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Historical Distribution, current Situation and future Potential of Sturgeons in Austrian Rivers

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Master Thesis

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Abstract

Worldwide the sturgeon family is either endangered or on the edge of extinction. There are many anthropogenic factors responsible for this situation, including hydroelectric power plant development, subsequent interruptions of longitudinal and lateral connectivity, disturbance or loss of habitat, pollution, overfishing, etc.

In the Danube five anadromous and potamodromous sturgeon species are native, which partially used to migrate up to the Bavarian Danube for spawning. The exact distribution of the various species within the Danube still remains unclear. In the Austrian section of the Danube only a small population of the potamodromous sterlet (*Acipenser ruthenus*) is left, which is threatened with extinction. There is little knowledge about the habitat use of this species in the Danube. In the last years sturgeon stocking (both accidentally and deliberately) and catches have increased throughout Austria. Unfortunately many of these fish are of allochthonous sturgeon species that pose a threat to autochthonous sterlet population. It is imperative that steps are undertaken to protect and support the remaining population of sterlets and for evaluating other stretches regarding their potential of supporting a viable sterlet population. Measures for reintroduction should be well - prepared and closely monitored as previous stocking programs did not have a significant impact on catches in most cases and almost never led to the establishment of self - reproducing populations.

The objective of this study was to summarize all available data about sturgeons in Austrian waters to obtain a clearer understanding of their historical and current distribution and to use the gained data to evaluate the potential of Austrian rivers for sturgeon populations.

Weltweit ist die Familie der Störartigen stark vom Aussterben bedroht. Gründe hierfür sind zum Beispiel die energiewirtschaftliche Nutzung der Gewässer mit den damit verbundenen Unterbrechungen der longitudinalen und lateralen Konnektivität, Zerstörung und Regulierung von Habitaten, Gewässerverschmutzung und Überfischung.

In der Donau sind fünf Störarten heimisch, zwei stationäre Arten im Süßwasser und drei Arten, welche früher aus dem Schwarzen Meer bis in die bayrische Donau zum Laichen aufstiegen. Die exakten Verbreitungsgrenzen der einzelnen Arten sind nach wie vor unklar. Im österreichischen Donauabschnitt existiert nur noch eine kleine Population des potamodromen Sterlets (*Acipenser ruthenus*), diese ist jedoch stark gefährdet. Über das Habitat dieser Art in der Donau ist bisher sehr wenig bekannt. In den letzten Jahren haben die Besatz - und Fangzahlen von Störartigen in Österreich stetig zugenommen. Viele dieser Fische sind jedoch allochthone Störe wodurch autochthone Sterletbestände gefährdet werden können. Es ist dringend nötig, Maßnahmen zum Schutz und zur Förderung dieser Restbestände zu unternehmen und weitere Gewässerabschnitte hinsichtlich ihres Potentials als Sterlethabitat zu evaluieren. Wiedereinbürgerungsmaßnahmen sollten wissenschaftlich begleitet werden, da frühere Besatzversuche geringe Auswirkungen auf Fangzahlen hatten und zu keiner Etablierung einer selbst - reproduzierenden Population führten.

Das Ziel dieser Studie war es sämtliche verfügbaren Daten über Störe in Österreich zusammenzufassen um so ein genaueres Bild über deren historische und aktuelle Verbreitung zu bekommen. Mit der erhaltenen Datengrundlage wurde das Potential verschiedener österreichischer Flüsse hinsichtlich ihrer Eignung als Lebensraum für Störe eingeschätzt.

Thanks to

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Contents

Introduction

Sturgeons are an ancient fish family, dating back over 200 Million years. The family comprises 27 species and is restricted to the northern hemisphere. Sturgeons are characterized by very long life cycles of up to over 150 years, late maturation and many species grow very large (up to 6 - 7 meters). Most species are anadromous, which means they live and feed in the sea and undertake long spawning migrations into large rivers. There are also potamodromous (landlocked) species and forms, spending their whole life cycle in freshwater. Worldwide, various sturgeon species are already extinct, endangered or threatened through human impacts such as overfishing, damming, habitat damage and pollution. Obstacles along migratory routes prevent recovery in many river systems. In addition the global demand for caviar exacerbates this trend.

In the Austrian section of the Danube five sturgeon species are native, two potamodromous (*Acipenser ruthenus* and *Acipenser nudiventris*) and two anadromous species (*Acipenser stellatus* and *Huso huso*) and one species (*Acipenser gueldenstaedtii*) with both anadromous and potamodromous forms. Heavy overfishing of the three large anadromous and one large potamodromous species in earlier centuries already led to their extinction. The construction of various power plants in the 20th century finally prevented their return (especially the construction of the Djerdap I and II dams at the Iron Gate in 1972 and 1984) and altered both the hydromorphology and associated habitats along the entire river system. In the medieval period fences were constructed across the whole river width in order to block the migration routes and easily catch the fish. This fishing method proved so effective that it took only approximately two centuries for the sturgeons to rapidly decrease and nearly vanish in Austrian waters. Today one small freshwater species, the sterlet (*Acipenser ruthenus*), can still be found, but only in small quantities and in restricted areas. The remaining populations are still threatened and often depend on stocking. To this extent there is neither sufficient knowledge about the historical distribution of the various sturgeon species within Austrian rivers, nor about the actual status and the habitat use of sterlet populations. For remaining populations, increased stocking and catches of native and non - native sturgeon species might add further pressure through hybridization and competition. Intensification of sturgeon aquaculture will further increase this trend.

The objective of this study was to create a synopsis compiling as much information regarding *Acipenserids* in Austrian rivers as possible. Four steps have been undertaken to accomplish this task: First various historical data and reports have been analyzed to obtain a better picture of the historical distribution of the various sturgeon species within Austrian rivers. Secondly the current situation was examined, using catch data from the last 30 years, stocking records and contacting numerous experts, fishermen and scientific organizations. The third step was to merge the data from step one and two with hydromorphological information to identify the location of areas suitable for sturgeon conservation and reintroduction. Fourth, an extensive literature study was undertaken to identify measures and obstacles for successful protection and reintroduction, followed by a discussion of the results.

Method

The first part of this study was to determine the historical distribution of sturgeons within Austrian waters. Four steps were involved: The first step was to go through various historical texts, books and other material. As a second step over one- hundred sturgeon preparations from the archive of the Museum of Natural History of Vienna have been analyzed concerning their species and the location of their catch. With this information a database (Historic Database - HDB) and maps for the different sturgeon species (Page 27 - 30) were created, distinguishing actual catch reports and general statements. Finally the database was compared with other scientists in order to look for missing information and ensure the study was comprehensive as possible. Especially helpful in this task were Dr. Gertrud Haidvogl (Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Life Sciences) and Bernhard Schmall (University Salzburg).

Fig. 1: Sterlet preparate of the Museum of Natural History in Vienna.
(Credit: Author)

To determine the current situation it was inevitable to look for information regarding recent catches and stocking of sturgeons and to create a database (Present Database - PDB). Consequently more than 300 organizations, governmental institutions, private persons, fish ecologists, fishermen, scientific organizations, sport fishing clubs and others were contacted. “Wanted posters” were placed in all fishing shops in Vienna and Linz, printed in fishing magazines as well as digital copies on various internet platforms (Annex II). This was a rather comprehensive and time consuming task and of course the final list cannot be claimed to be complete. With this information, the species and origin of both stocked and caught fish was determined. Catches in various lakes, ponds, etc. were excluded as many of these are stocked with various sturgeon species and would generate biased results. If there was no picture available and the report was not from an institution qualified to distinguish between the various sturgeon species, the specimens would be recorded as “unknown” in the database. Most fish were reported as “sterlets” or “sturgeon” by fishermen, using only the length of the snout as indication. Therefore many caught “sterlets” were finally detected as Siberian sturgeons by this author. Specimens caught before 1994 were generally considered to be sterlets, as the anadromous species were already extinct by then and sturgeon trade and aquaculture didn´t commence until the mid- to late nineties.

Using the two databases (HDB & PDB), evaluation of the potential of various river stretches in Austria regarding sturgeon restoration commenced. Because there is little to no knowledge regarding habitat use of sturgeons in Austrian rivers a very basic approach was used. The criteria used to identify potential habitat were: historic and current occurrence, condition of caught fish, signs of spawning activity, length of available river stretches/impoundments, length of connected tributaries, fragmentation and habitat heterogeneity. Functional fish passes for sturgeons are still in the early development stages and in the foreseeable future it is unlikely that such passes will be installed in Austrian rivers. Furthermore the problem of downstream migration is still unresolved. Therefore each impounded section had to be evaluated separately. As result a map with hotspots for sturgeon restoration was created (Fig. 18). The outcomes were discussed after an extensive literature study.

Species

Native species

Five sturgeon species are native in Austrian waters. One freshwater species, the sterlet (*Acipenser ruthenus*) can still be found in small quantities. It is also often sold in hatcheries for ornamental purposes, especially the white albino form is very popular for garden pond owners. The potamodromous ship sturgeon (*Acipenser nudiventris*) is nowadays limited to the middle Danube and on the brink of extinction as single specimens are rarely caught. Also there is no program for artificial propagation of the Danube stock in captivity as no brood stock is available. The Russian sturgeon (*Acipenser gueldenstaedtii*), the stellate sturgeon (*Acipenser stellatus*) and the beluga sturgeon (*Huso huso*) are now restricted to the lower part of the Danube, as the dams at the Iron Gate block upstream migration. Two different migration types are known to exist for at least the beluga sturgeon and the Russian sturgeon within the Danube: the vernal form migrates and spawns in spring, and the hiemal form migraties in fall, overwinters in the river, and finally migrates further to spawn in the following spring (KHODOREVSKAYA et al., 2009). All three species are also highly endangered, in particular the long- distance migratory hiemal forms. For all three species artificial propagation and stocking programmes are carried out in the lower Danube. They can also be found in hatcheries and aquaculture in Austria, however in most cases it is not clear whether the fish belong to Danube or Caspian genotypes. Consequently introduction of these fish into natural water bodies has to be considered as a potential risk to the autochthonous species. There is an ongoing discussion about a resident form of the Russian sturgeon in the middle Danube (HECKEL & KNER, 1857; HOLCIK et al., 1981; HENSEL & HOLCIK, 1997). If such a form existed it would probably be already extinct, as catches within the last twenty years (GUTI, 2006) are more likely to be fish that have escaped from hatcheries, rather than indicators for a relict population. Another sturgeon species, the common sturgeon (*Acipenser sturio*) historically only occurred in the lower Danube and did not reach the Austrian section (BACALBACA- DOBRIVICI & HOLCIK, 2000).

Fig. 2 - 6: Native sturgeon species from top left:

Sterlet (*A. ruthenus*)
Ship sturgeon (*A. nudiventris*)
Russian sturgeon (*A. gueldenstaedtii*)
Stellate sturgeon (*A. stellatus*)
Beluga sturgeon *(H. huso*)

(Credit: Author)

Species Descriptions

(compare to: HOLCIK, 1989; HOCHLEITHNER, 2004; KOTTELAT & FREYHOF, 2007; KIRSCHBAUM, 2010)

Russian sturgeon

(*Acipenser gueldenstaedtii* BRANDT, 1833)

Fig. 7: Russian sturgeon with an untypical long snout in a public fish tank.
(Credit: Marktgemeinde Engelhartszell)

Characteristics

The Russian sturgeon can reach up to 2.3 meters in length, a weight of around 110 kg and an age of around 50 years. Average sizes are 1.3 to 1.6 meters and 20 to 40 kg.

Distribution

The species lives in the Black, Asov and Caspian Sea. For spawning it migrates into large tributaries like the Danube, the Volga, the Ural and others. A potamodromous freshwater form exists or existed in some rivers.

Ecology

The females mature at an age of 10 - 16 years while the males need 8 - 13 years. Spawning migration takes place every 4 - 6 years for females and every 2 - 3 years for males. There exist both hiemal and vernal forms in the Danube. Spawning takes place in spring in deep river sections with high current and rock or gravel substrates. As all other sturgeons the Russian sturgeon is a benthic fish, feeding on various benthic invertebrates and occasionally small fish.

Economy

The Russian sturgeon has a high economical significance and is intensively fished for its Osietra caviar. Therefore its stocks are highly endangered. It is artificially produced for caviar, meat, restocking and ornamental purposes in many European countries.

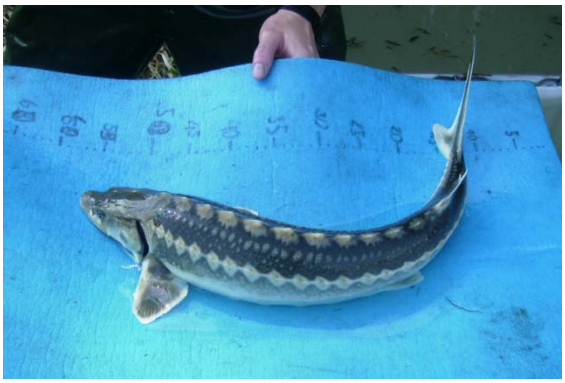


Fig. 8: Juvenile Russian sturgeon.
(Credit: Author)

Conservation status

Red List Austria (MIKSCHI & WOLFRAM, 2007): regionally extinct

Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V

CITES (CITES, 2012): Annex II

Ship sturgeon
(*Acipenser nudiventris* LOVETSKY, 1828)

Fig. 9: Adult ship sturgeon, caught near Bucharest in 1902.
(Credit: Author)

Characteristics
The species grows up to 2.2 meters and can reach a weight of 120 kg and an age of around 40 years. Average sizes and weights are between 1.2 meters and 1.6 meters with a weight of 20 to 30 kg.

Distribution
The ship sturgeon inhabits the Black, Asov, Aral and Caspian Sea and their tributaries. It also has potamodromous forms in various rivers.

Ecology
Ship sturgeon females mature after 12 - 14 years, males after 6 - 12 years. The females spawn every 2 - 3 years, the males every 1 - 2 years. Spawning time is in spring and the spawning places have similar characteristics as for other Danube sturgeons, like high flow velocity, water depths of 2 - 15 meters and gravel or rock substrates. It feeds mainly on various benthic invertebrates and occasionally small fish.

Economy
The economic value of the ship sturgeon is insignificant due to its low stocks. It is difficult to determine its importance in the past as it was often confused with Russian sturgeons or sterlets. It is artificially bred in small numbers for restocking in the Caspian Sea.

Conservation status
Red List Austria (MIKSCHI & WOLFRAM, 2007): regionally extinct
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V
CITES (CITES, 2012): Annex II

Sterlet
(*Acipenser ruthenus* LINNAEUS, 1758)

Fig. 10: Adult sterlet in a public fish tank. This fish was caught in the Danube near Jochenstein in 2011.
(Credit: Marktgemeinde Engelhartszell)

Characteristics
One of the smallest members of the sturgeon family it only grows up to 1.2 meters and 16 kg. Most adult specimens are 50 to 80 centimeters long. Its maximum age is around 25 years.

Distribution
As pure freshwater species the sterlet lives in large river systems draining in the Black, Asov, Caspian, Kara and White Sea. Typical rivers include Danube, Don, Ural, Volga, Lena, Drava and various others.

Ecology
The sterlet starts spawning with 3 - 5 years (males) and 4 - 8 years (females). Reproduction takes place every 1 - 2 years, the spawning migration in the river ranging up to 300 km (HOLCIK, 1989). Spawning time is in spring from April to June at similar sites as described for Russian and Ship sturgeon. The species feeds mainly on benthic invertebrates, but also on fish eggs and larvae.

Economy
Due to its small size the sterlet was not as heavily overfished as other species. It has a minor relevance for fisheries along the lower Danube. Sterlets are artificially bred in Europe, especially for restocking and ornamental purposes. As it matures early there is also interest in caviar production, especially with albino specimens.

Conservation status
Red List Austria (MIKSCHI & WOLFRAM, 2007): critically endangered, estimated number of reproducing adults < 1000
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V
CITES (CITES, 2012): Annex II

Stellate sturgeon
(*Acipenser stellatus* PALLAS, 1771)

Fig. 11: Adult stellate sturgeon in a public fish tank. (Credit: Author)

Characteristics
The stellate sturgeon reaches a length of 2.2 meters and because of its slim body shape a weight of 60 kg. The oldest caught stellate sturgeons had an age of around 35 years.

Distribution
The species lives in the Black, Azov and Caspian Sea and migrates into large tributaries for spawning. Single specimens were also caught in the Adriatic Sea.

Ecology
Males reach maturity with 6 - 12 years and spawn every 2 - 3 years, the females with 8 - 14 years and spawn every 3 - 4 years. Spawning habits are similar to other Danube sturgeons, although it is known that its spawning migrations in the Ural River are shorter than the migrations of beluga and Russian sturgeons (LAGUTOV & LAGUTOV, 2008). The species prey organisms are mostly benthic invertebrates and rarely small fish.

Economy
Due to the popularity of its caviar the species is heavily overfished in its natural range. The stellate sturgeon is bred in hatcheries for restocking and ornamental purposes, however it is more difficult to handle than other sturgeon species.

Conservation status
Red List Austria (MIKSCHI & WOLFRAM, 2007): regionally extinct
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V
CITES (CITES, 2012): Annex II

Beluga sturgeon
(*Huso huso* LINNAEUS, 1758)

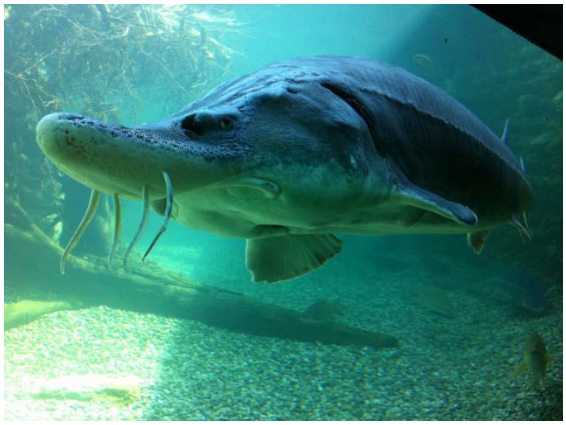


Fig. 12: Sub - adult beluga sturgeon (~180 cm) in a public fish tank.
(Credit: Marktgemeinde Engelhartszell)

Characteristics
As the largest freshwater fish in the world, the beluga sturgeon can reach lengths of 6 to 9 meters and weigh over 1.5 tons. Large specimens can have an age of over 100 years. According to new genetic studies the beluga sturgeon should be included in the genus *Acipenser* (KRIEGER et al., 2008).

Distribution
The beluga sturgeon inhabits the Black, Azov and Caspian Sea and migrates into the large tributaries for spawning. It is also native in the Adriatic Sea and the Po River.

Ecology
Beluga sturgeons reach their maturity very late, the males with 10 - 16 years and the females with 14 - 20 years. They spawn every 3 - 5 years in spring. Spawning habitat is similar to other Black Sea sturgeons. While juveniles feed on benthic invertebrates sub - adults and adults feed mostly on fish.

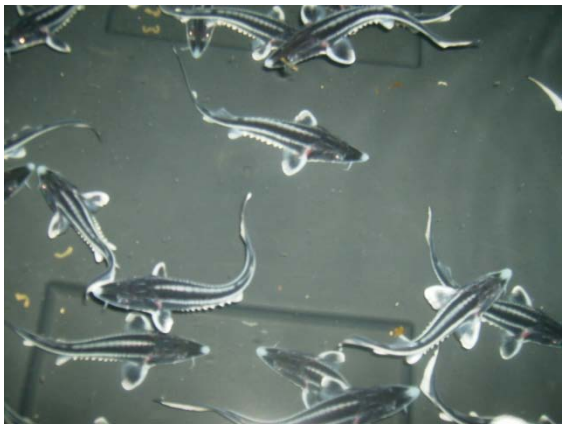


Fig. 13: Juvenile beluga sturgeons, 10 to 12 cm long and a few weeks old.
(Credit: Author)

Economy
As its caviar sells for up to 20.000 $ the beluga sturgeon has a high economical value. Unfortunately this led to overfishing in its natural range. It is artificially produced in hatcheries for restocking and caviar but due to its late maturation and difficult handling farmed caviar from beluga sturgeons is not yet available on the market.

Conservation status
Red List Austria (MIKSCHI & WOLFRAM, 2007): regionally extinct
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V
CITES (CITES, 2012): Annex II

Alien species

For economic reasons various exotic sturgeon species and hybrids have been introduced to Austria. The most important species is the Siberian sturgeon (*Acipenser baerii*) which is produced worldwide for its caviar and meat. Due to its robustness and lively behaviour it is also often sold for ornamental or sport fishing purposes. It can be found in many hatcheries, pet stores, etc. and is often confused with the sterlet. The white sturgeon (*Acipenser transmontanus*), originating from the North American Pacific coast, is produced mostly in Italy for caviar purposes and the males are sold throughout Europe for ornamental and especially sport fishing reasons. This species grows very fast but is not as easy to handle as the Siberian sturgeon. There have been some viral diseases with high mortalities in hatcheries and occasionally in the wild in the United States (VAN EENENNAAM et al., 2004) which can also infect European sturgeon species (HOCHLEITHNER, 2004). Also imported, but in smaller numbers, is the Adriatic sturgeon (*Acipenser naccarii*), mainly for ornamental and "collector" purposes. In the last years also small numbers of Atlantic sturgeon (*Acipenser oxyrinchus*) became available on the ornamental market. The North American paddlefish (*Polyodon spathula*) is mainly produced in Eastern Europe, and was long thought to be an interesting species for polyculture with carp. The production numbers, however, decreased in the last years. In addition to pure species various sturgeon hybrids have been imported, the most important being the bester (*A. ruthenus* x *H. huso*), the osster (*A. ruthenus* x *A. gueldenstaedtii*) and the "AL" (*A. naccarii* x *A. baerii*). All these species pose a potential threat to autochthonous (sturgeon) species once introduced into natural water bodies, either through hybridization, predation or competition for food and habitat.

