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German Action Plan

for the conservation and restoration of the European Sturgeon *(Acipenser sturio)*

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Figure 1: Large-scale nature conservation project Lenzener Elbtalauen – water meadow renaturation and flood protection through dyke relocation (section)

Produced within the framework of the Research and Development Project "National Action Plan for the Conservation of the European Sturgeon" (FKZ 3508 86 0400) to implement the European Action Plan for the Conservation and Restoration of the European Sturgeon adopted under the Bern Convention on 27 November 2007 (Rosenthal et al. [eds.] 2009).

Produced by: Gesellschaft zur Rettung des Störes *Acipenser sturio* L. e.V., Rostock

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FOREWORD

DEAR READER,

In 2010 – the International Year of Biodiversity – the European environment ministers have had to concede that the goal of halting further loss of biological diversity by 2010 cannot be achieved. At the same time, there is growing realisation that the conservation of biological diversity has the same dimension and significance for securing man's foundations of life as climate protection.

Sturgeons are living fossils that were found in large numbers in the North and Baltic Sea tributaries into the late 19th century. The European sturgeon as a self-sustaining species is now considered extinct in Germany and the rest of Europe, apart from a small relic population in France. River control measures and water pollution, the associated loss of habitats and decades of overfishing have led to a drastic decrease in populations, which also affects other migratory and freshwater fish species.

Due to their long life span, late maturity and long migration routes, sturgeons require special protection as they are particularly affected by the diverse changes and uses of their various habitats in rivers and the sea. For this reason the Federal Agency for Nature Conservation (BfN) launched a research and development project in 1996 on the reintroduction of sturgeons in the German North and Baltic Sea tributaries, which is still running with funding from the Federal Environment Ministry (BMU). The project is not only supported by the Society for the Conservation of Sturgeon (GRS) and the Institute of Freshwater Ecology and Inland Fisheries (IGB), but also by the Federal Research Ministry, and the Länder of Brandenburg and Mecklenburg-Western Pomerania.

Key elements of the project to reintroduce the European sturgeon (*Acipenser sturio*) include sound, internationally coordinated scientific support, a long-term focus, intensive incorporation of all stakeholders and users from an early stage, and cooperation with other European partners such as France. This is one reason sturgeon reintroduction was included in the German government's National Strategy on Biological Diversity in 2007 as a beacon project.

Based on the Action Plan for the Conservation of the European Sturgeon (*Acipenser sturio*) adopted by the Standing Committee of the Bern Convention in November 2007, this National Action Plan for

the Conservation and Restoration of the European Sturgeon was elaborated with the support of the institutions involved and representatives of resource users. The goal is to provide a binding framework for future work and a foundation for water body-specific management plans. The Action Plan presented in the International Year of Biodiversity takes on a key role in conserving sturgeon populations in rivers and coastal waters.

With its many goals and measures, this German National Action Plan for the Conservation and Restoration of the European Sturgeon incorporates users and other stakeholders. Many of them were closely involved in drawing up the plan. Important partners include fishers and anglers, particularly due to unwanted sturgeon bycatch, and the water sector, which, in accordance with the requirements of the European Water Framework Directive, pursues the goal of improving the ecological status of our rivers. In addition to a detailed description of *A. sturio*, its requirements in terms of the diverse habitats as well as of the threats and risks and the legal framework for conservation measures are outlined. The main focus is, however, on the very wide-ranging catalogue of measures with regard to rivers in western Germany.

Implementing the Action Plan is a long-term task requiring close cooperation between all stakeholders. I hope that this Action Plan will contribute to advancing the reintroduction of the sturgeon and also to improving the conditions for other water-dependent organisms and habitats.

If we can achieve this, the reintroduction of the European sturgeon could become a success story in Germany's efforts to protect and conserve biological diversity.

Prof. Dr. Beate Jessel
President of the Federal Agency for Nature Conservation (BfN)

Figure 2: Redynamisation of a waterway through connection of a river branch at Vreugderijkerwaard, IJssel, Netherlands

CONTENTS

EXECUTIVE SUMMARY

The European sturgeon (*Acipenser sturio* L.1758) is an anadromous migratory fish, spending most of its life in marine waters while returning to its native river for reproduction. Populations of the species have dramatically decreased during the last century. Besides anthropogenic changes to rivers such as channelizations, the construction of hydrodams (which block the upstream migration to spawning sites), and pollution, overharvest has been identified to be among the key elements that caused the dramatic decline of the populations.

Today, there are four primary problem areas adversely affecting survival, reproductive efficiency and return of the species (ranked in order of importance):

- mortality caused by accidental catch (by-catch) and illegal fishing (poaching). Minimising these losses is critical to the survival of the very limited number of remaining individuals in the Gironde and successful repopulation of the species in other river catchments;
- drastic changes of hydrologic and hydrodynamic regimes in rivers and estuaries (i.e. sand and gravel extraction, dyking and channelisation, hydrodams and more rapid runoff in the catchment area, with associated impacts upon sediment transport) are greatly affecting spawning and nursery habitats and can block migration to spawning sites;
- anthropogenic environmental pollution, e.g. from contaminants, eutrophication and increased thermal pollution, which can drastically affect reproductive success;
- the introduction of allochthonous species impose additional threats upon the species such as interspecific competition, disease transfer, and the risk of hybridisation potentially affecting efforts to re-establish the species, particularly if introductions are not reduced to negligible levels.

Additionally, climate change may also have an impact on future performance characteristics of the species by increasing water temperatures, altering faunal composition, water discharge volume, and changing seasonal water flow rates.

The current situation with only one known remaining population in France is dramatic. Although the size of the North-East Atlantic population in the Gironde is unknown, French experts assume that this population is probably limited to no more than a few hundred individuals. All indicators concur that *A. sturio* is now one of the most threatened fish species in Europe, being in critical danger of extinction.

Supporting a self-sustaining population of the European sturgeon is an obligation to which European Union member states have made a variety of commitments which also would allow the re-establishment of the species in key areas of its former natural range. If successful, these measures would also make an important contribution to protecting and maintaining biodiversity. At present, a multi-task approach seems to offer the most promising options for rescuing and recovering the species and re-establishing several populations. It is concluded that:

a) a consistent and massively supported *ex-situ* conservation programme is essential, taking advantage of the specimens already secured,

b) an *in-situ* conservation programme aggressively enforced is needed to prevent further loss of the remaining specimens

c) a strategic (long-term) programme on habitat rehabilitation is required to ensure that spawning and nursery sites meet the needs of the species and are accessible for the respective life cycle stages and

d) a programme to re-establish self-sustaining populations in selected key areas within the historic range is aggressively promoted.

This National Action Plan aims to prevent the European sturgeon (*A. sturio*) from becoming extinct and, in the mid-term, to re-establish viable populations of the European sturgeon in its historic range. It is based on the European Action Plan adopted by the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) on 27 November 2007, and has been adapted to German conditions. The aim of the National Action Plan is to establish and coordinate the bases for the conservation and re-establishment of the European sturgeon (*A. sturio*) in Germany. It will assist Germany to meet its obligations under international, bilateral and national agreements, guidelines and legislation. The concept and the individual actions and required measures were agreed by the Federal Government and the German federal states (*Länder*) in consultation with the relevant interest groups during the course of 2009, e.g. at a public hearing on 3 December 2009. In line with the specifics of planning, the implementation of the required measures will be conceptualised and coordinated, as far as possible, through catchment-specific management plans. Implementation of the National Action Plan is a long-term task which necessitates close cooperation among all stakeholders, especially with regard to the further development and elaboration of the Action Plan.

Figure 3: Release of ***A. sturio*** for telemetry study of migration and habitat utilisation

1 INTRODUCTION

The European sturgeon (*Acipenser sturio* L.1758) is an anadromous migratory fish, once one of the most widespread of sturgeon species. The vernacular name "common sturgeon" reflects the earlier status as a common species with high economic importance throughout its former range. Populations of the species were decreasing dramatically even at the end of the 19th century. Today, the European sturgeon is one of the most threatened fish species in Europe, being in a critical danger of extinction (IUCN Red List, Rochard *et al.* 1990). The species is now strictly protected under a number of international and European agreements (e.g. CITES, Bern Convention, Bonn Convention, European Habitats Directive) as well as under national legislation in most countries of its historic range.

The European sturgeon is now restricted to only one known relict population in the Gironde, with its tributaries Garonne and Dordogne, in France. This population reproduces infrequently (last observed in 1984, 1988, 1994 and eventually 1995) and reveals a continuous, substantial decline over the last few decades. For which the main reasons are anthropogenic activities such as overexploitation, modification of habitats and pollution.

This National Action Plan aims to re-establish a self-sustaining population of the European sturgeon in German waters. The proposed measures are also intended to halt population decline and help to safeguard the future of the species throughout its historic range.

The sturgeon has a complex life cycle, requiring a variety of different habitats (Holčik *et al.* 1989; Dettlaff *et al.* 1993, Holčik 2000). This, in combination with its late maturation and long life span, makes the species an ideally suited indicator for sustainable fisheries management, environmental quality and connectivity (Beamesderfer and Farr 1997) and an excellent model species for good ecological status in rivers, estuaries and marine waters as has been outlined in the Ramsar Declaration on Global Sturgeon Conservation (Rosenthal *et al.* 2006). However, its value as an indicator is guaranteed only if sufficiently large populations are available, or can be created through release, to populate the habitats.

Self-sustaining populations of the European sturgeon would make an important contribution to maintaining biodiversity, which is a strict obligation under a number of national, European and international regulations and Conventions.

The main problems for the conservation and restoration of the European sturgeon are the small population left in the wild, the complex life cycle, which requires a variety of habitats, the late onset of first maturity, and longevity of the species.

Figure 4: A sturgeon (***Acipenser sturio***) measuring 2.95 metres and weighing 360 pounds next to a normal catch. Caught on 20 July 1929 in the Untereider area near Pahlhude by sturgeon fisher Hans Frahm.

2 DESCRIPTION OF THE SPECIES

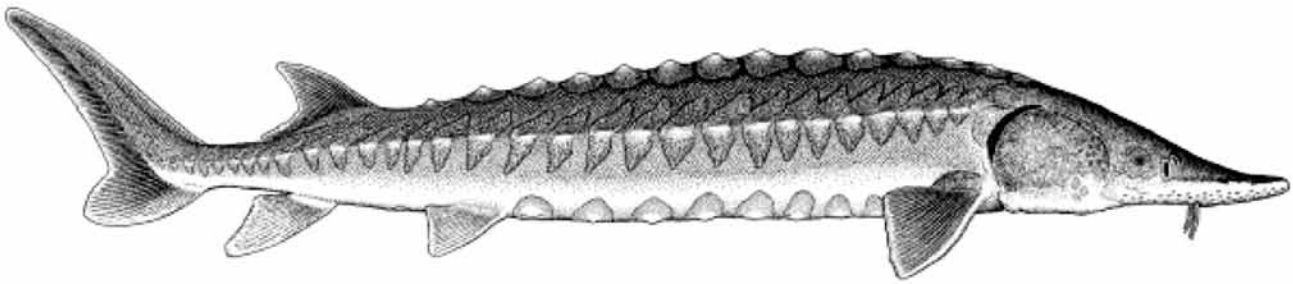

Figure 5: ***Acipenser sturio*** (based on Vecsei 2001)

Acipenser sturio belongs to the order *Acipenseriformes*, which is confined to the Northern hemisphere. The fossil records of this group date back approximately 200 million years. Today, there are nine species belonging to this order in East Asia, eight in North America, six in the Ponto-Caspian region and three in North Western Europe. In Germany, two species occurred historically in the coastal areas (*A. sturio*, *A. oxyrinchus*) and five occurred in the Danube River Basin (*A. güldenstädti*, *A. nudiventris*, *A. ruthenus*, *A. stellatus*, *Huso huso*).

The European sturgeon can be identified by a number of morphological, morphometric and genetic characteristics. However, under field conditions, discrimination between species can be difficult and in most cases requires expert assistance. For a general description of the species, please refer to the relevant keys for determination. A detailed overview of the sympatric species in European waters can be found in the Action Plan for the Conservation of the Sturgeons (*Acipenseridae*) in the Danube River Basin (Bloesch *et al.* 2006).

Figure 6: The different structures of the bony plates (scutes) of ***Acipenser sturio*** (right) and ***Acipenser oxyrinchus*** (left) from excavated findings (drawing by Hans Winkler, Ludwig and Gessner 2004, with permission by A. Ludwig IZW, Berlin)

DESCRIPTION OF THE SPECIES

The maximum length of *A. sturio* is reported to exceed 3.5 meters with a weight of more than 300 kg. Anecdotal information relating to the North Sea catchment indicates that in rare cases specimens may have reached up to 5 m in total length. Holčik *et al.* (1989) give size ranges for a number of areas during the past century, indicating that the average total length of fish entering the rivers ranged between 94 to 220 cm for males and 105 to 250 cm for females.

Details on the biology and especially the autecology of the European sturgeon are poorly known. The lifespan is presumed to last over 60 years with first maturity being reached after 10 – 16 years, depending upon geographical range and sex. Spawning season, age at first maturity, nutrition and growth varied between river systems over the geographical range (Holčik *et al.* 1989).

During their life cycle the European sturgeon utilises freshwater, estuaries and marine habitats at different stages. Experimentally, Magnin (1962) demonstrated that with increasing size, *A. sturio* progressively becomes acclimated to higher salinity and cannot adapt to sea water before reaching 50 cm. Ninua (1976) reported that in the Black Sea, young-of-year *Acipenser sturio* leave the estuary and migrate along the coast. Adults live on the continental shelf (Rochard *et al.* 1997a). When entering the final stages of maturity, they return to their natal river in order to reproduce. The driving external triggers for spawning are substrate structure, water discharge, temperature profile and photoperiod (Dettlaff *et al.* 1993). Spawning season is confined to late spring until early summer (March to April in Guadalquivir, Spain; May to June in the Gironde, France). Historically, the spawning period in the German rivers Elbe, Eider, Oste and Stör has been reported to occur from between June and August at water temperatures between 17 and 22° C. Spawning takes place in swift currents between 0.8 and 2.0 m/s over coarse substrate at considerable water depths either in the main channel or in lotic branches (Ninua 1976). Spawning and embryonic development take place in the lower reaches of rivers (barbel and bream region).

The first stage of development, i.e. the incubation period from oviposition to hatching, is temperature-dependent, lasting for 3 – 5 days (Ehrenbaum 1894). The hatched embryos and early larvae drift downstream and settle in crevices in the gravel close to the spawning sites where they continue their development.

Following the complete absorption of the yolk reserves, the fry start feeding on tiny plankton organisms for some days. During the onset of active feeding they gradually drift further downstream to more productive feeding grounds. Over several days, they convert from a pelagic to a benthic lifestyle, accompanied by a change in nutrition, mainly feeding on oligochaetes and chironomid larvae, which they detect by the use of electroreceptors and taste buds on the barbels. This freshwater phase lasts approximately six months (Magnin and Beaulieu 1963, Kinzelbach 1987, Holčik *et al.* 1989). The behaviour throughout this stage is not documented in great detail. Clear descriptions for habitat characteristics and habitat shifts during early larval and postlarval stages are incomplete or lacking.

At an age of 6 months, young-of-the-year sturgeons migrate downstream until they reach the estuary. During the first two years of the juvenile stage, the fish of the Gironde (France) stay exclusively in the brackish waters of the estuary. They stay in areas of low salinity (<8 ‰) during their first year (Elie 1997). With increasing size, they progressively become acclimated to higher salinity. The brackish reaches of the estuary with moderate salinities are utilised by juvenile fish for a period of about 1 – 2 years. In the Gironde it has been observed that these life stages are found in high densities in preferred areas with a sandy to muddy bottom, a depth exceeding five meters and temperatures of about 20° C. Here, they show a strong feed preference (Rochard 2002, Rochard *et al.* 2001, Castelnaud *et al.* 1991). Between the age of 2 and 7, the juvenile fishes reveal an alternating movement between the sea and the estuary, regularly returning to the estuary in winter known as the St. Jean migration (Magnin, 1962).

Figure 7: 4-cell stage (a), yolk sac embryo (b) and feeding larvae (c) below (***Acipenser oxyrinchus***)

From the age of 8 years onward, the sturgeon undergoes sexual differentiation and maturation acquiring adult characteristics. Both late juveniles and adults live exclusively in the marine environment. The large adult specimens predominantly utilise marine habitats with only short reproductive phases spent in the freshwater regions of the rivers. All available data indicate that during its stay at sea, *A. sturio* continues to be littoral, mainly utilising sandy or muddy substrates. The only available data on their distribution in these habitats originate from catches by fishermen. Two thirds of the catch records for late juveniles were reported from the continental shelf in water depths of 40 to 100 meters (Rochard *et al.* 1997 a, b). Adult European sturgeons have been caught in the Adriatic Sea in water depths of up to 200 m (Holčik *et al.* 1989).

