Contents

Action Plan for the conservation of Sturgeons (*Acipenseridae*) in the Danube River Basin

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Acknowledgements

This Action Plan is the result of a major collaborative process, engaging sturgeon stakeholders from across the Danube River Basin as well as from further afield. The centrepiece of this process was a consultative technical workshop held in Petronell, Austria, in July 2005. This brought together scientific experts, and those experienced in fisheries management, international trade issues, river basin planning and a wide range of other topics relevant to the conservation and restoration of sturgeons in the Danube. In addition to the sharing of information concerning the current status of, and threats to, Danube sturgeon species, the workshop resulted in the initial formulation of the Objectives and Actions contained in this Action Plan. A complete list of workshop participants appears below.

The preparation of the Action Plan text has been coordinated by a small editorial panel composed of Jürg Bloesch (IAD/EAWAG, Switzerland) Tim Jones (DJEnvironmental, UK – editor), Ralf Reinartz (IAD/Büro für Fischereifragen und Gewässerökologie, Germany – scientific expert and compiler of the background chapters), Beate Striebel (WWF). The editorial team was supported by the expertise of a Scientific Board, whose members were as follows: Juraj Holčík (Institute of Zoology, Slovak Academy of Sciences), Boyd Kynard (Conte Anadromous Fish Research Center, USA), Radu Suciu (Danube Delta National Institute for Research & Development, Romania) and Patrick Williot (Cemagref, Bordeaux, France).

A draft of the Action Plan was circulated at the end of August 2005 to all workshop participants, as well as to the Scientific Board, and this final version has been prepared taking into account the many written responses received, including valuable inputs from a number of stakeholders who had been unable to attend the workshop. The names of these individuals are also listed in Annex V.

Funding and organisational support

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August 23, 2005

Action Plan for the Conservation of Sturgeons in the Danube River Basin

To whom it may concern

The International Association for Danube Research (IAD) incorporated into the Societas Internationalis Limnologiae (SIL) is the oldest non-governmental organisation (NGO) in the Danube River Basin (founded in 1956) with residence in Vienna and representing about 450 members. IAD encompasses the following 13 countries: Germany, Switzerland, Austria, Czech Republic, Slovakia, Hungary, Croatia, Bosnia-Herzegovina, Serbia-Montenegro, Romania, Bulgaria, Moldova and Ukraine. The expert group “fish biology/ fishery” (one out of 12 scientific expert groups) is particularly involved in sturgeon research and protection. Members of IAD, in joint cooperation with WWF were actively involved in the preparation, drafting and reviewing of the Action Plan Document.

Having supported the sturgeon issue within the Roof Report 2004 of the ICPDR, we enthusiastically endorse the plan and truly hope that it will be approved by the Council of Europe and later by all Danube countries committed to the ICPDR and the implementation of the EU-Water Framework Directive. And most importantly we hope that proposed actions

will be timely implemented to achieve the goals and objectives to protect the highly endangered sturgeons as most important and typical residents of the Danube River System.

We will continue to sustain and perform scientific research on sturgeons and offer our further support to and participation in respective actions.

Dr. Ivana Teodorovic

Dr. Mirjana Lenhardt

IUCN/Species Survival Commission
Sturgeon Specialist Group

IUCN
The World Conservation Union

www.iucn.org/themes/ssc/sgs/sturgeon

September 25, 2005

Action Plan for the Conservation of Sturgeons in the Danube River Basin

To whom it may concern

The Sturgeon Specialist Group (SSG) is a global network of over 40 sturgeon experts contributing to the conservation and sustainable use of sturgeons with members in more than ten major sturgeon range states. The SSG was established under the auspices of the Species Survival Commission of the IUCN – The World Conservation Union. The SSG works in collaboration with various programmes of IUCN, such as the Red List Programme, the Wildlife Trade Programme and International Government and Non-government Organization. The SSG is well positioned to address the threats facing sturgeon species throughout the world.

The IUCN/Sturgeon Specialist Group strives hard to employ all existing scientific potentials and collaboration of researchers, scientists and all those interested in sturgeons, in raising the awareness of the serious situation facing sturgeons and convey the urgency and scale of conservation problems to the public particularly sturgeon experts, students and policy makers to prevent the extinction of these valuable species popularly known as living fossils.

The role of the SSG is to identify potential restoration projects, strengthen the development and implementation of sound restoration projects and science-based monitoring of such projects within communities, and develop long-term, ongoing national and regional partnerships to support community-based restoration of sturgeon habitats across a wide geographic area.

The **IUCN/Sturgeon Specialist Group therefore strongly recognizes and supports the "Sturgeon Action Plan in the Danube River Basin". We are assured that this Action Plan will develop** funding, technical assistance, workforce support or other in-kind services for its successful implementation.

Mohammad Pourkazemi (Assoc. Prof.)
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"The Society intents to act as an international forum of scientific discussion for all those interested in pertinent issues on sturgeons, while at the same time seeking for opportunities for close cooperation at international level".

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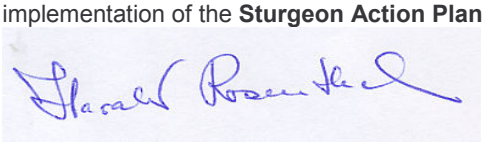
September 9, 2005

Action Plan for the Conservation of Sturgeons in the Danube River Basin

To whom it may concern

Sturgeons represent a unique and commercially valuable group of ancient fishes with an unusual long lifespan and late sexual maturity. For these reasons they are highly vulnerable and eploited near to extinction. The recovery of sturgeons is slow and long-term Action Plans are essential to protect these species. The World Sturgeon Conservation Society therefore strongly supports and encourages actions for their urgent protection and restoration, especially in the Danube River Basin, the only large river system in Europe where the protection of existing but dwindling sturgeon stocks is still possible. We are not only addressing a sustainable sturgeon management, but we also stress the ethical and cultural significance of such actions.

Following my participation on behalf of WSCS (as acting President) in the preparatory sturgeon workshop and discussions within WSCS, the Society represented by its Board of Directors strongly endorses the **"Sturgeon Action Plan in the Danube River Basin"** and hopes that the Plan will lead to adequate funding. Given the expertise and commitment of all involved in this plan and funding support, we envision a highly effective and successful implementation of the **Sturgeon Action Plan**.



Prof. Dr. Dr. h.c. mult. Harald Rosenthal,
President, WSCS

Aims and objectives of WSCS

The World Sturgeon Conservation Society (WSCS) founded in 2003 and representing over 470 members from 26 countries is dedicated to the world-wide conservation of the highly endangered sturgeon and paddlefish species (Acipenseriformes). The Society acts as an international forum

	of scientific discussion for all interested in sturgeon issues, while also seeking close international cooperation. The main objectives of the Society are: a. to foster the conservation of sturgeon species and restoration of sturgeon stocks world-wide *b.* to foster and support interdisciplinary and multi-disciplinary research on all aspects of sturgeons (e.g. biology, ecology, genetics, management). c. to enhance the co-operation between and among anglers, fishermen, scientists, governmental agencies, local communities and non-govern-mental organisations (NGOs) and international organisations. d. to inform the public at large on all aspects of the status and biology of sturgeons, their effective protection, and needs for appropriate management.. The Society focuses exclusively and directly on non-profit goals. It acts selflessly and serves primarily non-profit-oriented purposes.

Executive Summary

Six species of sturgeons are native to the Danube River Basin. The need for conservation action is urgent, given that recent observations in the Lower Danube indicate that all sturgeon populations are near to extinction. At global level, five of the six species are classified as either 'Endangered' or 'Critically Endangered', and the sixth 'Vulnerable' according to the 2004 IUCN Red List of Threatened Species:

– *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 Endangered**;
– *Huso huso* (Beluga or Great sturgeon) **Endangered.**

Spawning migration is an integral part of the natural life cycle of most sturgeons. This makes them especially sensitive to the impacts of physical barriers such as dams. Four of the Danube species live mainly in the shelf zone of the Black Sea, only entering the Danube system for spawning: *A. gueldenstaedti*, *A. stellatus*, *A. sturio*, *H. huso*, while *A. ruthenus*, the Danube form of *A. nudiventris* and a resident form of *A. gueldenstaedti* migrate within freshwater.

The key threats to Danube sturgeons, which are discussed in detail in Chapter 2, include:

– their particular vulnerability to anthropogenic impacts, due in part to their long-life cycle which means that populations take many years to recover;
– over-exploitation (due to the high commercial value of sturgeon products, caviar, in particular, and a lack of effective basin-wide coordination and enforcement of fishery and trade controls);
– habitat loss and degradation including the disruption of spawning migrations and pollution (e.g. due to dam construction, channelisation of rivers);
– introduction of exotic species and genotypes, alteration of the genetic status of populations.

While recognising that a range of measures has already been taken for the conservation of sturgeons, these have so far proved insufficient. The pressure from poaching and illegal trade remains intense and Danube sturgeon populations are perilously close to extinction. They will not survive unless fishing pressure is greatly reduced, and both migration routes and habitats for all life-cycle stages are protected and restored.

Therefore, this Action Plan, prepared on the basis of deliberations during an international stakeholder workshop held in Austria in July 2005, puts forward a series of Objectives and associated Actions required to achieve the Plan's ultimate Goal:

> 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.

It is impossible to overstate the urgency of coordinated and immediate basin-wide action by governments, government agencies, the commercial sector, research institutes and NGOs. It is also essential to underline that action must be taken simultaneously under all Objectives and that the first step after adoption must be agreement on adequate resourcing and detailed prioritisation of actions, as well as assignment of precise roles and responsibilities in their implementation.

1. Background Information

1.1 Summary of key points

Both the general biology of the order Acipenseriformes (paddlefishes and sturgeons) and peculiarities in the ecology of sturgeons are important for understanding the issues related to sturgeon conservation in the Danube River Basin. Of the six acipenserid species that were once native to the Danube, only four – *Acipenser gueldenstaedti*, *A. ruthenus*, *A. stellatus*, and *Huso huso* – still reproduce in the Lower Danube. *A. sturio* has possibly become extinct (Bacalbasa-Dobrovici & Holčík 2000), while the current status of *A. nudiventris* is unclear. In spite of the variety of databases used by riparian countries and uncertainties about the extent of poaching, catch statistics for the three anadromous[1] species (*A. gueldenstaedti*, *A. stellatus* and *H. huso*) document a dramatic decline in the Lower Danube River since the beginning of the 20th century. There is recent evidence, though, that the populations of *A. gueldenstaedti*, *A. stellatus*, *A. nudiventris* and *H. huso* are close to extinction.

In the Upper and Middle Danube, as well as a number of tributaries, migratory sturgeons have become extinct due to a combination of overfishing in past centuries, anthropogenic alterations of the riverine system (Reinartz 2002) and blocking of their natural spawning migrations – as documented in the case of the Middle Danube River following the completion

[1] anadromous = migratory species that ascend rivers, from the sea, to breed.

of the 'Iron Gates I' and 'Iron Gates II' hydroelectric dams in 1972 and 1985, respectively (see Box 2). A remnant population of a resident form of *A. gueldenstaedti* persists upstream of these dams, as demonstrated by occasional catches (Holčík 2005). The location of most key habitats – e.g. spawning sites – of migratory species in the Lower Danube River under these artificially changed migratory conditions, as well as the exact status of stocks and their reproduction, are still unknown.

Most stocks of the only true potamodromous[2] sturgeon species in the Danube Basin, *A. ruthenus*, depend on stocking in the Upper Danube. Due to a combination of water quality improvements and temporary protection and stocking measures, stocks of *A. ruthenus* have been increasing in the Middle Danube.

Various approaches have been applied for the conservation of sturgeon stocks worldwide (Williot *et al.* 2002). Stocks of migratory sturgeons in the Sea of Azov and Caspian Sea were formerly maintained by stocking of hatchery-reared juveniles. Although the release of these juveniles contributed significantly to numbers, populations could not be stabilised by stocking alone. Pollution, a lack of funding for hatcheries, low natural reproduction rates and an increase in fishing and poaching have led to a collapse of sturgeon stocks in these waters. Thus, Birstein *et al.* (in Balon 1997) conclude that even the best stocking programmes can only provide short-term solutions unless they are coupled to plans for protecting and increasing levels of natural reproduction.

The artificial propagation of Acipenserids is widely established in Europe, including Danube riparian states, and releases of sturgeons into the Danube River or the Black Sea have been conducted sporadically by individual countries.

New techniques (telemetry and ultrasonic tagging) allow the tracking of individual fish and thus the identification of key habitats. Fish passes for sturgeons are in operation in the former USSR and in North America. However, there are no 'standard' solutions for enabling sturgeons to negotiate dams (Kynard 2005).

Finally, new methods in sturgeon genetics allow the identification of individuals and their caviar, as well as the characterisation of populations for management purposes.

1.2 General introduction to sturgeons

Sturgeons and the closely related paddlefishes belong to the class of bony fishes, the Osteichthyes, within which the subclass Actinopterygii (ray-finned

[2] potamodromous = species that are migratory within freshwater systems only.

fishes) contains the Chondrostei and the order Acipenseriformes (see Box 1). The order Acipenseriformes is composed of three families, of which the family Acipenseridae (sturgeons; 26 species in the genera *Acipenser*, *Huso*, *Scaphirhynchus* and *Pseudoscaphirhynchus*) and the family Polyodontidae (paddlefishes; containing the monospecific genera *Polyodon* and *Psephurus*) are still represented by living species. The third family, the Chondrosteidae, is now extinct.

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.

Box 1: Summary of high-level sturgeon taxonomy

Class: Osteichthyes (bony fishes)
Subclass: Actinopterygii (ray-finned fishes)
Order: Acipenseriformes (sturgeons and paddlefishes)
Family: Acipenseridae (sturgeons)
Genera: *Acipenser*, *Huso*, *Scaphirhynchus**, *Pseudoscaphirhynchus**

* = genus not represented in the Danube River Basin

Sturgeons migrate mostly for reproduction and feeding. Three different patterns of migration have been described (Bemis & Kynard in Balon 1997):

- potamodromy (migration between key habitats within a freshwater riverine and/or lacustrine system);
- anadromy (most of the life cycle takes place at sea, but spawning migrations are conducted into freshwater);
- freshwater amphidromy (spawning migrations are conducted into freshwater, whereas feeding and growth occur during migration to and from salt water).

Although Acipenseriformes do not have a common life history and variation within and between species is the rule rather than the exception, there are some traits that all sturgeon and paddlefish species have in common. These are summarised below.

Almost all members of Acipenseriformes are endangered or threatened with extinction. All species reproduce in freshwater or water of low salinity, although adults may migrate into brackish or even salt water for feeding. Some even adapt to high levels of salinity during ontogenesis and migrate into full seawater after reaching a certain size, generally remaining on the

continental shelf (Danube example: *A. sturio*). Other sturgeon species or races spend their entire life cycle in freshwater (Danube examples: *A. ruthenus*, *A. nudiventris*, resident form of *A. gueldenstaedti*). It has also been found that migratory Ponto-Caspian species mature in freshwater ponds.

Sturgeons exhibit a 'periodic strategy' life-history, which is typical for large fishes with high fecundity and long life spans living in environments with large-scale cyclic or spatial variation. The life cycle of Acipenseriformes is generally quite long with puberty occurring late in life. Individuals spawn repeatedly, but most females do not spawn annually (Williot & Brun 1998).

The timing of spawning is highly variable. Most species spawn from spring to early summer over a wide range of temperatures (6 to 25° C). For several diadromous[3] sturgeon species winter (or fall) and spring (or vernal) races have been recognised. Fish of the winter race spend the winter in the river or the river mouth, hibernating in holes or deeper river bends, undertaking little or no feeding activity. They spawn far upstream, the year(s) after entering the river. The vernal races do not hibernate and only enter the river when temperatures are rising. Vernal fish mature the same year, further downstream, puberty is reached earlier and they spawn later in the same season. Spawning migration also depends on the flow regime of the river involved (see below).

Studies indicate that the availability of suitable spawning habitat is vital for the reproductive success of Acipenseriformes (Billard & Lecointre 2001). Spawning sites are characterised by hard substrates, varying in size from gravel to boulders, with many crevices and where water velocity near the bottom is generally low (i.e. boundary flow velocity). These areas are typically in the mainstream of the river, or close to the banks. The water depth at spawning sites varies from a few meters to 26 m and the current velocity ranges from 0.5 to 2.2 m s^{-1} in the water column, allowing for wide dispersal of fertilised eggs.

Almost nothing is known about mating and spawning habits. However, considering the short duration of sperm motility, a good degree of synchrony in the release of the male and female gametes has to be presumed (Billard & Lecointre 2001).

Eggs are adhesive and can be found immediately downstream of the spawning ground. During embryogenesis water velocities in the range 0.5 to 1.5 m s^{-1} have been reported. Hatching occurs after 200 to 250 hours, depending on the species and water temperature. The size of newly hatched larvae ranges from 6 to 15 mm. Early life stages of some species are pelagic

[3] diadromous = species that migrate between fresh and salt water at some point of their life cycle.

for a few days (Danube example: *A. stellatus* 11 to 12 days (SUCIU 2005)) and are transported downstream by currents. At a velocity of 45 cm s^{-1} they could disperse 40 km per day. After dispersing from spawning grounds, the free embryos settle to the bottom, usually on coarse substrates in a much lower water velocity (1 to 5 cm s^{-1}) and remain until they develop into larvae and start feeding on both planktonic and benthic organisms. The habitat requirements for early life stages changes seasonally.

Annual spawning success and recruitment are highly variable and depend on the flow regime during the reproductive period of the spawning female (Veshchev 1993; Veshchev & Debol'skii 2000). High flows can create increased bottom velocities which preclude or greatly reduce spawning success. Flow regime and water temperature are important factors determining the ontogenetic development of all early life intervals (eggs, free embryos, and larvae), which determines the timing of early behaviour and downstream dispersal. 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 (Veshchev 1994; Kriksunov & Mamina 1995). Year-class strength of populations is determined during the first months of life (Nilo *et al.* 1997). After the first year, sturgeons are usually no longer subject to predatory pressure that greatly affect year-class strength (Lukjanenko 1993).

In all well-studied populations, the same spawning site(s) are frequented each year. Such site fidelity might derive either from the distinct characteristics of the site or from homing behaviour. Homing fidelity has yet to be proven for sturgeons, but is thought to be the explanation for adults returning to an area that had been otherwise unvisited since the early life-stages.

Periods of high flow are an important trigger for the spawning migrations of many acipenseriform species, the higher water levels at such times enabling fish to pass through river stretches containing rapids or shallows. 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, whether those entering from pre-estuarine regions into the main river, or from the main river into tributaries (Pavlov 1989).

Spawning populations of Acipenseriformes show a complex multi-age structure. Sturgeons also show a strong tendency towards a breakdown in pre-mating isolating mechanisms, and a consequent increase in hybridisation with other sturgeon species, when spawning habitats are lost and animals of different species are confined to only a few suitable sites or when one species is rare compared to another species.

It is still uncertain whether anadromy or potamodromy is the plesiomorphic ('ancestral') life- history pattern for Acipenseriformes. The same species can

display different life histories and migration patterns in different river systems (Kynard in Balon 1997), while similar habitats within a river system may be used for different developmental stages by different sturgeon species (Bain in Balon 1997). The life history of sturgeons is highly adaptive.

1.3 Overview of sturgeon species in the Danube River Basin

It is generally accepted that six species of Acipenseridae are, or were, native to the Danube River Basin (Antipa 1909).

– *Acipenser gueldenstaedti* (Danube or Russian sturgeon),
– *Acipenser nudiventris* (Fringebarbel or Ship sturgeon),
– *Acipenser ruthenus* (Sterlet),
– *Acipenser stellatus* (Stellate or Starred sturgeon),
– *Acipenser sturio* (Common or Atlantic sturgeon),
– *Huso huso* (Beluga or Great sturgeon).

Other acipenseriform species and hybrids 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).

In the case of hybrids, there is no clear-cut demonstration of superiority compared to parental growth, food conversion and fecundity, and the use of exotic species and/or genotypes, as well as hybrids, in aquaculture is questionable in terms of the risks of escape into open waters and contamination of wild sturgeon populations (Billard & Lecointre 2001).

Sturgeon juveniles of various species and hybrids can also be found in the aquarium or pet trade, where they are sold to hobbyists. Although not used for intentional stocking of river systems, individuals of allochthonous taxa are sometimes released or escape and can occasionally adapt to conditions in the wild outside of their native range (see section 2.4 ‘Introduction of exotic species and genotypes, alteration of the genetic status of populations’).

1.3.1 Diadromy and migration

Of the six sturgeon species native to the Danube Basin, four are diadromous species living in the Black Sea shelf zone and entering the Danube Delta or Danube River itself for spawning: *A. gueldenstaedti*, *A. stellatus*, *A. sturio*, and *H. huso*.

Migration of sturgeons can be observed throughout the year in the Lower Danube. However, the three surviving anadromous species (*A. gueldenstaedti*, *A. stellatus*, *H. huso*), exhibit a dual-peaked migration pattern, where fish either enter the river to spawn in the same year (these individuals

belong to the ‘vernal’ or ‘spring’ race) or over-winter in the river, using deeper stretches of water or depressions in the river-bed, and spawn the following year (these individuals belong to the ‘fall’ or ‘winter’ race). The two different groups do not represent biological races however, but different strategies for the pre-spawning migration (fall and spring migrations) each with its advantages to certain individuals, but both groups spawn together. Migrants that move into the river in fall need wintering habitat and protection from harvest in their wintering sites (Kynard *et al.* 2002). The dual-peak migration pattern is documented through two corresponding peaks in the catching success experienced by commercial fishermen on the Lower Danube River, with migrants caught in spring and over-wintering animals in autumn and winter.