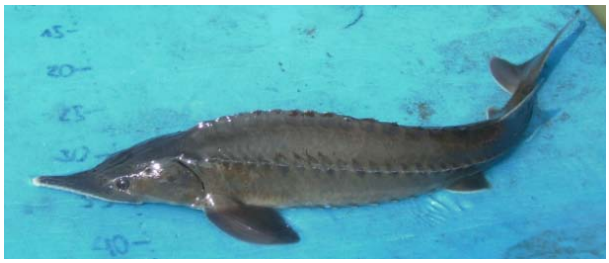


Fig. 14 - 21: Alien sturgeon species from top left:

Siberian sturgeon (*A. baerii*)
White sturgeon (*A. transmontanus*)
Adriatic sturgeon (*A. naccarii*)
Atlantic sturgeon (*A. oxyrinchus*)
Paddlefish *(Polyodon spathula*)
Bester hybrid (*A. ruthenus* x *H. huso*)
AL hybrid (*A. baerii* x *A. naccarii*)
Osster hybrid (*A. ruthenus* x *A. gueldenstaedttii*)

(Credit: Author)

Species Descriptions

(compare to: HOLCIK, 1989; HOCHLEITHNER, 2004; KOTTELAT & FREYHOF, 2007; KIRSCHBAUM, 2010)

Siberian sturgeon

(*Acipenser baerii* BRANDT, 1869)

Fig. 22: Large specimen of the Siberian sturgeon. (Credit: Author)

Characteristics

The Siberian sturgeon can reach 2 meters in length, a weight of 150 kg and an age of around 60 years. Average sizes are between 1.3 and 1.6 meters.

Distribution

The species lives in Siberia in the Kara and White Sea and in the Lake Baikal. For spawning it migrates into large tributaries like the Lena, the Ob, the Jennisei and others. There are both anadromous and potamodromous forms.

Ecology

Maturation depends on the geographical location of the various populations. The Siberian sturgeon is a benthic fish, feeding on various benthic invertebrates and occasionally small fish.

Economy

The Siberian sturgeon is endangered in its natural range. It is artificially produced for caviar, meat, restocking and ornamental purpose throughout the world. It is the most important sturgeon species for aquaculture.

Conservation status

CITES (CITES, 2012): Annex II

White sturgeon

(*Acipenser transmontanus* RICHARDSON, 1836)

Fig. 23: Sub - adult white sturgeon, farmed in Italy. (Credit: Author)

Characteristics

The species grows up to 6.5 meters in length and reaches a weight of around 800 kg.

Distribution

The white sturgeon lives along the North American Pacific coast and in its large tributaries. It also has landlocked forms in various rivers.

Ecology

White sturgeon females mature after 15 - 20 years, males after ~ 12 years. It feeds on various benthic invertebrates and fish.

Economy

The white sturgeon stocks are stable in various rivers, allowing strictly regulated sport fishing. Landlocked forms are still highly endangered. The species is artificially reproduced in North America and Europe for restocking and its caviar. In Europe males are often sold for sport fishing in “pay lakes” and for ornamental ponds.

CITES (CITES, 2012): Annex II

Adriatic sturgeon
(*Acipenser naccarii* BONAPARTE, 1836)

Fig. 24: Adult Adriatic sturgeon, farmed in Italy.
(Credit: Author)

Characteristics
Adriatic sturgeons grow up to 2 meters and 150 kg. Most adults are 110 to 150 centimeters long. The maximum age is around 50 years.

Distribution
The Adriatic sturgeon inhabits the Adriatic Sea and its large tributaries. There is an ongoing discussion of this species formerly inhabiting the Iberian Peninsula (CARMONA et al., 2009).

Ecology
The Adriatic sturgeon starts spawning with 6 - 8 years (males) and 8 - 12 years (females). Spawning time is in spring from March to May. The species feeds mainly on benthic invertebrates and occasionally on small fish.

Economy
This species was nearly extinct when artificial reproduction and restocking started around 30 years ago. Today it is bred for restocking and caviar in Italy and Spain. Small numbers of fish can also be found on the ornamental market.

Conservation status
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex II & IV
CITES (CITES, 2012): Annex II

Atlantic sturgeon
(*Acipenser oxyrinchus* MITCHILL, 1815)

Fig. 25: Juvenile Atlantic sturgeon.
(Credit: Matthias Maier)

Characteristics
The Atlantic sturgeon reaches a length of 4.2 meters, a weight of 370 kg and age of around 60 years.

Distribution
The species lives along the North American Atlantic Coast, from the Gulf of Mexico to the St. John River in Canada. It migrates into large tributaries for spawning. Around 2000 years ago it colonized the Baltic Sea and its rivers.

Ecology
Maturation age differs heavily between southern and northern populations. The species prey organisms are benthic invertebrates and fish.

Economy
The Atlantic sturgeon was extinct in the Baltic Sea. It is endangered in North America, however there is still a small commercial fishery in Canada. In order to build up a brood stock for restocking, fish were imported from Canada to Germany and Poland in the early 21st century. Lately some fish became also available for ornamental purposes

Conservation status
Habitat Directive (EUROPEAN COUNCIL, 1992): Annex V
CITES (CITES, 2012): Annex II

Paddlefish
(*Polyodon spathula* WALBAUM, 1792)

Fig. 26: Adult paddlefish.
(Credit: Author)

Characteristics
Maximum sizes and weights are around 2.5 meters and 100 kg. Although very closely related, the *Polyodontidae* differs from the *Acipenseridae* in many aspects of their ecology and physical appearance.

Distribution
This pure freshwater species inhabits the Mississippi River basin.

Ecology
In contrary to other sturgeons the paddlefish is not a benthic feeder but filters plankton instead. It lives pelagic in the middle and upper parts of the water column. Fish spawning the first time have a size of 1 to 1.2 meters. The spawning migration takes place in spring

Economy
The paddlefish is cultivated in North America, Europe and Asia for caviar and meat. It is often raised in ponds in polyculture with catfish, carp or other species. From time to time it is sold as ornamental fish.

Conservation status
CITES (CITES, 2012): Annex II

Economy & culture

Because of their size, their meat quality and the easy catch sturgeons were always an important food source for humans. Along the meat and the caviar, the bladder, skin and bones were utilized for producing glue, leather and soup subsequently (MOHR, 1952). Sturgeon fishing might have been an important factor for colonization of the Danube River basin (BALON, 1968). A stone sculpture, probably resembling a beluga sturgeon (Fig. 27) was discovered on the shore of the Danube at Lepenski Vir in the Iron Gate area. The sculpture was crafted in the Mesolithic, 8500 years BC. It is believed, that the annual migration of sturgeon was a symbol of fertility to the inhabitants of the Danube valley (RADOVANOVIC, 1997). Written records about sturgeon fishing along the Danube date back at least 3500 years BC (HOCHLEITHNER, 2004; KIRSCHBAUM, 2010). The fish were caught with harpoons, nets or fences (Fig. 28) covering the whole or parts of the river. Later, sturgeons were intensively fished by the ancient Romans. Legions, stationed along the Danube, depended on sturgeons as food source (BALON, 1968). As the numbers of fences grew in the fifth century, fishing regulations were implemented in order to avoid a total interruption of the sturgeon migration (BALON, 1968). The fences were restricted in their numbers and their size, allowing only half river - width coverage (SPINDLER, 1997). In 1053 the army of the German Emperor Heinrich the Third could have starved if they had not caught 50 giant beluga sturgeons (BALON, 1968). A document from 1230 states King Bèla IV. presenting 200 beluga sturgeons annually as a gift to the monastery Heiligenkreuz (BALON, 1968). BUSNITA (1967) estimates catch numbers for the Danube Delta alone of around 2000 tons in good years. Sturgeon butcher became a common profession (Fig. 29). On some days up to 450 sturgeons were sold on the Viennese fish market, their weight exceeding 50 tons (SPINDLER, 1997). Around the year 1500 a fence, blocking the whole width of the Danube was built near Budapest. Due to protests and politics the fence was destroyed and rebuilt several times (BALON, 1968). Beluga sturgeon fishing was such an attraction that the Viennese royal court visited the fences regularly (BALON, 1968). It is said that canons were used to shoo the sturgeons into the fence traps (BALON, 1968; SPINDLER, 1997). Salted meat was exported to Vienna, Praha, Munich and Paris (BALON, 1968). Because of over exploitation of the

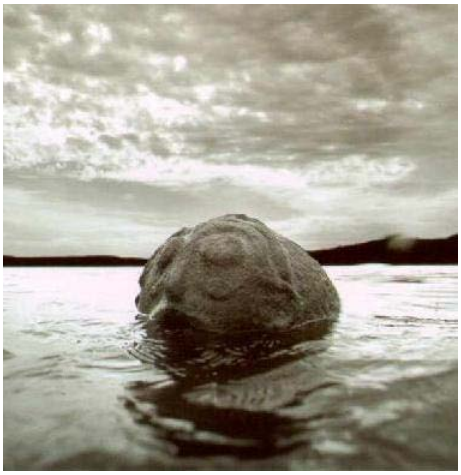


Fig. 27: Beluga sturgeon head sculpture, found near the Iron Gates, dating back 8500 years.
(Credit: RADOVANOVIC, 1997)

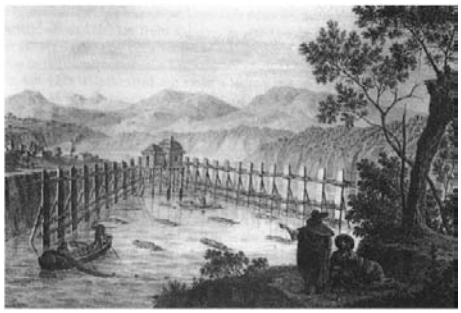


Fig. 28: Sturgeon fence on the Romanian Danube.
(Credit: Ludwig Ermini)

Fig. 29: Sturgeon butchering in Hamburg in the 19th century.
(Credit: MOHR, 1952)

stocks, catch numbers began to drop in the 16th century and the sturgeons, once food source for the masses became reserved for the privileged (BALON, 1968). The fishing grounds near Vah became property of the royal court (KHIN, 1957; BARTOSIEWICZ & BONSALL, 2008). The big sturgeon species nearly vanished from Austrian waters in the first half of the 19th century, leaving only the sterlet in considerable numbers (HECKEL & KNER, 1857). At the beginning of the 20th century sturgeons were already very rare on the Viennese fish market, single specimens being imported from the middle and lower Danube. Only the sterlet was still common but most fish were also imported from the middle and lower parts of the Danube (KRISCH, 1900), where it was still commercially fished until the beginning of the 21st century (HOLCIK, 1989; GUTI, 2006; GUTI, 2008). Management restrictions for the whole Danube basin were implemented in 1895 at a conference in Vienna (ANTIPA, 1905), nevertheless overfishing continued and with increasing habitat loss due to river incisions stocks continued to dwindle. After the construction of the Iron Gate Dams in the second half of the 20th century, fishery was concentrated in the lower parts of the Danube, fishermen using nets and longlines (Fig. 30) to catch sturgeon. As stocks continued to decrease, Romania banned sturgeon fishing in 2006 for 10 years, with Bulgaria following with a ban shortly thereafter (WSCS, 2008).

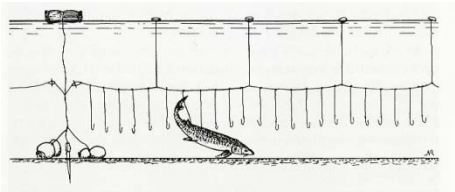


Fig. 30: Schematic of a longline used to catch sturgeons.
(Credit: HOCHLEITHNER, 2004)

Fig. 31: King Sigismund in a boat carried by two beluga sturgeons in the 15th century.
(Credit: WINDECK)

Inn & Salzach

Historic records

Reports of catches of sterlet range from 1890 to 1952, the most upstream being two catches in 1907 and 1927 near Rosenheim (MAIER, 1908; MARGREITER, 1927; JUNGWIRTH, et al. 1989). STREIBL reports three catches near Marktl and Malching in 1890, 1901 and 1902 (STREIBL; REINARTZ, 2008). The last reports are from the area around Schärding between 1945 and 1952, where an unknown number of catches is stated by FISCHER (1952). A sturgeon catch in 1746 near Ering, by some authors claimed to be a beluga sturgeon by others as “dick” (Russian sturgeon or ship sturgeon) (BROD, 1980) can be identified as Russian sturgeon according to the painting (Fig. 32). Around the year 1800 there are records for a specimen of Beluga sturgeon caught near Reichersberg (FREUDLSPERGER, 1936), while KERSCHNER (1956) dates the same catch around 1880. The fish was stuffed and kept in the monastery Reichersberg. Unfortunately it was destroyed later, so that the systematic status of this specimen remains unclear (SCHMALL & RATSCHAN, 2011).

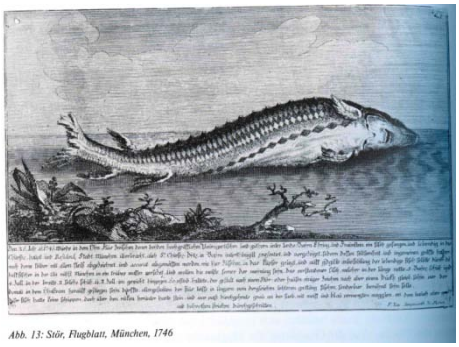


Fig. 32: Painting of the sturgeon caught 1746 near Ering.
(Credit: Bernhard Schmall)

In the Salzach the sterlet is claimed by some authors to occur rarely (AIGNER & ZETTER, 1859; PEYRER, 1874), while others say it occurred frequently (FREUDLSPERGER, 1936). According to SCHMALL & RATSCHAN (2011) it was common until ~1800 and was rarely caught in later years. There is one reported catch near Laufen in the midst of the 19th century (HECKEL, 1854; SIEBOLD 1863). The last known catch at the end of the 1850ies, caught by Josef Aigner, was kept alive in the castle Mirabell (AIGNER & ZETTER, 1859; ZETTER, 1862; SCHMALL & RATSCHAN, 2011). The catch of a Russian sturgeon, pictured in the castle Hellbrunn near Salzburg, was thought by some authors to be of Salzach origin (ZAUNER, 1997). The diocese Passau however had fishing rights not only along the Salzach but also at the lower Inn and the Danube, therefore the origin of this fish cannot be determined accurately (SCHMALL & RATSCHAN, 2011). There is also a portrayal of a beluga sturgeon (Fig. 33) in the castle Hellbrunn, with its subtext stating that the fish was caught near Tittmonig in 1617 having a weight of 237 pounds and a length of 3 meters (HOCHLEITHNER, 2004).

Fig. 33: Replica of the beluga sturgeon painting in Hellbrunn.
(Credit: Author)

Stocking and recent catch

There is no information available regarding stocking in the Inn and the Salzach. But some oral reports claim occasional sturgeon catches in the impoundment Stammham, the mouth of the Alz River (Inn) and the mouth of the Alz- Channel (Salzach) (SCHMALL & RATSCHAN, 2011). There is evidence about the catch of a Siberian sturgeon in the mouth of the river Alz in 2003(Fig. A3) and one Russian sturgeon, one Siberian sturgeon and one unknown specimen (probably also Siberian sturgeon as the catches were reported as one "sturgeon" and two "sterlets") in the impoundment of Stammham in 2004 (Fig. A2 & A4). A white sturgeon (Fig. A1), also reported as "sterlet", was caught in the lower Salzach around 2002 (FRIEDRICH, 2009).

Potential for restoration

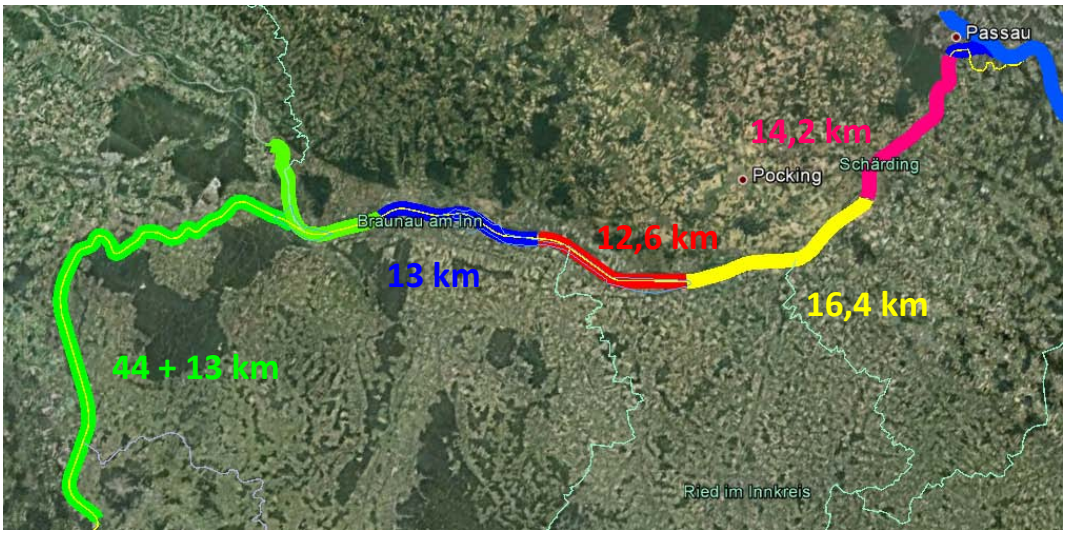


Fig. 34: Fragmentation of the lower Inn and Salzach along the German - Austrian border. The various colors show different impoundments, whereas similar colors show connected sections of other rivers. (Credit: Author/GoogleEarth)

The lower Inn has five power plants along the Austrian - German border and is therefore highly fragmented. With the average length of the impoundments of approximately 14 km it is very unlikely that it could support a viable, self- sustaining population of sterlets. In the Salzach stretch downstream of Laufen (where the natural border of sturgeon distribution is due to a natural change of the hydromorphological conditions) 44 km of free flowing river are still connected to a 13 km long stretch of the Inn. All recent catches of sturgeon were either in this section or in the impoundment of the Inn power plant directly upstream of this stretch. These findings lead to the suggestion that this is the only remaining section in the Austrian Inn – Salzach system with certain potential for reintroducing sterlet. How much habitat for sturgeons is really available in this area has yet to be determined due to factors like hydromorphological changes and "rhithralization effects" downstream of Laufen.

Danube

Historic records

The sterlet was stated as frequent in the Lower Austrian Danube in the 19th century (FITZINGER & HECKEL, 1836). Investigations in the fish collection of the Museum of Natural History of Vienna brought up 14 specimens caught in or near Vienna between 1831 and 1960. The size of these fish ranged from ~30 cm to ~70 cm. Also noted should be an albino specimen caught in 1877. While some authors state that the species was common in Upper Austria (FITZINGER & HECKEL, 1836; HECKEL & KNER, 1857; BREHM, 1910), others claim it was rare (LORI, 1871; KERSCHNER, 1956). KERSCHNER (1956) reports a catch, sold on the fish market in Linz in 1905. Interestingly there is much more information available for the Bavarian Danube. 13 catches, ranging up to Ulm could be found, from 1457 to 1905 (Tab. 1), the biggest specimen being caught near Deggendorf in 1886 with a length of around 100 cm (STREIBL; REINARTZ, 2008). JAECKEL (1864) writes of 3-4 catches per year near Passau in the midst of the 19th century and KINZELBACH (1994) states a temporarily high abundance of sterlets in the area of Ulm in the Middle Ages. There are also reports of one specimen from the Isar near Landshut in 1861 (SIEBOLD, 1863) and the Lech near Thierhaupten (JAECKEL, 1864). MOHR (1952) stated that a dedicated fishery for sterlet in Austria does not pay off.

Fig. 35: Ship sturgeon caught 1936 in Vienna.
(Credit: Österreichs Fischereiwirtschaft)

The ship sturgeon was said to migrate up to Komorn and to rarely enter the Austrian Danube (FITZINGER & HECKEL, 1836). In 1936 one specimen was caught in Vienna with a length of around 160 cm (Fig. 35). The original text describes it as Russian sturgeon (ÖSTERREICHS FISCHEREIWIRTSCHAFT, 1936) whereas ZAUNER (1997) correctly identifies it as ship sturgeon. FITZINGER & HECKEL (1836) also write about a catch near Regensburg, which is doubted by others (SIEBOLD, 1863), as the authors didn`t determine the species of the fish themselves. JAECKEL (1864), with an example of the original catch report and a picture available, states that according to the picture, the fish is most likely *Acipenser nudiventris*.

According to FITZINGER & HECKEL (1836), the Russian sturgeon also entered the Austrian Danube only on rare occasions. The authors distinguished two forms of the Russian sturgeon, *Acipenser gueldenstaedtii*, migrating up to Komorn and *Acipenser schypa* migrating up to Bratislava. This could be an indication for a separate freshwater form of this species. In the same book, a reported catch of a 36 - pound fish near Regensburg in 1679, is described (FITZINGER & HECKEL, 1836). Another catch near Donauwörth in 1457, with a weight of 165 pounds is described as a Russian sturgeon (JAECKEL, 1864). However there is no indication how the author could determine the species of this specimen.

Regarding the stellate sturgeon there are only two reports for the upper Danube basin. FITZINGER & HECKEL (1836) and MOHR (1952) said that it migrated up to Komorn and very rarely entered Austrian waters. SIEBOLD (1863) states that it rarely occurred in the Isar in Bavaria.

The beluga or great sturgeon was once very abundant in Austrian waters, but due to overfishing became very rare as early as the beginning 19th century, migrating mostly up to Bratislava (FITZINGER & HECKEL, 1836). The same situation also seems very likely for Russian, ship, and stellate sturgeon. A specimen with over five feet length was caught in 1692 near Straubing (FITZINGER & HECKEL, 1836). GAMLITSCHEK (1897) reports of beluga sturgeon catches "with great success" near Tulln. In 1605, a specimen with 81 kg was caught near Vilshofen in Bavaria (WACHA, 1856). Another catch stated by the same author near Ulm in 1822 was actually a sterlet (SIEBOLD, 1863).

Fig. 36: Traditional beach seine fishery for sturgeon, probably located on the Danube.
(Credit: OÖ Landesfischereiverband, 1997)

In 1886 a sturgeon was caught in the Danube Channel in Vienna, with a length of around 160 cm (HUGO, 1886). Unfortunately the exact species remains unclear. A second unspecified individual was caught in 1852 near Passau (JAECKEL, 1866).