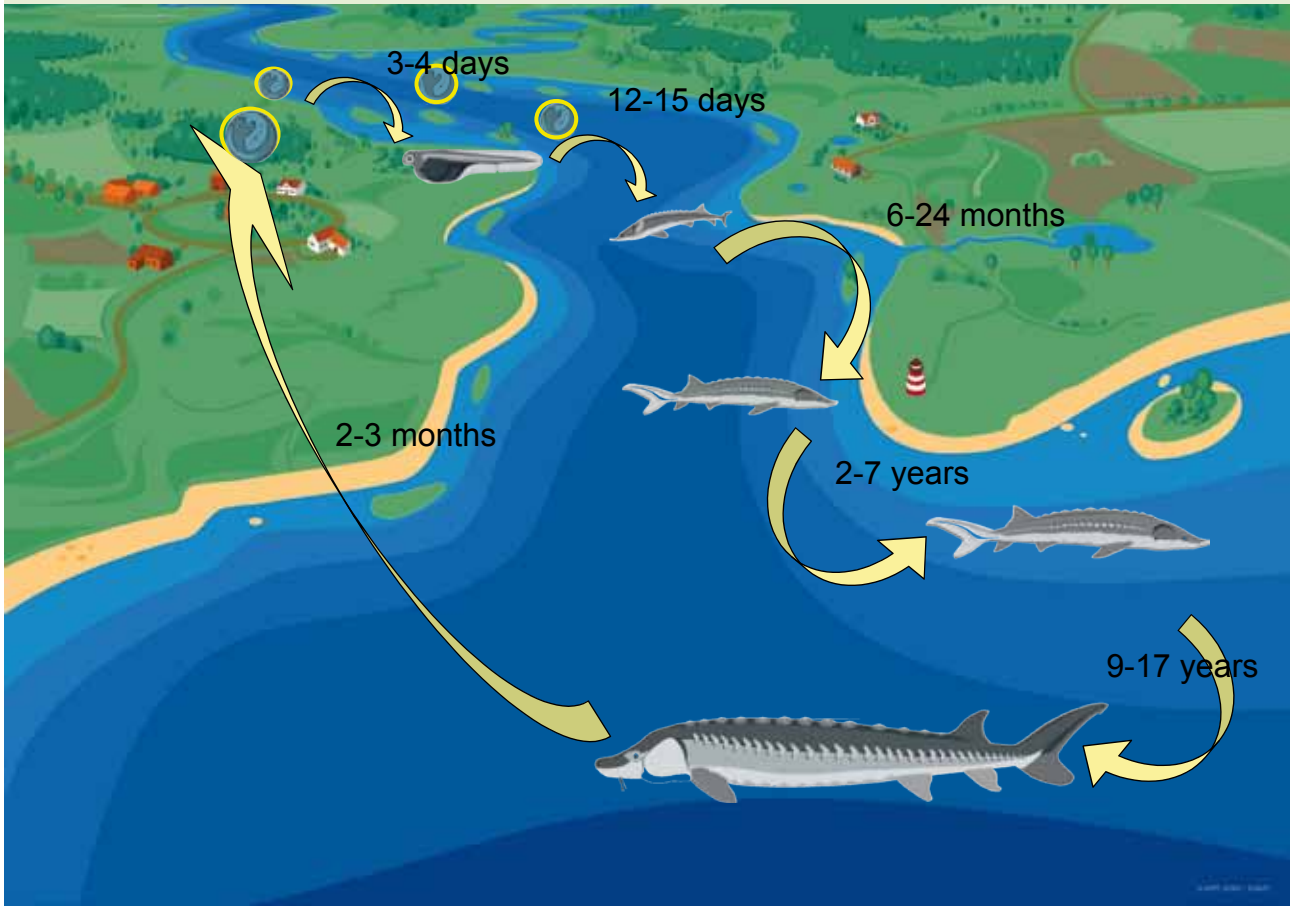

Figure 8: Habitat use and migration of various development stages of ***Acipenser sturio*** – with reference to the Gironde population, France

The European sturgeon of the Gironde reaches maturity at ages between 10 and 12 years in males and between 13 and 16 in females (Williot *et al.* 1997). The spawning migrations associated with reproduction vary from region to region. In the Guadalquivir River, migrations commonly occurred in March and April, in the Gironde, between March and May, and in the Rioni, they occurred in April and May at level temperatures of river and sea water. In the Elbe, spawning migrations mainly took place in May and June and lasted until August (Quantz 1903).

Sturgeons do not reproduce every year and the frequency of their reproductive cycle is variable. Based on the available studies, it is believed that males participate in reproduction events approximately every second year, whereas females may only take part at 3 or 4 year intervals (Williot *et al.* 2007). These assumptions are well in line with the reproductive behaviour observed in a number of other sturgeon species in the same geographic range (Van Eenennaam and Doroshov 1998; Hildebrand *et al.* 1999; Detlaff *et al.* 1993).

3 DISTRIBUTION AND CURRENT SITUATION

The European sturgeon (*A. sturio*) was historically found in the major rivers and coastal waters of Western Europe, in the Black Sea, in the Mediterranean Sea, including the Adriatic and Tyrrhenian Sea, along the Atlantic coast, from Portugal (South) to the Scandinavian Peninsula (North), and in the North Sea with its major tributaries. Single specimens have been reported along the coasts of Iceland and of the White Sea, as well as along the Atlantic and Mediterranean coasts of Northern Africa (Magnin 1962; Holčik *et al.* 1989). Of all sturgeon species in Europe, *A. sturio* historically had the largest area of distribution (Holčik *et al.* 1989). The status of the species in the Black and Mediterranean Seas is uncertain. Morphometric variations and ecological differences have not yet been verified further or evaluated conclusively (Holčik 2000, Elvira *et al.* 2000).

The range of the species since the 12th century excluded the Baltic Sea and its tributaries (Ludwig *et al.* 2002, 2008). Here, the presence of *A. oxyrinchus* in increasing shares of the population since 300 B.C. has been demonstrated. In the Loire, Gironde and Adour in South Western France, too, as well as in Great Britain, *A. oxyrinchus* was shown to have been present between 3000 and 1000 B.C. (Desse-Berset, 2009). However, the relative abundance of *A. oxyrinchus* in these areas has not been investigated.

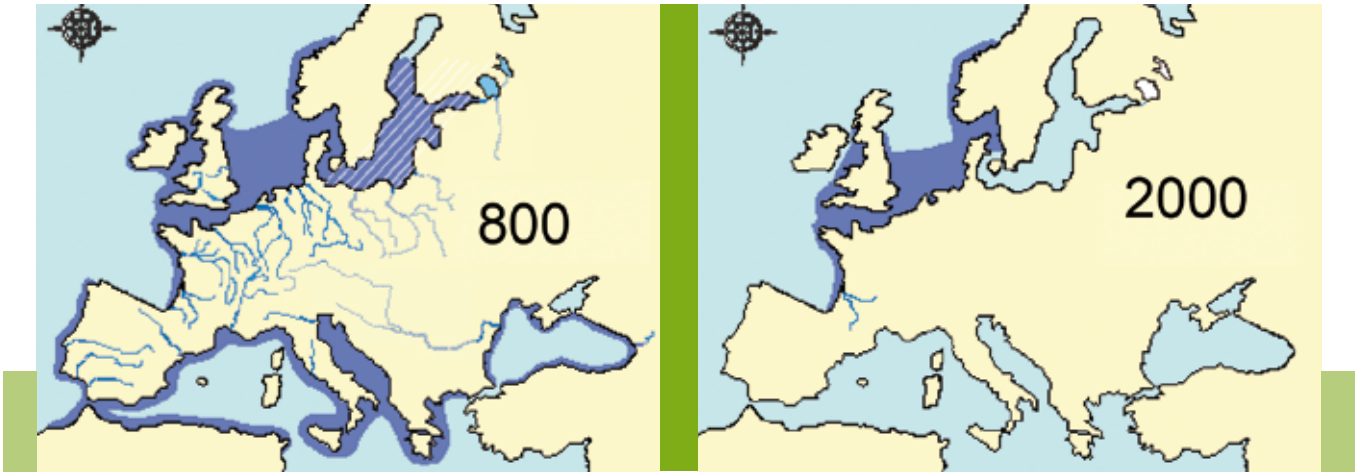

Figure 9: A comparison of the range of ***Acipenser sturio*** in the years 800 and 2000 A.D. (modified after various sources: Holčik et al. 1989, Elie 1997 and Ludwig et al. 2002)

In Germany, the European sturgeon was abundant in all the main tributaries to the North Sea (Dunker 1960). Its occurrence decreased with distance from the sea. In the Elbe, sturgeon migrated in large numbers as far as Magdeburg (Kisker 1924). However, its occurrence in the Czech part of the Elbe River has always been rare and its presence in the Vltava River upstream to Prague has been exceptional (Frič 1872 a, b, c). In the Rhine, sturgeon migrated in large numbers as far as the Moselle but was only rarely found in the Upper Rhine or the Main (Holčik 1989). In the Ems, Weser and Eider populations, specimens migrated up to 200 km upstream to spawn.

The decline of the species became apparent in the late 19th century, such that after the 1920s, the Eider was the only river in Germany in which the species regularly reproduced (Steinert 1951). Blankenburg (1910) assumed the area between Lexfähre and Pahlhude, approximately 84 – 66 km before the river mouth, to be the main spawning ground. According to Ehrenbaum (1923) and Heidrich (1933), too, the spawning grounds lay above the dam that now exists at Nordfeld weir. In the Lower Eider, Ems and Oste rivers, regular catches of sturgeon were still made until the end of the 1960s (Spratte 2001).

During the second half of the 20th century, only individual catches were reported across much of the range, e.g. in the Netherlands and Belgium until 2008, in Norway until 2008, in the United Kingdom until 2005, in Germany until 1993, in Spain until 1992, in Italy until 1991 and in the Danube river in Romania until 1965 (Almaca and Elvira 2000, Arlati pers. comm., Fernández-Pasquier 2000, Van Winden *et al.* 2000, Manea 1980, Bacalbasa-Dobrovici 1991, 1997). Catches occurring since the 1980ies in Northern Europe have often originated from the French population (Rochard *et al.* 1997a). Only in the Gironde (France) and in the Rioni River (Georgia) catches were reported regularly until the 1980s (Castelnaud *et al.* 1991, Debus 1997, Zarkua, pers. comm.).

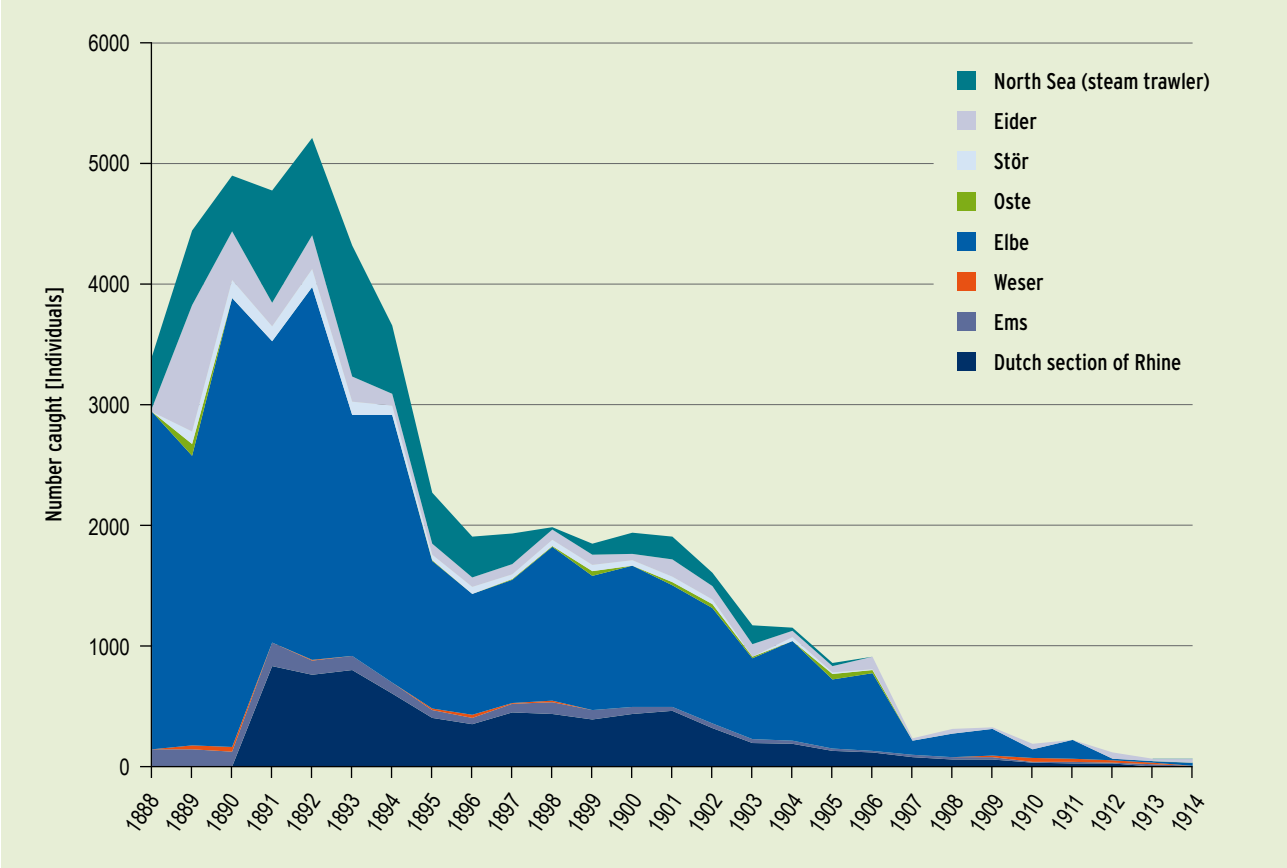

Figure 10: Catches (cumulative) of specimens of the European sturgeon in the North Sea catchment between 1888 and 1914 (based on Demoll and Meier 1940)

The population in the Gironde, Dordogne and Garonne declined between 1951 and 1980. During this period, catches of sturgeon dropped by 94 %, from 2500 fish per decade to only 150. Despite the fact that the species was protected in 1982 in France, the decline in the population continued. This is reflected in the number of captures for scientific purposes as well as the recorded by-catch, which dropped from under 10 per year in the 1980s to a few individuals since the late 1990s.

The current situation with only one known remaining population worldwide in France, in the Gironde, Garonne and Dordogne basin, is critical. Today, the European sturgeon is close to extinction. The last population is at an extremely low level, mainly present in French waters, with some adult and subadult individuals observed from time to time in the United Kingdom, Belgium and the Netherlands. Although the size of the North-East Atlantic population remains unknown, it is assumed, based on marking

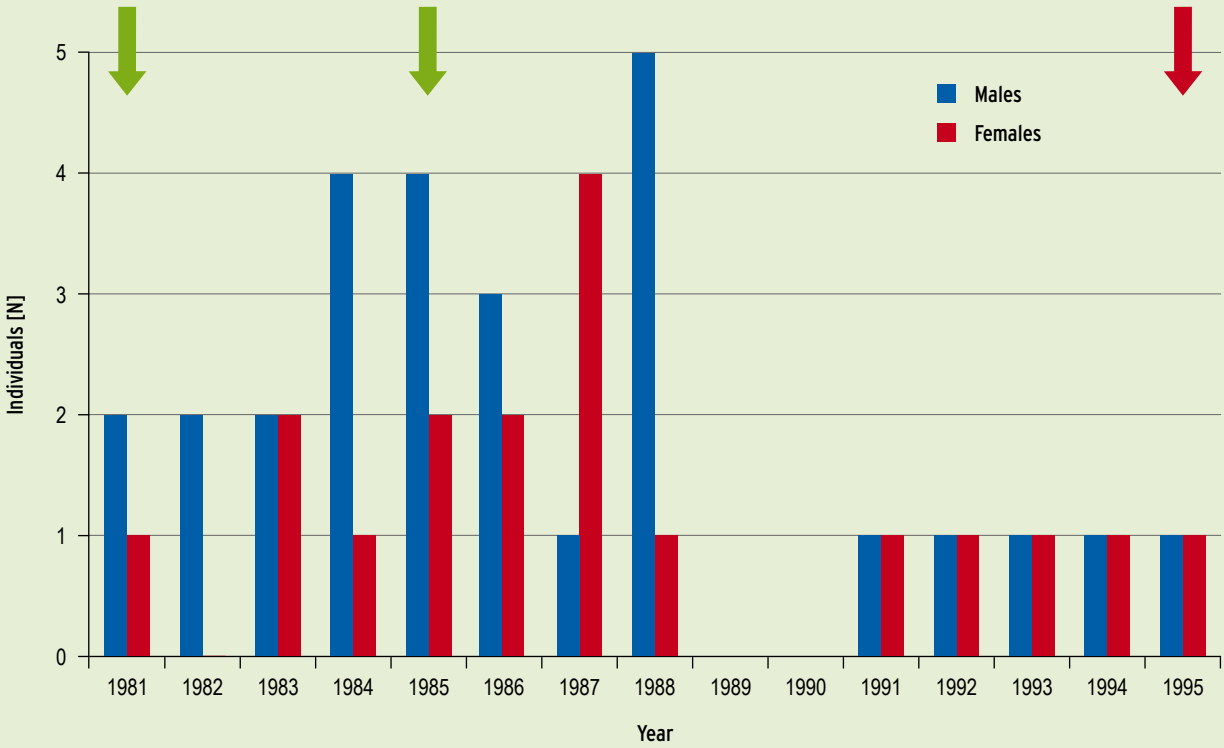

Figure 11: Catches of mature ***Acipenser sturio*** in the Gironde/Garonne/Dordogne with artificial reproduction (green arrows) and successful rearing of fingerlings (red arrow)

experiments and reported catches, that this population is probably limited to no more than just a few hundred individuals (Rochard *et al.* 2001). The species is classified as critically endangered (CR-A2d) according to the IUCN criteria, and considered already extinct in the following countries: Albania, Algeria, Croatia, Denmark, Georgia, Greece, Ireland, Italy, Morocco, Norway, Portugal, Romania, Russian Federation, Slovenia, Spain, Sweden, Switzerland, Turkey and Ukraine. In Germany, the species is classified as extinct or missing (Bless *et al.* 1994, Fricke *et al.* 1996).

Natural reproductions were last observed in 1988 and 1994 (Williot *et al.* 1997). Research in genetics strongly suggests that the cohort of 1994 derives from only one mating pair (Ludwig *et al.* 2004), which testifies to the very low number of active spawners in nature and thus to the critically endangered status of the species.

Since the early 1980s, in the Gironde estuary 41 accidentally captured fish have been used in artificial propagation trials. Some were finally maintained in captivity at the biological station of Cemagref (Agricultural and Environmental Engineering Research Institute). Among them 10 were females, only two of which were in an optimal state for reproduction allowing induced spawning in 1981, 1985 and 1995 only.