The Danube sturgeons include: one species (*A. ruthenus*) that has freshwater populations and – possibly – a population (or populations) in the lower river that is freshwater amphidromous; one species that has both diadromous and freshwater populations (*A. gueldenstaedti*); and one species that occurs only in its freshwater form (*A. nudiventris*). Data from other river systems suggest, however, that remnant diadromous populations may exist or have existed in the Danube River system.

There are basically three kinds of long-distance displacements during the life-cycle of sturgeons:

i. spawning migrations of the adult fishes – from the sea into the rivers for anadromous species, and upstream migrations for potamodromous species;
ii. the catadromous/downstream movements of spent adults after the completion of spawning; and
iii. the downstream dispersal of early life stages, which takes place first through passive drifting or active swimming.

Dispersal behaviours are innate and the dispersal rate is mainly affected by water temperature, water flow (velocity), and behaviour of the dispersing life stages. Habitat preferences of migrants are innate, but often differ among species. This frequently places fish of different species in slightly different ecological niches during dispersal. The specific behavioural and dispersal patterns of Danube sturgeons are unknown (Kynard 2005).

1.3.2 Reproduction

Four sturgeon species still reproduce in the Lower Danube River (*A. gueldenstaedti*, *A. ruthenus*, *A. stellatus*, *H. huso*).

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 (Hensel & Holčík in Balon 1997). Due to the blocking of migration routes by the Iron Gates dams (see Box 2) these spawning sites can no longer be reached by migratory sturgeons. However, there is a considerable lack of knowledge concerning the exact location of former key habitats within the Danube River system.

Box 2: The Iron Gates dams

Where the Danube River forms the border between Romania and Serbia & Montenegro, it flows through the Iron Gates gorge. In 1972 and 1985, respectively, construction of two major hydropower dams – known as 'Iron Gates I' and 'Iron Gates II' – was completed below the gorge at points 942 km and 863 km upstream of the mouth of the Danube Delta.

It has been reported that catches of *Huso huso* and *Acipenser 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).

The Iron Gates dams are not equipped with technical measures designed to assist fish migration – e.g. fish passes or bypasses – and therefore constitute a permanent barrier to upstream migration of most sturgeons. However, the sporadic capture of migratory sturgeons upstream of the Iron Gates shows that a very few individuals manage to negotiate the locks used by shipping.

The locations of spawning sites in the Lower Danube River under the changed (post-Iron Gates) migratory and hydrological conditions are mostly unknown and subject to current field research. Only one spawning site of *Huso huso* has been identified recently (through catching larvae). There is no information available about the location of spawning sites or the extent of reproduction of potamodromous species/forms (*A. ruthenus*, *A. gueldenstaedti*, *A. nudiventris*) anywhere in the Danube Basin.

1.3.3 Juvenile rearing habitat

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.

Table 1: Status and characteristic traits of sturgeons from the Danube River as compi-
Grey areas indicate the occurrence of a species in the Black Sea – Danube River endangered; **EN** = endangered; **VU** = vulnerable; **-**: no occurrence;**?**: status is and improvement of water quality; ●: reserves are reduced to a minimum).
[NB: THIS TABLE IS TO BE READ BOTH ON PAGES 26 AND 27.]

Species		***Acipenser gueldenstaedti*** Danube or Russian Sturgeon (migratory form)		***A. gueldenstaedti*** Danube or Russian Sturgeon(resident form)		***A. nudiventris*** (Danube stock) Ship Sturgeon	
Distribution Status	**Time period**	Historic	Current	Historic	Current	Historic	Current
	Upper Danube River	Rare	EX	-	-	Rare	EX
	Middle Danube River		EX		EN		CR
	Lower Danube River		EN	?			?
	North Western Black Sea		EN	-	-	-	-
	Max. length [cm]	236		No information		221	
	Max. age [yrs.]	33		No information		36*	
	Age at maturation [yrs.] ♂ ♀	11 – 13 12 - 16		No information		6 – 9 12 – 14**	
	Spawning season	March-November		No information		April-May**	
	Absolute fecundity [eggs female^{-1}]	29.500 – 406.800		No information		2000.000 – 1.300.000	
	Pattern	Anadromous		No information		Potamodromous	
	Peak/seasonal races	Spring-fall		No information		No information	
Feeding regime		benthic organisms (fishes and inver-tebrates)		benthic organisms (fishes and inver-tebrates)		benthic organisms (fishes and inver-tebrates)	

* = Ural River (Caspian Sea: Kazakhstan and the Russian Federation); ** = Kura River (Caspian Sea: Azerbaijan); River population is lacking.

-led from literature (Reinartz 2002, modified).
system in the given time period according to literature (**EX**: extinct; **CR** = critically unclear; ■: depends on stocking; ▲: stocks recovered due to stocking, legal protection

A. ruthenus Sterlet		***A. stellatus*** Stellate or Starred Sturgeon		***A. sturio*** Common or Atlantic Sturgeon		***Huso huso*** Beluga or Great Sturgeon	
Historic	Current	Historic	Current	Historic	Current	Historic	Current
	■ VU	rare	EX	-	-	Rare	EX
	▲ VU		EX	?	-		EX
	● VU		EN	Rare	EX		EN
-	-		EN	Rare	EX		EN
125		218		600		800	
24		35		48		> 100	
3 - 5 4 – 7		3 – 6 7 - 10		7 – 9 8 – 14***		10 – 13 13 – 15	
April-May		May-June		May		April-May	
7.000 – 108.000		70.300 – 430.000		790.000 – 1.820.000		228.400 – 964.800	
Potamodromous		Anadromous		Anadromous		Anadromous	
April-May		Spring-fall		No information			
Benthic organisms (mainly invertebrates)		Benthic organisms (fishes and inverte-brates)		Benthic organisms (fishes and inverte-brates)		Marine and freshwater fishes	

*** = Rioni River (Black Sea: Georgia) – data from other river populations are used, as information on the Danube

1.3.4 Feeding

Sturgeons possess tactile barbels located at the front of the mouth, which is protactile – meaning that it can be pushed outwards and forwards – and have thickened lips. 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 bottom invertebrates (insects, insect larvae, annelids and molluscs) and also occasionally on bottom 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).

The following tables summarise key facts and important events about and for the Danube River sturgeon species.

Table 2: Important events for Danube River sturgeon species

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 collapse. 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.

Date	Event
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. How-ever, 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 Ásványráró, 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.

1.4 Single species accounts for sturgeons in the Danube River Basin (based on compilations in Holčík 1989)

1.4.1 *Acipenser gueldenstaedti* Brandt, 1833 (Danube or Russian Sturgeon)

Picture: FAO-FIGIS

Distribution

Acipenser gueldenstaedti occurs in the Black, Azov and Caspian Sea and the rivers that discharge into them. In addition to the main diadromous form, a potamodromous freshwater form has been reported from various rivers including the Middle Danube.

Life history and ecology

A. gueldenstaedti is an anadromous species that completes its life cycle travelling back and forth between marine and freshwater environments. During the period spent at sea, the species inhabits shallow waters on the continental shelf, mainly in brackish water, and where there are high concentrations of invertebrates and small benthic fishes – the main prey items for adults, as well as crustaceans – the prey favoured by juveniles.

In common with other migratory acipenserids, the population structure of *A. gueldenstaedti* is complex and multi-aged.

This species regularly ascended the Danube River to Bratislava and rarely as far as Vienna and Regensburg, and was formerly encountered in the following Danube tributaries: Vah, Drava, Sava, Tisza and Morava Rivers (see below).

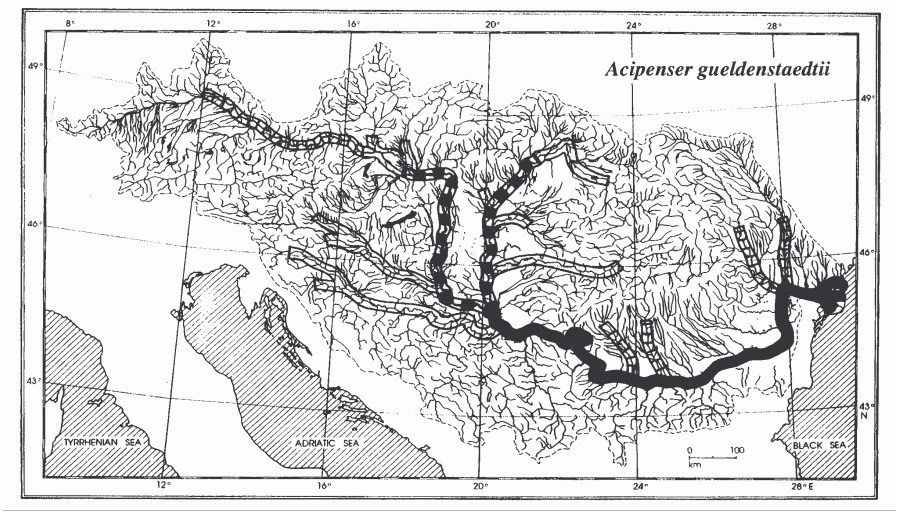
The spawning run into the rivers usually begins in early spring, reaches its peak in mid- or late summer and ceases in late autumn. Some authors state that there is a dual-peaked spawning run with either the spring or the fall run being the largest. In the Lower Danube River there is a single sturgeon spawning run, which reaches its maximum intensity during the period July to September. Evaluation of fishery data from the former Yugoslavian stretch of the Danube River, however, provided evidence for dual-peaked migration.

This species reproduces on gravel or stony beds at depths of 4 to 25 m, where the current velocity is 1 to 1.5 m s^{-1}. Most of the reproduction takes place on the riverbed of the main channel, while a minority of the fishes lay their eggs on inundated floodplains along the river. A small part of the spawning shoal reproduces near the mouth of the Danube, but the great majority migrate a considerable distance upstream before spawning.

Population size and development

A. gueldenstaedti was formerly the most widely distributed anadromous sturgeon species in the Danube River and regularly migrated upstream to Bratislava (river km 1,869) and spawned in this stretch of the Middle Danube in May and June. Rarely, some individuals ascended as far as Vienna (river km 1,925) and Regensburg (river km 2,381). The species occurred in the following left-bank tributaries of the Danube: the Morava (at Suchohrad), Vah, Tisza (up to Versenyi) and its tributaries, the Szamos, Zagyva, Körös and the Mures (up to Mihalt). It also occasionally entered tributaries of the Lower Danube, including the Olt, the Jiu (up to Transsylvania) the Prut and the Siret. Frequented right-hand tributaries were the Drava (and its tributary, the Mura, as far inland as Austria), the Sava (up to Litija as well as its tributary, the Kupa River, up to Karlovac).

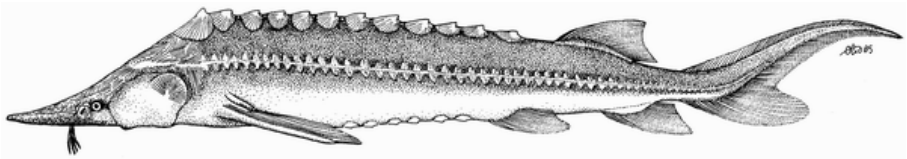
Figure 1: Distribution of the Russian sturgeon, *Acipenser gueldenstaedti*, in the Danube drainage system. Regular (continuous black) and occasional (black and white area) occurrence at present; regular (continuous white) and occasional (striped white area) occurrence in the past. (from Hensel & Holčík 1997 Original figure by K. Hensel)



Besides the migratory stock there are indications that a relict population of a resident form of *A. gueldenstaedti* might still be present in the Middle Danube as the species is occasionally caught by anglers in the Hungarian and Slovakian stretches.

The total number of *A. gueldenstaedti* feeding in the north-western part of the Black Sea in the period from 1966 to 1974 was estimated to be 209,000. The current stock size is unknown.

1.4.2 *Acipenser nudiventris* Lovetsky, 1828 (Ship Sturgeon or Fringebarbel)



Picture: FAO-FIGIS

Distribution

Acipenser nudiventris is basically a diadromous species that inhabits the Black, Azov, Caspian and Aral Seas, from which adults ascend the rivers to spawn. However, the species also occurs as a potamodromous form, which remains continuously in fresh water. The stocks in the Danube River belong to the freshwater form and the species is found only rarely in the Black Sea and the Sea of Azov.

A. nudiventris was formerly recorded in the Lower and Middle Danube (occasionally also in the Delta) – ascending as far as Komárno, 1,766 km from the river mouth, and even Bratislava at km 1,869 – but only rarely entered Austrian waters. Occasional specimens were taken in the following tributaries: Váh, Tisza (at Szeged), Sava and Drava, and in the lower sections of the Prut and Siret.

Life history and ecology

Animals of this species in the Danube River system belong to the freshwater form and feed mainly on benthic invertebrates such as insect larvae, molluscs and crustaceans.

The optimum temperature range for egg development is believed to be between 11 and 15 °C and spawning occurs when temperatures reach this level. There is no information on spawning sites in the Danube Basin, though in the Kura River (Caspian Sea Basin) and Amu-Darya River (Aral Sea

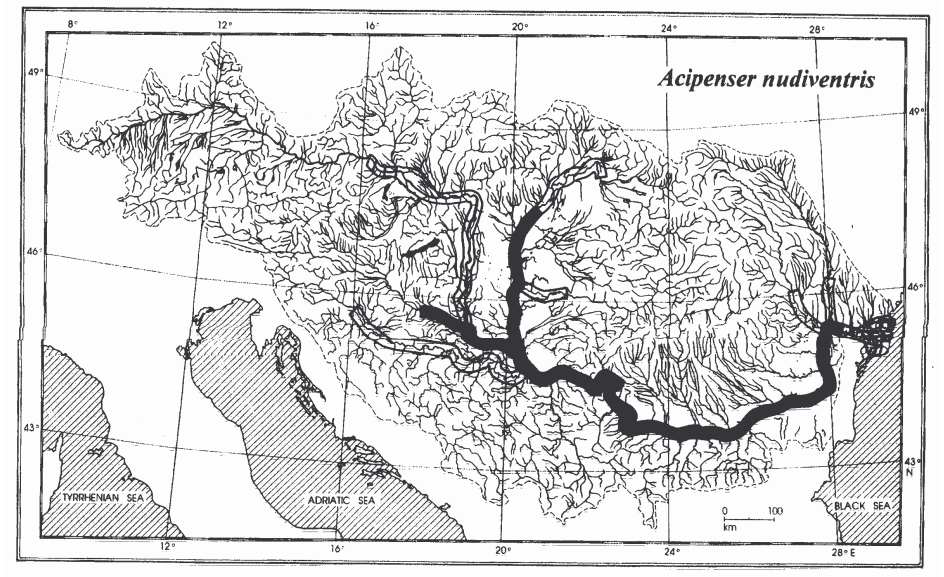
Basin) these sites can be found on gravelly or stony bottoms or along sections with firm, clayey sediments and water velocities between 1 and 2 m s^{-1}.

Population size and development

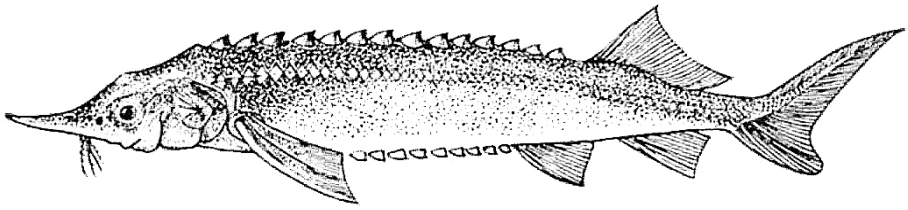
A. nudiventris was never abundant in the Danube River Basin. Verification on the basis of historical documents is difficult, however, since small specimens can easily be confused with *A. ruthenus* and larger specimen with *A. gueldenstaedti*. Fishermen often did not distinguish between these species.

A. nudiventris is very scarce in the Danube River Basin nowadays. The species has disappeared completely from the Austrian and Slovak stretches of the Danube, and is extremely rare in the Hungarian section. However, the capture of a male in the Serbian stretch of the Danube, near Apatin, in October 2003 confirmed the species' continuing presence in the Danube Basin, and there was a recent report (May 2005) from the Mura, where the river forms the border between Croatia and Hungary, close to its confluence with the Drava. There have been no documented catches from the Lower Danube in Romania for 30-40 years. However, there are reports from Romanian fishermen of sporadic seasonal catches of unusual sturgeons with *nudiventris*-like traits, which might indicate the species' presence downstream of the Iron Gates dams.

Figure 2: Distribution of the ship sturgeon, *Acipenser nudiventris*, 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 & Holčík 1997, Original figure by K. Hensel)



1.4.3 *Acipenser ruthenus* Linnaeus, 1758 (Sterlet)



Picture: FAO-FIGIS

Distribution

Acipenser ruthenus is an Eurasian species inhabiting rivers flowing into the Caspian, Black, Azov, Baltic, White, Barents and Kara Seas. While it is nowadays the most widely distributed sturgeon species in the Danube River Basin, its range formerly reached as far as Ulm in Germany and numbers were also much higher, being abundant in Bratislava, for example. *Acipenser ruthenus* also ascended or occurred in the following right-hand tributaries: Isar (up to Landshut), Inn and its tributary the Salzach (up to Laufen), Sio (to Lake Balaton), Raba, Drava (up to Maribor), Mura (up to Graz), Sava (up to Sevnica) and its tributaries the Lonja and Kupa (up to Karlovac). Frequented left-hand tributaries include: the Morava (up to Moravka Nova Ves), Vah (up to Trencin, exceptionally up to Liptovsky Svaty Mikulas) and its tributaries the Nitra (up to Landor) and Zitava, the Hron (up to Kamenica and Hronom), Ipel, Tisza (up to Sighetul Marmatie) and its tributaries the Bega and Mures (up to Auid), the Zagyva and Bodrog (the latter up to Brehov) with the tributaries Latorica, Laborec, Uh, Somes and Tamis.

Life history and ecology

A. ruthenus is a potamodromous species, inhabiting the lowland and foothill zones of rivers and usually never leaving fresh water. Individuals of this species only occasionally move into the brackish water of estuaries for feeding.

Tagging experiments have revealed a maximum migration distance in the Danube River of more than 300 km.

A. ruthenus usually stays in the current in deep depressions of the riverbed, over stony, gravelly or sandy bottoms. When the water level rises in spring, the fish move onto the flooded lowlands to feed. Small individuals are often encountered in sandy shallows.

In reservoirs, individuals usually stay at the upstream end where there is a current and the conditions are similar to those in free-flowing rivers.

Larval and juvenile fish remain at the spawning sites among rocks and stones during their early development, but later the juveniles disperse to feeding grounds.

As the water temperature decreases the fish form large shoals in the deepest sections of the river or in depressions in the river bed to over-winter without feeding.

The main food items in all rivers consist of small benthic organisms. However, especially in lowland rivers and downstream sections of reservoirs, zooplankton also plays a significant nutritional role.

A. ruthenus generally spawns in spring high-water periods. During spring floods, adults swim upstream for spawning, which is initiated when a suitable water temperature is reached.

In the Middle Danube, timing ranges from April to May when water temperatures are between 8 and 19 °C at water depths of up to 10 m. The optimal temperature for reproduction ranges from 12 to 17 °C.

There are two types of spawning sites: floodplain areas that are flooded by the rising spring water levels and sites on the riverbed. Spawning on the riverbed occurs at depths of 7 to 15 m. The eggs are laid on pebbles 1 to 7 cm in diameter, and rarely on gravelly-sand bottoms. The current velocity ranges from 1.5 to 5 m s^{-1}. In impoundments, reproduction usually occurs in the region farthest upstream, where there is still significant water current.

After spawning, the spent fishes (= fishes after the release of their gametes during spawning) move slowly downstream to bays, sandy shoals or channels with muddy bottoms, where they feed intensively.

Population size and development

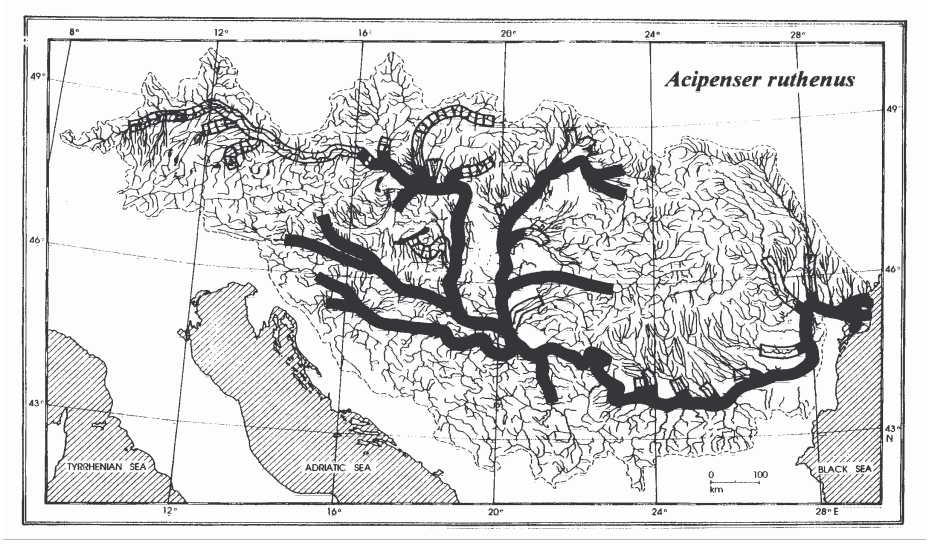
After a decline of stocks in the Upper and Middle Danube River in previous centuries, the species' range has again been increasing since the 1980s. Although it has been almost extirpated from the Upper Danube (continued occurrence in Germany and Austria depends strongly on stocking, with the exception of a supposed autochthonous relict population on the Austrian–German border), stocks in the Middle Danube (Slovakia and Hungary) seem to be recuperating. Thus, in 1980, *A. ruthenus* reappeared in the Morava River as far as the Suchohrad region. They have also begun to appear in the lower reaches of the Váh River, and now occur regularly as far upstream as Bratislava.