Tab. 1: Historic catches in the Austrian and Bavarian Danube and two Bavarian tributaries (Isar & Lech). (Credit: Author)

Location	Species	Size	Weight	Year	Note	Source
Upper Austria	Sterlet			1905		KERSCHNER, 1956
Vilshofen	Beluga sturgeon		81000gr	1605		WACHA, 1956
Regensburg	Ship sturgeon ?		12 pounds			FITZINGER & HECKEL, 1836
Steppberg	Sterlet			1673		FITZINGER & HECKEL, 1836
Regensburg	Russian sturgeon		36 pounds	1679		FITZINGER & HECKEL, 1836
Straubing	Beluga sturgeon	over 5 feet		1692		FITZINGER & HECKEL, 1836
Regensburg	Sterlet					SIEBOLD, 1863
Regensburg	Sterlet					SIEBOLD, 1863
Bogen	Sterlet					SIEBOLD, 1863
Landshut (Isar)	Sterlet		5 pounds	1861		SIEBOLD, 1863
Ulm	Sterlet	22 inch	2,5 pounds	1822		SIEBOLD, 1863
Deggendorf	Sterlet	100 cm	10 kg	1886		STREIBL; REINARTZ 2008
Vilshofen	Sterlet	56 cm		1887		STREIBL; REINARTZ 2008
Vilshofen	Sterlet	45 cm		1881		STREIBL; REINARTZ 2008
Passau	Sterlet			1864	3 - 4 ind./year	JAECKEL, 1864
Thierhaupten (Lech)	Sterlet			1786		JAECKEL, 1864
Donauwörth	Russian sturgeon ?		165 pounds	1457		JAECKEL, 1864
Passau	unknown			1852		JAECKEL, 1866
Vienna	Ship sturgeon	~1,6m	~20 kg	1936		ZAUNER 1997; ÖFW 1936
Bad Deutsch- Altenburg	Sterlet	~0,5m		1959		Collection NHM
Vienna	Sterlet	~0,35m		1884		Collection NHM
Haslau	Sterlet	~0,35m		1831		Collection NHM
Vienna	Sterlet	~0,3m		1877	Albino	Collection NHM
Vienna	Sterlet	~0,35m		1877		Collection NHM
Vienna	Sterlet	~0,35m		1877		Collection NHM
Vienna	Sterlet	~0,35m		1877		Collection NHM
Vienna	Sterlet	~0,35m		1877		Collection NHM
Vienna	Sterlet	~0,35m		1877		Collection NHM
Vienna	Sterlet	~0,4m		1877		Collection NHM
Vienna, Reichsbrücke	Sterlet	~0,6m		1958		Collection NHM
Hainburg	Sterlet	~0,7m		1960		Collection NHM
Vienna	Sterlet	~0,7m		1958		Collection NHM
Vienna, Danube Channel	unknown	~1,6m		1886		HUGO, 1886

Stocking and recent catch

Although there are various rumours regarding stocking of sterlet and other sturgeon species in the Austrian Danube, research gave very little reliable data. SPINDLER (1994) mentions a stocking of beluga sturgeon near Linz in 1996. Using a picture of the stocking action (Fig. A27), received by the Upper Austrian Fishing Authorities (Oberösterreichischer Landesfischereiverband), the stocked fish could be identified as Russian sturgeon. There is a report about a second stocking of Russian sturgeon in the Donau - Auen National Park in 2005 (HOCHLEITHNER, pers. comm.; ÖSTERREICHISCHER FISCHEREIVERBAND, 2005). These activities can be seen mostly as some sort of public - relation actions, as the establishment of a population is highly unlikely. Such measures have to be seen even with scepticism, as through hybridization and competition the stocked fish might pose a threat to remaining sterlet populations. There has been stocking of sterlet in quite some stretches, however the best information is available for the area around and downstream of Vienna. Between 2002 and 2005 an intensive program, initiated by the Wiener Fischereiausschuss, took place upstream and downstream of the Freudenau power plant with fish ranging from 35 - 40 cm. All stocked sterlet in the database were obtained from hatcheries which, to the knowledge of this author, use the Danube stock for reproduction.

Tab. 2: Stocking in the Austrian Danube in the last 30 years. (Credit: Author)

Location	Species	Size	Quantity	Year	Note	Source
Linz	Russian sturgeon	70 - 80 cm	?	1996	Fig. A27	OÖ LFV, 1996
Wachau	Sterlet	15 - 25 cm	~700	1994		KIWEK, 1995
above pp Freudenau	Sterlet	?	?	?		HOCHLEITHNER, pers. comm.
above pp Freudenau	Sterlet	35 - 40 cm	~7000	2002 - 2005	Fig. A38	HP of WFA
below pp Freudenau	Sterlet	35 - 40 cm	~3000	2002 - 2006	Fig. A38	HP of WFA
Albern harbour	Sterlet	30 - 40 cm	5	2010	Fig. A43	SCHEIBLECHNER, pers. comm.
Donau- Auen National Park	Russian sturgeon	8 - 12 cm	300	2005	Fig. A41 & A42	ÖSTERREICHS FISCHEREI, 2005; HOCHLEITHNER, pers. comm.
Donau- Auen National Park	Sterlet	15 - 25 cm	~1000	2001	Fig. A40	HOCHLEITHNER, pers. comm.
Regelsbrunn	Sterlet	15 - 25 cm	~1000	1994	Fig. A39	HOCHLEITHNER, pers. comm.
near mouth of March	Sterlet	15 - 25 cm	~700	1994		KIWEK, 1995

In the impoundment of Aschach (for a short description see Annex III) and especially at its head directly below the Jochenstein power station, sterlets of all age classes are caught since the 1950ies (ZAUNER, pers. comm.; WAIDBACHER, pers. comm.). The species was and still is rather common and many fishermen rarely record their catches. Even with just a portion of the actual catch numbers in the database, there are 22 sterlet catches from 2002 until 2011 recorded (Tab. 3). Most are caught directly downstream of the Jochenstein power plant, using nets. The furthest downstream record is near Obermühl. To this point there are no indications of the species using the slow - flowing impoundment area upstream of the Aschach power station. In comparison to other fish species the sturgeons cope well with the stress of being entangled in a net and show no injuries or odd behaviour (ZAUNER, pers. comm.). The caught fish in the database range from around 30 cm (2 y/o) to around 85 cm (at least 10 y/o). In 2011 two tagged sterlets were caught (ZAUNER, pers. comm.) (Fig. A13), which were stocked in the Bavarian river Schwarze Laber (HIRMER, 2011). These specimens migrated around 150 km downstream and passed several power plants. A disturbing discovery was made in 2006/07, when several hybrids and a mature Siberian sturgeon were caught in this area (REINARTZ, 2008). These hybrids between male Siberian sturgeon and female sterlet give the first indication for hybridization between native and alien sturgeon species in a river system and of the Siberian sturgeon spawning naturally outside of its natural range (LUDWIG et al., 2009).

Other species and hybrids have been caught in various sections of the Upper Austrian Danube, like paddlefish near Schlögen (LFVOOE, 2003) and Alkoven (HOLCIK, 2006), Siberian sturgeon (WIESMAYER, pers. comm.) and hybrids (OÖ NACHRICHTEN, 2005) near Linz and fish of unknown species near Linz (WIESMAYER, pers. comm.) and Abwinden.

A sterlet, caught in 1984 near Linz (WIESMAYER, pers. comm.) is of interest, as it might have migrated downstream from the Jochenstein population or was a remnant in this Danube section (Fig. A22). Below the Wallsee - Mitterkirchen power plant two Sterlets have been caught in 1997, with the fisherman observing another two specimens feeding in a backwater (ANGERER, pers. comm.) (Fig. A26).

There are no reported catches for the Melk impoundment and very few for one of the two last free-flowing sections in Austria, the Wachau, on its downstream end dammed by the Altenwörth power station. Three catches of unknown species could be found (Tab. 3) and one Russian sturgeon (Fig. A28), reported as beluga sturgeon by the fisherman. A very large sterlet was caught at an unknown point (Fig. A29), probably a relic of a former population.

Downstream of the Altenwörth power station a sterlet with 54 cm was caught in 1980 (KOVARIK, pers. comm.). A very big specimen with around 90 cm (ELSBACHER, pers. comm.) and at least 10 years age was caught in 2003 (Fig. A35). Both specimens are probably either migrants from other stretches or relics of a former population. Also various exotic species and hybrids have been caught in this stretch, especially after the 2002 flood. Most of them identified as big Siberian sturgeons, all of which in very good condition (Fig. A33 & A34 and probably A30 & A31).

Before construction of the Freudenau power station, juvenile sterlets have been caught near Langenzersdorf and Klosterneuburg between 1986 and 1990 (KROMP, pers. comm.). Later catches were adult fish ranging from 60 cm to 100 cm (WAIDBACHER, pers. comm.; DELLINGER, pers. comm.; WAIDBACHER & STRAIF, 2005), with four fish being recorded. Although intensive stocking was carried out between 2002 and 2005, no catches in this area could be recorded in the following years.

In 1999 and 2000 EBERSTALLER et al. (2001) could catch eight specimens of sterlet directly below the Freudenau dam during a survey of the newly built fish ladder (Fig. A36). These fish, caught with nets, could be wild fish or originate from the stocking of 1994. After the stocking by the Wiener Fischereiauschuss 2002 - 2005 various sturgeon catches occurred in this area. 14 could be recorded in the database of the author, but probably many more occurred and were not published or registered. Likely most of the caught fish are sterlets (for example Fig. A36), but without pictures or exact descriptions identification is nearly impossible. There are also records regarding sightings of fish from the stocking, with over 1 m length in 2003 (EDER, 2003). However, they cannot belong to the stocked fish from this period due to their size, the size of the stocked fish (Tab. 2) and the average growth rate of sterlets. It remains unclear if these fish are wild remnants, earlier stocked fish or of another sturgeon species released in the Danube. From the Hungarian section of this stretch there are no catch records of sterlets (GUTI, pers. comm.), while HOLCIK (1989) states some catches of sterlets in this section in the 1980ies and also the catch of a paddlefish in 2006 (HOLCIK, 2006).

Tab. 3: Catches in the Austrian Danube in the last 30 years. (Credit: Author)

Impoundment	Location	Species	Size	Weight	Year	Note	Source
Aschach	below pp Jochenstein	Sterlet	~50 cm		2002	Fig. A10	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	~35 cm		2002	Fig. A11 & A10	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	~60 cm		2002	Fig. A16	ZAUNER, pers. comm.
Aschach	Schlögen	Paddlefish	115 cm	8700 gr	2003	Fig. A21	HP of LFVOOE
Aschach	Niederranna	Sterlet	76 cm	1335 gr	2005	Fig. A20	HP of HOFKIRCHEN
Aschach	below pp Jochenstein	Sterlet	~85 cm		2006	Fig. A17	REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Siberian sturgeon	~75 cm		2006/2007	Fig. A18	REINARTZ, 2008
Aschach	below pp Jochenstein	Hybrid Sibster			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Hybrid Sibster			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Hybrid Sibster			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Hybrid Sibster			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Hybrid Sibster			2006/2007		REINARTZ, 2008
Aschach	below pp Jochenstein	Sterlet	~45 cm		2007	Fig. A12	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	50 cm		2008	Fig. A9	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	~60 cm		2008	Fig. A15	ZAUNER, pers. comm.
Aschach	Obermühl	unknown	60 cm		2010		FISCHERFORUM
Aschach	below pp Jochenstein	Sterlet	~45 cm		2011	Fig. A7	ZAUNER, pers. comm.

Tab. 3: (Continued) (Credit: Author)

Impoundment	Location	Species	Size	Weight	Year	Note	Source
Aschach	below pp Jochenstein	Sterlet	54 cm		2011	Fig. A14	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	49 cm		2011	Fig. A8	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	46 cm		2011	Fig. A6	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	49 cm		2011	Fig. A5	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	35 cm		2011	stocked in Schwarzer Laber Fig. A13	ZAUNER, pers. comm.
Aschach	below pp Jochenstein	Sterlet	35 cm		2011	stocked in Schwarzer Laber	ZAUNER, pers. comm.
Aschach	mouth of Dandlbach	Sterlet	~30 cm		2011	Fig. A19	ZAUNER, pers. comm.
Aschach	Schlögen	unknown			2011		ZAUNER, pers. comm.
Ottensheim	Alkoven	Paddlefish	120 cm	8500 gr	1993		HOLCIK, 2006
Abwinden - Asten	Linz	Hybrid	~115 cm			possibly *A. naccarii* x *H. huso* Fig. A23	OÖ NACHRICHTEN, 2005
Abwinden - Asten	Linz	Sterlet	~45 cm		1984	Fig. A22	WIESMAYER, pers. comm.
Abwinden - Asten	Linz	Siberian sturgeon	~75 cm		1999	Fig. A25	WIESMAYER, pers. comm.
Abwinden - Asten	Linz	unknown	~60 cm		2011		WIESMAYER, pers. comm.
Abwinden - Asten	Abwinden	Hybrid	~110 cm		2003	possibly *A. naccarii* x *H. huso* Fig. A24	HP of HECHTSPRUNG
Wallsee - Mitterkirchen	below pp Abwinden	unknown		5000 - 7000 gr	2001-2003		FISCHERFORUM
Ybbs - Persenbeug	below pp Wallsee	Sterlet	40 cm		1997		ANGERER, pers. comm.
Ybbs - Persenbeug	below pp Wallsee	Sterlet	50 cm		1997	Fig. A26	ANGERER, pers. comm.
Altenwörth	Hollenburg	unknown	38 cm		2002		HP of DONAUFISCHER
Altenwörth	Dürnstein	Russian sturgeon	100 cm	4000 gr	2003	Fig. A28	
Altenwörth	below pp Melk	Sterlet	~85cm		2007-2010	Fig. A29	TROST, pers. comm.
Altenwörth	below pp Melk	unknown	~95 cm		2009		ANGELFORUM
Altenwörth	Emmersdorf	unknown			2011		FÜRNWEGER, pers. comm.

Tab. 3: (Continued) (Credit: Author)

Impoundment	Location	Species	Size	Weight	Year	Note	Source
Greifenstein	below pp Altenwörth	Sterlet	54 cm		1980		KOVARIK, pers. comm.
Greifenstein	below pp Altenwörth	Hybrid	~115 cm		2002	possibly *A. gueldenstaedtii* x *H. huso* Fig. A32	JUNGWIRTH, pers. comm.
Greifenstein	below pp Altenwörth	Sterlet	~90 cm		2003	Fig. A35	ELSBACHER, pers. comm.
Greifenstein	below pp Altenwörth	unknown	~90 cm		2005		ELSBACHER, pers. comm.
Greifenstein	below pp Altenwörth	Siberian sturgeon	~110 cm		2005	Fig. A33	JUNGWIRTH, pers. comm.
Greifenstein	Zwentendorf	unknown			2010		KOVARIK, pers. comm.
Greifenstein	below pp Altenwörth	Siberian sturgeon	96 cm		2011	Fig. A34	JUNGWIRTH, pers. comm.
Freudenau	Langenzersdorf	Sterlet	25 - 35 cm		1986		KROMP, pers. comm.
Freudenau	Langenzersdorf	Sterlet	25 - 35 cm		1988		KROMP, pers. comm.
Freudenau	Langenzersdorf	Sterlet	25 - 35 cm		1990		KROMP, pers. comm.
Freudenau	Klosterneuburger Durchstich	Sterlet	~100 cm		1993		WAIDBACHER, pers. comm.
Freudenau	Klosterneuburger Durchstich	Sterlet			1999		WAIDBACHER & STRAIF, 2005
Freudenau	Klosterneuburger Durchstich	Sterlet			1999		WAIDBACHER & STRAIF, 2005
Freudenau	Klosterneuburger Durchstich	Sterlet	~60 cm		1990-1994		DELLINGER, pers. comm.
Gabcikovo	below pp Freudenau	Sterlet	70 cm		1999	Fig. A36	EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	56 cm		1999		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	74 cm		2000		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	67 cm		2000		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	70 cm		2000		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	68 cm		2000		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	68 cm		2000		EBERSTALLER, et al., 2001
Gabcikovo	below pp Freudenau	Sterlet	67 cm		2000		EBERSTALLER, et al., 2001

Tab. 3: (Continued) (Credit: Author)

Impoundment	Location	Species	Size	Weight	Year	Note	Source
Gabcikovo	Freudenau harbour	unknown	72 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Danube- Oder channel	unknown	40 - 50 cm		2009/2010		HP of WFA
Gabcikovo	Freudenau harbour	unknown			2011		PETROUSCHEK, pers. comm.
Gabcikovo	Freudenau harbour	unknown			2011		PETROUSCHEK, pers. comm.
Gabcikovo	Freudenau harbour	unknown			2011		ZENS, pers. comm.
Gabcikovo	Freudenau	Sterlet	75 cm	3152 gr	2011	Fig. A37	SCHLAPPAL, pers. comm.
Gabcikovo	Cunovo	Paddlefish	114 cm	8200 gr			HOLCIK, 2006
unknown		Siberian sturgeon	~115 cm			Fig. A30	
unknown		Siberian sturgeon	~130 cm		2007/2008	Fig. A31	JUNGWIRTH, pers. comm.

Potential for restoration

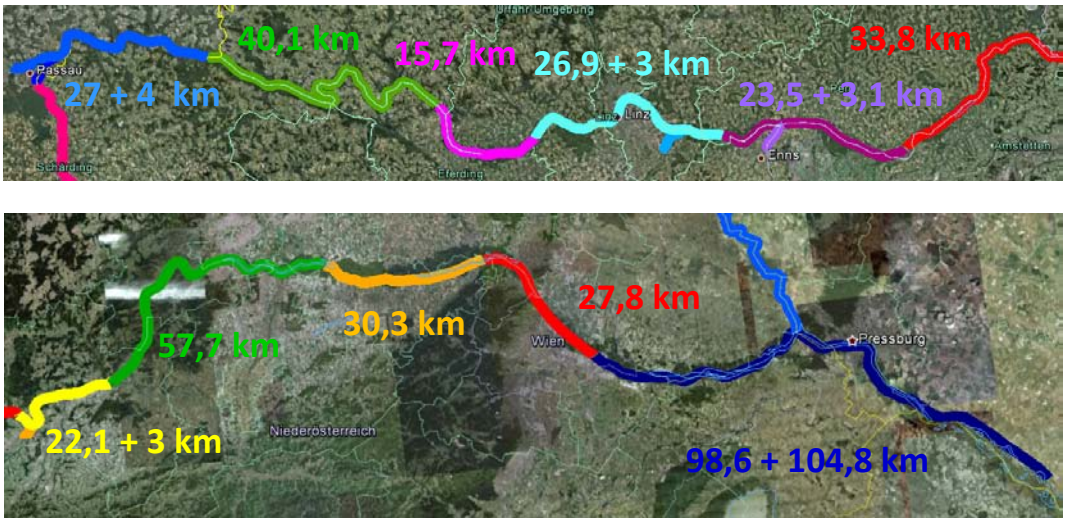


Fig. 37: Fragmentation of the Upper Autrian and Lower Austrian Danube. Impoundments from top left: Jochenstein, Aschach, Ottensheim, Abwinden - Asten, Wallsee - Mitterkirchen, Ybbs - Persenbeug, Melk, Altenwörth, Greifenstein, Freudenau, Gabcikovo. (Credit: Author/GoogleEarth)

According to various scientists (ZAUNER, pers. comm.; WAIDBACHER, pers. comm.; REINARTZ, pers. comm.; FRIEDRICH, 2009) the Jochenstein population is the last remaining, reproducing population of the sterlet in the Austrian Danube. This population has to be protected from habitat degradations and other negative influences like hybridization with alien sturgeon species. The increasing number of alien sturgeon species within natural water bodies poses a threat to native populations and restocking plans in all catchments. As we do not know the exact status and size of the Jochenstein population, nor the location and characteristics of their key habitats within this section (feeding, wintering, spawning and nursing), further research has to be carried out. Once the habitats are known and described, similar areas can be searched for or reconstructed in other river stretches.

Other stretches of the Upper Austrian Danube are partially much shorter and differ in their hydromorphological characteristics. The connected tailwater sections of the large tributaries Inn, Traun and Enns are only 3 - 4 km long. If the catches of sterlets near Linz in the 80ties and Mitterkirchen in the 90ties were of native sterlet stocks, these populations have most likely gone extinct. It might be that with ongoing revitalization and habitat improvement, adequate sterlet habitats become available again. If so, restocking should be done with juveniles hatched from the Jochenstein brood stock.

The situation on most Lower Austrian Danube stretches is similar to Upper Austria. The Melk impoundment is very short, with only a very small section of the Ybbs connected to it. In the free-flowing section through the Wachau only very few catches have been recorded. Nevertheless it has to be seen as a priority area due to its status and characteristics. It might be possible to find adequate sterlet habitats in the future, especially with ongoing habitat improvements and revitalizations, mostly through LIFE+ projects.

The high number of sturgeon catches below the Altenwörth power plant may be the result of the 2002 flood. At least the feeding habitat in this stretch seems to be excellent, as all caught fish are of very good condition. A sterlet caught in 1980 and a very big specimen from 2003, which is unlikely to origin from stocking due to its sheer size, were probably relics of a former population. Also the reports of 1 - 2 year old sterlets caught in the late 80ties near Klosterneuburg show that at this point spawning took place downstream of the by then already built Greifenstein power station. This therefore indicates the former existence of a sterlet population in this area not too long ago. After the Freudenau power station was built, the sterlet vanished in this area and even intense stocking did not show any improvement.

The river section with the highest potential regarding sturgeon restoration/reintroduction in Austria is the free- flowing section between Vienna and Gabcikovo, comprising the Donau – Auen National Park. The section is around 100 km long and still connected to around 70 km of the March River and around 30 km of the Thaya River, both earlier inhabited by sturgeons. This system is the longest open, free- flowing river system in Austria. It offers both epi - and metapotamal characteristics, subsequently higher habitat variability and a greater chance of habitat availability for all life stages. Human impacts on the hydromorphology in the Thaya - March system are comparatively low. Although in the Danube most shorelines are stabilized with rip-rap, ongoing revitalization takes place, connecting backwaters and improving habitat, especially in the National Park area. Intensive stocking took place at the beginning of the 21st century, and catches increased afterwards. Occasional catches and sightings of bigger specimens indicate the existence of a modest number of wild fish. To this point there is no proof of reproduction in this area, suggesting the lack of spawning places, the low adaption capability of stocked fish to natural conditions and/or an insufficient number of wild spawners or mature stocked fish. The increasing density of European catfish (*Silurus glanis*) in this area, might also pose a threat to juveniles. The same can be stated for the large stocks of various allochthonous gobies (*Neogobius melanostomus*, *Neogobius kessleri*, *Neogobius gymnotrachelus*, *Proterohinus marmoratus*) in the whole catchment (for details see Chapter Predation). Before any actions are taken, it is inevitable to try to determine the reasons for the decline of the sterlet stocks in this area to increase the chances of success for restoration measures. Any efforts in this area should be executed on a multilateral basis between the countries Austria, Slovakia, the Czech Republic and Hungary. If the dams at the Iron Gates and Gabcikovo will be passable for sturgeons sometime in the future, the stretch downstream of Vienna will have to play an important role for spawning. Making further passage through the ten power plants in Austria possible will be a much more difficult task to undertake. In contrast to the anadromous species the reintroduction of the landlocked ship sturgeon in this area might be more promising (ZAUNER, 1997; DER STANDARD, 2004; SALZBURGER WIRTSCHAFT, 2004; KRONENZEITUNG OBERÖSTERREICH, 2004; SALZBURGER NACHRICHTEN, 2004; FRIEDRICH, 2009). But as the status of the ship sturgeon has to be considered on the brink of extinction and there is no brood stock available in captivity, such considerations can only be made for the mid- to distant future (for details see Chapter Stocking and Reintroduction).

