



Background Document for the Common sturgeon -
Acipenser sturio



OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

Acknowledgement

This report has been prepared by the Coastal and Marine Nature Conservation Unit of the German Federal Agency for Nature Conservation (BfN) with input from the French Public agricultural and environmental research institute (Cemagref) and the French National Fisheries Committee (CNPMEM).

Photo acknowledgement:

Cover page: "Sturio 2009": Didier Taillefer - SMEAG (a sturgeon from the 2007 reintroduction programme released in the Gironde estuary in 2009)

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OSPAR Background Document for the Common sturgeon - *Acipenser sturio*

Executive Summary

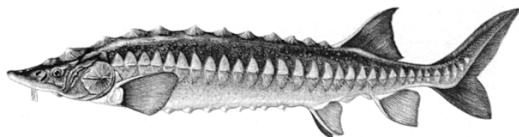
This Background Document for common sturgeon - *Acipenser sturio* - has been developed by OSPAR following the inclusion of this species on the OSPAR List of threatened and/or declining species and habitats (OSPAR Agreement 2008-6). The document provides a compilation of the reviews and assessments that have been prepared concerning this species since the agreement to include it in the OSPAR List in 2003. The original evaluation used to justify the inclusion of *Acipenser sturio* in the OSPAR List is followed by an assessment of the most recent information on its status (distribution, population, condition) and key threats prepared during 2009-2010. Chapter 7 provides proposals for the actions and measures that could be taken to improve the conservation status of the species. In agreeing to the publication of this document, Contracting Parties have indicated the need to further review these proposals. Publication of this background document does not, therefore, imply any formal endorsement of these proposals by the OSPAR Commission. On the basis of the further review of these proposals, OSPAR will continue its work to ensure the protection of *Acipenser sturio*, where necessary in cooperation with other competent organisations. This background document may be updated to reflect further developments or further information on the status of the species which becomes available.

Récapitulatif

Le présent document de fond sur l'*Esturgeon d'Europe* a été élaboré par OSPAR à la suite de l'inclusion de cette espèce dans la liste OSPAR des espèces et habitats menacés et/ou en déclin (Accord OSPAR 2008-6). Ce document comporte une compilation des revues et des évaluations concernant cette espèce qui ont été préparées depuis qu'il a été convenu de l'inclure dans la Liste OSPAR en 2003. L'évaluation d'origine permettant de justifier l'inclusion de l'*Esturgeon d'Europe* dans la Liste OSPAR est suivie d'une évaluation des informations les plus récentes sur son statut (distribution, population, condition) et des menaces clés, préparée en 2009-2010. Le chapitre 7 fournit des propositions d'actions et de mesures qui pourraient être prises afin d'améliorer l'état de conservation de l'espèce. En se mettant d'accord sur la publication de ce document, les Parties contractantes ont indiqué la nécessité de réviser de nouveau ces propositions. La publication de ce document ne signifie pas, par conséquent que la Commission OSPAR entérine ces propositions de manière formelle. A partir de la nouvelle révision de ces propositions, OSPAR poursuivra ses travaux afin de s'assurer de la protection de l'*Esturgeon d'Europe*, le cas échéant avec la coopération d'autres organisations compétentes. Ce document de fond pourra être actualisé pour tenir compte de nouvelles avancées ou de nouvelles informations qui deviendront disponibles sur l'état de l'espèce.

1. Background Information

Acipenser sturio (Linnaeus, 1758); common sturgeon, also known as European sturgeon



A.sturio is a migratory species reproducing in fresh water and then moving into the sea until ready to spawn again. It is a long-lived and slow-growing species, feeding on crustaceans, molluscs, polychaete worms and small fishes. It has a long life cycle reaching maturity at an age of 8 - 14 years according to sex and climatic conditions. This sturgeon can grow to a total length of 500 cm (Muus, 1999) and reach 400 kg in weight (Muus and Dahlstroem, 1968), and possibly lives to 100 years.

A.sturio was originally exploited for its flesh and, more recently, for caviar. In the early 1900s, annual fish catches were of the order of 10 000 in Western Europe (van Winden *et al.*, 1999). In the Gironde estuary, there was a fishery for caviar from the 1920s but the population decreased dramatically following 1970 and is now closed. The species has been totally protected in France from 1982 onwards (Trouverey *et al.*, 1984). In spite of this status, the species has been declining (Williot *et al.*, 1997; 2002a). Future trends are currently very unclear, with this species facing a high risk of extinction.

2. Original Evaluation against the Texel-Faial Selection Criteria

OSPAR Regions and Dinter Biogeographic Provinces where the species occurs

OSPAR Regions: II, IV,

A. sturio have been known to occur in south-western UK waters (Region III) and in Region I, which are not specifically mentioned in the OSPAR List.

Dinter Biogeographic Provinces: Boreal

OSPAR Regions and Dinter Biogeographic Provinces where the species is under threat and/or in decline

All where it occurs

Evaluation against the Texel-Faial criteria for which the species was included on the OSPAR List

A. sturio was nominated for inclusion on the OSPAR List with particular reference to its global/regional importance, decline, and sensitivity with information also provided on threat.