Increasing abundance in the Slovakian and Hungarian sections of the Danube River is not only the result of improved water quality, but also due to the efforts of artificial propagation and release of this species in Hungary.

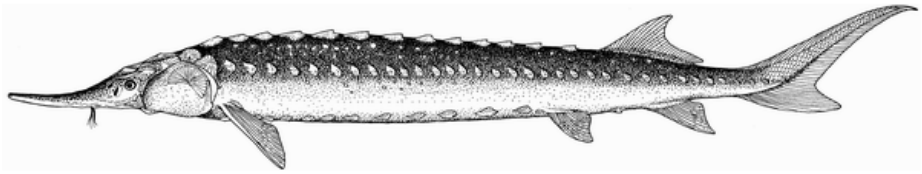
At the beginning of the 1980s, Slovak fishermen could easily catch up to 300 *A. ruthenus* in a single haul of a 300 m beach seine. First increases in catches in the Hungarian part of the Danube River began in 1971, probably due to the damming of the Tisza River, which displaced the species from its traditional spawning grounds.

In the Serbian stretch of the Danube the most abundant population occurs near Belgrade and in the upstream sections near Vojvodina as well as in the lower parts of the Sava and Tisza Rivers. However, the Iron Gates dams are also blamed for a decrease in catches, since they prevent migrations from the lower parts of the Danube River to areas upstream of the gorge.

Figure 3: Distribution of *Acipenser ruthenus*, in the Danube River Basin. 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 & Holčík 1997, Original figure by K. Hensel)



1.4.4 *Acipenser stellatus* Pallas, 1771 (Stellate Sturgeon)



Picture: FAO-FIGIS

Distribution

Acipenser stellatus inhabits the Caspian, Azov, Black, and Aegean Seas, from which it enters surrounding rivers, including the Danube. The species is represented by a migratory form only and travels considerable distances, both at sea, where it feeds and spends the winter, and in rivers where it spawns.

It was always rare in the Middle and Upper Danube, occasionally ascending upstream as far as Komarno, Bratislava, the Austrian stretch, or even the Bavarian Danube, near Straubing, and the Isar River. During its spawning migrations *A. stellatus* also entered tributaries of the Lower Danube River, such as the Prut, Siret, Olt and Jiul Rivers. In the Middle Danube it ascended the Tisza River (up to Tokaj) and the lower courses of the Tisza's tributaries the Maros and Körös Rivers, as well as the mouth of the Zagyva River, the lower courses of the Drava and Sava Rivers and the mouth of the Morava River.

At present, as a result of river regulation and damming, the range of *A. stellatus* in the Caspian, Azov, and Black Sea watersheds has decreased significantly. The extent of the spawning grounds has also been reduced considerably and migration routes and timing have been changed. Nowadays, most individuals ascend the Danube River only as far as the Iron Gates dams at river km 863.

Life history and ecology

A. stellatus is an anadromous species. However, there are subpopulations that differ in the timing of their migrations and spawning, the location of their spawning grounds, the water temperature at spawning, and ripening of the gonads. For the Black Sea and the Danube River both spring and winter forms have been described.

There are two phases of the spawning migration. First, fish move from the open sea onto the continental shelf close to a river mouth. Secondly, they run upstream along the river bed, guided principally by the flow of water.

This species prefers warmer habitats than other Danube sturgeons and its spawning runs into the river occur at water temperatures higher that those prevailing during the migrations of the other species and take place immediately after those of *Huso huso* and *Acipenser gueldenstaedti*.

Like other Acipenserids, *A. stellatus* enters the Danube River to spawn throughout almost the entire year, but two peak periods are evident. The run begins in March at a water temperature of 8 to 11° C, reaches its peak intensity in April, and continues through May. A second, more intense migration begins in August and lasts until October.

A. stellatus is a typical benthic inhabitant of coastal marine waters and the lowland sections of rivers. Benthic invertebrates are the main food source for adults, but plankton may play an important role in the nutrition of the early larval stages.

This species spawns on river-banks inundated by spring floods and above the stony bottom of the river bed at relatively fast currents of 0.7 to 1.8 m s^{-1} at the bottom and 1.1 to 1.9 m s^{-1} at the surface. The eggs are laid on beds of scattered stones, pebbles, and gravel mixed with shell fragments and coarse sand. The optimal spawning conditions include a high velocity of water flow from 1.2 to 1.5 m s^{-1}, and a clean gravel bottom. When the preferred substrate is not available, eggs are deposited on other material, such as shifting sand mixed with clay. A decrease in current velocity can lead to increased mortality of embryos. In the Danube River spawning occurs from May to June at temperatures between 17 and 23 °C. Virtually nothing further is known about the spawning habits of this species.

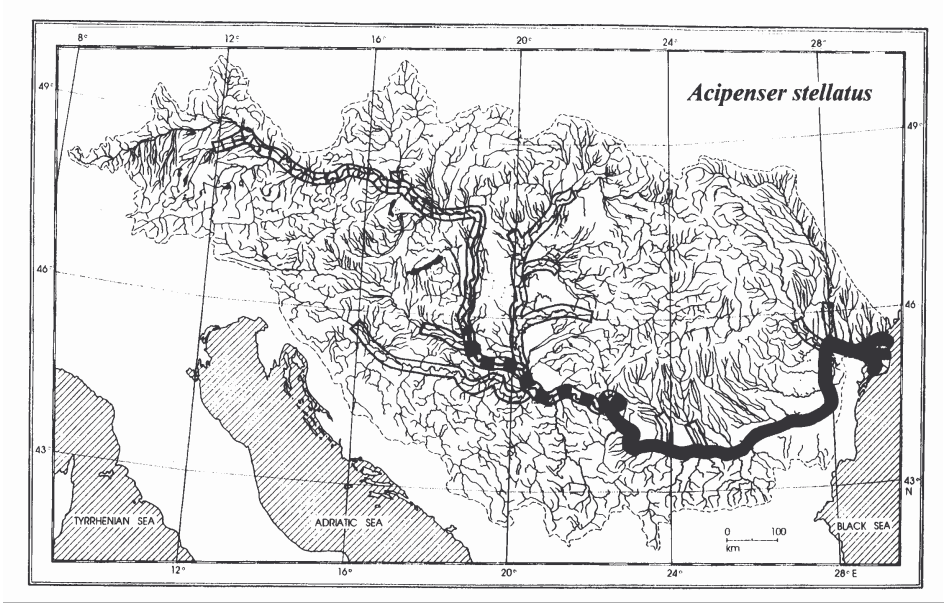
The juveniles of *A. stellatus* are phototropic. Thus, during the initial period of life, the larvae inhabit not only the lower and middle water layers in the rivers but also occur at the surface. They drift downstream, and, during subsequent development, their capability of active movement increases. The distribution of juveniles on the bed of the Danube is influenced by food supply, current and turbidity. Juveniles migrate downstream at depths of 4 to 6 m. The life span in the river lasts from May to October and active feeding begins when the larvae reach 18-20 mm.

Population size and development

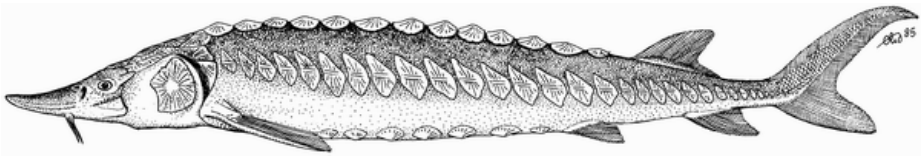
A. stellatus was always rare in the Middle and Upper Danube and has now been extirpated from the Upper Danube and the upstream (Hungarian-Slovakian) stretch of the Middle Danube River as only a few individuals succeed in passing through the shipping locks at the Iron Gates dams. The last known specimen from the Slovakian section was taken at Komarno on 20 February 1926, and the last from the Hungarian stretch was reported at Mohacs in 1965.

Recently studies of telemetry and tag return were conducted on A. stellatus in the Lower Danube (Romania) by Kynard *et al*. (2002). Tag returns of 38 % in 1998 and 27 % in 1999 (plus a likely large unreported return) demonstrated that there is a severe over-harvest of the species, particularly by the Galati fishery. The authors predict the imminent collapse of stocks in the Lower Danube River, if the present rate of harvest is continued.

Figure 4: Distribution of *Acipenser stellatus* in the Danube Basin. 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 & Holčík 1997, Original figure by K. Hensel)



1.4.5 *Acipenser sturio* Linnaeus, 1758 (Atlantic or Common Sturgeon)



Picture: FAO-FIGIS

Distribution

Acipenser sturio occurs exclusively in Europe and West Asia and is confined to the North-eastern Atlantic Ocean, especially to shallow parts of the North Sea, and some coastal waters in the Mediterranean and Pontic region,

including the Ligurian, Tyrrhenian, Adriatic, Ionian, North Aegean, Marmara and Black Seas. Within these regions, the species once ascended all major river systems to spawn.

In the Black Sea Basin, *A. sturio* formerly ascended into the Lower Danube River, the Inguri/Dzhvari and Rioni Rivers in Georgia, and the Yesil Irmak and Kizil Irmak in Turkey. Nowadays the species is close to extinction and is believed already to have gone extinct in the Lower Danube. The presence of this species in the Inguri/Dzhvari and Rioni River systems in Georgia has also become extremely doubtful.

Life history and ecology

A. sturio is basically an anadromous species. This species spends most of its adult life on the continental shelf. In spring, mature individuals leave the sea and enter freshwater systems to spawn. They enter rivers from January to October, with peak migration usually occurring in periods of high water between early April and the end of May. The exact dates depend on the geographic location of the river. Southern populations begin to appear in rivers earlier than northern populations.

All available data indicate that during its stay at sea, *A. sturio* is a littoral species limited mainly to estuaries with muddy bottoms. Most young-of-the-year stay in rivers close to the spawning grounds where they hatched, but some move downstream to estuaries during their first summer.

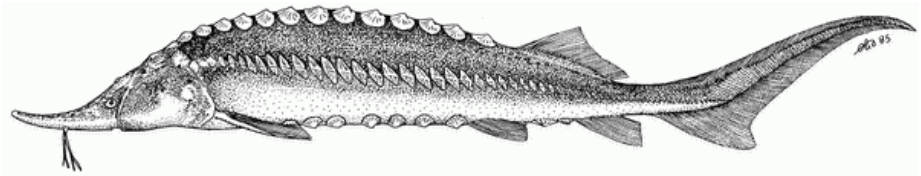
There is little information on diet for this species. When in fresh water, the juveniles feed on larvae of aquatic insects, worms, crustaceans and molluscs. Fresh- and brackish-water invertebrates have been found in young *A. sturio* inhabiting the estuary of the Rioni River. Juvenile feeding habits are known for the Gironde estuary where the diet consists mainly of polychaetes. Adults feed on benthic invertebrates, such as molluscs, polychaete worms, isopods, shrimps, and small fishes,
Spawning takes place in deep pools with swift currents over a rocky or pebble bottom, either in the main channel or in lotic branches.

Population size and development

A. sturio was always the rarest sturgeon species in the Black Sea Basin and its presence was only documented at the beginning of the 20th century. Single specimens were then recorded from the catches of fishermen in both the Danube River and the Black Sea. It seems likely that this species also spawned in the Lower Danube since young-of-the-year and hybrids with other species were described in the 1930s, suggesting simultaneous spawning with other Acipenserids on the sand banks off the Danube Delta.
Reports of *A. sturio* upstream, from Bulgarian and Serbian stretches of the Danube, are contradictory. According to one source, the last record of

A. sturio in the Serbian part of the Danube River was in 1954. Nowadays, it seems likely that the species has disappeared from the western Black Sea and the Lower Danube River and that its continued occurrence in the Black Sea watershed in the Inguri/Dzhvari and Rioni Rivers of Georgia is extremely doubtful.

1.4.6 *Huso huso* Linnaeus, 1758 (Beluga or Great Sturgeon)



Picture: FAO-FIGIS

Distribution

Huso huso inhabits the Black, Azov, Caspian, and Adriatic Seas and occurs naturally only as a diadromous form. In the Black Sea Basin, the species formerly congregated in considerable numbers for spawning in the large rivers of the region, including the Danube, Dniester, Southern Bug, and Dnieper, as well as rivers along the eastern shore of the Basin.

The winter race regularly ascended the Danube as far as Bratislava (river km 1,860 – 1,870) and very occasionally reached the Austrian stretch, and even the German stretch (the latter up to Straubing at river km 2,320). The species also entered the lower Morava River (one reported catch at Lanzhot), the Vah River (up to Trnovec nad Vahom, exceptionally up to Trencin), the Zitava River (up to Nesvady), the Drava River, the Tisza River (up to Trakany) and its tributaries the Zagyva, Körös and Maros Rivers, the Sava River (up to Zagreb) and its tributary the Kupa River, and the lower courses of the Velika Morava and Olt Rivers.

Life history and ecology

H. huso is a migratory anadromous species. When living in marine waters, the species inhabits mainly the pelagic zone and is probably confined to regions with muddy bottom substrates. For the first year of life, juveniles remain in shallow, relatively warm habitats on the continental shelf. During both the seaward and the spawning migrations, the fish travel in the deepest parts of the riverbed.

The anadromous migration period begins at the end of January or during February and ends at the end of November or in December. Throughout its range, the species has developed both winter/fall and spring/summer races. Members of the spring race reproduce in the same year during which they enter the rivers, while those of the winter race spend the winter in fresh water and reproduce in spring the following year.

In the Danube River, spawning migrations can be observed almost all year round. Nevertheless, two peak periods have been noted, one for the winter race and one for the spring race. The spring run is observed from January to April, beginning soon after ice-melt at temperatures of 4 to 5 °C. The autumn run begins in August and reaches its peak in October and November.

H. huso is a true predator and larger individuals may even take aquatic birds and baby seals. While benthic and planktonic invertebrates form the main food supply for juveniles, other fishes are taken from a juvenile length of just 2 to 3 cm. Fishes (both pelagic and benthic) constitute the primary diet by the time a length of 9 cm has been reached.

Regardless of the season of entry into a given river *H. huso* breeds during the period of high discharge in spring. In the Danube River, this occurs in April and May. This sturgeon spawns at a lower temperature and within a narrower temperature range than other migratory sturgeon species, and spawning usually coincides with a flood peak. The optimal temperature for spawning is reported to lie within the range 9 to 17 °C. It has also been reported that autumn spawning occurs in the Danube River during October and November at water temperatures close to those prevailing in spring, but this information requires confirmation. The hatchlings do not remain in the river for long and travel to the sea as larvae.

The location of spawning sites does not depend on distance from the river mouth but rather on the presence of conditions conducive to reproduction, such as the right type of bottom substrate and a suitable current velocity. In general, *H. huso* spawns further upstream than any other anadromous migratory sturgeon and therefore the regulation of the water flow and construction of dams have had the greatest impact on the natural reproduction of this species. Spawning *H. huso* seek out a section of river with a stony or gravelly bottom, only very rarely using sand or clay. Spawning usually takes place at a depth of 4 to 15 m, but may occur as deep as 40 m. The current velocity at the spawning site is about 1.5 to 2 m s^{-1}. The main spawning sites are in the river bed, but temporary sites in floodplains may also be utilised. Limited spawning may also occur in the lower courses of the river. For instance, there are reports from the Kilia Arm of the Danube River Delta, in a stretch of river where an especially strong current exposes a stony bottom. Recent field studies revealed a spawning site in the Lower Danube at river km 310. Other details about the spawning habits of *H. huso* are still unknown.

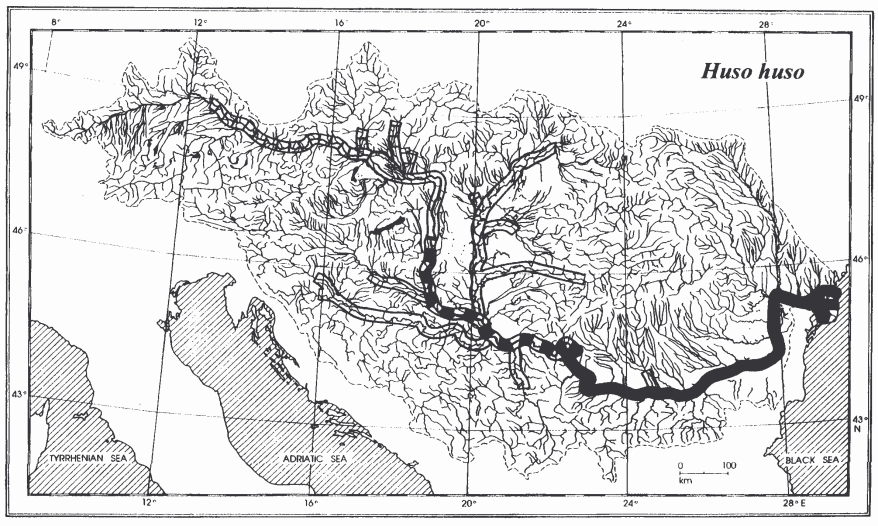
The main spawning grounds in the Middle Danube River were formerly situated in the so-called Zitny Ostrov reach below Bratislava (river kms 1,766 – 1,866), as well as between Budapest and Szentendre. The main fishery was in the Little Danube (the northern branch of the Danube River) near the mouth of the Vah River at the village of Kolarovo, and in the Danube River, between Komarno and Sap.

Population size and development

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 the 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 set in by the beginning of the 16th century, but exploitation continued through the 17th and 18th century, so that by the 19th century only a few individuals were still being caught (see Table 2). 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 the extensive river modifications carried out in recent decades (e.g. irrigation and hydropower dams, dyke construction and channelisation), the species has suffered further population decline and range restriction, with its migratory movements now confined by dams. *H. huso* nowadays only reaches the Iron Gates dam, 863 km from the sea.

Figure 5: Distribution of *Huso huso* 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 & Holčík 1997, Original figure by K. Hensel)



1.5 Legal and conservation status of sturgeons in the Danube River Basin

The following table summarises key information concerning the legal and conservation status of sturgeons in the Danube, notably the current Red List status of each species, as assessed by IUCN – The World Conservation Union in 2004, as well as its legal status under intergovernmental Conventions (Convention on International Trade in Endangered Species of Wild Fauna and Flora – CITES and associated EU Regulation, Convention on Migratory Species, Bern Convention) and the EU Habitats Directive. (For further details see Annex IV.) On the one hand, the fact that Danube sturgeons remain highly threatened in spite of their status under these international instruments reinforces the urgent need for significantly enhanced Danube-wide co-operation and action, as set out in this Action Plan. On the other hand, the instruments themselves provide important tools and mechanisms for the delivery of such actions on the ground.

Table 3: Legal and conservation status of Danube River sturgeons

Categories / Species	***Acipenser guelden-staedti*** (Black Sea stock)	***Acipenser nudiventris*** (Danube River sub-population)	***Acipenser ruthenus*** (Caspian and Black Sea drainage stock)	***Acipenser stellatus*** (Black Sea stock)	***Acipenser sturio***	***Huso huso*** (Black Sea stock)
I. Conservation status of species, stocks and subpopulations						
'2004 IUCN Red List of Threatened Species' category Year of Assessment Assessor	Endangered (EN A1acde) 1996 SSG [1)]	Critically endangered (CR A1cd +2cd) 1996 SSG [1)]	Vulnerable (VU A1cd) 1996 SSG [1)]	Endangered (EN A1acde +2d) 1996 SSG [1)]	Critically endangered (CR A2d) 1996 SSG [1)]	Endangered (EN A1acde+2d) 1996 SSG [1)]
Regional / local status (according to the literature and contributions to the expert workshop held in Petronell, Austria, 6-7 July 2005)	Migratory form is extinct in the Upper and Middle Danube. Remnants of potamodromous form still present in the Middle Danube River, as documented by incidenttal catches in Hungary and Slovakia. Stocks of migratory form in the Lower Danube River threaten to collapse due to over-harvest.	Extremely rare species in the Middle and Lower Danube River as documented by incidental catches and reports by fishermen upstream and down-stream of the Iron Gates dam.	Still present in the Upper Danube River partially supported by stocking. Partial recovery of stocks in the Middle Danube River due to improvement of water quality and supportive stocking. Reproductive stocks in the Lower Danube River, exploitation status unclear.	Extinct in the Upper and Middle Danube River. Stocks in the Lower Danube River threaten to collapse due to over-harvest.	Extinct in the Danube River Basin but still present in the Black Sea watershed.	Extinct in the Upper and Middle Danube River. Stocks in the Lower Danube River threaten to collapse due to over-harvest.

Categories / Species	*Acipenser guelden-staedti* (Black Sea stock)	*Acipenser nudiventris* (Danube River sub-population)	*Acipenser ruthenus* (Caspian and Black Sea drainage stock)	*Acipenser stellatus* (Black Sea stock)	*Acipenser sturio*	*Huso huso* (Black Sea stock)
II. Legal status of species						
EU Habitats Directive (92/43/EEC) [2] Appendix	V	V	V	V	II and IV	V
Date	21/05/92	21/05/92	21/05/92	21/05/92	21/05/92	21/05/92
EU Habitats Directive (97/62) [3] Appendix					II (priority)	
Date					28/11/97	
EC Reg. No 1497/2003 [4] (amending EC Reg. No. 338/97) Appendix	B	B	B	B	A	B
Date	30/08/03	30/08/03	30/08/03	30/08/03	30/08/03	30/08/03
CMS [5] Appendix	II	II	II (only Danube River population)	II	II	II
Date	14/02/00	14/02/00	14/02/00	14/02/00	14/02/00	14/02/00
CITES [6] Appendix	II	II	II	II	I	II
Date	01/04/98	01/04/98	01/04/98	01/04/98	29/07/83	01/04/98
Bern Convention [7] Appendix			III	III	II	III
Date			01/03/02	01/03/02	01/03/02	01/03/02

[1] IUCN SSC/SSG (Species Survival Commission/ Sturgeon Specialist Group)

[2] EU Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC)

Annex II lists: animal and plant species of Community interest whose conservation requires the designation of Special Areas of Conservation.