March & Thaya

Historic records

The sterlet is stated to occur in the March by various authors (HEINRICH, 1856; KRAFT, 1874; REMES, 1902), although no exact locations are given. According to REMES (1902) it also occurred in the Thaya. WEEGER (1884) reports of “sturgeon” catches near Rabensburg and Hodonin, which are most likely Russian sturgeon, as the Russian sturgeon is also stated to occur in the March (JEITTELES, 1864; REMES, 1902). The Beluga sturgeon at least migrated up to the Landshut area as there are reports of catches of fish up to two meters of size (REMES, 1902; ZBORIL & ABSOLON, 1916). HEINRICH (1856) states the species occurred in the area around Lundenburg and MAHEN (1927) writes that it was very rare. For the areas near Rabensburg and Hodonin, beluga sturgeon catches are also reported (WEEGER, 1884).

Stocking and recent catch

There are no records of stocking in the March and Thaya themselves, only a stocking of sterlets in the Danube near the mouth of the March (see Tab. 2) was carried out in 1994 (KIWEK, 1995). Furthermore it was not possible to obtain any data about sturgeon catches in the last 30 years except a note of 2- 3 catches annually by commercial fishermen since 1980 (HOLCIK, 1995). According to SPINDLER (1994) it is likely that the sterlet vanished from the March system.

Potential for restoration (See Chapter Danube - Potential for restoration)

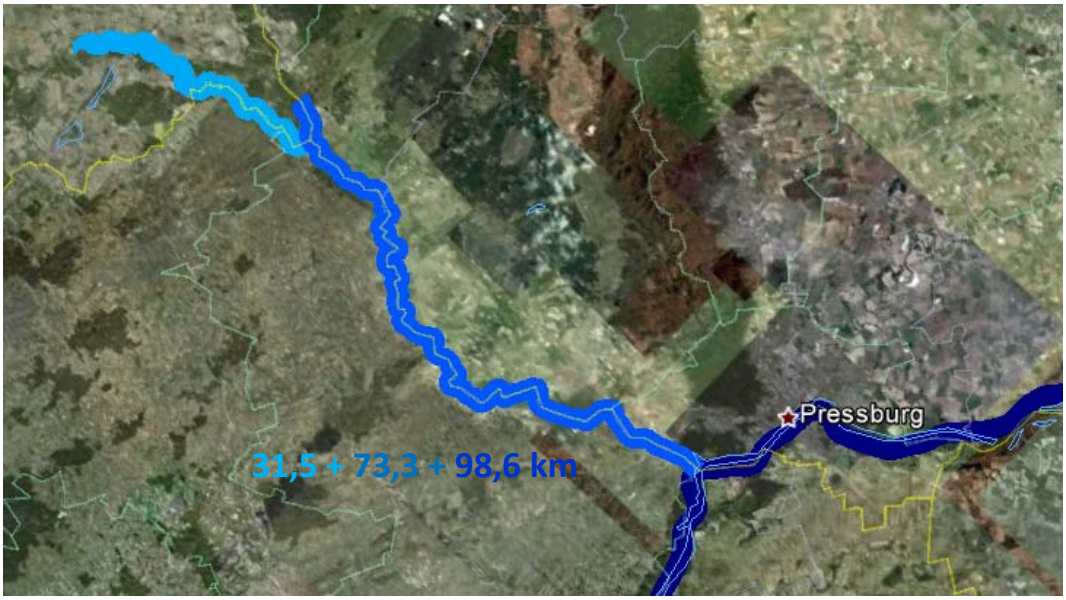


Fig. 38: Length of the Thaya - March - Danube system. (Credit: Author/GoogleEarth)

Other Tributaries

Historic records

Except for the rivers already mentioned, also other big tributaries have been examined, especially the Traun, Enns and Ybbs. Interestingly the only note was that sterlet rarely occurred in the mouth of the Enns river (ANONYMOUS, 1884). It is not known whether sturgeons never inhabited the lower parts of these rivers, or if there are just no records. However it seems likely that at least the lowest tailwater stretches close to the Danube were used for spawning. An interesting note is that FRAUENFELD (1871) stocked the Hadersdorfer pond with a few dozen sterlets from the Danube in the year 1847. Through a flood shortly thereafter most individuals escaped and one was caught in the Vienna River below the Gumpendorfer dam (FRAUENFELD, 1871).

Stocking and recent catch

There is no data available concerning stocking, only an oral report regarding the lower Traun with an unknown number of fish of unknown species and origin (LAHMER, pers. comm.). The fishing regulations for the lower Traun state sturgeons and beluga sturgeon as protected. Unfortunately it was not possible to gain further information on this subject. It is possible that there is a link to the stocking of sturgeon in the harbour of Linz in 1998 (Tab. 2; Fig. A27). There are two reports of paddlefish in Upper Austria. One specimen (Fig. A44) was found dead in the grille of a power plant in the Aschach River in 1996 (JAGSCH, 1996; ZAUNER, 1997). A second fish was caught in the Enns River (JUNGWIRTH, pers. comm.).

Potential

Very short tailwater stretches of Traun, Enns and Ybbs, with around three kilometers each, are still connected to the Danube. Also there are many power stations, other barriers and in the Traun even a diverted river section in the lower parts. Other problems are the habitat alterations, the hydromorphological changes and “rhithralization effects” in some parts. Therefore these rivers can be assumed unsuitable for sterlet reintroduction at this point, leaving only their mouths as possible habitat.

Drava

Historic records

Occurrence of the sterlet in the Drava is proved by various authors (HECKEL & KNER, 1857; GLOWACKI, 1885; MOJSISOVICS, 1897), but there is no indication how far upstream its distribution has been in the past. It is stated to have been a common fish near Warazdin but rarely reached Ptuj. Occasionally it was seen near Maribor (WOSCHITZ, 2006). FITZINGER & HECKEL (1836) also report of the Russian sturgeon, ship sturgeon and beluga sturgeon, HECKEL & KNER (1857) also of the stellate sturgeon. It is unclear if these species only migrated up to Legrad near the mouth of the Mura River, or further upstream to the Ptuj area (WOSCHITZ, 2006). One catch of ship sturgeon in the Mura in 2005 (GUTI, 2006) proofs that this species at least migrates up to the mouth of the Mura. Another specimen was caught further downstream near Heresznye in 1989 (GUTI, 2006). Regarding the available information (HONSIG - ERLENBURG & FRIEDL, 1999; WOSCHITZ, 2006) it remains doubtful if any of the five sturgeon species ever occurred in today`s Austrian Drava.

Stocking and recent catch

The various impoundments of the Drava were stocked from 1982 to 1995 with sterlets. In total around 1000 specimen, mostly ranging from 30 to 50 cm in length and partially from 5 to 20 cm, were stocked in four different impoundments (Annabrücke, Rosegg, Völkermarkt, Lavamünd). The fish were partially wild fish from the Hungarian Danube and partially artificially bred Danube - stock fish from the hatchery in Szasalombhatta, Hungary (HONSIG - ERLENBURG & FRIEDL, 1999). In 2010 300 additional sterlets were stocked by a hydropower company in the Völkermarkt impoundment. The fish were obtained from a hatchery in Waldschach, Styria (SALZMANN, pers. comm.). A fishing club stocked 50 additional sterlets in 2010 in the Annabrücke impoundment (PLEYER, pers. comm.). A questionable stocking took place in 2010, releasing an unknown quantity of Russian sturgeon of unknown origin in the Völkermarkt impoundment (HONSIG - ERLENBURG, pers. comm.).

Tab. 4: Stocking in the Drava. (Credit: Author)

Location	Species	Size	Quantity	Year	Note	Source
Impoundment Annabrücke	Sterlet	45 - 55 cm	130	1982		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Rosegg	Sterlet	45 - 55 cm	130	1982		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Rosegg	Sterlet	5 - 10 cm	150	1983		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Annabrücke	Sterlet	28 - 55 cm	70	1987		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Völkermarkt	Sterlet	28 - 55 cm	300	1987		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Lavamünd	Sterlet	20 - 30 cm	111	1991		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Lavamünd	Sterlet	20 - 30 cm	90	1995		HONSIG - ERLENBURG & FRIEDL, 1999
Impoundment Völkermarkt	Sterlet	~20 cm	300	2010		SALZMANN, pers. comm.
Impoundment Völkermarkt	Russian sturgeon	unknown	unknown	2010		HONSIG - ERLENBURG, pers. comm.
Impoundment Annabrücke	Sterlet	~25 cm	50	2005		PLEYER, pers. comm.

In the years following the stocking many specimens where caught and reported, especially in the impoundment Annabrücke (69 ind.), mostly in the free- flowing section downstream the power station Ferlach, and the impoundment Völkermarkt (20 ind.) (HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.). In total 45 specimen were reported between 1982 and 1993 and 74 specimen between 1994 and 2008, the biggest specimen with 107 cm and 8 kg being caught in the impoundment Feistritz in 2002 (MACHACEK, pers. comm.). The fish caught before 1993 are most certainly sterlets. Many fish caught later are also probably sterlets, but there is the possibility that other species have been introduced by then. After the stocking, sterlets were also caught in the Slovenian Drava near the border (HONSIG - ERLENBURG & FRIEDL, 1999). Of interest is that at least some specimens were able to pass the power plants unharmed through the turbines (HONSIG - ERLENBURG & PETUTSCHNIG, 2002). A stomach examination of a fish in 1993 showed that it mostly fed on larvae of caddisflies, belonging to the genus *Hydropsyche*, and partially on chironomids. As *Hydropsyche* larvae are not typical for lenitic waters, the specimen probably fed in the flowing section directly below the power plant or in the mouth of a tributary (HONSIG – ERLENBURG & FRIEDL, 1999). There are various oral reports of fishermen regarding juvenile sterlets in the

Annabrücke impoundment, not originating from stocking measures. Nevertheless a natural reproduction could not be verified (HONSIG - ERLENBURG & FRIEDL, 1999). During a benthic sampling in the Völkermarkt impoundment in 1998 a head capsule of a 2.5 cm long specimen could be found (HONSIG - ERLENBURG & FRIEDL, 1999), which is the first and to this point only proof of reproduction in the Austrian Drava. The larva was found 200 m downstream of a tributary in 8 m depth with a low flow velocity of 0.1 m/s over gravel bottom, overgrown with algae (HONSIG - ERLENBURG & FRIEDL, 1999). This habitat seems to be suitable regarding food supply and cover from predation.

Tab. 5: Sturgeon catches in the Drava from 1982 to 2008. (Credit: Author)

Impoundment	Species	Size	Weight	Year	Number	Source
Rosegg	Sterlet			1982	1	HONSIG - ERLENBURG & FRIEDL, 1999
Rosegg	Sterlet			1982	1	HONSIG - ERLENBURG & FRIEDL, 1999
Rosegg	Sterlet	35,5 cm	208 gr	1985	1	HONSIG - ERLENBURG & FRIEDL, 1999
Feistritz	Sterlet			1984	2	HONSIG - ERLENBURG & FRIEDL, 1999
Feistritz	unknown	107 cm	8000 gr	2002	2	MACHACEK, pers. comm.
Ferlach	Sterlet	47 - 58 cm		1987	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown	40 cm	300 gr	1997	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown			1997	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown	92 cm	4500 gr	1998	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown			1998	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown	55 cm		1998	1	HONSIG - ERLENBURG & FRIEDL, 1999
Ferlach	unknown	86 cm		2000	1	KOGLER, pers. comm.
Ferlach	unknown			2001	2	KOGLER, pers. comm.
Annabrücke	Sterlet			1983	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	Sterlet	35 cm		1983	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	Sterlet	50 cm		1984	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	Sterlet	50 cm	590 gr	1985	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	Sterlet	34 cm	100 gr	1987	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	Sterlet	63 cm		1988	1	HONSIG - ERLENBURG & FRIEDL, 1999

Tab. 5: (Continued) (Credit: Author)

Impoundment	Species	Size	Weight	Year	Number	Source
Annabrücke	Sterlet			1993	5	HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.
Annabrücke	unknown			1994	2	HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.
Annabrücke	unknown			1995	2	HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.
Annabrücke	unknown	90 cm		1996	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	unknown			1996	3	HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.
Annabrücke	unknown	96 cm		1997	1	HONSIG - ERLENBURG & FRIEDL, 1999
Annabrücke	unknown			1997	3	HONSIG - ERLENBURG & FRIEDL, 1999; PLEYER, pers. comm.
Annabrücke	unknown			1998	2	PLEYER, pers. comm.
Annabrücke	unknown			1999	4	PLEYER, pers. comm.
Annabrücke	unknown			2000	1	PLEYER, pers. comm.
Annabrücke	unknown			2001	5	PLEYER, pers. comm.
Annabrücke	unknown			2002	7	PLEYER, pers. comm.
Annabrücke	unknown			2003	2	PLEYER, pers. comm.
Annabrücke	unknown			2004	4	PLEYER, pers. comm.
Annabrücke	unknown			2005	7	PLEYER, pers. comm.
Annabrücke	unknown			2006	8	PLEYER, pers. comm.
Annabrücke	unknown			2007	3	PLEYER, pers. comm.
Annabrücke	unknown			2008	2	PLEYER, pers. comm.
Völkermarkt	Sterlet	47 cm		1982	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	52 cm		1982	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	30 - 52 cm		1982	5	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	40 - 60 cm		1983	5	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	65 cm		1985	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	72 cm	1700 gr	1990	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	52 cm	690 gr	1990	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet			1992	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	55 cm		1992	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	unknown	78 cm	2000 gr	1996	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	unknown	70 cm		1997	1	HONSIG - ERLENBURG & FRIEDL, 1999
Völkermarkt	Sterlet	2,5 cm		1998	1	HONSIG - ERLENBURG & FRIEDL, 1999

Tab. 5: (Continued) (Credit: Author)

Impoundment	Species	Size	Weight	Year	Number	Source
Schwabegg	Sterlet			1988	1	HONSIG - ERLENBURG & FRIEDL, 1999
Schwabegg	Sterlet			1989	1	HONSIG - ERLENBURG & FRIEDL, 1999
Schwabegg	Sterlet	68 cm		1990	1	HONSIG - ERLENBURG & FRIEDL, 1999
Schwabegg	Sterlet	66 cm	800 gr	1991	1	HONSIG - ERLENBURG & FRIEDL, 1999
Lavamünd	Sterlet	50 - 55 cm		1988	2	HONSIG - ERLENBURG & FRIEDL, 1999
Lavamünd	Sterlet	52,5 cm	500 gr	1993	1	HONSIG - ERLENBURG & FRIEDL, 1999
Lavamünd	unknown	50 - 60 cm		1998	4	HONSIG - ERLENBURG & FRIEDL, 1999
Lavamünd	Sterlet	94 cm	4800 gr	2003	1	FISCHERFORUM (Fig. A45)

Potential for restoration

Fig. 39: Fragmentation of the potamal section of the Austria Drava. (Credit: Author/GoogleEarth)

The various impoundments of the potamal Austrian Drava are rather short, with the flowing sections in between being even shorter. It seems unlikely that a self sustaining population can be established. As the size of the caught fish rose continuously over the years after stocking, it can be assumed that all of these catches are of stocked fish and no natural reproduction took place. Three possible explanations might be: an insufficient number of spawners, lack of spawning habitat and/or poor adaption of stocked fish to the natural environment. However there might be two possible exceptions. As there are various reports of sightings of juvenile sterlets in the Annabrücke impoundment (HONSIG – ERLENBURG & FRIEDL, 1999) there could be, or at least could have been, adequate spawning habitat. The finding of the sterlet larva in the Völkermarkt impoundment (HONSIG - ERLENBURG & FRIEDL, 1999) indicates that at least one successful spawning took place. As most catches also occurred in these two impoundments, any restoration efforts in Carinthia should be concentrated on them. Nevertheless it has to be kept in mind that it is uncertain if the sterlet ever occurred in the Austrian Drava.

Mura

Historic records

MOJSISOVICS (1897) states the sterlet occurred in the Mura up to Graz and tells about a catch in the Andritzbach in 1890. It is likely that sterlets once were abundant in the stretch between Spielfeld and Bad Radkersburg. Statements that the species once occurred in the Austrian part of the Raab River are unlikely to be true due to the small size of the river in this area, however it did occur in the Raab up to Körmend (WOSCHITZ, 2006). GLOWACKI (1885) describes the Russian sturgeon for the mouth of the Mura, while other reports from the area around Bad Radkersburg remain doubtful (WOSCHITZ, 2006). ZAUNER et al. (2000) state an occasional presence in the Mura along the Austrian- Slovenian border as possible. The catch of a ship sturgeon near Murakesztur on the Hungarian – Serbian border in 2005 (GUTI, 2006) proves the presence of this species in the Mura. If the Russian sturgeon was present in the Mura along the Austrian - Slovenian border in the past, it seems likely that also ship sturgeon, or even stellate or beluga sturgeon, were at least sporadically present.

Stocking and recent catch

In 2001 the Mura near Graz was stocked by the Arbeiterfischereiverein Graz with what was said to be sterlets. Unfortunately no statistics, pictures or other data were available, so that the exact species, the origin of the fish, the size and the quantity stocked remains unknown. In August 2005 members of the Institute of Hydrobiology and Aquatic Ecosystem Management found a dead Siberian sturgeon (Fig. A46) above the power plant Murau during a fish - ecological monitoring (WIESNER pers. comm.). In 2010 two Siberian sturgeon (Fig. A47 & A48) were caught in following nights near Spielfeld (Homepage of FV LEIBNITZ). Looking at the pictures of the fish and their length (78 & 79 cm) it might be even the same specimen. Both catches were reported as “sterlet” (Homepage of FV LEIBNITZ).

Potential for restoration

Fig. 40: Fragmentation of the Mura downstream of Graz and along the Slovenian - Austrian border. (Credit: Author/GoogleEarth)

The Mura downstream of Graz has many hydro - electric power stations but also other barriers which are not passable by sturgeons. The average length of the stretches in between is around 5 km. Hydromorphological changes and channelization led to “rhithralization effects” of the Mura River in the area around Graz, so that the habitat is not suitable for sterlet but for many other highly endangered rheophilic species like the Danube salmon (*Hucho hucho*) or riffle dace (*Telestes souffia*). An interesting area is the 21 km long section downstream of the last migration barrier near the village Misselsdorf. This stretch along the Austrian – Slovenian border is still connected to around 110 km of Mura, 240 km of Drava and 840 km of Danube. This makes obvious that any efforts in this area regarding sturgeon have to be multilateral between Austria, Croatia, Hungary, Slovenia and Serbia. The initial measures taken should concentrate on habitat improvements and reconstruction for the potamodromous sturgeon species. It can be assumed that many other species would also benefit from habitat improvements, fishing regulations and protection of key habitats. With these first steps implemented, restocking of sterlet in the Mura should be the next action. If this turns out to be successful and if a ship sturgeon brood stock is available by then, this stretch of the Mura could serve as nursery habitat for restocked juvenile ship sturgeon. The problem of exotic sturgeon species might have certain relevance in this area. There is a high density of hatcheries, aquaculture and recreational fishing lakes in lower Styria. Many of these keep or sell various sturgeon species like Siberian sturgeon, Russian sturgeon, white sturgeon, paddlefish or beluga sturgeon. It is more than likely that these fish are stocked (accidentally or on purpose) in the Mura or its tributaries. For example one lake for recreational fishery, located directly next to the Sulm River, an important tributary of the Mura, is densely stocked with Siberian sturgeons. The lake was flooded at least twice in the last years; so it seems very likely that a number of sturgeons escaped into the Sulm and went downstream into the Mura.

Summary

Historic records

Even through intensive research it is not possible to obtain a picture of the exact distribution of the five sturgeon species in Austria. Therefore there are two categories in the maps: Occurrence of the species verified by reported catches (**green**) and areas where the species was only stated by some authors or where occurrence seemed plausible regarding the distribution of other species with similar ecological demands (**yellow**).