The current sturgeon population of the Gironde mainly originates from the 1988, 1994 and 1995 cohorts. These fish are now old enough to reproduce but the number of returning fish is continuing to decline. Only a few individuals have been recorded in the last two years, although the juveniles of these year classes were observed in the estuary of the Gironde in thousands in the 1990s.

The largest number of larvae was obtained in 1985, but these died after hatching (Williot *et al.* 1997). In 1995 Cemagref realised the first induced and controlled reproduction and successful rearing of larvae and juveniles despite the initially poor quality of the broodfish. The resulting offspring were used for stocking the river with feeding larvae as well as fingerlings

Figure 12: Marked ***A. sturio*** (grey tags) for release in the Elbe near Lenzen 2008

(Williot *et al.* 2005, 2007). One group was retained for captive rearing in the facilities of Cemagref at St. Seurin near Bordeaux (France), and at the IGB (Leibniz Institute of Freshwater Ecology and Inland Fisheries) in Berlin (Germany). This means that in France, three groups of animals are currently available which are being reared in captivity at Cemagref in brackish water: two groups of wild origin (23 fish born during the time 1984 – 1994 originating from accidental captures +19 juveniles resulting from the 1994 cohort from experimental fisheries), plus one group of 43 individuals resulting from the controlled reproduction of 1995. In Germany, 11 fish originating from the 1995 reproduction are being reared. In addition, France and Germany each have around 150 specimens originated from the 2007 – 2009 cohorts.

In light of the poor state of wild populations, the future of the European sturgeon mainly relies on controlled reproduction and stocking to enhance the wild population. The major constraint on controlled propagation of wild catches is the extremely limited availability of fish which are at a sufficient state of maturity. Additionally, synchronisation of maturation of male and female individuals and the precise forecasting of maturation, its control through environmental parameters and the associated uncertainty surrounding the optimal time for reproduction all constitute major obstacles to predictable reproduction. Based on results achieved so far, a focus on *ex-situ* conservation measures and accompanying research programmes to support subsequent rearing has proved to be the only sensible approach at present. This approach has recently received much encouragement because of the successful *ex-situ* reproduction and rearing at Cemagref since June 2007.

A high survival rate of more than 85 % has been obtained during the first 50 days of rearing, which enabled more comprehensive stocking measures to be carried out with more than 130,000 specimens in total between 2007 and 2009. These results are highly encouraging, urging for continued and substantial support for the subsequent rearing and accompanying research programmes, which are key elements to further success of the *ex-situ* conservation measures.

4 THREATS AND RISKS

The threats to existing populations, or those that can be foreseen for new populations to be reintroduced, are similar throughout the range. However, their impact varies from one watershed to another. They are known to some extent in the Gironde basin. The effects of habitat destruction, navigation and fisheries are well documented; impacts of damming, pollutants and eutrophication could not yet be assessed with certainty due to low population levels. In the basins where the species no longer exists, the effects of the various factors can be derived from the historic decline of the species. It is much more difficult to determine the effects of persistent environmental changes on the potential suitability of the waters for the species. Morphologically diverse and near-natural functional river habitats are particularly crucial for successful reproduction and survival in the early life history stages. The deterioration of these habitats is a major threat to the species. Threats in the later phases of the life history, such as fishing mortality, obstacles to migration and accumulation of pollutants, add to the initial risks..

Today, there are four primary problem areas impacting survival, reproductive efficiency and thus return of the species (ranked in order of importance):

- losses caused by accidental catch (by-catch) and illegal fishing (poaching). Minimising these losses is critical to the survival of the very limited number of remaining individuals in the Gironde and successful repopulation in other river catchments;
- drastic changes of hydrologic and hydrodynamic regimes in rivers and estuaries (i.e. sand and gravel extraction, dyking and channelisation, hydrodams and more rapid flow in the catchment area, with associated disruptions to sediment transport) are greatly affecting spawning and nursery habitats and can block migration to spawning sites;
- anthropogenic environmental pollution, e.g. from contaminants, eutrophication and increased thermal pollution, which can drastically affect reproductive success;
- interspecific competition with allochthonous species, disease transfer, and potential risk of hybridisation pose additional threats to efforts to re-establish the species, particularly if introductions are not reduced to negligible levels.

Four other problem areas are particularly critical for the implementation of conservation actions:

- limited knowledge of species-specific habitat requirements at various phases of the life history, adverse impacts of habitat alterations and potential counter-measures against habitat loss;
- dispersal of the very small remaining population over a very large area from the Bay of Biscay to the North Sea;
- dependence on the only one *in-situ* breeding population in France and a very limited gene pool with few specimens in the *ex-situ* populations in France and Germany;
- potential risk of rapidly changing environmental conditions due to climate change.

4.1 Fisheries-related mortality

The lack of ecologically sustainable fisheries management and substantial shortcomings in the enforcement of the EU fisheries policy, which was reformed in 2002, are still a major problem. Today, fisheries-related mortality is considered to be one of the main causes for the decreasing numbers of the European sturgeon in the Gironde population, thus reducing the potential of the remaining population to recover by natural recruitment.

Figure 13: Illegal sturgeon catch (TL 261 cm and 120 kg) off the coast of Swansea, Wales 2.6.2004 – left: in the trawl net, right: unloading

The main cause of fisheries-related mortalities is by-catch, i.e. the accidental capture of sturgeon during legal fisheries practice. Most of the fishing concerned involves the use of beam trawlers, trawls, trammel nets and gillnets (Rochard *et al.* 1997b), targeting bottom roundfish or flatfish. Mortalities either occurr as fish are brought on board dead, or by keeping them on board as a trophy or curiosity. In 1996, from Spain to England, the number of catches was estimated to be 450, with a mortality rate of 57 % (Rochard *et al.* 1997b). Estimates of these losses are difficult due to the range and lack of accurate data, but were assessed to comprise 100 to 400 individuals annually at the end of the 1990s (Lepage pers. comm.). Currently, the annual captures comprise a smaller number of individuals, mainly reflecting the extremely low remaining abundance. A further source of catch-related mortality is directed illegal fishing or poaching.

It has been estimated that in France, a few fishes are still captured on a targeted basis, perhaps between 10 and 20 every year (Lepage, pers. comm.). Given the currently critical state of the population, even the loss of one single adult specimen would be significant, compromising the future of the species. Survival of re-introduction from reared populations will therefore only be successful if the by-catch mortality can be largely reduced. The long-term target must be to reduce fisheries-related mortality for the entire population to below 5 % in order to keep the population within secure limits.

In order to reduce by-catch, information campaigns in France in the late 1990s and since 2005 revealed considerable success and have provided a clear and positive example of active participation of the fishery sector to protect the species while recording and releasing by-catch (Mayer and Lepage 2001; Michelet 2006). The aim of these campaigns is to improve the level of knowledge and awareness about sturgeon capture in the fishery sector and thus help to ensure that accidental catches are released or integrated into the *ex-situ* population.

Various authors have shown that the strict enforcement of management and conservation measures can help to protect sturgeon populations (Williot 1984, Rosenthal and Gessner 1992, Tsvetnenko 1993, Beamesderfer & Farr 1996). In contrast, in the Caspian Sea, the lack of enforcement since the end of the 1980s demonstrated significant negative impacts of marine fisheries on native sturgeon populations.

Figure 14: An example of a design used in the information campaign for the fishery sector

Figure 15: Morphological alterations in the bifurcation area of the River Elbe in Hamburg at km 620 between 1789 and 2000 (acc. to ARGE Elbe)

4.2 Morphological alterations of rivers and estuaries

Sturgeons, like all migratory fish species, are particularly threatened by man-made habitat alterations such as the construction of dams, physical alterations of river morphology and resulting hydrological as well as pollution stressors. Increased fine sediment transport and changes in the flow regime caused by straightening and deepening of the river for navigation affect the sturgeon population in similar ways to those documented for populations of other rheophilic species, as changes in the river morphology and discharge patterns have contributed to the loss of many spawning grounds (Kinzelbach 1987).

The extraction of gravel or sand directly disturbs sensitive habitats, particularly during the early phases of the life history (Castelnaud *et al.* 1981). The loss of habitat structures resulting from gravel extraction at habitats for spawning or early life stages directly reduces reproductive performance. On the feeding grounds, too, sand and gravel extraction can cause loss of habitat or may result in mortalities (Lepage and Rochard 1997). Effects of dredging and deposition of material were intensively studied in the St. Lawrence River, Quebec, Canada. Negative impacts on habitat utilisation of Atlantic sturgeon and benthic invertebrate productivity were reported (Hatin *et al.* 2007). Additionally, the loss of surface area due to dyking and dredging as well as the disconnection of side channels and backwaters further reduces the available habitat for juveniles in all Central European rivers.

Deepening of the lower reaches of the rivers to improve navigability results in increased influx of salt water. In the Elbe River, the increased salt water wedge today reaches 60 km further upstream compared to the condition in 1880 (Kausch 1996). As a result, the historic spawning sites at Brunsbüttel and Glückstadt have been rendered dysfunctional. Salinity-dependent stratification in the deepened lower reaches of the rivers also disrupts the oxygen content, as water exchange and hence oxygen input in the tropholytic deep water zone have decreased.

Figure 16: Aerial views of the mouth of the river Eider and the Eider Barrage at Kating/Tönning, Schleswig-Holstein

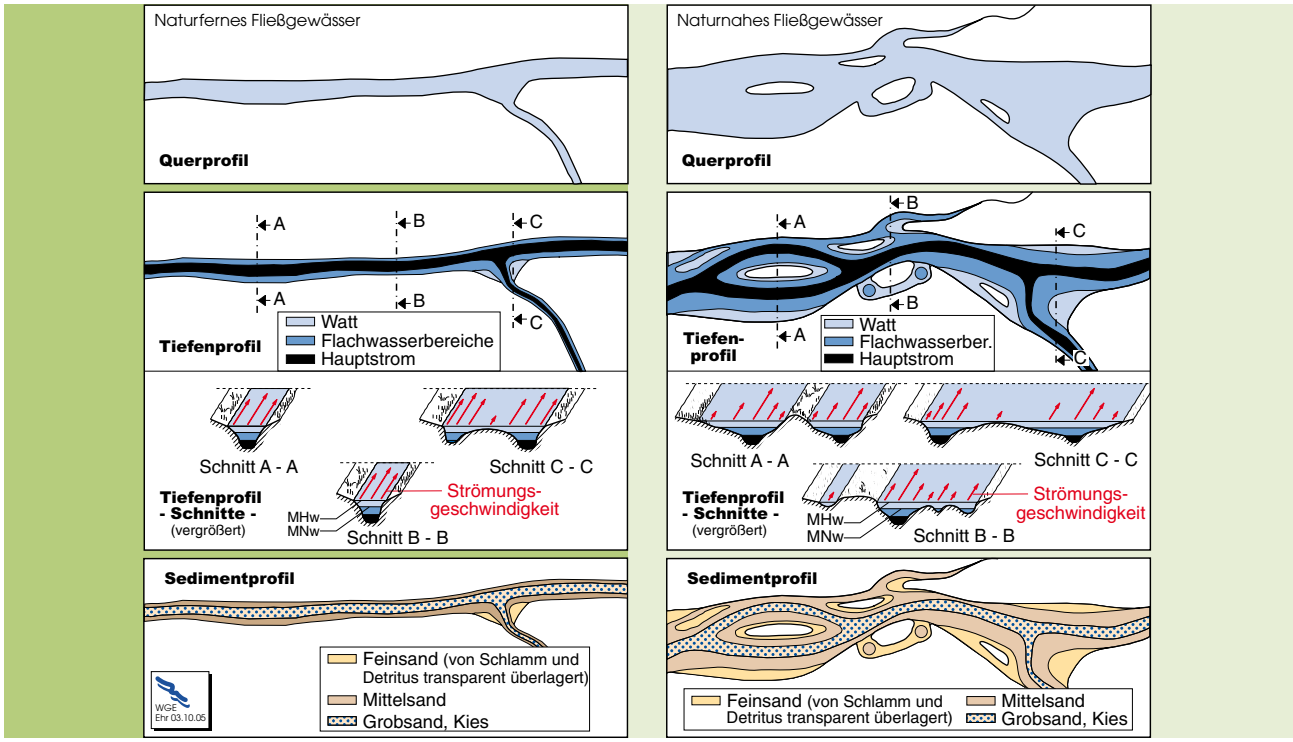

Figure 17: Schematic comparison of a non-natural and a near-natural stretch of river (source: ARGE Elbe)

Mortalities caused by abstraction of coolingwater for power stations or for other purposes, such as irrigation of crops, have been observed but few data are available about its extent. Water abstraction for cooling may result in direct damage or losses. The extent of this damage largely depends on the efficiency of the technology being used to prevent intake of fish with cooling water, as the possibility that the current may act as an attractant to migrating fish cannot be ruled out. In assessing the effects, the location along the river where water is abstracted is important, as there is a correlation between the size of the sturgeon, the duration and swimming speed. A major impact of such systems is postulated for fragile species (shads – *Alosa alosa* – in particular) for the nuclear plant of the Blayais, in the Gironde estuary. According to the reports, only one specimen of European sturgeon was documented in the clogged material from the inlet rakes, which was washed ashore in the 1980s. The low number of fishes found is attributed to the low population size and a lack of continuous monitoring, as an example from the Lower Elbe shows. Here, in 1996, approximately 40 individuals of juvenile exotic sturgeons were collected from the rakes of the intake system of a nuclear power plant during a study documenting fish losses in the facility. Clear impacts have been documented at a cascade power station on the River Rioni near Kutaisi, where water diversion reduced the water discharge in the main river channel, providing insufficient flow on the spawning sites and hence reducing their functionality (Mix and Gessner 2001).

Damming prevented passage to the spawning sites in various rivers (Inguri, Kizil Irmal, Yesilirmak, Po, Rhone, Guadalquivir, Garonne, Dordogne, Rhine, Weser, Eider). Morphological alterations to the Danube and its tributaries and the completion of the Iron Gate dams in the 1970s resulted in the loss of important spawning sites in the Middle Danube River up to Vienna (Lenhardt *et al.* 2005). Comparable effects were observed in the Lower Eider in 1936 with the installation of the dam at Nordfeld. In the late 1920s, Schütt (1927) already warned: "If the planned installation of the dam at the mouth of the Eider is carried out, the sturgeon will disappear from the Eider and probably from all over Germany altogether." The author's warning was sadly all too justified: following the construction of Nordfeld weir, not one incident of natural reproduction occurred. Kroezus (1967) assumes that the last natural reproduction of sturgeon in the Eider took place in 1934/35

Figure 18: Aerial view of Nordfeld dam and weir

In the Garonne and Dordogne basins, the Bergerac dam on the Dordogne (constructed 1851) and the Golfech dam on the Garonne (constructed in 1971) are the obstacles to migration located furthest downstream. Before that, the European sturgeon went upstream to Toulouse on the Garonne, to reproduce. Jego *et al.* (2002) mapped the remaining spawning sites downstream and estimated that in theory, they would allow the reproduction of about 200 females every year. However, the effects of these dams on flooding events, migration behaviour and temperature development throughout the spring have not been evaluated and are not fully understood. By contrast, Fernández-Pasquier (1999) concludes that

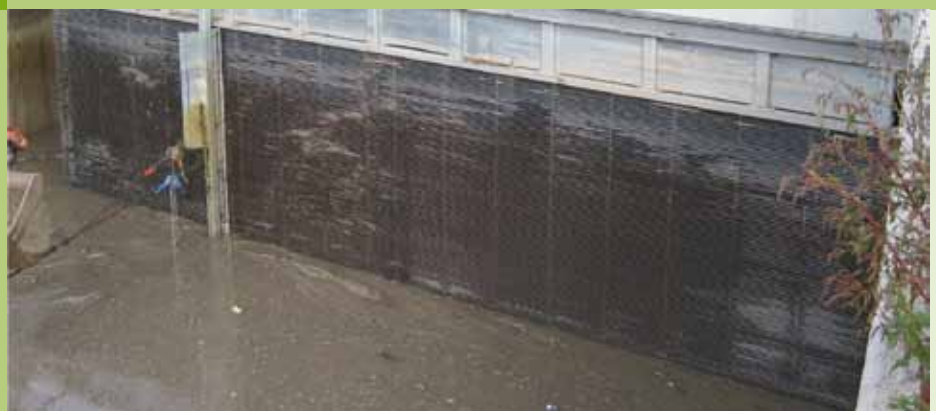

Figure 19: Rakes with horizontal bars for removing flotsam and rake cleaner mechanism

the decreasing flow of the Guadalquivir following the damming of the River could be partly responsible for the disappearance of the European sturgeon.

Despite the fact that the role of dams – blocking migration routes – has been acknowledged as early as the Middle Ages and has led to restrictions in their construction (summarised in Hoffmann 1996, Beneke 1881), the development of dams continued with the increasing importance of the waterways for industrial development from the mid 19th century (Kausch 1996). Detailed studies on the effects of damming have been performed on sturgeon species in several river basins in the world, for example for *Acipenser transmontanu*s on the Fraser River and the Columbia River (Hildebrand *et al.* 1999; Coutant 2004) and for *Acipenser sinensis* in the Yangze River in China (Kynard *et al.* 1994; Yang *et al.* 2006). Regulated river flow contributed to the physical alterations of habitat by limiting or altering spring peaks of discharge, reducing translocation and cleaning of the gravel beds (Coutant 2004), thereby reducing the availability of spawning sites. Additionally, the decrease in discharge also reduces migration fidelity, limiting the distance of upstream migration as well as the number of fish to enter a given river (Kinzelbach 1987; Holčik 1989; Kynard 1997).

A variety of structures to assist sturgeons during their spawning migration have been tested. Functional designs are therefore available. A major constraint on their functionality is the length of the water retention area above the dam. Experience gained in the Soviet Union has shown that without a sufficient current in the upper reaches, the fishes leave the reservoir via the dam. A further unresolved problem is safeguarding the outmigration of adult sturgeon and, depending on the type of dam, also of juveniles. Considerable efforts are required here in order to implement appropriate solutions.