Global/Regional Importance: The common sturgeon today is limited in its distribution to a population centred on the River Gironde in France and possibly the River Rioni in Georgia, which drains into the Black Sea. As it includes the remnants of a much more widespread and abundant population (see section on decline), the OSPAR Maritime Area is of global importance for this species.

Decline: *A.sturio* was once common throughout the North Sea, the shelf region of the eastern North Atlantic, the Mediterranean and the Black Sea. Following a rapid decline at the end of the 19th century in central Europe, the species was extirpated in the second half of the last century throughout Europe (for example,

Almaca, 1988; Elvira *et al.*, 1991; Elvira & Almodovar, 1993). *A.sturio* sturgeon is now extinct in a number of its former spawning rivers including the Elbe and the Rhine. It is limited in its distribution to a population centred on the River Gironde in France. A second possible population in the River Rioni in Georgia, which drains into the Black Sea, has been unconfirmed since 1991.

The reasons for the decline were mainly due to by-catch, poaching, habitat degradation (spawning grounds, nursery areas) and physical obstacles to migration (Lepage & Rochard 1995).

The reduction of *A.sturio* to only one population within Europe clearly has increased the risk of losing the species entirely. This is further accentuated by limited reproductive success since 1988, ongoing by-catch and illegal fishing, which have all contributed to the reduction of the population. Attempts to restore sturgeon populations in other river systems have been hindered by a lack of stock.

Sensitivity: *A.sturio* requires a relatively long time to reach sexual maturity, which means that they have a slow recovery time in response to population impacts. This varies between populations but is about eight years for males and 14 years for females. After spawning for the first time, males reproduce every 1-2 years and females every three or more years (Rochard *et al.*, 1990). The species is vulnerable to physiological stresses when they migrate between fresh and saline water and it is at this time that they are also most vulnerable to fishing.

Threat: Threats have not changed since the species was nominated for the OSPAR List, but are further elaborated upon in section 4.

3. Current Status of the Species

Distribution in the OSPAR Maritime Area

No known changes since the time it was listed in 2001.

At one time *A. sturio* was the widest distributed sturgeon species in Europe. In the early 20th century it was found off all European coasts except the Baltic Sea and migrated up most of the large rivers to spawn. This included the Rhine and the Elbe which were the most important west European rivers for the species.

Today the species only forms one relict population in the Gironde, France. The main foraging grounds of the species are located in the Gironde estuary for the first seven years of the life cycle, during the following years the fish have mainly been caught along the costal waters of the Western Gulf of Biscay and along the English Channel (Castelnau *et al.*, 1991). Individuals of this population have been described as straying around the British Isles into the North Sea and to Norway (Trondheim). Migration into Iberian waters has not yet been confirmed.

Several sub-populations have been described. According to genetic data the Gironde and the North Sea populations can be considered as one (Ludwig *et al.*, 2004). Sub-populations in the west of the Iberian Peninsula and the Mediterranean have been extirpated according to recent data (Elvira *et al.*, 2000). The latter has been proven as a genetically distinguishable group. For the Black Sea the status of the species is unclear (Holcik, 2000), material to verify the specific status of the local population is lacking.

Population (current/trends/future prospects)

There has been no known change in the *A.sturio* population since its initial listing. Future trends are currently very unclear, with this species facing a high risk of extinction.

There is no total estimate of the population size but it is known to have been greatly reduced. Historically, this species inhabited nearly all the large tributaries of the European Atlantic, the Black, Adriatic, Mediterranean and North Seas. *A.sturio* is now extinct in a number of its former spawning rivers including the Elbe and the Rhine. Only two clusters remain centered on the Gironde-Garonne-Dordogne basin in France, and in the Rioni basin in Georgia (Rochard *et al.*, 1990).

The ICES review of this nomination by the Working Group on Fish Ecology (WGFE) concluded that the geographical distribution of the last known population of common sturgeon (spawning in the Gironde basin) is within the OSPAR Maritime Area. The species is of particular importance in the Gironde system, but can be encountered in most of the coastal zones. The decline in the OSPAR area, as well as in a number of other populations is clear. The last remaining population has been monitored and still exhibits evidence of a decrease and it may be that a viable population no longer exists (ICES, 2003).

Condition (current/trends/future prospects)

No known change since it was first listed. Future trends are currently very unclear, with this species facing a high risk of extinction.

Only three single natural reproductions have been observed in the Gironde population since 1980 (Arne, 2002). The collapse of the sturgeon catches and local extinctions have provided the data on which this species has been given international protection through the EC Habitats and Species Directive and a number of international conventions.

Limitations in Knowledge

No change since the species was first listed.

Data on the threat and decline of *A.sturio* originally came through anecdotal reports, but this has subsequently been supported by the collapse of the fishery throughout its range and the fact that the species has become locally extinct in many parts of its former range. Data on the marine range of individuals remains limited, but the tagging of fish since 1982 has provided information on the location of captures at sea. Incidental captures of tagged and untagged fish off the French coast were reported to the French 'Cemagref' Institute by commercial fishermen as a result of an awareness campaign. A database was developed with over 200 records of incidental capture at sea that has been able to partially characterise the marine habitat of this species.