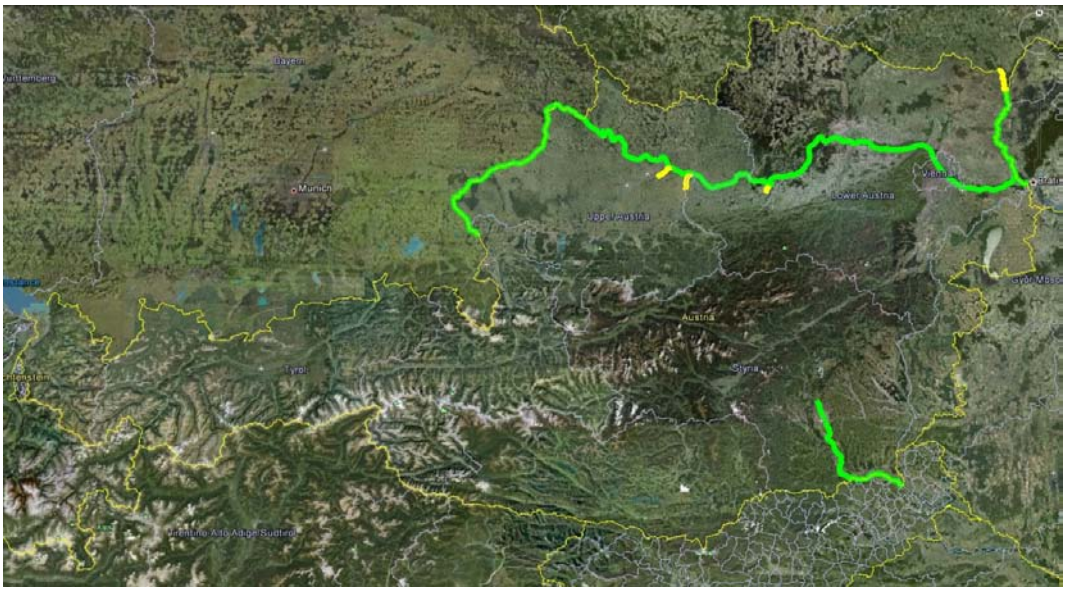


Fig. 41: Historic distribution of the sterlet in Austrian rivers. (Credit: Author/GoogleEarth)

The sterlet occurred throughout the Austrian Danube and in Bavaria upstream to Ulm. It undertook spawning migrations up to 300 km of length (HOLCIK, 1989). Keeping the species` range and the migration pattern in mind and combining it with records of catches, it can be stated that it was common in the Austrian Danube, even if it might have been only temporarily present in some stretches. It also occurred in the Inn along the Austrian - German border and in the Salzach upstream to Laufen which can be seen as the border of sterlet distribution due to hydromorphological changes in this area. Although there are almost no reports regarding the Traun, Enns and Ybbs, it can be assumed that at least the lower 5 to 10 km were occasionally used by sterlets or other sturgeon species. The March was inhabited by sterlets along the Austrian - Slovakian border and very likely also the lower sections of the Thaya. In the Mura a catch near Graz proves the occurrence of this species in this area, but due to hydromorphological characteristics it can be expected that it was more abundant in the Austrian - Slovenian border section of the Mura. As there is no indication of the species presence in the Austrian Drava, the closest known sporadic occurrence being 70 km downstream near Maribor (WOSCHITZ, 2006), the sterlet probably never occurred in the Austrian Drava stretch.

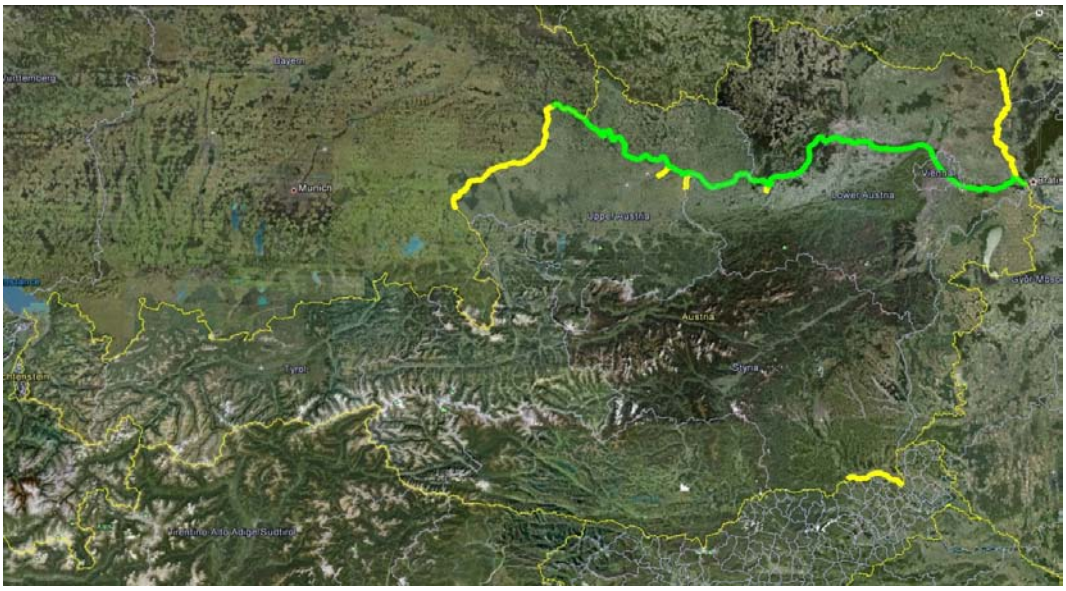


Fig. 42: Historic distribution of the ship sturgeon in Austrian rivers. (Credit: Author/GoogleEarth)

The ship sturgeon occurred in the whole stretch of the Danube, as catches near Vienna and Regensburg proved. Although not abundant in the 19th century (FITZINGER & HECKEL, 1839), it is likely that the species was already overfished by then and more numerous in earlier times. The situation is further complicated by fishermen making no distinction between juvenile ship sturgeons and sterlets and between adult ship sturgeons and Russian sturgeons. There are no reports for other rivers in Austria but looking at the distribution of the large migratory species it is possible that the ship sturgeon also occurred in the Salzach, Inn, March and Mura. Also the most downstream sections of the Traun, Enns, Ybbs or Thaya might have had suitable habitat near their confluences with the Danube or the March respectively.

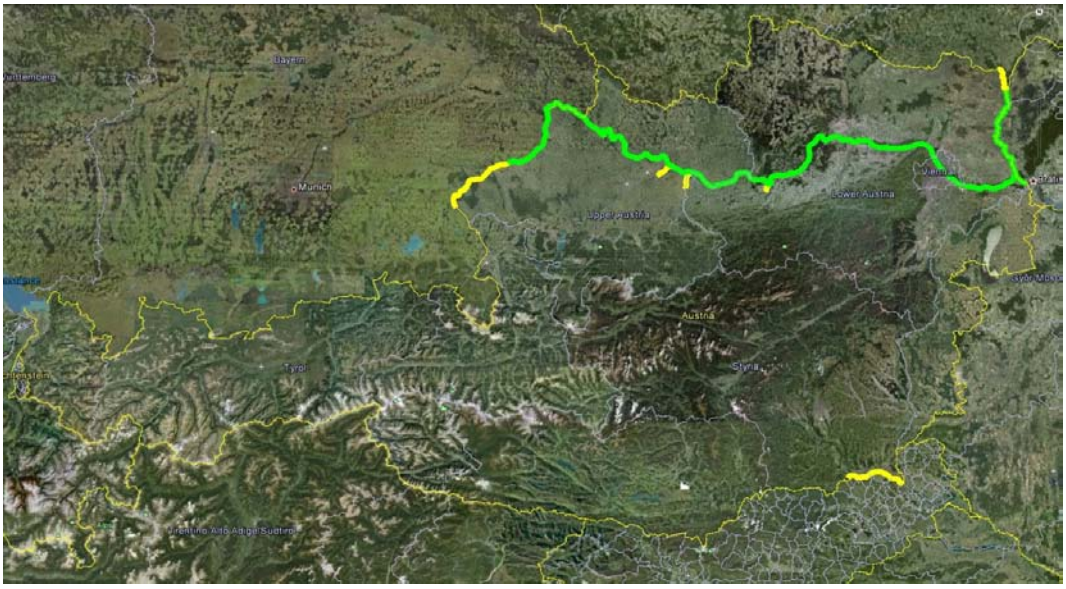


Fig. 43: Historic distribution of the Russian sturgeon in Austrian rivers. (Credit: Author/GoogleEarth)

Russian sturgeons migrated up to the Bavarian Danube. It is also said to have been rare by FITZINGER & HECKEL (1839), but this might be the same situation as described for the ship sturgeon. A catch near Schärding (BROD, 1980) shows the presence of this species in the Inn; it probably also occurred in the Salzach upstream to Tittmonig. In the March it has been reported upstream to Hodonin. For the other tributaries, the same situation can be assumed as for the ship sturgeon. Various authors also assume the species in the Mura along the Austrian - Slovenian border (ZAUNER et al., 2000).

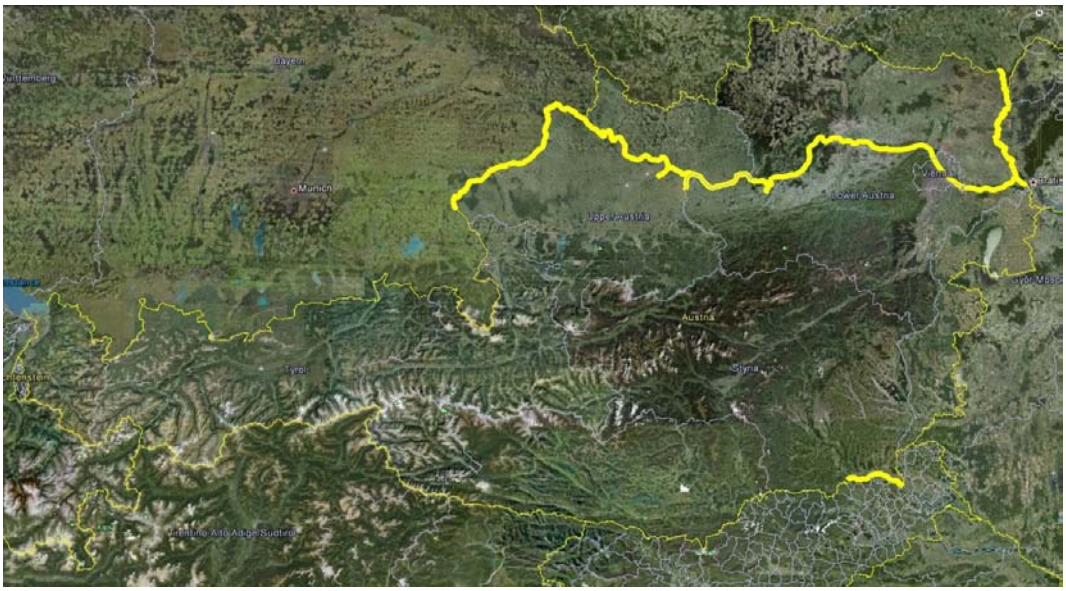


Fig. 44: Historic distribution of the stellate sturgeon in Austrian rivers. (Credit: Author/GoogleEarth)

There are no reports of stellate sturgeons in Austrian waters, only two statements from the 19th century describing it rarely entering the Austrian Danube (FITZINGER & HECKEL, 1839) and rare occurrences in the Isar in Bavaria (SIEBOLD, 1863). It probably was more abundant in earlier times and used similar habitat and stretches as the other species. In the Ural River the spawning migration of the stellate sturgeon is considerably shorter than of Russian and beluga sturgeon (LAGUTOV & LAGUTOV, 2008), which might be similar in the Danube, being an indication that the species might have been less frequent than others.

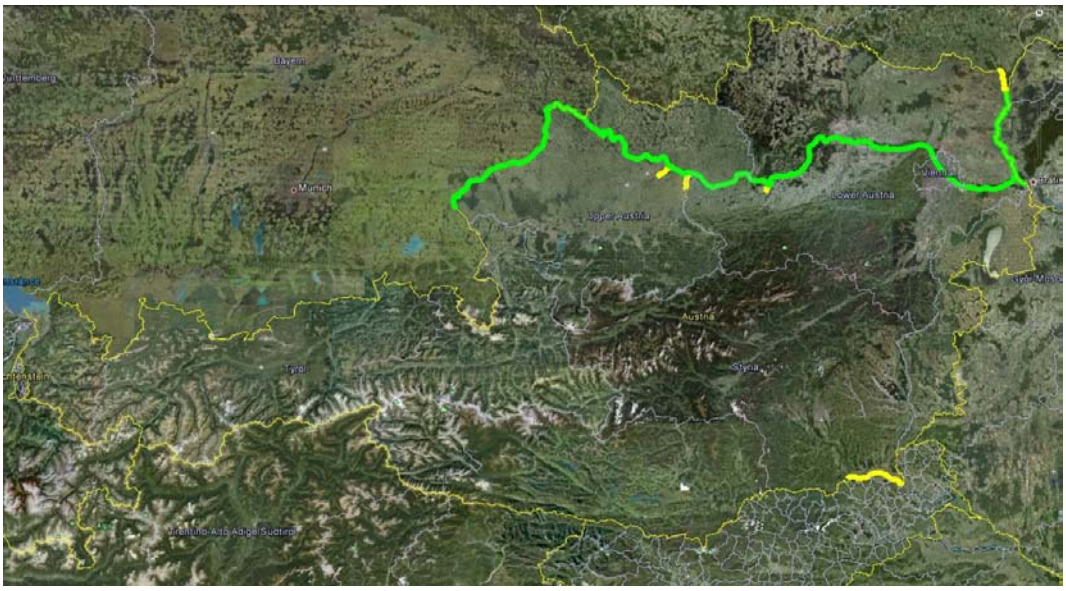


Fig. 45: Historic distribution of the beluga sturgeon in Austrian rivers. (Credit: Author/GoogleEarth)

The beluga sturgeon occurred throughout the Austrian Danube and the Inn. In the Salzach it migrated at least up to Tittmonig. Again, this species was stated as rare in Austrian waters in the 19th century (FITZINGER & HECKEL, 1839). In this case, the same authors stated that it was abundant in former times, which directly indicates overfishing in earlier centuries. For the March, catches are reported as far upstream as Hodonin. For the other rivers, the situation might be similar to the Russian and ship sturgeon.

Stocking

Stocking was and still is conducted in various Austrian rivers, especially in the Danube and the Drava. Most stocked fish are sterlets, but there were also some stocking actions with extinct species like Russian sturgeon. The high number of illegally stocked or escaped alien sturgeon specimens is problematic due to possible hybridization or competition with native species. In the Drava a high number of sterlets was stocked between 1982 and 1995 in various impoundments. In the Danube stocking efforts with sterlets were concentrated near Vienna and in the Donau - Auen National Park area from 1994 to 2010.

Recent catch

A total of 223 sturgeon specimens from Austrian rivers (Fig. 46) could be included in the database (PDB). It is estimated, however that the real number, including unrecorded catches, is two to four times higher. Around 90 reported catches are sterlets, half of them caught in the Danube and the other half in the Drava. Over 100 fish could not be identified due to the lack of pictures or usable information regarding morphological characteristics. Probably most of these fish are sterlets and Siberian sturgeons. Twelve Siberian sturgeons could be reported. In river stretches not stocked with sterlets or not comprising a sterlet population, this species is by far the most abundant in Austrian waters. Other species are caught to a lesser extent, for example white sturgeons, Russian sturgeons, hybrids or paddlefish.

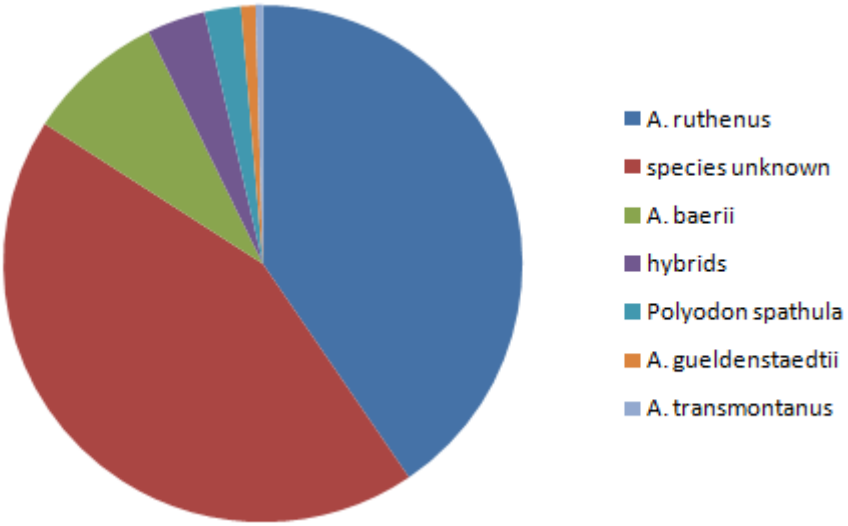


Fig. 46: Sturgeon catches 1980 - 2011 in Austrian rivers. (Credit: Author)

In the Danube, 83 specimens could be recorded (Fig. 47). Around forty of these are sterlets, half of them being caught in the Aschach impoundment in the last 10 years. Catches of juveniles and adults are reported since the 1950`s. Therefore this indicates the last remaining self- sustaining population of this species in Austria. Other sterlet catches are from various stretches: most interesting being catches steming from former populations in the 1980ies and early 1990ties near Linz, Wallsee, Altenwörth and Klosterneuburg. There is evidence of a natural reproduction near Klosterneuburg prior to the construction of the Freudenau power station. Intensive stocking in the early 21st century didn`t have any impact on catches upstream the Freudenau power station, whereas catches in the free flowing section downstream of Vienna increased after stocking. Many caught specimens remain unidentified but it can be assumed that most of those are sterlets or Siberian sturgeons. Alien sturgeon species and hybrids have been caught in nearly all Danube stretches, most fish being caught below the Altenwörth power station. An alarming discovery was the hybridization of native sterlets with alien Siberian sturgeon in the Aschach impoundment (LUDWIG et al., 2009), posing a threat to this last reproducing sterlet population (see Chapter Discussion - Alien species).

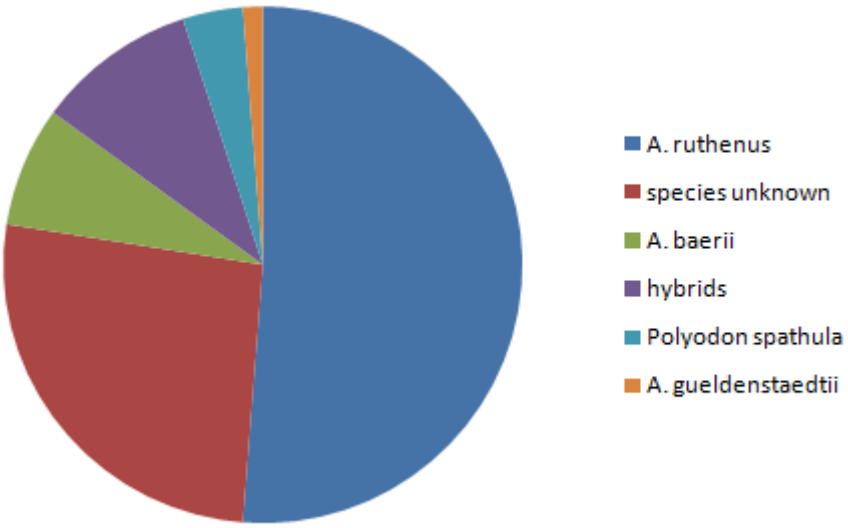


Fig. 47: Sturgeon catches 1980 - 2011 in the Austrian Danube. (Credit: Author)

Potential for restoration

Although Austrian rivers suffer from various habitat alterations like channelization, migration barriers like hydro electric power stations or weirs, channel incisions, etc., some stretches still have the potential to support a viable population of sterlets (see Chapter Discussion). Before any restocking takes place it should be tried to determine why the species disappeared and if suitable habitat is available.

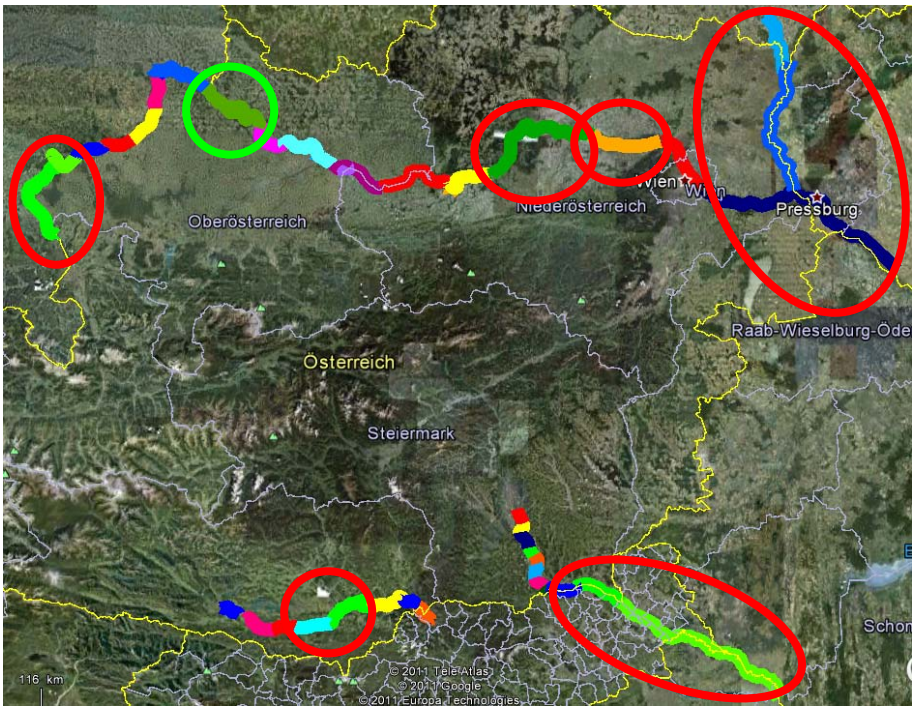


Fig. 48: Fragmentation and hotspots (circles) for sturgeon restoration in Austria. (Credit: Author/GoogleEarth)

Special attention has to be paid to the last remaining population below the Jochenstein power station (see Fig. 48 **green**). Protection of this population from various influences like habitat loss and especially hybridization with alien sturgeon species are top priorities. Fish from this stretch could be used to produce juveniles for restocking and more importantly for research on the habitat use of this population. Telemetric studies would be one possible way in order to identify and later reconstruct similar habitat in other Austrian river stretches.

The river system with the highest potential regarding reintroduction is the Danube downstream of Vienna, connected with the March and Thaya, in total offering a free flowing river stretch of around 200 km in length. The latter two rivers show relatively few human impacts regarding hydromorphology and the Danube flows mostly through the protected area of the Donau - Auen National Park. The system offers high habitat variability including both epi- and metapotamalic characteristics. Various questions regarding successful restocking of sturgeons have to be assessed, especially habitat availability, quality of stocking material and predation.

Other stretches that should be evaluated are the second free flowing Danube section in the famous Wachau valley in connection with the impoundment Altenwörth as well as the impoundment of Greifenstein. Sturgeon individuals caught in the latter show a very good condition, the available food resources seem to be adequate.

Another river with a high potential for recolonisation is the Mura along the Austrian - Slovenian border. Even if there is only a very short stretch on Austrian territory, it is connected to over 1000 km of free flowing Mura, Drava and Danube. If adequate spawning and nursery habitat is available it could be restocked with fry and juveniles of sterlet and later even with juvenile ship sturgeons or anadromous sturgeon species once the Iron Gate dams become passable as there is an ongoing discussion regarding a feasibility study for construction of fish passes at these dams. One risk that has to be kept in mind is the high density of aquaculture plants and hatcheries in the area and the widespread distribution of alien sturgeon species within these.