The effects of shipping upon fish assemblages were already being discussed in the early 20th century. Direct impact caused by shipping accounted for numerous losses of young of the year sturgeon in the Vistula River (Seligo 1931). Sheer forces that are caused by the passing ships create current velocities that exceed the swimming capacity of juvenile fish, thereby dislocating them (Engelhardt *et al.* 2004). Inland shipping additionally imposes threats on the fish by direct mechanical impact. According to several US agencies (Status Assessment of *A. oxyrinchus* 2007), ship strikes are a major concern in waters that are used for navigation purposes intensively. This could become a serious concern, especially for ships with deep draughts in shallow waters, as for German coastal navigation as well.

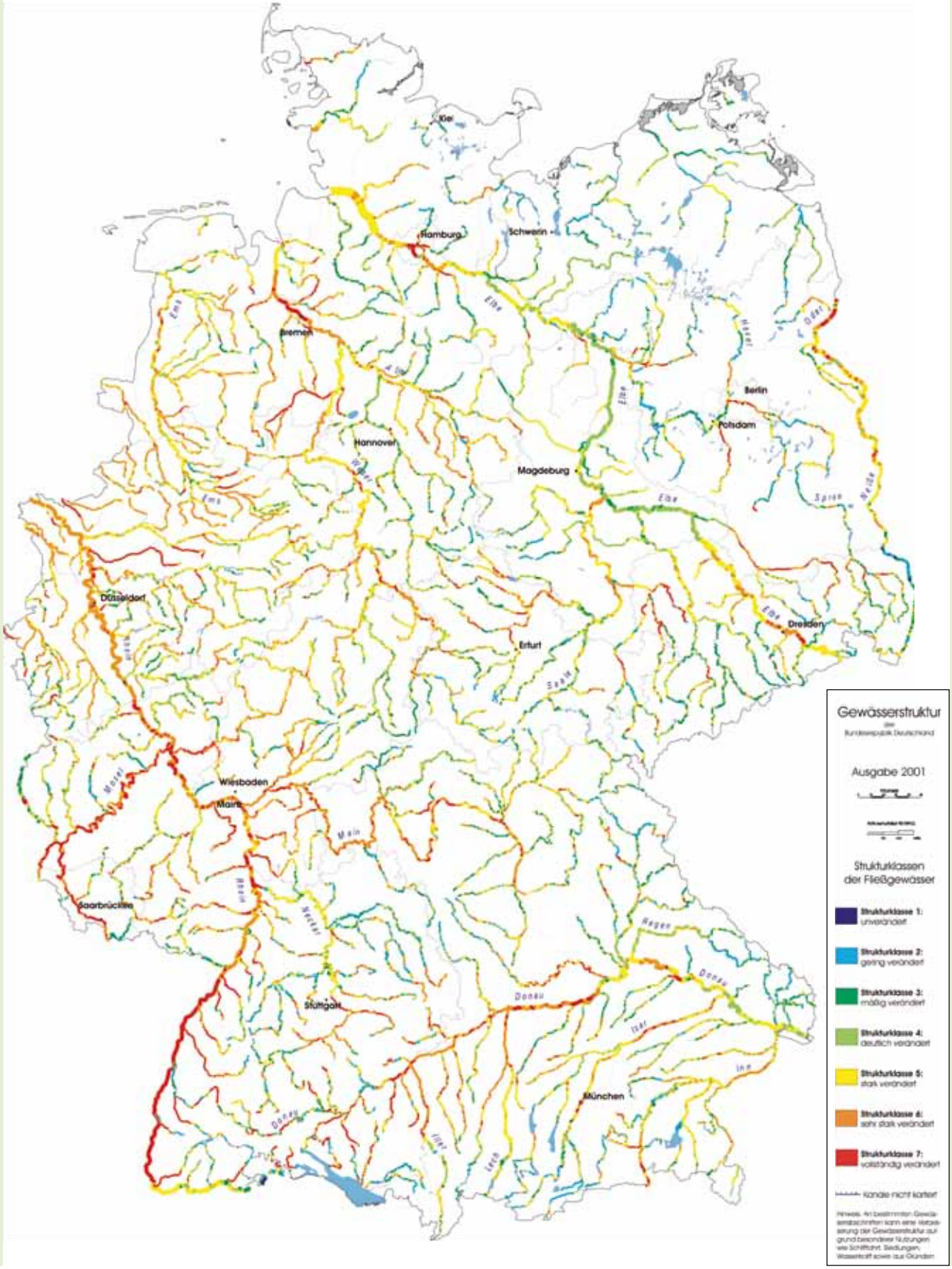

Figure 20: River structure quality map for Germany (modified). Kindly approved by the Working Group of the Federal States on Water Issues (LAWA)

4.3 Environmental pollution of rivers and estuaries

Historically, various effects resulting from pollution have been identified to affect sturgeon populations: **(a)** acute toxicity resulting from direct exposure to soluble pollutants at high concentrations, **(b)** chronic effects resulting from bioaccumulation of lipid soluble substances such as insecticides and pesticides mainly affecting reproductive success, and **(c)** eutrophication effects resulting from excessive nutrient release in freshwater habitats, causing oxygen deficits, disruption of pH values, and clogging of interstitial spaces. Acute toxicity was an important factor in the late 19th century when wastewater purification was virtually absent (Schiemenz 1905). Sturgeon rivers and habitats were particularly affected by these stressors due to the high sensitivity of early life cycle stages (Bonne 1905). Heyking (1914), for example, describes the Stör River, a tributary of the Lower Elbe River, as the "non plus ultra" in demonstrating the effects of river pollution caused by effluent from the leather industry. Also, high nutrients levels and pollution have severely impacted the sturgeon populations of the entire Danube basin (Stamenkovic 1991, Bacalbasa-Dobrovici 1997). In many German river basins, the situation has improved as a result of measures to control water pollution, but may still be relevant at a local level.

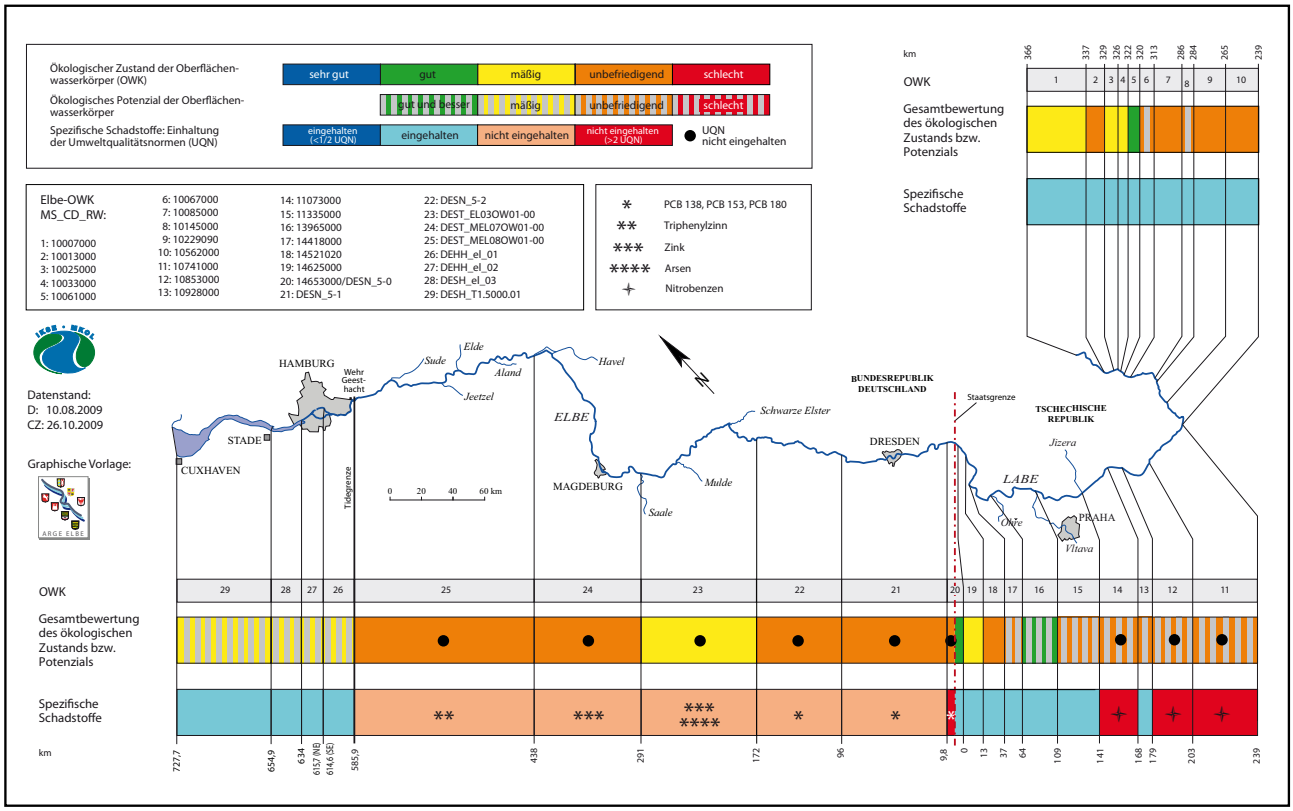

Figure 21: Chemical status of watercourses, with reference to the Elbe (source: ICPER)

THREATS AND RISKS

Sturgeons are particularly sensitive to pollution due to their longevity, which gives way to bioaccumulation of high levels of pollutants. Insecticides and pesticides such as DDT and its degradation products as well as PCBs and HCHs bioaccumulate over time, affecting reproductive success and thus impair recruitment in many species. They primarily influence cell membrane functions and can cause the loss of functional integrity of tissue and/or organs at different developmental stages with subsequent morphological malformations (Akimova and Ruban 1995; 1996, Bickham *et al.* 1998). Sub-lethal effects have been described to comprise behaviour alterations, damage to liver and gill tissues, altered enzyme activity, diminished condition (health) index, hermaphroditism, degeneration and absorption of gametes, as well as amitoses in oocytes, leading to the reduction of reproductive potential of populations. Similar effects have been described for contamination with hydrocarbons and heavy metals (Lukyanenko *et al.* 1999). Recently, there has been a greater focus on and study of the endocrinological effects of chemical substances on aquatic animals, higher levels of which are passing through modern wastewater purification plants. Significant effects on fish have been recorded (e.g. sex reversal), but more research is required here.

In the Gironde estuary, the concentration of cadmium in the water is 10 to 20 times higher than in the other Atlantic estuaries (Maurice 1994, Durrieu *et al.* 2005). Williot *et al.*(1997) hypothesized a resultant effect on reproduction. However, recent results from Maury-Brachet *et al.* (2008) concluded a low probability of this event due to short exposure times during the final maturation phase. This hypothesis is valid only provided that bioaccumulation is negligible during the juvenile and adult stage at sea. Here, a number of open scientific questions require urgent attention.

A further impact is mainly caused by communal and agricultural wastes and the resulting nutrient input into a system. Nutrient-rich water has a high productivity, triggering bacterial, fungal and algal growth. The first two groups generally perform best at elevated temperatures which are typical as spawning temperatures for *A. sturio.* As a result, fungal and bacterial pressures in waters with high organic load have the potency to destroy the eggs and kill the embryos. This is considered one of the main reasons for population decline of the European sturgeon in the Rivers Elbe, Rhine and Seine during the industrial revolution. These impacts were significant locally, for instance for wastewater discharge on or above spawning sites (such as the Köhlbrand, Elbe River) but the overall impact increased with rising utilisation of rivers for wastewater discharge.

Furthermore, the effects of power stations and industrial plants on the thermal load in river water resulting from the discharge of cooling water, and the ensuing effects on sturgeon, must also be taken into account. Adverse effects can be anticipated in the summer months in particular, as an increase in the water temperature of up to 8° C is often a requirement of operating licences. In this context, it is not only the mean temperature increase which is significant, but also short-term maximum temperatures as limit values for dispersal. Besides the stress to which fishes are subjected as a result of the abrupt temperature changes, the already low water flow in summer and high productivity of the waters caused by the temperature increase can reduce oxygen availability. The ensuing reaction, namely to avoid the acute increased-temperature zone, and the impairment caused by the reduced oxygen content can significantly limit habitat availability for sturgeon. In cases resulting in local hypoxia in particular, this may also cause acute mortality when sturgeons have no compensation mechanisms at their disposal.

Figure 22: Native species: North Sea catchment area: ***A. sturio***; Baltic Sea catchment area: ***A. oxyrinchus***; Danube catchment area: ***A. ruthenus*** (left-hand column from top to bottom). Other species (***A. baerii***, ***A. güldenstädtii*** and hybrids, right-hand column from top to bottom) have been introduced

4.4 Introduction of allochthonous species

The release of allochthonous species – despite the existence of relevant bans in the nature conservation and fishing laws of the federal states – must still be considered a potential threat, since the introduction of exotic species may have negative effects on the native species and their populations, particularly in substantially altered ecosystems (Leppäkoski *et al.* 2002). In this treatise the authors clearly demonstrate the overall long-term impact exotic species can have on trophic interactions, particularly expanding during warmer summers, which will become increasingly significant in light of climate change.

Further, diseases may find new hosts and may also proliferate because of lack of pre-exposure with subsequent resistance as has evolved with native disease agents. Besides these overriding implications in the context of the introduction of alien species, genetic effects cannot be ruled out, as sturgeons exhibit the potential for hybridisation (Antipa 1909, Kozhin 1964). According to current knowledge, these hybrids are fertile, which means that they can transfer the mixed genetic material to the next generation, resulting in a loss of genetic information and a decrease in adaptive capacity with respect to habitats.
There are four potential sources of introduction of exotic sturgeon in Europe: **(a)** Fish are released by aquarium and garden pond hobbyists who want to get rid of overly large specimens, **(b)** sportfishing clubs deliberately wish to add sturgeons to their trophies and release fish intentionally, **(c)** escapes from fishponds and farms happen accidentally despite the existence of clear rules governing the use of alien and locally absent species in aquaculture pursuant to Commission Regulation (EC) No. 535/2008 of 13 June 2008 laying down detailed rules for the implementation of Council Regulation (EC) No. 708/2007 concerning use of alien and locally absent species

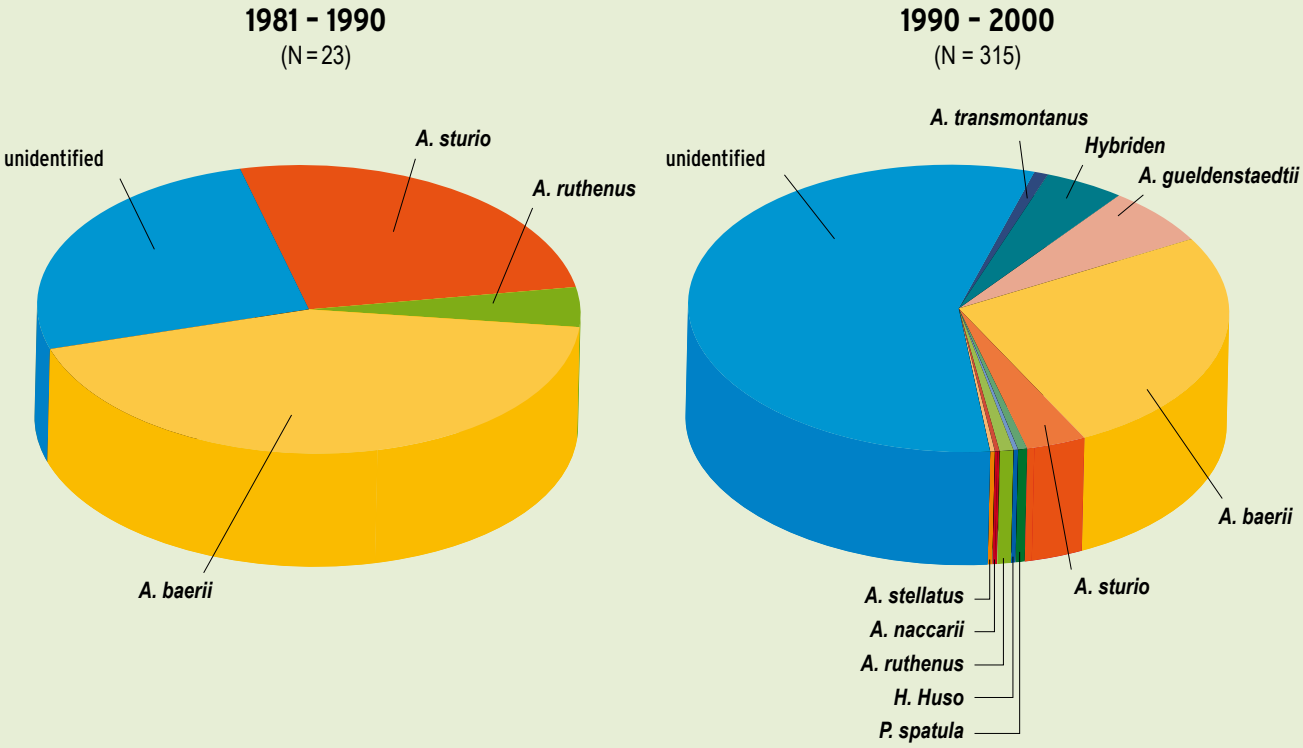

Figure 23: Increase in the number of species in reported sturgeon catches in Germany, 1981 – 1990 (left, N = 23) and 1991 – 2000 (right, N = 315), source: GRS

Figure 24: Harvesting sturgeons from a pond in Mecklenburg-Western Pomerania

in aquaculture, **(d)** illegal stocking by professional fishermen (Britton and Davis 2006). The number of records of non-indigenous sturgeon species in German coastal and estuarine waters has been reported to increase since the early 1990s (Spratte and Rosenthal 1996, Arndt *et al.* 2000, Arndt *et al.* 2002). Releases caused by accidents were also observed in the Gironde in 1999 following a storm surge. Several thousand *Acipenser baerii*, Siberian sturgeon, escaped. These escapes provided a serious difficulty for inland fishermen or anglers, who now have to be able to distinguish between two species of sturgeon, one strictly protected and the other requiring removal.

