# *FINAL REPORT*

# First Action Plan for the European Sturgeon (*Acipenser sturio*) for the Lower Rhine

***Paving the way towards a reintroduction and restoration of the European Sturgeon***

2020 - 2030

October 2020

**Produced within the framework of the Rhine Sturgeon Project 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., 2009) and the 'Pan-European Action Plan for Sturgeons' adopted under the Bern Convention on November 30, 2018.**

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RHEINISCHER FISCHEREIVERBAND RhFV von 1880 e.V.

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Naar een dynamische delta

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***Geographical Scope:*** The Lower Rhine (the river branches of the River Rhine in The Netherlands and the River Rhine in North Rhine Westphalia in Germany) and the Dutch part of the North Sea.

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# FOREWORD

We depend on everything that lives for our clean air, clean water, sufficient oxygen and the right conditions to grow food. People are inextricably linked to nature. In fact, we are nature. We cannot live without those beautiful animals and plants, and only with nature in all its diversity can we have a healthy future.

But our relationship with nature is broken. Biodiversity – the rich diversity of life on Earth – is being lost at an alarming rate. The population sizes of mammals, birds, fish, amphibians and reptiles have seen an alarming average drop of 68% since 1970. And freshwater biodiversity is declining far faster than that in our oceans or forests.1 in 3 freshwater species are threatened with extinction .

This loss effects our own health and well-being. Today, catastrophic impacts for people and the planet loom closer than ever. Climate change, shocking biodiversity loss and devastating pandemics are sending us a clear signal. It is time to restore our troubled relationship with nature. Fortunately, we still have that chance.

We must actively help critical species such as the European sturgeon that are on the verge of extinction to find their way back to our Dutch waters. Dutch rivers were once teeming with sturgeon. Due to overfishing, polluted water and the canalisation of the rivers sturgeons became extinct in the Netherlands.

Since 2009, the World Wide Fund for Nature in the Netherlands has been working with ARK Nature and Royal Dutch Angling Association on the return of the European sturgeon to the Rhine. I am proud that we, with many partners - including ministries, provinces, knowledge institutions, the shipping sector and nature organizations - are taking big steps to bring the European sturgeon back to the Netherlands permanently.

This way we herald a time together where we regain balance with our planet and create a world in which humans and nature live in harmony.

Kirsten Schuijt
CEO WWF Netherlands

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# 1. Executive Summary

Historically, the European sturgeon occurred in all coastal waters and main river systems of northwest Europe. The Rhine used to be a major sturgeon river too. Due to overfishing, bad water quality and canalization, the spawning population of the sturgeon in the Rhine disappeared within a period of only a few decades. In 1953 the last adult sturgeon was caught in the Rhine. The lifespan of the European sturgeon is presumed to last over 60 years. It is an anadromous fish species and during its life cycle it utilizes freshwater, estuaries and marine habitats at different stages. Today, the European sturgeon is listed as critically endangered by the International Union for Conservation of Nature and Natural Resources (IUCN) and one of the most endangered fish species in Europe, being in a critical danger of extinction. The status of the species calls for urgent, well-coordinated and concise actions to prevent its extinction. (See chapter 5)

There is a small population of the European sturgeon in the Gironde, Garonne and Dordogne rivers in France, protected and supported with a brood stock program. Part of the brood stock is also used for the German European sturgeon program, to build up an Elbe population. Strategically located between the Gironde-Dordogne-Garonne and the Elbe, the Rhine is identified as a third potential river to start with experimental releases of the European sturgeon. Since 2009, WWF – The Netherlands, ARK Nature and the Dutch Angling Association (Sportvisserij Nederland) have been cooperating intensively to investigate to what extent the Rhine is suitable for the reintroduction of the European sturgeon and started the Rhine Sturgeon Project. In 2012 and 2015 sub-adult sturgeons were experimentally released to gain insight in the behaviour and success of sturgeons in the Rhine as it is today. (See chapter 3)

In 2018 an assessment was carried out, based on available literature, previous feasibility studies and data of the experimental releases. In the assessment the opportunities, potentials and obstacles were summarized, and preliminary actions and key actors were identified. For all anthropogenic factors the potential threats, adverse impacts and potential measures were discussed and further analysed by using a SWOT analysis with all relevant key stakeholders, multiple interviews, workshops and expert meetings. An overview of the potential opportunities, threats and uncertainties is given in figure 9 of the present report. All factors of influence are classified as ‘no impediment’, ‘potential impediment’ or ‘impediment’ for the return of the species or ‘insufficient knowledge available’. For the latter measures are formulated to mitigate and/or research possible effects. (See chapter 4)

The main goal (until 2030) to which the First Sturgeon Action Plan for the Lower Rhine will contribute is to finalize the feasibility and risk assessment phase and prepare the decision for an official reintroducing of the European sturgeon population in the Lower Rhine by 2030. The related work for the next 10 years, will be carried out in close cooperation with Dutch, German and French partners. The geographic scope for the Rhine Sturgeon Project and the First Sturgeon Action Plan comprises the Lower Rhine, i.e. the lower parts of the River Rhine in The Netherlands and Germany (North Rhine – Westphalia) and the Dutch part of the North Sea. (See chapter 6)

The action plan for 2020-2030 forms a framework for action and cooperation, based on an attractive agenda for all parties involved. The agenda with all actions, planning and cost estimates are translated into a Roadmap for implementation of the Action plan in 2020-2030. (See chapter 7)

# 2. Introduction to the First Sturgeon Action Plan for the Lower Rhine

Sturgeons (Acipenseridae) are among one of the oldest fish species still living on Earth. Sturgeon fossils were found from the Triassic period, some 208 to 245 million years ago. Worldwide, there are 27 sturgeon species known, all of them endemic to the Northern hemisphere. Sturgeons are of significant ecological, commercial and recreational value. The threats adversely affecting sturgeon populations are closely linked to their biological and ecological requirements. All sturgeons share specific characteristics, like late maturation, long life span, low specific fertility and specific homing behaviour that makes them susceptible to anthropogenic impacts such as fisheries, obstruction of migration routes and destruction of physical habitats.

The European sturgeon (*Acipenser sturio*) is an anadromous migratory fish, once endemic to all of the large river systems of Europe from the Black Sea to the North Sea. 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 at the end of the 19th century. Today, the European sturgeon is listed as critically endangered by the International Union for Conservation of Nature and Natural Resources (IUCN) and one of the most endangered fish species in Europe, being in a critical danger of extinction (IUCN Red List, Rochard *et al.* 1990, Gessner *et al.* 2010). The species is strictly protected under a number of international and European agreements (e.g. Convention on the International Trade in Endangered Species (CITES), Bern Convention, Bonn Convention, European Habitats Directive) as well as under national legislation in most countries of its historic range (Bastmeijer, 2019).

The status of the species calls for urgent, well-coordinated and concise actions to prevent its extinction.


**Figure 1 – Info map European sturgeon in the Danube catchment area. Published as part of LIFE project sterlet hatchery in Vienna, Austria.**

To date, 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). The population in France is protected and supported with releases of juveniles originating from a brood stock from the *ex-situ* breeding and rearing centre in Saint-Seurin-sur-l'Isle, near Bordeaux. Part of the brood stock is also used for the German European sturgeon programme, to build up an Elbe river population. To maintain the European sturgeon, there has been a joint venture between France and Germany since 1996. National action plans for both countries were published in 1997, 2011 (Dreal, A., 2011) and 2010 (Gessner *et al.* 2010), describing, among other things, actions to preserve the Gironde-Dordogne-Garonne population in France and the Elbe river population in Germany. In France, the follow up Sturgeon Action Plan 2020-2029 has recently been published for public consultation in January 2020[1].

Strategically located between the Gironde-Dordogne-Garonne and the Elbe, the Rhine is identified as a third potential river to start with experimental releases of the European sturgeon (Rheinischen Fischereiverbandes von 1880 e.V., 2010). In 2009, WWF–The Netherlands, ARK Nature and the Dutch Angling Association (Sportvisserij Nederland) started the *Rhine Sturgeon Project*, with the overall long-term goal (2030-2040) to re-establish a sturgeon population in the Lower Rhine to an extent that ensures the species survival. To date, the Rhine Sturgeon Project is in its experimental research phase to identify the risks and conducting feasibility studies mitigating the risks already identified.

The main goal (until 2030) to which the *First Sturgeon Action Plan for the Lower Rhine* will contribute is to finalize the *feasibility and risk assessment phase* and prepare the decision for an official start of a reintroduction programme of the European sturgeon in the Lower Rhine by 2030 (or sooner if feasible). This First Sturgeon Action Plan for the Lower Rhine contributes and is supplementary to the French and German National Action Plans.


[1] http://www.consultations-publiques.developpement-durable.gouv.fr/projet-de-plan-national-d-action-pour-l-esturgeon-a2115.html

# 3. Protecting the European Sturgeon

## 3.1 The European sturgeon: profile and life cycle

Sturgeon in general has a complex life cycle, requiring a variety of different habitats. In combination with its late maturation and long life span, makes the species an ideally suited indicator for good ecological status in rivers, estuaries and marine waters, connectivity and sustainable fisheries management (Gessner *et al.* 2010, Rosenthal *et al.* 2006). Self-sustaining populations of the European sturgeon would make an important contribution to maintaining Biodiversity. Based on the experiences in France and Germany, 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.

Historically, the European sturgeon occurred in all coastal waters and main river systems of northwest Europe and east Asia. The Rhine used to be a major sturgeon river. The maximum length of the European sturgeon is reported to exceed 3.5 meters with a weight of more than 300 kg. The lifespan is presumed to last over 60 years with first maturity being reached after 10 – 16 years, depending upon geographical range and sex. 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 males usually participate in reproduction once every 2 years, while the female only migrate upstream once every 3 to 4 years to spawn. The females lay 500,000 to 2,500,000 eggs, depending on their length and weight (Kranenbarg J., *et al.* 2018, Gessner *et al.* 2010, Holčik *et al.* 1989).

All sturgeons spawn in freshwater and are migratory. They repeatedly move between different habitats for spawning, feeding and wintering to complete their lifecycle. This migration often covers long distances and crossing of borders in international watersheds when returning to their spawning grounds.

The European sturgeon is an anadrome fish species. During their life cycle the European sturgeon utilizes freshwater, estuaries and marine habitats at different stages.

Life cycle phases of European sturgeon based on literature (Kranenbarg J., *et al.* 2018, Gessner *et al.* 2010, Holčik *et al.* 1989) and field observations in the Gironde, France:

1. *Spawning*. Spawning season is confined to late spring until early summer (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 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 branches.

2. *Downstream migration*. The hatched embryos drift downstream and settle in crevices in the gravel close to the spawning sites where they continue their development. The early larvae gradually drift further downstream towards more productive feeding grounds. This freshwater phase lasts approximately six months.

3. *On growing*. At an age of 6 months, the young 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.


**Figure 2 – Historic and potential life cycle of the European sturgeon in the Lower Rhine.**

4. *Juveniles*. The juvenile sturgeon will enter the North Sea where they mature in the delta and in the shallow waters along the coast. 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.

5. *Becoming adults*. The juveniles carry out long distance migrations in marine waters to feed overs several years until they become adult sturgeons (10-16 years old, depending on sex and latitude).

6. *Returning to spawn*. When entering the final stages of maturity, mature fish return to their natal river in order to reproduce. Once the eggs have been laid, the adult sturgeons swim back to sea in a few days' time.

Annex A summarizes the main biological characteristics of the European sturgeon.

## 3.2 Decline of the species

In the Rhine, sturgeon used to migrate in large numbers as far as the Moselle but was only rarely found in the Upper Rhine or the Main (Holčik, 1989). The species used to live in the Netherlands and the lower parts of the Rhine in Germany for more than thousand years. Archeologically bottom finds from the first century proof that the European sturgeon occupied the River Rhine basin and the large tributary Main two thousand years ago. In the 1950's one of the last sturgeons was caught (see Figure 3 and 4).

Spawning populations of sturgeons became extirpated in nearly all European rivers, due to the deterioration of water quality, the degradation and loss of habitat, the disruption of connectivity from sea to the spawning sites, inland navigation and overharvest fishing.

In addition, there are more recent changes that could have a negative impact on the species, the most important being a significant intensification of coastal fishing, the construction of dams on migration routes to spawning grounds (including coastal defense constructions such as the Afsluitdijk and the Deltawerken in the southwestern delta of The Netherlands) and intensified inland shipping from the Port of Rotterdam to Germany. The impact of the above factors can pose a detriment threat to the European sturgeon in the Rhine system and the adjacent Dutch coastal zone as described in chapter 4.

**Figure 3 – One of the last European sturgeon in the Netherlands caught in Hardinxveld in 1952.**

The current situation with only one known remaining population in France (Gironde, Garonne and Dordogne basin) and releases to build up a population in the Elbe River in Germany, is critical. Natural reproductions in France were last observed in 1988 and 1994 (Williot *et al.* 1997). Although the population size in France is increasing over the last 15 years, the European sturgeon is close to extinction. The last population is at a low level. The species is classified as critically endangered (CR-A2d) according to the IUCN criteria, and considered already extinct in many countries.

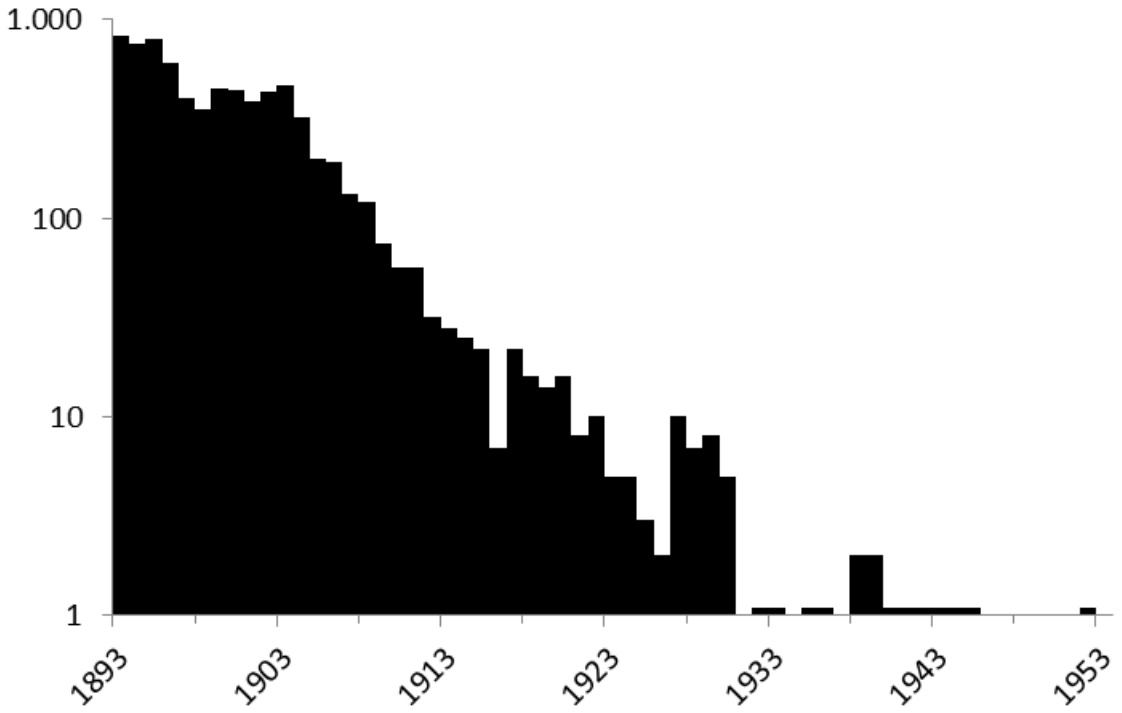


**Figure 4 - Number of sturgeons caught per year in Dutch rivers 1893-1953 on a logarithmic scale (y-axis). Source: fishing statistics.**

## 3.3 Rehabilitation of the European sturgeon

In light of the poor state of wild populations, the future of the European sturgeon mainly relies on controlled reproduction and stocking to enhance and reinstate the wild population.

Since the 1980s, work has been done to restore the last wild European sturgeon population in the Gironde-Dordogne-Garonne river system. For this purpose, an *ex-situ* breeding and rearing centre was established in Saint-Seurin-sur-l'Isle, near Bordeaux, where initially sturgeons caught in the wild were kept for the breeding of young sturgeons. Between 2007-2014, there have been regular breeding successes in the French breeding centre. Thanks to this French breeding program and the commitment of the French partners, the European sturgeon still exists (Figure 5) and since 2007 more than 1.7 million juvenile sturgeons (and larvae) and more than three thousand sturgeons aged 1 year or older have been released.


**Figure 5 - Evolution of the distribution of the European Sturgeon in Europe between 1850 and 2018 (French Action Plan: Plan national d'actions en faveur de l'esturgeon européen *Acipenser sturio* 2020-2029).**

As part of the French-German cooperation, a sturgeon breeding centre was established in Berlin in 1998. Complemented by a reintroduction program for the Elbe River. This program used larvae born in the French breeding centre to establish an autonomous ex situ stock and to experimentally release some 20,000 juveniles in the Elbe river to set the foundations for a local population. Due to a shortage of reproductions from the French brood stock after 2014 the releases in France and Germany have been interrupted since 2015.

Strategically located between the Gironde-Dordogne-Garonne and the Elbe, the Rhine is identified as a third potential river to start with experimental releases of the European sturgeon and gradually work on a sustainable reintroduction of this magnificent and ancient fish.

## 3.4 The Rhine Sturgeon Project

Since 2009, WWF – The Netherlands, ARK Nature and the Dutch Angling Association (Sportvisserij Nederland) have been cooperating intensively on the European sturgeon topics in the Lower Rhine in the Netherlands and Germany (North Rhine-Westphalia, NRW).

These organisations took the initiative in 2010 to investigate to what extent the Rhine is suitable for the reintroduction of the European sturgeon and started the *Rhine Sturgeon Project*. In addition, a *Rhine Sturgeon Platform* has been set up consisting of Dutch, French and German knowledge organisations and stakeholders.


**Figure 6a – First release of sturgeon in the Rhine by Princes Laurentien in 2012 / 6b - Unveiling of the life-size sturgeon on the beach near the lighthouse in Hellevoetsluis, along the Haringvliet (photo © John de Pater).**

The overall long-term goal (2030-2040) of the *Rhine Sturgeon Project* is to re-establish a sturgeon population in the Lower Rhine. Due to their extended life cycle, sturgeon reintroduction programmes are lasting several decades. A sturgeon population is expected to develop in a period of 15 – 25 years. Therefore, the reintroduction follows a gradual and phased process. To date, the Rhine Sturgeon Project is in its experimental research phase to identify the risks and conducting feasibility studies mitigating the risks.