In the Drava, habitat is limited due to the numerous impoundments and only short flowing sections in between. The reports about juveniles in the impoundment Annabrücke and the finding of a sterlet larva in the impoundment Völkermarkt (HONSIG - ERLENBURG & FRIEDL, 1999) are the only two indications of spawning after the stocking in the 1980ies and 90ies. Therefore any efforts in the Drava regarding sterlet restoration should focus on these two stretches.

The lower Salzach and Inn systems are also very small - fragmented and show many hydromorphological alterations. The only interesting stretch is the connected environment of the Salzach and Inn of around 60 km length. All recently recorded sturgeon catches are from this area near the confluence of the Salzach River.

As the most important stretches are along borders to other countries all efforts regarding protection and reintroduction should be either bi- or multilateral. Any actions taken should have pre- and post monitoring to prove the success.

Discussion

Feeding habitat

According to catch data of this study, sterlets tend to stay at the upstream end of impounded sections with similar current patterns and conditions as in free - flowing rivers. Catches within the central parts of the impoundments are scarce. All pictures of caught specimens show that fish are in a very good condition. Therefore it can be assumed that at least intact feeding habitat and sufficient food supply are still available in the Austrian Danube. In the Danube sturgeons feed mostly in the main channel and occasionally in backwaters. Some authors even suggest the use of flooded lowlands (HOLCIK, 1989; BLOESCH et al., 2005; GUTI, 2008). As sturgeons are benthic fish, most of the diet consists of various benthic invertebrates. Some species like *A. sturio* show a high feeding selectivity in the wild while others like the closely related *A. oxyrinchus* rather shows opportunistic feeding habits (GESSNER, 2009). Therefore a straight forward interspecies transfer of behavioural characteristics is not suitable for all sturgeons (GESSNER, 2009). Most important prey organisms for the sterlet are *Chironomidae*, *Trichoptera*, *Ephemeroptera* and *Simuliidae* (HOLCIK, 1989). Additionally eggs of other fish are an important food source at least during certain times of the year, making out half of the stomach contents (HOLCIK, 1989). A recent study of sterlet diet in the Hungarian Danube showed that sterlets of all age classes prefer consuming chironomids, while bigger specimens also intensively feed on *Trichoptera* and gammarids of the genus *Corophium* (FIESZL et al., 2011). Plankton may also be important for the nutrition of fry of some sturgeon species. Therefore flooded lowlands might play an important role for healthy sterlet stocks. Mussels of the genus *Corbicula* have been found to be a temporally important food source for white sturgeon in North America (MILLER, 2004). These introduced mussels also occur in high densities in the Austrian Danube, especially in the impoundments. Additionally the various introduced Ponto - Caspian gammarid species might be a significant food source as the stocks increase throughout the Danube (MOOG, pers. comm.).

Wintering habitat

MOHR (1952) states that sterlet and ship sturgeon spend the winter in the Danube in deep areas with clayey bottom without feeding while the beluga sturgeon prefers muddy bottom. Although these statements are questionable sterlets generally tend to stay in large shoals within deep sections of the river with good oxygen supply. A wintering site located directly in Budapest was discovered recently downstream a concrete bridge pier (GUTI, pers. comm.).

Spawning habitat

Sturgeons spawn on gravel or rocky bottom in the main river channel. Some authors also suggest the use of floodplain sites flooded during high water levels (GUTI, 2006). The use of clayey and sandy substrates, as described by various earlier authors, has been ruled out for the Gulf sturgeon *Acipenser oxyrinchus desotoi* (SULAK & CLUGSTON, 1999). It can be assumed that the same may be

true for other sturgeon species as the eggs would be at permanent risk of being covered by the fine substrate and limited oxygen supply. According to KIRSCHBAUM (2010) spawning and feeding habitats for sterlets are the same during low water levels, while spawning migrations tend to be longer during high water levels. HOCHLEITHNER (2004) states the spawning taking place in depths of 2 - 15 meters at gravel bottoms and with flow velocities of 1.5 to 5 m/sec. Areas with laminar flow show increased spawning activity (KHOROSHKO & VLASENKO, 1970), as the eggs are evenly distributed on the substrate, allowing good oxygenation and no sedimentation (ARNDT et al., 2006). Following spawning the spent adults migrate downstream to feed in bays and backwaters. HOLCIK (1989) states that the spawning grounds of sterlets are located close to the wintering sites. Interpreting catch statistics of commercial fishermen in Hungary, optimal conditions for reproduction of sterlet and other litophilic spawners are during moderate high - waters in spring, as mortality of eggs and juveniles at very high water levels is increased (GUTI, 2011). A possible explanation is that with increasing shear stress and movement of the gravel substrates during high water levels many of the eggs, sticking to the sediment surface, are crushed. Since sturgeon juveniles and fry are not very powerful swimmers (PEAKE, 2004) losses due to flood - induced drift might also play an important role. A traditional spawning site in the Szigetköz floodplain in Hungary was destroyed after the construction of the Gabcikovo power plant (GUTI, 2008).The spawning sites were located in depths of around 8 meters with gravel substrate (GUTI, pers. comm.). As the sterlets of the Jochenstein population are caught directly below the power plant most time of the year (ZAUNER, pers. comm.), they probably spawn on the rocky substrate in this area. According to KHOROSHKO & VLASENKO (1970), ide (*Leuciscus idus*) and asp (*Aspius aspius*) use the same spawning grounds as sturgeons. These two species could be used as indicators to search for potential sturgeon spawning habitats (GESSNER & BARTEL, 2000).

Nursery habitat

Fry and juveniles remain at the spawning sites between rocks and stones whereas older juveniles are often encountered in sandy shallows (HOLCIK, 1989). The larva, found in a benthic sample in the Drava in 1998, was found 200 m downstream of a tributary in 8 m depth with a low flow velocity of 0.1 m/s over gravel bottom, overgrown with algae (HONSIG -ERLENBURG & FRIEDL, 1999). An experimental study researching the impact of various substrates on fry of Atlantic sturgeons showed significantly lower mortalities and better condition in fish reared over gravel substrate compared to fish reared over sand or without substrate (GESSNER et al., 2008).

Predation

There is little data about the different life stages of sturgeons regarding predation. Generally fry and small juveniles are most vulnerable. Due to their size and their bony scutes sub - adults and adults are well protected from predators. Young sterlets sometimes tend to feed from the surface, exposing their white belly. Stocking of a pond with 1000 fish of 5 cm size resulted in a disaster, as most of the fish were eaten by seagulls (REICHLE, 1997). Other piscivorous birds like cormorants would likely have similar impacts, although observations under natural conditions have not yet been conducted. In North America predation of young lake sturgeons (*Acipenser fulvescens*) by crayfish (*Procambarus clarkii*) could be observed in a pond (AUER, 2004). Many Austrian rivers are inhabited

by high densities of allochthonous crayfish (*Pacifastacus leniuscuslus* and *Orconectes limosus*). Invasive goby species have been observed near spawning sturgeons in the Great Lakes and are suspected to feed on sturgeon eggs and larvae (AUER, 2004). The same goby species (bighead goby, *Neogobius kessleri*, round goby, *Neogobius melanostomus* and tubenose goby, *Proterohinus marmoratus*) actually are extremely abundant in the Austrian Danube and its tributaries and are assumed to have highly negative impacts on native fish biocenosis. High densities of the European catfish (*Silurus glanis*) also pose a threat to sturgeon stocks both by direct predation and trophic competition. Negative impacts on Adriatic sturgeon stocks in various North Italian rivers are suspected by the increasing stock of catfish (PUZZI et al., 2009; BRONZI et al., 2011). The European catfish is a common species in the Austrian Danube and its stocks are likely to rise with increasing water temperatures due to climate change.

Stocking and reintroduction

Stocking has been discussed with some controversy and major problems with the prevalent method of stocking sub- adult and adult fish have been described for various fish species and especially salmonids (PINTER, 2008). Before any stocking actions with sturgeons take place it should be determined if suitable habitat for all life stages is available. Stocking with sturgeons has been conducted in larger scales since the second half of the 20th century but failed in most cases due to various reasons.

The large stocking programs in the Caspian Sea, with millions of fingerlings released each year in the brackish estuaries increased the catches in the sea but did not significantly impact the catch numbers in the rivers. This indicates that the stocked fish do not have the homing fidelity. Obviously they are not able to find their natal rivers and to locate appropriate spawning places at the right time (LAGUTOV & LAGUTOV, 2008).

Sturgeons reared in ponds over a longer period are trained to feed on pellet feeds. Own observations showed that older fish kept under such conditions often tend to ignore occasional supplied natural food items like fish, roe, crayfish, mussels or frozen *chironomids*. It can be assumed that many of these fish would poorly adapt to natural conditions.

Quantity and the genetic variation also play an important role for sustainable stocking. The length of the stocked river stretch and the available habitat (carrying capacity) as well as the estimated natural mortality have to be considered. Such considerations are a prerequisite to ensure the stock comprises enough spawners for founding a new population. In order to avoid genetic bottlenecks and inbreeding, the parental generation should be as big as possible. An isolated population should comprise of at least 50 and over a long term of at least 500 mature specimens (FRANKLIN, 1980). Later studies suggest even higher numbers of 1000 to 5000 individuals (JUNGWIRTH et al., 2003).

Tab. 6: Possible risks affecting the success of stocking various age classes (+ low/ ++ medium/ +++ high). (Credit:

	fry	juveniles	adults
predation	+++	++	
homing fidelity	+	++	+++
adaption to natural environment	+	++	+++
food supply	+++	+	+

Stocking of sterlet fry in Hungary started in the 1980ies with several ten thousand specimens released each year. However the impact on the catch numbers remains questionable (GUTI, 2006; GUTI, 2011).

Three years after reintroduction with 2000 juvenile sterlets from Hungary into the Danube in the impoundment Geisling in Germany first mature female specimens were caught in the area (REICHLE, 1997). The fast growth and early maturity indicate sufficient food supply. Nevertheless there are however no hints about successful reproduction.

Stocking of juvenile and adult sterlets in various impoundments in the Austrian Drava in the 1980ies did have a significant impact on the catch statistics (HONSIG - ERLENBURG & FRIEDL, 1999), but as catch numbers decreased in recent years the species seems to vanish. Although the stocked fish partially have been fed with natural feeds and there are two hints of natural reproduction (HONSIG - ERLENBURG & FRIEDL, 1999), no self - sustaining population could be established. Possible reasons are the insufficient number of stocked fish or mature spawners, lack of habitat, missing homing fidelity or poor adaption to natural conditions.

Stocking in other Austrian river stretches increased catch numbers but also failed to indicate any natural reproduction. As the caught fish are of very good condition they were apparently able to adapt to natural food sources. Research on juvenile white sturgeons in the Kootenai River, ranging from 23 to 72 cm in length, for three years after release showed that most juveniles successfully adapted to natural conditions, with an estimated survival rate of 60% in the first and 90% in the subsequent years (IRELAND et al., 2002; BURTSEV, 2009).

The introduction of sturgeon species outside of their natural range failed in most cases: for example the introduction of the sterlet in northern Germany (BREHM, 1910), the Russian sturgeon in the Baltic Sea and its tributaries (HOCHLEITHNER, 2004), the Siberian sturgeon in the Baltic Sea and the Volga (HOLCIK, 1989; PEGASOV, 2009). Although fish were caught on a regular basis (HOLCIK, 1989) they did not establish reproducing populations. A worldwide overview about various introductions, reintroductions, stocking and their success is given in WILLIOT et al. (2009).

With all these factors in mind it can be recommended to rear the fish for stocking in the same water as in the river and to feed them as much natural diet as possible. Whenever possible fry and fingerlings should be used for stocking and released near spawning sites to support “imprinting” on their home river and birthplace. Action plans for the Adriatic sturgeon in the Ticino River in Italy and the Guadalquivir in Spain suggest similar measures (ARLATI & POLIAKOVA, 2009; PUZZI et al., 2009;

DOMEZAIN, 2009). Stocking should take place at least as long as the first stocked generation starts reproduction. When dealing with highly endangered species with only limited numbers of fish available for releasing (like the common sturgeon (*Acipenser sturio*) or the ship sturgeon), and also in river stretches with high risks of predation, it might be more promising to use bigger fish for stocking (KIRSCHBAUM et al., 2011). Ideally all stocking actions should be closely monitored, at least until the first generation of stocked fish starts spawning.

The reintroduction of the ship sturgeon in Austrian waters as proposed by various authors in and in various newspapers (ZAUNER, 1997; DER STANDARD, 2004; SALZBURGER WIRTSCHAFT, 2004; KRONENZEITUNG OBERÖSTERREICH, 2004; SALZBURGER NACHRICHTEN, 2004; FRIEDRICH, 2009) is severely hampered by the lack of fish in captivity and the rarity of the species in the wild. The minimal population size and genetic bottleneck of this species in the Danube might have already been exceeded. At the moment, one mature male ship sturgeon, caught near Mohács in 2010, is kept in the hatchery of a research institute in Hungary (GUTI, 2011). As it is unpredictable when a female becomes available and the specimen seems to be not in very good condition (GUTI, pers. comm.), dispermic androgenesis to produce offspring (GRUNINA, et al., 2009), or cryoconservation of the sperm (NORDHEIM, et al., 2001) and releasing the specimen should be considered. As the species is nearly extinct in the Danube and potamodromous forms are also native in the Volga and Ural basin (LAGUTOV & LAGUTOV, 2008; KHODOREVSKAYA et al., 2009) it should be discussed to use these stocks for reintroduction if genetic differences between Danube and Caspian genotypes are minor. The IUCN guideline for reintroductions requires the used specimen to be as closely related to the native population as possible in order to increase the chances for optimal adaptation (IUCN/SSC RE - INTRODUTION SPECIALIST GROUP, 1995). Another possibility would be to put the genetic approach aside in favour of a species - conservation level approach. The Caspian and the Black Sea separated ~5 Mio years ago but reconnected for an indefinite time at the end of the last ice age around 10.000 years ago, giving sturgeon stock the possibility of genetic exchange between the two basins. Unfortunately the potamodromous Ural River stock of ship sturgeon is also close to extinction (LAGUTOV & LAGUTOV, 2008). The questions regarding upstream and downstream passage of sturgeons at the Iron Gates and Gabcikovo dams remain unresolved to this point. Therefore any efforts of reintroducing the anadromous sturgeon species in Austrian rivers are questionable. The still discussed possible potamodromous form of the Russian sturgeon seems to be even rarer than the ship sturgeon and might already be extinct.

Alien species

Alien sturgeon species and stocks pose a serious threat to autochthonous sturgeon stocks through possible hybridization, competition or diseases. The encounter of mature Siberian sturgeons and hybrids between Siberian sturgeons and sterlets in the impoundment of Aschach (LUDWIG et al., 2009) verified the seriousness of this issue and disproved other authors questioning the Siberian sturgeons ability to adapt to conditions in middle European rivers (REICHLE, 1997). Some authors suggest the caught hybrids to be accidentally stocked fish (GESSNER, 2009). Although this so - called sibster hybrid can be found in hatcheries it is very rare and unlikely to be released in such high numbers. A nearly ripe female Siberian sturgeon was also caught in the Garonne River in France (WILLIOT et al., 2009), posing a threat to the last population of *A. sturio*. Although a big scale establishment of Siberian sturgeon populations in European waters is unlikely, with rising stocks of

mature fish over the next years the possibility cannot be dismissed on a regional level. Introduction of stellate sturgeons in the Aral Sea led to a collapse of native ship sturgeon stocks due to various introduced parasites (HOCHLEITHNER, 2004). Various viral diseases found in hatcheries raising white sturgeon, shovelnose sturgeon and Russian sturgeon also pose a serious threat to wild populations (HOCHLEITHNER, 2004; VAN EENEENNAAM et al., 2004). Numerous paddlefish have been caught in several countries along the Danube, especially in the lower parts and the possibility of its naturalization was discussed by some authors (HOLCIK, 2006; SIMONOVIC et al., 2006). In Germany high numbers of various allochthonous sturgeon species have been caught in the last years (ARNDT et al., 2000; WIESNER et al., 2010) posing a threat to conservation programs for the common sturgeon (*Acipenser sturio*) in the North Sea and the Atlantic sturgeon (*Acipenser oxyrinchus*) in the Baltic Sea. Most caught specimens are Siberian sturgeons, Russian sturgeons or of unknown identity (ARNDT et al. 2001). Like in Austria it can be assumed that the number of unrecorded catches is several times higher. As sturgeon production levels increase worldwide, it is clear that the number of alien sturgeons within various river systems will rise if no precautionary actions are taken. Although this development cannot be stopped or reversed in the near future, various measures to deal with this topic have been discussed (ARNDT et al., 2001, FRIEDRICH, 2009). Sensitization of fishermen, hatchery and garden pond owners etc. regarding the risks of releasing allochthonous sturgeons into wild water bodies can be seen as a first step. At this point caught fish are often only distinguished by fishermen between “sterlet” (long snout) and “sturgeon” (short snout). Other possible future measures include stricter trade control, higher fines for illegal stocking and encouraged “taking” of exotic sturgeons by fishermen once they are able to differentiate them from sterlets (FRIEDRICH, 2009).

Tab. 7: Intensity of sturgeon trade in Austria in the last years (+ rare/ ++ regularly/ +++ often). (Credit: Author)

	juvenile	**adult**
A. ruthenus	+++	+
A. gueldenstaedtii	+++	++
A. stellatus	++	+
H. huso	+	+
A. baerii	+++	+++
A. naccarii	+	+
A. transmontanus	+	++
A. oxyrinchus	+	
P. spathula	+	
hybrids	++	++

Management

Tab. 8: Fishing regulations for sterlet in Austria. (Credit: Author)

	minimum size limit	closed season	source
Upper Austria	45 cm	1. May - 30. June	OÖ. LANDESFISCHEREIVERBAND, 2004
Lower Austria	45 cm	1. May - 30. June	NÖ. LANDESREGIERUNG, 2001
Vienna	protected	protected	WIENER LANDESREGIERUNG, 2008
Styria	50 cm	1. April - 30 June	STEIERMÄRKISCHE LANDESREGIERUNG, 2000
Carinthia	40 cm	1. January - 30. June	KÄRNTNER LANDESREGIERUNG, 2001
Salzburg	protected	protected	SALZBURGER LANDESREGIERUNG, 2003

Due to its conservation status it is recommended to protect the sterlet in all states. To this point the minimum size limits are even too small to guarantee at least one reproduction cycle (FRIEDRICH, 2009). This topic is under discussion in Upper Austria (PILGERSTROFER, pers. comm.). Fortunately, most recreational fishermen tend to release caught specimens alive. A commercial fishery on the Austrian Danube is nearly non - existing, as there are only a handful fishermen using nets to catch various cyprinids and other fish. The bycatch sometimes comprises sterlets, which are released in most cases.

Recommendations and open questions

Still there is little knowledge of the habitat use of sturgeons in the Danube and other Austrian rivers. Future conservation actions depend on sufficient information on the characteristics of key habitats. Therefore, the last remaining population in Jochenstein should be studied closely in order to be able to identify the various habitats and to search for similar areas in other river stretches. Appropriate methods would include implants of radiotelemetric or hydroacoustic transmitters in a number of fish to describe their migration patterns and exact locations within the Danube. At this point there are no reports of catches downstream of Obermühl, indicating the fish may only use a 25 km long section of the upper impoundment. The recent catch of two marked specimens (ZAUNER, pers. comm.) stocked in the river Schwarze Laber in Germany further showed the attractiveness of this stretch for sterlets, as these specimens migrated over 150 km downstream, passed several power plants on their way and finally stayed in the upstream section of the Aschach impoundment. Hence, the Jochenstein population can be seen as the key to sturgeon conservation and restoration in Austria.

The factors which caused extinction of the sterlet in many stretches remain still unclear. One key factor seems to be the loss of spawning places, like upstream of Vienna. Here, spawning places were indicated by catches of juveniles, but finally lost after the construction of the Freudenau power plant. This key factor coupled with already low numbers of mature adults may have led to the vanishing of the sterlet in most river sections.

The construction of artificial spawning grounds proved to be successful below the power plants Krasnodar and Fedorovskiy in the Kuban River. They were built 300 to 1500 meters below the dams but unfortunately after three years they diminished due to siltation and deposition (CHEBANOV et

al., 2008). Positive results downstream of the Volgograd dam in the Volga River also showed the effectiveness of such sites (MALTSEV, 2009). The layer should be at least 20 cm thick and composed of gravel with a diameter of 3 - 10 cm (KOTENEV, 2009). Construction of artificial spawning sites should be considered as an option in the Austrian Danube, especially below the Freudenau power plant. Regarding sustainability such sites should be located in areas with natural gravel sediments or constructed with gravel in a grain diameter big enough in order to avoid deposition of the gravel banks. Using hydrodynamic models and sediment regime monitoring, the gravel banks can be observed and constructed in a way to maximize their efficiency and durability.

Literature

Aigner, J. & J. T. M. Zetter, 1859: Salzburgs Fische. Jahresbericht des vaterländischen Museums Carolino- Augusteum der Landeshauptstadt Salzburg.

Anonym, 1884: Rechenschaftsbericht des oberösterreichischen Fischerei- Vereines über das Jahr 1883. Mitteilungendes oberösterreichischen Fischerei- Vereines Jg. 4, Nr. 14, Pages 87 - 91.

Antipa, G., 1905: Die Störe und ihre Wanderungen in den europäischen Gewässern mit besonderer berücksichtigung der Störe der Donau und des Schwarzen Meeres. Bericht an den internationalen Fischerei - Kongreß in Wien 1905.

Arlati, G. & L. Poliakova, 2009: Chapter 14 - Restoration of Adriatic Sturgeon (Acipenser naccarii) in Italy: Situation and Perspectives. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 237 - 245.

Arndt, G. M., Gessner, J., Anders, E., Spratte, S., Filipak, J., Debus, L. & K. Skora, 2000: Predominance of exotic and introduced species among sturgeons captured from the Baltic and North Seas and their watersheds, 1981 - 1999. Boletin Instituto Espanol de Oceanografia 16, Pages 29 -36.

