

the **Allis shad** in the  
**Gironde-Garonne-Dordogne**  
basin

*Reasons for the decline  
and needs for  
conservation*



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# The Allis shad in the Gironde-Garonne-Dordogne basin

## *Reasons for the decline and needs for conservation*

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# Introduction

The Gironde is one of the biggest river estuaries in Europe. Besides the conditions found in the rivers discharging into it, the wealth of the estuary is one of the key factors why the Gironde watersheds house the largest populations of migratory fish. Some of these are the last of the remaining in Europe and of particular importance in the European context. Yet ten years ago the Gironde watersheds also housed the biggest population of the allis shad in Europe. Year and year out hundreds of thousands of allis shads returned into the Garonne and the Dordogne. Up to 350,000 fish were targeted by fisheries and played an important role in the local cuisine.

Their huge abundance was the reason why the allis shad from the Gironde watersheds served as genitor fish for the first reintroduction project of the allis shad in a river system in the former distribution range and helped to reestablish a population in the river Rhine, a European project involving partners in the Aquitaine, Germany and the Netherlands.

The Rhine itself formerly housed an even bigger allis shad population, which however became extinct within the first decades of the twentieth century due to an over exploitation by fisheries and coincidental effects of habitat destruction, water body fragmentation and pollution.

After the conditions for the habitation had been improved and the fish fauna had been rehabilitated accordingly, plans were made to reestablish populations of migratory fish, which are flagship species for healthy river conditions and after the first salmon have been found to return into the system and to reproduce naturally, ideas came up to start an attempt to bring back the allis shad into the Rhine. The breeding techniques for allis shad have been successfully developed by Irstea (formerly Cemagref) before the beginning of the project. During the project, methods have been improved by the partners in the Aquitaine Region. Allis shad larvae from genitor fish from the Garonne and the Dordogne could be bred this way and were released in the Rhine basin in Germany with support of the LIFE program of the European Union.

the size of the population has declined to less than 1% of the average number in the nineties

However, even in the Gironde basin the situation has drastically changed in the recent years. The number allis shad returning to the watersheds for spawning has continuously decreased since 2003 and despite fisheries for allis shad are prohibited since 2008, the average size of the population in the last three years has declined to less than 1% of the average number in the nineties. Within less than one decade the role of the allis shad population in the

Gironde basin has changed from a population which guaranteed a precious output for fisheries along the rivers and to serve also as a donor population for a restoration program to a highly threatened population. Both, the continuation of the reestablishing measures on the Rhine system, as well as the exploration of the reasons for its collapse in the Gironde watersheds were the objectives of a Life+ project starting in 2011.



*Allis shad (MIGADO)*

# What are diadromous fish ?

Diadromous fish are amongst the most specialized species in the world and draw several advantages from their way of adaptation towards two totally different environments.

They split their life-cycle into a part which is spent in freshwater and one at sea. Most diadromous species in Europe migrate into freshwater for spawning (anadromous species), however, they leave the rivers yet in the juvenile stage, and spend a considerable part of their life in the estuary and the sea where they grow much faster into adults than in the freshwater. This is probably the main benefit of the anadromous life style as it enables the fish to produce more biomass and gametes than specimen of similar aged freshwater species. Furthermore, spawning in freshwater habitats implies fewer risks and a better survival of the offspring and is thus more efficient for the population than spawning in the sea. On the other hand, catadromous species like the eel spawn in the sea and enter the rivers at the juvenile stage in which they grow into maturity and go back into the Sea for spawning.

In quasi natural systems with low anthropogenic impacts, anadromous fish can form large populations which underlie inter-annual fluctuations mainly caused by hydro-climatic conditions. The diadromous life-style however requires a high degree of connectivity between the different habitats which need to be utilized in the life-cycle and at least in some species, as in salmon, a high demand towards the quality of their environment. Besides habitat fragmentation and impairment, the highest threat for population of diadromous fish mainly occurs during the migration periods, especially during the spawning migration of the adults, as this migration is seasonally predictable in all species. The estuaries and rivers then act as bottlenecks in which the migrants concentrate and are easy prey, particularly for fisheries.