The Rhine Sturgeon Platform initiated the investigation of opportunities and potential threats for a sustainable reintroduction of the species in the Lower Rhine. Aspects such as the availability and accessibility of spawning grounds, juvenile habitats, migration possibilities and legal status and obligations have been investigated.

In close cooperation with the Ministry of Infrastructure and Water Management and the Ministry of Agriculture, Nature and Food quality in The Netherlands, two experimental releases of juvenile sturgeons in the Lower Rhine were conducted in 2012 and 2015[2]. Tagged juveniles were obtained from the *ex-situ* breeding and rearing centre in Saint-Seurin-sur-l'Isle with approval of our French and German partners, as well as the responsible Ministries in The Netherlands, France and Germany. Based on the two experimental releases, it was concluded that the juveniles in the age of 3-5 years old were well able to find their way back to the North Sea; that the brackish zone in the estuary is important to adapt from fresh to saltwater and that the North Sea coast is an important habitat for the sturgeon to mature.


**Figure 7 - Cooperation with the French research institutes at the breeding and rearing centre in Saint-Seurin-sur-l'Isle, France.**

From 2015 to 2020, the Rhine Sturgeon Platform was funded by the *Droomfonds* project Haringvliet (financed by the *Nationale Postcode Loterij*, in which six large Dutch nature conservation NGOs participate) and by the EU funded LIFE Nature and Biodiversity (2016) and LIFE IP Delta Nature program (2016).

As part of the LIFE program, the Rhine Sturgeon Project obtained support and support letters for from various international partners. These organisations support a gradual recovery of estuarine and coastal nature development and improved conditions for the return of migratory fish by reconnecting the Rhine/Meuse river basins with the North Sea. In 2016, support letters were received from:

- International Commission for Protection of the Rhine (ICPR), Koblenz, Germany;
- Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany;
- DREAL Aquitaine, Regional Department of the Ministry of Environment, Poitiers, France;
- District Council Dusseldorf, North Rhine-Westphalia, Germany;
- World Sturgeon Conservation Society (WSCS), Neu Wulmstorf, Germany;
- French National Institute of Research in Science and Technology for Environment and Agriculture (IRSTEA), Cestas (Bordeaux), France;
- Leibnitz-Institute of Freshwater Ecology and Inland Fisheries (IGB);
- Center for Study of Mediterranean Rivers (CERM), Manlleu, Spain;
- Gesellschaft zur Rettung des Störs, Rhineland Fishery Association;
- Stiftung Wasserlauf, Siegburg, Germany;
- Rheinischer Fischereiverband, Siegburg, Germany.

These organisations support the work of a feasibility and risk assessment study to analyse the possibilities for a sustainable reintroduction of the sturgeon in the Lower Rhine and to continue with experimental releases.

[2] In 2012 an tracking study focused on the migration path of the experimental released juvenile sturgeon to the North Sea from the Rhine system. For this research the migration behavior of 47 tagged European sturgeons in the spring and summer of 2012 were studied. In 2015, a similar study was carried out with 53 sturgeons released upstream at the German border. The NEDAP TRAIL System of Rijkswaterstaat was used in both studies to monitor the movement of the sturgeons.

In 2018 the Rhine Sturgeon Project has agreed on an official contract with the France sturgeon partner responsible for the European sturgeon conservation and breeding program, MIGADO[3]. This is a major step within the cooperation. The supply of sturgeon larvae and fingerlings for the coming 5 years (until 2024) is secured for experimental releases.

The Rhine Sturgeon Project is officially partner and contributes also financially to the European Sturgeon Conservation Program at the breeding and rearing centre in Saint-Seurin-sur-l'Isle.

## 3.5 Towards the *First* Action Plan for the Sturgeon for the Lower Rhine

Sturgeons are excellent ambassadors for nature conservation approaches because they utilize various habitat shifts during the completion of their life cycle over marine, estuarine and riverine habitats. A consequent restoration and protection of critical habitats for sturgeons will enhance the ecological quality of rivers, coastal and marine waters and the resources associated to them. As a result, the interconnected and restored aquatic habitats will benefit from more floral and faunal diversity. This is the common understanding of sturgeon specialists from all around the world, repeatedly declared in international conferences and declarations[4].

The European Sturgeon Conference in 2018[5] - jointly organized the Government of Austria in the frame of the Austrian EU Presidency and the International Commission for the Protection of the Danube River – was to raise awareness to the challenges in place and to trigger comprehensive action for sturgeon conservation and restoration at Pan European and basin level.

The key recommendations can be summarized as to:

1. Protect and preserve sturgeon species as emblematic flagship or umbrella species on biodiversity conservation for future generations.
2. Account for the need for long-term and adequately resourced sturgeon conservation measures supported by improved governance framework and a comprehensive basin Action Plan.
3. Protect and restore rivers as dynamic, disturbance driven systems. Their hydro morphology and ecosystem services depend upon intact functionality as well as longitudinal/lateral connectivity.
4. Ensure that attempts to restore and protect sturgeon populations to effective control and combat fraud and illegal, unregulated and unrecorded catch and trade while at the same time supporting sustainable aquaculture as an alternative mode of production of sturgeon commodities.

In line with the above formulated recommendations, the partners of the Rhine Sturgeon Project are committed to work on a sustainable return of the sturgeon in the Lower Rhine and the North Sea at the long term. The partners are inspired by the successful results in France and Germany, the positive output of all the research conducted, the results of the experimental releases and above all the successful French – German - Dutch cooperation.

In 2018, the partners of the Rhine Sturgeon Project initiated the development of the *First Action Plan for the European sturgeon for the Lower Rhine* focussing on objectives and activities to be conducted in the period 2020-2030. The First Sturgeon Action Plan for the Lower Rhine aims to determine if a viable population of the European sturgeon can be

[3] http://www.migado.fr/
[4] The 'Ramsar Declaration on Global Sturgeon Conservation' in 2005 and the 'Vienna Declaration on Global Sturgeon Conservation' in 2018 initiated by the World Sturgeon Conservation Society (WSCS).
[5] https://danubis.icpdr.org/event/18288

established in the Lower Rhine and the southern North Sea by 2030 - 2040. Developing the First Sturgeon Action Plan for the Lower Rhine is also part of the LIFE IP Delta Nature program of the Ministry of Agriculture, Nature and Food Quality, NL.

The main goal (until 2030) to which the First Sturgeon Action Plan for the Lower Rhine will contribute is to finalize the feasibility and risk assessment phase and prepare the decision for an official reintroducing of the European sturgeon population in the Lower Rhine by 2030 (or sooner if potentially feasible).

This First Sturgeon Action Plan for the Lower Rhine contributes and is supplementary to the National Sturgeon Action Plans of Germany and France. The First Sturgeon Action Plan for the Lower Rhine is in line with the French and German initiatives and builds up existing experiences and knowledge from these two river systems, collected by IGB, IRSTEA and MIGADO. Together, these initiatives are crucial and most probably the last chance to save the European sturgeon species from extinction.

The potential return of the European sturgeon in the Rhine is a result of the extensive work that has been done in the Rhine basin in the last decades to facilitate the return of houring, shad, seatrout and salmon to the system. Besides, both in The Netherlands and in Germany, huge investments were done on flood prevention measures, implementing the EU Water Framework Directive (WFD) and define, restore and protect Natura 2000 sites in the basin. Riverine habitats have been restored in recent decades, floodplains are again connected to the river, river water has become cleaner and fishing more sustainable. Many potential threats seem to be no longer an impediment to the return of this impressive freshwater fish.

In 2018 and 2019, an extensive stakeholder analysis and a process of joint fact finding was conducted to discuss the challenges and threats and built up awareness and support with key stakeholders and partners (see also next paragraph). An important outcome of the First Sturgeon Action Plan for the Lower Rhine will be to support cooperation among the Rhine Sturgeon Project partners and stakeholders based on transparency and shared responsibilities.

In this First Sturgeon Action Plan for the Lower Rhine, the partners of the Rhine Sturgeon Project outline the necessary actions and steps towards a potential return of the European sturgeon by 2030 – 2040. The First Action Plan is supported by the Ministry of Infrastructure and Water Management and the Ministry of Agriculture, Nature and Food quality in The Netherlands, DREAL Aquitaine, Regional Department of the Ministry of Environment in France and the Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia in Germany. The First Action Plan was developed in cooperation with more than 20 key stakeholders.

## 3.6 Cooperation with key stakeholders and partners

A successful reintroduction is not possible without close coordination and cooperation with key stakeholders and partners. Discussions were held with all relevant stakeholders and several workshops were conducted to discuss potential obstacles, to find solutions and to identify actions. This First Sturgeon Action Plan for the Lower Rhine is developed in close cooperation with key stakeholders. It comprises objectives and actions for the short-term (2 years), medium-term (5 years) and long-term (10 years).

The First Sturgeon Action Plan for the Lower Rhine provides an overview of the strengths, opportunities and threats / risks. Both the opportunities and the threats are substantiated based on a thorough review of literature, feasibility studies, results of experimental releases and a process of joint fact finding with key stakeholders.

The following actors and stakeholders were consulted or were actively engaged in the development of the First Sturgeon Action Plan for the Lower Rhine:

- *International Conventions*: Bern Convention, International Union for Conservation of Nature (IUCN), Convention on the International Trade in Endangered Species (CITES), Convention on Migratory Species (CMS)

- *River Basin Organization*: International Commission for Protection of the Rhine (ICPR) and its relevant working groups and expert groups;

- *National Governments*: Ministry of Infrastructure and Water Management and the Ministry of Agriculture, Nature and Food quality in The Netherlands;

- *Regional Governments*: provinces of North-Holland, South-Holland, Utrecht, North-Brabant and Gelderland; regional departments of the Ministry of Infrastructure and Water Management; Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia (Germany) and DREAL Aquitaine, Regional Department of the Ministry of Environment, France;

- *Scientific Institutions*: IRSTEA and MIGADO (France), IGB (Germany), RAVON (The Netherlands), MARIN (The Netherlands), Universities of Leiden, Wageningen and Delft;

- *Civil Society Organizations (CSOs)*: WWF – The Netherlands, ARK Nature, Dutch Angling Association, Dutch professional fishermen's associations (VisNed, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West), Cascade (sand and gravel industry), EWA (Dutch organization of Energy from Water), Port of Rotterdam, Koninklijke BLN-Schuttevear (Dutch organization for inland navigation), VEMW (Dutch organization for industrial water users), Waterrecreatie Nederland and Watersportverbond.

# 4. Suitability of the Lower Rhine and North Sea for reintroduction of sturgeon

## 4.1 The European sturgeon is out there

Although the European sturgeon is endangered and almost extinct, due to reintroductions in France and Germany the species is still present in the Baltic Sea, the North Sea and the Gulf of Biscay. As for the Lower Rhine, the main question is if the Lower Rhine is potentially fit for a sustainable reintroduction and natural spawning?

Figure 8 shows an overview of recapture reports collected between 2006 and 2017. Individual sturgeons are marked as either originating from the restocking programmes from the Gironde (white dots), the Elbe (blue dots), or of the experimental releases from the Rhine (green dots). The Rhine and its potential sturgeon habitat is strategically located between the Gironde and the Elbe river basins.

From this map it becomes clear that as a result of the highly migratory nature of the species, sturgeons are present in the North Sea and near the mouth of the river Rhine.

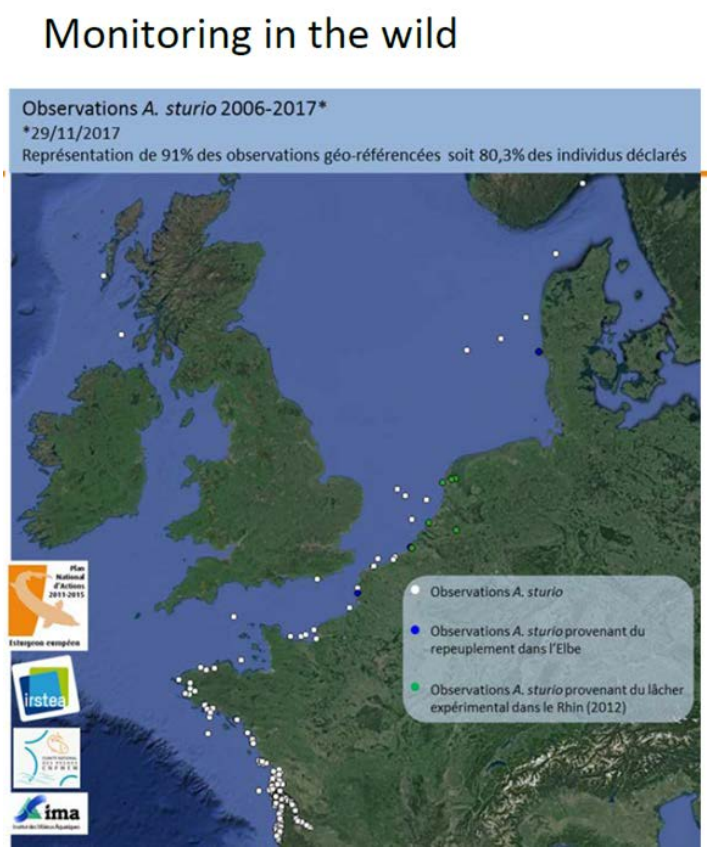


**Figure 8 - Monitoring results between 2006 and 2017 of European sturgeons in the wild.**

## 4.2 Overview of anthropogenic factors: potential threats and adverse impacts

In 2018, the European Sturgeon Platform conducted a risk assessment[6], based on all available data, feasibility studies, (inter)national literature and results of the two experimental releases. In the assessment the opportunities, potentials and obstacles were summarized, and preliminary actions and key actors were identified. For all anthropogenic factors the potential threats, adverse impacts and potential measures were discussed and further analysed by conducting a SWOT analysis with all relevant key stakeholders, multiple interviews, workshops and expert meetings.

In this paragraph, the outcome of the assessment, the SWOT analysis, interviews and workshops determining the main threats and impacts related to the various life cycle stage of

[6] Kranenbarg J., B. Houben & N. Brevé, 2018. Preliminary study of Rhine action plan for European sturgeon. Necessary actions and actors with regard to a reintroduction program in the Rhine. RAVON, Nijmegen. Report nr. 2017.105.

the sturgeon are summarized. For more details of the results of the risk assessment see Annex B. The results of the SWOT analysis are summarized in Annex C.

The potential anthropogenic factors that could impede the reintroduction and natural spawning of the sturgeon in the Lower Rhine are schematised in the figure below.

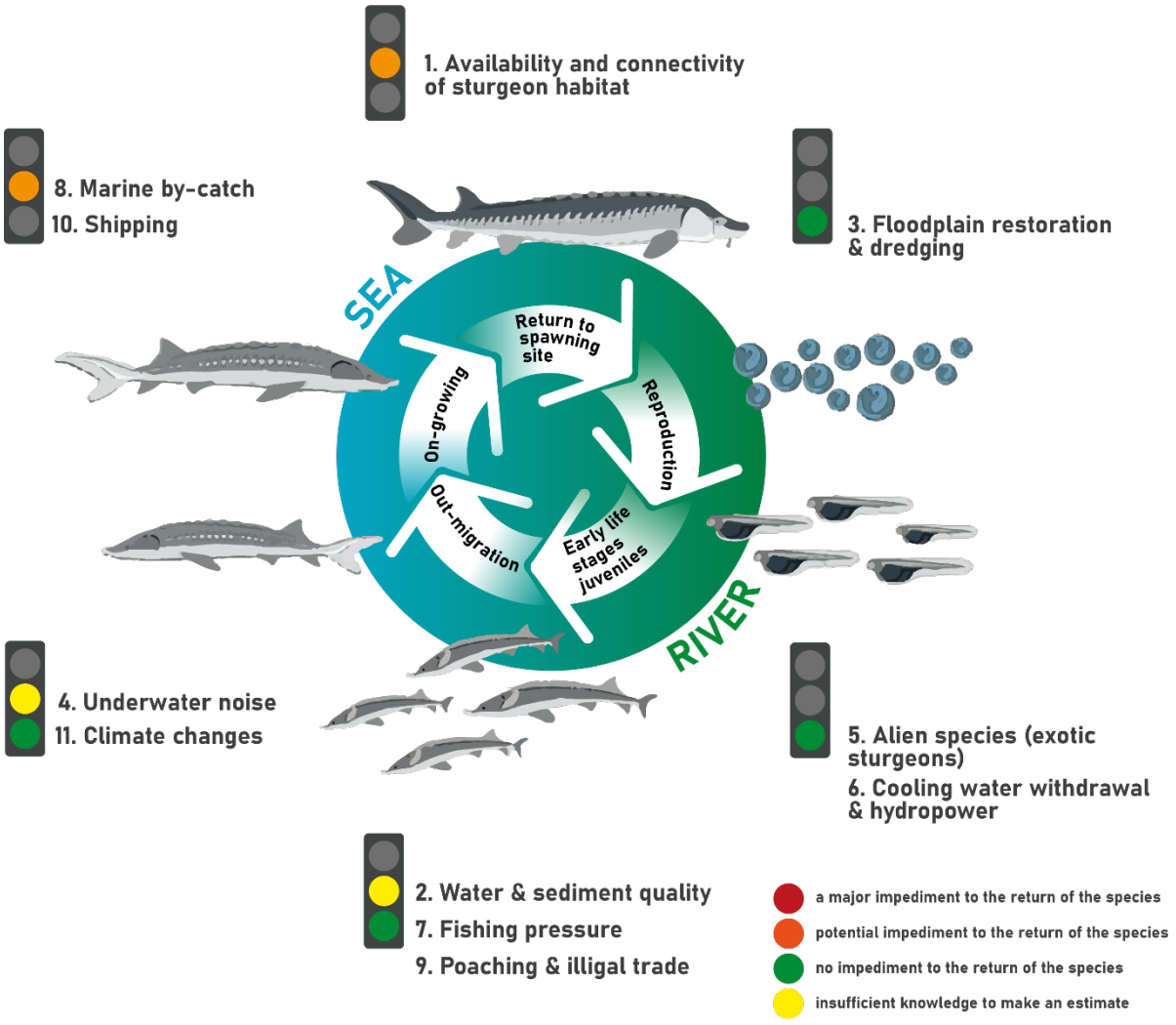


**Figure 9 - Schematic lifecycle of the sturgeon (PAN EU Action Plan, 2018) and potential threats impacting the various stages for the Lower Rhine.**

Table 1 provides a summary of main threats impacting the life cycle stages of the sturgeon and the current status of the Lower Rhine system. It can be concluded that:

1. From the 11 identified critical anthropogenic factors for the Lower Rhine, 6 factors do not impede the return of the sturgeon and 4 factors do have some concern. These 4 factors were analysed and discussed more in detail in the workshops and expert meetings.