Figure 1: Distribution of the western *A.sturio* population

Figure 1A shows the known range distribution of the west European population of *A. sturio*. The shaded area shows the current known range in the Atlantic & North Sea. Small circles with dates indicate observations for other localities up to 2000 (adapted from Rochard *et al.*, 1990 and Castelnau *et al.*, 1991)

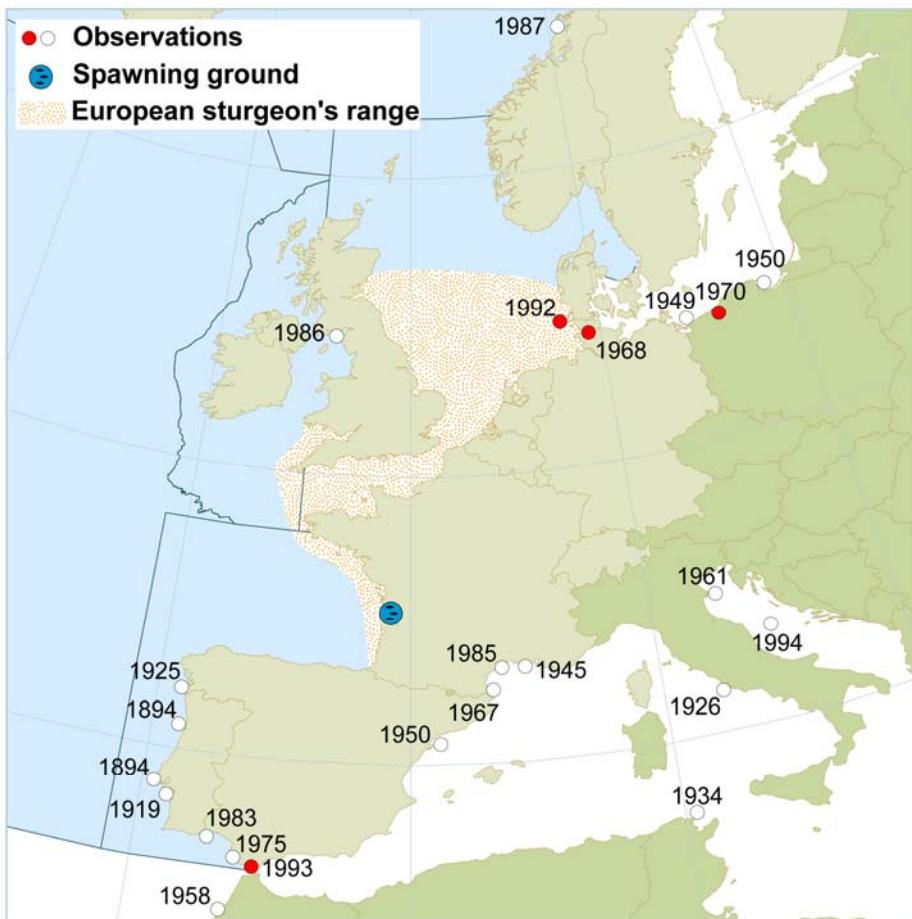
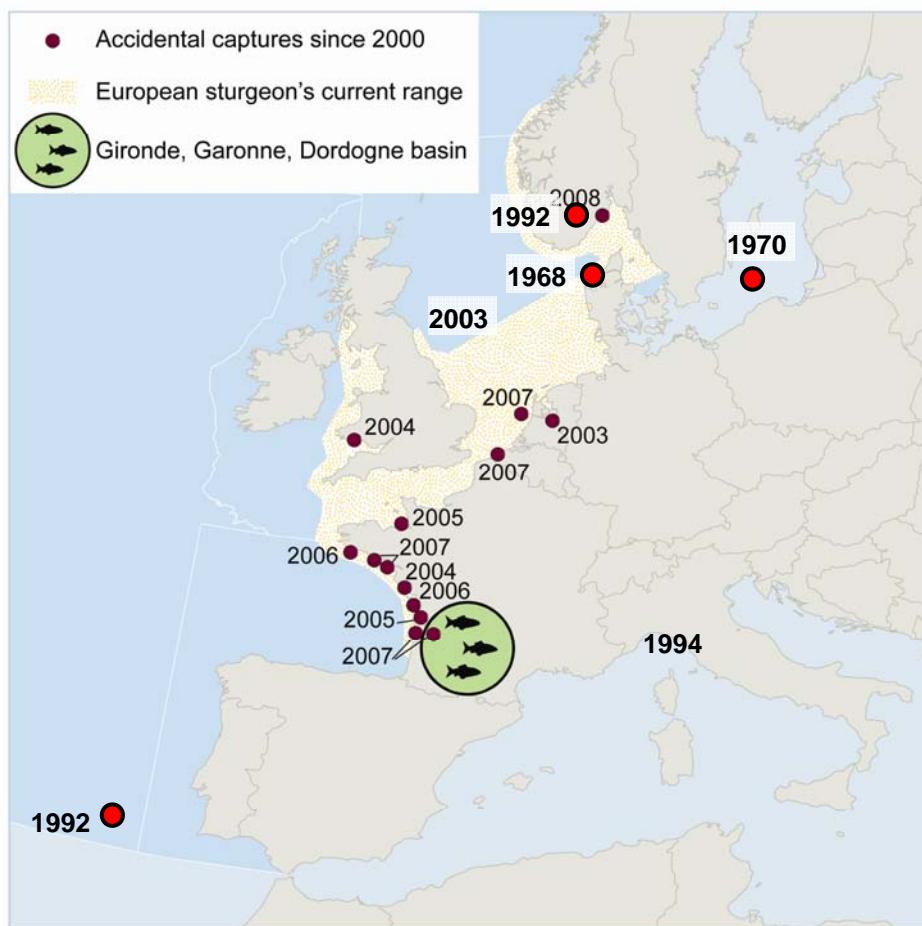