4.5 Impacts of climate change

Impacts such as climate change are postulated to have played a significant role in the decline of *A. sturio* in the Baltic during the Little Ice Age (early 15th to 19th century) (Ludwig *et al.* 2002). In the near future, changes in precipitation and its seasonal distribution and increasing temperatures might result in considerable alteration of the environmental conditions for migration and reproduction of this species. Studies by Beguer *et al.* (2007) do not indicate a significant influence of temperature on the distribution of the European sturgeon in the past. Nevertheless, changes in annual temperature and precipitation trends in combination with altered river discharge patterns and subsequently changed seasonal water flow rates may well have an effect on spawning migration and riverine residence time of juveniles. Reasons for this include changes in oxygen content, food availability and other factors. Impacts of climate change, both those which are already evident and those which can be anticipated on the basis of forecasts, will occurr in what is, in historical terms, a very short time period. It is apparent that this is an unprecedented phenomenon. It is therefore difficult, to make reliable predictions about the impacts on, and reactions of, ecosystems and their components due to the gaps in scientific knowledge.

5 LEGAL ASPECTS

The European sturgeon (*A. sturio*) is currently protected by a number of legal instruments, including:

- International conventions
- Regional regulations, including European Union legislation
- National legislation

When considering these instruments, a distinction must be made between those which are binding and those which are recommendatory. Additionally, some directly aim to protect and conserve *A. sturio*, while others are less specific and are only of indirect relevance to *A. sturio*. Below, only those regulations which are directly binding on Germany and aim to protect the European sturgeon are discussed in more detail. Other legal provisions are outlined in Annex 3.

5.1 International instruments

The states currently responsible for the status of the European sturgeon are often Contracting Parties to a number of global biodiversity-related conventions and are therefore bound to apply their provisions to the conservation of the European sturgeon (*A. sturio*).

5.1.1 Bonn Convention

The decision to include the European sturgeon (*Acipenser sturio*) in Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) was taken in 1999, by the 6th meeting of the Conference of the Parties (COP6) to the CMS, in response to an initiative by Germany. Appendix II covers migratory species that have an unfavourable conservation status or would benefit significantly from international cooperation. The Convention encourages range states to conclude global or regional agreements for species listed in Appendix II, giving priority to those species in an unfavourable conservation status. In 2005, COP8 decided to add *Acipenser sturio* to Appendix I of the CMS as well, which lists migratory species in danger of extinction (the Convention allows the listing of a migratory species in both Appendix I and Appendix II, as the obligations of Parties with respect to species listed in the two appendices are different and complementary).

According to the Convention, Parties are to:

- promote, cooperate in and support research relating to migratory species;
- endeavour to provide immediate protection for migratory species included in Appendix I, including the prohibition of taking of animals belonging to such species (exceptions for research purposes are possible).

In addition, range states of Appendix I species must endeavour to:

- conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction;
- prevent, remove, compensate for or minimise, as appropriate, the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species;
- prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species.

Furthermore, Resolution 7.7 on the Implementation of Existing Agreements and Development of Future Agreements, adopted in 2002, called upon CMS Party Range States of sturgeons listed in CMS Appendices to take the lead to develop an appropriate CMS instrument on sturgeons.

In 2005, Resolution 8.5 was adopted, on the same issue of existing and future agreements under the CMS. Concerning sturgeons, this Resolution urged

the resumption of cooperative activities with CITES (see section below) and invited consideration of possible CMS action regarding an appropriate instrument for sturgeons.

European countries such as France and Germany have given greater priority to utilising the Bern Convention (see 5.2.1), as an existing instrument which permits direct agreements to be made for the protection of the sturgeon in the European range, than to adopting new instruments under the CMS.

5.1.2 Washington Convention (CITES)

The European sturgeon (*A. sturio*) has been listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (also known as CITES or the Washington Convention) since its entry into force in 1975. This is the category of species threatened with extinction. Listing means that international trade of the species, in any form, is generally prohibited and is subject to particularly stringent regulations, in order not to further endanger its survival. Trade can only be authorised in exceptional circumstances, such as for scientific research or if the fish originates from captive breeding. Resolution Conf. 12.7 (Rev. CoP14) on "Conservation of and trade in sturgeons and paddlefish" (adopted in 2002 and amended in 2003 and 2007), urged range states to:

- encourage scientific research and adequate monitoring of the status of populations,
- curtail the illegal fishing of and trade in sturgeon and paddlefish specimens,
- explore ways of enhancing the participation of representatives of all agencies responsible for sturgeon and paddlefish fisheries in conservation and sustainable-use programmes for these species,
- promote regional agreements between range states of sturgeon and paddlefish species aiming at proper management and sustainable utilisation of these species;
- in the case of range states of sturgeons in the Eurasian region, take into account the recommendations in document CoP12 Doc. 42.1 when developing regional conservation strategies and action plans.

CITES regulates imports and exports of live sturgeon (fingerlings, juveniles and adults) as well as of fertilised eggs and sturgeon products, which may be relevant in the context of measures aimed at the conservation and restoration of the European sturgeon (*Acipenser sturio*).

The European Union enforces CITES on a uniform and binding basis via European species protection law. It aims to protect wild animals and plants currently or likely to become threatened by international trade, by regulating the trade in these species. *A. sturio* is listed in Annex A of Council Regulation (EC) 338/97. Article 8 of this Regulation prohibits trade in *A. sturio*.

5.2 Regional instruments

5.2.1 Bern Convention

The European sturgeon is listed as a strictly protected species (Annex II) in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). Each Contracting Party is required to take appropriate and necessary legislative and administrative measures to ensure its special protection and, in particular, prohibit (Article 6):

- all forms of deliberate capture and keeping and deliberate killing,
- the deliberate damage to or destruction of breeding or nesting sites,
- the deliberate disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation, insofar as disturbance would be significant in relation to the objectives of this Convention,

- the deliberate destruction or taking of eggs from the wild or keeping these eggs,

- the possession of and internal trade in these animals, alive or dead, including stuffed animals and any readily recognisable part or derivative thereof, where this would contribute to the effectiveness of the provisions of this article.

Parties are required to coordinate their efforts to ensure the species conservation throughout its range (Article 10). They commit themselves to:

- cooperate whenever appropriate and in particular where this would enhance the effectiveness of measures taken under other articles of this Convention, and to encourage and coordinate research related to the purposes of this Convention, and

- encourage the reintroduction of native species of wild flora and fauna when this would contribute to the conservation of an endangered species, provided that a study is first made in the light of the experiences of other Contracting Parties to establish that such reintroduction would be effective and acceptable (Article 11).

The Standing Committee of the Bern Convention has approved the initiative of developing an action plan for the Western European sturgeon (*Acipenser sturio*) and adopted this action plan at its meeting on 28 November 2007. In addition, the Standing Committee of the Bern Convention has adopted Recommendation 116 (2005) on the conservation of sturgeon (*Acipenseridae*) in the Danube River Basin, asking Parties to consider drafting and implementing national action plans for the sturgeon species listed in the Appendix to the Recommendation, and to take note, in that context, of the Action Plan for the Conservation of Sturgeons (*Acipenseridae*) in the Danube River Basin.

5.2.2 OSPAR Convention

The OSPAR Strategy on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area, adopted within the framework of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), comprises four elements: ecological quality objectives, protection of species and their habitats; the creation of an ecologically coherent network of well-managed marine protected areas, and programmes to reduce the potential detrimental effects of human activities in the maritime area covered by the Convention.

Acipenser sturio is listed in the OSPAR List of Threatened and/or Declining Species and Habitats as a threatened species, specifically for the OSPAR regions "North Sea and Bay of Biscay."

The Working Group on Marine Protected Areas, Species and Habitats (MASH) is responsible for overseeing the list of threatened and/or declining species and habitats. Germany and France have been leading the development of measures for the protection of *A. sturio*, and put forward a draft monitoring and assessment strategy to MASH in November 2007. France and Germany are currently supporting the following measures:

- *ex-situ* conservation measures to protect the genetic resources/genetic diversity of the last natural population,

- controlled reproduction programmes that take into account genetic aspects,

- release of young specimens into two appropriate hydrologic schemes in order to at least reduce the risks of species extinction,

- effective protection and restoration of recognised or potentially threatened habitats of the species,

- prohibition of the release of non-native sturgeon species;

- improvement of the coordination and cooperation of national sturgeon restoration programmes, integration of sturgeon restoration into other protection and restoration activities (e.g. salmon, eel, habitats, protected areas, etc.);

- monitoring programmes to detect the status of the species and alterations to its habitats;
- education, outreach, and training programmes for fishermen.

5.3 European laws and regulations

All range states for the European sturgeon along the Atlantic coast are members of the European Union, as are relevant Mediterranean countries, such as Spain, France, Italy, Greece, Malta, Cyprus and Slovenia.

The European sturgeon is a species for which the member states of the European Union have a particular responsibility since the range of the species lies to a very large extent within the EU's borders. This is especially true for France as it hosts the only known reproductive population of *A. sturio*. The relevant Community law in this case is Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).

The European sturgeon is listed in the Habitats Directive among the priority animal species of Community interest (Annex II) and its conservation requires the designation of Special Areas of Conservation (SACs). As regards European sturgeon, eleven areas have been designated up to now and six others are in the process of being approved (see Annex 2). The species is also included in the list of animal species of Community interest in need of strict protection (Annex IV).

Article 6 is a key provision of the Habitats Directive, and aims to protect plant and animal species from interference and similar disturbance. It provides that member states must take appropriate steps to avoid the deterioration of natural habitats and of the habitat of priority species, as well as disturbance of those species if such disturbance could be significant in relation to the objectives of the Directive.

The transposition of the Directive and hence this Article into the national legislation of the member states constitutes a strict obligation. Nevertheless, the European Court of Justice has ruled that lack of transposition does not free those states from their obligations derived from this legal instrument.

Over the past decade, the Habitats Directive has been implemented primarily in relation to terrestrial and aquatic habitats. However, the peculiarities of natural marine habitats and marine species or, as in the case of sturgeon, diadromous species, have to be considered. Discussions were conducted within the European Commission to improve the implementation of the NATURA 2000 network of protected areas in the European marine environment, which led to the publication of Commission guidelines in May 2007, including:

- a better interpretation of the definition of some marine habitats,
- establishment of selection guidelines for marine SACs,
- guidance on issues related to the management of such areas.

5.4 National regulations

In Germany, the legal status of the European sturgeon is regulated at national level and at the level of the federal states (*Länder*) in accordance with their respective competences. *Acipenser sturio* has been listed in the IUCN Red List of Threatened Species for Germany since 1976 (Blab and Nowak 1976). It is strictly protected by the Federal Nature Conservation Act as well as the Nature Conservation Acts of the federal states. Fishing of *A. sturio* and in some cases other species of sturgeon is prohibited by the fisheries laws of the federal states. Sales and transfers of *A. sturio* have been prohibited by ministerial decree since June 1976 in accordance with the Washington Convention.

LEGAL ASPECTS

Exemptions are subject to approval being granted by the federal and *Land* agencies responsible for implementing the relevant legislation.

A national programme for the protection and remediation of the species was initiated in 1996. Suitable river habitats for reproduction and early life stages have been identified in the Rivers Elbe, Oste, Stör and Rhine to date. The verification and characterisation of the habitats for juveniles were carried out following the first releases of fish tagged with telemetry transmitters. In accordance with the legal framework for Natura 2000, no sites have been specifically designated under the Habitats Directive for Germany, because of the species' absence from the rivers and its extreme scarcity in German coastal and marine waters.

Also because of its extreme scarcity and unknown status, *Acipenser sturio* has not been proposed as an indicator species under the EU Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy – WFD). The sturgeon was therefore not included in the river basin management plans and programmes of measures published by Germany in December 2009 in accordance with the provisions of the WFD.

6 OBJECTIVES AND MEASURES

6.1 Goals and overall objectives

The Action Plan aims to re-establish self-sustaining populations of *A. sturio* in the German waters forming part of its historic range and thus to prevent it from becoming extinct in Europe through the progressive reconstitution through close national and international cooperation of range states, at all organisational levels. The sequence of actions suggested in this chapter does not represent a priority listing. Many of the issues require simultaneous implementation of several actions.

The Action Plan specifically focusses on the implementation of effective conservation measures for *A. sturio* while simultaneously contributing to global biodiversity conservation and sustainable management of aquatic resources. This is part of the fulfilment of the international agreemen to halt the loss of biodiversity by 2010, as also agreed in Germany's National Strategy on Biological Diversity (BMU 2007) and adopted as a lighthouse project.

It is suggested that this Action Plan will be applied likewise to the work to protect the Baltic sturgeon (*Acipenser oxyrinchus*) in the Baltic Sea region and relevant tributaries.

6.2 Activities and expected results

A range of measures has already been taken for the conservation of the European sturgeon. However, these have so far proven to be only partially successful, so improved efforts are needed to secure the survival of the species.

The mortality from by-catch remains a continuous threat to the remaining and newly released individuals and must be reduced further.

Appropriate, i.e. secure and long-term *ex-situ* measures are an essential prerequisite for the conservation of the species.

Remediation of the metapopulation will require supportive stocking activities including the initiation of restocking in other watersheds than the Gironde. These measures are based upon the respective IUCN guideline fort the reintroduction of fauna and flora (IUCN 1995) as well as the specific guideline for fish species currently under development. Migration routes and habitats for all life cycle stages should be protected and restored in all waters forming part of the historic range, since habitat loss prevents the natural recovery of the populations.

The plan has seven main conservation objectives which may be grouped under four general components. Details of the required measures for each of the actions are listed in Annex 1 under each of the objectives, along with the respective institutions to which actions are mainly addressed. The indicators of success are also listed with the specific milestones to be reached. These components are:

- **Component 1:** *In-situ* conservation of *Acipenser sturio*
- **Component 2:** Protection and restoration of essential sturgeon habitats
- **Component 3:** *Ex-situ* conservation and re-introduction of *Acipenser sturio*
- **Component 4:** International cooperation

The specific planning and implementation of the numerous actions listed below will depend on the outcome of monitoring and current research findings.

The *in-situ* measures are most important in those waters in which repopulation of the European sturgeon already or in the near future are agreed upon to take place. In order to create the conditions required for natural repopulation, these measures should also be implemented in all waters potentially suitable for sturgeon. In practice, this could result in a shift of the priorities listed in Annex I.

The significance of the listed actions and associated milestones may vary from catchment to catchment and the intention, within this framework, is merely to provide an overview of the work priorities. The coordination, elaboration and timescale for the measures and the verification of results remain a matter for the river basin management plans.

The main objectives and associated actions for each of these components are outlined in detail in Annex I, with relevant priorities, measures, target groups, success indicators and milestones, and can be summarised as follows:

6.2.1 Component 1: *In-situ* conservation of *Acipenser sturio*

Objective 1: Significant reduction of fishing mortality

Avoiding losses due to fisheries-related mortality is one of the most important prerequisites to protect the remaining population *in-situ*. For the effective rebuilding of populations, too, reducing mortality is a key factor. A high level of acceptance and support from the fishery sector are crucial to the success of the Action Plan. Measures must include, for example, a programme to reduce accidental catches and *in-situ* monitoring. The experience in France and initial results in Germany clearly demonstrate that this is possible.

Actions

- Intensively involve and provide further training for professional and recreational fisheries to significantly reduce mortality due to accidental catches.
- Raise public awareness about the threat to and protected status of *A. sturio*.
- Enhance cooperation of fishermen and fisheries inspections to increase awareness of the protection status of the species.
- Develop incentives to promote release and accurate reporting.
- Monitor *A. sturio* by-catch and by-catch mortality.
- Develop and introduce selective fisheries techniques, and exclude non-selective clearly adverse fishing techniques in critical habitats of *A. sturio* (spawning sites, juvenile aggregations, nursing grounds).

Objective 2: Effective control of allochthonous species

Invasive non-indigenous species pose a critical threat to biodiversity, a fact of equal importance to the loss of native species. The present rate of increasing reports of exotic sturgeon species (including hybrids) within the native range of *A. sturio* is alarming, as these non-native species may negatively affect the integrity of ecosystems in which the native sturgeon thrives, mainly competing for habitat and food resources.

Actions

- Prevent escapes from fish farms and ponds (especially sturgeon).
- Prevent illegal and accidental introductions of alien species (including sturgeons) into the wild.
- Inform the general public about the risk of introductions focusing on sturgeon.
- Create the prerequisites for the removal of, and the skills to identify, exotic species in accordance with national laws and if necessary adapt national laws in line with existing intergovernmental and international codes and guidelines.

Figure 25: Model of the fish ladder system at Geesthacht Nord, Elbe River

6.2.2 Component 2: Protection and restoration of essential sturgeon habitats

Objective 3: Protecting and improving essential riverine and estuarine sturgeon habitats

Habitats historically utilized by *A. sturio* as spawning and nursery grounds in riverine and coastal waters have deteriorated and information on their status and options for rehabilitation is scanty. There is an urgent need to improve the knowledge base on the subject while also seriously addressing issues concerning habitat fragmentation and needs for interconnections ("ecological footsteps"). There should be a particular focus on maintaining ecological functions such as the continuity of larger river systems, as these constitute the main freshwater ranges.

Actions

- Identify, map and analyse the functionality of present and potential essential *A. sturio* habitats.
- Monitor habitat status and utilisation.
- Protect or restore critical habitat functions.
- Identify and map barriers to sturgeon migration in rivers of the historic distribution area where reintroductions are foreseen.
- Re-open and reconstruct sturgeon migration routes, including construction of suitable fish passes (in existing and future constructions): **(a)** Conduct feasibility studies for fish passage to potential upstream spawning sites; **(b)** Remove or open dams if feasible; **(c)** Monitor the efficiency of, and if necessary improve, fish passes.
- Integrate the identified needs in the setting-up of river basin management plans and programmes of measures under the EU Water Framework Directive.
- Designate and manage protected areas to integrate essential sturgeon habitats into relevant networks including marine habitats of *A. sturio.*
- Adopt the protection and development of *A. sturio* as a goal in appropriate Natura 2000 areas (SACs).