*Salmon during upstream migration (MIGADO)*



*Young eel during upstream migration (EPIDOR)*

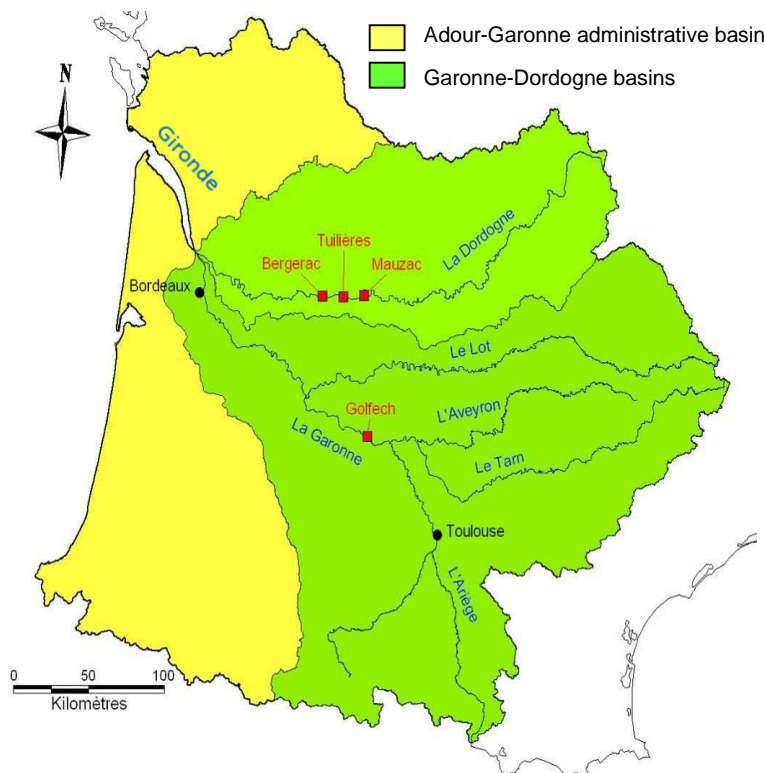
# The Gironde-Garonne-Dordogne basin

The Gironde system includes two river basins: the Garonne river coming from the Pyrenean mountains and the Dordogne coming from the Massif Central. The watershed covers 81,000 km<sup>2</sup> and the mean annual rate of freshwater discharge is around 1000m<sup>3</sup> s<sup>-1</sup>. The two rivers merge near Bordeaux in the largest European estuary (around 625 km<sup>2</sup>).

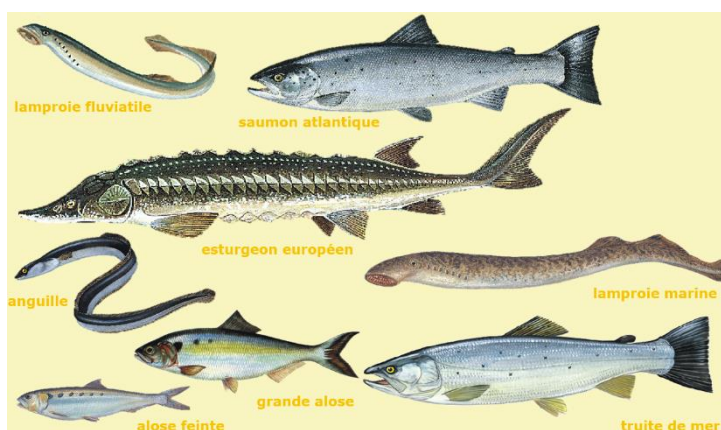
The river Garonne is 580 km long and the catchment area has a size of 55.000 km<sup>2</sup>, The river Dordogne is 480 km long and the catchment area covers an area of 23.700 km<sup>2</sup>. The first obstacle for fish migration in the river Dordogne occurs 190 km upstream at the dam of Bergerac. It is followed by the second dam about 10 km upstream at Tuilières. In the river Garonne the first dam occurs 270 km upstream of the sea near the city of Agen at Golfech. All dams are equipped with fish passes or fish lifts.

There is a commercial fishery in the estuary and the lower part of the rivers. Fishermen mainly target diadromous species (eel, lamprey), shrimps (*Palaemon longirostris*) and few marine vagrant species like the meagre (*Argyrosomus regius*), the sea bass (*Dicentrarchus labrax*, *D. punctatus*) and the sole (*Solea solea*). Recreational fishermen, using different gears however globally target the same species.