Figure 1B shows accidental captures since 2000 (Data source: Sturio project (www.sturio.eu))



4. Evaluation of Threats and Impacts

Threat and link to human activities

Relevant human activity: Navigation and inland water shipping (maintenance dredging), fishing, harvesting; extraction of sand, stone and gravel; construction: land-based activities.

Category of effect of human activity: Physical – habitat destruction, substrate removal and change, water flow rate changes. Biological – removal of target species, by-catch, and alteration of benthic community structure.

Currently, the three main threats are considered to be:

- habitat alteration (e.g. dams, dug channels and gravel extraction) which directly affects reproductive success and appears to have been the main reason for the past collapse of *A.sturio* stocks (Gessner, 2000);
- by-catch and poaching, despite occurring relatively infrequently, pose the largest current threat to the limited numbers of individuals remaining. By-catch occurs mainly in the gillnet and trawl fisheries (Lepage & Rochard, 1997).
- the introduction of non-indigenous sturgeons into open waters, which has occurred since the early 1990s from accidental release (escaping from fish farms) and intentional stocking (mostly

by anglers and aquarists), poses the risk of pathogen transfer (Pavlov *et al.*, 2000), competition (Brosse *et al.*, 2003) and hybridisation (Arndt *et al.*, 2003). This is of particular concern in areas where these fish interact with a native population (Gironde) or in areas where restoration efforts are underway and interaction is anticipated.

Monitoring all three main threats will necessarily have to increase when restoration efforts begin to release fish into rivers in the attempt to rebuild self-sustaining populations.

Three additional threats to sturgeon in the OSPAR Maritime Area include:

- pollution as a reason for reproductive failure or as a reason for long-term accumulation of bioactive chemicals (Williot *et al.*, 2002b);
- loss of feeding habitat in estuarine areas as a consequence of canalisation and sediment deposition (Hatin *et al.*, 2002);
- human activities that result in changes in river flowrate.

5. Existing Management Measures

A.sturio is listed on Annexes II & IV of the EC Habitats Directive, the Bern Convention and the Bonn Convention. It is protected under Appendix I of CITES. It was classified as Critically Endangered A2d [ver 2.3] by IUCN in 1996.

Artificial breeding is underway in France with reintroduction of juveniles to the wild. The first stocking was done in 1995 with 9 000 individuals. These fish showed the same growth rate as the 1994 wild year class (Lochet *et al.*, 2004). A recent artificial reproduction programme in the Gironde estuary in 2007 led to the stocking of 5000 individuals. This is promising because it was the first time that *A.sturio* captive bred breeding stock had been used. The potential for producing more alevins is growing with time and in 2008 and 2009 respectively 80 000 and 40 000 reared alevins were released into the Garonne and Dordogne. To date, there has been no evidence of an improvement in conservation status, but the status of the present broodstock in captivity should allow production of fish for stocking on a more regular basis in future years.

As part of an ongoing research project in Germany, the first 50 specimens were released in September 2008 into the Elbe River using broodstock from France with the aim to gain more knowledge on habitat preferences and threats. This programme will also experiment with restocking in the Oste and Stör rivers.

However, these efforts will only be successful in the long term if conditions that led to the decline of this species in the first place have been adequately addressed (see above).

There are no known dedicated monitoring programmes except in France, where a monitoring programme is conducted by Cemagref. This monitoring programme is restricted to the Gironde estuary. However, there are other fisheries research programmes throughout Europe that would note a sturgeon if one was captured.

Recreational fisheries are largely unregulated and the extent of potential impacts is unknown.

Under current EC fisheries regulations, directed commercial fishing of sturgeon is prohibited in the OSPAR Maritime Area and by-catch should be returned to the sea. However, the recent catch, landing and sale of a sturgeon in the Netherlands (Ijmuideren, 5 July 2007) indicate that enforcement and education are inadequate. This by-catch incident is the latest in a series of events from various countries (04/2003 in Leiden (NL); 06/2004 in Swansea (UK); and 06/2004 in Les Sables d'Olonne (Fr)).

Building upon previous experience with a national awareness campaign for Atlantic French sea fisheries, in 2008 an international action plan and awareness campaign for the restoration of *A.sturio* was launched in Belgium, Denmark, Germany, Ireland, the Netherlands, Spain, UK, led by the French National Committee on Marine Fisheries and WWF France, with funding from the European Fisheries Fund.

6. Conclusion on Overall Status

There is no known change in the status of this species since it was proposed to be listed by OSPAR in 2001. Future trends are currently very unclear, with this species facing a high risk of extinction. Because of its extremely depleted state, even an apparent positive trend in population should not be interpreted to mean that no further actions are required. Current management measures, while ostensibly helpful, do not appear to be sufficient to allow for the recovery of this species.