2. Since the last decades, due to national policies on integrated water resources management in combination with EU regulation and joint efforts of the International

Commission for Protection of the Rhine (ICPR), the water quality and ecological habitat of the Rhine has improved considerably.

3. The water quality, the flow conditions and the substrate of the Rhine are potentially suitable for the spawning of European sturgeon. For the Lower Rhine the hydro morphology is relatively undamaged and partly restored. So called 'Room for the river' projects and potential measures such as longitudinal dams ensure that the habitat variation will increase, and possibly provide habitat for young sturgeons.

4. With the partially opening of the Haringvliet sluices in 2018, the start of a recovery of the brackish zone in the estuary of the Rhine is an important step forward for the restoration of (inter)national migratory fish species.

5. There are no major *downstream migration* obstacles for the species between the potential spawning and rearing habitats and the North Sea. The Rhine has an open connection with the sea through the Nieuwe Waterweg (Port of Rotterdam) and the partially open Haringvliet sluice.

6. There is still some concern related to the *upstream migration*, although the connectivity of the Rhine is secured up to the first main-sluice-weir system at Iffezheim in Germany. The narrow entrance of the Nieuwe Waterweg, its busy shipping traffic and the irregular partially opening of the Haringvliet might be an obstacle for migratory fish, including sturgeon.

7. Feeding conditions along the Dutch coast for the growing young sturgeons are good, although fishing activities and marine by-catch might be a bottleneck in the coastal areas.

8. Important pressure that requires more analysis and research is the intense shipping and inland navigation on the Lower Rhine and its impact on especially upstream migrating adult sturgeon.

9. Considering future climate changes, the Rhine is potentially one of the most suitable sturgeon rivers in Europe.

**Table 1 - Schematic lifecycle of the sturgeon and main threats impacting the various stages for the Lower Rhine.**

| **Main threats** | **Impact in life cycle of sturgeon** | | | **Status in the Lower Rhine** | **Main literature reference (if applicable)** |
|---|---|---|---|---|---|
| | *adult* | *egg & larval* | *Juvenile* | | |
| **1 – Availability and connectivity of sturgeon habitat** | | | | | |
| *Upstream migration* |  | n/a | n/a | There is still some concern related to the *upstream migration*, although the connectivity of the Rhine is secured up to the first main-sluice-weir system at Iffezheim in Germany. The narrow entrance of the Nieuwe Waterweg, its busy shipping traffic and the irregular partially opening of the Haringvliet might be an obstacle for migratory fish, including sturgeon.<br><br>The Nieuwe Waterweg (port of Rotterdam) is always open, however during their reproduction migration, with a peak between April and June, the Haringvliet sluices and discharge sluices in the Afsluitdijk will be frequently closed due to low river discharge. | Kranenbarg *et al.* 2018.<br><br>Groen *et al.* 2019 |
| *Downstream* |  | n/a |  | The spawning grounds are located between the | Breve *et al.* |

| Main threats | Impact in life cycle of sturgeon | | | Status in the Lower Rhine | Main literature reference (if applicable) |
|---|---|---|---|---|---|
| | *adult* | *egg & larval* | *Juvenile* | | |
| *migration* | | | | German-Dutch border and approximately Bonn, along the main stem of the Rhine. The spawning and rearing habitats are in open connection with the sea.<br><br>There are no major *downstream migration* obstacles for the species between the potential spawning and rearing habitats and the North Sea. The Rhine has an open connection with the sea through the Nieuwe Waterweg (Port of Rotterdam) and the partially open Haringvliet sluice. After finalizing the fish migration river in the Afsluitdijk between the Waddenzee and Lake Ijsselmeer, fish migration will be improved here too.<br><br>Spawned sturgeons can swim back to the sea and the maturation areas along the coastal zone and estuary are accessible to young sturgeons. | 2018. |
| *River habitat quality* | | | | Habitat variability has been affected by straightening river sections and normalisation of the Rhine to improve inland navigation. However, suitable spawning grounds are sufficiently present. | Staas, 2017.<br><br>Groen *et al.* 2019 |
| *Estuary habitat quality* | n/a | n/a | | Estuarine habitats have been degraded by dams. However, there is a fresh-salt transition in the Nieuwe Waterweg and since 2018, a partial opening of the Haringvliet sluices will result in an estuarine brackish zone up- and downstream of the sluice. The effect on migratory fish is monitored actively. | N/A |
| *Coastal zone habitat quality* | | n/a | | The conditions along the Dutch coast are good in terms of habitat quality and sufficient nourishment. | Winter *et al.* 2015. |
| *Hydropower* | | | | There are no hydropower stations along the Waal and the Rhine in Germany.<br><br>As migrating sturgeon (upstream and downstream) will mainly use the mainstream of the Rhine and the Waal, passage of the 3 hydropower plants along the Meuse and Nederrijn is not likely and the potential impact shall be small.<br><br>However: river modification through hydropower operation can restrict the availability and quality of habitats on side branches such as the river Lek. Along the Rhine in The Netherlands, the weir structures near Hagestein and Amerongen do have turbines for hydropower. The two weirs are passable for upstream migrating fish. For downstream migration no protection measures are in place. | De Leeuw & Winter, 2008.<br><br>Workshop with Maarten Bruijs (Pecten Aquatic), January 2019. |
| **2 - Water & sediment quality** | | | | | |
| Water quality | | | | The water quality improved drastically over the last decades and the measures taken as part of the 'room for the river' program and the WFD improved the ecological status of the Lower Rhine. This had a favourable influence on the potential development of the sturgeon in the Rhine by restoring habitat (spawning and egg-setting areas, growth areas, foraging sites). | Plum *et al.* 2014<br><br>IKSR-CIPR-ICBR, 2018 |
| Sediment quality | | n/a | | The sediment in the Lower Rhine is polluted for decades. The tide is turning, pollution sources | Acolas *et al.* 2019 |

| Main threats | Impact in life cycle of sturgeon | | | Status in the Lower Rhine | Main literature reference (if applicable) |
|---|---|---|---|---|---|
| | *adult* | *egg & larval* | *Juvenile* | | |
| | | | | decreased severely, and polluted sediments are removed and processed. However, eels caught in the Lower Rhine still exceed safe consumption levels. The effect on sturgeon(reproduction) is unknown. | Van den Dungen *et al.* 2016.<br><br>Maury-Brachet *et al.* 2008 |
| **3 – Floodplain restoration and dredging** |  |  |  | River modification through flood protection measures as well as transformation of wetlands can enhance the availability and quality of habitats. A good example is the 'room for the river' programme to restore flood plains in The Netherlands and the new program of Integrated River Management (IRM).<br><br>Dredging changes, the heterogeneity of the riverbed in the Rhine. Normalization of the riverbed by dredging to serve the needs for navigation affects potential shelter in deeper gullies and holes. However, all sediments are reused in the river and due to the highly dynamic circumstances in the Rhine the effect is expected to be minimal. Research and monitoring should be executed.<br><br>Remark, potential spawning ground should be protected against dredging activities. | www.ruimtevoorderivier.nl<br><br>Dredging policy in The Netherlands (RWS). |
| **4 – Under water noise** |  | n/a |  | The effects of underwater noise on sturgeon are uncertain. Effects on several fish species are shown. Additional research and monitoring should be conducted. | Slabbekoorn *et al.* 2010<br>Groen *et al.* 2019 |
| **5 – Alien species (exotic sturgeons) & impact of predators.** |  |  |  | At present, the presence of exotic sturgeon species in the Rhine is limited. No breeding is known in the Rhine.<br><br>Relatively many exotic species have settled in the Rhine basin. All these species eat other fish (also eggs, larvae and smaller juvenile sturgeon). The effect on sturgeon(reproduction) will be monitored. Based on the experience in France, exotic species and other predators is not observed as a threat to the return of the species.<br><br>For eggs and larvae and early juveniles, the goby species as well as increasing density of catfish could be a problem. This needs to be monitored and investigated further.<br><br>Based on observations and information of professional fishermen, the increase of the population of seals in the coastal zone is negatively affecting the fish population. This might have an impact on the sturgeon as well and should be studied and monitored during the years to come. | Unpublished data Dutch Angling association.<br><br>Field experiences from France. |
| **6 – Cooling water withdrawal** |  |  |  | The impact of fish impingement at cooling water intakes mainly applies to small length classes (eggs, larvae, 0 + fish, < 15 cm). Juveniles and adults are withdrawn to a much lesser extent due to their ability to escape from the intake area by increased swimming capacity. For larvae ad early juveniles, water abstraction can be detrimental when located adjacent to the main migration corridors. | Workshop with Maarten Bruijs (Pecten Aquatic), January 2019. |

| Main threats | Impact in life cycle of sturgeon | | | Status in the Lower Rhine | Main literature reference (if applicable) |
|---|---|---|---|---|---|
| | *adult* | *egg & larval* | *Juvenile* | | |
| | | | | Maximum flow rate at inlets is regulated at ~0,3 m/s and in front of the inlet trash racks are applied as a standard feature, which strongly reduce withdrawal of larger specimens. The number of large-scale (cool) water inlets along the main stem of the (lower)Rhine (i.e. directly abstracting from the river) is limited. It is expected that the impact on sturgeon will be very low, because sturgeons are good swimmers, and most will not encounter the vicinity of large (cooling)water intakes. | |
| **7 - Fishing pressure** | | | | | |
| Professional fishing on the river |  | n/a |  | There is hardly any professional commercial fishing along the major migration corridors of the Lower Rhine because of the eel ban due to pollution of sediments. | Staatscourant 2011, 5691<br><br>https://zoek.officielebekendmakingen.nl/stcrt-2011-5691.html |
| Recreational fishing on the river |  | n/a |  | Potentially, there is a lot of recreational fishing along the major migration corridors of the Lower Rhine. However, the chances of catching sturgeon are low and 'catch & release' is common practice.<br><br>Attention must be paid to the impact of by-catch by recreational fishing (awareness and proper 'catch and release' handling to minimise mortality). Although the volumes are much smaller, the impact of by-catch by recreational fishing is relatively high compared to marine by-catches by professional fishermen (IMARES, 2008). | IMARES, 2008<br><br>Unpublished data Dutch Angling association. |
| **8 - Marine by-catch** |  | n/a |  | Pressure of professional commercial fishing in the estuary, coastal waters and at sea is high. Risk of mortality due to marine by-catch. Survival rate depends on awareness of fisherman and innovation of fishing gear. Sector is closely involved in raising awareness and conducting monitoring. | Winter *et al.* 2015<br>Michelet, N. 2011 |
| **9 – Poaching and illegal trade** |  | n/a | n/a | No issues for the Rhine. Control needed when reintroduced. | n/a |
| **10 – Shipping** | | | | | |
| Downstream part / Port of Rotterdam |  | n/a |  | The Port of Rotterdam is intensively navigated. Sturgeons are vulnerable for propeller strikes, as is shown in studies in the Delaware River (Brown and Murphy, 2010) and others. | Spierts, 2016<br><br>Brown & Murphy, 2010.<br><br>Groen *et al.* 2019 |
| Along the river |  |  |  | The river Rhine is intensively navigated. Sturgeons are vulnerable for propeller strikes, as is shown in studies in the Delaware River (Brown and Murphy, 2010) and others.<br><br>Ship propellers can damage sturgeons severely; the potential impact in the Rhine is still unknown. The influence of navigation on the survivability of | Spierts, 2016<br><br>Brown & Murphy, 2010.<br><br>Groen *et al.* 2019 |

| Main threats | Impact in life cycle of sturgeon | | | Status in the Lower Rhine | Main literature reference (if applicable) |
|---|---|---|---|---|---|
| | *adult* | *egg & larval* | *Juvenile* | | |
| | | | | sturgeons in the river Rhine must be further investigated. | |
| **11 - Climate changes** | | | | | |
| Water temperature |  |  |  | Climate models indicate that the temperature regime of the Rhine will remain favourable.<br><br>Since last years, we observe more frequent periods of draught especially in the months of April and May, resulting in a decrease of discharge and low water tables. This might have an impact on the development of temperatures for spawning. This phenomena is not really modelled yet. | Lassalle *et al.* 2009, 2010 and 2011. |
| Discharge regime |  |  |  | Climate models indicate that the discharge regime of the Rhine will remain favourable.<br><br>Since last years, we observe more frequent periods of draught especially in the months of April and May, resulting in a decrease of discharge and low water tables. This might increase the impact of inland navigation. | Lassalle et al, 2009, 2010 and 2011.<br><br>De Wit *et al.* 2008 |
| | | | | | |

| | |
|---|---|
|  | *a major impediment to the return of the species* |
|  | *potential impediment to the return of the species* |
|  | *no impediment to the return of the species* |
|  | *there is insufficient knowledge to make an estimate* |

## 4.3 Availability and connectivity of sturgeon habitat

In particular from the second half of the 19th century onwards the morphology of the Rhine changed due to modifications carried out by man, including flood protection works, river training works, the removal of bends, the deepening of the river (dredging) and the construction of weirs and groynes (normalisation of the river). This has impacted the morphology of the riverbed and blocked the connectivity and accessibility for migratory fish in large parts of the Rhine basin (especially the middle- and upper part).

In general, the development of the river with croynes to mobilize the sediment is creating migrating sand dunes and mobility of finer sediment that adversely influences the macrofauna. The reduction in macrofauna diversity and abundance also negatively affects the feed availability for fish including sturgeons. The homogenization of river cross section, the loss of banks and pools further eliminates the refuges for juveniles. As such, river normalization works by croynes has a substantial adverse effect on the fish community structure and abundance.

For sturgeon, the following river habitats are important and must be available and accessible:

- Spawning grounds with suitable conditions for the development of eggs and larvae. There is potential spawning habitat in The Netherlands near the German border and there is accessible spawning habitat along the mainstream of the Rhine in NRW, Germany. The

Lower Rhine in the Netherlands is important as the main migration corridor towards the North Sea and provides important growth areas for young sturgeons (1-2 years).

- Growing up habitat downstream from the spawning grounds for juvenile habitat during the first to second year of life. These areas are available in Germany and The Netherlands. Based on robustness in suitable growth habitat at various flow rates, the Waal and the Lower Rhine – found to be most suitable as growth areas for young sturgeons.
- Pools and deeper places for the adult sturgeons to hide, especially in the vicinity of the breeding sites.
- A gradual fresh-salt gradient for migration between the sea and the river system.
- Food-rich estuarine and coastal zone for the further growth of juvenile sturgeons from the first or second year of life.

### Availability of spawning grounds

The study by Staas (2017) shows that more than 30% of the mainstream of the Lower Rhine in North Rhine-Westphalia is potentially suitable for spawning. There are six locations identified that are promising (see Annex B). These areas are located around 50, 60, 110, 130, 180 and 190 km upstream of the Dutch border, respectively. There may also be suitable spawning grounds in the Lippe, in the Rhine upstream of North Rhine-Westphalia, or more downstream around the Gelderse Poort in The Netherlands. Furthermore, side canals laid out for nature development may offer suitable spawning habitats.

In Germany (NRW), potential critical sturgeon habitats in the lower Rhine are already identified and they are part of the FFH area '*Rhein-Fischschutzzonen zwischen Emmerich und Bad Honnef*', for the moment there is no need to extend these areas.

### Availability of growing up habitat

Based on the analysis of robustness in suitable growing up habitat at various flow rates in The Netherlands, the Waal, Biesbosch and the Lower Rhine seem to be most suitable. The deeper shore areas next to the shipping channel (between the croynes or behind longitudinal dams), within the side channels and wetland and flood plain areas connected to the rivers are suitable as growth habitat for the sturgeon. At the Waal, the proportion of suitable growing up habitat increases at a flow rate of 4000 m³/s as the water depth in the shallow part of the relatively wide shore zone increases (see figure 10).

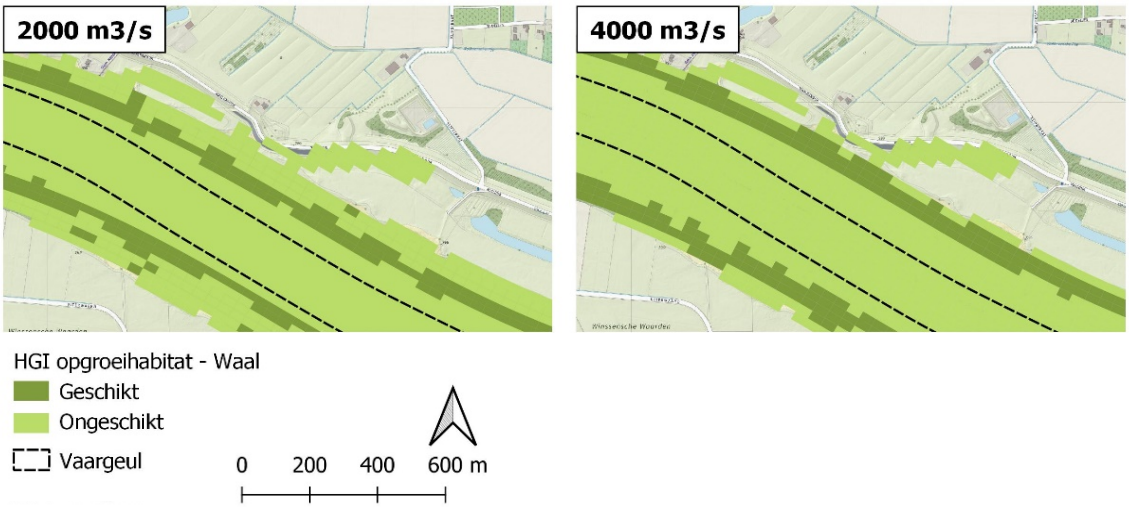


**Figure 10 - Shift from suitable growth habitat in Waal at a flow rate of 2000 m3/s to 4000 m3/s (Source: Groen *et al*. 2019, RAVON Report No. 2018.152).**

After their first year of life, juvenile sturgeons will mature further in the estuarine part of the river system and the coastal zone (Williot *et al*. 2011). The nutrient-rich coastal areas are of great importance for the further growth of young sturgeons and probably also as a foraging area for adult sturgeons. The model study of Winter *et al*. 2015), shows that the Dutch coastal zone contains a good habitat for the growth of juvenile sturgeons. Further recovery of estuary habitats in brackish zones is important for acclimatization of migratory fish (Staas, 2017; Groen *et al.* 2019).