Figure 26: Compensation measure – construction of a side channel connected at mean water level in the Mittelelbe (middle Elbe) region near Magdeburg

Objective 4: Improvement of water quality

Water quality objectives play an important role in habitat restoration and species recovery programmes. Our knowledge on requirements of various life cycle stages of sturgeons in terms of chemical and biological water quality criteria is fragmentary and requires further scientific study.

Actions

- Identify water quality requirements for spawning and nursery habitats and compare threshold values with the pollution found in natural habitats.
- Identify, register and remove sources of pollution which can have a direct impact on water quality of critical sturgeon habitats.
- Integrate the identified needs in the revision of river basin management plans and programmes of measures under the EU Water Framework Directive.

6.2.3 Component 3: : *Ex-situ* conservation and re-introduction of *Acipenser sturio*

Objective 5: *Ex-situ* conservation of *Acipenser sturio*

As outlined above, there seems to be no alternative presently but to pursue ex-situ conservation to save the common European sturgeon from becoming extinct while building up a broodstock sufficiently large for mass reproduction and pursue rearing programmes for release of produced juveniles.
A sequence of actions is required to achieve the objective.

Actions:

- Establish and expand existing broodstock as a founder population for subsequent release.
- Genetic characterisation of all individuals of the broodstock (including gene bank).
- Establish a breeding plan to maximise genetic diversity.

- Improve cultivation methodology to optimise survival rates. Improve growth and prevent diseases specific to fish kept in captivity.
- Optimise diet composition and feeding regimes according to the requirements of life cycle stages.
- Implement appropriate risk management systems to safeguard cultivation.
- Large-scale rearing of juveniles in sufficient quantities and quality for release.
- Establish a sustainable health management system.
- Establish cryopreservation of gametes and/or embryos, accompanied by identification of possible selection effects and verification of the potential for pathogen transfer.
- Develop methods for gamete quality assessment to allow optimal control of the maturation process.

Objective 6: Release of *A. sturio* for population re-establishment or enhancement

The goal is to re-establish self-sustaining populations in as many areas of its natural range as possible.

These releases have to be **(a)** substantial in number because of the high natural mortality, **(b)** long-lasting (for decades) because of the slow growth of the species and its extreme longevity, **(c)** apply the appropriate "time-size-release window" and **(d)** utilize habitats of strategic importance to nursing and imprinting (homing).

Actions:

- Select suitable river basins for restocking and, if appropriate, revitalisation measures.
- Prepare management plans (including designation of responsibilities, e.g. responsible authority, monitoring, surveillance of success), for the re-establishment of populations in those rivers.
- AGuarantee gradual adaptation of reared stocking material for fitness of survival under natural conditions: **(a)** Establish the optimum time-size-release window for juveniles allowing best survival and rates of return, **(b)** Establish appropriate rearing facilities and procedures for rearing of stocking material.
- Develop and apply marking techniques to monitor the success of the release programmes.

Figure 27: River Spree at the Charlottenburg sluice showing a shortened meander stretch and the channelised river bed

6.2.4 Component 4: International cooperation and coordination

Objective 7: International cooperation and coordination

The six conservation objectives above have to be backed up by the establishment of an appropriate cooperation mechanism between all stakeholders, including governmental agencies, research institutions and NGOs in range states actively involved in sturgeon conservation projects and long-term programmes. Therefore, it is proposed to set up a European coordination group specifically to discuss and coordinate the implementation of the Action Plan and relevant national actions. The existing international river basin commissions and national river basin associations can be utilised additionally as platforms for international cooperation and coordination. The River Basin Community Elbe (FGG Elbe) as well as the International Commission for the Protection of the Elbe River (ICPER) and the International Commission for the Protection of the Rhine (ICPR) are particularly important for the Elbe and Rhine respectively.

7 ANALYSIS OF GAPS IN SCIENTIFIC AND PRACTICAL KNOWLEDGE

Although there is a substantial need for further research for the protection and conservation of sturgeon, it can be assumed that the knowledge required for successful species conservation in the case of the European sturgeon (*Acipenser sturio*) is already available. In accordance with the precautionary principle, actions aimed at the protection and conservation of the European sturgeon should not be delayed pending definitive clarification of the remaining scientific questions. Research must continue in support of conservation measures and contribute to their continuous improvement.

Some of the prerequisites are relevant to several of the actions and associated measures. As certain research topics may benefit various actions, they are not listed specifically in the table but are described separately here, together with the associated action, measure or milestone as basic guidance.

Although there are many research priority needs, eight subject areas are highlighted here. Others might gain higher importance in the future as progress in knowledge is made. Therefore, the listing below does not exclude other issues but focusses on subjects pertinent to key actions and their respective objectives and measures.

In-situ protection

- To improve the protection of the species in marine waters, more detailed knowledge on the habitat utilisation and the underlying attractants is required. This knowledge also improves the options for protection measures for essential habitats and the network interconnecting them.

- Effects of climate change may become important in relation to subsequent changes in environmental conditions in different habitats essential for various life cycle stages of *A. sturio* and Action Plan measures should take these into consideration. Some critical issues include:
  - Drastic changes of hydrodynamic regime and timing of spring floods, affecting spawning migration and habitat characteristics.
  - Changes in the temperature regime of the rivers and the effects upon
    - migration time to spawning habitats,
    - residence time in river sections for juveniles, and seaward downstream migration,
    - changes in food availability in space and time, mainly in habitats for juveniles,
    - potential effects on riverine and/or estuarine residence time and size at outmigration to sea, and
    - impacts on survival potential and population structure.

ANALYSIS OF GAPS IN SCIENTIFIC AND PRACTICAL KNOWLEDGE

Figure 28: First release of ***A. sturio*** in the middle Elbe River near Lenzen on 4 September 2008

Ex-situ conservation

- Although the basic physiological functions are known, a serious knowledge gap exists for captive populations with regard to the optimum environmental conditions to induce gonad maturation (e.g. combinations of light-temperature and feeding regimes) while producing high quality gametes.
- During the controlled reproductions of the *ex-situ* population, hatchery techniques optimising the quality of the offspring must be developed.
- The optimum feed compositions matching the requirements of various life cycle stages are largely unknown. This knowledge is urgently needed to improve the quality of parent fish with special reference to overall health status and quality of gametes.
- Genetic studies, with a particular focus on the characteristics of spawners, optimum mating strategy (breeding records etc.), genetic variability (rate of inbreeding, cross-breeding etc.), are required.

Because of the longevity and late maturation of *A. sturio*, such knowledge is critical for restocking programmes based on small numbers in the founder population.

Release of juveniles

- Identify the optimum size of fish for stocking under varying environmental conditions.
- Imprint juveniles to home to their native river.
- Achieve optimal adaptation to the natural habitat and fitness for competitive performance (fitness for best survival after release).
- Optimise rearing costs.
- Improve habitat suitability for release.

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ANNEX I

List of the actions, measures, target groups, success indicators and milestones for a successful re-introduction of *A. sturio*

Column 1 contains a priority which is coded as follows:
A = important in the short term, **B** = attainable in the medium term, **C** = targeted over the long term

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 1: Significant reduction of fishing mortality				
1.1 A	Intensively involve professional and recreational fisheries to significantly reduce mortality due to accidental catches	• Organise a structure to effectively communicate the risk status of ***A. sturio*** (address database, e-mail distribution list of contact persons) • Arrange information campaigns in all fishing communities including recommendations for safe handling • Produce fact sheets and stickers for distribution • Build up personal contacts with the fishermen via local contacts	• Representatives of professional fisheries organisations, fisheries administration, • Individual fishermen as key contacts • Sport and recreational fisheries, anglers, sportfishing clubs at local, regional and national level	**Timescale:** Starting immediately **Success indicators:** Accidental catches are reduced to a negligible level **Milestones:** • The communications database is complete • Regular information is distributed • Knowledge about the status of the species is disseminated in the fishery sector • Catch reports and subsequent releases increase (unreported catches become unlikely) • Sturgeon landings are significantly reduced
1.2 B	Raise public awareness about the status of ***Acipenser sturio*** as a "protected species" and the state of international and community law	• Initiate information campaigns in coastal communities, at schools, at fisheries events and at fish wholesale centres • Produce well-designed fact sheets (brochures) especially for the general public • Organise exhibitions and documentation on the need to protect the species and restore its habitat	• The general public in terms of measures • Local and regional media	**Timescale:** Starting immediately **Success indicators:** The general public, professional and recreational fisheries and the relevant government authorities are well informed about the endangered status of the species and the ongoing activities to save it. **Milestones:** • Good media coverage is achieved over space and time • The general public identifies increasingly with the goals of the campaign • Local activities develop

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 1: Significant reduction of fishing mortality				
1.3 B	Enhance cooperation of fishermen and fisheries inspections to increase awareness of the protection status of the species	• Encourage the stakeholders to exchange conservation campaign goals • Establish a round table for project planning • Involve the fisheries boards and inspections as contacts in order to reach the fishermen	• Professional and recreational fisheries • and their organisations within a network with the fisheries boards	**Timescale:** During stocking measures **Success indicators:** The commercial inland and marine fisheries cooperate with the relevant authorities **Milestones:** • The critical status is universally recognised and the responsibility of the stakeholders is largely known • Interrelationships are established which lead to improved acceptance of control measures • There is a regular exchange of information concerning unresolved issues
1.4 A	Develop incentives to promote active conservation through the release of ***A. sturio*** and encourage accurate reporting	• Develop and distribute report forms • Develop and finance awards for fisheries (premiums and other rewards e.g. baseball caps, knives, mugs, involvement in PR campaigns) • Create incentives (premiums) for reporting accidental catches • Create a trust-based system for registering the reports • Establish an infrastructure for recording catch reports and contacting fishermen	• Fishermen, fisheries inspections, district and municipal administrations, fisheries boards, local members of parliament	**Timescale:** On commencement of and during the stocking measures **Success indicators:** Fishermen participate actively in conservation measures and regard their contribution as a win-win situation **Milestones:** • Measures are accepted and appreciated by the fishermen • Returned report forms contain extensive details

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Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 1: Significant reduction of fishing mortality				
1.5 A	Monitor ***A. sturio*** by-catch and mortality	• Systematically collect catch data from professional and recreational fisheries • Develop sturgeon capture databases at national and international level and ensure that data are exchanged and compared among the range states • Ensure that any dead ***A. sturio*** that are caught are collected for further examination	• Professional fisheries • Recreational fisheries • Fisheries inspection agencies Research institutions (database)	**Timescale:** On commencement of the stocking measures **Success indicators:** The by-catch statistics have improved constantly allowing a better evaluation of the endangered species in the range states **Milestones:** • More reports on by-catch lead to better availability and quality of data • Fisheries inspections do not detect any by-catch beyond the data reported • By-catch data are exchanged between the stakeholders of the range states and the German federal states ***(Länder)*** in the distribution area.

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 1: Significant reduction of fishing mortality				
1.6 B	Develop and introduce selective fishing techniques where these are required for the protection of ***A. sturio*** Exclude non-selective, clearly adverse fishing techniques in critical habitats of ***A. sturio*** (migration corridors, spawning sites, juvenile aggregations, important food habitats) Make use of financial instruments (e.g. the European Fisheries Fund (EFF)) to cushion the socio-economic effects caused by the introduction of ecosystem-compatible fishing equipment	• Undertake a detailed investigation of the fishing techniques associated with sturgeon by-catch (e. g. target species, colour of the net, mesh size, deployment, time of the year) • Seek alternative options for the sustainable fishing of target species (gear modification) • Conduct investigations to determine the effects of gear modifications on selectivity for the target species and the reduction of sturgeon by-catch • Tests on the modified equipment carried out jointly by fisheries and research facilities • Determine the need for compensation in the event that a fishery is less effective in deploying modified equipment, and provision of funds • Review whether temporary or local fishing restrictions using specific equipment are required and possible in critical habitats	• Fisheries administration, fishermen, fisheries research institutions – political/ technical authorities (for legal requirements and compensation payments) • Fisheries inspections • Fishing equipment industry	**Timescale:** Starting immediately or on commencement of the stocking measures **Success indicators:** • Selective fishing equipment is developed and used at the recommended times and sites • The survival rates of primarily juvenile and immature sturgeon improve markedly as a result of various life cycle stages escaping from the different commercial equipment **Milestones:** • The application of equipment (period, type of equipment and area of use) and risk of sturgeon by-catch are known • The utilisation of alternative techniques or the restrictions on use are accepted by fishermen. • The use of alternative equipment does not significantly reduce the target species catch • The agreed equipment modifications are largely backed by the fishery sector • Compensation measures, and the funding of these, are established to compensate reductions in equipment effectiveness and other catch restriction

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 2: Effective prevention and avoidance of the introduction of allochthonous species				
2.1 A	Prevent escapes from fish farms and ponds (especially exotic sturgeon)	• Implement Regulation (EC) No. 708/2007 of 11 June 2007 concerning the use of alien species in aquaculture, and the ICES Code of Conduct • Develop and implement techniques that prevent alien species from escaping: **A) Ponds** • Use effective escape prevention devices (e.g. double outlet grids) in constant operation, and a fail-safe system design for flooding • Prevent fish from being taken by wild animals **B) Land-based systems** • Enforce the use of effective devices to prevent escapes at outlets (e.g. to retain early life cycle stages) **C) Net cages** • Avoid using these to retain sturgeon in open waters • Collect information on potential interactions between exotic species and natural fauna • Develop compulsory mass marking systems that last throughout the lifetime of the fish • Impose and enforce stronger legal consequences	• Scientists • Fish farming industry • Aquaculture facility developers • Management personnel • Water authorities • Fisheries boards	**Timescale:** Starting immediately **Success indicators:** • Regulation (EC) No. 708/2007 of 11 June 2007 is implemented in national law • Exotic species are largely prevented from escaping from fish farms; the risk of environmental changes, the threat of changes to the inventory of species and the potential hybridisation of the sturgeon species are reduced as a result **Milestones:** • Farms use effective measure to reduce the risk of escapes • Mass marking is established for farmed fish allowing the ownership of captured fish to be identified • The use of net cages in open waters to breed exotic species is largely reduced (or prohibited) • There is diminishing evidence of alien sturgeon species and other alien species in the wild

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 2: Effective prevention and avoidance of the introduction of allochthonous species				
2.2 A	Prevent illegal and accidental introductions of alien fish species (including sturgeons) into the wild	• Provide fact sheets, at places where sturgeon are purchased, on the regulations and the potential consequences of releasing alien species (see 2.1) to prevent them from being released into the wild • Ensure the compulsory and individual marking of ornamental and farmed sturgeon species by means of suitable internal/implantable tags that are registered in a central database • Disseminate information to the appropriate media (e.g. magazines) on the ecological risks of releases by the ornamental fish industry • Enforce strict controls on fingerling production through fisheries organisations and relevant authorities to prevent the release of associated exotic species • Support enforcement measures	• Fish farmers • The ornamental fish trade • Aquarists • Angling associations • Relevant authorities • The fishery sector	**Timescale:** Starting immediately **Success indicators:** The international trade in and transport of alien sturgeon species across watersheds are largely reduced **Milestones:** • Information on the risk of releasing alien species is known to interested parties (aquarists, angling clubs) and the general public • Sturgeon-like fish caught in the wild can be identified and their former owners determined • Diminishing release rates of alien fish species are ascertained • Illegal actions are consistently prosecuted whenever they occur (with a declining number of cases over time)

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 1: ***In-situ*** conservation of ***A. sturio***				
Objective 2: Effective prevention and avoidance of the introduction of allochthonous species				
2.3 A	Inform the general public about the risk of allochthonous sturgeon introductions	• Provide the media with information on regulations (see 2.1) to prevent the release of exotic species into the wild • Provide information to the relevant media (e.g. magazines) on the ecological risks of such releases	• General public: Associations (e.g. WSCS, EAS, EAFP, WWF; fisheries associations, Nature and Biodiversity Conservation Union [NABU], Friends of the Earth Germany [BUND]) • The media • Sturgeon farmers/breeders and dealers • Institutions concerned with invasive species (including inter-governmental organisations such as ICES and EIFAC)	**Timescale:** Within the next 5 to 7 years **Success indicators:** The need for conservation, and the need to prevent the negative effects on biodiversity especially on sturgeon species and their habitats, are generally known and accepted, with public awareness being refreshed on an ongoing basis **Milestones:** • The media periodically disseminate information about the risks involved with releasing alien species • A website on the risks of releasing alien species (including sturgeon) is established and linked to producers' and trade websites.
2.4 A	Train fisheries in the skills to accurately identify and specifically remove alien species	• Hold training courses • Provide material to identify such species • Educate and support experts in the identification of the sturgeon species caught	• Fisheries • Fisheries and nature conservation administration • Fisheries scientists • National institutions • Fisheries inspections • Professional fisheries • Associations	**Timescale:** In terms of the removal, immediately, implementation of guidelines and codes: 5 to 10 years **Success indicators:** Regulation (EC) No. 708/2007 of 11 June 2007 governing aquaculture, the ICES and EIFAC codes and the OIE recommendations are applied as far as possible in the range states and the German federal states (***Länder***) in the distribution area. **Milestones:** • Fishermen identify alien sturgeon accurately and remove them in a targeted fashion • Fisheries act under legal protection
B	Promote the further development of national laws in line with existing intergovernmental and international codes and guidelines	• Implement existing guidelines at national level • Harmonise the legal framework for fish farmers/ breeders, both within and outside the EU		

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.1 A	Identify, map and analyse the functionality of present and potential essential ***A. sturio*** habitats	• Identify essential sturgeon habitats and their characteristics • Determine the historic and functional habitat heterogeneity • Identify restrictions in habitat availability and/or human utilisation that have a direct impact on the development of ***A. sturio*** populations	• Environmental authorities at state and federal state (***Land***) level • Water authorities • Water and soil associations • Waterways and Shipping Administrations (WSVs) • River basin management organisations • Associations involved in habitat conservation • Research institutions involved in aquatic sciences and environmental research	**Timescale:** Starting immediately for the next 5 to 10 years **Success indicators:** The occurrence and functionality of areas of relevance to the conservation of ***A. sturio*** are identified and mapped. **Milestones:** • The potential capacity of upstream areas for reproduction is identified • Comprehensive GIS-based databases on habitat quality are produced for local and regional areas as well as for the entire historic range of the species • The maps are available to the various main target organisations of the campaign