7. Action to be taken by OSPAR

As set out in Article 4 of Annex V of the Convention, OSPAR has agreed that no programme or measure concerning a question relating to the management of fisheries shall be adopted under this Annex. However where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the authority or international body competent for that question. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

The main management measures that would assist the recovery of sturgeon populations in the OSPAR Maritime Area would address improvement of water quality, physical habitat conditions (such as river beds and estuaries), access to suitable spawning grounds in the estuaries and rivers of Europe, reduction of bycatch, and re-introduction. However, as noted [in the background document], re-introduction is currently hampered by limited brood stock.

Suggestions for further actions include the following:

Action/measures that OSPAR could take, subject to OSPAR agreement

Communication on Mitigation Measures: Taking account of the largest threats (poor river habitat, fishing by-catch & illegal catch, foreign species introductions), the relevant EU and national bodies should be informed about the listing by OSPAR of this species, and the willingness of OSPAR to cooperate in developing protective measures.

Mitigation measures could include, for example,

- a. developing fishing gear adaptations to allow by-caught individuals to escape (such as researched in the gillnet fishery in the Szczecin lagoon),
- b. increased penalties associated with the sale of the species, and
- c. EU guidelines on the handling and introduction of non-indigenous sturgeon species.

Awareness Raising: OSPAR and Contracting Parties should undertake, individually or in a coordinated way, efforts towards raising the awareness of management authorities and fishermen in particular, as well as retailers and the public, concerning the value of this OSPAR listed species and its current status. Fishermen, enforcement officers (from not just fisheries, but also food authorities) and fish handlers should be clear that it is illegal to deliberately kill and sell sturgeon. The primary issue here is better communication throughout the “chain of custody” (from fisherman to consumer), as well as increasing public interest in sturgeon in general. Greater awareness would also help address possible problems in the recreational fishery, which is largely unregulated. In France, awareness campaigns for fishermen have resulted in a significant increase in the numbers of declarations of by-catch and individuals released back to the sea. OSPAR should seek cooperation with the recently launched internal plan of action for the restoration of the European Sturgeon, led by the French National Committee on Marine Fisheries and WWF France, with funding from the European Fisheries Fund.

Actions/measures for relevant Contracting Parties

Protected Areas: OSPAR Contracting Parties should identify and select appropriate areas for inclusion in the OSPAR MPA Network, protecting estuarine habitats (and riverine habitats – though not in the OSPAR Area), taking into consideration current sturgeon distribution and areas warranting possible future re-introduction.

Reintroduction: Depending on the availability of broodstock, Contracting Parties in whose territory *A. sturio* is considered native, should aim at establishing appropriate restocking programmes (as e.g. Germany is currently undertaking).

Annex 1: Overview of Data and Information provided by Contracting Parties

Table 1: Data provided by OSPAR Contracting Parties

Contracting Party	Feature occurs in Contracting Party's Maritime Area	Contribution made to the assessment (e.g. data/information provided)	National reports References or web links
Belgium			
Denmark			
France	Yes; only country in OSPAR region where <i>A.sturio</i> still breeds	See references list in Annex III	<p>Elie P. (Coord.) 1997. Rapport final Life Sturio</p> <p>Rochard E. (Coord.) 2002. Restauration de l'esturgeon européen <i>Acipenser sturio</i>. Rapport scientifique</p> <p>Rochard E. & Williot P. coord., 2006. Actions de recherches proposées pour contribuer au plan international de restauration de l'esturgeon européen <i>Acipenser sturio</i>.</p> <p>Rosenthal H., Bronzi P., Gessner J., Moreau D., Rochard E. and Lasén C., 2007. Draft Action Plan for the conservation and restoration of the European Sturgeon.</p> <p>http://www.coe.int/t/dg4/cultureheritage/Conventions/Bern/T-PVS/sc27_inf04rev_en.pdf</p> <p><u>annexes</u></p> <p>http://www.coe.int/t/dg4/cultureheritage/Conventions/Bern/T-PVS/sc27_inf04add_en.pdf</p>
Germany	Yes; but only as a vagrant	See references list in Annex III	Gessner, J., Debus, L., Filipiak, J., Spratte, S., Skora, K.E. and G.M. Arndt. 1999. Catches of sturgeons in German and adjacent waters since 1980. Journal of Applied Ichthyology 15(4): 136-142.
Iceland			
Ireland			
Netherlands			
Norway			
Portugal			

Spain	Most recent specimen caught on 14 Sep 1992 in Gibraltar Strait	See references list in Annex III	http://www.mma.es/secciones/biodiversidad/inventarios/inb/atlases_Peces/pdf/acipenser_sturio.pdf ; http://www.mma.es/secciones/biodiversidad/especies_amenazadas/vertebrados/libro_rojo_vert/pdf/ESTURION_SOLLO.pdf Almaça, C. & B. Elvira 2000. Past and present distribution of <i>Acipenser sturio</i> L., 1758 on the Iberian Peninsula. Boletín. Instituto Español de Oceanografía 16(1-4): 11-16. http://www.ieo.es/publicaciones/boletin/pdfs/bol16/16_011-016.PDF
Sweden			
UK			

A.sturio was first included in the OSPAR List in 2003 following nomination by Portugal, Germany and Belgium. Contact persons:

- Fátima Brito, Direcção Geral do Ambiente, Rua Murgueira-Zambujal, 2720-865 Amadora, Portugal.
- Ronald Fricke, Staatliches Museum fuer Naturkunde, Rosenstein 1, D-70191 Stuttgart, Germany
- Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3e en 23e Linierregimentsplein, 8400 Oostende, Belgium.