### Connectivity

In comparison with many other large rivers, the lower reaches of the Rhine are free accessible for migratory fish and only a few weirs are constructed. Upstream from the Dutch border, the Rhine can be freely migrated for approximately 660 km up to the weir at Iffezheim.

The policy of the Ministry of Infrastructure & Water management in The Netherlands aims to restore connectivity as much as possible for migratory fish (salmonids) by constructing fish passes and fish-friendly lock management such as the partially opening of the Haringvliet sluices and the construction of the fish migration river in the Afsluitdijk.

Figure 10 provides an overview of the migration possibilities for sturgeon from 2018. This shows that if the measures for the Haringvliet sluices and the Afsluitdijk (fish migration river from 2025) are implemented, the possibilities for the sturgeon and other migratory fish species to migrate between the sea and the Rhine system improve significantly. This means that a large part of the area where the species reproduced until the beginning of the 20th century are accessible.

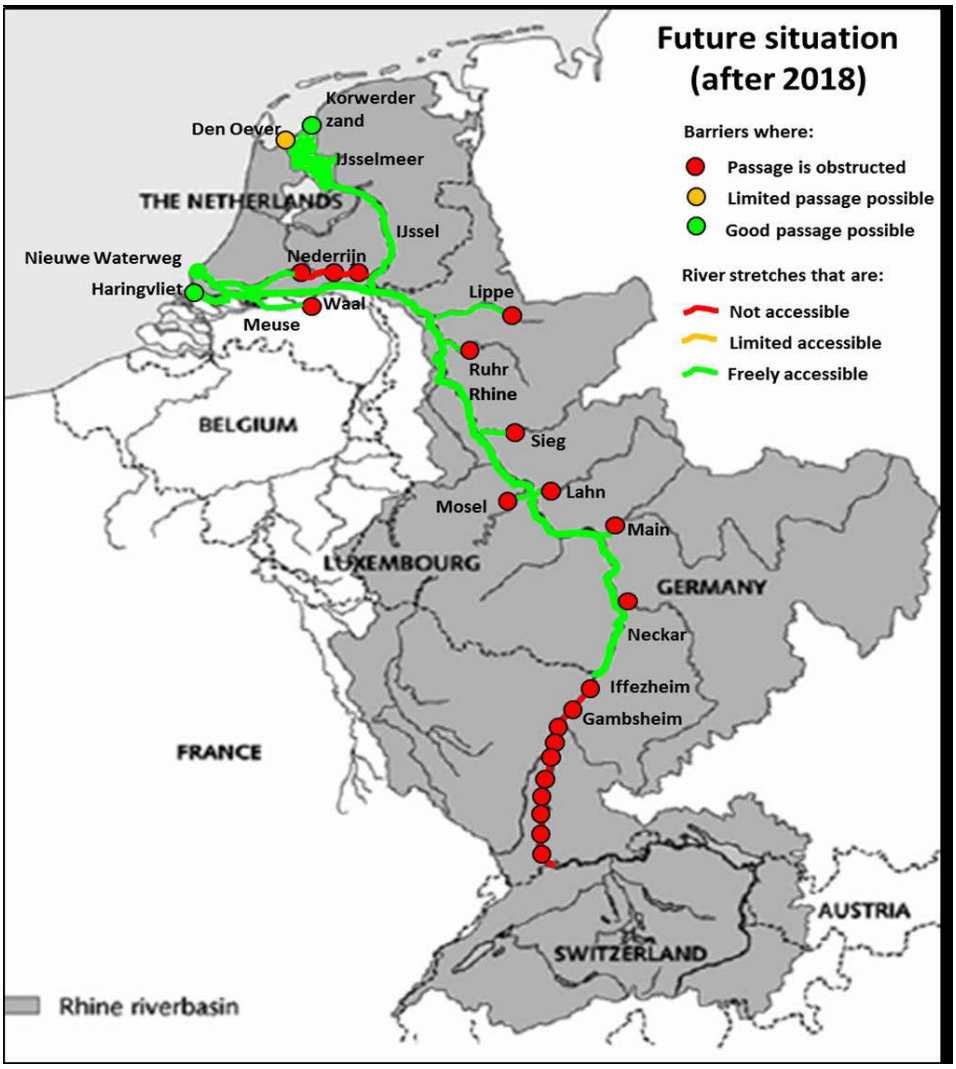


**Figure 11 - Migration possibilities for sturgeon in the Rhine from 2018. Source: Winter *et al.* 2015.**

As stated in paragraph 4.2, there is still some concern related to the upstream migration. The narrow entrance of the Nieuwe Waterweg, its busy shipping traffic and the irregular partially opening of the Haringvliet might be an obstacle for migratory fish, including sturgeon. The coming years will be important to learn more about the impact on fish migration and estuary development due to the partly opening of the Haringvliet sluices. It is a process of 'learning and implementing' a new water management strategy in the lower part of the Rhine, to find a maximum balance between ecology, economy and water safety. A joint cooperation with Rijkswaterstaat, professional fishermen, regional water authorities and nature organisations is crucial.

Figure 12 – Port of Rotterdam, the open connection with the North Sea.

Figure 13 - Artist impression of the fish migration river in the Afsluitdijk (projected).

Figure 14 – Haringvliet sluices, the storm surge barrier between the mouth of the Rhine and the North Sea.

## 4.4 Water & sediment quality

From the first half of the 20th century, the Rhine became increasingly polluted by the direct discharge of industrial and domestic wastewater. This caused a lot of fish mortality and many species disappeared. The fire at the Swiss chemical company Sandoz in 1986, in which heavily contaminated fire extinguishing water led to enormous fish mortality, was a wakeup call for the countries within the Rhine basin. The 'Rhine Action Programme' was introduced by the ICPR in 1987 as a comprehensive ecological restoration programme of the Rhine. The Atlantic salmon (Salmo salar) was chosen as the symbol for improving the environment of the Rhine basin.

In January 2001, the responsible ministers adopted the Rhine 2020[7], a 'Programme on the Sustainable Development of the Rhine' following the Rhine Action Programme (1987-2000). Core parts of the Rhine 2020 programme are the implementation of the Rhine habitat patch connectivity, Salmon 2020 and further improvement of water quality and ecology. The Rhine 2020 supports the implementation of the EC-Water Framework Directive[8] and will contribute to achieving a 'good chemical and ecological status' in the Rhine river basin by 2027. The Rhine is now one of the cleanest major rivers in Europe.

Despite the improved water quality, there is still contamination, especially as a built-up of the past in layers of sediment in the estuary and downstream branches of the river. In theory, due to old age and bottom-feeding, sturgeon can accumulate levels of toxic substances such as

[7] https://www.iksr.org/en/icpr/rhine-2020/
[8] https://www.iksr.org/en/eu-directives/european-water-framework-directive/

insecticides, heavy metals and PCBs. For example, eels caught in the Lower Rhine still exceed safe consumption levels. However, the effect on sturgeon(reproduction) is still unknown.

## 4.5 Floodplain restoration and dredging

### Floodplain restoration

The floodplain restoration measures in the lower parts of the Rhine in The Netherlands and Germany, part of the Rhine Action Programme and Rhine 2020 programme, have had a favourable influence on the potential habitat development (spawning and egg-setting areas, growth areas, foraging sites).

Besides the ongoing work on the WFD and Natura 2000, nationwide policies are being implemented in The Netherlands that could also be beneficial to the reintroduction of the sturgeon. The Ministry of Infrastructure and Water management is implementing a program called *Integrated River Management (IRM).* The IRM Programme is complemented by the LIFE IP Delta Nature program of the Ministry of Agriculture, Nature and Food Quality, NL[9].

With the IRM Programme, the ministry together with the regional stakeholders, will develop an integrated strategy and program of measures (such as longitudinal dams, smart dredging and supplementation, riverbed restoration, removal of banks and flood plain development) to cope with the challenges of the main river system in The Netherlands related to water safety, navigability, freshwater availability, water quality and natural and economic development. In order to maintain river functions sustainably, new policies will be developed related to maintain the discharge capacity and riverbed stability of the river in the coming years. The IRM programme will be developed in close cooperation with the implementation of the Nature 2000 ambitions for the main river system. LIFE IP Delta Nature takes up the challenge to improve governance related to aquatic nature development and the implementation and realization of Nature 2000 in The Netherlands.

**Figure 15 - The sturgeon is also part of a promotional drawing of Cascade, the trade association of the mineral-extracting industry: sand, gravel, clay, limestone and silver sand-winning in the Netherlands.**

[9] https://life-ip-deltanatuur.nl/cms/view/58797179/english

### Dredging

In the Netherlands, the dredging policy and riverbed maintenance is based on maintaining a guaranteed depth of 3.5 m compared to the so-called agreed low river level (*Overeengekomen Lage Rivierstand, OLR*). In addition, the aim is to dredge as efficient as possible, so that no sediment disappears from the river system. Excess of sediment is deposited in deep trenches and holes in the river. This changes the Natural heterogeneity of the soil and this can be disadvantageous for the presence of deeper places near the breeding sites or foraging areas for young sturgeons. Deep trenches and holes in the riverbed can serve as a shelter (refugium) and resting place for adult migrant sturgeons (and other migratory fish species). Most of the deeper pits are in the outside bend just behind the heads of the groynes (Groen *et al.* 2019).

There are relatively much deeper pits in the river branches in The Netherlands. To maintain these can be of great importance as resting areas for upstream migrating adult sturgeons.

**Figure 16 - Millingerwaard near Nijmegen, The Netherlands. A potential sturgeon habitat.**

## 4.6 Alien species (exotic sturgeons) and predators

There are no observations of exotic sturgeon species reproducing in the Rhine basin.

Since the extinction of the European sturgeon, relatively many exotic species have settled in the Rhine basin. All these species eat other fish. The exotic bottom-bound goby species, which nowadays are abundant in the Rhine, are expected to be able to feed on the eggs and larvae of the European sturgeon. Pike perch, which is also very common in the Rhine, is expected to feed on smaller juvenile sturgeons. The effect on sturgeon(reproduction) will be

monitored. Based on the experience in France, exotic species and other predators is not observed as a threat to the return of the species.

In the adult phase, the European sturgeon is no longer predated due to its size. The eggs, larvae and juveniles however can be predated by native and non-native (exotic) predators. The latter are a problem in the Rhine, especially the goby species form the Danube catchment. This needs to be monitored and investigated further. Nonetheless, other native species, like the North-Sea Houting and Allis shad are having spectaculars come-backs and seem to have no issues with non-native predators. Moreover, populations of non-native species seem to stabilize or even collapse in recent years.

Based on observations and information of professional fishermen, the increase of the population of seals in the coastal zone is negatively affecting the fish population. This might have an impact on the sturgeon as well and will be studied and monitored during the years to come.

## 4.7 Cooling water withdrawals and hydropower

### Cooling water withdrawal

In the Netherlands, an 'Ecological Assessment Method for Cooling Water Withdrawals' has been developed to assess the impact on fish population as part of the Cooling Water Regulation, applicable to intakes of power stations and other industries. The impact of fish ingress foremost applies to small length classes (eggs, larvae, 0 + fish, < 15 cm), due to their passive presence in water flow, limited orientation (especially during dark periods) and low swimming capacity. Juveniles >15 cm and adults get impinged to a much lesser extent because of their increased swimming capacity, rheotaxis (orientation to flow) and behavior (hesitation to pass through trash racks). For larvae ad early juveniles, water abstraction can be detrimental when located adjacent to the main migration corridors. The regulated approach velocity in front of trash racks is low (< 0.3 m/s). Survival of impinged fish is related to the presence and efficiency of a Fish Recovery and Return system.

There are several large-scale cooling water withdrawals along the (lower)Rhine, the largest belonging to power stations. In the Netherlands, in the port of Rotterdam, these are mainly situated in port areas adjacent to the main river, such as the Beerkanaal. It is expected that any impact of (cooling) water withdrawal of sturgeon will be low as they are not likely to encounter the direct vicinity of such intakes. In addition, as sturgeons are good swimmers and are of relatively large sizing, they can easily escape the hydraulic area of concern in front of intakes.

### Hydropower

In the Netherlands, there are three low-head hydropower plants (HP's) located along the Meuse (2: Linne, Lith) and Nederrijn (1: Maurik). For hydropower plants, the hydraulic conditions are clearly different from cooling water intakes. In principle, HP's (typically with adjacent regulation weir and a fish pass) are designed and positioned such that main flow of the river/canal passes through the turbines to produce energy. Often the approach velocity towards the intake gradually increases and easily reaches >1m/s in front of the trash racks. As (migratory) fish follow the main flow of the river during downstream migration, these have 3 optional routes: the weir, the turbine or the fish pass/bypass. Survival of turbine passage at low-head HP's is strongly related to the chance the fish will be struck by guide vanes and runner blades of the turbines, which is related to the length of the fish.

As migrating sturgeon (upstream and downstream) will mainly use the mainstream of the Rhine and the Waal, passage of the 3 hydropower plants along the Meuse and Nederrijn is not likely and the potential impact shall be small. For sturgeons passing one of the

hydropower plants, there will be no/little impact if the sturgeon goes efficiently over the weir and/or can find the fish bypass.

Regarding the development of regulations for sturgeon in relation to cooling water withdrawals and hydropower, this amounts to the addition of 'the sturgeon' as a species in existing regulation and policies in The Netherlands (WFD, Natura 2000, policies on cooling water withdrawal and hydropower).

## 4.8 Professional and recreational fishing and marine by-catch

Because sturgeon becomes sexually mature at a late age (females only from 12 years of age), the species is sensitive to mortality due to fishing (professional and recreational). A distinction can be made here between fishing at the rivers where the species breeds and fishing in the estuaries and coastal zones where the sturgeons continue to grow up and search for food.

### Fresh water

Professional Dutch river fishing virtually disappeared in the second half of the 20th century as a result of the degradation of river systems and commercially interesting migratory species such as salmon and shad disappeared. Since 2010 also fishing on eel using fish traps was banned in almost the entire river area due to the high levels of dioxin in this species, which makes consumption a health risk.

Given the limited number of professional fishermen still active on the major rivers, it is estimated that current river fishing does not pose a threat to the sturgeon's return. However, freshwater fishing in the delta and the high fishing pressure in the IJsselmeer and Ketelmeer deserves attention.

Potentially, there is a lot of recreational fishing along the major migration corridors of the Lower Rhine. However, the chances of catching sturgeon are low and 'catch & release' is common practice. Attention must be paid to the impact of by-catch by recreational fishing (awareness and proper 'catch and release' handling to minimise mortality). Although the volumes are much smaller, the impact of by-catch by recreational fishing is relatively high compared to marine by-catches by professional fishermen (IMARES, 2008).

### Marine waters

Fishing in the coastal zone and estuaries is mentioned as a major threat in almost all areas where sturgeon species are still present or where reintroduction projects are ongoing. This is mainly due to fact that the rich fishing grounds are also important potential food areas for the sturgeon

Fishing along the Dutch coast with bottom-trawling nets has intensified further since the disappearance of the sturgeon in the 1950s. Because the sturgeon is a bottom-bound fish, the chance of catching them with bottom capturing devices is relatively high (see also Annex B).

Based on experience in Germany and France, a potential threat for a return of the European sturgeon is the impact of marine-by-catch, especially in the brackish zone and coastal areas. The professional fishing intensity is high within the Rhine estuary and along the Dutch coast. This is the area where the young sturgeons grow up: 0,5-2 year within the brackish zone and 2-7 years in the coastal zones. It is more than likely that sturgeons will be caught in these areas as marine-by-catch. The chance of marine by-catch at open sea, beyond the 12-mile zone, is very limited.

However, if treated correctly, the chance of survival of sturgeons caught in bottom trawling nets is relatively high (Lepage & Rochard 2011, Beardsall *et al.* 2013). Although sturgeons are

strong and their chance of survival after a by-catch is considerable; survival depends on proper handling on board and a quick and careful 'catch and release'. Mortality due to professional fishing is a bottleneck, but fishermen can contribute to the recovery of the species by taking measures to prevent accidental and direct removal and mortality due to by-catch and handling on board.

The release of sturgeons by professional and recreational fishermen is therefore essential. It is also important for fishermen to register the by-catches of sturgeons (preferably on an individual level by marking animals). This data provides insight into the development of the sturgeon stock, migrations and habitat use of the species.

### Cooperation with the professional and recreational fishing sector

Both the professional and recreational fishing sector recognizes and encourages a healthy and vital aquatic ecosystem. A diverse fish population is important, for both marine and freshwater systems. The European sturgeon, as a protected species, could be part of such a healthy aquatic environment. For the survival and recovery of the species it is of great importance that the professional and recreational fishing sector is fully engaged in the process for a sustainable reintroduction.

From the French experience, we learned that a successful sturgeon reintroduction is only possible when there is close contact and cooperation with the recreational and professional fishermen. The mutual approach is to minimize the chance of by-catch by improved fishing techniques and to raise awareness to optimize the treatment on board in order to limit mortality as much as possible. Continuity of awareness campaigns among fishermen will be essential to instruct fishermen on the importance of the reintroduction program of the European sturgeon and provide clear instructions how to act professionally when a sturgeon is caught.

Because European sturgeons can migrate over large distances along the coastal areas, international education and cooperation of professional fishermen is essential for the conservation of the species.

The instructions what to do with by-catch of a sturgeon are well-known by the professional fishermen. By-catch notifications are helpful to gather information about the life of the sturgeon in the wild. Each catch can affect the success of the research. It is therefore important that every catch is reported. Until now, there is no real incentive for fishermen to report the by-catch of a sturgeon and it will depend on the fishermen and the circumstances if they will report the catch. Professional fishermen will release the by-catch surgeons, because they are aware that they are obliged to do so. More attention must be paid to the awareness of recreational fishermen, many recreational fishermen are not fully aware of the obligations to preserve and release salmon, sea trout and sturgeon (IMARES 2008).

If fishermen report the by-catch, notifications can be reported to a dedicated email address and telephone number (see below), and/or are stored in a digital registration system of the Ministry of Agriculture, Nature and Food Quality (fishing registration and information system, VIRIS).

**Figure 17 - Instruction for professional fishermen when catching a sturgeon.**


**If you catch a protected European Sturgeon:**

1. Record length, weight, date and location of the catch.
2. If the sturgeon is tacked: do not remove the tag and record the number of the tag.
3. Take a picture of the fish and, if possible, the tag.
4. Put the fish back alive with care as soon as possible.
5. Report the catch via steurwwf@gmail.com, or Wageningen Marine Research, or call 06 22257387.