The system is hosting 11 diadromous species: two shads (*Alosa alosa*, *Alosa fallax*), two lampreys (*Lampetra fluviatilis*, *Petromyzon marinus*), the flounder (*Platichthys flesus*), the thin lipped mullet (*Liza ramada*) the European eel (*Anguilla Anguilla*), the European sturgeon (*Acipenser sturio*), and two salmonids (*Salmo salar*, *salmo trutta*). The smelt (*Osmerus eperlanus*) is no longer observed in the Gironde estuary because of the rise of the water temperature (climate change). Among these species, five are listed in the Habitat Fauna and Flora Directive and are concerned by the Natura 2000 network.



Gironde-Garonne-Dordogne basin (ONEMA, BD Carthage).

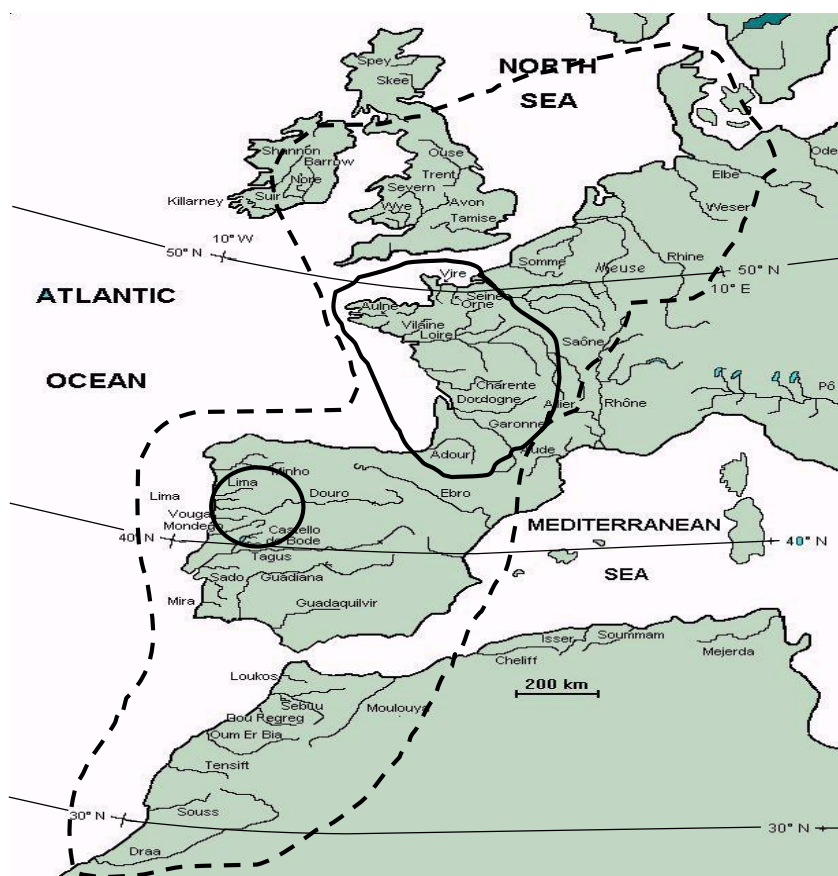


The eight migratory fish of the Gironde-Garonne-Dordogne basin

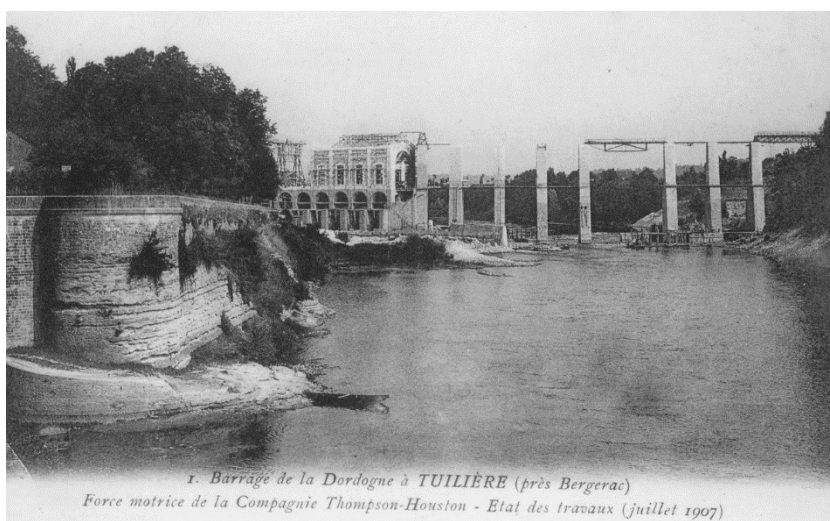
# A little history

At the beginning of the 20th century nearly all large rivers in West and Central Europe that drain into the Atlantic Ocean, the North and West Mediterranean Sea in the latitudinal range between South Scandinavia and North Africa housed populations of allis shad and also other diadromous species. A complex of anthropogenic factors such as overfishing, habitat destruction, gravel extraction and buildings of transversal barriers like weirs and dams, increasingly diminished the formerly often big populations and cut-off the adults from their remaining spawning grounds in the rivers. Furthermore, the increasing pollution of many rivers, particularly draining, densely populated catchments, areas of intensive agriculture and industrial areas, deteriorated the environmental conditions, even in less fragmentized rivers. Due to their complex life-cycle diadromous fish were affected by these factors in a multiple way and were the first species that became extinct in many European rivers by the middle of the 20th century.