Annex 2: Description of the proposed monitoring and assessment strategy

Rationale for the proposed monitoring

Regular monitoring of the migrating common sturgeon population will be necessary to guarantee the effectiveness of measures taken to restore the species to a favourable conservation status in the OSPAR Maritime Area. Both the remaining population as well as any reintroduced fish should be monitored in order to assess the trends in distribution and abundance.

Use of existing monitoring programmes

To date, only France has conducted monitoring, restricted to quantitative population surveys in the Gironde estuary.

Synergies with monitoring of other species

Any fisheries related research and/or monitoring programmes should be advised to forward any information on incidentally caught or observed specimens of *A. sturio*.

Assessment criteria

Criteria have been developed against which the status of *A. sturio* populations can be assessed as favourable, unfavourable-inadequate or unfavourable-bad thus requiring different degrees of conservation effort. These criteria and the threshold levels that would signal a change in management and monitoring are summarised in Table 2.

Note that many of these criteria are not part of the recommended monitoring programme (below). However, they are listed such that assessments can still be carried out using these criteria, should they be monitored.

The first six parameters for the estimation of the population status are likely to be more directly applicable in an initial assessment and thus carry more weight. The next six parameters may depend on additional factors including the developmental potential of the population or its status relative to the carrying capacity of the area and thus are varying among regions and will require greater interpretation.

A *favourable* population status would only require continued monitoring. An *inadequate* status would require intensified monitoring also of the threats, and an investigation of management measures leading to recommendations on how to improve the status. A *bad* population status would require measures to be taken while further investigation (as per inadequate status) is underway. Currently (2008) the status of *A. sturio* is *bad*.

Table 2: Proposed Indicators on the Conservation Status of *Acipenser sturio* [to be further elaborated]

Population status	Favourable	(Unfavourable) Inadequate	(Unfavourable) Bad
Criteria			
Anthropogenic mortality	M<0.1	M<0.2	M>0.2
By-catch reports	Fishermen report all catches of sturgeon and release them alive	Fishermen report majority of catches and release live fish	Fishermen infrequently report on catches and releases are uncertain
Sturgeon distribution	in > 90% of historic area	in > 60% of historic area	in < 60% of historic area
Occurrence of exotic species	No exotic sturgeon species occur in open water bodies	Exotic sturgeon species are restricted to waters where <i>A. sturio</i> is not reproducing	Exotic sturgeon species are sympatric (live in the same areas as <i>A. sturio</i>)
Abundance	> 50% of historic levels	> 25% of historic levels	< 25% of historic levels
Health status of by-caught animals – Parasites	low prevalence of parasites and/or of pathological abnormalities (values to be developed)	medium prevalence of parasites and/or of pathological abnormalities (values to be developed)	high prevalence of parasites and/or of pathological abnormalities (values to be developed)
Health status of by-caught animals – Toxin loading	low contamination of body tissues (values to be developed)	medium contamination of body tissues (values to be developed)	high contamination of body tissues (values to be developed)
Habitat quality	no oxygen depletion (as proxy for eutrophication); naturally structured substrates of the sea bottom	rare oxygen depletion (as proxy for eutrophication); reduced complexity in the substrates of the sea bottom	regular oxygen depletion (as proxy for eutrophication); eliminated structure and complexity in the substrates of the sea floor
Available prey abundance	high (values to be developed)	medium (values to be developed)	depleted (values to be developed)
Sturgeon density	high or increasing (values to be developed)	medium (values to be developed)	low or decreasing (values to be developed)
Age structure	Age pyramid comprises all life stages including multiple spawning females	Age pyramid comprises all life stages including spawners	Age pyramid comprises most stages including some spawners
Reproduction success	High (number of YOY exceed 10,000)	Medium (number of YOY exceed 5,000)	Poor (number of YOY < 1,000)
Reproduction frequency	high (annual or biannual)	medium (every 2-6 years)	low (spawning intervals > 6 years)

Techniques/Approaches

Baseline Monitoring

- Relevant current and historical data should be collected into a national data base and be made available to OSPAR;
- Standardized by-catch reporting (by informed and trained fishermen);
- Specialized surveys in the Gironde and eventually in other areas if restocking is conducted.

Enhanced Monitoring

- Non-lethal fin ray samples of live by-caught specimens;
- Biopsies of dead by-caught specimens.

Selection of Monitoring Locations

Generally, the monitoring and reporting of by-caught specimens has to take place in the entire OSPAR Maritime Area, though with an emphasis on coastal shelf areas and river basins.

Specialized surveys should continue in the Gironde estuary, and eventually in other river basins if restocking programmes are to be conducted.

Timing and Frequency of Monitoring

Baseline Monitoring

- Continuous by-catch monitoring in all areas.
- Annual specialized surveys in areas where *A. sturio* is known or suspected to still exist.