Arndt, G. M., Gessner, J., & E. Spratte, 2001: Doch noch Störe in Deutschland? - Fänge von einheimischen und nicht einheimischen Stören in mitteleuropäischen Küstengewässern. In: Verband deutscher Sportfischer e. V., 2001: Der Stör *Acipenser sturio* L. Fisch des Jahres 2001. Offenbach, Pages 50 - 62.

Arndt, G. M., Gessner, J. & R. Bartel, 2006: Characteristics and availability of spawning habitat for Baltic sturgeon in the Odra River and its tributaries. In: Gessner, J., 2009: Prerequisites for the remediation of the indigenous sturgeons Acipenser sturio Linnaeus 1758 and A. oxyrinchus Mitchill 1815 in river systems of northern Germany - development of methods and contributions towards scientific criteria and concepts for a recovery management plan. Humboldt University Berlin.

Auer, N., 2004: Chapter 12 - Conservation. In: Breton, G. T. O., Beamish F. W. H. & R. S. McKinley (Editors), 2004: Sturgeons and Paddlefish of North America. Fish and Fisheries Series, Kluwer Academic Publishers,Pages 252 - 276.

Bacalbaca –Dobrivici, N. & J. Holcik, 2000: Distribution of *Acipenser sturio* L., 1758 in the Black Sea and its watershed. Boletin Instituto Espanol de Oceanografia 16, Pages 37 - 41.

Balon, E. K., 1968: Einfluß des Fischfangs auf die Fischgemeinschaften der Donau. Arch. Hydrobiol./Suppl. XXXIV (Donauforschung III), Stuttgart, Pages 228 - 249.

Bartosiewicz, L. & C. Bonsall, 2008: Complementary taphonomies: Medevial sturgeons from Hungary. Archéologie du Poisson, 30 ans d`Archéo - Ichtyologie au CNRS, Antibes, Pages 35 - 45.

Bloesch, J., Jones, T., Reinartz, R., & B. Striebel (Editors), 2005: Action Plan for the Conservation of the Sturgeons (Acipenseridae) in the Danube River Basin. Convention on the Conservation of European Wildlife and Natural Habitats, Strasbourg.

Brehm, A. G., 1910: Das Leben der Tiere - Die Kriechtiere - Die Fische. Deutsche Buch Gemeinschaft, Berlin, Page 400.

Breton, G. T. O., Beamish F. W. H. & R. S. McKinley (Editors), 2004: Sturgeons and Paddlefish of North America. Fish and Fisheries Series, Kluwer Academic Publishers.

Brod, W. M., 1980: Historische Streiflichter auf Fisch und Fischerei. Im Dienste der Bayrischen Fischerei- 125 Jahre Landesfischereiverband Bayern e. V.: 173 - 237 aus H& W 1997.

Bronzi, P., Castaldelli, G., Cataudella, S. & R. Rossi, 2011: Chapter 16 - The Historical and Contemporary Status of the European Sturgeon, *Acipenser sturio* L., in Italy. In: Williot, P., Rochard, E., Desse - Berset, N., Kirschbaum, F. & J. Gessner (Editors), 2011: Biology and Conservation of the European Sturgeon Acipenser sturio L. 1758 - The Reunion of the European and Atlantic sturgeons. Springer Science + Business Media B. V., Pages 227 - 241.

Burtsev, I. A., 2009: Chapter 22 - Towards the Definition of Optimal Size - Weight Standards of Hatchery - Reared Sturgeon Fry for Restoration. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 359 - 368.

Busnita, T., 1967: Die Fischerei und Fischereiwirtschaft. In: Liepolt, R. (Editor), 1967: Limnologie der Donau. E. Schweizerbart`scheVerlagsbuchhandlung, Stuttgart.

Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V.

Chebanov, M. S., Galich, E. V. & D. V. Ananyev, 2008: Strategy for conservation of sturgeon under the conditions of the Kuban River flow regulation. In: Rosenthal, H., Bronzi, P., Poggioli, C. & M. Spezia, (Editors) 2008: Passages for fish - overcoming barriers for large migratory fish. World Sturgeon Conservation Society Special Publication No. 2, Books on Demand GmbH, Norderstedt, Pages 70 - 82.

Convention on international Trade in endangered Species of wild Flora and Fauna, 2012: Appendices I, II and III valid from 3 April 2012. Page 27.

Der Standard, 2004: FH Salzburg mit Stör - Studie. 31.01.2004.

Domezain, A., 2009: Chapter 26 - Main Steps and Proposals for a recovery Plan of Sturgeon in the Guadalquivir River (Spain). In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 423 - 452.

Eberstaller, J., Pinka, P. & H. Honsowitz, 2001: Überprüfung der Funktionsfähigkeit der Fischaufstiegshilfe am Kraftwerk Freudenau. Schriftenreihe der Forschung im Verbund Band 72, Vienna.

Eder, K., 2003: Sterletprojekt bis 2005 verlängert. Österreichs Fischerei, 56, Page 170.

European Council, 1992: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Fieszl, J., Bogacka-Kapusta, J., Kapusta, A., Szymanska, U. & A. Martyniak, 2011: Feeding ecology of sterlet *Acipenser ruthenus* L. in the Hungarian section of the Danube. Arch. Pol. Fish. 19, Pages 105 - 111.

Fisch und Fang, 2000: Sterlet im Traunsee. Nr. 12/2000, Page 14.

Fischer, H., 1952: Die Störe. Österreichs Fischerei 5/1952, Page 251.

Fitzinger, J. A. & J. Heckel, 1836: Monographische Darstellung der Gattung *Acipenser*. Annalen des Wiener Museums der Naturgeschichte, 1. Band, Vienna.

Franklin, I. R., 1980: Evolutionary change in small populations. In Wilcox, E. A. (Editor), 1980: An Evolutionary Ecological Perspective. Sunderland, Pages 135 - 149.

Frauenfeld, G. R. v, 1871: Die Wirbeltierfauna Niederösterreichs, Blätter des Vereins für Landeskunde von Niederösterreich 5, Pages 108- 123.

Freudlsperger, H., 1936: Kurze Fischereigeschichte des Erzstiftes Salzburg, Mitteilungen der Gesellschaft für Salzburger Landeskunde. Jg. 76, 77, Teil1 + 2.

Friedrich, T., 2009: Störartige in Österreich- Chancen und Perspektiven im Freigewässer. Österreichs Fischerei, 62, Pages 250 - 258.

Gamlitschek, A., 1897: Die Stadt Tulln und ihre Fischwässer von ehegestern und heute. In: Mitteilungen des österreichischen Fischerei- Vereins 17, Pages 26 - 33.

Gessner, J. & R. Bartel, 2000: Sturgeons spawning grounds in the Odra River tributaries - a first assessment. . In: Gessner, J., 2009: Prerequisites for the remediation of the indigenous sturgeons Acipenser sturio Linnaeus 1758 and A. oxyrinchus Mitchill 1815 in river systems of northern Germany - development of methods and contributions towards scientific criteria and concepts for a recovery management plan. Humboldt University Berlin.

Gessner, J., Kamerichs, C. M., Kloas W. & S. Wuertz, 2008: Behavioural and physiological responses in early life phases of Atlantic sturgeon (*Acipenser oxyrinchus* Mitchill 1815) towards different substrates. In: Gessner, J., 2009: Prerequisites for the remediation of the indigenous sturgeons Acipenser sturio Linnaeus 1758 and A. oxyrinchus Mitchill 1815 in river systems of northern Germany - development of methods and contributions towards scientific criteria and concepts for a recovery management plan. Humboldt University Berlin.

Gessner, J., 2009: Prerequisites for the remediation of the indigenous sturgeons Acipenser sturio Linnaeus 1758 and A. oxyrinchus Mitchill 1815 in river systems of northern Germany - development of methods and contributions towards scientific criteria and concepts for a recovery management plan. Humboldt University, Berlin.

Glowacki, J. Ed., 1885: Die Fische der Drau und ihres Gebietes. 16. Jahresbericht des Steierm. Landes Untergymnasiums zu Pettau, Pettau.

Grunina, A. S., Recoubratsky, A. V., Barmintsev, V. A., Vasi`eva E. D. & M. S. Chebanov, 2009: Chapter 11 - Dispermic Androgenesis as a Method for Recovery of Endangered Sturgeon Species. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 187 - 204.

Guti, G., 2006: Past and present status of sturgeons in Hungary. IAD Conference 2006.

Guti, G., 2008: Past and present status of sturgeons in Hungary and problems involving their conservation. Fundam. Appl. Limnol./Arch. Hydrobiol., Suppl. 162., Large Rivers Vol. 18. No.1-2, Pages 61 - 79.

Guti, G., 2011: Some results of ichthyological research in the Danube Research Institute of the Hungarian Academy of Sciences. Presentation at the University of Natural Resources and Life Sciences, Vienna, 25.05.2011.

Haidvogl, G. & H. Waidbacher, 1997: Ehemalige Fischfauna an ausgewählten österreichischen Fließgewässern. Department of Water, Atmosphere and Environment - Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Applied Life Sciences, Vienna.

Heckel, J., 1854: Die Fische der Salzach. Verh. zool.-bot. Ver. Wien 4, Pages 189 - 196.

Heckel, J. & R. Kner, 1857: Die Süßwasserfische der österreichischen Monarchie mit Rücksicht auf die angränzenden Länder. Verlag von Willhelm Engelmann, Leipzig.

Heinrich, A., 1856: Mährens und k.k. Schlesiens Fische, Reptilien und Vögel. Brünn.

Hensel, K. & J. Holcik, 1997: Past and current status of sturgeons in the upper and middle Danube River. – Env. Biol. Fish. 48, Pages 185 - 200.

Hirmer, M., 2011: Sterlet soll wieder heimisch werden. Fischer & Teichwirt – Fachzeitschrift für die Binnenfischerei, 62. Jahrgang Nr. 11/2011, Nürnberg, Page 413.

Hochleithner, M., 2004: Störe- Biologie und Aquakultur. AquaTech Publications, Kitzbühel.

Holcik, J., Bastl, I., Ertl, M. & M. Vranowsky, 1981: Hydrobiology and ichthyology of the Czechoslovak Danube in relation to predicted changes after the construction of the Gabcikovo-Nagymaros River Barrage System. – Práce lab. rybar. hydrobiol 3, Pages 19 - 158.

Holcik, J. (Editor), 1989: The Freshwater Fishes of Europe - Vol. 1, Part II General Introduction to Fishes/*Acipenseriformes*. AULA- Verlag Wiesbaden.

Holcik, J., 1995: Acipenseriformes. In: Barus V. & O. Oliva (Editors), 1995 Mihulovci Petromyzontes a ryby Osteichthyes (1). (Lampreys Petromyzontes and bony fishes Osteichthyes), Fauna Cˇ R a SR, Vol. 28/1, Academia, Praha, Pages 372 - 397.

Holcik, J., 2006: Is naturalization of paddlefish in the Danube river basin possible? Journal of Applied Ichthyology 22, Suppl. 1/2006, Pages 40 - 43.

Honsig- Erlenburg, W. & M. Friedl, 1999: Zum Vorkommen des Sterlets (A. ruthenus L.) in Kärnten. Österreichs Fischerei, 52, Pages 129 - 133.

Honsig- Erlenburg, W. & W. Petutschnig, 2002: Fische, Neunauge, Flusskrebse, Grossmuscheln. Natur Kärnten, Sonderreihe des Naturwissenschaftlichen Vereins für Kärnten, Klagenfurt.

Hugo, A., 1886: Jagdzeitung 29.

Ireland, S. C., Beamesderfer, R. C. P., Paragamian, V. L., Wakkintn, V. D. & J. T. Siple, 2002: Success of hatchery - reared juvenile white sturgeon (Acipenser transmontanus) following release in the Kootenai River, Idaho, USA. Journal of Applied Ichthyology 18, Pages 642 - 650.

IUCN/SCC Re - Introduction Specialist Group, 1995: IUCN/SCC Guidelines for Re - Introductions. International Union for the Conservation of Nature, Glad, Pages 1 - 7.

Jäckel, A. J., 1864: Die Fische Bayerns. Ein Beitrag zur Kenntnis deutscher Süßwasserfische, Regensburg.

Jäckel, A. J., 1866: Ichtyologisches aus meinem Tagebuch 1865. Correspondenzblatt des zoologisch-mineralogischen Vereines in Regensburg, Zwanzigster Jahrgang, Nr. 5 - 6, 1866.

Jagsch, A., 1996: Löffelstör in der Aschach? - Mitteilungen des OÖ LFV. Dezember 1996. OÖ Landesfischereiverband, Linz.

Jeitteles, L. H., 1864: Die Fische der March bei Olmütz, aus Jahresbericht über das kaiserlich.-königliche Gymnasium in Olmütz während des Schuljahres 1864.

Jungwirth, M., Schmutz, S. & H. Waidbacher, 1989: Fischökologische Fallstudie Inn-Fischerbiologische Untersuchung im Hinblick auf Bewirtschaftungsfragen. Fischerei- Revierausschuß Innsbruck Stadt und Land.

Jungwirth, M., Haidvogl, G., Moog. O., Muhar, S. & S. Schmutz, 2003: Angewandte Fischökologie an Fließgewässern. Facultas Verlags und Buchhandels AG, Vienna, Pages 206 - 209.

Kärnter Landesregierung, 2001: Verordnung der Landesregierung vom 6. März 2001, Zahl: -11-FIAG 23/2-2001, über die Schonzeiten und Mindestfangmaße (Brittelmaße) für Wassertiere (Kärntner Fischereischonzeitenverordnung - K-FSV). Klagenfurt.

Kerschner, T., 1956: Der Linzer Markt für Süßwasserfische insbesondere in seiner letzten Blüte vor dem ersten Weltkrieg.

Khin A., 1957: A magyar vizák története, Mezo´´gazdasagi Muzeum Fuzetei 2, Pages 1 - 36.

Khodorevskaya, G., Ruban, G. I. & D. S. Pavlov 2009: Behaviour, migrations, distribution and stocks of sturgeons in the Volga- Caspian basin. World Sturgeon Conservation Society: Special Publication n° 3, Neu Wulmstorf and Moscow.

Khorosko, P.N. & A. D. Vlasenko, 1970: Artificial spawning grounds für sturgeons. Journal of Applied Ichthyology 10, Pages 286 - 292.

Kinzelbach, R., 1994: Ein weiterer alter Nachweis des Sterlet in der Baden-württembergischen Donau. Biologie der Donau.

Kirschbaum, F., 2010: Störe - Biologie, Systematik, Krankheiten, Wiedereinbürgerung, Wirtschaftliche Bedeutung. Aqualog animalbook GmbH, Rodgau, Page 63.

Kirschbaum, F., Williot, P., Fredrich, F., Tiedemann, R. & J. Gessner, 2011: Chapter 21 - Restoration of the European Sturgeon *Acipenser sturio* in Germany. In: Williot, P., Rochard, E., Desse - Berset, N., Kirschbaum, F. & J. Gessner (Editors), 2011: Biology and Conservation of the European Sturgeon Acipenser sturio L. 1758 - The Reunion of the European and Atlantic sturgeons. Springer Science + Business Media B. V., Pages 309 - 333.

Kiwek, F., 1995: Sterlet Programm. Österreichs Fischerei 48, Pages 2 - 3.

Kottelat, M. & J. Freyhof, 2007: Handbook of European Freshwater Fishes, Kottelat Publications, Cornol, Pages 46 - 60.

Kotenev, B. N., 2009: Chapter 21 - Hydrological and Production Characteristics of the Main Basins for Reproduction and Fattening of Sturgeons. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 345 - 357.

Kraft, C., 1874: Die neuesten Erhebungen über die Zustände der Fischerei in den im Reichsrate vertretenen Königreichen und Ländern. Mitt. a. d. Gebiete d. Statistik Jg. XX/IV, Vienna.

Krieger, J., Hett, A.K., Fuerst, P.A., Artyukhin, E. & A. Ludwig, 2008: The molecular phylogeny of the order Acipenseriformes revisited. In: Journal of Applied Ichthyology, Proceedings of the 2nd Status Workshop on Identification of Acipenseriformes Species in Trade, Volume 24, Pages 36 - 45.

Krisch, A., 1900: Der Wiener Fischmarkt. Druck und commissionsverlag von Carl Gerold`s Sohn, Vienna.

Kronenzeitung Oberösterreich, 2004: Stör wieder ansiedeln - Kaviar aus der Donau. 6.02.2004.

Lagutov, V. (Editor), 2008: Rescue of sturgeon Species in the Ural River Basin. Proceedings of the NATO Advanced Research Workshop on Rescue on Sturgeon Species by means of Transboundary Integrated Water Management of the Ural River Basin, Orenburg, 2007, Springer Science + Business Media B. V.

Lagutov, V. & V. Lagutov, 2008: The Ural River sturgeons: Population dynamics, catch, reasons for decline and restoration strategies. In: Lagutov, V. (Editor), 2008: Rescue of sturgeon Species in the Ural River Basin. Proceedings of the NATO Advanced Research Workshop on Rescue on Sturgeon Species by means of Transboundary Integrated Water Management of the Ural River Basin, Orenburg, 2007, Springer Science + Business Media B. V.

Liepolt, R. (Editor), 1967: Limnologie der Donau. E. Schweizerbart`scheVerlagsbuchhandlung, Stuttgart.

Lori, 1871: Die Fische in der Umgegend von Passau. Beiträge zur Fauna Niederbayerns.

Ludwig, A., Lippold, S., Debus, L. & R. Reinartz, 2009: First evidence of hybridization between endangered sterlets (*Acipenser ruthenus*) and exotic Siberian sturgeons (*Acipenser baerii*) in the Danube River. Biol. Invasions 11, Pages 753 - 760.

Mahen, J., 1927: Castecna revise ryb dunajske obiasti. Sbornik Klubu Pirodovedeckeho v Brne, Vol. 9.

Maier, H. R., 1908: Sterlet im Inn. Allgemeine Fischerei- Zeitung, 1908, Jrg. 33, Nr. 23, Pages 96 - 97.

Maltsev, S. A., 2009: Chapter 16 - Conservation of the Sturgeon Fish in Lower Volga. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 265 - 273.

Margreiter, H., 1927: Ein Sterlet im Inn gefangen. der Tiroler Fischer 2, Page 94.

Mikschi, E. & G. Wolfram, 2007: Rote Liste der Fische (Pisces) Österreichs. In: Bundesministerium für Land- und Forstwirtschaft 2007: Rote Listen gefährdeter Tiere Österreichs, Teil 2: Kriechtiere, Lurche, Fische, Nachtfalter, Weichtiere. Böhlau Verlag, Wien-Köln-Weimar, Pages 107 - 136.

Miller, M. J., 2004: Chapter 4 - The Ecology and functional Morphology of Feeding of North American Sturgeon and Paddlefish. In: Breton, G. T. O., Beamish F. W. H. & R. S. McKinley (Editors), 2004: Sturgeons and Paddlefish of North America. Fish and Fisheries Series, Kluwer Academic Publishers,Pages 87 - 102.

Mohr, E., 1952: Der Stör . WestarpWissenschafften- Verlagsgesellschaft.

Mojsisovics, A. v. M., 1897: Das Thierleben der österreichisch-ungarischen Tiefebenen. Alfred Hödler, Vienna.

NÖ. Landesregierung, 2002: Niederösterreichische Fischereiverordnung 2002. St. Pölten, Page 6.

Nordheim, H. v., Gessner, J., Kirschbaum, F., Anders, E. & G. M. Arndt, 2001: Das Wiedereinbürgerungsprogramm für *A. sturio* - Hintergründe und Konzeption. In: Verband deutscher Sportfischer e. V., 2001: Der Stör *Acipenser sturio* L. Fisch des Jahres 2001. Offenbach, Pages 39 - 40.

Österreichs Fischereiwirtschaft, 1936: Fang eines großen Störes in Wien. IV Jahrgang, Page 69.

OÖ. Landesfischereiverband, 1996: Mitteilungen des OÖ LFV. Juni 1996, Linz, Page 228.

OÖ. Landesfischereiverband, 1997: Leitfaden zur Fischkunde und Angelfischerei. Linz.

OÖ. Landesfischereiverband, 2004: Fischerei und Gesetz. Linz, Page 72.

OÖ. Nachrichten, 2005: Rotauge & Blaunase. 10.12.2005.

Österreichischer Fischereiverband, 2005: Waxdick- Besatz für die Donau. Österreichs Fischerei, 58, Pages 193 - 194.

Peake, S. J., 2004: Chapter 7 - Swimming and Respiration. In: Breton, G. T. O., Beamish F. W. H. & R. S. McKinley (Editors), 2004: Sturgeons and Paddlefish of North America. Fish and Fisheries Series, Kluwer Academic Publishers, Pages 147 - 166.

Pegasov, V. A., 2009: Chapter 20 - The Ecological Problems of Introduction and Reintroduction of Sturgeons. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 339 - 343.

Peyrer, C., 1874: Fischereibetrieb und Fischereirecht in Österreich. Ackerbauministerium, Vienna.

Pinter, K., 2008: Rearing and Stocking of Brown Trout, *Salmo trutta L.:* Literature Review and Survey of Austrian Fish Farmers within the Frame of the Project - Initiative Troutcheck. Department of Water, Atmosphere and Environment - Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Applied Life Sciences, Vienna.

Puzzi, C. M., Bellani, A., Trasforini, S. & A. Ippoliti, 2009: Chapter 17 - Experience of Conservation of *Acipenser naccarii* in the Ticino River Park (Northern Italy). In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 275 - 298.

Radovanovic, I., 1997: The Lepenski Vir culture: A contribution to interpretationof its ideological aspects. In: M. Lazic (Editor) Antidoron Dragoslavo Srejovic completis LXV annis ad amicis, collegis, discipulis oblatum. Belgrade: Center for Archaeological Research, Pages 87 - 93.

Reichle, G., 1997: Der Stör. Verlag Lassleben, Kallmünz.

Reinartz, R., 2008: Artenhilfsprogramm Sterlet- Abschlussbericht 2004 - 2007. Landesfischereiverband Bayern, Münster.

Remes, 1902: Die Fische der March.

Rosenthal, H., Bronzi, P. & P. Williot (Editors), 1997: 3rd International Symposium on Sturgeons, Piacenza, Italy. Journal of Applied Ichthyology 15.

Rosenthal, H., Bronzi, P., Poggioli, C. & M. Spezia (Editors), 2008: Passages for fish - overcoming barriers for large migratory fish. World Sturgeon Conservation Society Special Publication No. 2, Books on Demand GmbH, Norderstedt.