Annex IV lists: animal and plant species of Community interest in need of strict protection.

Annex V lists: animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures

[3] Amendment to the Directive (92/43) revising Annex II.

[4] EU Wildlife Trade Regulation:

Council Regulation (EC) No 338/97on the protection of species of wild fauna and flora by regulating trade therein

Annex A and B contain species which are threatened in their survival by international trade or trade within the European Community. Annex A mainly contains species which may be threatened by extinction.

[5] Convention on Migratory Species, 1979 (the 'Bonn' Convention) & associated Agreements

Annex II lists migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation organised by tailored agreements. For this reason, the Convention encourages the Range States to conclude global or regional Agreements for the conservation and management of individual species or, more often, of a group of species listed on Appendix II.

[6] Convention on International Trade in Endangered Species of Wild Fauna and Flora

Appendix I lists species that are threatened with extinction and for which international commercial trade in specimens of these species needs to be prohibited. However, trade may be allowed under exceptional circumstances, e.g. for scientific research. In such cases, trade is authorised by the granting of both an export permit (or re-export certificate) and an import permit. Trade in captive bred specimens is also allowed under certain conditions.

Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called 'look-alike' species, i.e. species for which the specimens in trade closely resemble those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorised by the granting an export permit or re-export certificate; no import permit is necessary. Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met – above all, that trade will not be detrimental to the survival of the species in the wild and that the specimens to be (re-)exported were obtained legally.

[7] Bern Convention: Convention on the Conservation of European Wildlife and Natural Habitats

Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species specified in Appendix II which contains strictly protected fauna species (see Article 6) and Annex III protected fauna species (see Article 7).

Information contained in the above table was retrieved from databases maintained by the UNEP World Conservation Monitoring Centre (WCMC) available at http://www.unep-wcmc.org as well as from literature and workshop contributions.

2. Main threats to Sturgeon populations in the Danube River Basin

2.1 Vulnerability of sturgeons to anthropogenic impacts

It is difficult to relate the threatened status of a given sturgeon species to a single cause or change in the environment. However, sturgeons exhibit certain traits (summarised here from Chapter 1) that make them extremely susceptible to anthropogenic impacts.

– As a source of sturgeon meat and caviar, sturgeons are very valuable and thus subject to high fishing pressure. Due to a lack of sexual dimorphism in most species, both sexes are equally harvested and slaughtered.

– Natural hybridisation occurs between all species, which facilitates hatchery production of hybrids, but may be ecologically disastrous, when allochthonous species, genotypes or hybrids are introduced (Billard & Lecointre 2001).

– The life cycle of Acipenseriformes is generally quite long with puberty occurring late in life. Therefore spawning populations need a long time to recover from negative impacts such as over-exploitation.

– Annual spawning success and recruitment are highly unpredictable and depend on the availability of suitable spawning habitat and suitable flow and temperature regimes during the reproductive period of the female spawner. Stocks depend on the high fecundity of individual spawners; females do not spawn annually; thus a loss of traditional spawning sites and alterations to the hydrological and temperature regime may negatively affect reproduction success.

– Particular spawning and wintering sites are frequented each year and migrations are predictable, facilitating the catch of animals. Such site fidelity might derive either from the distinct characteristics of the site or from homing behaviour. Periods of high flow are an important trigger for the spawning migrations of many acipenseriform species and also support the passage of rapids and shallow river stretches (Pavlov 1989).

As a consequence of the above-listed factors, the two greatest current threats to sturgeons in the Danube River are:

– over-exploitation,
– 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 unsound 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 factor.

2.2 Over-exploitation

Fishing is a traditional and important commercial activity in the Danube River Basin. Sturgeons, however, exhibit unusual combinations of morphology, habits and life history characteristics (see section 2.1 above, and Chapter 1 for further details), which make them highly vulnerable to impacts from human activities, particularly fisheries.

Billard & Lecointre (2001) state that

> Overfishing, accidental by-catch of juveniles, and poaching (to satisfy the high demand for sturgeon caviar) remain major problems. It is obvious that most of the highly endangered stocks are located in international waters, either at sea or in rivers. Some multi- or bi-lateral agreements may exist for the management and protection of the stocks but they do not work well and the tendency of nations is to catch all the fish they can. In Eurasia, in the Caspian and Black seas, in the lower Danube or in the Amur River, the state of the endangered species is recognised by scientists for most sturgeon populations. Government agencies managing rivers, however, do not take appropriate measures of protection and still allow fishing.

It is clear that 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.

Stocks in the Lower Danube River have also been decreasing dramatically due to confusing fisheries legislation and the lack of fishing regulations as well as an unknown extent of poaching.

The following trends are provided as proof of over-exploitation of sturgeons in the Lower Danube River (Navodaru *et al*. 1999):

– decrease in catch size,
– increase in fishing effort,
– decrease in length size of landed (caught) fish,
– decrease in Catch Per Unit Effort (CPUE),
– by-catch of younger fish.

Over-exploitation of *A. stellatus* in the Romanian section of the Danube River has also been proven by means of a 4-year biometric study of fish catches (CEAPA et al. 2002). Compared with the age frequencies from 1965 to 1968, a significant shift in the proportion of the age classes towards a rejuvenation of the population was observed. Also, the average total length (*Tl*) for the period from 1997 to 2000 (mean *Tl*=119.73 cm) decreased, compared with data from the previous 30 years (mean *Tl*=131.16).

Apart from over-exploitation of spawners, stocks also suffer from by-catches in other fisheries. Young sturgeons feeding in shallow areas are often caught in Black Sea pound nets, although these catches have decreased drastically over the last 40 years due to the scarcity of juveniles. Even in deeper waters of the Black Sea, young sturgeons are threatened by gillnets used to catch *Sprattus sprattus* (sprat). Furthermore, the use of non-selective fishing methods and gear in the Lower Danube River, such as unbaited hooks (with which fishes are hooked in the dorsum or dorsal fin), are destructive because of the harvesting of immature individuals and the fatal wounding of animals that are not harvested (Bacalbasa-Dobrovici in Balon 1997).

Anadromous sturgeon species are also threatened by *Alosa pontica* (pontic shad) fisheries, which use drift nets, since the spawning run of this species occurs about the same time as the peak of sturgeon migration in spring. It has also been stated that by-catch (primarily in riverine/estuarine gillnets and estuarine/marine trawl nets) appears to be the second major source of mortality for sturgeons. The impact on sturgeon populations by marine fisheries is also documented by the fact that a temporary recovery of sturgeon stocks was observed after the implementation of a moratorium on sturgeon harvest in the Caspian Sea in 1962.

At present, it is difficult to provide accurate figures for the size of Lower Danube River sturgeon catches because of illegal or unreported fishing, which regionally can make up about half of the total catch and up to 90 % of the sturgeon catch (Bacalbasa-Dobrovici & Patriche 1999). Data on sturgeon catches from the 20th century are somewhat confusing, since different databases are quoted and data are claimed to be inaccurate. Billard & Lecointre (2001) even suspect that governments often provide overestimates of potential sturgeon capture and caviar production to the CITES authorities, to increase their export quotas.

Only four out of six sturgeon species, considered native to the Lower Danube system, are still being harvested commercially. Official data showed that sturgeon catches had decreased dramatically in the past: in Romania from about 1,144 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. Navodaru *et al.* (1999) provide a detailed description of the current status of sturgeon fishery on the basis of a Rapid Rural Appraisal (RRA) conducted on the Lower Danube River.

According to the above mentioned authors, the sturgeon meat is sold on national markets, whereas caviar is exported. Prices received by fishermen at point of landing are 4–5 USD per kg for meat and 60-100 USD per kg for caviar (beluga caviar even up to 180 USD per kg), however, no date or currency reference are given. There are flourishing black markets in Romania and Ukraine and to a lesser extent in Serbia & Montenegro, favoured by the centralised political system. There are no signs of a black market in Bulgaria since licensed fishermen have permission to trade fish and caviar. By a comparative analysis of the statistical data from sturgeon catches in different riparian countries, it could be shown 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 the *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 exists with an important yield in the 20th century of between 300-400 tons per year on average, with the following percentages: 47 % Romania, 39 % Ukraine (note the difference between the official catch and the data from this scientific assessment), 12 % Bulgaria and 2 % Serbia & Montenegro. Caviar production was estimated to be about 31 tonnes with the same percentage distribution between countries as for sturgeon production.

Reports from experts attending the workshop in Petronell in July 2005, however, state that in 2004 only individuals of the species *Acipenser gueldenstaedti* and *Huso huso* were caught legally in the Lower Danube River.

According to Navodaru *et al*. (1999) the fishing effort since 1990 has been increasing because there is no entry limit regulation (except for Serbia & Montenegro). In 1998 the overall fishing capacity was about 2,584 fishing units (2,584 boats and more than 5,168 licensed fishermen), among which 54 % are Romanians, 39 % Bulgarians, 6 % Ukrainians and less than 1 % Serbians.

A. ruthenus is also a very important commercial fish. In the past, the size of the catch was considerable. Nowadays, exact data on catches of this

species in the Danube catchment area cannot be attained. Bacalbasa-Dobrovici (1991) states, that reserves in the Romanian Danube River have been “reduced to a minimum”.

2.3 Habitat loss and degradation including the disruption of spawning migrations and pollution

Sturgeons suffer from habitat loss and degradation of their habitat due to river modification. Stocks are affected most severely by the disruption of spawning migrations. This was demonstrated in the case of the Volga River (Russian Federation), where the majority of spawning sites for *H. huso* were lost after the construction of the Volgograd dam. For the Danube River and Black Sea populations of migratory sturgeons the extensive morphological damage to the Danube and its tributaries, together with high levels of pollution, have severely impacted the sturgeon populations of the whole Basin. In particular, the completion of the Iron Gates dams in the 1970s and 1980s meant the loss of important spawning sites in the Middle Danube River up to Gabčíkovo. As early as 1890-1896, first river regulation in the Djerdap region already partially prevented sturgeons from reaching the upper part of the Danube River (Lenhardt *et al.* 2005). After damming, spawning fish are confined to restricted spawning sites. Enclosed sturgeon populations can also experience negative effects due to inbreeding and loss of genetic variability (Gilpin & Soule 1986). Changes in the water flow regime through damming and major irrigation schemes are also detrimental for anadromous sturgeons. Currently, most of the spawning sites of migratory sturgeons in the Lower Danube River under changed migration patterns (i.e. since completion of the Iron Gates dams) are unknown.

River modification can result in the loss of, or changes to, macro-invertebrate fauna and also disrupts the connectivity of rivers and their floodplains. Other anthropogenic impacts, such as water pollution and siltation, can impact negatively on the functionality of spawning sites and on the development of embryos, and can also reduce the abundance of benthic invertebrates found in the diet of most sturgeons. This applies to rivers, their estuaries and the sea. Sand and gravel exploitation poses another threat to sturgeon habitats. Thus, gravel extraction for construction purposes destroyed sturgeon spawning sites near Calarasi (river km 373). (Bacalbasa-Dobrovici in Balon 1997)

Water quality of the Danube River is degraded by point- and non-point-source pollution from urban areas, industry and agriculture. While diffuse sources presently prevail in the Upper Danube, point sources are still significant in the Middle and Lower Danube (ICPDR 2004). In the Lower Danube, some larger tributaries are still heavily polluted, with large pollution plumes along the banks of the river. In the past decade the nutrient load has decreased significantly, due mainly to the effective installation of waste water treatment plants in the Upper Danube countries and a significant

decline in industry and agriculture as a result of difficult economic conditions in the Lower Danube countries.

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 substances in river and sea-shelf sediments, and subsequent up-take through the food-chain (Akimova & Ruban 1996; Bickham *et al*. 1998). Since endocrine disruptors, hormone active substances (HAS) and persistent organic chemicals (POC), such as PCPs and PAHs, are known to stress fish populations worldwide, it can be hypothesized that sturgeons in the Danube River Basin are also impacted. Sub-lethal effects may include, among others, damage to liver and gill tissues, altered enzyme activity, diminished condition (health) index, hermaphroditism, degeneration and absorption of gametes, as well as amitoses in oocytes, leading to the reduction of reproductive potential of populations.

Floodplains and natural deltas are known to fulfil a vital role as natural biofilters for nutrients and contaminants. The Danube Delta is the transition zone between fresh riverine water and salt water from the Black Sea, and therefore comprises a delicate brackish ecosystem. Channelisation, dredging of shipping canals and artificial links between different river branches, aquaculture and agriculture projects (polders) have impacted negatively on the hydrology (sediment transport and water flow through the three main branches and associated wetlands) and nutrient retention (biofilter) capacity of the delta. The significant morphological destruction of the Danube Delta can best be seen from space images, when compared to those, for example, of the Lena River in the Russian Federation. Despite such damage, the UNESCO Biosphere Reserve and other nature reserves still provide major areas of outstanding ecological value and sturgeon habitats.

As a result of these changes, and enhanced by the high nutrient load of the Danube River, eutrophication and turbidity have increased, while oxygen concentrations and biodiversity have decreased, which in turn create adverse effects in the shelf area of the north-western part of the Black Sea. The drastic changes to the natural flow and sediment transport of the Danube River throughout the basin may potentially have strong negative impacts on sturgeon migration behaviour, since it is the brackish delta zone where fish enter from the sea into the river system.

The shelf area of the Black Sea is crucial for Danube River sturgeons during the marine periods of their life-cycle (Bacalbasa-Dobrovici 1991; Bacalbasa-Dobrovici in Balon 1997, Bacalbasa-Dobrovici & Patriche 1999). The status of the Black Sea is determined by the inputs of major tributaries (Rivers Dniester, Dnieper, and Danube) and by the dominant north-south direction of marine currents, by land-based sources of pollution and by the processes taking place in the continental shelf.

2.4 Introduction of exotic species and genotypes, alteration of the genetic status of populations

The release of allochthonous species or stocks must also be considered as a potential threat, since the introduction of exotic species may have negative effects on the ecosystem. Natural hybridisation can occur between all sturgeon species, which facilitates the artificial propagation of hybrids, but may be ecologically disastrous when allochthonous species, genotypes or hybrids are released into the environment. It has also been reported in the literature that stocked juveniles of hatchery origin are not adapted to conditions in natural riverine/marine surroundings (Freyhof & Serov 2000). For example, studies of the effective and genetic consequences of the introduction of *A. stellatus* from the Caspian Sea into the basin of the Sea of Azov revealed the ineffectiveness of the stocking programme, since the introduced stocks displayed less successful reproduction (Tsvetnenko 1993).

Negative effects on sturgeon populations from large-scale stocking and the introduction of exotic stocks that are not genetically adapted to the recipient river system (e.g. by the import of fertilised eggs or juveniles from other watersheds) have already been documented for other river basins (Tsvetnenko 1993; Ludwig *et al.* 2002). These effects include loss of genetic variability, or the disappearance of whole forms. This was the case for the fall or winter races of anadromous sturgeons in the Sea of Azov. Thus, a major demand on artificial propagation and hatchery management practices must be the preservation of the genetic heterogeneity of sturgeon populations (Chebanov & Savelyeva 1999).

The question of whether or not the sturgeon specimens selected for re-introduction are genetically adapted to the recipient river system is not a trivial one. This is demonstrated by the ongoing sturgeon restoration programme in the Baltic Sea where the North American species *A. oxyrinchus* is now believed to be the native species (having invaded the Baltic about 1,200 years ago) and not the European species *A. sturio* that was nearly extinct by the 1950s (Ludwig *et al*. 2002). New methods of DNA analysis may be applied to centuries-old museum specimens.

2.5 Recent conservation measures

Activities for the ongoing restoration and conservation of Danube River sturgeons can be summarised under the following headings:

– artificial propagation and stocking,
– scientific research,
– conservation and sustainable management programmes.

2.5.1 Artificial propagation and stocking

Methods for the artificial propagation of sturgeons have been widely established throughout the world and complete guidelines are available for many species on the basis of hatchery research. These also include rare species as well as incidentally caught individual specimens (Williot *et al.* 2000). Despite a considerable hatchery routine regarding the artificial propagation of some sturgeon species used especially for aquaculture (e.g. *Acipenser ruthenus* and *Acipenser baerii*), there still are gaps in knowledge concerning the successful breeding and rearing of a lot of other species (Williot *et al*. 2002). Artificial propagation and stocking of early life stages into the river has also been conducted in the Danube River Basin.

In the Upper and Middle Danube River, recent efforts have focused on *Acipenser ruthenus*. Stocking has been conducted since the end of the 1960s in Germany, Austria, Hungary and Slovakia, where captive brood-stock of this species has also been established in various hatcheries. Stocking has included attempts to reintroduce the species in river stretches where it is extinct, as well as supportive stocking into existing populations (Reinartz 2002).

In the Lower Danube River artificial propagation and stocking have been carried out for the anadromous species *Acipenser gueldenstaedti*, *Acipenser stellatus* and *Huso huso*. In Romania, culture techniques rely on the catch of mature wild fish for reproduction and have focused on extensive raising systems in natural ponds, often as polyculture in combination with conventional pond fishes (Cyprinids).

Artificial propagation of sturgeons in Romania has been carried out by various hatcheries, especially during a governmental programme that began in 1991. In 1995, however, the subsidies for sturgeon breeding and rearing were cancelled. The programme also faced difficulties in obtaining spawning fish, especially specimens of *A. gueldenstaedti* and *H. huso* (Bacalbasa – Dobrovici & Patriche 1999).

In Bulgaria a new enterprise for the propagation of sturgeons was started at the end of the 1990s and regular introduction of sturgeon fry has been carried out for both the Danube River and the Black Sea. This stocking relies on established captive brood-stock. Current activities in Bulgaria also aim at the establishment of a living gene bank for *Acipenser nudiventris* based on the capture of wild broodstock.

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 reducing the fishing pressure on wild sturgeon stocks.

2.5.2 Scientific Research

A survey of the Lower Danube sturgeon fishery was conducted in the 1990s. Results indicated that a major sturgeon fishery still existed in the Lower Danube River, amounting to 300 metric tons per year, on average. This number is ten times higher than official estimates. The survey also provided evidence for over-exploitation of sturgeons in the Lower Danube River, with an estimated extent of poaching of up to 90 percent (Navodaru *et al*. 1999).

At the end of the 1990s a four-year biometric study of *A. stellatus* brood-fish from experimental and commercial fisheries in the Lower Danube River was conducted (Ceapa *et al*. 2002). This revealed a considerable shift towards younger animals and decrease in size of fish (mean *Tl*) – both classic signs of over-fishing (see Chapter 2.2 Over-exploitation).

Further research on the genetic variation of anadromous sturgeon species in the Lower Danube River (Suciu *et al*. 2000) generated the following results:

– all species are identifiable on the basis of genetic patterns;
– substantial micro-satellite variability was found for all species except *H. huso;*
– genetic heterogeneity among *A. stellatus* individuals suggests more than one population in the Danube River Basin;
– the genetic relationships between *A. stellatus* individuals indicate that there are three major groups; and
– comparisons of nuclear and mitochondrial DNA suggested a recent decline in *H. huso* numbers, especially females.

Tracking of adult sturgeon spawners, by means of ultrasonic tagging, was conducted in Romania in the 1990s (Kynard *et al.* 2002). The main aim of this research was to understand the movements of migratory sturgeons in the Lower Danube River (mostly *A. stellatus*) and to identify spawning sites. Most of the tagged animals were harvested or did not resume their migration after tagging, thus leaving the location of spawning sites in the Lower Danube River still undiscovered at that time and also yielding proof of the severe over-harvest of *A. stellatus*.

Subsequent research at the beginning of the millennium revealed the location of a spawning site for *H. huso* and an over-wintering site for anadromous sturgeons in the Lower Danube River.

Mark and recapture experiments on young-of-the-year (YOY) *H. huso*, also conducted in the Romanian reach of the Danube, have delivered initial results on the timing of migration, abundance, aggregation and specific growth rate of juveniles of this species. The main aim of this research is the establishment of an annual juvenile index of abundance for all migratory sturgeons in the Lower Danube River (Suciu 2005).

A literature study on the biology, status and conservation of Danube River sturgeons as a basis for restoration and conservation measures on behalf of the International Association for Danube Research (IAD), Bezirk Oberpfalz (Regional authority of Upper Palatinate/Bavaria, Germany) and Landesfischereiverband Bayern e.V. (Bavarian Fisheries Association) was completed in 2002 (Reinartz 2002).

2.5.3 Conservation and sustainable management

Though CITES quotas have been introduced, both legal catches and the high percentage of unknown illegal catches, continue to diminish sturgeon populations, and some countries are unable to fulfil their quotas any longer. 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):

> The dramatic decrease in landings of Eurasian sturgeon have been occurring in different countries under different political systems over the last hundred years. As a result, the example of the disappearance of a sturgeon resource at a given place proved to be of no help for another country. Reasons for the decline were essentially the same every where. All sturgeon populations were commercially exploited. It is noteworthy that the only recovering sturgeon population is a freshwater species, the sterlet, Acipenser ruthenus, in the Hungarian part of Danube, is now supporting a recreative fishery. From all the reported figures of sturgeon landings, none of them shows steady state landings over a period longer than ten years, that is youth for most of sturgeon. It means that none of the fisheries could be considered as having been exploited in a sustainable way for at least one biologically significant period. Thus, no reference exists of such a situation with regard to the applied management procedures. Which could be the minimum duration as representing an equilibrated management? As it was shown that detrimental effects of damming might be delayed for about 20 years (Volga example), this time span must be considered a minimum time for recovering measures. With regard to the present status of sturgeon stocks, none of the managing measures, if any, proved to be efficient. In contrast, biological and ecological knowledge were claimed to be known enough to provide suitable recommendations for a sustainable management of sturgeons populations.