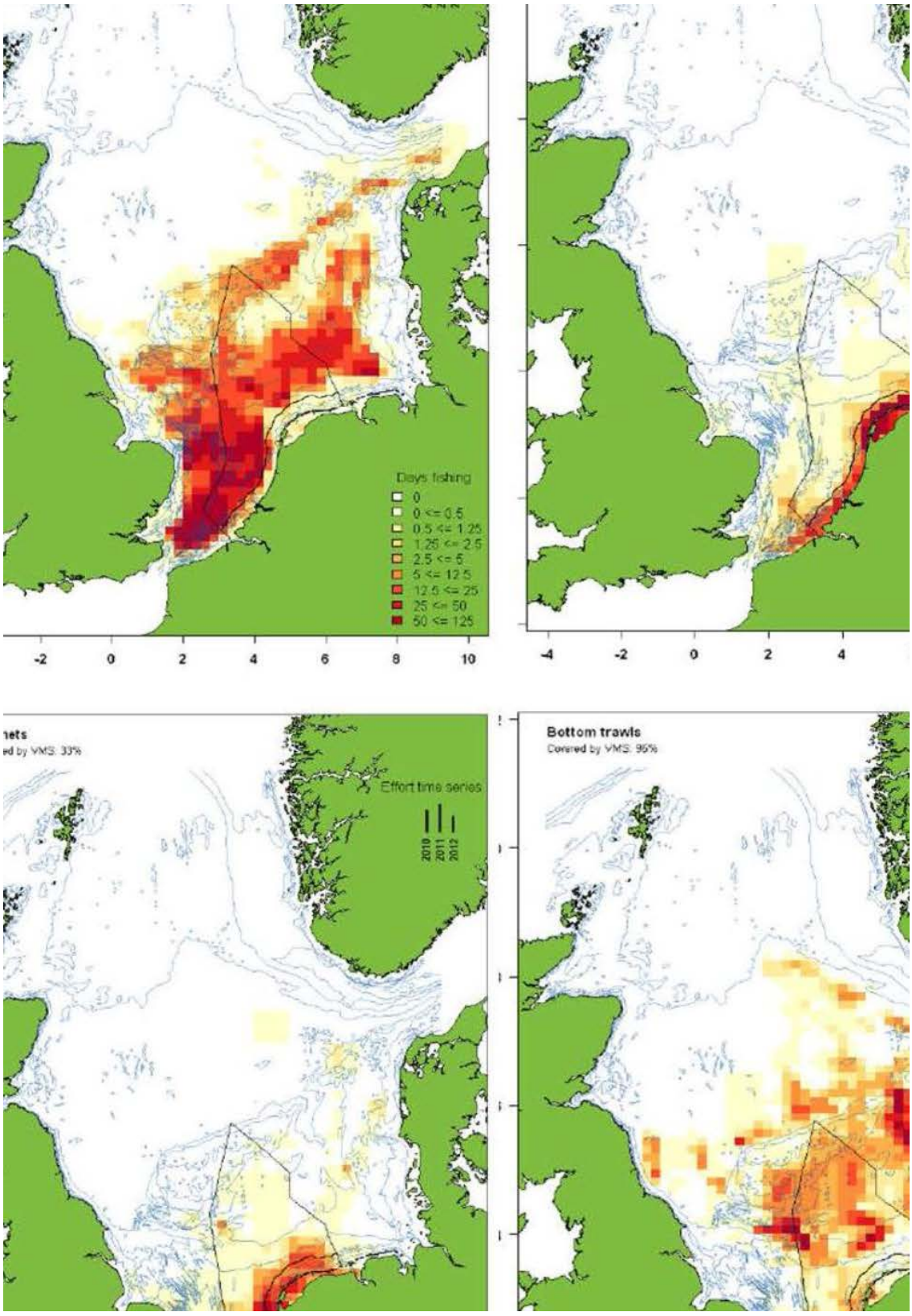


**Figure 18 - Fishing intensity Dutch fishermen with respectively large beam trawl (top left), small beam trawl (top right), Gillnet (bottom left) and bottom trawl (bottom right). Source: Winter *et al.* 2015.**

## 4.9 Shipping and underwater noise

### Introduction

On the river Waal in The Netherlands and the Rhine in NRW, the shipping intensity is substantial. There are several aspects of shipping which can affect sturgeons and other fish species:

1. Ship propellers can (fatally) harm fish;
2. Underwater noise due to shipping can affect communication and migration;
3. Habitats can be affected by turbulence and strong currents related to shipping and thereby disrupting the fish, including the presence of food;
4. Wave action and scouring can wash ashore juveniles.

Until now, there is no direct evidence of damage from shipping to sturgeons and other fish in de lower Rhine. Although dead fish on banks are reported frequently which show cutting marks which can be caused by ship propellers but possibly also by hydropower and/or pumping stations. Also 3 out of 87 experimentally released European sturgeons of the 2012 batch were found dead on the banks within 4 days (Brevé, N.W.P., et al, 2019.). These fish were wounded externally. Further investigation is necessary on the impact of shipping on the migration route Rotterdam – Germany (at some parts on the Waal over 110,000 shipping passages per year, which corresponds to on average a passing ship every 5 minutes 24/7).

A short overview of the current knowledge on the threats of shipping mentioned above is given below.

### Propellers

In 2016 ATKB performed a literature review on the effects of ship propellers on migratory fish species, with emphasis on the European sturgeon (Spierts, 2016). The outcome is summarized in this paragraph.

One aspect that increases the chance of sturgeon being hit by ship propellers is that these ancient fish lack the possibility to regulate their buoyancy by secreting gasses from the blood into their swim bladder. They therefore totally need to rely on gulping air at the surface of the water in order to inflate their swim bladder and are as a consequence more vulnerable to passing ships. Sturgeon ichtyoplankton (larvae), juveniles and adults can be entrained through ship propellers in rivers, the rate of entranement is assumed to be lower in wide river sections, deep water and swift current. Fish eggs, larvae and juveniles may also become stranded by shoreline drawdowns that are induced by passage of large commercial ships.

Especially reports from the USA, Canada and China show many cases of damaged (deep cuts) and killed, sliced, sturgeons of different species in rivers where industrial shipping activity is heavy. The probability of sturgeons being hit by a ship propeller depends i.a. on fish length, propeller size (diameter), number of propellers and propeller RPM (rotations per minute).

There are also reports of damaged sturgeons in the Kiel Canal, connecting the Elbe river with the Baltic sea (Ostsee). In this relatively narrow canal, compared to the Elbe estuary, European sturgeons were reported to be damaged by passing ships when they still occurred in the area (Spratte, S., 2013).

### Underwater noise

In June 2019 a stakeholder workshop was organised with the input of several experts. Dr. H.W. Slabbekoorn of Leiden University introduced the possible effects of underwater noise. A summary of remarks and conclusions of the discussion is given below.

There is no hard-scientific evidence that shipping noise has a negative effect on the migration of the sturgeon and other species. However, there is a lot of evidence that anthropogenic noise has effects on the behaviour of fish, at all levels (foraging, migration, reproduction, etc.). It is therefore difficult to say anything about ecological effects. More fundamental research should also be done on this relatively unknown field of expertise.

The decline of the European sturgeon has already started at the end of the 19th century, that underwater noise has played a very important role in this, is unlikely. There are also examples of rivers with a lot of shipping where sturgeons also successfully migrate and reproduce, this can also give indications about sensitivity. It is known from birds that several species adapt to sound, this can also be applicable to fish and the sturgeon. Sound may also be used to guide or keep them away, for example from ships.

### Habitat

Another aspect of shipping is that it has a significant effect on the quality of habitat. The passage of large ships can have a major impact on the littoral habitat of young sturgeons due to wave action and the sucking effect of the water. Because the littoral habitat in the Waal is frequently subject to the turbulent effects of shipping, it may therefore be less suitable for young sturgeons. Collas *et al.* (2017) have shown that the construction of longitudinal dams in the Waal can significantly reduce the hydraulic turbulence in the shore zone. They also function as a barrier for the underwater noise of ships passing (Green *et al.* 2019). The area behind the longitudinal dams therefore potentially also offers opportunities as habitat for young sturgeons. However, it is expected that the sturgeons mainly will migrate through the main channel. A management measure could be to increase the discharge through longitudinal side channels during migration peaks to facilitate migration.

**Figure 19 - Construction of longitudinal dams in the Waal can significantly reduce the hydraulic turbulence in the shore zone.**

In the Nederrijn - Lek the shipping intensity is considerably less than the Waal, from this point of view this river route would therefore be better suited for young sturgeons. During the downstream migration, however, these animals would come across several weirs, depending on the release location. Downstream migration over weirs can theoretically cause extra mortality. In addition, it is unknown whether adult sturgeon use the fishways next to the weirs, when they return the same route.

Any measure that provides shelter can have a function as refuge (side channels, lowering of summer dikes, deep area's in the main channel etc.). Habitat conditions for sturgeons can be improved by rehabilitating riverbanks, more natural banks provide food and shelter for (migrating) fish, among which the sturgeon. Altering the navigational channel design can also result in less mortalities among migrating fish. The depth for example is in some river stretches very low plus the width is becoming increasingly narrow with decreasing water levels (Spierts, 2016).

**Figure 20 - Shipping at the Waal near Nijmegen, July 2019.**

An expert session was organised at Research institute Marin (February 2020) and follow up research was identified (see paragraph 4.11).

## 4.10 Impact of climate change

The impact of climate changes on the Rhine basis will result in an overall increase in temperature, with summers on average warmer and drier and winters warmer and wetter. The Rhine discharge regime will shift to an increase in winter discharge and a sharp decrease in summer discharge (De Wit *et al.* 2008). Both temperature and discharge regime have an impact on the European sturgeon's breeding success. A model was used to compute the impact of climate changes on the suitability of European river systems for sturgeon. The Rhine comes out as a potentially suitable river system for spawning and growing up of sturgeons.

Future sturgeon habitat suitability in the face of climate change is assessed in several studies (Lasalle, *et al.* 2009, 2010 and 2011). A predictive distribution model was established, and projections were performed at two time-steps, 2050 and 2100[10]. The model incorporated average annual winter and summer precipitation and air temperature for most of the former European sturgeon habitats in Europe, Turkey, Caucasus and North-Africa.

Species presence in a system was categorized into three functional groups: spawning basins, where the species reproduced; transitory basins, where the species occurred infrequently

[10] For this study, the HadCM3 Global Climate Model (GCM) and the A2 and A1FI emissions scenarios were used.

and in very low numbers; unexplored basins, where the species was never recorded. The European sturgeon was reported to be present in 68 out of the 196 basins investigated. It historically reproduced in 24 large basins, located exclusively in Europe, the eastern most basins were the Rioni and the Inguri rivers flowing through Georgia into the Black Sea.

Most of the former sturgeon distribution range was assessed as being strongly affected by climate change, especially basins along the southern limit of its range.

In the '2050' simulation, only some 55% of historical spawning basins are predicted to be particularly suitable to the species. Historical spawning basins which become unsuitable will be most exclusively in the southern parts of Europe; especially the Ebro and the Tiber basins. For the '2100' simulation, 18 out of the 24 historical spawning basins are projected to experience a drastic decrease in suitability. However, five northern basins seem to be potentially suitable for spawning: the Rhine, the Oder, the Vistula, the Neman and the Neva rivers (Lasalle, 2010 and 2011).

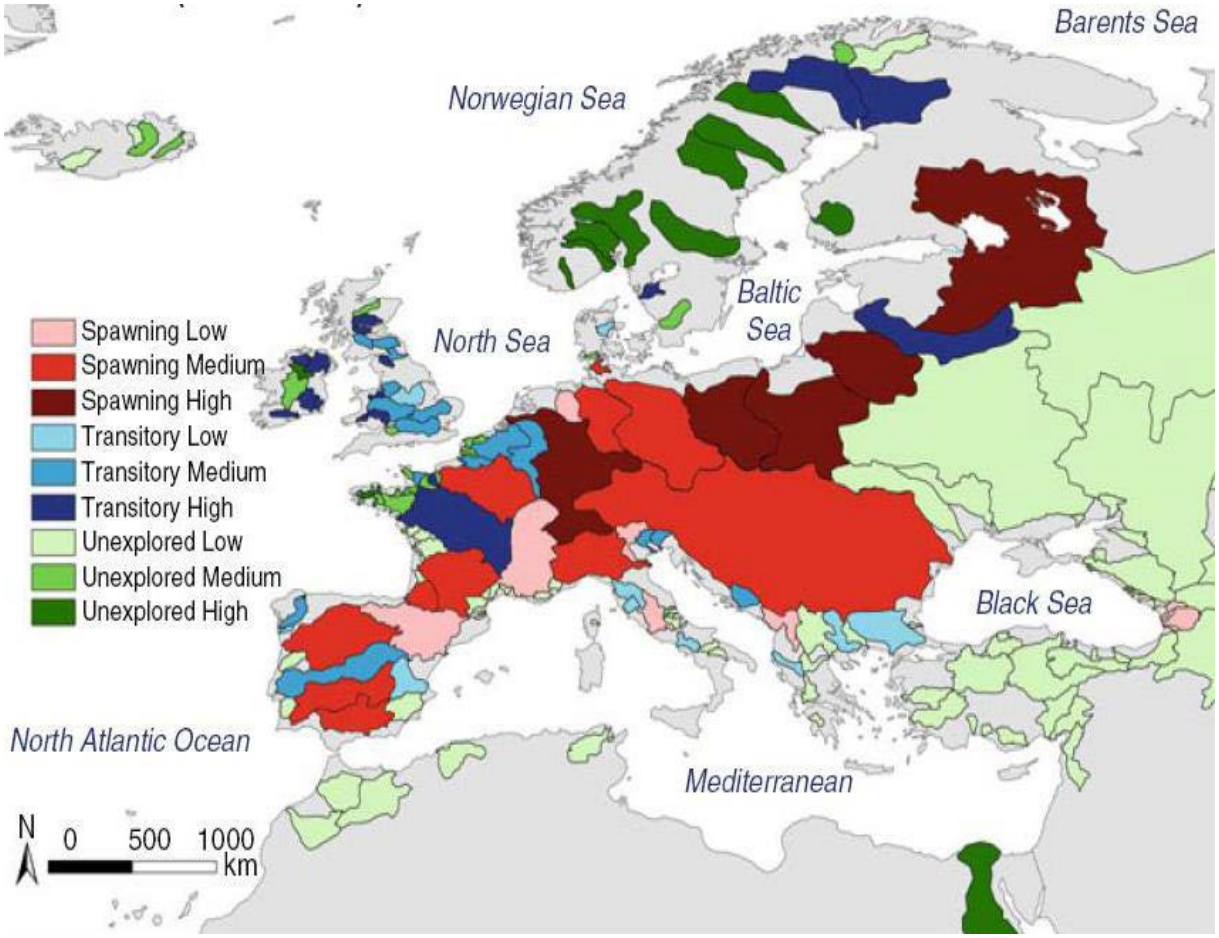


**Figure 21 - Mean probabilities of occurrence providing potential future basin suitability for the European sturgeon displayed according to the functional group of basins and calculated using the final BRT model and A2 and A1FI climate change scenarios for the middle and end of the 21st century scenario's (Lassalle *et al* 2010 and 2011).**

## 4.11 Recommendations for cooperation and follow up research

Several issues and points of interest are raised by stakeholders during the workshops, interviews and stakeholder meetings. These issues must be considered carefully when continuing with the implementation of the First Sturgeon Action Plan for the Lower Rhine. Therefore, it is important to set up a cooperation structure with all key stakeholder during the implementation phase to facilitate transparency and mutual trust among all parties. A successful reintroduction will only succeed when all relevant stakeholders are committed and respect each other's ambitions and points of interest.

**Table 2 - Points of interest to be considered during the implementation period of the First Sturgeon Action Plan for the Lower Rhine.**

| Item | Description | Relevant stakeholder(s) |
|---|---|---|
| Permitting and licensing processes | Does the reintroduction of the European sturgeon result in additional demanding permitting processes when it comes to minimum requirements for the ecological quality of surface waters?<br><br>Stakeholders need the trust that the reintroduction does not lead to additional legal barriers, the risk must be acceptable. | Industry |
| Mitigation measures | Does the reintroduction of the European sturgeon result in additional mitigation measures that need to be implemented for new expansion developments?<br><br>Stakeholders need the trust that the reintroduction does not lead to additional mitigation measures, the risk must be acceptable. | Port of Rotterdam |
| Fresh water supply | The agreements regarding the fresh water supply as part of the re-opening of the Haringvliet sluices may not be affected by the reintroduction of the European sturgeon. A more permanent discharge of fresh water through the Haringvliet may result in a better migration window for migratory species without affecting current agreements. | Port of Rotterdam, Industry |
| Fisheries | The Dutch fishery sector faces many challenges. The reintroduction of the Sturgeon is not their main concern. The reintroduction may not lead to more restrictions. | Vissersbond |
| Hydropower | Fish damaged after passing hydropower turbines may lead to a negative public opinion about hydropower. | Energie Uit Water (EWA) |
| Recreational navigation | Modifications of river infrastructure like ship locks and weirs may not have a negative effect on shipping. | Waterrecreatie Nederland. |
| River connectivity | The Sturgeon project focuses on the main Rhine river branches and not on the tributaries of the Rhine river. Water authorities need the trust that the reintroduction does not necessarily lead to additional modification of fish passes in the tributaries where sturgeons were present historically. | Water authorities |

Based on the analysis of anthropogenic factors imposing a potential threat on the return of the sturgeon in the Lower Rhine and to further detail and finalize the feasibility and risk assessment phase, follow up research will be conducted:

### Habitat suitability study for the lower river branches in The Netherlands

The model study of Winter *et al.* 2015, shows that the Dutch coastal zone contains a good habitat for the growth of juvenile sturgeons. It is still unclear to what extent the downstream parts of the (lower) Rhine in The Netherlands can play a role as growth or spawning areas for sturgeon. In addition to Staas, 2017, Winter *et al.* 2015 and Groen *et al*. 2019, it is recommended to analyse further the habitat suitability in the lower river branches in The Netherlands.

### Habitat suitability study for the river Scheldt in The Netherlands and Belgium

The river Scheldt might be of interest as foraging area. The scope of the First Sturgeon Action Plan is the Lower Rhine, i.e. the river branches of the River Rhine in The Netherlands and the River Rhine in North Rhine Westphalia in Germany and the Dutch part of the North Sea, not the estuary of the river Scheldt. Nevertheless, it is recommended to analyse the potentials of the river Scheldt for its habitat suitability.

### Sediment quality and its impact on sturgeon(reproduction)

The sediment in the Lower Rhine is polluted for decades. The tide is turning, pollution sources decreased severely, and polluted sediments are removed and processed. However, eels caught in the Lower Rhine still exceed safe consumption levels. The effect on sturgeon(reproduction) is unknown.