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.2 A	Protect or restore critical habitat functions	• Identify and evaluate the influencing factors for maintaining essential habitat functions for ***A. sturio*** • Identify and implement measures to temporarily or permanently limit the utilisation of essential habitats • Identify alternative measures to restore and preserve habitat functionality in areas where changes have occurred as a result of utilisation • Plan, finance and implement renaturation measures • Register the habitats identified as essential under the Natura 2000 network • Establish the functional connectivity of essential habitats (habitat connectivity)	• Research institutions • River basin management organisations • Policy-makers • Environmental/nature conservation authorities • Inspection/supervisory authorities • Water authorities • WSVs • River basin commissions and associations • Environmental offices	**Timescale:** 3 to 5 years after commencement, for a period of 30 years or more **Success indicators:** • Protected areas of relevance to ***A. sturio*** are identified, placed under protection and this protection is enforced • Essential habitats become increasingly available once more through renaturation **Milestones:** • The activities to be recorded, as required by the protected area regulations, are identified and coordinated management is established • Temporary closure plans are established • The monitoring of the areas, including the measures to implement renaturation activities, are coordinated and are either implemented or in the process of being implemented

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.3 A	Identify and map barriers to sturgeon migration in rivers of the historic distribution area where reintroductions are foreseen	• Identify obstacles to migration that directly prevent access to the historic spawning sites • Identify the conditions caused by barriers to migration that limit successful reproduction	• Research institutions • River basin management organisations • Water authorities • WSVs • Environmental and nature conservation authorities (local and national)	**Timescale:** Starting immediately **Success indicators:** All the barriers to migration in historic sturgeon rivers, and their effects on the population, are registered and identified **Milestones:** • The barriers to migration between the river mouth and the proven historic migration sites for ***A. sturio*** (spawning sites) have been identified • Constructions that have a negative impact on migration are identified (although these barriers do not have to have completely blocked the migration routes) • Measures to improve continuity have been identified
3.4 B	Open and reconstruct sturgeon migration routes, including construction of suitable fish passes (in existing and future constructions)	• Establish the criteria for the utilisation of migration aids for the upstream and downstream migration of adult sturgeon • Conduct planning and monitoring activities to determine the sturgeon losses at the constructions	• Policy-makers • Ministries • Water authorities • WSVs • Inspection/supervisory authorities • River basin management organisations • Research institutions • Associations • Environmental offices	**Timescale:** 3 – 5 years after commencement and for a period of >>20 years **Success indicators:** • Measures to improve continuity are identified and agreed. Barriers are removed or can be by-passed by sturgeon • The fish ladder design is workable for sturgeon • Upriver migration takes place (at least in part) • There is evidence of the upstream migration of sturgeon

ANNEX I

List of the actions, measures, target groups, success indicators and milestones for a successful re-introduction of *A. sturio*

Column 1 contains a priority which is coded as follows:
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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.4.1 B	Conduct feasibility studies on the options for fish passage to potential upstream spawning sites and from these sites to the river mouths	• Identify barriers in relevant river systems • Evaluate the influences on migration • Assess the feasibility of the improvement measures proposed	• Research facilities • Nature conservation authorities • Fisheries associations • WSVs • Dam operators (and relevant inspection/supervisory authorities)	**Timescale:** Starting immediately **Success indicators:** Feasibility studies have been completed for most of the places where the function of historic migration routes has been restricted, and detailed solutions have been proposed and tested **Milestones:** • Experimental pilot studies for upstream and downstream passages are under way • The performance data have been collected and analysed
3.4.2 B	Remove or open hydro-dams or modify barriers to migration if feasible	• Develop measures to overcome barriers to migration for adults and juveniles on the basis of feasibility studies. Undertake sturgeon-friendly rehabilitation in the river system (e.g. removing dams, constructing functional by-passes of barriers, installing suitable fish passes, making seasonal modifications to dam management plans during spawning migrations) • Integrate these into the planning measures for implementing the WFD • Incorporate minimum standards for sturgeon fish passes into implementing provisions and recommendations	• Water authorities • Policy-makers • Research institutions • River basin catchment managers • Environmental offices • Appraisers • Environmental authorities	**Timescale:** After submission of feasibility studies, for a period of >> 20 years **Success indicators:** Upstream and downstream sturgeon migrations become possible once more and the influences of transverse structures (hydrodams) are minimised **Milestones:** • The upstream migration of adult sturgeon is recorded • Natural reproduction takes place again in the historic habitat • Juvenile fish can migrate freely • Turbine passage or losses through power plant rakes have fewer negative impacts

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.4.3 C	Monitor the efficiency of fish passes	• Determine the efficiency of migration aids for the upstream migration of sturgeon • Conduct annual evaluations on the number and age structure of the sturgeon migrating through a re-opened section of river • Estimate the number of migrating juvenile fish and the mortality caused by the passage	• Research institutions • Fisheries	**Timescale:** After stocking, for a period of more than 10 years **Success indicators:** Publications and internal reports show an increase in effective migration, and proposals for further improvements are submitted where required **Milestones:** • The increasing establishment of structures that support or facilitate sturgeon migration • Increasing numbers of migrating juvenile ***A. sturio*** fish are detected • Mortality caused by turbines etc. is reduced or non-existent
3.5 C	Monitor habitat status and utilisation	• Conduct annual evaluations of the number, condition and age structure of migrating fish in a specific habitat • Record reproduction success by means of appropriate monitoring • Conduct a separate evaluation of the habitat utilisation of spawning and nesting sites	• Research institutions • Fisheries	**Timescale:** Immediately after commencement (for released fish) for a period of more than 20 years (reference: reproduction success) **Success indicators:** Monitoring programmes are established for population development and dynamics **Milestones:** • Data on the abundance and population structure are collected on a regular basis and are available in a status evaluation database • Sampling programmes to track the larvae and juveniles in upstream habitats are established

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 3: Protecting and improving the quality and continuity of essential riverine and estuarine sturgeon habitats				
3.6 B	Designate and manage protected areas to integrate essential sturgeon habitats into relevant networks including marine habitats of ***A. sturio***	• Identify the requirements to safeguard the foothold function • Outline the changes in habitats to restore connectivity • Adapt the conservation goals for areas under the European Habitats Directive and enhance the standard data forms • Designate protected areas according to ***Land*** conservation laws if required • Conclude voluntary contractual agreements with riparian owners and authorised fisheries • Change the quality of the habitat in line with the requirements	• Ministries • Nature conservation authorities • River basin management organisations • Policy-makers • Research institutions • River basin management organisations • Associations	**Timescale:** After 3 to 5 years at the earliest and for a period of more than 20 years if required **Success indicators:** Essential habitats have been identified and registered under Natura 2000 or within the framework of the OSPAR Convention **Milestones:** • The effectiveness of existing habitats is known • Improvement measures have been implemented • The connectivity meets the requirements • Essential habitats are protected and restored • Habitat connectivity permits adequate population sizes
3.7 B	Integrate the identified needs of ***A. sturio*** in terms of habitat quality – as far as possible – in the setting-up of management plans and programmes of measures under the EU Water Framework Directive	• Cooperate with the water resources management authorities of the river basin, considering the importance of controlling the detrimental effects on ***A. sturio*** that have been identified • Establish criteria for fulfilling good ecological status for sturgeon development in the area concerned • Incorporate the criteria into the WFD programme of measures and management plans (from 2015)	• Water resources management authorities • Relevant authorities • Inspection/supervisory authorities • Environmental offices	**Timescale:** Dependent on the timescale for implementing the European WFD **Success indicators:** Habitat requirements are taken into account in management plans and programmes of measures **Milestones:** • Habitat requirements are known to the responsible water authorities • Habitat requirements are recognised as being part of good ecological status and are taken into account

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 2: Protection and restoration of essential sturgeon habitats				
Objective 4: Improvement of water quality				
4.1 A	Identify water quality requirements for spawning and nursery habitats of ***A. sturio***	• Conduct literature searches and specific research to determine the water quality requirements, identify critical substances, and monitor the effect of the relevant toxic and endocrine-disrupting compounds that occur	• Research institutions • River basin management organisations • Water authorities • Associations	**Timescale:** Starting immediately **Success indicators:** • Critical water quality parameters are identified • Damage thresholds for particularly harmful compounds are established
4.2 A	Identify, register and remove sources of pollution which can have a direct impact on water quality of critical sturgeon habitats	• Use data from water management bodies to identify potentially harmful sources of contamination • Prepare a GIS-based map to collect information on the sources of pollution • Implement measures to progressively remove harmful inputs	• Water authorities • Inspection/supervisory authorities • Research institutions • Polluters • Environmental offices	**Timescale:** Starting immediately **Success indicators:** The types of pollution that endanger sturgeon habitats are known and the sources of pollution are progressively removed **Milestones:** • Potential sources of contamination are known and localised • The level of knowledge about the quality and quantities of pollution sources has improved • Plans and activities are in place to remove the sources of pollution
4.3 B	Integrate the needs of ***A. sturio***, in terms of water quality, into the management plans and programmes of measures under the EU Water Framework Directive	• Cooperate with the water authorities of the river basins, considering the importance of controlling the detrimental effects that have been identified • Establish criteria for fulfilling good ecological status, taking account of the obstacles to sturgeon development in the area concerned • Incorporate the criteria into the WFD programme of measures and management plans	• Water authorities • Policy-makers • Relevant authorities • Environmental offices	**Timescale:** Dependent on the timescale for implementing the European WFD

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: *Ex-situ* conservation and re-introduction of *A. sturio*				
Objective 5: *Ex-situ* conservation of *A. sturio*				
5.1 A	Establish and expand existing ***A. sturio*** broodstock as a founder population	• Co-ordinate the objectives with France • Preserve the existing broodstock using the best available technology • Risk management • Spread the rearing risk over various operational facilities that are independent from one another • Develop strategies to minimise the genetic effects associated with rearing (produce and maintain a rearing plan) • Incorporate – after a period of quarantine – additional individuals from the wild populations into the broodstock	• Research institutions • Fish breeders (especially experts in sturgeon rearing and broodstock management) • Research institutions concerned with genetics	**Timescale:** Starting immediately **Success indicators:** The broodstock is established at various sites in confinements with secure and safe rearing conditions that are suitable for establishing ***A. sturio*** populations **Milestones:** • The number of captive rearing facilities rises in the next 5 to 8 years • The number of effective broodstocks rises in the next 5 to 10 years • The number of effective breeders per broodstock rises to the level required for safe and regular reproduction • Sound health monitoring is guaranteed • The genetic diversity within the broodstock is maintained or improved by the addition of captured specimens
5.1.1 C	Establish a suitable health monitoring system and therapy techniques	• Identify potential pathogens • Determine the environments in which outbreaks of disease occur • Develop preventive measures and therapies	• Fisheries and veterinary research • Fisheries and vetinerary authorities • Fish breeders	**Timescale:** 5 years **Success indicators:** • Outbreaks of disease are rare • Interventions occur immediately and are effective • No mass losses
5.1.2 A	Develop methods for gamete quality assessment to allow optimal control of the maturation process	• Develop standardised quality assessment protocols using various types of bio-tests	• Research institutions • ***Ex-situ*** conservation facilities	**Timescale:** 5 to 10 years **Success indicators:** • Special bio-test procedures (guidelines) have been set up and are being applied • The maturation process is optimised

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: *Ex-situ* conservation and re-introduction of *A. sturio*				
Objective 5: *Ex-situ* conservation of *A. sturio*				
5.2 A	Ensure the characterisation of all individuals of the broodstock	• Introduce the individual marking of the entire broodstock to (a) identify the individual and (b) enable the fate of the fish and their offspring to be tracked • Conduct comprehensive genetic characterisation on the basis of mt DNA and microsatellites and thus draw up the characteristics and degree of relatedness of the individual specimens	• Institutions with ***ex-situ*** populations • Research institutions (including international experts from the range states in the case of special issues)	**Timescale:** Starting immediately and in the next 3 – 5 years, and ongoing **Success indicators:** An individual record (as used for breeding lines in animal rearing programmes) is registered in a central database (includes registering the characteristics and documenting the captive rearing process of the ***ex-situ*** populations) **Milestones:** • The broodstock is genetically characterised • Individual protocols are standardised for all captive broodstock facilities in the range states
5.2.1 B	Establish cryopreservation of sturgeon sperm	• Improve the cryopreservation techniques for storage without dysfunctional effects • The physiological and resulting genetic effects of cryopreservation are known • The impacts of using cryopreserved sperm are not selective	• Research institutions and universities • International gene banks	**Timescale:** Starting immediately **Success indicators:** • Cryopreservation techniques and gamete banks for the protection of genetic diversity are established • Cryopreserved sperm is available for selected farmed fish
5.2.2 C	Establish cryopreservation of ***A. sturio*** gametes (oocytes, eggs and/or embryos)	• As in 5.3.1 but with the focus placed on oocytes and mature eggs	• Research institutions	**Timescale:** 5 to 10 years, depending on capacity **Success indicators:** The survival of cryopreserved oocytes is ensured

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: *Ex-situ* conservation and re-introduction of *A. sturio*				
Objective 5: *Ex-situ* conservation of *A. sturio*				
5.3 A	Establish a breeding plan for ***A. sturio*** to maximise effective population size and genetic diversity	• Determine the current and historic genetic population structure • Understand the effects of genetic heterogeneity in a sturgeon population • Assess the potential for genetic management • Develop a breeding plan with the aim of stabilising and preserving the genetic heterogeneity of ***A. sturio***	• Research institutions specialising in population genetics, sturgeon farms	**Timescale:** Starting immediately **Success indicators:** A breeding plan is established. **Milestones:** • Studies on the population genetics in captive broodstock facilities (including historical samples) are either in progress or complete • Fingerling production from a genetically defined and selected broodstock is under way and guarantees offspring with a high genetic diversity • A general framework for breeding plans is established
5.4 A	Guarentee continuous improvement of cultivation methodology	• Determine the best captivity conditions to adapt and rear animals caught in the wild (ponds, artificial watercourses, soil quality, vegetation, diet etc.) • Determine the best regime for captive rearing (diet, temperature, water quality criteria, flow quantities, flow velocities, type of pool, size of pool etc.)	• Research institutions • Fish breeders	**Timescale:** Starting immediately **Success indicators:** The guidelines for preserving and rearing broodstock to improve the performance of the ***ex-situ*** conservation facilities are complete and proving to be very successful **Milestones:** • There is evidence of improvements in the health status and physiological performance of the broodstock • The well-being of the captive fish can be measured • The survival and well-being of the reared specimens in all life cycle stages has improved

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: *Ex-situ* conservation and re-introduction of *A. sturio*				
Objective 5: *Ex-situ* conservation of *A. sturio*				
5.5 A	Optimise diet composition and feeding regimes according to the requirements of life cycle stages	• Determine the diet requirements of the different life cycle stages • Test different natural diets to compile a list of feed preferences • Test different fresh and industrial feed	• Research institutions • Sturgeon breeders • Fish food producers	**Timescale:** Starting immediately **Success indicators:** The efficiency of broodstock productivity and juvenile fish production is improved **Milestones:** • The feed for farmed fish is optimised for the life cycle stage concerned • The survival of critical life cycle stages is improved • Growth and feed utilisation are improved
5.6 B	Implement appropriate risk management systems to safeguard rearing	• Implement testing procedures for risk assessment with the aim of reducing risks associated with the design and operation of the system	• Engineering associations concerned with risks and norms (technical standards) • Aquaculture • Fisheries research • Equipment suppliers • Veterinary authorities	**Timescale:** Starting immediately **Success indicators:** Risk management strategies have been developed and are being applied fully **Milestones:** • Operating records show no serious errors in the technology used • No fish losses as a result of accidents • System errors are rare and are rectified by suitable error protection mechanisms that prevent any negative effects on the fish populations
5.7 B	Develop the principles for high-quality, large-scale rearing for release	• The optimum module to ensure the occurrence of fingerlings at the suitable habitats is complete • Develop and adapt the criteria and tests to determine the fitness of fish for release	• Research institutions • Sturgeon farms • Aquaculture facility developers	**Timescale:** 3 to 5 years after commencement for a period of more than 10 years **Success indicators:** Stocking facilities are up and running and successful

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: ***Ex-situ*** conservation and re-introduction of ***A. sturio***				
Objective 6: Release of ***A. sturio*** for population re-establishment or enhancement				
6.1 A	Select suitable river basins for the release of ***A. sturio*** and for revitalisation measures where required	• Develop a strategic plan for release sites in line with the availability of sturgeon habitats for early life cycle stages	• BMU, BfN • Relevant authorities at ***Land*** level • Research institutions	**Timescale:** Immediately for the selection of river basins, distribution plan after 3 to 5 years **Success indicators:** • Suitable river basins have been selected in a limited number of river basins within the federal states (***Länder***) in the range • These are reviewed periodically and ranked according to their ecological, technical, social and political feasibility **Milestones:** • Special release plans have been set up and coordinated among the participating federal states (***Länder***) in the range

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: ***Ex-situ*** conservation and re-introduction of ***A. sturio***				
Objective 6: Release of ***A. sturio*** for population re-establishment or enhancement				
6.2 B	Prepare management plans (including responsibility, monitoring, surveillance of success), for the re-establishment of ***A. sturio*** populations in the selected rivers	• Approve the planning and implementation of measures to rehabilitate bodies of water • Improve the infrastructure for the release • Prepare a practical release plan in accordance with quality and quantity criteria • Establish a harmonised monitoring system	• The Action Plan Coordination Committee • Research institutions • Specific experts • Relevant authorities • Fisheries research institutions	**Timescale:** 3 years from project commencement for a period of up to 15 – 25 years **Success indicators:** The protection measures for ***A. sturio*** have gradual and lasting positive effects on the recovery of the population in certain parts of the historic range **Milestones:** • The level of ***ex-situ*** reproduction permits the release of growing numbers of juveniles • Suitable habitats for cultivation and acclimatisation are available in all release testing facilities • The habitats are assessed by means of monitoring programmes