This clearly reinforces the need for the current Action Plan over and above existing conservation measures.

In November 2003 the fisheries authorities and CITES Management Authorities of Bulgaria, Romania, Serbia & Montenegro and Ukraine agreed on a “Regional Strategy for the conservation and sustainable management of sturgeon populations in the North-Western Black Sea and the Lower Danube River”.

This “Regional Strategy” is a prerequisite under CITES for agreeing to annual catch and export quotas for sturgeons. The *Strategy* is comprehensive, covering information gaps in sturgeon biology and fisheries and how to address them, measures to protect sturgeons and their habitats, adaptive management, restocking and reintroduction, stock assessments, regulations and enforcement, etc. The CITES Secretariat will implement an evaluation by appropriate experts of this Regional Strategy in 2006, offering oppor-tunities to assess achievements, update the document where necessary, and align the strategy and the present Action Plan. From 2006 onwards, such an evaluation will take place every three years.

In Germany (Bavaria) a conservation programme for *Acipenser ruthenus* was initiated by the Landesfischereiverband Bayern e.V. (Bavarian Fisheries Association) in March 2005. The main aim is the restoration of this species in its former distribution area in the German stretch of the Upper Danube River.

Preparations to set up a National Action Plan for migratory sturgeons are currently underway in Serbia & Montenegro (Lenhardt *et al.* 2005).

A series of management obligations and recommendations was included in CITES Resolution Conf. 12.7 (Rev. CoP13). These include for instance: regular external reviews and updates of the regional strategies; strict timing for establishing catch and export quotas, and obligations to provide on an annual basis scientific justifications; obligations to register sturgeon production and caviar processing sites annually – all Danube riverine states have to comply with this obligation until 1st of November 2005.

Since 1971, monitoring of migrating young sturgeons has been carried out in the Ukrainian sector of the Danube River and the adjacent areas of the Black Sea shelf, which is an important nursing area for juveniles of the Danube River sturgeon species. The monitoring is conducted with special trawl nets in a standardised manner that allows gathering and comparing of reliable data on the composition of spawning species and the relative size of spawning stocks. However, the by-catch of young sturgeons in other commercial fisheries was also observed, which, for example, resulted in the closure of the *Alosa pontica* (shad) fishery in June 2002, after a considerable by-catch of YOY-sturgeons in gillnets was demonstrated.

2.6 Gaps in knowledge

Although there is a considerable body of scientific and technical information on sturgeons in general, and on Danube River species in particular, there remain important gaps. Among the key questions that should be addressed within the framework of the current Action Plan are:

– What is the reference situation for Danube River sturgeons concerning abundance, population structure, distribution, migration and habitat for the period before anthropogenic impacts on the riverine/marine system? How did these anthropogenic impacts affect sturgeon populations?
– What is the current population and exploitation status (numbers, migrations, extent of reproduction, extent of harvest) of *A. ruthenus* in the Upper and Middle Danube River since restocking was initiated, and which factors caused its extinction in the Upper Danube in the first place?
– What is the current status of *A. ruthenus* in the Lower Danube River under the influence of intensive exploitation of sturgeon stocks?
– What is the status of the potamodromous forms of *A. nudiventris* and *A. gueldenstaedti* up- and downstream of the Iron Gates dams?
– What is the current status of migratory anadromous sturgeon stocks (*A. stellatus* and *A. gueldenstaedti, H. huso*) in the Lower Danube River?
– What are the exact, current sturgeon catches of each (correctly identified) species in the Lower Danube River and the North-Western Black Sea and how do they correlate with stock status in terms of catch size, species and biometrics?
– Which key habitats and migration patterns (and reaches for both) can be identified in the life-cycle of sturgeons in the Upper, Middle, Lower Danube River and the Black Sea?
- Therefore, what conclusions can be reached concerning the exact habitat and migration requirements of sturgeons in the Danube River during the completion of their life-cycle?
– Which potential key habitats for migratory anadromous sturgeons are still available in the Middle Danube River, where are they located and how have they been affected by anthropogenic factors?
– Since biological background information concerning sturgeon husbandry/stocking is far from complete, how can Objective 7 of this Action Plan ('To re-establish extinct or near-extinct sturgeon populations in the Danube, by securing future sources of genetic material of all species and populations, by restocking and by temporal supportive stocking') be achieved when wild spawners are lacking? Because management of wild spawners, building *ex situ* functional broodstock, and fingerling rearing are not well known for all species, some time may be required to answer this question.
– Which are the best and most realistic measures of success (and/or failure) in conserving Danube sturgeons, suitable for monitoring timely and effective implementation of this Action Plan?

3. Action Plan Goal and Objectives

3.1 Goal

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.

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 a unique group of fishes alive for future generations;
– many livelihoods in the Lower Danube depend on the commercial use of sturgeons but these livelihoods are under threat due to unsustainable management of fisheries, including severe over-exploitation;
– 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.

3.2 Objectives

The Action Plan is based around 12 Objectives, which may be grouped under four general headings[4]:

Basin-wide coordination of sturgeon policy and best-practice management

In the past sturgeons were abundant throughout the entire Danube River Basin. All sturgeon species are migratory to a certain extent and will cross national borders during their migrations, therefore a basin-wide approach is vital for the success of any conservation and/or restoration measures for sturgeons.

The EU Water Framework Directive is founded on the principle that river basins (or sub-basins) – i.e. geographical and hydrological units determined

[4] The order in which these groupings are presented should not be taken to imply priority. Prioritisation is dealt with in Chapter 4.

by natural boundaries – should form the basis for integrated water resource management. This differs from the most widely followed approach until recently, which was typically based on administrative or political boundaries. Initiatives taken for the Maas, Schelde or Rhine river basins, among others, may serve as positive examples for this approach, with co-operation and joint objective-setting across Member State borders. In the case of the Rhine such cooperation also goes beyond the territory of EU Member States.

Basin-wide coordination of sturgeon conservation and restoration in the Danube River Basin is therefore consistent with the objectives of the EU-WFD, as well as with the Convention for the Protection of the Danube River.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) provides the overarching framework within which governments in the Danube Basin cooperate on trade-related issues relevant to sturgeon conservation.

Objective 1: To develop, adopt and implement a comprehensive policy on sturgeon fisheries and their management covering the whole of the Danube River Basin and the Black Sea[5].

Objective 2: To ensure that scientifically based, best-practice management of sturgeon stocks is applied throughout the Danube River Basin and in the Black Sea[5], and to initiate, support and coordinate the research required for such an approach.

Legislation and enforcement controls for sturgeon fisheries and trade

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 indicate that all sturgeon populations are near to 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 some years before a positive impact is seen and will then need to remain in place in the long term.

The adaptation of existing fisheries legislation to ecological requirements and the principles of sustainable harvesting, as well as the standardisation of

[5] While this Action Plan is primarily concerned with the Danube River Basin, the fact that most of the region's sturgeons spend an important part of their life-cycle in the Black Sea means coordination between Danube and Black Sea States of relevant policies and stock management practices is essential.

legislation and strengthening of law enforcement at international level, are further basic prerequisites for sturgeon conservation and restoration in the Danube River Basin.

Objective 3: To ensure that legislation on sturgeon fisheries and trade is being effectively implemented at national, regional and international levels throughout the Danube River Basin (including the Black Sea) and that gaps and/or obstacles to implementation are identified and addressed.

Objective 4: To reduce – and ultimately bring a stop to – illegal harvesting of sturgeons by strengthening the implementation and enforcement of fishery legislation and inspection controls at national level.

Objective 5: To improve the socio-economic conditions for local-community stakeholders involved in sturgeon fisheries.

Objective 6: To reduce significantly, and ultimately to eliminate, illegal international, national and regional trade in sturgeon products.

Conservation of sturgeon species and populations, including their genetic integrity

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 for 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.

Objective 7: To re-establish extinct or near-extinct sturgeon populations in the Danube, by securing future sources of genetic material of all species and populations, by restocking and by temporal supportive stocking.

Objective 8: To implement immediate conservation actions – and ultimately a catch moratorium – to ensure continued survival and popu-lation restoration of *A. nudiventris* and *A. gueldenstaedti*, both critically endangered.

Protection, management and restoration of sturgeon habitats, including reopening of migration routes

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 making dams in the Lower Danube passable for sturgeons. For instance, making the Iron Gates dams passable would give access to approximately 800 km 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.

The EU Water Framework Directive requires that all surface waters should be of "good ecological status", which is defined as permitting only a slight departure from the biological community that would be expected in conditions of minimal anthropogenic impact. Annex V of the WFD lists "composition, abundance and age structure" of a water body's fish fauna among the key biological elements for classifying the ecological status of surface and transitional waters. Monitoring the status of sturgeon popu-lations is clearly a significant component of assessing the overall status of the fish fauna in the Danube River Basin and can therefore be seen as having an important role to play in determination of ecological status under the WFD. It is essential that this be reflected in national/regional/River Basin District lists of indicator species for the Danube and its major tributaries.

The WFD also 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 (see Chapter 1.5), 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.

Objective 9: To re-open sturgeon migration routes by enabling upstream and downstream sturgeon passage at dams and other current barriers to sturgeon movements.

Objective 10: To implement appropriate protection, management and restoration measures for key sturgeon habitats.

Objective 11: To ensure that water quality and quantity throughout the Danube River Basin meet the conditions required for healthy sturgeon populations at all life-cycle stages.

Objective 12: To avoid further degradation of riverine ecosystems within the Danube River Basin and to ensure that the requirements of sturgeon conservation are fully integrated into implementation of the EU Water Framework Directive in the Danube River Basin.

4. Actions required for achieving the Goal and Objectives at a Danube River Basin level

This chapter presents the Actions required to achieving each of the Objectives, and ultimately the Goal of the Action Plan. A short rationale is provided for each Action (see section 3 above for a general explanation of the Objectives themselves) and the geographical applicability and sturgeon species for which the Action is relevant are also indicated. This is followed by a brief outline of what objectively verifiable 'indicators of success' might be, and a summary of the main stakeholder groups to whom the Action is addressed.

Note on 'Prioritisation and timeframe'

Immediately after the statement of each Objective is a paragraph providing general indications of the level of priority and relative timeframe attached to the Actions under the given Objective. Given the urgency of the conservation challenge in the case of Danube sturgeons, only activities that are considered high priority are included in the Action Plan. Nevertheless, some particularly stand out as requiring immediate implementation. Similarly, it is recognised that the Actions are achievable within widely varying timescales. Short-term is used to indicate a period of less than 5 years, Medium-term indicates 5 to 10 years; Long-term indicates more than 10 years.

One of the immediate steps on adoption of the Action Plan should be to secure agreement among the key stakeholders on an implementation strategy, including more detailed prioritisation, roles and responsibilities and a timeframe with clear deadlines and milestones (see Action 1.1).

By way of synthesis, the most important and urgent Objectives/Actions are indicated below in the Table 3. It is clear that issues of timing and resourcing must be agreed jointly by the countries of the Danube River Basin. However,

the table contains those elements of the plan that appear most urgent to relieve the fishing pressure and to ensure protection and progressive restoration of sturgeon migration routes and habitats. Without such measures, it is likely that sturgeons will disappear from the Danube Basin.

Table 3: Proposed prioritisation of objectives/actions

– 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 and in a further step Gabčíkovo dam passable for sturgeons (feasibility study, planning and implementation of migratory facilities) (*Objective 9, Actions 9.1-9.6*) – 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 (*Objectives 4*) – Socio-economic improvement in the Lower Danube achieved (*Objectives 5*)

Note on correspondence with existing 'Regional Strategy for the Conservation and Sustainable Management of Sturgeon Populations of the North-West Black Sea and Lower Danube River in accordance with CITES' agreed in 2003 by Bulgaria, Romania, Serbia & Montenegro, and Ukraine: a comparison has been made between the present Danube-wide Action Plan and the 2003 Regional Strategy. Where there is significant correspondence between the two documents, the relevant 'Item' of the Regional Strategy is noted in square brackets in the tables below, either immediately after the 'Objective' or in the 'Action' column.

Note on 'Geographical applicability'

Under this heading, 'Whole Danube Basin' is used to indicate an Action that applies to the territory historically inhabited by sturgeons within the hydrological catchment of the Danube River Basin. This includes the Danube River itself and all tributaries and sub-tributaries in which sturgeons occur or formerly occurred. Where Actions are addressed to governments in the

'Whole Danube Basin' this includes all states whose territory includes the current and former distribution of sturgeons, in alphabetical order: Austria, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Romania, Serbia & Montenegro, Slovak Republic, Slovenia and Ukraine. This effectively encompasses all ICPDR Member States. Use of the terms 'Upper', 'Middle' and 'Lower' Danube Basin follows the widely used convention of dividing the Danube River and its major tributaries into three parts: namely upstream of the Gabčíkovo Dam (= Upper Danube), between the Gabčíkovo Dam and the Iron Gates dams (= Middle Danube), and between the Iron Gates dams and the Black Sea (= Lower Danube).

Note on the role of the ICPDR

The role of the ICPDR in the implementation of the Action Plan has not yet been discussed among the Contracting Parties. Until such time as the Action Plan has been endorsed by the Contracting Parties all references to the ICPDR should be considered as provisional.

Objectives

[NB: The tables are to be read over both even and odd pages]

Objective 1: To develop, adopt and implement a comprehensive policy Danube River Basin and the Black Sea	
Prioritisation and timeframe: all Actions under this Objective are considered to effective implementation of the rest of the Action Plan will flow. While all should less, Action 1.1 should be completed within two years.	
Action	**Rationale**
Action 1.1 Ensure adoption and adequate resourcing by all Danube Basin states, of this Action Plan (under the Bern Convention), and, through a Danube Basin-wide intergovernmental agreement, appoint an international body charged with coordinating and monitoring its implementation, including definition of an implementation strategy (with clear assignment of deadlines, milestones, roles and responsibilities).	The Action Plan will only be meaningful if it is adopted, resourced and implemented effectively. The latter depends on basin-wide intergovernmental agreement, together with effective coordination and monitoring.
Action 1.2 Undertake a rapid assessment of existing national and international policy requirements (including *inter alia* fishery management and control policy) relevant to the conservation and management of sturgeon populations and the extent to which these are currently harmonised within the Danube Basin.	This action will provide the necessary basis for Action 1.1 and support other proposed Actions.
Action 1.3 Ensure that the existing Regional Strategy for the Conservation and Sustainable Management of Sturgeon Populations of the North-West Black Sea and Lower Danube River in accordance with CITES agreed in 2003 by Bulgaria, Romania, Serbia & Montenegro, and Ukraine is compatible with this Action Plan.	The synergies derived from compatibility between this Action Plan and the Regional Strategy will enable more effective implementation and strengthening of both and more efficient use of resources.
Action 1.4 Ensure that the relevant range states (Bulgaria, Romania, Serbia & Montenegro and Ukraine) collaborate fully in evaluating the Regional Strategy in the context of this Action Plan. [Regional Strategy: Item 3/ Objective 3.1]	The Regional Strategy will be revised by experts and the CITES Secretariat in 2006. This will allow for the coordinated implementation of the Regional Strategy and Action Plan, as referred to in Action 1.3.
Action 1.5 Foster convergence between existing (and newly emerging) national sturgeon action plans/programmes and this international Action Plan. [Regional Strategy: Item 2/ Objective 2.1]	Effective action, and efficient use of resources, will not be achieved at Basin level if national efforts are poorly coordinated. This Action is closely linked to Action 1.4.

on sturgeon fisheries and their management covering the whole of the			
warrant immediate implementation, given that they provide the basis from which therefore be considered 'short term', i.e. achieved within a period of five years or			
Geographical applicability	**Relevant species**	**Indicator(s) of success**	**Action addressed mainly to**
Whole Danube Basin.	All species.	Plan adopted in the framework of Bern Convention. Agreement on sturgeons signed by all Danube states. Coordinating/monitoring body appointed and functioning (see also Action 2.1). Implementation strategy with clear deadlines, milestones, roles and responsibilities – agreed and published.	Council of Europe / Bern Convention to initiate action. All Danube Basin states, Council of Europe, ICPDR. Existing legal and institutional arrangements could be used to provide the frameworks for both the agreement coordinating/ monitoring body.
Whole Danube Basin.	All species.	Assessment published and made freely available on line.	All Danube Basin states, Council of Europe; ICPDR could assist with facilitating the process.
Lower Danube	All species.	Common priority actions are agreed under both initiatives and the revision of the Regional Strategy in 2006 ensures compatibility with the Action Plan.	Governments and government agencies, CITES authorities in Lower Danube states; CITES Secretariat and other inter-governmental bodies, experts (scientists, technicians), NGOs.
Lower Danube	All species.	Implementation of Regional Strategy assessed by relevant experts and the CITES Secretariat; results taken into consideration for a revised Regional Strategy; measures to address shortcomings identified and communicated to relevant range States; implementation plan agreed with these states. New evaluation in 2009.	CITES authorities in relevant Lower Danube states; sturgeon experts; the CITES Secretariat; relevant government agencies and inter-governmental bodies.
Whole Danube Basin.	All species.	All relevant range states commit to ensuring convergence.	Governments, government agencies, fisheries, research institutes.

Objective 2: To ensure that scientifically based, best-practice management the Black Sea and to initiate, support and coordinate the research required [Regional Strategy: Item 1.1]		
Prioritisation and timeframe: effective coordination of research and monitoring for its wider implementation. All Actions under this Objective require immediate objective, scientifically based quotas are set. The urgency for this Action means within 5 years).		
Action	**Rationale**	**Geographical applicability**
Action 2.1 Ensure permanent coordinated basin-wide research and monitoring activities, (covering *inter alia* habitat use, migration, population dynamics, genetics, fisheries and trade) that directly support this Action Plan. [Regional Strategy: Item 1.1, parts of Items 1.2, 1.4, 1.5]	Sound and objective scientific data are essential for planning, implementing and monitoring all measures set out in this Action Plan, notably adaptive management of sturgeon stocks.	Whole Danube Basin and relevant parts of the Black Sea.
Action 2.2 Establish an international database as the central repository for information on Danube sturgeons (drawing in particular on the data generated under Actions 2.3 to 2.6). Promote the contribution of information by the scientific and commercial sector. [Regional Strategy: Item 1.4]	Data are currently fragmented, difficult to access and not peer reviewed. Valuable 'grey' literature is not always available to researchers and decision makers. Language limits access to local information.	Whole Danube basin.
Action 2.3 Assess the level of sturgeon bycatch in Black Sea coastal fisheries. [Regional Strategy: Item 1.4]	The extent to which marine fisheries pose a threat to sturgeon stocks is unknown and needs to be understood to develop appropriate management plans.	Bulgaria, Romania Ukraine and other (non-Danube) Black Sea littoral states.
Action 2.4 Develop and implement a Danube Basin-wide sturgeon stock assessment system capable of providing the information required to design, implement and monitor appropriate management interventions (particularly for critically endangered species and populations) including fishing quotas and re-stocking plans. [Regional Strategy: Items 1.1, 1.5]	This Action Plan largely depends on the availability of reliable and regularly updated assessments for stocks of all Danube sturgeon species, e.g. in order to ensure that the setting of harvest quotas does not threaten sturgeon stocks and in compliance with CITES provisions concerning international trade in sturgeon products.	Whole Danube Basin.

of sturgeon stocks is applied throughout the Danube River Basin and in for such an approach.		
activities, targeted towards implementation of the Action Plan, is a prerequisite attention, but the primary aim should be completion of Action 2.6, whereby that every effort must be made to secure implementation in the short term (i.e.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Research priorities identified and allocated to research bodies, funding needs identified, and a timeframe for their implementation agreed to by all relevant riverine states and institutions. Designated institutions working jointly on stock and habitat assessments, using agreed international standards and methodologies. Coordinating body (see Action 1.1) overseeing relevant research and monitoring activities.	Governments and government agencies, research institutes, international bodies (FAO, IUCN, WSCS etc.) IAD.
All species.	Content, language, structure and location of data-base agreed. Information is continuously compiled passively and pro-actively, and the database is populated with all published information relevant to sturgeons in the Danube River. Agreement reached on provision of and access to data, based on the principle of equitable access to all Action Plan stakeholders. Simple guides to use and promote database are available in all riverine states in local languages and relevant research institutions. Database operational.	Governments and government agencies, research institutes, private sector, NGOs.
All species except *A. ruthenus*, which is confined to fresh water.	Formal by-catch reporting system adopted and mechanisms – including incentive measures – to minimise by-catch agreed to. Awareness raised among marine fishermen. By-catch data available and taken into considera-tion when establishing harvest and export quotas.	Governments and government agencies responsible for marine fisheries; CITES Management Authorities; UNEP Black Sea Regional Programme, FAO.
All species.	Inception workshop held. Appropriate software, data requirements and sampling procedures identified. Stock assessment procedures established, agreed and applied by all riverine states on an annual basis.	Governments and government agencies responsible for fisheries; research institutes, international bodies (e.g. ICPDR, FAO, CITES Secretariat, Black Sea Environ-ment Programme).