### Impact of predators on sturgeon(reproduction)

For eggs and larvae and early juveniles, the goby species as well as increasing density of catfish could be a problem. This needs to be monitored and investigated further.

### Shipping and its impact on sturgeon(reproduction)

Ship propellers can damage sturgeons severely; the potential impact in the Rhine is still unknown. The influence of navigation on the survivability of sturgeons in the river Rhine must be further investigated.

The Rhine is a different system as for example the Elbe, Gironde or Donau. The main channel is narrower and navigation intensity is higher. Research carried out the coming years should focus on clarifying the main source of fish mortality (hydropower, pumping stations and or ship propellers) and quantifying the effect of shipping on fish migration in general, among which potentially sturgeon migration. First steps are already taken by Sportvisserij Nederland with two ongoing research proposals.

Several innovations in fish friendly ship propellers have passed in recent years. There is not a breakthrough yet, as was seen for fish friendly pumping stations now being implemented by Dutch regional water managers the past decade. These kinds of changes are typically slow. At the moment the market for ship propellers is driven by fuel efficiency and $CO_2$ reduction. However, the sector wants to become greener and the *Platina Green Award* is an incentive to also contribute to a lower ecological impact of shipping.

### Underwater sound and its impact on sturgeon(reproduction)

Anthropogenic sounds underwater have effects on the behaviour of fish. Scientific literature is available. The effects on migratory fish, including sturgeon, in the Rhine system are unknown. This requires fundamental research.

The identified follow up research is summarized in the framework for action (see also chapter 7).

# 5. Legal framework for Rehabilitation and Protection

## 5.1 Legal status of the European sturgeon

The sturgeon has the highest possible protected status imaginable for a wild animal species. This is not only because the species is protected under many international conventions and the EU Habitats Directive, but also because the species has been given the most extensive protection within each of these systems. Under three of the four treaty systems examined, the sturgeon has also received substantial attention in 'soft-law' documents, such as recommendations or resolutions (Bastmeijer, 2019).

All sturgeon species of the family Acipenseridae are red listed by the IUCN and are more threatened than any other group of species globally (IUCN 2010[11]).

**Table 3 - Species covered by the Pan-European Action Plan, their conservation status according to ICUN and respective listings in main conventions**

| Species | IUCN Red List Status (2011) | CITES (1998) | EU Habitats Directive (1992) | Bern Convention (1979) | Bonn Convention CMS (1979) |
|---|---|---|---|---|---|
| Russian sturgeon complex (Acipenser gueldenstaedtii, A. persicus (colchicus)) | CR (Critically Endangered) | Appendix II | Annex V | not listed | Appendix II (no subspecies) |
| Adriatic Sturgeon (Acipenser naccarii) | CR (Critically Endangered) | Appendix II | Annex II and IV | Appendix II | Appendix II |
| Ship sturgeon (A. nudiventris) | CR (Critically Endangered) | Appendix II | Annex V | not listed | Appendix II |
| Atlantic or Baltic sturgeon (*A. oxyrinchus)* | Globally NT (Near Threatened) Baltic Population CR/EX | Appendix II | treated as *A. sturio* | Not listed since the species was discriminated from *A. sturio* in 2002 only | Appendix I and II treated as *A. sturio* |
| Sterlet (A. *ruthenus*) | VU (Vulnerable) | Appendix II | Annex V | Appendix III | Appendix II (Danube population) |
| Stellate sturgeon (A. stellatus) | CR (Critically Endangered) | Appendix II | Annex V | Appendix III | Appendix II |
| European/Common sturgeon (*A. sturio*) | CR (Critically Endangered) | Appendix I | Annex II and IV | Appendix II | Appendix I and II |
| Beluga (*Huso huso*) | CR (Critically Endangered) | Appendix II | Annex V | Appendix II (Mediterranean population), Appendix III | Appendix II |

IUCN list of categories ranging from LC (least concern), VU (vulnerable), NT (near threatened), EN (endangered), CR (critically endangered), to EX (extinct) based on their population development, their range, and population status as described by the Assessment Guideline (IUCN 2016).

CITES Appendices I and II differentiate species for which international trade is forbidden or restricted to few exemptions due to their population status (Appendix I) and species for which international trade requires an agreed upon system of permits based upon population assessments and harvest quotas (Appendix II).

[11] https://www.iucn.org/content/sturgeon-more-critically-endangered-any-other-group-species

The species listed in the EU Habitats Directive's Annexes are protected in various ways[12]: Annex II: core areas of their habitat are designated as sites of Community importance (SCIs) and included in the Natura 2000 network to be managed in accordance with the ecological needs of the species. Annex IV: a strict protection regime must be applied across their entire Natural range, within and outside Natura 2000 sites. Annex V: Member States must ensure that their exploitation and removal from the wild is compatible with maintaining them in a favourable conservation status.

The Bern Convention lists species in different Appendices based upon the degree of protection for the different species at the time of listing. Appendix II comprises highly protected species while Appendix III includes species with protection status.
The Convention on the Conservation of Migratory Species of Wild Animals (CMS) or Bonn Convention Appendix I lists migratory species threatened with extinction. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. Appendix II lists migratory species that need or would significantly benefit from international cooperation. For this reason, the Convention encourages the Range States to conclude global or regional agreements.

The status of the sturgeon under the Bern Convention, the Bonn Convention, the OSPAR Convention, the Rhine Convention and the EU Habitats Directive and the main consequences of this status are summarized in Annex D. Attention is also paid to the relevant recommendations and resolutions and to the question whether/where the relevant components have been incorporated into Dutch law (Bastmeijer, 2019).

## 5.2 Pan-European Action Plan for Sturgeons

*"This action plan could be the last chance for Europe's sturgeons. Without urgent action, the continent will lose these iconic fish species within our lifetime – species that have been on Earth for over 200 million years"* said Beate Striebel-Greiter, WWF's Sturgeon Coordinator.

The First Sturgeon Action Plan for the Lower Rhine is based on the 'Pan-European Action Plan for Sturgeons[13]', prepared by the World Sturgeon Conservation Society and WWF, adopted on November 30, 2018 at the 38th Standing Committee Meeting of the Bern Convention. On May 22, 2019, the European Commission and experts from EU member states[14] endorsed the implementation of this continent-wide Action plan to save the sturgeon species from extinction under the EU Habitats Directive. The 'Pan-European Action Plan for Sturgeons' is the first action plan for a fish species implemented under this EU Directive.

The Pan-European Sturgeon Action Plan covers 8 European sturgeon species[15] – 7 of which are listed as critically endangered on the IUCN Red List of threatened species[16]. The plan aims to conserve the last surviving sturgeon populations in Europe, restore habitats and reintroduce sturgeon to many rivers. The plan outlines actions that countries will take to tackle poaching and the illegal trade in wild sturgeon products – another immediate threat to the survival of the species.

[12] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/
[13] Download: https://rm.coe.int/pan-european-action-plan-for-sturgeons/16808e84f3. Editors / authors: Thomas Friedrich, University of Natural Resources and Life Sciences (WSCS); Jörn Gessner, Leibniz-Institute of Freshwater Ecology and Inland Fisheries (WSCS); Ralf Reinartz, Consultant for fisheries and aquatic ecology (WSCS); Beate Striebel-Greiter, WWF International, Danube-Carpathian Programme Office.
[14] Expert Group on the Birds and Habitats Directives (NADEG)
[15] The 8 European native species are Russian Sturgeon (Critically Endangered), Adriatic Sturgeon (Critically Endangered), Ship Sturgeon (Critically Endangered), Stellate Sturgeon (Critically Endangered), Atlantic Sturgeon (Critically Endangered), Beluga Sturgeon (Critically Endangered), Baltic Sturgeon (Critically Endangered) and Sterlet (Endangered/Vulnerable).
[16] www.iucnredlist.org

Main drivers for drafting a multi-species Action Plan for sturgeons under the Bern Convention are:

1. The conservation status of all sturgeon species in Europe has become highly critical without showing signs of recovery, indicating that previous action has not been successful. The Pan-European Action Plan claims four main reasons for the insufficient implementation of existing action plans: (i) lack of simplicity; (ii) lack of coordination and clear responsibility; (iii) lack of resources and (iv) lack of public and political awareness.

2. Sturgeons are excellent flagship species for ecologically healthy rivers and seas due to their size, longevity, diverse habitat utilization and their migratory life cycle that connects coastal waters to the upper reaches of riverine ecosystems. Therefore, their protection needs a holistic approach, connecting international waters, coastal areas, and often multi-national river systems.

3. The conservation of sturgeons needs a comprehensive and integrated approach, as well as secured and long-term funding of priority conservation measures in order to suit these long-lived species.

4. The Pan-European Action Plan under the Bern Convention also particularly emphasizes the establishment of immediate *ex situ* measures for safeguarding, recovery, and re-establishment of all species in an attempt to prevent their extirpation, while at the same time implementing measures to increase the *in-situ* protection.

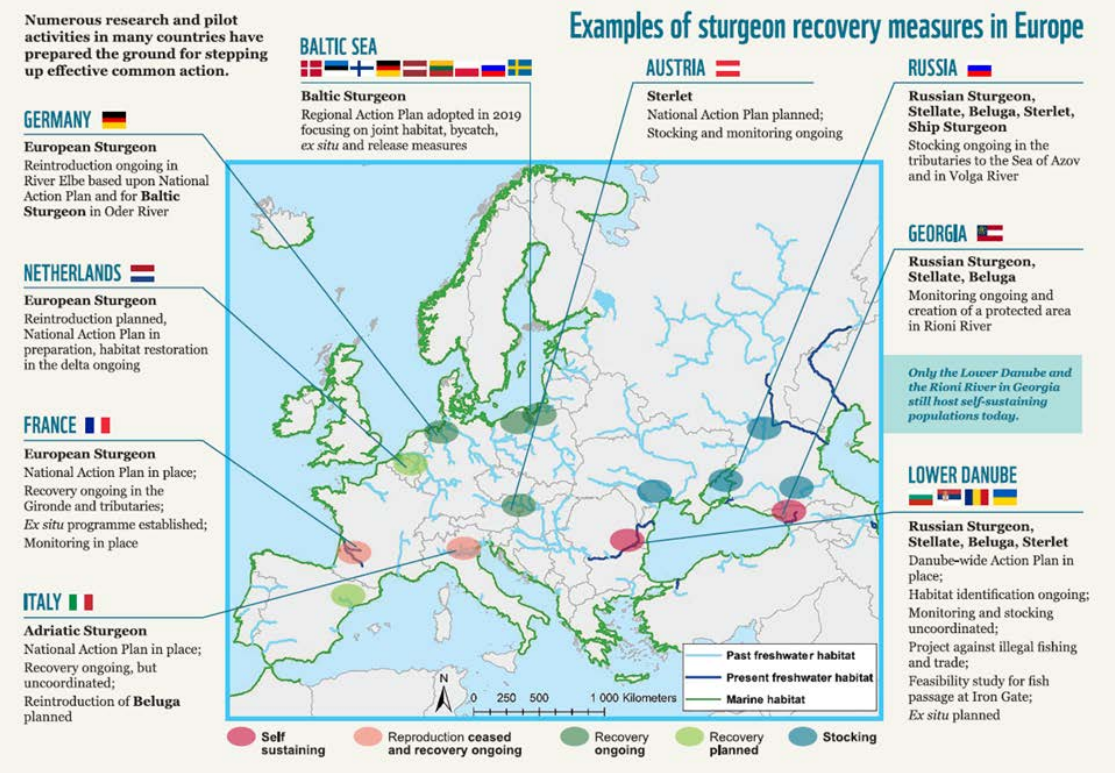


**Figure 22 - Examples of sturgeon recovery measures in Europe (Pan-European Action Plan for Sturgeons, 2018).**

While formulating the First Sturgeon Action Plan for the Lower Rhine, the above-mentioned concerns and recommendations have been considered. Both the First Sturgeon Action Plan

for the Lower Rhine and the 'Pan-European Action Plan for Sturgeons are based on the conservation objectives agreed upon in the framework of the Vienna Declaration and the key messages of the 2018 European Sturgeon Conference in Vienna (see Annex E).

## 5.3 IUCN criteria for sustainable reintroduction

Official reintroduction of a species is strictly bounded and regulated by national and international legislation. As a baseline for the Rhine Sturgeon Project and the preparation of this First Sturgeon Action Plan for the Lower Rhine, we used the criteria for reintroduction adopted by the IUCN[17].

Reintroduction of the European sturgeon in the Lower Rhine is classified as reintroduction within a species' indigenous range. Design and implementation of such a reintroduction follows the stages of project design, implementation and management, including gathering baseline information and analysis of threats and iterative rounds of monitoring.

This ensures that process and progress are recorded. Changes in reintroduction objectives or management can be justified, and outcomes can be determined objectively. Any reintroduction should be fully documented, and their outcomes made public and available to inform future conservation planning.

As part of any reintroduction program, both a *Feasibility Assessment* and *Risk Assessment* should be conducted. The feasibility assessment covers the full range of relevant biological and non-biological factors. The risk assessment focussed on the identification of threats and potential solutions in close cooperation with the relevant key stakeholders.

The First Sturgeon Action Plan for the Lower Rhine summarizes the results of the feasibility and risk assessment phase so far and identifies remaining critical key issues to be analysed more in detail to comply with all IUCN criteria, necessary to the start an official reintroduction programme.

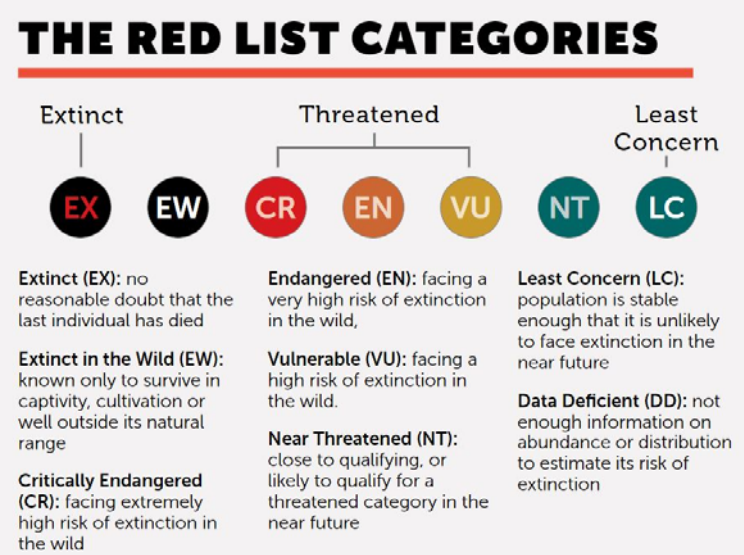


**Figure 23 - The European sturgeon is listed as critically endangered by the International Union for Conservation of Nature and Natural Resources (IUCN) and as such one of the most endangered fish species in Europe.**

[17] IUCN/SSC (2013). *Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0*. Gland, Switzerland: IUCN Species Survival Commission.

During the implementation of the First Sturgeon Action Plan for the Lower Rhine (2020-2030), the objectives and results of the actions will be monitored and assessed frequently. This will feed into the feasibility- and risk assessment and if necessary, will result in adjustment of the objectives.

Based on the criteria for reintroduction adopted by the IUCN, an *exit strategy* will be developed, and three main issues will be addressed here:

1. The future impact of anthropogenic factors is depending on population size and dynamics, i.e. recovery and compensation mechanisms within the population. An acceptable mortality rate should be established for a sustainable sturgeon population for the (lower) Rhine.
2. Quantify and describe under which conditions the evaluation of the First Sturgeon Action Plan for the Lower Rhine will not be followed up by the implementation of an official reintroduction programme.
3. If there will be an official reintroduction programme after 2030, under which conditions the project will be defined as successful/unsuccessful ('stop criteria').

# 6. Scope and phasing of the Rhine Sturgeon Project

## 6.1 Geographic scope

All sturgeon species spawn in rivers. Rivers, therefore, are crucial habitats in the sturgeon lifecycle. Populations can be defined by assigning them to distinct spawning populations in specific rivers, which represent independent entities. This is of special importance for their management in marine catchments with presence of sturgeons from the same species originated from different river basins, which is the case for the European Sturgeon.

**Table 4: List of river catchments with current or historic importance as reproduction habitat for European sturgeon species of the Atlantic and North Sea basin (source: Pan-European Action Plan, 2019).**

| Sea Basin | River catchment | Species | Status |
|---|---|---|---|
| Atlantic NE | | | |
| | Guadalquivir | A. sturio | EX |
| | Guadiana | A. sturio | EX |
| | Minho | A. sturio | EX |
| | Tagus | A. sturio | EX |
| | Douro | A. sturio | EX |
| | *Gironde (Garonne/ Dordogne)* | *A. sturio* | *SR* |
| | Seine | A. sturio | EX |
| | Severn | oxyrinchus<br>A. sturio | NP<br>NP |
| North Sea | | | |
| | Tees | A. sturio | NP |
| | Ouse | A. sturio | NP |
| | Trent | A. sturio | NP |
| | Thames | A. sturio | NP |
| | Schelde | A. sturio | NP |
| | Meuse | A. sturio | EX |
| | *Rhine* | *A. sturio* | *EX (RE planned)* |
| | Ems | A. sturio | EX |
| | Weser | A. sturio | EX |
| | *Elbe* | *A. sturio* | *RE* |
| | Eider | A. sturio | EX |

Legend: The current status is coded as follows:

- SR = supportive release (supporting existing individuals)
- RE = Reintroduction
- NP = Occasional sightings, reproduction not proven
- EX = Extinct

In the Gironde and the Elbe supportive release and reintroduction of populations is ongoing. Shared stocks by country and species are provided in Annex 3 of CITES Resolution Conf. 12.7 (Rev. CoP17; https://www.cites.org/sites/default/files/document/E-Res-12-07-R17.pdf).

The principal geographic scope for the Rhine Sturgeon Project and the First Sturgeon Action Plan comprises the Lower Rhine, i.e. the river branches of the River Rhine in The Netherlands and the River Rhine in North Rhine Westphalia in Germany and the Dutch part of the North Sea.


**Figure 24 - Past and present distribution map of Acipenser sturio (Pan-European Action Plan for Sturgeons, 2018).**

## 6.2 Main goals of the Rhine Sturgeon Project and the First Sturgeon Action Plan for the Lower Rhine

The overall long-term goal of the *Rhine Sturgeon Project* is to re-establish a sturgeon population in the Lower Rhine to an extent that ensures the species survival. Due to their extended life cycle, sturgeon reintroduction programmes are lasting several decades. A sturgeon population is expected to develop in a period of 15 – 25 years. Therefore, the reintroduction follows a gradual and phased process. To date, the Rhine Sturgeon Project is in its experimental research phase (feasibility and risk assessment).