Data Collection and Reporting

Baseline Monitoring

Relevant data on by-catch:

- Date;
- Location and depth;
- Type of fishing gear and species targeted;
- Size (fork length);
- Weight (kg);
- No. of tag if present;
- Visual condition (parasites, etc.);
- Fate (returned to sea, dead, sold, etc.).

Enhanced Monitoring

- Fin ray samples (needs well trained technician when conducted on live fish);
- Biopsies (needs detailed protocol with regards to the objectives (e.g. genetic identification, pathology search, etc.)).

Table 3: Options for Monitoring European Atlantic Sturgeon and their Evaluation

<u>Monitoring objective</u>	<u>Method</u>	<u>Data quality</u>	<u>Benefits - Disadvantages</u>
Group I: Quantitative Monitoring			
1. Presence (Gessner et al., 1999)	1. Surveys of by-catch to be initiated by questionnaires including descriptions of species 2. Monitoring programmes such as experimental fisheries attempts	Summary data, improved quality if geographic info is made available, reliability of species identification depends on observer training Restricted spatial and temporal application	Moderate cost, long-term, High cost,
2. Distribution (Rochard et al., 1997)	1. Surveys of by-catch to be initiated by questionnaires including descriptions of species 2. Monitoring programmes 3. Genetic analysis of historical catches (museum specimens)	Summary data, improved quality if geographic information is made available, reliability of species identification depends on observer training Restricted spatial and temporal application	Moderate cost, long-term, High cost, Moderate costs, long term assessment, identifies and segregates sympatric species
3. Density	Monitoring programmes	Restricted spatial and temporal application	High cost, accurate estimates
4. Trend (changes in absolute abundance) (Rochard et al., 1997, Gessner 2000)	1. Repeated sampling under comparable conditions (e.g., site, month etc.); 2. Locally dedicated surveys, data analysis of by-catch data 3. Analysis of historic catch data, considering the differences in unit effort	Potential over- or under-estimation Reliability of species identification depends on observer training Sufficient quality for the timing and dynamics of historic decline	Very high costs especially for narrow confidence limits, weather dependent Low cost Moderate costs, for some populations analysis is available

<u>Monitoring objective</u>	<u>Method</u>	<u>Data quality</u>	<u>Benefits - Disadvantages</u>
Group II: Biological Aspects			
5. Seasonality (Rochard <i>et al.</i> , 1997)	1. Collect the data from by-catch information (Lepage <i>et al.</i> , 2002, Rochard <i>et al.</i> , 1998)	Good, reliable data, some habitat descriptors	Moderate cost
	2. Local surveys in known aggregation areas to identify changes in abundance in various years and seasons	Good, reliable data including qualitative descriptors of habitat characteristics possible	High cost
6. Movements (Castlenaud <i>et al.</i> , 1991, Rochard <i>et al.</i> , 1998)	1. Tagging of migratory sub-adults and late juveniles		
	2. Ultrasonic-telemetry from ships or with hydrophone arrays	Possibly difficult to generalize due to small sample size	High cost, small sample sizes, but high conservation value (e.g. for MPA boundaries)
7. Habitat use (Hatin <i>et al.</i> , 2002, Brosse <i>et al.</i> , 2003)	Ship-borne telemetry surveys (for abiotic <i>in situ</i> -measurements) and hydrophone arrays	Surveys are to be carried out seasonally to verify the utilization of the habitat during the different seasons	High cost, but high conservation value (e.g. to model distribution)
(Jego <i>et al.</i>, 2002)	Characterization of intensively utilized habitat concerning the morphological, hydrological and ecological properties	Detailed characteristics for critical habitat,	Moderate to high costs, but high conservation value (e.g. to model distribution)
8. Reproduction success (Williot <i>et al.</i> , 2002)	Larval surveys in the rivers with known sturgeon reproduction in June, July and August to determine reproductive success	Information mostly qualitatively, abundance data have to be verified to the total density	Only one river system currently to be involved, labour intensive, success dependent upon knowledge of flow and temperature conditions as key factors for reproduction

<u>Monitoring objective</u>	<u>Method</u>	<u>Data quality</u>	<u>Benefits - Disadvantages</u>
9. Recruitment	Juvenile Index in estuaries during the concentration of the fish in these waters prior to long distance migrations	Allows the monitoring of the abundance of the year classes 2-5 in the estuary,	Verification of data on percentage of juvenile recruitment lacking for OSPAR region
<u>Monitoring objective</u>	<u>Method</u>	<u>Data quality</u>	<u>Benefits - Disadvantages</u>
Group III: Aspects of Population Health			
10. Age Structure (Rochard et Jatteau, 1991)	Composition of by-catch (non-lethal fin ray samples)		Slow coverage due to small sample size, training requirement of crew
11. Health status	1. Disease prevalence in necropsies 2. Antibody prevalence & immuno-competence in live tissue samples (remote biopsies) 3. possibly indirectly: through change in distribution (anthropogenic impact)	Possibly difficult to generalize due to small sample size; Potentially biased by cause of death; and time after death Cause-effect relationship possibly difficult to prove	High cost, slow coverage due to small sample size, significant changes difficult to detect, but high conservation value
12. Reproductive status Williot et al., 2002	Reproductive tissue samples of by-caught individuals during monitoring surveys	Good, low sample sizes, limited applicability	Slow coverage due to small sample size, significant changes difficult to detect
13. Toxin loads (Wirth et al., 2002)	Tissue samples of by-caught or remote biopsies	Cause-effect relationship possibly difficult to prove and sources may be difficult to determine	High cost, slow coverage due to small sample size, significant changes difficult to detect, but high conservation value
14. Genetic population structure (Ludwig et al., 2004)	Tissue samples of by-caught individuals	Potentially biased by location of corpse recovery	Biopsy sampling: sampling difficult to arrange for fishermen, slow coverage during surveys due to small sample size