Objective 2: To ensure that scientifically based, best-practice management the Black Sea and to initiate, support and coordinate the research required [Regional Strategy: Item 1.1]		
Prioritisation and timeframe: effective coordination of research and monitoring for its wider implementation. All Actions under this Objective require immediate objective, scientifically based quotas are set. The urgency for this Action means within 5 years).		
Action	**Rationale**	**Geographical applicability**
Action 2.5 Agree and adopt fishing seasons, catch limits, size limits etc. according to objective scientific advice (essentially based on the outputs of Action 2.4). [Regional Strategy: Item 1.6]	There is a clear need for more harmonised and scientifically managed regulation of sturgeon fisheries. This may include agreements on temporary catch moratoria for certain species.	Whole Danube Basin and relevant parts of the Black Sea.
Action 2.6 Identify and implement means of involving fishery communities in sturgeon management and conservation.	Increased stakeholder involvement is likely to promote greater commitment to implementing conservation-related measures.	Whole Danube Basin and Black Sea.

of sturgeon stocks is applied throughout the Danube River Basin and in for such an approach.		
activities, targeted towards implementation of the Action Plan, is a prerequisite attention, but the primary aim should be completion of Action 2.6, whereby that every effort must be made to secure implementation in the short term (i.e.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Protocol to calculate the level of catch, in accordance with the conditions in the Danube Basin agreed, adopted and applied by all relevant Danube riverine states. Full compliance ensured with CITES provisions on the establishment and communication of annual catch and harvest quotas. New or amended regulations on sturgeon fishery adopted as necessary.	Governments and government agencies responsible for fisheries; research institutes; CITES Management Authorities; international bodies (e.g. ICPDR, FAO, CITES Secretariat, Black Sea Environment Programme).
All species.	Attitudinal indicators developed (in co-operation with sociological and economic experts) and measured over time following targeted outreach activities and information sessions.	Governments and government agencies responsible for fisheries; fishery communities, NGOs.

Objective 3: To ensure that legislation on sturgeon fisheries and trade levels throughout the Danube River Basin (including the Black Sea) and [Regional Strategy: Item 1.6]	
Prioritisation and timeframe: as with Objectives 1 and 2, this Objective seeks to priority Actions, but it would probably be unrealistic to expect that all significant effective implementation/enforcement of existing instruments.	
Action	**Rationale**
Action 3.1 Ensure the enforcement of existing national legislation and multinational agreements, with special regard to CITES and the Regional Strategy for the Conservation and Sustainable Management of Sturgeon Populations of the North-West Black Sea and Lower Danube River in accordance with CITES.	It is essential that measures are taken to secure effective implementation of existing national, regional and international legal instruments for sturgeon conservation. Gaps and obstacles (see Action 3.2 should be assessed in parallel).
Action 3.2 Assess against the requirements of this Action Plan the adequacy (completeness, coherence, harmonisation) of both national and international legal instruments relating to sturgeon conservation, fisheries and trade, the protection and restoration of sturgeon habitats etc. Identify key gaps, obstacles to implementation and make recommendations for measures to address these gaps and obstacles. [Regional Strategy: parts of Item 1.6, 1.7 and 2]	There are numerous potentially overlapping or conflicting legal instruments at different levels, while in certain Danube States legislation is insufficient to ensure the adequate implementation of the Action Plan.
Action 3.3 Ensure that representatives of key stakeholders are consulted and proactively involved in the preparation of any new sturgeon-specific legal instruments, and/or revision of existing instruments, whether at national or international level.	Stakeholder involvement is likely to ensure that all key issues are covered and to promote commitment to implementation.
Action 3.4 Secure inclusion of sturgeons in Annexes II and IV of the EU Habitats Directive and the implementation of corresponding measures by Member States to achieve 'favourable conservation status' for these species.	Most Danube sturgeon species are currently included under Annex V (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures). This may appear to suggest that the conservation status of sturgeons is less precarious than it really is. It also restricts significantly the availability of EU LIFE funding under current criteria.

is being effectively implemented at national, regional and international that gaps and/or obstacles to implementation are identified and addressed.
underpin implementation of the Action Plan as a whole. These are therefore high legislative gaps will be filled in the short term. Highest priority should go to

Geographical applicability	Relevant species	Indicator(s) of success	Action addressed mainly to
Whole Danube Basin.	All species.	Independent assessment of effectiveness of existing legal measures, taking into account CITES national reports, information from TRAFFIC; national reports under the Regional Strategy etc.	Governments and government agencies, convention secretariats, ICPDR
Whole Danube Basin.	All species.	Key gaps identified and recommendations for measures to address these gaps published. Progress in acting upon the gap analysis assessed and reported on every three years, notably to the governments, the Council of Europe and the CITES Secretariat.	Governments and government agencies, Council of Europe, ICPDR.
Whole Danube Basin.	All species.	Attitude testing developed to assess and monitor degree to which involvement is perceived by key stakeholders.	Governments and government agencies, fisheries, local government, Council of Europe, ICPDR, NGOs.
EU Member States and Accession Countries and – potentially – Neighbouring Countries.	All species.	Amendments to Annexes II and IV are formally adopted to include all Danube sturgeon species	Governments, European Commission, European Parliament Council of Europe.

Objective 4: To reduce – and ultimately bring a stop to – illegal harvesting fishery legislation and inspection controls at national level.		
Prioritisation and timeframe: this is another set of Actions which are all vitally depends largely on the groundwork laid through (eg Objectives 1-3) it is probably		
Action	**Rationale**	**Geographical applicability**
Action 4.1 Develop tools for monitoring effectiveness and enforcement of legal instruments and control measures relating to sturgeon fisheries. [Regional Strategy: part of Item 2]	Legal instruments have no value unless they are effective and properly enforced.	Whole Danube Basin.
Action 4.2 Allocate the necessary resources (human, technical and financial) for effective enforcement of sturgeon fishery regulations. [Regional Strategy: part of Item 3]	Insufficient resources are currently allocated to enforcement.	Lower Danube (Bulgaria, Moldova, Romania, Serbia & Montenegro, Ukraine) for fisheries enforcement; basin-wide for trade issues.
Action 4.3 Improve coordination and cooperation between key bodies (e.g. police, fisheries associations, NGOs, researchers) involved in controlling/ regulating fisheries.	In most countries, several agencies are nominally in charge of controlling sturgeon fisheries and trade, but collaboration is often minimal. Strengthening links will ensure that enforcement activities are more efficient.	Lower Danube (Bulgaria, Moldova, Romania, Serbia & Montenegro, Ukraine) for fisheries enforcement; basin-wide for trade issues.
Action 4.4 Provide continuous training and capacity building to enforcement agencies.	Enforcement capacity is weak in many countries of the region.	Lower Danube (Bulgaria, Moldova, Romania, Serbia & Montenegro, Ukraine) for fisheries enforcement; basin-wide for trade issues.
Action 4.5 Identify incentives for fishermen and fishing companies and the sturgeon industry to operate an effective system of self-regulation.	There is a lack of existing incentives for the private sector to engage in sturgeon stock management measures.	Whole Danube Basin.

of sturgeons by strengthening the implementation and enforcement of		
important for realising the Goal of this Action Plan. However, since this Objective most realistic to view its realisation as medium to long term (5-10 years or more).		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Monitoring tools identified and applied by relevant agencies in all riverine states. Information regularly exchanged between states and used to improve legal instruments and controls via the coordinating/monitoring body established in Action 1.1.	All Danube Basin states, CITES Secretariat, Council of Europe, ICPDR (potential for assistance with coordination).
All species.	Relevant states have established what resources are required, and have taken steps to ensure that the necessary resources are allocated.	National governments.
All species.	Teams of fisheries inspectors and customs officers created in each range state and working jointly on investigating sturgeon fisheries and trade. Investigation results and report outcomes exchanged on a regular basis.	Government agencies, CITES Secretariat, Interpol, World Customs Organisation (WCO), IUCN, TRAFFIC
All species.	Targeted training materials in local languages available to relevant enforcement agencies. Materials updated every two years. Training is provided to Members of dedicated fisheries inspection teams on an annual basis. Multinational training courses provided every two years, targeting specifically cross-border situations and international trade.	National governments, Interpol, WCO, CITES Secretariat.
All species.	Increased sense of ownership of fishing companies and communities by giving them more responsibility over the fishing of sturgeons, including control. Socio-economic incentives identified in close collaboration with the relevant stakeholders. Targeted outreach programmes implemented to enhance responsible fisheries and sturgeon production and processing. Regular communication ensured with the private sector on the status of sturgeons and the sturgeon industry.	National governments, fishing companies and cooperatives.

Objective 4: To reduce – and ultimately bring a stop to – illegal harvesting fishery legislation and inspection controls at national level.		
Prioritisation and timeframe: this is another set of Actions which are all vitally depends largely on the groundwork laid through (eg Objectives 1-3) it is probably		
Action	**Rationale**	**Geographical applicability**
Action 4.6 In concurrence with Actions identified under Objective 2, maintain efficient electronic data storage and exchange mechanisms for information on sturgeon fishery management, including violations of laws and regulations. [Regional Strategy: parts of Items 1.4 and 1.6]	Provision of a technical tool for information sharing on cases of illegal catch and trade. Reach political will and tools to exchange information on cross-border poaching and smuggling.	Lower Danube (incl. Bulgaria, Moldova, Serbia Montenegro, Romania, Ukraine) particularly. Basin wide for international trade issues.

of sturgeons by strengthening the implementation and enforcement of		
important for realising the Goal of this Action Plan. However, since this Objective most realistic to view its realisation as medium to long term (5-10 years or more).		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Information accessible by all Danube countries on sturgeon management and fisheries, including instances of illegal fishing or trade, and information that Parties to CITES need to provide on a regular basis to the CITES Secretariat. Database of cases of poaching and smuggling (seizures, confiscation) detected in the basin created and officially adopted by all states. Bi- or multilateral agreement(s) adopted for official exchange, between customs and police of confidential information on sturgeon catch and trade.	Governments and government agencies, CITES Secretariat, UNEP/WCMC (World Conservation Monitoring. Centre), TRAFFIC, Interpol, WCO, NGOs.

Objective 5: To improve the socio-economic conditions for local-commu-		
Prioritisation and timeframe: certain activities (e.g. Action 5.1) are relatively (e.g. Action 5.2) require much longer-term engagement. Given that over-fishing is local communities, addressing the socio-economic context must be a high priority.		
Action	**Rationale**	**Geographical applicability**
Action 5.1 Undertake a rapid assessment of 'chains of custody' in sturgeon fisheries and product markets. [Regional Strategy: part of Item 1.7]	There is a lack of knowledge concerning the economics of sturgeon fisheries and markets. This action would provide better understanding of the socio-economic context and help identify priority areas for intervention.	All Danube Basin countries that have markets in sturgeon products, but especially the Lower Danube.
Action 5.2 Create alternative income sources (e.g. through tourism and sport fishing) for local fishermen where fishing poses a threat to sturgeons.	Economic pressure and lack of existing alternatives encourage over-fishing and poaching.	Lower Danube.
Action 5.3 Promote fair and equitable access to legal sturgeon fisheries through an appropriate and effectively enforced licensing system.	Fishermen's access to sturgeon catches is currently highly biased and subject to corruption.	Lower Danube.
Action 5.4 Restructure the sturgeon market to ensure that income from legal catches and trade benefits more local communities.	Benefit from sturgeon products are currently distributed inequitably. If local communities benefit, there is an incentive to adopt sustainable fishery practices.	Lower Danube.
Action 5.5 Ensure that a higher proportion of sturgeon products are processed at local community level, and that value is added e.g. through development of new sturgeon products.	Increased income from sturgeon processing will provide a greater economic incentive for sustainable exploitation of stocks.	Whole Danube Basin.

nity stakeholders involved in sturgeon fisheries.		
straightforward and can be completed within a short period of time, while others driven to some extent by a lack of alternative income-generating options for		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species, though with main focus on *Acipenser gueldenstaedti*, *A. stellatus* and *Huso huso*.	Areas for improvement in the structure of the fishery and marketing clearly identified.	Governments and government agencies, fishery and caviar companies, fishermen's associations; TRAFFIC, CITES Secretariat.
All species, though with main focus on *Acipenser gueldenstaedti*, *A. stellatus* and *Huso huso*.	Levels of inward investment into other sectors; number of new jobs available to members of local communities. Number of people dependent on sturgeon fisheries reduced.	National and local levels of government, private sector.
All species, though with main focus on *Acipenser gueldenstaedti*, *A. stellatus* and *Huso huso*.	Monitoring data show that fishermen are gaining more equitable access to sturgeon fisheries (assumes monitoring is in place).	Government agencies and local communities (especially in Romania).
All species, though with main focus on *Acipenser gueldenstaedti*, *A. stellatus* and *Huso huso*.	More balanced distribution of benefit from sturgeon fishery, processing and marketing.	Governments (especially Ukraine), fishery and caviar industries.
All species.	Market monitoring data show that higher market values are obtained for existing products and markets are created for 'new' sturgeon products (e.g. leather, cartilage, isinglass, sturgeon trophies).	Sturgeon fishery and processing industries, fishing communities and associations, governments and government agencies (e.g. those dealing with trade)

Objective 6: To reduce significantly, and ultimately to eliminate, illegal inter- **[Regional Strategy: items 1.6, 1.7]**		
Prioritisation and timeframe: Illegal international trade is a key diver of over- priorities for the whole Action Plan. However, given the complex factors involved, to long-term outcome (5-10 years or longer).		
Action	**Rationale**	**Geographical applicability**
Action 6.1 Develop a DNA-based identification system for sturgeon and its products in trade. [Regional Strategy: part of Item 1.6]	Currently it is often impossible to distinguish sturgeon products from those of other species. This Action will enable identification of caviar in trade, including means of distinguishing between products from wild and farmed sources.	Whole Danube Basin.
Action 6.2 Implement individual marking of fish as a measure to control the legal catch.	Improving the traceability of caviar and other sturgeon products, and identifying the fish through the whole chain of custody will facilitate controls of domestic and international markets.	Danube Countries that allow fishing of sturgeons.
Action 6.3 Implement and enforce the CITES universal caviar labelling system. [Regional Strategy: part of Item 1.6]	Current lack of means to allow for the traceability of caviar and other sturgeon products, identifying the fish through the whole chain of custody.	All Danube countries.
Action 6.4 Initiate intergovern- mental consultation to explore the feasibility of a verification system for CITES documents.	It is presently difficult to immediately verify if annual export quotas are being exceeded or if fraudulent re-export or import is occurring. The CITES Parties agreed that there was a need for assessing if real-time monitoring and control of CITES documents and level of trade during the year would be feasible.	Whole Danube Basin.
Action 6.5 Assess and monitor the domestic market including the chain from fishermen to restaurants sellers and exporters of products (volumes, value, prac-tices etc.).	In the absence of knowledge of volumes of caviar legally or illegally consumed domestically, no accurate estimate can be made of the impact of trade on sturgeon populations. This action provides the baseline for further steps.	All countries, particularly the Lower Danube.
Action 6.6 Provide adequate resources and build necessary capacity for authorities to control the trade effectively (including customs, police, food inspectors etc.)	Current insufficient knowledge of police and customs officers.	Current insufficient knowledge of police and customs officers.

national, national and regional trade in sturgeon products.		
exploitation of Danube sturgeons. Pursuit of this Objective is one of the highest significant progress towards elimination of illegal trade is realistically a medium-		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All commercially exploited species.	Set of reference tissue samples of all Danube sturgeon species and populations available for verification by forensic analysis. An operational identification system in place by 2007.	IUCN, CITES Secretariat, Danube Delta Institute etc.
All commercially exploited species.	Measures adopted to link the distribution of officially registered coded tags with the catch quota allocated to a fishing company and/or community/association.	Government agencies, fishing companies and communities/ associations from both processing and trade sectors.
All commercially exploited species.	Legislation in place and processing/trading companies participating in the production and affixing of CITES labels on all caviar containers. All caviar on sale in Danube river countries is labelled in accordance with CITES. An information campaign targeting caviar consumers raises their awareness respectively the importance of labels.	Government agencies, fishing companies and communities/ associations from both processing and trade sectors, NGOs.
All commercially exploited species.	Pending feasibility, electronic scanning and related database of CITES documents designed to accurately estimate the level of caviar export of the year and verify the validity of CITES re-export from a particular shipment exported. [see CITES Decisions 13.44 to 13.47]	Government agencies, UNEP World Conservation Monitoring Centre, CITES Secretariat.
All commercially exploited species.	Data on domestic markets available, analysed and published on line.	Government agencies, local governments.
All commercially exploited species.	Increase of well-trained staff, of adequate identification materials (guides/manuals), of targeted controls at borders and within each country.	National governments.

Objective 6: To reduce significantly, and ultimately to eliminate, illegal inter- **[Regional Strategy: items 1.6, 1.7]**		
Prioritisation and timeframe: Illegal international trade is a key diver of over-priorities for the whole Action Plan. However, given the complex factors involved, to long-term outcome (5-10 years or longer).		
Action	**Rationale**	**Geographical applicability**
Action 6.7 Establish and submit catch and export quotas in a timely manner as required by CITES.	Sturgeon catch and export quotas must be known prior to the beginning of the year in order to justify the issuance of CITES permits.	Whole Danube Basin.
Action 6.8 Register and compile a list of fishing, processing and trading companies, in compliance with CITES provisions.	Need for customs and police officers to verify company codes appearing on caviar labels.	Whole Danube Basin.
Action 6.9 Identify and implement measures (e.g. 'green' labelling) to raise awareness of sturgeon conservation issues among international and national consumers of sturgeon products (including health risks from illegal products).	Such measures may lead to increased pressure for retailers to prove the legality of sturgeon products.	Regional and international markets.

national, national and regional trade in sturgeon products.		
exploitation of Danube sturgeons. Pursuit of this Objective is one of the highest significant progress towards elimination of illegal trade is realistically a medium-		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All commercially exploited species.	Annual export quotas and all baseline information on status of stocks and other necessary information are submitted to the CITES Secretariat within the agreed annual timeframes. The Secretariat evaluates the information and published the quotas. The relevant range States assess the possibility to regularly make available the information they submit to justify catch and export quotas.	CITES Management and Scientific Authorities, CITES Secretariat.
All commercially exploited species.	List of registered fishing, processing and trading companies submitted to the CITES Secretariat by all range States and CITES trading countries, regularly updated and annually published. The list forms the basis for targeted outreach activities, information sharing, education and the activities relevant to the private sector mentioned under Objectives 4, 5, and 6.	CITES Secretariat, CITES Management Authorities.
All commercially exploited species.	Green label concept defined, established, officially approved by governments or authorised body, and made available to the private sector. The 'green labels' are compatible with and strengthen the CITES universal labelling requirements for caviar. Targeted consumer campaigns to encourage the consumption of labelled sturgeon products. Shift in consumer behaviour measured, and appropriate measures agreed to strengthen 'green' consumption pattern. (see also Action 6.3 CITES labels).	Governments, private sector, NGOs, consumer associations.

Objective 7: To re-establish extinct or near-extinct sturgeon populations in and populations, by restocking and by temporal supportive stocking. **[Regional Strategy: part of Item 1.3]**		
Prioritisation and timeframe: all of these Actions are effectively emergency the necessary basis for urgent restocking measures. However, given that restocking future, these actions imply commitment to applied research and monitoring over the		
Action	**Rationale**	**Geographical applicability**
Action 7.1 Establish live gene banks in combination with Action 6.1 (DNA-based identification system for sturgeon and its products).	A representative (reference) sample for each species and population must be collected and stored. To avoid genetic pollution, management of Danube sturgeon populations should take guidelines on conservation genetics fully into account.	Whole Danube Basin.
Action 7.2 Establish sperm and tissue banks. [Regional Strategy: part of Item 1.3]	A representative (reference) sample for each species and population must be collected and stored. To avoid genetic pollution, management of Danube sturgeon populations should take guidelines on conservation genetics fully into account.	Whole Danube Basin.
Action 7.3 Make a list of all hatcheries that rear sturgeon (including any outside of the Danube River Basin)**.**	This information may help to preserve genetic integrity locally. CITES Parties are obliged to license legal sturgeon exporters (including e.g. hatcheries that export live fish) and processing plants, and to make this information available to the Secretariat by 30 November of each year for publication.	Within and outside the Danube Basin.
Action 7.4 Conduct genetic analysis and inventory of captive brood stock (*ex-situ* population) in all hatcheries with the following component steps: (a) Collect fin samples; (b) Agree protocol for uniform DNA analysis; (c) Conduct laboratory analysis; (d) Compile, evaluate and publish directory of genetic diversity.	(a)Provides material for genetic sampling (b) Uniform criteria (c) Database (d) Help planning of sound management.	Whole Danube Basin.
Action 7.5 Share information on breeding techniques, equipment etc.	To derive later on a standard protocol (quality of fingerlings and recruitment).	Within and outside the Danube Basin.
Action 7.6 Collect information on stocking (e.g. quantity, size of fish, timing, location). [Regional Strategy: part of Item 1.3]	To optimise utility of the produced stocking material.	Whole Danube Basin.

the Danube, by securing future sources of genetic material of all species		
responses, for which immediate implementation is required, because they provide measures. However, given that restocking will be needed for the foreseeable long term.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	The necessary facilities established in the Danube River Basin, and coordination between them ensured.	Fishery authorities, ministries, private hatcheries, universities, research institutions.
All species.	One central sperm/tissue bank established and fully operational.	Fishery authorities, ICPDR.
All species.	Hatchery monitoring is in place. No non-Danube species permitted within the Danube River Basin at sites where access to rivers is possible. All Danube countries comply with the CITES Registration and licensing schemes.	Private sector, Governments, government agencies, ICPDR. CITES Management Authorities; CITES Secretariat
All species.	(a) 200-500 samples per species (b) Written material published (c) Analysed and characterised genetic structure and diversity (d) Written published monography, distributed to all stakeholders in the region.	(a) Same staff making the stock assessment; (b) Steering committee (to be established); (c) Universities and institutes; (d) All fisheries and environmental authorities, universities, institutes.
All species.	Information being shared on a regular and timely basis.	Fisheries authorities, hatcheries, research institutes etc.
All species.	Regularly updated information is made publicly available and is readily accessible,	Fisheries authorities, hatcheries, research institutes etc.

