrations, a basin-wide approach is vital for the success of any conservation and restoration measure for sturgeons. Basin-wide coordination of sturgeon conservation and restoration in the Danube River Basin is consistent with the objectives of the EU-WFD as well as with the Convention for the Protection of the Danube River (DRPC) and the Convention on International Trade (CITES).

Table 2. Sturgeon Action Plan 2006. Proposed prioritisation of objectives/actions (From AP 2006)

- Immediate and significant decrease of fishing pressure, catch quota diminished, possible introduction of a moratorium for at least *Acipenser nudiventris* and *A. gueldenstaedti* *(Objective 2, Action 2.6, Objectives 6 & 8)*
- Making Iron Gates dams passable for sturgeons (feasibility study, planning and implementation of migratory facilities) *(Objective 9, Actions 9.1-9.3)*
- Research on key sturgeon habitats *(Objective 10)*
- Establishing the coordination/monitoring body *(Objectives 1 & 2, Action 1.1, 2.1)*
- Gene bank and DNA-based identification system for sturgeons and their products established *(Objectives 6 & 7, Action 6.1, 7.1)*
- Control of domestic and international markets effective *(Objective 6)*
- Restocking plans ready for implementation *(Objective 7)*
- International legislation & trade harmonised *(Objectives 3 & 4)*
- Illegal sturgeon harvesting drastically reduced *(Objective 4)*
- Socio-economic improvement in the Lower Danube achieved *(Objective 5)*

5.2 Legislation and enforcement controls for sturgeon fisheries and trade (Objectives 3–6)

The long-term sustainability of fisheries – and especially of sturgeon harvest – in the Danube River Basin has been threatened by over-exploitation, habitat loss and degradation, inadequate fisheries legislation, and insufficient monitoring control and surveillance systems at both national and international levels. Recent observations in the Lower Danube River indicate that all sturgeon populations are near extinction, meaning that there is an immediate and urgent need for stringent control measures. The long life-cycle of sturgeons means that such controls will be required for a period of several years before a positive impact can be seen and will then need to remain in place for the long term. The adaptation of existing fisheries legislation to ecological requirements and the principles of sustainable harvesting, as well as the standardisation of legislation and strengthening of law enforcement at international level, are basic prerequisites for sturgeon conservation and restoration in the Danube River Basin.

5.3 Conservation of sturgeon species and populations, including their genetic integrity (Objectives 7–8)

Biodiversity may be defined as the number and variety of living organisms in a certain region or river basin; this includes species diversity but also genetic and ecological integrity and diversity within a given species. A loss of biodiversity reduces an ecosystem's richness and its ability to recover from natural or human-induced impacts.

Sturgeon populations are unique to a given river system due to river-specific selective evolutionary forces (e.g. unique hydrological characteristics, length of river system). This means that the same sturgeon species will display different ecological traits in different river systems (e.g. the duration of larval drift). The loss of a certain ecotype of sturgeon within a certain river system therefore also represents an irreplaceable loss of biodiversity, which cannot be compensated by the introduction of the same species from a different river basin. Restocking from hatcheries is at best an emergency action of 'last resort' and cannot be a substitute for natural reproduction in the long term.

5.4 Protection, management and restoration of sturgeon habitats, including reopening of migration routes (Objectives 9–12)

Migration between different key habitats is an integral part of the life-cycle of all sturgeon species. The availability of – and access to – sturgeon habitats in the riverine/marine system is therefore a basic prerequisite for the conservation and restoration of sturgeon biodiversity in the Danube River Basin and the Black Sea.

Only naturally self-reproducing sturgeons can sustain healthy and viable populations in the long term. Since sturgeons migrate from the sea upstream to their spawning grounds, it is evident that priority must be given to restoring river continuity with regard to migration routes. For instance, making the Iron Gates dams passable would give access to approximately 800 additional kilometres of the Danube River itself and to several of its major tributaries such as the Tisza, Sava and Drava Rivers. If, in a second step, the Gabčíkovo dam were made passable, sturgeons could migrate as far upstream as Vienna. This is a challenging task for both hydraulic engineers and fishery biologists (BLOESCH et al., 2005).

The WFD states that implementation must achieve compliance with the environmental objectives laid down in other EU legislation for protected areas, notably under the Habitats Directive. As Danube sturgeon species are listed in the Annexes of the Habitats Directive, conservation and restoration of sturgeon biodiversity, namely the achievement of favourable conservation status, is an important element of achieving compliance between the WFD and Habitats Directive.

5.5 Actions required for achieving the goal and objectives of the Action Plan

All detailed actions are listed in the AP-Document (AP 2006), providing the rationale behind, the geographical applicability and the relevant species, the indicators of success, and the main actors addressed. By way of synthesis, the most important and urgent Objectives/Actions are indicated in Table 2. A prioritization is based on short-term measures/actions (indicating a period of less than 5 years), medium-term measures/actions (indicating 5 to 10 years), and long-term measures/actions (indicating more than 10 years). It is important to note that the main actions must be performed in parallel in the Lower, Middle and Upper Danube, such as to maintain sturgeon populations that can migrate and spawn, i. e., to encompass the entire life-cycle.

An international and interdisciplinary "sturgeon networking" is of crucial importance to ensure optimum information flux, communication, and coordination of measures. In this respect, it is clear that the ICPDR will play a crucial role in the implementation of the Action Plan in the framework of the EU-WFD (FLECKSEDER, 2006).

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