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Annex 4: Conservation Management Measures

The main management measures to assist the recovery of *A.sturio* populations in the OSPAR Maritime Area are:

Ex-situ measures including all accessible individuals to protect the genetic plasticity and heterogeneity of the remaining population

Genetic diversity: Because of the chance to increase the genetic variability, *ex-situ* measures should immediately be intensified since they provide the only key to support a long-term restoration plan by securing the species in the first place. If available, the release of juveniles would be a very effective tool to increase the stock size and increase the number of future spawners. Early release is considered most effective to ensure optimal adaptation and imprinting of the fish to the natural conditions. The release would additionally allow more intensive studies on habitat utilization and the underlying mechanisms. The available broodstock should be genetically characterized and a genetic breeding pan should be followed to minimize the potential for in and out-breeding and to maintain the greatest possible heterogeneity.

Reduction of by-catch

Developing fishing gear adaptations to allow by-caught individuals to escape (such as researched in the gillnet fishery in the Szczecin lagoon) would help to reduce the fisheries induced mortality rates.

Release of juveniles

Restocking *A.sturio* in rivers where it is considered to be native may be essential to the recovery of the population.

Information campaigns

Public information: In order to allow protection to become effective, additional, intensive information would be required to trigger the fishermen to collaborate. Together with increased control and effective penalties, this would lead to increased protection. In addition, in order to increase the size of the captive stock and to protect the remaining fish in the wild, information campaigns with the fishermen not only in France but in Great Britain, Belgium, the Netherlands, Germany, Spain and Denmark are important to effectively protect the remaining individuals of the species.

Protection of critical habitats

Sand and gravel extraction: the low priority of the effective protection of the species can be seen for example from continuous trials to allow gravel extraction from the last reproduction refuge of the species in the Gironde river. Repeated attempts to prevent this activity since 1999 have only been effective temporarily. Since renewed applications have been made to extract sediments from the river in large quantities, the protection of critical habitat in the Gironde habitats must be considered very ineffective.

Habitat protection: Due to the lack of knowledge on marine distribution and due to conflict with other resource users, protection of marine habitat for instance in the Bay of Biscay has not as yet occurred. In Germany, the protection of potentially critical habitats under the EU Habitats Directive is a first step.

Protected areas for marine and estuarine feeding and nursery grounds

Protected areas: Protection of marine and estuarine feeding and nursery grounds is of minor importance to date, since the only effect currently would be a reduction of fisheries pressure. The

habitat requirement is not well enough understood to allow the development of relevant habitat quality criteria.

In order to provide suitable habitat for reproduction, early life stages and juveniles, habitat protection for these stages would be highly required.

Increased coordination and cooperation of national programmes for sturgeon restoration

Research: Cooperation between France and Germany concerning the restoration of *A. sturio* has led to an improved flow of information as well as to a series of joint actions concerning public information habitat protection. A more intensive approach would be possible if joint funding for such activities becomes available.

Cooperation: Increased coordination and cooperation of national programmes for sturgeon restoration and integration in other protection and restoration activities (e.g. salmon, eel, shad, whitefish, habitat, refuges etc.) is required.

Financial constraints: Currently, the effective increase of the *ex-situ* stock of *A. sturio* is limited to a large degree by the lack of funding. Repeated attempts to secure funds for this important prerequisite of restoration in the Gironde and the North Sea tributaries have been of limited success.

Inhibit release of non-indigenous sturgeon species

Prevention of the release of non-indigenous sturgeon species: No effective measures have been taken throughout the former range of the species. Even if the ICES Code of Practice is followed for introductions, releases occur throughout the range.

The measures applied to limit the establishment of new species in aquaculture do not effectively limit the distribution of these species in the wild. Incidental release and escapes have resulted in an introduction of 21 tons of Siberian sturgeon (*A. baerii*) into the Gironde in 2000, indicating that additional precautions should be taken. In areas where *A. sturio* is only a vagrant, the effect of introductions is more pronounced, with 100% of accidental catches comprising exotic species (Arndt *et al.*, 2003).

Enforcement of existing regulations

Landing of sturgeon: Most of the fish caught outside of the Gironde estuary are landed. Lack of information about the legal background, combined with low or non-existent penalties for catching protected species, provides no incentive for fishermen to support the conservation of *A. sturio* and large numbers are thus lost to fishing. Stricter enforcement of existing regulations and measures is therefore needed.

Indirect measures for protection include limiting fisheries pressure in coastal waters through programmes for the management of other fish stocks, water quality improvements and increased habitat diversity as a result of designations for the protection of other species.



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