Objective 7: To re-establish extinct or near-extinct sturgeon populations in and populations, by restocking and by temporal supportive stocking. **[Regional Strategy: part of Item 1.3]**		
Prioritisation and timeframe: all of these Actions are effectively emergency the necessary basis for urgent restocking measures. However, given that restocking future, these actions imply commitment to applied research and monitoring over the		
Action	**Rationale**	**Geographical applicability**
Action 7.7 Publish code of conduct to prevent disease spread.	Hygiene is essential to preventing the spread of disease which may enter wild populations from hatcheries.	Whole Danube Basin.
Action 7.8 Develop a re-stocking plan (perhaps on the basis of a technical workshop/conference) and code of practice for sturgeon in the Danube. [Regional Strategy: part of Item 1.3]	Standardisation of procedures and coordinate effective implementation.	Danube – initially in selected area with the ultimate aim of system wide coverage. Priorities for site selection will be determined as part of the restocking plan based on the habitat information.
Action 7.9 Implement, monitor and adjust, as appropriate, the restocking plan. [Regional Strategy: part of Item 1.3]	To document success and failure and then understand necessary improvement actions (adaptive management).	Whole Danube Basin.
Action 7.10 In addition to Action 7.2 develop/adapt uniparental propagation methods for the most endangered species, in order to be able to conduct propagations even in the case of only one breeder of the species, e.g. *A. nudiventris*	In the case of species and forms close to extinction, uniparental propagation would provide a final 'last resort' conservation measure.	Whole Danube Basin.

the Danube, by securing future sources of genetic material of all species		
responses, for which immediate implementation is required, because they provide measures. However, given that restocking will be needed for the foreseeable long term.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Distribute completed code in local language versions.	Authorities, aquarium and garden pond trade.
All species.	Restocking plan and code of practice are agreed among stakeholders, published and periodically updated in response to Action 7.9.	All stakeholders involved in sturgeon conservation.
All species.	Annual reports of fishery authorities confirm that restocking plan is being implemented and adaptive management of the plan applied.	Hatcheries and governments to lead. Main implementation will be realised by the respective fisheries institutions (mainly government-supported)
All extremely rare species.	Technique successfully developed and shared within the research community.	Research institutes, fisheries.

Objective 8: To implement immediate actions – and ultimately a catch mora- *A. nidiventris* and *A. gueldenstaedti*, both critically endangered. **[Regional Strategy: part of Item 1.3]**		
Prioritisation and timeframe: emergency activities (especially Actions 8.3 and 8.4) order to avoid extinction in the wild of either species.		
Action	**Rationale**	**Geographical applicability**
Action 8.1 Undertake targeted awareness campaigns (adapted to key stakeholder groups) focusing on the status of, and threats to, both species in the Danube Basin.	Support for conservation and restoration actions is more likely to be generated on the basis of stakeholder awareness.	Middle and Lower Danube.
Action 8.2 Provide information and feed-back to all Danube fishermen in local languages.	Ensure collection of genetic material of species on edge of extinction.	Middle and Lower Danube.
Action 8.3 Agree protocols for special hatchery procedures to be used in Action 8.4.	Ensure effective, co-ordinated action.	Middle and Lower Danube.
Action 8.4 Collect fish from the wild and apply special hatchery procedures for breeding from the captive stock (see also Actions under Objective 7).	Restore populations.	Middle and Lower Danube.
Action 8.5 Take the precarious status of the two species into consideration when agreeing on annual catch and export quotas, including the possible introduction of a moratorium on catching either species.	Lower Danube riverine states already ban the commercial fishing of *A. nudi-ventris* with the exception of the catch of a small number of live fish for aqua-culture and restocking purposes.	Lower Danube.

-torium – to ensure the continued survival and population restoration of		
that require immediate implementation and completion as rapidly as possible in		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
A. nudiventris, *A. gueldenstaedti*.	Materials produced, translated and distributed. Attitude of target audiences evaluated after one year, and campaign adapted or repeated as necessary.	Public, authorities, NGOs.
A. nudiventris, *A. gueldenstaedti*.	Fishermen contacting relevant agencies in order to report the catch of either species (focal point to be established in each country).	Fishermen, fishery authorities, focal points.
A. nudiventris, *A. gueldenstaedti*.	Protocols approved by authorities.	University of Veszprem, Hungary.
A. nudiventris, *A. gueldenstaedti*.	Genes of living fish present in gene banks.	University of Veszprem, Hungary, working with local partners.
A. nudiventris, *A. gueldenstaedti*.	The total allowable catch of *A. nudiventris* and *A. gueldenstaedti* takes into consideration the conservation status of the species. The ban on commercial catches of *A. nudiventris* is maintained and a temporary catch moratorium for *A. gueldenstaedti* is considered. Catches of both species contribute to restocking programmes.	

Objective 9: To re-open sturgeon migration routes by enabling upstream sturgeons movements. **[Regional Strategy: part of Item 1.2]**		
Prioritisation and timeframe: restoration of upstream and downstream migration is progress needs to be made with implementation of all Actions and it is considered at the longest (i.e. within 5-10 years).		
Action	**Rationale**	**Geographical applicability**
Action 9.1 Conduct feasibility studies for upstream and downstream fish passage at Iron Gates dams I & II. [Regional Strategy: part of Item 1.2]	The Iron Gates dams block movements of all sturgeon species between the Lower and Middle Danube, notably migrations to/from spawning habitats. There are no fish passage facilities at present. Removal of the Iron Gates dams is not a politically realistic current option.	Though implemented at two specific locations in the Middle/ Lower Danube, completion of Actions 9.1, 9.2 and 9.3 would have positive consequences for sturgeon conservation in the whole Danube Basin.
Action 9.2 Plan and design fish passage facilities for Iron Gates dams I & II.	As Action 9.1.	As Action 9.1.
Action 9.3 Implement final design and construction of fish passage facilities at Iron Gates dams I & II and ensure that their performance is effectively monitored and evaluated.	As Action 9.1.	As Action 9.1.
Action 9.4 Conduct feasibility study for fish passage at Gabčíkovo dam.	Gabčíkovo dam blocks movements of fish between the Middle and Upper Danube. There are no fish passage facilities at present.	Though implemented at a specific location in the Middle Danube, completion of Actions 9.4, 9.5 and 9.6 would have positive consequences for sturgeon conservation in the whole Danube Basin.
Action 9.5 Plan and design fish passage facilities at Gabčíkovo dam.	As Action 9.4.	As Action 9.4.
Action 9.6 Implement final design and construction of fish passage facilities at Gabčíkovo dam and ensure that its performance is effectively monitored and evaluated.	As Action 9.4.	As Action 9.4.

.. / ..

and downstream sturgeon passage at dams and other current barriers to		
one of the highest priorities for sturgeon conservation in the Danube. Rapid that with the necessary political will, all can be achieved within the medium term		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All sturgeon species present or historically present. All other migratory fish would also benefit from such action.	Feasibility study (conducted with input of sturgeon specialists and subject to scientific and technical peer review) published.	Governments of Romania, Serbia & Montenegro; specialists in sturgeon ecology, engineering of fish passage solutions and construction at major dams etc; other national and international stakeholders. The basin-wide benefits of this action mean that options for cost sharing should be envisaged.
As Action 9.1.	Agreement on best design by stakeholders.	As Action 9.1.
As Action 9.1.	Fish passage facilities installed, operational and monitored.	As Action 9.1.
All sturgeon species present or historically present. All other migratory fish would also benefit from such action.	Feasibility study (conducted with input of sturgeon specialists and subject to scientific and technical peer review) published.	Governments of Slovak Republic, Hungary; specialists in sturgeon ecology, engineering of fish passage solutions and construction at major dams etc; other national and international stakeholders.
As Action 9.4.	Agreement on best design by stakeholders.	As Action 9.4.
As Action 9.4.	Fish passage facilities installed, operational and monitored.	As Action 9.4.

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Objective 9: To re-open sturgeon migration routes by enabling upstream sturgeons movements. **[Regional Strategy: part of Item 1.2]**		
Prioritisation and timeframe: restoration of upstream and downstream migration is progress needs to be made with implementation of all Actions and it is considered at the longest (i.e. within 5-10 years).		
Action	**Rationale**	**Geographical applicability**
Action 9.7 Identify and assess barriers to sturgeon migration on Danube branches and tributaries, and in the Black Sea coastal zone (**Note:** completion of Actions 9.1 to 9.6 not dependent on completion of this assessment, since major adverse impacts of Iron Gates and Gabčíkovo already known).	Within the Danube Basin, including the Black Sea coastal zone, there are numerous artificial barriers to upstream and downstream movements of sturgeons. The present overview must be up-dated and specified for sturgeon issues.	The study could be divided into: Black Sea coastal zone; Lower Danube branches and tributaries; Middle Danube branches and tributaries; Upper Danube and tributaries.
Action 9.8 Prioritise mitigation measures for barriers to sturgeon migration and initiate planning, design, construction and monitoring/ evaluation of fish passage facilities. (**Note:** action to mitigate known significant barriers should not be delayed while Action 9.7 is undertaken)	Most dams, weirs etc. within the Danube Basin are not equipped with any fish passage facilities.	Whole Danube Basin (including Black Sea coastal zone).
Action 9.9 Prevent mortality of young sturgeons at water withdrawal sites.	Young sturgeons are vulnerable to being killed or severely damaged by water withdrawal installations.	Whole Danube Basin.

and downstream sturgeon passage at dams and other current barriers to		
one of the highest priorities for sturgeon conservation in the Danube. Rapid that with the necessary political will, all can be achieved within the medium term		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
As Action 9.4.	Dams, weirs and other potential barriers to sturgeon migration mapped with regard to sturgeons and their likely impacts assessed.	Governments of Danube Basin countries, ICPDR, scientific/technical research institutes.
As Action 9.4.	Upstream and downstream migration routes progressively re-opened and their effectiveness closely monitored.	National and international stakeholders. ICPDR could provide framework for international prioritisation.
As Action 9.4.	Water withdrawal installations are fitted with technical measures that neutralise, or, at the very least, significantly reduce the threat to young sturgeons.	Governments; water industry (public and private sectors); scientific/technical research institutes.

Objective 10: To implement appropriate protection, management and resto- **[Regional Strategy: part of Item 1.2]**		
Prioritisation and timeframe: this group of Actions provides for the long-term While some Actions, such as 10.1 should be addressed in the short term, field Commitment.		
Action	**Rationale**	**Geographical applicability**
Action 10.1 Undertake a gap analysis of current knowledge about key life-cycle habitats and migrations of Danube sturgeons. [Regional Strategy: part of Item 1.2]	There are serious gaps in baseline knowledge concerning the location and use of key habitats for sturgeon life-cycle stages throughout the Danube Basin.	Lower Danube. Middle and Upper Danube.
Action 10.2 Develop reference conditions for key habitats and migrations on the basis of Action 10.1. [Regional Strategy: part of Item 1.2]	A reference is required to help identify actual and potential key habitats.	Whole Danube Basin.
Action 10.3 Complete an inventory (identify and verify) of key sturgeon habitats on the basis of Actions 10.1 & 10.2. [Regional Strategy: part of Item 1.2]	Key habitats cannot be adequately protected, managed and/or restored without the baseline knowledge from an up-to-date site/habitat inventory.	Whole Danube Basin.
Action 10.4 Design and implement appropriate measures for the protection, management and monitoring of existing key habitats/sites for Danube sturgeons. [Regional Strategy: part of Item 1.2]	Given current gaps in knowledge, most key habitats and sites do not yet benefit from any sturgeon conservation measures.	Lower Danube. Middle Danube. Upper Danube.
Action 10.5 Conduct feasibility/prioritisation studies for habitat restoration measures at selected sites (e.g. based on data from reference habitats; availability of technical solutions for restoration; level of stakeholder support, availability of resources).	Habitat restoration measures and resources should be targeted at those sites where the chances of success are greatest.	Whole Danube Basin.
Action 10.6 Implement and monitor habitat restoration measures at priority sites selected by Action 10.5. [Regional Strategy: part of Item 1.2]	Habitat restoration measures and resources should be targeted at those sites where the chances of success are greatest.	Whole Danube Basin.

ration measures for key sturgeon habitats and migrations		
future of sturgeons in the Danube River Basin by securing and restoring habitats. will be seen in the medium to long term and require a corresponding resource		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species. *A. ruthenus.*	Inventory of current knowledge and corresponding gap analysis published and available on line.	National fisheries research institutes; international coordinating bodies.
All species.	Reference habitats published.	Research institutes.
All species.	Inventory of key Danube sturgeon habitats/ sites completed, verified and published on line.	Research institutes.
All species. *A. ruthenus,* *A. nudiventris.* *A. ruthenus.*	Habitat protection and management plans agreed by stakeholders and published on line. Monitoring reports published annually. Management plans revised at least once every three years.	Governments, research institutes.
All species.	List of priority sites for restoration measures agreed.	Governments, research institutes, fisheries, ICPDR.
All species.	Site-based habitat restoration implemented. Management and restoration plans published, implemented and periodically reviewed.	Governments, Research institutes, fisheries, ICPDR.

Objective 11: To ensure that water quality and quantity throughout the lations at all life-cycle stages.		
Prioritisation and timeframe: the prioritisation and timeframe for implementation of published and corresponding Programmes of Measures implemented for each ICPDR) by 2008 and 2012, respectively. 'Good ecological status' must be achieved		
Action	**Rationale**	**Geographical applicability**
Action 11.1 Promote full implementation of the EU Water Framework Directive.	Maintaining good water quality and sufficient quantity and managing these attributes at a river-basin level are prerequisites for successful long-term protection and restoration of sturgeon populations in the Danube Basin.	Whole Danube Basin.
Action 11.2 Identify critical pollution pressures (whether diffuse or point source) on sturgeon populations in the Danube River Basin and ensure that appropriate pollution reduction/removal measures are developed and implemented in the relevant framework/process (e.g. WFD).	There are many activities being implemented to improve water quality in the Danube Basin. However, these may not give sufficient priority to tackling pollution pressures that have a critical impact on one or more sturgeon life-cycle stages.	Whole Danube Basin.
Action 11.3 Establish and implement water management plans in the Danube River Basin District that are in line with the requirements of the WFD.	To ensure the ecological requirements of sturgeon populations in the Danube River Basin are met (water discharge triggers sturgeon migration and flow velocity is crucial for spawning and early life stages; the water regime should be near-natural).	Whole Danube Basin.

Danube River Basin meet the conditions required for healthy sturgeon popu-		
the EU Water Framework Directive. Draft Rver Basin Management Plans must be River Basin District (in the case of the Danube, this under the coordination of the in each River Basin District by 2015.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	WFD compliance milestones, especially the requirement to achieve 'good status' of all waters and compliance with other relevant environmental objectives for protected areas under EU legislation by 2015.	National Governments (most Danube countries are either EU Member States or Candidate Countries); Danube River Basin District Authority/ ICPDR.
All species.	Inventory of types and sources of main pollution pressure on sturgeons is published on line.	Governments, research institutes, fisheries, ICPDR.
All species.	Ecologically unsustainable water management schemes no longer being approved. Environmental objectives of the WFD are achieved in the Danube River Basin District.	Governments, government agencies, ICPDR.

Objective 12: To avoir further degradation of riverine ecosystems within the vation are fully integrated into implementation of the EU Water Framework [Regional Strategy: part of Item 1.2]		
Prioritisation and timeframe: as for Objective 11, the timeframe for implementation Framework Directive. Draft River Basin Management Plans must be published and District (in the case of the Danube, this is under the coordination of the ICPDR) by ments of proposed major infrastructure projects (including TEN-T) in the Danube		
Action	**Rationale**	**Geographical applicability**
Action 12.1 Ensure ecologically sound maintenance of rivers with respect to key sturgeon habitats (as identified under Objective 10) and in line with the WFD.	Dredging and other river-bed interventions may damage or destroy spawning and early life-stage (ELS) habitats.	Whole Danube Basin (notably the Danube River and its main tributaries).
Action 12.2 Review proposals for development of navigation in the Danube Basin, including those in the framework of TEN-T, and ensure that proposals that would have an adverse impact on key sturgeon habitats are neither supported nor implemented.	River deepening and canalisation destroys river-bed habitats (due to direct damage) and floodplain habitats (due to disruption of the functional link between river and floodplain) used by sturgeons.	Danube River.
Action 12.3 Avoid further construction of flood protection embankments that would have significant impacts on natural floodplains.	The loss of access to floodplains negatively affects the life cycle of sturgeons.	Danube River and its main tributaries (especially in the Middle and Lower Basin).
Action 12.4 Assess all existing and new proposals for dam construction against the recommendations of the World Commission on Dams. This action supplements Action 9.7 on existing dams. [Regional Strategy: part of Item 1.2]	Construction of dams causes changes that damage sturgeon habitats and block migration routes.	Danube River and its main tributaries

Danube River Basin and to ensure that the requirements of sturgeon conser-Directive in the Danube River Basin.		
of this Objective will be inextricably linked with implementation of the EU Water corresponding Programmes of Measures implemented for each River Basin 2008 and 2012, respectively. Urgent work is required to ensure that impact assess-Basin incorporate the fullest information on sturgeons.		
Relevant species	**Indicator(s) of success**	**Action mainly addressed to**
All species.	Key habitats (as identified under Objective 10) are not threatened by gravel extraction and other interventions.	Transport/water authorities of all countries where the Danube and its tributaries are navigable; Danube Commission/ICPDR.
All species for spawning and early life stage habitats. *A. ruthenus*, in particular, for foraging habitats.	Revised and ecologically acceptable ('sturgeon friendly') navigation projects/ plans are elaborated.	Governments; EU institutions/ bodies; key navigation companies; Danube Commission/ICPDR.
All species, but *A. ruthenus* in particular.	No construction of flood banks occurring within the floodplain.	Water authorities and governments (especially Middle and Lower Danube countries); Danube Commission/ICPDR.
All species.	Any new dams built within the Danube River Basin meet the ecological criteria set out by the World Commission on Dams and WFD.	National governments; EU institutions/bodies; hydropower companies.

Annexes

Annex I

References

Akimova, N.V. & Ruban, G.I. (1996); A classification of reproductive disturbances in sturgeons (Acipenseridae) caused by an anthropogenic impact. – Journal of Ichthyology, Vol. 36, No. 1 pp 61-76.

Antipa, G. (1909): Fauna ichtiologica a Romaniei. - Acad. Rom. Publ Fond. Adamachi, Bucuresti.

Bacalbasa-Dobrovici, N. (1997): Endangered migratory sturgeons of the Lower Danube River and its delta. – in Balon (ed.) (1997) pp 201-207.

Bacalbasa-Dobrovici, N. & Holčik, J. (2000): Distribution of Acipenser sturio L., 1758 in the Black Sea and its watershed. - Boletin. Instituto Espanol de Oceanografia 16 (1-4)- pp 37-41.

Bacalbasa-Dobrovici, N. & Patriche, N. (1999): Environmental studies and recovery actions for sturgeons in the Lower Danube River system. - Journal of Applied Ichthyology Vol. 15, Nr. 4/5 pp 114-115.

Bain, M.B. (1997): Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. – in Balon (ed.) (1997) pp 347-358.

Balon, E.K., (ed.) (1997): Environmental Biology of Fishes 48/1-4: 435 pp.

Bemis, W.E. & Kynard, B. (1997): Sturgeon rivers: an introduction to acipenseriform biogeography and life history. – in Balon (ed.) (1997) pp 167-183.

Bemis, W.E., Findeis, E.K. & Grande, L. (1997): An overview of Acipenseriformes. - in Balon (ed.) (1997) pp 25-71.

Bickham, J.W., Rowe, G.T., Palatnikov, G., Mekhtiev, A., Mekhtiev, M., Kasimov, R.Y., Hauschultz, D.W., Wickliffe, J.K. & Rogers, W.J., (1998): Acute and genotoxic effects of Baku harbor sediment on Russian sturgeon, *Acipenser gueldenstaedti*. - Bull. Environ. Contam. Toxicol. 61 pp 512-518.

Billard, R. & Lecointre, G. (2001): Biology and Conservation of the sturgeons and paddlefish. – Rev. Fish Biol. Fish. 10: 355-392.

Birstein, V.J., Hanner, R., & Desalle, R. (1997): Phylogeny of Acipenseriformes: cytogenetic and molecular approaches. – in Balon (ed.) (1997) pp 127-155.

Birstein, V.J., Waldman, J. & Bemis, W.E., eds. (1997): Sturgeon biodiversity and conservation. – Developments in Environmental Biology of Fishes, Vol.17. Kluwer Academic Publishers, Dordrecht, Holland. 445 pp. (Simultaneously published as Environmental Biology of Fishes, Volume 49).

Birstein, V.J., Betts, J. & Desalle, R. (1998): Molecular identification of *Acipenser sturio* specimens: a warning note for recovery plans. – Biol. Conserv. 84: 97-101.

Ceapa, C., Williot, P. & Bacalbasa-Dobrovici, N. (2002): Present state and perspectives of stellate sturgeon brood fish in the Romanian part of the Danube. – Internat. Rev. Hydrobiol. 87 (5/6): 507-514.

Chebanov, M.S. & Savelyeva, E.A. (1999): New strategies for brood stock management of sturgeon in the Sea of Azov basin in response to changes in patterns of spawning migration. - Journal of Applied Ichthyology 15 (1999) pp 183-190.