The main goals (until 2030) to which the First Sturgeon Action Plan for the Lower Rhine will contribute is to:

1. Finalize the feasibility and risk assessment phase to comply with IUCN criteria for reintroduction and prepare for decision making (go / no go) to proceed with an official reintroduction programme of the European sturgeon in the Lower Rhine by 2030 (or sooner if feasible).
2. Future population is protected from accidental and directed removal: fishing and shipping mortality is reduced as much as possible.
3. Potential sturgeon critical habitats are identified (and restored if necessary).
4. Fish migration (including sturgeon) and up- and downstream connectivity in the Lower Rhine is secured and facilitated.
5. A sturgeon monitoring program is designed and implemented to be able to evaluate and quantify the impact and effectiveness of the activities of the First Sturgeon Action Plan for the Lower Rhine.
6. Adequate funding, communication and evaluation of First Sturgeon Action Plan for the Lower Rhine.

## 6.3 Phasing of the Rhine Sturgeon Project

For the overall Rhine Sturgeon Project, three phases can be identified:

### Phase 1 (2014 – 2020) – The European sturgeon back to the Lower Rhine ?

1. Lower Rhine system meets IUCN criteria to start with *experimental* releases of juveniles (including monitoring and reporting). Continue with experimental reintroduction over the coming years;
2. A lot of analysis and research has been conducted and published (including migration behaviour, habitat suitability analysis, analysis of pressures such as fishing and shipping, analysis of legal context);
3. Experiences shared internationally (Gironde, Elbe, Danube, international conferences);
4. Official cooperation between the Rhine sturgeon project and the French breeding program is started.
5. Stakeholder analysis accomplished to identify further potential obstacles, constraints, but also challenges;
6. Presentation of the First Action Plan for the European Sturgeon for the Lower Rhine with contributions and participation of relevant stakeholders.

### Phase 2 (2020 – 2030) – The European sturgeon could come back ...

1. Adopt the First Sturgeon Action Plan for the Lower Rhine to finalise the feasibility and risk assessment phase;
2. Continue and scale up of the experimental releases of juveniles and subadults, including monitoring of migration behaviour (start again in spring 2021);
3. Further outline of the First Sturgeon Action Plan for the Lower Rhine and implement the proposed actions/measures by the responsible partners (project management and cooperation agreement);
4. Linking the proposed actions/measures with ongoing external initiatives (future sand and gravel extraction, national program of Integral River Management, ambitions of the Port of Rotterdam);
5. Continue with additional follow up research (impact of shipping, sediment quality, exotic species, habitat suitability);
6. Experiences shared internationally (Gironde, Elbe, Danube, international conferences);
7. Monitoring of progress and evaluation of all activities of the First Sturgeon Action Plan for the Lower Rhine;
8. Prepare of the decision-making process (go / no go) for an official reintroducing of the European sturgeon population in the Lower Rhine by 2030.
9. Set up a rearing station near the spawning sites in the Rhine, similar as been done for the Elbe river.
10. Evaluation and actualization of the First Sturgeon Action Plan for the Lower Rhine and implementation programme and draft the 2nd Sturgeon Action Plan.

### Phase 3 (2030 – 2040) – The European sturgeon is coming back.

1. With the 2nd Sturgeon Action Plan approved in The Netherlands and internationally supported by the ICPR, Germany and France; the reintroduction program can start officially.
2. Experiences shared internationally (Gironde, Elbe, Danube, international conferences);
3. All signals / potential bottlenecks on 'green' by implementing the appropriate measures from the 2nd Sturgeon Action Plan;
4. Working towards the establishment of a breeding centre for the Rhine.
5. Actualization of the 2nd Sturgeon Action Plan and implementation programme when necessary.

# 7. Framework for Action and Cooperation for 2020-2030

## 7.1 Framework for a supporting agenda

The structure of the First Sturgeon Action Plan for the Lower Rhine follows the logic of other Species Action Plans, but also considers the supporting agenda and interests of key stakeholders. It forms a framework for action *and* cooperation, based on an attractive agenda for all parties involved in the First Sturgeon Action Plan for the Lower Rhine.

The main goals of the First Sturgeon Action Plan for the Lower Rhine are linked with a *supporting agenda* relate to specific interests of key stakeholders benefitting when the goals are achieved. *Results* are the underlying conditions that need to be achieved in order to accomplish each goal. Results are the direct consequences of successfully implemented actions and results addresses important drivers of the threat or problems identified in the problem analysis. *Actions* are implemented in order to achieve the results and are formulated as quantifiable as possible.

Timescales and priorities for each action are stated as:

| | |
|---|---|
| *Ongoing:* | *currently being implemented and should continue* |
| *Short-term:* | *launched within the next 2 years (2020-2021)* |
| *Medium-term:* | *launched within the next 5 years (2020-2025)* |
| *Long-term:* | *launched within the next 5-10 years (2025-2030)* |
| | |
| *Low* | *Beneficial to have in place but does not require short-term action* |
| *Moderate* | *Measure is important for the overall implementation of the plan* |
| *High* | *Measure is essential for the overall implementation of the plan* |
| *Tbd* | *Priority of action not clear yet/might vary from case to case* |

## 7.2 Main goals and supporting agenda of the First Sturgeon Action Plan for the Lower Rhine

This section describes the goals and supporting agenda. The results, necessary actions, priorities, phasing and responsible actors and stakeholders are summarized in the next section 6.3.

GOAL 1: FINALIZE THE FEASIBILITY AND RISK ASSESSMENT PHASE TO COMPLY WITH IUCN CRITERIA FOR REINTRODUCTION AND PREPARE FOR DECISION MAKING (GO / NO GO) TO PROCEED WITH AN OFFICIAL REINTRODUCTION PROGRAMME OF THE EUROPEAN STURGEON IN THE LOWER RHINE BY 2030.

*Supporting agenda: Framework for cooperation with relevant stakeholders to improve fish migration in the Rhine which benefits EU and national legislation; increased international cooperation between The Netherlands, Germany (NRW) and France at (Rhine) basin-, national- and regional level between authorities, NGOs and knowledge institutes.*

This objective aims to comply with IUCN criteria by 2030, or sooner if feasible. This includes finalizing the feasibility and risk assessment phase, conducting additional analysis and research, proceeding with experimental reintroduction, continue with the cooperation of a joint breeding programme with IRSTEA and MIGADO, large scale reintroduction of juveniles at

breeding grounds and ultimately prepare for a decision-making process (go / no go) to start an official reintroduction program of the European sturgeon in the Lower Rhine.
After reintroduction the population needs to be supported with yearly releases of juveniles, until a viable population has been established.

### GOAL: 2: FUTURE POPULATION IS PROTECTED FROM ACCIDENTAL AND DIRECTED REMOVAL: FISHING AND SHIPPING MORTALITY IS REDUCED AS MUCH AS POSSIBLE.

*Supporting agenda: strengthen cooperation between professional and recreational fisheries and between fisheries sector and National- and regional authorities and NGOs; supporting the economical sustainability of the certified Dutch fishery sector; supporting the navigation sector with innovations towards cost effective and low emission shipping considering environmental impact (the Platina Green Award is an incentive to also contribute to a lower ecological impact of shipping).*

This objective aims to prevent mortality of individuals due to anthropogenic factors after (experimental) reintroduction. Actions are related to prevention and mitigation of potential losses of individuals. Potential related threats are accidental and direct removal due to fisheries (recreational and professional, marine and inland by-catch) and mortality due to shipping (impact of turbulence, direct collision or strikes by ship propellers).

### GOAL 3: POTENTIAL STURGEON CRITICAL HABITATS ARE IDENTIFIED (AND RESTORED IF NECESSARY).

*Supporting agenda: contribute to the national and regional policies for water, ecology, nature development, water safety and navigation (WFD, Natura 2000, IRM, PAGW, LIFE IP Delta Nature); contribute to the sustainable and environmental sound corporate strategies of the sand and gravel extraction industry and the Port of Rotterdam.*

In its lifecycle, the European sturgeon uses the coastal areas, estuaries and large rivers. For the recovery of the species, it is of great importance that the habitats important for the different stages of life and the migratory routes between them are protected and restored. In several feasibility studies, the historical and potential suitable habitats were identified. The actions related to this objective are focused on the protection and restoration of these habitats, and on the national- and regional commitment for these actions.

Sand and gravel extraction industry is a valuable partner. With their projects they create waterbodies. They convert land (often agricultural land) into floodplains and wetland areas. Port of Rotterdam is also positive when it comes to developments that promote nature and habitat in the effluence of the Rhine. For example, project Groenepoort-Noord near Maassluis and Groenepoort-Zuid near Rozenburg, both located in the brackish tidal area. There are more tidal parks in the planning and design phase (Island Brienenoord). These projects may act as stepstones and refugia and are part of the recovery of the brackish zone.

### GOAL 4: FISH MIGRATION (INCLUDING STURGEON) AND UP- AND DOWNSTREAM CONNECTIVITY IN THE LOWER RHINE IS SECURED AND FACILITATED.

*Supporting agenda: contribute to the national and regional policies for water, ecology, nature development, water safety and navigation (WFD, Natura 2000, IRM, PAGW, LIFE IP Delta Nature); contributes to free navigation and an open and accessible Port of Rotterdam.*

Prevent as much as possible any future construction of migration obstacles from sea to source (key sturgeon habitat) and accommodate migration through potential present obstacles.

### GOAL 5: A STURGEON MONITORING PROGRAM IS DESIGNED AND IMPLEMENTED TO BE ABLE TO EVALUATE AND QUANTIFY THE IMPACT AND EFFECTIVENESS OF THE ACTIVITIES OF THE FIRST STURGEON ACTION PLAN FOR THE LOWER RHINE.

*Supporting agenda: contributes to aquatic and marine research on fish migration; strengthen cooperation between professional and recreational fisheries and between fisheries sector and National- and regional authorities and NGOs.*

Actions focus on the establishment of a monitoring programme covering all life stages of the sturgeon, with emphasize on close cooperation with fisheries sector and research institutes.

### GOAL 6: ADEQUATE FUNDING, COMMUNICATION AND EVALUATION OF FIRST STURGEON ACTION PLAN FOR THE LOWER RHINE.

*Supporting agenda: support the education and awareness campaigns of National- and regional authorities and NGOs on water and ecology; participating stakeholders (authorities, NGOs, fisheries sector, inland navigation sector, industrial water use sector, Port of Rotterdam and the Sand and gravel extraction industry) are able to use the success of the return of the sturgeon as a success story to promote their business in balance with a natural river system; it can boost international cooperation within the basin.*

Process related actions which focus on development of strategies for:

- Adequate funding for the objectives above to enable the implementation of the First Sturgeon Action Plan for the Lower Rhine;
- Communication to create commitment and support, sturgeons serve as flagship species for healthy river ecosystems and support by the general public, political actors, authorities, relevant stakeholders for conservation measures has increased;
- Evaluate and monitor First Sturgeon Action Plan for the Lower Rhine implementation to allow adaptive management.

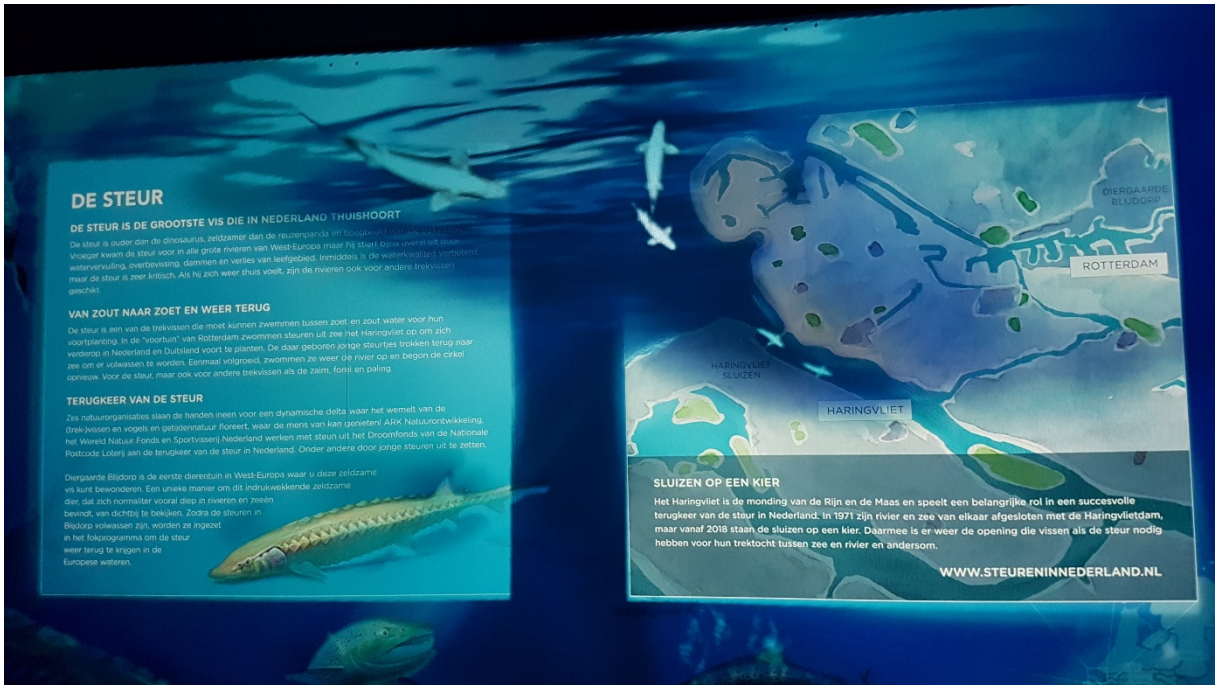


**Figure 25 - Display of the return of the European sturgeon in Oceanium in Blijdorp Zoo, Rotterdam.**

## 7.3 Results, actions, priorities, time scale and organizations responsible

This section describes the results, necessary actions, priorities, phasing and contribution of key actors and stakeholders for each of the 6 goals of the First Sturgeon Action Plan for the Lower Rhine.

*Ongoing:* *currently being implemented and should continue*
*Short-term:* *launched within the next 2 years (2020-2021)*
*Medium-term:* *launched within the next 5 years (2020-2025)*
*Long-term:* *launched within the next 5-10 years (2025-2030)*

| **GOAL 1: FINALIZE THE FEASIBILITY AND RISK ASSESSMENT PHASE TO COMPLY WITH IUCN CRITERIA FOR REINTRODUCTION AND PREPARE FOR DECISION MAKING (GO / NO GO) TO PROCEED WITH AN OFFICIAL REINTRODUCTION PROGRAMME OF THE EUROPEAN STURGEON IN THE LOWER RHINE BY 2030.** | | | | |
|---|---|---|---|---|
| *Supporting agenda: Framework for cooperation with relevant stakeholders to improve fish migration in the Rhine which benefits EU and national legislation; increased international cooperation between The Netherlands, Germany (NRW) and France at (Rhine) basin-, national- and regional level between authorities, NGOs and knowledge institutes.* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *Adoption of the First Sturgeon Action Plan for the Lower Rhine in The Netherlands.* | Finalizing the First Sturgeon Action Plan for the Lower Rhine with contribution and participation of relevant stakeholders. | High | Ongoing / finalisation 2020 | • WWF, ARK Nature, Dutch Angling association.<br><br>In cooperation with *all partners* involved in the First Sturgeon Action Plan for the Lower Rhine. |
| | Adopt the First Sturgeon Action Plan for the European sturgeon in the Lower Rhine. | High | Short-term | • Ministry of Agriculture, Nature and Food Quality, NL<br>• Ministry of Infrastructure and Water Management, NL<br><br>With support of the Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany. |
| | Presentation and feedback of the First Sturgeon Action Plan for the Lower Rhine from the ICPR / Fish Expert Group. | High | Short-term | • WWF, ARK Nature, Dutch Angling association<br>• ICPR / Fish Expert Group |

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| *Program for the implementation of the First Sturgeon Action Plan for the Lower Rhine.* | A cooperation structure established with all key stakeholders to facilitate the implementation of the First Action Plan and to ensure transparency and mutual trust among all parties. Close cooperation with the French and German partners is essential.<br><br>Implementation and coordination of the First Sturgeon Action Plan for the Lower Rhine (program management, follow up on the actions and monitoring the implementation). | High | Short-term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine.<br><br>International partners:<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany<br>• DREAL Aquitaine, Regional Department of the Ministry of Environment, France<br>• IRSTEA<br>• IGB, WSCS<br>• Der Rheinische Fischereiverband von 1880 e.V., LANUV |
| *Continuing with experimental reintroduction and releases of larvae and tagged juveniles.* | Step 1: new experimental releases of tagged juveniles, including monitoring of migration and foraging behaviour. Within mandate of license issued by the Ministry of Agriculture, Nature and Food Quality, NL. | High | Medium term (2021-2024) | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with:<br>• DREAL Aquitaine, Regional Department of the Ministry of Environment, France<br>• IRSTEA (based on existing cooperation agreement)<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany<br>• Der Rheinische Fischereiverband von 1880 e.V., LANUV |

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| | Step 2: upscaling of the experimental releases of juveniles (3 week – 10 months old fish). Including monitoring survival rates, foraging and migration behaviour.<br><br>2-5 percentage of the breeding success in the France breeding facilities is released in the Rhine, as agreed with the France breeding centre. Releases of (10) thousands of juvenile sturgeon along the Rhine. Permits are given by Dutch and German ministries. | Moderate | Long term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with:<br>• DREAL Aquitaine, Regional Department of the Ministry of Environment, France<br>• IRSTEA (based on existing cooperation agreement)<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany<br>• Der Rheinische Fischereiverband von 1880 e.V., LANUV |
| *Follow up investigations and research to complement the feasibility and risk analysis to comply with the IUNC criteria for reintroduction.* | Based on the analysis of anthropogenic factors imposing a potential threat on the return of the sturgeon in the Lower Rhine, follow up research will be conducted:<br>• Habitat suitability study for the lower river branches in The Netherlands and for the river Scheldt in The Netherlands and Belgium, see also objective 3;<br>• Sediment quality and its impact on sturgeon(reproduction);<br>• Impact of predators on sturgeon(reproduction);<br>• Shipping and its impact on sturgeon(reproduction), see also objective 2;<br>• Underwater sound and its impact on sturgeon(reproduction). | High | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine, including research institutes (WUR, TUD, IMARES, MARIN, University of Leiden, etc.). |
| *Set up a rearing station for the Rhine.* | Step 3: set up a rearing station near the spawning sites in the Rhine, similar as been done for the Elbe river. | Moderate | Long term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with:<br>• DREAL Aquitaine, Regional Department of the Ministry of Environment, France |