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Component 3: ***Ex-situ*** conservation and re-introduction of ***A. sturio***				
Objective 6: Release of ***A. sturio*** for population re-establishment or enhancement				
6.3 **C**	Guarantee the fitness for survival of stocking material through gradual adaptation to natural conditions Establish appropriate rearing capacities and processes for rearing of stocking material	• Develop strategic methods to prepare juveniles reared in protected cultivation facilities for the actual and competitive conditions in the natural environment (e.g. the ability to avoid predators) • Prepare and/or modify rearing facilities in which fish to be released can be adapted to the local environmental conditions at the release site (e.g. water quality, adaptation to natural food, pathogens)	• Research institutions	**Timescale:** On commencement of the stocking activities **Success indicators:** • Suitable capacities for acclimatising and releasing ***A. sturio*** are established and operational • Good handling and practical routines ensure that the objectives of the Action Plan are being achieved • The survival of recaptured specimens is demonstrated by several recaptures over the years • The gradual recovery of the sturgeon populations can be demonstrated by the good survival rates of released fish up to maturity • The natural spawning of released sturgeon is observed **Milestones:** • Improvements in the rearing practice are incorporated into the system design • The survival rates of ***A. sturio*** improve with each new release activity • The optimum size of juveniles for release is determined for specific release sites • Reports on the capture of released ***A. sturio*** by fisheries operations increase

No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 3: ***Ex-situ*** conservation and re-introduction of ***A. sturio***				
Objective 6: Release of ***A. sturio*** for population re-establishment or enhancement				
6.4 **A – B**	Establish the optimum size and time to release juvenile ***A. sturio*** to ensure the best chances and rates of survival Set up a distribution plan for restocking material to selected river basins in Germany	• Analyse the local (region-specific) hydrologic conditions • Analyse the local, usable benthos and plankton productivity (key elements of the food web) as a basis for determining the carrying capacity	• Local research institutions • Specific experts • Participants of national and international research and implementation programmes of the AP	**Timescale:** 5 – 10 years **Success indicators:** The survival and return rates increase continuously in the course of implementation **Milestones:** • The ecological status of the release habitats is known and the suitability status for restocking purposes have been assessed • The continuous monitoring of survival by means of cost-effective mass marking techniques has been achieved • The improved survival of the released species according to documentation from suitable monitoring programmes (marking and recapture)
6.5 **B**	Develop and apply marking and monitoring techniques to monitor the success of the release programmes	• Establish marking protocols for chemical and external tags • Develop techniques for large-scale marking to accurately determine age • Marking and detection equipment available • Install telemetry receivers • Monitor behaviour and distribution • Communicate the results to local fisheries and relevant authorities	• Fisheries research institutions • Specific experts • Relevant authorities • Participants of national and international research and implementation programmes of the AP	**Timescale:** Continuity on commencement of the restocking operation **Success indicators:** • Recapture rates of released specimens increase and the collection of telemetry data is successful • The identification of survival and growth rates is possible at population level **Milestones:** • Monitoring programs are established and secured • The review of marking techniques is complete and marking protocols are produced on a continuous basis

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No.	Actions	Measures required	Main target groups for actions	Timescales, indicators and milestones
Component 4: International cooperation and coordination				
Objective 7: The six conservation objectives above must be complemented by the establishment of appropriate cooperation mechanisms				
7 **A**	As a main cooperation mechanism, a European coordination group should be established, comprising experts from the range states, to specifically discuss and coordinate individual or jointly financed projects for the implementation of the Action Plan. BMU/BfN will coordinate the national activities	• Identify suitable experts for a joint platform to coordinate the re-population efforts in the range • Produce and coordinate a meeting and planning schedule • Collect regular information on planned, ongoing and completed national and regional projects in relation to the AP, and identify any gaps in science and technology that need to be filled to fully implement the AP	• National nature conservation organisations (with a long-term commitment to species protection) • Associations such as WSCS and GRS as moderators and/or platforms for meetings • Nature conservation authorities at ***Länder*** level • BMU/BfN • EU member states	**Timescale:** Starting immediately to run continuously **Success indicators:** • A cooperation committee is founded (with a flexible membership that changes in accordance with the ongoing or planned projects) • The schedule of work is established and the meetings are held when required • Communication is established on a regular basis • Minutes of meetings and project reports are produced which are available upon request

ANNEX II

Particularly suitable habitats in Germany with potential significance for *A. sturio*

Name of site	Area (ha)	Site		Comments (Natura 2000 ref. no.)
		Atlantic	Continental	
Untereider, Schleswig-Holstein	3,606.00	x		DE-1719-391
Mittlere Stör, Bramau und Bünzau, Schleswig-Holstein	211.00	x		DE-2024-391
Osteschleifen zwischen Kranenburg und Nieder-Ochtenhausen, Niedersachsen	49.00	x		DE-2320-332
Oste mit Nebenbächen	3,720.00	x		DE-2520-331
Unterelbe, Niedersachsen	18,680.00	x		DE-2018-331
Rapfenschutzgebiet Hamburger Stromelbe, Hamburg	340.00	x		DE-2424-303
Mühlenberger Loch/Neßsand	804.00	x		DE-2424-302
Hamburger Unterelbe	707.00	x		DE-2526-305
Elbe zwischen Geesthacht und Hamburg, Niedersachsen	573.00	x		DE-2526-332
Elbeniederung zwischen Schnackenburg und Geesthacht, Niedersachsen	22,654.00		x	DE-2528-331
Elbe mit Hohem Elbufer von Tesperhude bis Lauenburg mit angr. Fl., Schleswig-Holstein	734.00		x	DE-2628-392
Elbaue zwischen Saalemündung und Magdeburg	5,446.00		x	DE-3936-301
Elbaue Beuster-Wahrenberg	2,903.00		x	DE-3036-301
Elbaue Werben und Alte Elbe Kannenberg	1,983.00		x	DE-3138-301
Elbaue zwischen Sandau und Schönhausen	2,307.00		x	DE-3238-302
Aland-Elbe-Niederung nördlich Seehausen	2,573.00		x	DE-2935-301
Mulde unterhalb Muldestausee			x	DE-4239-302
Elbaue zwischen Derben und Schönhausen	4,371.00		x	DE-3437-302
Elbaue bei Bertingen	2,477.00		x	DE-3637-301
Elbaue südlich Rogätz mit Ohremündung	1,607.00		x	DE-3736-301
Elbaue zwischen Griebo und Prettin	7,840.00		x	DE-4142-301
Schwarze Elster			x	DE-4143-301
Elbaue Steckby-Lödderitz	3,050.00		x	DE-4037-302
Kühnauer Heide und Elbaue zwischen Aken und Dessau	3,573.00		x	DE-4138-301
Dessau-Wörlitzer Elbauen	7,400.00		x	DE-4140-304
Stromelbe im Stadtzentrum Magdeburg, Sachsen-Anhalt	64.00		x	DE-3835-301
Elbe, Brandenburg	1,322.00		x	DE-2935-306

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Name of site	Area (ha)	Site		Comments (Natura 2000 ref. no.)
		Atlantic	Continental	
Rhein-Fischschutzzonen zwischen Emmerich und Bad Honnef Nordrhein-Westfalen	2,336.00	x		DE-4405-301
Ahrtal			x	DE-5408-301
Mittelrhein (insbesondere bei Spey, Oberwerth sowie bei Niederwerth			x	DE-5510-301
Mosel (Unterlauf)			x	DE-5908-301
Helgoland mit Helgoländer Felssockel, Schleswig-Holstein	5,509.00	x		DE-1813-391
Doggerbank (Mittlere Nordsee)	169,895.00	x		DE-1003-301
Östliche Deutsche Bucht	313,512.76	x		DE-1011-401
Sylter Außenriff	513,428.39	x		DE-1209-301
Borkum-Riffgrund	62,548.00	x		DE-2104-301

ANNEX III

Regulations with less or indirect relevance to the protection of *A. sturio* and its habitats

1. Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat was adopted in 1971. The 6th Conference of the Parties to the Ramsar Convention (COP6), held in 1996, adopted Resolution VI-2 adding two specific criteria, based on fish, for identifying wetlands of international importance (criteria 7 and 8). In addition, the Convention requires Parties to consult with each other about the implementation of their obligations, in particular when a wetland or water system is shared between them. In this case, they must endeavour to coordinate and support present and future policies and regulations on the conservation of wetlands and their flora and fauna (Article 5).

Paragraphs 30 and 34 of Resolution IX-4 adopted by COP9 in November 2005 urge Parties to take the necessary measures, within their frameworks for integrated river basin and coastal zone management, to:

- Maintain or reinstate aquatic biota migration pathways,
- Reduce the impacts of point source and diffuse pollution in all its forms, and
- Protect critical spawning and nursery grounds.

In addition, this Resolution strongly urged Parties to:

- Review their policies, laws and programmes for regulating the introduction of aquatic biota for aquaculture and the aquarium industry,
- Control the accidental movement of species, and
- Avoid introduction of invasive and/or alien species.

It should be noted that many of the habitats protected under the Ramsar Convention also include coastal habitats of the littoral zone, an area where most of the juveniles and adults of sturgeons thrive. In this context, the Ramsar Declaration on Global Sturgeon Conservation (May 2005) is mentioned here as it builds on elements relevant to the Ramsar Convention (Rosenthal *et al* 2006).

2. Convention on Biological Diversity

The 193 Parties to the Convention on Biological Diversity (CBD), adopted in 1992, are obliged to conserve biological diversity, use its components sustainably, and regulate access to genetic resources. Parties must adapt or develop national strategies, plans or programmes for the conservation and sustainable use of biodiversity. Germany has adopted the repopulation of the European sturgeon as a lighthouse project in its National Strategy on Biological Diversity.
A national restoration plan needs to be developed and implemented, in line with obligations under other international conventions.

CBD Parties must also integrate the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans and policies. This provision of Article 6 is of direct relevance to this Action Plan, as it implies that biodiversity concerns, such as the conservation of European sturgeon, need to be integrated into the fisheries policies of range states.

Article 8 of the CBD includes provisions for *in-situ* conservation of biological diversity. Relevant obligations for Parties, as set out in this Article, are:

- to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, including through the development and implementation of plans or other management strategies (Article 8[f]);
- to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species (Article 8[h]);
- to develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations (Article 8[k]).

Article 9 of the CBD is also relevant for this Action Plan, as it includes the following obligations for Parties in the field of *ex-situ* conservation and "predominantly for the purpose of complementing *in-situ* measures":

- adopt measures for the *ex-situ* conservation of components of biological diversity, preferably in the country of origin of such components;

- establish and maintain facilities for *ex-situ* conservation of and research on plants, animals and microorganisms, preferably in the country of origin,

- adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions.

3. United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea (UNCLOS) entered into force in 1994, and lays down the fundamental obligation of all states to protect and preserve the marine environment, including the need to prevent, reduce and control pollution of the marine environment from land-based sources.

It is important to note that UNCLOS extended the sovereignty of coastal states to an adjacent belt of sea, described as the territorial sea, to a limit not exceeding 12 nautical miles. The Convention also granted coastal states sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources of their Exclusive Economic Zone (EEZ), as well as jurisdiction for the protection and preservation of the marine environment of their EEZ.

UNCLOS urges all states to cooperate at the global and regional level to formulate rules and standards for marine protection, which has been taken up by a number of organisations, including IMO, UNEP and the FAO (see below).

Obligations under UNCLOS which are relevant in the context of this Action Plan include the need to take all measures necessary to prevent, reduce and control pollution of the marine environment, including from the intentional or accidental introduction of alien or new species (Article 196). Furthermore, this Convention states that specific obligations assumed by Parties under other specialised conventions regarding the protection and preservation of the marine environment need to be carried out in a manner consistent with the general principles and objectives of UNCLOS (Article 237).

Further developing UNCLOS, the Agreement for the Implementation of the Provisions of UNCLOS relating to the Conservation and Management of Straddling Fish Populations and Highly Migratory Fish Populations was adopted, although it only entered into force in 2001. This Agreement introduces a number of innovative measures, particularly in the area of environmental and resource protection, as it obliges Parties to adopt a precautionary approach to fisheries exploitation and gives expanded powers to port states to enforce the adequate management of fisheries resources.

4. Food and Agriculture Organization of the United Nations

The necessity to combat the degradation and depletion of fish populations, both in the zones under national jurisdiction and in the high seas, as well as its causes, such as overfishing and excess fishing capacity, by-catch and discards, has been tackled by the FAO through the 1995 Code of Conduct for Responsible Fisheries. The Code provides a framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment. The FAO Committee on Fisheries (COFI) is charged with monitoring and updating the Code. A set of technical guidelines have been produced by the FAO in support of the implementation of the Code.

In the context of the Code of Conduct for Responsible Fisheries and its overall objective of sustainable fisheries, the issue of illegal, unreported and unregulated (IUU) fishing is of serious and increasing concern, as it undermines efforts to conserve and manage fish populations. The International Plan of Action to Pre-

vent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing was adopted in 2001 and, like the Code of Conduct, has a non-legally binding nature.

Another tool developed within the framework of the Code of Conduct is the 2003 Strategy for Improving Information on Status and Trends of Capture Fisheries. The Strategy is a voluntary instrument whose overall objective is to provide a framework and plan for the improvement of knowledge and understanding of fishery status and trends as a basis for policy-making and management for the conservation and sustainable use of fishery resources within ecosystems.

In 1999 the FAO published its Strategic Framework for 2000 – 2015, including objectives supporting the conservation, improvement and sustainable use of natural resources for food and agriculture such as fisheries.

5. The EU's Common Fisheries Policy

The European Union's Common Fisheries Policy (CFP) allows the exploitation of living aquatic resources that ensures the sustainability of economic, environmental and social conditions, taking into account the impact of fishing activities on the environment. For this purpose, the Community must apply the precautionary approach in taking measures designed to protect and conserve living aquatic resources, to provide for their sustainable exploitation and to minimise the impact of fishing activities on marine ecosystems (and non-target species) (Chapter I, Article 2 and Chapter II, Article 4, item (g), indent (iv) of Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy).

The Common Fisheries Policy allows the exploitation of living aquatic resources, including anadromous and catadromous species during their marine life, providing that the precautionary approach to fisheries management is followed strictly, taking sound management measures to conserve target species, associated or dependent species, as well as non-target species. Sturgeons should not be neglected in these considerations and management measures.

6. Council Regulation concerning alien and locally absent species

In June 2007, the Council of the European Union adopted Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture. This regulation aims to better control the introduction of non-native species in aquaculture in order to prevent negative impacts on native species and ecosystems. This regulation builds on the voluntary codes of practice developed over the past decades by intergovernmental organisations such as ICES (International Council for the Exploration of the Sea), EIFAC (European Inland Fisheries Advisory Commission of FAO) and IOE (World Organisation for Animal Health).

7. European Commission Communication on Biodiversity 2010 and beyond

According to the Communication of the European Commission entitled "Halting the loss of biodiversity by 2010 and beyond", adopted in May 2006, the reformed Common Fisheries Policy, when fully implemented, will reduce fishing pressure, improve the status of harvested populations and better protect non-target species and habitats. The European Union also plans to develop a strategy to address alien invasive species.

8. European Water Framework Directive

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive) requires that all ground and surface waters should be of good status by 2015. To achieve good status, it requires in particular the adoption and implementation of management plans and programmes of measures for

ANNEX III

Regulations with less or indirect relevance to the protection of *A. sturio* and its habitats

each river basin (rivers with their tributaries, including transitional and coastal waters and ground water belonging to the catchment) nationally and internationally. For the 10 river basins relevant to Germany, these plans and programmes were completed by the end of 2009 and published on 22 December 2009. They must be revised every six years. To date, the sturgeon has not played a role in the implementation of the WFD in Germany.

Annex V of the WFD lists the quality elements (Annex V, No. 1.1) and the normative definitions of ecological status classifications (Annex V, No. 1.2) for surface waters, which include the composition, abundance and, in part, the age structure of fish fauna. The normative definitions contained in Annex V, No. 1.2.1 define good ecological status (GES) in respect of fish fauna in rivers as meaning "only slight changes in species composition and abundance from type-specific reference condition communities" due to anthropogenic influences on the physical-chemical and hydromorphological quality components; the age structures of the fish communities may show some signs of disruption due to anthropogenic influences on the physical-chemical and hydromorphological quality components and in a few cases point to disruption of reproduction or development of a specific species such that some age classes may be absent. The WFD has clear cross-linkages with nature conservation and species protection. It also requires the maintenance of good status of water bodies in water-dependent protected areas (Article 4 [1 c]), Article 6, Annex IV WFD). The Habitats and Birds Directives are also relevant to the programmes of measures (Article 11[3 a]), Annex VI, A ii) and x)).

ANNEX IV List of Abbreviations

CBD	Convention on Biological Diversity
CFP	Common Fisheries Policy
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
COFI	Committee on Fisheries
EEZ	Exclusive Econonomic Zone
EIFAC	European Inland Fisheries Advisory Commission
FAO	Food and Agriculture Organization of the United Nations
FFH	Fauna-Flora-Habitat
GRS	Gesellschaft zur Rettung des Störs e.V.
ICES	International Council for the Exploration of the Sea
ICPER	International Commission for the Protection of the Elbe River
IMO	International Maritime Organization
IUU	Illegal, Unregulated and Unreported Fishing
MASH	Working Group on Marine Protected Areas, Species and Habitats
OIE	World Organisation for Animal Health
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
SAC	Special Area of Conservation
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
WFD	Water Framework Directive
WSCS	World Sturgeon Conservation Society

NOTES

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