Choudhury, A. & Dick, T.A. (1998): The historical biogeography of sturgeons (Osteichthyes: Acipenseridae): a synthesis of phylogenetics, palaeontology and palaeogeography. – J. Biogeogr. 25: 623-640.

Council of Europe: Guidelines for Action Plans for Animal Species. – Council of Europe document (T-PVS-(ACPLANS)(97) 8).

FAO-FIGIS: The FAO Fisheries Global Information System. – http://www.fao.org.

Freyhof, J. & Serov, D. (2000): Urzeitliche Fische in Bedrängnis. - DATZ 53. Jhg Nr. 4 pp 24-27 (in German).

Dobrovolov, I., Ivanova, P. & Tsekov A. (2005): Genetic-biochemical identification of some sturgeons and their hybrids (Pisces, Acipenseridae) – Verh. Internat. Verein. Limnol. 29/2 (Lahti): 917-921.

Ene, C., Suciu, R., Ene, F. & Dumitrache, C. (1996): Researches on the marine migratory sturgeons of the Danube River (I). Recent data on the feeding habits of sturgeon in the region of the Danube River mouths. - Scientific Annals of the Danube Delta Institute, Tulcea 4 (1): 91 – 95.

Gilpin, M.E. & Soule, M.E. (1986): Minimum viable populations: processes of species extinction. - In: Soule, M.E. (ed), Conservation Biology: The Science of Scarcity and Diversity Sinauer Associates, Sunderland, Massachusetts. P 584.

Hansen, M.M., Kenchington, E. & Nielsen, E.E. (2001): Assigning individual fish to populations using microsatellite DNA markers. – Fish Fish. 2: 93-112.

Hensel, K. & Holčik, J., 1997: Past and current status of sturgeons in the Upper and Middle Danube River. – in Balon (ed.) (1997) pp 185-200.

Hochleithner, M. (1996): Störe: Verbreitung/Lebensweise/Aquakultur. – AV-Ratgeber Österreichischer Agrarverlag, Klosterneuburg. 202 pp.

Holčík, J., ed. (1989): The freshwater fishes of Europe. Vol.1, Part II General introduction to fishes/Acipenseriformes . – AULA-Verlag Wiesbaden. 469 pp.

Holčík, J., Kinzelbach, R., Sokolov, L.I. & vasil'ev, V.P. (1989): *Acipenser sturio* Linnaeus, 1758. - in Holčík (ed.) (1989) pp 367-394.

Holčík, J., Klindová, A., Masár, J. & Mészáros, J. (2005): Current status of sturgeons in the Slovakian rivers of the Danube River basin and proposals for their conservation and restoration. – Contribution to the workshop “Action Plan for Danube River sturgeons” by IAD and WWF, July 6-7, Petronell/Austria.

ICPDR (2004): The Danube River Basin District – Part A – basin-wide overview / Danube Basin Analysis (WFD Roof Report 2004) 191 pp.

Janković, D. (1993): Populations of Acipenseridae prior and after the construction of the HEPS Derdap I and II. - Acta Biol. Iugoslavica, Ichthyol. 25 pp 29-34.

Kriksunov, Y.A. & Mamina, K.M. (1995): Effect of flows in the Ural River on recruitment of stellate sturgeon, *Acipenser stellatus*. - Journal of Ichthyology, 35 (1) pp 52-58

Kynard, B. (1997): Life history, latitudinal patterns, and status of the shortnose sturgeon, *Acipenser brevirostrum*. - in Balon (ed.) (1997) pp 319-334.

Kynard, B. (2005): Restoration of Sturgeons Impacted by Dams Using Fish Passage – Technical contribution (oral presentation) to the workshop “Action Plan for Danube River sturgeons” by IAD and WWF, July 6-7, Petronell/Austria.

Kynard, B., Suciu, R. & Horgan, M. (2002): Migration and Habitats of Danube sturgeons in Romania: 1998-2000. – J. Appl. Ichthyol. 18: 529-535.

Lelek, A. (1987): The Freshwater Fishes of Europe. Vol. 9, Threatened Fishes of Europe. – Aula Verlag Wiesbaden. 343 pp.

Lenhardt, M., Hegedis, A., Jaric, I. (2005): Action plan for sturgeon species management in fishery waters of Republic Serbia. - Institute for Biological Research, Belgrade, 1-21.

Ludwig, A., Gessner, J., Kirschbaum, F., Jenneckens, I. & Debus, L. (2002): Do restocking programs minimize the genetic variability in sturgeon populations? - http://www.inform.umd.edu/EdRes/Colleges/LFSC/FacultyStaff/dinouye/scbab stracts/Ludwig.htm. [as at 31st October 2002]

Ludwig, A., Debus, L., Lieckfeldt, D., Wirgin, I., Benecke, N., Jenneckens, I., Williot, P., Waldman, J.R., & Pitra, C. (2002): When the American sea sturgeon swam east. – Nature 419: 447-448.

Lukjanenko, V.I. (1993): Allgemeine Informationen über Störe. - Fischer & Teichwirt 12 44. Jhg (in German).

Navodaru, I., Staras, M., & Banks, R. (1999): Management of the sturgeon stocks of the Lower Danube River system. – In: R. Stiuca and I. Nuchersu (eds.): "The Delta's: State-of-the-art protection and management". – Conference Proceedings, Tulcea, Romania 26-31 July, 1999, pp. 229-237.

Navodaru, I., Staras, M. & Cernisencu, I. (2001): The challenge of sustainable use of the Danube Delta Fisheries, Romania. – Fish. Manage. Ecol. 8: 323-332.

Nilo, P., Dumont, P., & Fortin, R. (1997): Climatic and hydrological determinants of year-class strength of St. Lawrence River lake sturgeon (*Acipenser fulvescens*). - Canadian Journal of fisheries and aquatic sciences, Ottawa Vol. 54, N. 4, pp 774-780.

Pavlov, D.S. (1989): Structures assisting the migrating of nonsalmonid fish USSR. - FAO Fisheries Techn. Papers 308 98 pp.

Pirogovskií, M.I., Sokolov, L.I. & Vasil'ev, V.P., 1989: *Huso huso* (Linnaeus, 1758).- in Holčík (ed.) 1989 pp 156-200.

Pintér, K., 1991: Sturgeons in Hungary, past and present situation. In P. Williot /Ed./ Acipenser, Cemagref Publ. pp 173-178.

Pintér, K., 1998: Die Fische Ungarns. Ihre Biologie und Nutzung. - Akadémiai Kiadó, Budapest (in German).

Popova, A.A., Shubina, T.N. & Vasil'ev, V.P., 1989: *Acipenser stellatus* Pallas, 1771. - in Holčík (ed.) 1989 pp 395-443

Raymakers, C. (2005): Legal status in Danube and Black Sea sturgeons-the role of CITES. – Technical contribution (oral presentation) to the workshop “Action Plan for Danube River sturgeons” by IAD and WWF, July 6-7, Petronell/Austria.

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

Reinartz, R., Bloesch, J., Ring, T. & Stein, H. (2003): Sturgeons are more than caviar: A plea for the revival of sturgeons in the Danube River. – Large Rivers 14/3-4; Arch. Hydrobiol. Suppl. 147/3-4: 387-403.

Reinartz, R. (2005): Sturgeon populations in the Danube River. – Technical contribution (oral presentation) to the workshop “Action Plan for Danube River sturgeons” by IAD and WWF, July 6-7, Petronell/Austria.

Simonović, P., Budakov, L., Nikolić, V. & Marić, S. (2005): The recent record of the ship sturgeon *Acipenser nudiventris* in the Middle Danube (Serbia) – Biologia, Bratislava 60/2: 231-233.

Sokolov, L.I. & Vasil'ev, V.P. (1989): *Acipenser nudiventris* Lovetsky, 1828. - in Holčík (ed.) (1989) pp 206-226.

Sokolov, L.I. & Vasil'ev, V.P. (1989): *Acipenser ruthenus* Linnaeus, 1758. - in Holčík (ed.) (1989) pp 227-262.

Suciu, R., Ferguson, A., 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.

Suciu, R. (2005): Habitats, Ecology, Genetics, Fishery Management and Stocking of Sturgeons in the Lower Danube River, Romania (a review). – Technical contribution (oral presentation) to the workshop “Action Plan for Danube River sturgeons” by IAD and WWF, July 6-7, Petronell/Austria.

Tsvetnenko, Y.B. (1993): The effectiveness and genetic consequences of the introduction of the stellate sturgeon, *Acipenser stellatus*, into the Azov basin from the Caspian Sea. - Journal of Ichthyology, 33 (9) pp 1-10.

Veshchev, P.V. (1993): Effect of water level in the Volga on the reproduction of starred sturgeon. - Water Resources Vol. 20, Nr. 2, pp 240-244.

Veshchev, P.V. (1994): Scale of natural reproduction of Volga starred sturgeon in contemporary ecological conditions. - Russian Journal of Ecology Vol. 25, No. 2 pp 120-127.

Veshchev, P.V. & Debol'skii, V.K. (2000): Hydrological factors governing the reproduction of stellate sturgeon in the Lower Volga River. - Water Resources, Vol. 27, No. 5 pp 498-503.

Vlasenko, A.D., Pavlov, A.V. & Vasil'ev, V.P. (1989): *Acipenser gueldenstaedti* Brandt, 1833. - in Holčík (ed.) (1989) pp 294-344.

Williot, P. & Brun, R. (1998): Ovarian development and cycles in cultured Siberian sturgeon *Acipenser baerii*. - Aquat. Living Res. 11 pp 111-118.

Williot, P., Brun, R., Pelard, M. & Mercier, D. (2000): Induced maturation and spawning in an incidentally caught adult pair of critically endangered European sturgeon, *Acipenser sturio* L.. – J. Appl. Ichthyol. 16: 279-281.

Williot, P., Arlati, G., Chebanov, M., Gulyas, T., Kasimov, R., Kirschbaum, F., Patriche, N., Pavovskaya, L., Poliakova, L., Pourkazemi, M., Kim, Y., Zhuang, P. & Zholdasova , I. M. (2002): Status and management of Eurasian sturgeon: an overview. – International Review of Hydrobiology, 87: 483-506.

Annex II

Glossary of sturgeon-related technical terminology

Term	Meaning
Acipenseridae / acipenserid	Noun and adjective used to refer to the sturgeon Family.
Acipenseriformes / acipenseriform	Noun and adjective used to refer to the Order of fishes which includes sturgeons and paddlefishes.
adaptation	Changes in an organism's structure or habits that allow it to adjust to its surroundings.
allochthonous	Imported from outside the system; may apply to introduced or exotic species.
amphidromous	Refers to the migratory behaviour of fishes moving from freshwater to the sea and *vice versa*, not for breeding purposes but for other key elements of the life cycle (e.g. feeding or over-wintering).
anadromy / anadromous	Noun and adjective referring to species that ascend rivers from the sea for breeding.
autochthonous	Formed or originating in the place where found; may apply to native species.
benthos / benthic	Noun and adjective pertaining to the invertebrates living at the bottom (in the sediments) of a waterbody.
biodiversity	The entity of different plant and animal species, focused on different scales and usually applied to whole ecosystems.
brood stock	Adult fish used to propagate the subsequent generation of hatchery fish.
by-catch	In fisheries science, by-catch refers to species caught in a fishery intended to target another species, as well as repro-ductively-immature juveniles of the target species. By-catch is a serious issue that can contribute to species endangerment.
catadromy / catadromous	Noun and adjective referring to fishes that migrate from fresh water to salt water to spawn or reproduce.
captive brood stock	Fish spawned and raised in captivity.
CPUE / Catch Per Unit Of Effort	The catch of fish, in numbers or in weight, taken by a defined unit of fishing effort. Also called; catch per effort, fishing success, availability.
diadromy / diadromous	Noun and adjective referring to fish that must migrate between fresh and salt water at some point in their life cycle.
Djerdap dams	Serbian name for the Iron Gates dams.
ecotype	A genetically induced variety within a single species, adapted to local ecological conditions.
embryogenesis	The formation and development of an embryo.
estuarine	An area where a freshwater river meets the ocean and tidal influences result in fluctuations in salinity.
euryhaline	Having a wide tolerance to salinity.
exogenous feeding	To rely on active feeding respectively preying on food organisms in contrast to endogenous feeding like e.g. the absorption of the yolk sac.
fecundity	Absolute: the total number of eggs produced by a female fish /

Term	Meaning
	relative: the number of eggs per weight unit of the female.
fingerling	Refers to a young fish in its first or second year of life.
fishing effort	The total fishing gear in use for a specified period of time.
free embryo	embryo shortly after hatching
gamete	The male sperm or female egg which fuse together to form a zygote.
gonad	The ovaries or testes, the organ that produces gametes, eggs or sperm.
habitat	The area in which an animal, plant, or microorganism lives and finds the nutrients, water, sunlight, shelter, living space, and other essentials it needs to survive. Habitat loss, which includes the destruction, degradation, and fragmentation of habitats, is the primary cause of biodiversity loss.
hatchery	An artificial propagation facility designed to produce fish for harvest or spawning escapement. A conservation hatchery differs from a production hatchery in that it specifically seeks to supplement or restore naturally spawning populations.
homing	The behavioural act of returning to an original location, e.g. spawning site.
hydro-acoustics	A technique to track fishes by means of infrasonic sound signals.
inbreeding	Mating or crossing of individuals more closely related than average pairs in the population.
incubation	The period of time from egg fertilisation until hatching.
key habitat	Essential habitat for the completion of a species' life cycle, e.g. spawning site.
life cycle	The series of stages in form and functional activity through which an organism passes from fertilised ovum to the fertilised ovum of the next generation.
living gene bank	the keeping and artificial reproduction of 'wild' brood-stock in captivity for the conservation of a certain species, genotype or ecotype, as well as the production and replenishment of the stocks endemic to a particular locality. This may involve more than hatchery, where the stocks may – if necessary – be kept for several generations, awaiting the reduction or elimination of threat factors in the wild.
migration route	The route along which migratory animals move between key habitats. In an unmodified linear riverine system this includes the whole riverine continuum.
nursery zone	A key habitat in which conditions are especially favourable for the growth and development of early life stages.
ontogeny/ontogenesis	Developmental life history of an organism.
paddlefish	Paddlefishes (family Polyodontidae) are closely related to sturgeons and also belong to the order of Acipeneriformes. Today there are only two living species in Asia and North-America.
pelagic, lacustrine zone	The open water region beyond the littoral zone.
phylogeny / phylogenetic	Noun and adjective pertaining to the evolutionary history of a group or lineage, or the evolutionary relationships within and between taxonomic levels; the relationships of groups of organisms as reflected by their evolutionary history.
(phyto)plankton / planktonic	Noun and adjective referring to minute floating forms of micro-scopic and small macroscopic plants and animals in water. They form the

Term	Meaning
(see also zooplankton)	important beginnings of food chains for larger animals.
plesiomorphic	A plesiomorphic character of a taxon is one which it shares with an ancestral group. It is not a unique, derived character (synapomorphy or apomorphy), but a primitive character that tells us nothing about its evolutionary position.
potamodromy / potamodromous	Exhibiting a behaviour involving migrations within freshwater habitats only.
puberty	The period of life during which an individual becomes capable of reproduction.
radio-telemetry / telemetry	Automatic measurement and transmission of data from remote sources via radio to a receiving station for recording and analysis. In the case of animal sciences this often refers to the tracking of individuals and groups to comprehend movements and habitat use during completion of the life-cycle.
recruitment	The amount of fish added to the stock each year due to growth and/or migration into the area.
reference habitat	An idealised description of a certain habitat defining natural or near-natural (optimum) habitat conditions and parameters.
rheoreaction	The reaction of an animal to an oncoming current. Rheotaxis, for example, is a behaviour in fishes (and other aquatic animals).
spawning	The act of reproduction of fishes. The mixing of the sperm of a male fish and the eggs of a female fish.
spawning site	The site or area within a waterbody where eggs are deposited.
spent fishes	Adult fishes after spawning.
stock	A specific population of fish spawning in a particular stream during a particular season.
year class (or cohort)	Fish in a stock born in the same year. Most fish species in temperate waters reproduce during a relatively short period each year. That period may be different for each species. Fisheries scientists refer to all of the fish of any species hatched during one annual spawning period as a year class. For mathematical purposes, fishery analysts often treat members of the year class as if all fish were hatched on one day. All fish hatched during this period are recognised as a year class.
year class strength	The size of a year class. A stock may produce a very small or very large year class which can be pivotal in determining stock abundance in later years.
yolk	The part of an egg containing nutrients.
yolk sac / yolk sac larva	The stored food reserve (yolk) and its surrounding membranes. Larvae at the stage of internal feeding.
Young-Of-Year, YOY	All of the fish of a species younger than one year of age. Usually scientists assign an arbitrary "birth date" to all fish of a species hatched over a two or three month period in a given year. The fish are then assigned Age 1 status on that birth date; this is usually January 1.
zooplankton (see also phytoplankton)	Small aquatic animals that are suspended or swimming in water.

Annex III

Vernacular names for Danube River sturgeon species, by language

Scientific Name	English	French	Spanish	Romanian	Bulgarian	Ukrainian	Serbian / Croatian
Acipenser gueldenstaedtii	Danube Sturgeon Russian Sturgeon	Esturgeon de Russie Esturgeon du Danube	Esturión del Danubio	Nisetru	Ruska esetra	Russkii osetr	Jesetra
Acipenser nudiventris	Ship Sturgeon Spiny Sturgeon Fringebarbel Sturgeon	Esturgeon nu Esturgeon à barbillons frangés	Esturión barba de flecos	Viza / Bogzar	Ship	Ship	Sim
Acipenser ruthenus	Sterlet	Sterlet	Esterlete	Cigă Cega	Chiga	Sterljad	Kečiga
Acipenser stellatus	Stellate Sturgeon Starry Sturgeon	Esturgeon étoilé	Esturión estrellado	Pastruga	Pastruga	Sevrjuga	Pastruga
Acipenser sturio	Atlantic Sturgeon	Esturgeon Esturgeon commun	Esturión Esturión común	Sturion Sip Sipul	Nemska essetra	Atlanticheskii osetr	Atlantska jesetra
Huso huso	Beluga Great Sturgeon	Beluga	Beluga	Morun	Moruna	Beluga	Moruna

Scientific Name/Language, Country	Hungarian	Slovak	Czech	German
Acipenser gueldenstaedtii	Vágótok	Jeseter ruský	Jeseter ruský	Waxdick Russischer Stör Donaustör
Acipenser nudiventris	Simatok	Jeseter hladký	Jeseter hladký	Glattdick
Acipenser ruthenus	Kescege	Jeseter malý	Jeseter malý	Sterlet Sterlett
Acipenser stellatus	Sőregtok	Jeseter hvezdnatý	Jeseter hviezdnatý	Sternhausen Scherg
Acipenser sturio	Közönséges tok	Jeseter velký	Jeseter velký Jeseter veliký Jeseter obecný	Stör Atlantischer Stör
Huso huso	Viza	Vyza	Vyza / Vyza velká	Hausen Großer Stör Beluga

Annex IV

IUCN (The World Conservation Union) Red List Criteria relevant for the conservation of sturgeons in the Danube River Basin

EXTINCT (EX) – A taxon is **Extinct** when there is no reasonable doubt that the last individual has died.

(Does not apply to any Danube River sturgeon species according to IUCN criteria, although *Acipenser sturio* is most probably extinct in the Danube River Basin. However, due to the presumed extinction of this species already in the early 20th century, Danube River stocks were not assessed according to IUCN criteria. *Acipenser sturio* is still present in the Black Sea drainage in the Rioni River (Georgia)).

EXTINCT IN THE WILD (EW) – A taxon is **Extinct in the wild** when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

(Does not currently apply to any Danube River sturgeon species.)

CRITICALLY ENDANGERED (CR) – A taxon is **Critically Endangered** when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) described below.

(Applies to *Acipenser nudiventris* – Danube River subpopulation; and to *Acipenser sturio* – probably extinct in Danube River basin, see above).

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

   a) direct observation,

   b) an index of abundance appropriate for the taxon,

   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat,

   d) actual or potential levels of exploitation,

   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence,

b) area of occupancy,

c) area, extent and/or quality of habitat,

d) number of locations or subpopulations,

e) number of mature individuals.

3) Extreme fluctuations in any of the following:

a) extent of occurrence,

b) area of occupancy,

c) number of locations or subpopulations,

d) number of mature individuals.

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals),

b) all individuals are in a single subpopulation.

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN) - A taxon is **Endangered** when it is not **Critically Endangered** but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

(Applies to the Black Sea stocks of *Acipenser gueldenstaedti*, *Acipenser stellatus*, *Huso huso*)

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation,
   b) an index of abundance appropriate for the taxon,
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation,
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
   a) extent of occurrence,
   b) area of occupancy,
   c) area, extent and/or quality of habitat,
   d) number of locations or subpopulations,
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence,
   b) area of occupancy,
   c) number of locations or subpopulations,
   d) number of mature individuals.

C) Population estimated to number less than 2500 mature individuals and either:

1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
   a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals),
   b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU) - A taxon is **Vulnerable** when it is not **Critically Endangered** or **Endangered** but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

(Applies to the Caspian and Black Sea drainage stock of *Acipenser ruthenus*)

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation,
   b) an index of abundance appropriate for the taxon,
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation,
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in any of the following:
   a) extent of occurrence,
   b) area of occupancy,
   c) area, extent and/or quality of habitaty,
   d) number of locations or subpopulations,
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence,
   b) area of occupancy,
   c) number of locations or subpopulations,
   d) number of mature individuals.

C) Population estimated to number less than 10,000 mature individuals and either:

1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:

   a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals),

   b) all individuals are in a single subpopulation.

D) Population very small or restricted in the form of either of the following:

1) Population estimated to number less than 1000 mature individuals.

2) Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Annex V

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