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| | | | | • IRSTEA (based on existing cooperation agreement)<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany |
| *An exit strategy is defined.* | Based on the criteria for reintroduction adopted by the IUCN, an exit strategy has been developed:<br>1. An acceptable mortality rate is defined for a sustainable sturgeon population for the (lower) Rhine.<br>2. Quantify and describe under which conditions the evaluation of the First Sturgeon Action Plan for the Lower Rhine will not be followed up by the implementation of an official reintroduction programme.<br>3. If there will be an official reintroduction programme after 2030, under which conditions the project will be defined as successful/unsuccessful ('stop criteria'). | Moderate | Long term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with:<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany |
| *Go / no go to start an official sturgeon reintroduction program in the Lower Rhine.* | Evaluation of the experimental reintroduction program and the results of the follow up investigations and research to complement the feasibility and risk analysis and to comply with the IUNC criteria for reintroduction.<br><br>Preparation of the decision-making process to formally start an official sturgeon reintroduction program.<br><br>If an official reintroduction program will start, a 2nd Sturgeon Action Plan for the Lower Rhine should be prepared. | Low | 2030<br><br>(or sooner if feasible) | • Ministry of Agriculture, Nature and Food Quality, NL<br>• Ministry of Infrastructure and Water Management, NL<br><br>With support of the ICPR / Fish Expert Group, Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany. DREAL Aquitaine, Regional Department of the Ministry of Environment, France and IRSTEA.<br><br>• In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine. |

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| *Depending on the go/no go: working towards the establishment of a breeding centre for the Rhine.* | Step 4: expansion of existing breeding centres in France (for the Gironde population) and Germany (for the Elbe river population) with a (re)breeding centre for a Rhine population. This will be the 3rd ex situ centre for A. Sturio in the world and necessary for repopulating the Rhine with sturgeon in the long term. Following best practice guidelines for husbandry (such as IUCN 2013, FAO 570). | Low | After 2030 | |

| **GOAL 2: FUTURE POPULATION IS PROTECTED FROM ACCIDENTAL AND DIRECTED REMOVAL: FISHING AND SHIPPING MORTALITY IS REDUCED AS MUCH AS POSSIBLE.** | | | | |
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| *Supporting agenda: strengthen cooperation between professional and recreational fisheries and between fisheries sector and National- and regional authorities and NGOs; supporting the economical sustainability of the certified Dutch fishery sector; supporting the navigation sector with innovations towards cost effective and low emission shipping considering environmental impact (the Platina Green Award is an incentive to also contribute to a lower ecological impact of shipping).* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *Strengthen cooperation with the professional fishing sector.* | Structural engagement and participation of the professional fishermen's associations in the policy debate and development of projects in the Rhine delta. | High | Ongoing | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West). |
| | Conduct a baseline monitoring (0-meting) of migratory fish in the Rhine Delta – Haringvliet water body, based on a mutual agreed monitoring program. | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with RWS, Wageningen Marine Research, Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association. |
| | Start a joint effort to monitor the ongoing sedimentation of the 'Voordelta' and work together on the accessibility of the harbour of Stellendam. | High | Short term | • Ministry of Infrastructure and Water management, NL<br><br>In cooperation with RWS, Port of Rotterdam, Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West). |
| *Accidental removal and mortality due to subsequent handling is reduced for professional fisheries and recreational fisheries (bycatch and handling on board).* | Raise awareness among both professional and recreational fishermen, fishermen's organisations and fisheries inspection of the endangered and protected status of the species. | High | Ongoing | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL |

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| | | | | In cooperation with Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association. |
| | Establish guidelines, raise awareness and actively promote the guidelines for proper handling and registration of the bycatch on board. | High | Ongoing | • Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association.<br><br>In cooperation with Ministry of Agriculture, Nature and Food Quality, WNF, ARK Nature. |
| | Monitor the bycatch of sturgeons to gain insight into survival, growth, distribution and important habitats. A reward for proper registration could be an incentive to improve monitoring and registration. | High | Ongoing | • Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association.<br><br>In cooperation with Ministry of Agriculture, Nature and Food Quality, WNF, ARK Nature. |
| | Establish a uniform registration system (through e-mail or app) to prevent separate systems for each specific research or fish species. | Moderate | Medium-term | • Ministry of Agriculture, Nature and Food Quality, NL<br><br>In cooperation with Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association. |
| *Direct removal and mortality due to targeted fishing is prohibited for professional fisheries and recreational fisheries.* | Targeted professional and recreational fishing of sturgeon species is/remains prohibited. | High | Ongoing | • Ministry of Agriculture, Nature and Food Quality, NL<br><br>In cooperation with Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association. |
| | Fishing free zones 250m up- and downstream of fish passages and sluices. | High | Ongoing | • Ministry of Agriculture, Nature and Food Quality, NL<br>• Ministry of Infrastructure and Water management, NL<br><br>In cooperation with Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, |

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| | | | | NetVISwerk, Vissersvereniging Zuid West) and Dutch Angling association. |
| *The Dutch professional fishing sector is economically sustainable and certified.* | Maximize sustainable professional fishing. The sector has several sustainability and quality labels, such as MSC, ASC, DUPAN and Waddengoud. | High | Ongoing | • Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West).<br><br>In cooperation with the sustainability and quality labels and the International Council for the Exploration of the Sea (ICES). |
| | Continue to develop and improve professional fishing techniques that can reduce the by-catch (not only sturgeons). | Moderate | Medium term | • Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West).<br><br>In cooperation with the WUR. |
| | Restrict or reduce fishing techniques that are harmful to migratory fish, such as the sturgeon on migratory routes and in important growing up and foraging areas.<br><br>Especially in the areas that prove to be of great importance for the species, especially the Biesbosch and the brackish zones of the Haringvliet and Nieuwe Waterweg, the use of fishing traps that causes high mortality should be limited as much as possible. | Moderate | Medium term | • Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West).<br><br>In cooperation with the WUR and VisNed. |
| *Accidental losses of individuals by ship strikes is assessed and reduced.* | Identification of locations and extent of losses of migratory fish through ship strikes. | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with Shipping organisations (Schuttevear), Port of Rotterdam, MARIN, WUR, TUD. |
| | Identify the position in the water column of young upstream migrating sturgeons and adult upstream migrating sturgeons and assessment of collision risk with ships.<br><br>Under laboratory conditions identify the effect of currents caused by shipping on the soil sediment and | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with Shipping organisations |

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| | the eggs and larvae contained therein. | | | (Schuttevear), Port of Rotterdam, MARIN, WUR, TUD. |
| | Identification of measures to reduce accidental losses through ship strikes. | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with Shipping organisations (Schuttevear), Port of Rotterdam, MARIN, WUR, TUD, Commercial parties. |

| **GOAL 3: POTENTIAL STURGEON CRITICAL HABITATS ARE IDENTIFIED (AND RESTORED IF NECESSARY).** | | | | |
|---|---|---|---|---|
| *Supporting agenda: contribute to the national and regional policies for water, ecology, nature development, water safety and navigation (WFD, Natura 2000, IRM, PAGW, LIFE IP Delta Nature); contribute to the sustainable and environmental sound corporate strategies of the sand and gravel extraction industry and the Port of Rotterdam.* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *Existing critical habitats are identified and protected from deterioration.* | Existing critical sturgeon habitats are identified in The Netherlands.<br><br>Remark: in Germany (NRW), potential critical sturgeon habitats in the lower Rhine are already identified and they are part of the FFH area *'Rhein-Fischschutzzonen zwischen Emmerich und Bad Honnef'*, for the moment there is no need to extend these areas. | Moderate | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with RWS, provinces (Zuid-Holland, Gelderland, Noord-Brabant). |
| | Critical boundary conditions to improve fish migration conditions, including the potential return of the sturgeon, is part of the integrated approach of the IRM program in The Netherlands (related topics: water management objectives, dredging policies and riverbed maintenance). | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with RWS, provinces (Zuid-Holland, Gelderland, Noord-Brabant). |
| *Potential habitats restored in key river stretches.* | Consider the specific criteria for sturgeon habitats, when new potential habitats will be restored as part of IRM, Programmatische Aanpak Grote Wateren (PAGW) and floodplain restoration (WFD and Natura 2000). | Moderate | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with RWS, provinces (Zuid-Holland, Gelderland, Noord-Brabant), Cascade. |
| | Expanding the recovery of brackish zones in the Rhine delta, important for acclimatization of migratory fish. | High | Long term | • Ministry of Infrastructure and Water Management, NL<br>• Ministry of Agriculture, Nature and Food Quality, NL<br><br>In cooperation with RWS, Port of Rotterdam, WWF, ARK Nature, Dutch Angling association. |

| **GOAL 4: FISH MIGRATION (INCLUDING STURGEON) AND UP- AND DOWNSTREAM CONNECTIVITY IN THE LOWER RHINE IS SECURED AND FACILITATED.** | | | | |
|---|---|---|---|---|
| *Supporting agenda: contribute to the national and regional policies for water, ecology, nature development, water safety and navigation (WFD, Natura 2000, IRM, PAGW, LIFE IP Delta Nature); contributes to free navigation and an open and accessible Port of Rotterdam.* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *No further migration obstacles are built in key river stretches.* | Prevent as much as possible any future construction of migration obstacles from sea to source in the main Lower Rhine river, based on existing legislation, laws, treaties and conventions. | High | Ongoing | • Ministry of Infrastructure and Water Management, NL<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany. |
| | Establish prerequisites for mitigation measures if future construction of migration obstacles in the main Rhine river is being planned, taken into account the criteria for all migratory fish, including sturgeon. | Moderate | Ongoing | • Ministry of Infrastructure and Water Management, NL<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany. |
| *Migration improved at key migration obstacles.* | Further identify and analyse relevant and potential obstacles for sturgeon migration in the main Rhine river branches. | High | Ongoing | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL |

| **GOAL 5: A STURGEON MONITORING PROGRAM IS DESIGNED AND IMPLEMENTED TO BE ABLE TO EVALUATE AND QUANTIFY THE IMPACT AND EFFECTIVENESS OF THE ACTIVITIES OF THE FIRST STURGEON ACTION PLAN FOR THE LOWER RHINE.** | | | | |
|---|---|---|---|---|
| *Supporting agenda: contributes to marine research on fish migration; strengthen cooperation between professional and recreational fisheries and between fisheries sector and National- and regional authorities and NGOs.* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *Sturgeon monitoring program for the period 2020-2030 is designed and implemented.* | Identify competent authorities and relevant sectors to establish monitoring within the North Sea and Rhine basin, both marine- and freshwaters. | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with:<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany.<br>• RWS, Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Shipping organisations (Schuttevear). |
| | Define criteria and set up a dedicated system of monitoring: expand the MWTL-monitoring programme in The Netherlands, monitoring by-catch by professional and recreational fishermen and by e-DNA (screening presence type in relevant habitat areas). | High | Short term | |
| | Active monitoring of viability, migration behaviour and sustainability of the experimental reintroduction of juveniles, with special emphasis on impact of shipping, dredging and fisheries. | High | Medium term | |
| | Regularly evaluate the monitoring results and adjust the monitoring programme if necessary. | High | Medium term | |
| *Monitoring protocol drafted for the period 2030-2040.* | A monitoring protocol is drafted before 2030 to be implemented after final decision (go) to proceed with an official reintroduction program. | Low | Long term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br>• Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, Germany.<br><br>In cooperation with RWS, Dutch professional fishermen's associations (Visned, Nederlandse Vissersbond, NetVISwerk, Vissersvereniging Zuid West) and Shipping organisations (Schuttevear). |

| **GOAL 6: ADEQUATE FUNDING, COMMUNICATION AND EVALUATION OF FIRST STURGEON ACTION PLAN FOR THE LOWER RHINE.** | | | | |
|---|---|---|---|---|
| *Supporting agenda: support the education and awareness campaigns of National- and regional authorities and NGOs on water and ecology; participating stakeholders (authorities, NGOs, fisheries sector, inland navigation sector, industrial water use sector, Port of Rotterdam and the sand and gravel extraction industry) are able to use the potential success of the return of the sturgeon as a success story to promote their business in balance with a natural river systems; it can boost international cooperation within the basin.* | | | | |
| *Result* | *Action* | *Priority* | *Time scale* | *Organisations responsible* |
| *Adequate funding instruments for short- and medium-term actions are in place.* | Funding (including potential EU funding sources) to execute the First Sturgeon Action Plan for the Lower Rhine for the short- and medium term (period 2020-2025) should be arranged. | High | Short term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine. |
| *Adequate funding instruments for long term actions are in place.* | Funding (including potential EU funding sources) to execute the First Sturgeon Action Plan for the Lower Rhine for the long term (period 2025-2030) should be arranged. | Moderate | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine. |
| *Legal prerequisites support sturgeon conservation measures.* | Revisit listing of species in National and regional policy and regulations following the current status (IUCN, Bern Convention, CITES, NATURA 2000). | Moderate | Medium term | • Ministry of Agriculture, Nature and Food Quality, NL<br>• Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with provinces (IPO). |
| *Awareness for sturgeons and the urgency of conservation measure is increased.* | Develop and implement a targeted communication strategy to increase awareness among the general public, stakeholders and responsible authorities to keep the First Sturgeon Action Plan for the Lower Rhine on the (political) agenda. | High | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine. |

| | | | | |
|---|---|---|---|---|
| *International exchange between relevant stakeholders is increased.* | Organize every 2 years an expert meeting to evaluate and discuss the progress of the First Sturgeon Action Plan for the Lower Rhine with national and international stakeholders. | Medium | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with International Rhine Commission (Fish expert group), DREAL Aquitaine, Regional Department of the Ministry of Environment, France, Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of North Rhine-Westphalia, IRSTEA and IGB. |
| *Monitoring and evaluation of the First Sturgeon Action Plan for the Lower Rhine.* | Reporting schedule and reporting mechanism agreed (aligned to other legally required reporting). Reports of focal points are presented at national and international level. | High | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In cooperation with International Rhine Commission (Fish expert group) and Bern Convention. |
| | Medium term (5yrs) and long term (10yrs) evaluation of the First Action Plan leading to adaptive management decisions, or continuations of activities. | High | Medium term | • ***Rhine Sturgeon Program team***, cooperation of WWF, ARK Nature, Dutch Angling association, Ministry of Agriculture, Nature and Food Quality and the Ministry of Infrastructure and Water Management, NL<br><br>In close cooperation with *all parties* involved in the First Sturgeon Action Plan for the Lower Rhine. |

## 7.4 Roadmap for implementation 2020-2030

The action plan for 2020-2030 forms a framework for action and cooperation, based on an attractive agenda for all parties involved. We will work on:

1. Adoption of the First Sturgeon Action Plan for the European sturgeon in the Lower Rhine and establishment of a joint project consortium to facilitate cooperation and joint fact finding.
2. Continued experimental releases of larvae and (tagged) juveniles from French brood stock.
3. Set up of the Rhine rearing station. Aiming for experimental releases of juvenile sturgeon reared along the river Rhine, from 2025 onwards.
4. Further research to complement the feasibility and risk assessments, to comply with the IUNC criteria for reintroductions together with relevant sectors and partners.
5. Bycatch and accidental mortality in professional and recreational fisheries are assessed and largely reduced.
6. Accidental losses caused by ship strikes are assessed and largely reduced.
7. Existing critical habitats (spawning and nursery grounds) are identified, restored and protected.
8. No further migration obstacles are built (stand still principle) in key river stretches and sturgeon migration is improved at key migration barriers.
9. Sturgeon monitoring program for the period 2020-2030 is designed and implemented.
10. Raise awareness for sturgeons. The urgency of conservation measure is increased.

**Table 5: Proposed budget for the First Sturgeon Action Plan for the Lower Rhine (in keuro / year).**

| Main activity of the 2020-2030 Roadmap | | 2020 | 2021 | 2022 | 2023 | 2024 | | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Program management / joint project consortium | 25 | 25 | 20 | 20 | 20 | | 20 | 20 | 20 | 20 | 20 | 20 |
| 2 | Continuing with experimental releases | 50 | 50 | 75 | 75 | 75 | | 75 | 75 | 75 | 75 | 75 | 75 |
| 3 | European sturgeon centre (2020-24) / set up of Rhine rearing station (start 2025) | 40 | 40 | 40 | 40 | 40 | | 100 | 50 | 50 | 50 | 50 | 50 |
| 4 | Follow up with investigations and research | 35 | 50 | 25 | 25 | 25 | | 0 | 25 | 0 | 25 | 0 | 25 |
| 5 | Cooperation with professional fishermen (*) | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Cooperation with shipping sector (*) | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | Habitat suitability (**) | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Connectivity (**) | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Monitoring programme of life fish | 10 | 10 | 10 | 10 | 10 | | 10 | 10 | 10 | 10 | 10 | 10 |
| 10 | Communication | 10 | 10 | 10 | 10 | 10 | | 10 | 10 | 10 | 10 | 10 | 10 |
| | | | | | | | Total | | | | | | |
| | **Total budget** | **170** | **185** | **180** | **180** | **180** | **895** | **215** | **190** | **165** | **190** | **165** | **190** |
| | Cofinaning secured | 170 | 160 | 40 | 0 | 0 | 370 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Budget support by other partners** | **0** | **25** | **140** | **180** | **180** | **525** | **215** | **190** | **165** | **190** | **165** | **190** |

(*) budget is part of activity 4 and 9.
(**) investments in river restoration and connectivity is not part of the Action Plan.

**Remark: between 2010-2020 the program was financed by WWF, SVN and ARK with a total budget of approximately 200 keuro per year (2 million euro between 2010-2020). This includes own funds and external funds.**

| Main activity of the 2020-2030 Roadmap | | Cofinanced by: |
|---|---|---|
| 1 | Program management / joint project consortium | ARK, WNF, SVN, NPL, Life, Interreg |
| 2 | Continuing with experimental releases | ARK, WNF, SVN |
| 3 | European sturgeon centre (2020-24) / set up of Rhine rearing station (start 2025) | |
| 4 | Follow up with investigations and research | |
| 5 | Cooperation with professional fishermen (*) | |
| 6 | Cooperation with shipping sector (*) | |
| 7 | Habitat suitability (**) | |
| 8 | Connectivity (**) | |
| 9 | Monitoring programme of life fish | |
| 10 | Communication | ARK, WNF, SVN |
| | **Total budget** | |
| | Cofinaning secured | *Between 2010-2020 the program is financed by WWF, SVN and ARK. (this includes own funds and external funds)* |
| | **Budget support by other partners** | |

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