Salzburger Landesregierung, 2003: Salzburger Fischereiverordnung, LGBl. Nr. 1/2003 §1.

Salzburger Nachrichten, 2004: Stör soll in die Donau zurückkehren. 6.02.2004.

Salzburger Wirtschaft, 2004: Nach 70 Jahren Störe in der Donau. 30.01.2004.

Schmall B. & C. Ratschan, 2011: Die historische und aktuelle Fischfauna der Salzach - ein Vergleich mit dem Inn. Beitrag Naturkunde Oberösterreichs 21, Pages 55 - 191.

Siebold, C. T. E., 1863: Die Süßwasserfische von Mitteleuropa. Verlag von Willhelm Engelmann, Leipzig.

Simonovic, P., Maric, S. & V. Nikolic, 2006: Occurrence of paddlefish *Polyodon spathula* (Walbaum, 1792) in the Serbian part of the lower River Danube. Aquatic Invasions Volume 1, Issue 3, Pages 183 - 185.

Spindler, T., 1994: Status der Fischfauna der March. Wissenschaftliche Mitteilungen des Niederösterreichischen Landesmuseums 8, Pages 177 - 189

Spindler, T., 1997 : Fischfauna in Österreich. Bundesministerium für Umwelt, Jugend und Familie, Vienna.

Steiermärkische Landesregierung, 2000: Verordnung der Steiermärkischen Landesregierung vom 11. Dezember 2000 über die Schonzeiten und Mindestfanglängen von Wassertieren. LGBl. Nr. 81/2000, Graz, Page 1.

Streibl, D., (without Date): Über den Sterlet. Privatarchiv Huber.

Sulak, K. J., & J. P. Clugston, 1999: Early life history and population structure of Gulf sturgeon, *Acipenser desotoi*, in the Suwanee River, Florida. In: Rosenthal, H., Bronzi, P. & P. Williot (Editors), 1997: 3rd International Symposium on Sturgeons, Piacenza, Italy. Journal of Applied Ichthyology 15, Pages 116 - 128.

Van Eeneennaam, J. P., Chapman, F. A. & P. L. Jarvis, 2004: Chapter 13 - Aquaculture. In: Breton, G. T. O., Beamish F. W. H. & R. S. McKinley (Editors), 2004: Sturgeons and Paddlefish of North America. Fish and Fisheries Series, Kluwer Academic Publishers, Page 300.

Verband deutscher Sportfischer e. V., 2001: Der Stör Acipenser sturio L. Fisch des Jahres 2001. Offenbach.

Wacha, G., 1956: Fische und Fischhandel im alten Linz, Naturkundliches Jahrbuch der Stadt Linz.

Waidbacher, H., Zauner, G., Kovacek, H. & O. Moog, 1991: Fischökologische Studie Oberes Donautal in Hinblick auf Strukturierungsmaßnahmen im Stauraum Aschach. Department of Water, Atmosphere and Environment - Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Applied Life Sciences, Vienna

Waidbacher, H. & M. Straif, 2005: Erhebung und Einschätzung des Erhaltungszustandes der in Anhang II und V der FFH - Richtlinie genannten und in Wien vorkommenden und geschützten Fischarten - Berichtsjahr 2005. Department of Water, Atmosphere and Environment - Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Applied Life Sciences, Vienna.

Weeger, 1884: Fische von Donau und Mähren, Mitteilungen des Österreichischen Fischereivereins, 1887.

Wiener Landesregierung, 2008: 44. Verordnung der Wiener Landesregierung betreffend Schonzeiten und Mindestmaße der Fische sowie Krebse und Muscheltiere. Vienna, Page 2.

Wiesner, C., Wolter, C., Rabitsch, W. & S. Nehring, 2010: Gebietsfremde Fische in Deutschland und Österreich und mögliche Auswirkungen des Klimawandels. Bundesamt für Naturschutz, Bonn - Bad Gobesberg, Pages 23 - 38.

Williot, P., Rochard, E., & F. Kirschbaum, 2009: Chapter 23 - Acceptability and Prerequisites for the Successful Introduction of sturgeon species. In: Carmona, R., Domezain, A., Garcia - Gallego, M., Hernando, J. A., Rodriguez F. & M. Ruiz - Rejon (Editors), 2009: Biology, Conservation and Sustainable Development of Sturgeons. Springer Science + Business Media B. V., Pages 369 - 384.

Williot, P., Rochard, E., Desse - Berset, N., Kirschbaum, F. & J. Gessner (Editors), 2011: Biology and Conservation of the European Sturgeon Acipenser sturio L. 1758 - The Reunion of the European and Atlantic sturgeons. Springer Science + Business Media B. V.

Windeck, E., 1445 - 1450: Kaiser Sigismunds Buch.

Woschitz, G., 2006: Rote Liste gefährdeter Fische in der Steiermark. Unpublished study for the Government of Styria.

Zauner, G., 1997: Acipenseriden in Österreich. Österreichs Fischerei, 50, Pages 183 - 187.

Zauner, G., Pinka, P. & M. Jungwirth, 2000: Wasserwirtschaftliches Grundsatzkonzept Grenzmur - Phase 1, TB 2.1 Fischökologie. Fachabteilung 3a, Eigenverlag EZB, Engelhartszell.

Zauner, G., Pinka, P. & O. Moog, 2001: Pilotstudie Oberes Donautal: Gewässerökologische Evaluierung neugeschaffener Schotterstrukturen im Stauwurzelbereich des Kraftwerks Aschach. Department of Water, Atmosphere and Environment - Institute of Hydrobiology and Aquatic Ecosystem Management, University of Natural Resources and Applied Life Sciences, Vienna.

Zborˇil, J. & K. Absolon, 1916: Zoologicka´ pozorova´nı´ z okolı´ hodonı´nske´ho (Zoological observation from the Hodonı´n region). Cˇ asopis moravske´ho musea zemske´ho 15, Pages 3 - 12.

Zetter, J.T.M., 1862: Vortrag über die Einbürgerung der künstlichen Fischzucht in Salzburg. Monats-Blatt der k.k. Landwirtsch.-Gesellschaft. Salzburg 12.

Retrieved via internet

Angelforum: www.angelforum.at/storfange-in-osterreichischen-flieszgewassern-t10941.html

Donaufischer: www.donaufischer.at/module-Fischerforum-viewtopic-topic-1631.phtml

Fischerforum:
www.fischerforum.or.at/index.php?page=Thread&postID=54559&highlight=sterlet#post54559

www.fischerforum.or.at/index.php?page=User&userID=4368

www.fischerforum.or.at/index.php?page=Thread&threadID=8792

Hechtsprung: www.hechtsprung.tv

Homepage of the Fischereiverein Leibnitz: www.fvl.at/cms/ 26.11.2010.

Homepage of the village Hofkirchen: www.hofkirchen.at/artikel.shtml?newsid=2521

Homepage of the Landesfischereiverband Oberösterreich:
www.lfvooe.at/Reviere/donau_rohrbach_loeffel.html

Homepage of the Wiener Fischereiausschuss:
www.wiener-fischereiausschuss.at/huchen_sterlet.htm

Homepage of the World Sturgeon Conservation Society:

www.wscs.info

Annex I

Inn & Salzach

Fig. A1: White sturgeon (*A. transmontanus*) caught in the mouth of the river Salzach around the year 2002.

(Credit: unknown)

Störfall am Stammhamer Kraftwerk

Ein äußerst seltener Fang

Fig. A2 and A3: Newspaper articles concerning catch of a "sturgeon" and three "sterlets" in the river Inn near Burghausen in 2004. The species caught are actually one Russian sturgeon (*A. gueldenstaedtii*) and two Siberian sturgeons (*A. baerii*) and one specimen of unknown species.

(Credit: FV Burghausen)

Fig. A4: The above mentioned Russian sturgeon.

(Credit: Christian Zagler)

Danube Upper Austria

Fig. A5: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011.

(Credit: TB Zauner)

Fig. A6: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011.

(Credit: TB Zauner)

Fig. A7: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011.

(Credit: TB Zauner)

Fig. A8: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011. Note the untypical number of dorsal plates.

(Credit: TB Zauner)

Fig. A9: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2008.

(Credit: TB Zauner)

Fig. A10: Two sterlets (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2002. Note the albino specimen.

(Credit: TB Zauner)

Fig. A11: Albino specimen of *A. ruthenus* caught downstream of the Jochenstein power plant in 2002.

(Credit: TB Zauner)

Fig. A12: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2007.

(Credit: TB Zauner)

Fig. A13: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011. This specimen was stocked in the German river Schwarze Laber and travelled 150 km downstream.

(Credit: TB Zauner)

Fig. A14: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2011.

(Credit: TB Zauner)

Fig. A15: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2008.

(Credit: TB Zauner)

Fig. A16: Sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2002.

(Credit: TB Zauner)

Fig. A17: Big specimen of sterlet (*A. ruthenus*) caught downstream of the Jochenstein power plant in 2006.

(Credit: TB Zauner)

Fig. A18: Siberian sturgeon (*A. baerii*) caught downstream of the Jochenstein power plant in 2006/2007.

(Credit: TB Zauner)

Fig. A19: Juvenile sterlet (A. ruthenus) caught downstream of the Jochenstein power plant in 2011.

(Credit: unknown)

Fig. A20: Sterlet (*A. ruthenus*) caught near Niederranna in 2005.

(Credit: Andreas Eilmannsberger)

Fig. A21: Paddlefish (*Polyodon spathula*) caught near Schlögen in 2003.

(Credit: Franz Auer)

Fig. A22: Sterlet (*A. ruthenus*) caught near Linz in 1984.

(Credit: Franz Lahmer)

Fig. A23: Hybrid caught near Linz. Possibly *naccarii x huso*.

(Credit: Franz Lahmer)

Fig. A24: The same hybrid variant as above caught downstream of Linz in the year 2003.

(Credit: unknown)

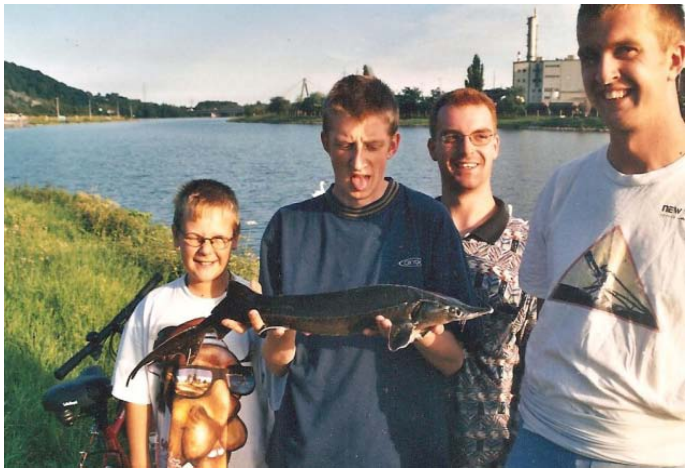


Fig. A25: Siberian sturgeon (*A. baerii*) caught in the harbor of Linz in 1999.

(Credit: Franz Wiesmayer)

Fig. A26: Sterlet (*A. ruthenus*) caught downstream of the power plant Wallsee - Mitterkirchen in 1997.

(Credit: Hans- Peter Angerer)

Fig. A27: Newspaper article regarding stocking of "Beluga sturgeon" in Linz in 1996. The actual species of the stocked fish is *A. gueldenstaedtii*, the Russian sturgeon.

(Credit: OÖ Landesfischereiverband)

Danube Lower Austria

Stör in der Donau

WAS MACHT ein Stör in der Donau? Diese Frage kann wohl nicht einmal Neptun selbst beantworten. Tatsache jedenfalls ist, dass **Heinz Renner**, seines Zeichens Chef des „Wachauerhofes" in Marbach an der Donau, einen vier Kilo schweren und ein Meter langen Jungfisch dieser Art aus Österreichs großem Strom ziehen konnte. Der Hausen-Beluga-Stör ist normalerweise im Atlantik, in der Nord- oder Ostsee zuhause. Wie er sich in die Donau verirrt hat, bleibt rätselhaft. Einerlei: Den eifrigen Petrijünger freut's! Und auch Enkerl Bettina sowie Schwiegersohn Joachim sind hellauf begeistert.

Fig. A28: Newspaper article regarding the catch of a "beluga sturgeon" in Marbach in 2003. The actual species of the fish is *A. gueldenstaedtii*, the Russian sturgeon.

(Credit: Heinz Renner)

Fig. A29: Very large sterlet specimen caught downstream of the Melk power plant around 2007 - 2009.

(Credit: Christoph Trost)

Fig. A30: Siberian sturgeon (*A. baerii*) caught in the Lower Austrian Danube.

(Credit: unknown)

Fig. A31: Siberian sturgeon (*A. baerii*) caught in the Lower Austrian Danube. Note the good condition of the specimen.

(Credit: unknown)

Fig. A32: Hybrid (possibly *gueldenstaedtii x huso*) caught downstream of the Altenwörth power plant in 2002.

(Credit: Institute of Hydrobiology and Aquatic ecosystem management)

Fig. A33: Siberian sturgeon (*A. baerii*) caught downstream of the Altenwörth power plant in 2005. This fish is also in very good condition.

(Credit: Mathias Jungwirth)

Fig. A34: Siberian sturgeon (*A. baerii*) caught downstream of the Altenwörth power plant in 2011.

(Credit: unknown)

Fig. A35: Large sterlet (*A. ruthenus*) caught downstream of the Altenwörth power plant in 2003. Note the deformed body.

(Credit: Robert Elsbacher)

Fig. A36: Sterlet (*A. ruthenus*) caught downstream of the power plant Freudenau in Vienna in 1999 or 2000.

(Credit: TB Eberstaller)

Fig. A37: Sterlet (*A. ruthenus*) caught downstream of the power plant Freudenau in Vienna in 2011.

(Credit: Robert Schlappal)

Fig. A38: Stocking of sterlets in the Freudenau impoundment between 2002 and 2005.

(Credit: Christian Wiesner)

Fig. A39: Stocking of sterlets near Regelsbrunn in 1994.

(Credit: Martin Hochleithner)

Fig. A40: Stocking of sterlets in the Danube - Auen National Park in 2001.

(Credit: Martin Hochleithner)

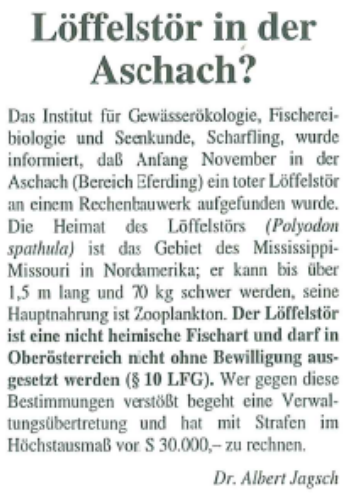
Fig. A41 and A42: Stocking of Russian sturgeons in the Danube - Auen National Park in 2005.

(Credit: Leopold Feichtinger)

Fig. A43: Stocking of a few specimens of sterlet as PR - activity in 2010 in Vienna.

(Credit: VIA- Donau)

Other Tributaries



Löffelstör in der Aschach?

Das Institut für Gewässerökologie, Fischereibiologie und Seenkunde, Scharfling, wurde informiert, daß Anfang November in der Aschach (Bereich Eferding) ein toter Löffelstör an einem Rechenbauwerk aufgefunden wurde. Die Heimat des Löffelstörs *(Polyodon spathula)* ist das Gebiet des Mississippi-Missouri in Nordamerika; er kann bis über 1,5 m lang und 70 kg schwer werden, seine Hauptnahrung ist Zooplankton. **Der Löffelstör ist eine nicht heimische Fischart und darf in Oberösterreich nicht ohne Bewilligung ausgesetzt werden (§ 10 LFG).** Wer gegen diese Bestimmungen verstößt begeht eine Verwaltungsübertretung und hat mit Strafen im Höchstausmaß vor S 30.000,– zu rechnen.

Dr. Albert Jagsch

Fig. A44: Newspaper article concerning a dead paddlefish (*Polyodon spathula*) found in the river Aschach.

(Credit: OÖ Landesfischereiverband)

Drava

Fig. A45: Large sterlet (*A. ruthenus*) caught near Wunderstätten in 2003.

(Credit: unknown)

Mura

Fig. A46: Siberian sturgeon (*A. baerii*) found dead above the power plant Murau in 2005.

(Credit: Christian Wiesner)

Fig. A47: Siberian sturgeon (*A. baerii*) caught near Wildon in 2010.

(Credit: Josef Riedl)

Fig. A48: Siberian sturgeon (*A. baerii*) caught near Wildon in 2010.

(Credit: Stefan Pretenhofer)

Natural Lakes

Erstmals: Stör im Hallstättersee

Garantiert kein Anglerlatein: Fischereimeister Peter Wimmer ging ein Stör ins Netz – 76 Zentimeter lang, 2,2 Kilo schwer. Das gab's noch nie.

Die Art ist am Schwarzen Meer heimisch. Dieser Stör – eigentlich ein Sterlet – dürfte mit Brutbesatz in den See gelangt sein. FOTO: SINGER

Fig. A49: Newspaper article regarding the catch of a "sterlet" in Lake Hallstatt. The actual species of this specimen is however the Siberian sturgeon (*A. baerii*).

(Credit: unknown)

Sterlet im Traunsee

GMUNDEN. Berufsfischer zogen im Sommer sechs Sterlets aus dem Traunsee, und das an verschiedenen Stellen. Jetzt fürchten die Fischer, dass die offenbar illegal eingesetzte Art den Laich einheimischer Fische bedroht und Krankheiten einschleppt. -fw-

Foto: H. Frei

Der Sterlet – eine Gefahr im Traunsee.

Fig. A50: Magazine article regarding the catch of six "sterlets" in the Traunsee. The species on the picture is a Siberian sturgeon (*A. baerii*), and there is also a report of stocking of ten specimens of *A. baerii* into the Traunsee (MAIER pers. comm.).

(Credit: Fisch & Fang 12/2000)

Annex II

Wanted poster

Fangmeldungen gesucht!
Besatzaufzeichnungen gesucht!

Mein Name ist **Thomas Friedrich.** Ich studiere an der **Universität für Bodenkultur** in Wien und schreibe meine Diplomarbeit über **die Situation der Störartigen in Osterreich.** Ich versuche einerseits, möglichst viele historische Daten über diese Fischfamilie in österreichischen Gewässern zu erfassen und andererseits, so viele aktuelle Fangmeldungen von Störartigen wie möglich in unseren Fließgewässern aufzunehmen und nach Art zu bestimmen.

Endergebnis soll eine Einschätzung des Potentials einzelner Fließgewässer hinsichtlich der Eignung für einen Störbestand, sowie eine Einschätzung der zukünftigen Entwicklung unter Berücksichtigung von allochthonen Arten in der Aquakultur, Artenschutzprojekten, etc. werden.

Ich bin daher primär auf der Suche nach folgenden Daten:

- **aktuelle Fangmeldungen** von Stören in österreichischen Fließgewässern (1980 - bis jetzt), wenn möglich mit Foto, Fangjahr, Größe, Gewicht, Fänger und Name des Gewässers/genauer Gewässerabschnitt.
- **Informationen über etwaige Besatzmaßnahmen in österreichischen Fließgewässern** betreffend Art / Stückzahl / Größe / Name des Gewässers / genauer Gewässerabschnitt / Besatzjahr

Sollten Sie über diesbezügliches Wissen verfügen, würde ich mich über eine Mitteilung von Ihnen sehr freuen.

Vielen Dank für Ihre Mithilfe,
Thomas Friedrich

Kontakt:
Thomas Friedrich | E-Mail: friedrich_stoere@yahoo.de | Tel. Nr.: +43 650/4507428

Sollten Sie über kein Foto Ihres Fangs verfügen, bitte ich Sie den Stör anhand dieser Bilder zu identifizieren:

Häufige Arten:

Sterlet
(*Acipenser ruthenus*)

- spitze Schnauze
- kleine weiße Seitenschilder
- weiße Flossensäume
- max. 1,2m meistens bis 80cm
- hellbraun, weiß/gelber Bauch

Sibirischer Stör
(*Acipenser baerii*)

- spitze Schnauze
- graubraun bis schwarz
- Knochenschilder gleiche Farbe wie Untergrund
- keine weißen Flossensäume
- max. 2,2m meistens 1-1,3m

Waxdick
(*Acipenser gueldenstaedti*)

- stumpfe Schnauze
- große weiße/gelbe Knochenschilder
- helle Flossensäume
- schwarzbraun, weiß/gelber Bauch
- max. 2,4m meistens 1-1,4m

Seltene Arten:

Hausen (*Huso huso*)

Sternhausen (*Acipenser stellatus*)

Löffelstör (*Polyodon spathula*)

Weißer Stör (*Acipenser transmontanus*)

Ohne Abbildungen: Adriatischer Stör (*Acipenser naccarii*), Albinosterlet, Hybriden

Annex III

The Aschach impoundment

Fig. B1: The impoundment Aschach and the famous Schlögener Schlinge.
(Credit: GoogleEarth)

Fig. B2: Upper section of the impoundment with the Jochenstein power plant on the left and the Niederranna Bridge on the right.
(Credit: GoogleEarth)

As it is the home of the last self - reproducing population of the sterlet (*Acipenser ruthenus*) the Aschach impoundment shall be characterized by a few words: The impoundment has a length of around 42 km and is the longest impoundment within the Austrian Danube. It is partially situated along the Upper Austrian - Bavarian border with its upper boundary, the Jochenstein power plant at km 2203 and the Aschach power plant on its downstream end at km 2162 (Fig. B1). The Jochenstein power plant was built in 1956 and the Aschach power plant in 1964. Gravel banks became submersed and lost most of their ecological functions, while shorelines were stabilized with rip - raps (ZAUNER et al., 2001). The headwater section with similar hydrological conditions to a natural river is around 7 km long (Fig. B2). The stagnant section starts near the Niederranna Bridge (Fig. B2 - on the right) and is around 35 km long (WAIDBACHER et al., 1991). The upper part is characterized through rocky substrates and high flow velocities. Although sediment transport is blocked through various power plants the sediment composition in this area correlates with the natural condition. Further downstream gravel and sandy substrates are dominant. At the end of the 20th century various revitalizations like the construction of gravel banks were initiated (ZAUNER et al., 2001).