Vital populations of the allis shad and other diadromous species remained in anthropogenic less affected river systems in Western France and Portugal. In some of them, fisheries for allis shad and other migratory fish remained economically important. However, even in these rivers the populations of migratory fish have suffered from several impacts. For instance the native population of salmon disappeared in the Dordogne soon after the first dams have been built and hampered the fish from reaching their spawning areas in the headwater regions in the Massif Central and the Périgord mountains. The populations of Atlantic sturgeon died out in the entire distribution range mainly due to overfishing, except for the Gironde watersheds. The populations of allis shad were not endangered for a long time despite intensive fisheries.



Historical distribution (dotted line) and current (solid line) of the Allis shad (Baglinière)

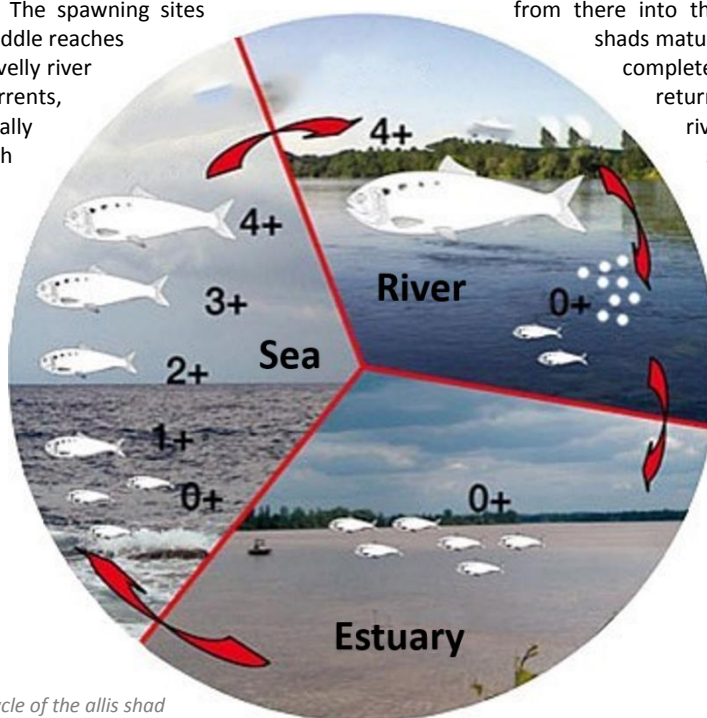


Construction of the Tuilières dam on the Dordogne in 1907

# The Biology of the allis shad

The allis shad (*Alosa alosa*) belongs to the family of herrings (*Clupeidae*) and spends, just like their marine relatives, the major part of its life at sea. Like the closely related twaite shad (*Alosa fallax*), which often co-occurs in the same rivers but, unlike allis shad, seldom moves far upstream the tidally influenced zone, the adults penetrate the estuaries in spring when water temperatures rise above 11°C and swim up the rivers for spawning, which occurs at water temperatures above 14°C. The spawning sites are situated in the rivers middle reaches (barbel region) and are gravelly river stretches with moderate currents, which however typically increase as the depth decreases. Such conditions can for instance be found at inner-bend areas, flooded gravel banks and the mouths of tributaries.

The actual spawning act occurs at night at the surface. The fish swim in circles while they shed their eggs and sperm into the water with a loud splashing, which is quite clearly perceptible. The fertilized eggs sink to the bottom where they are trapped amongst gravel. After hatching, the offspring stays for some weeks to months in the rivers and then migrates downstream in summer and autumn into the brackish parts of the river mouths and at the latest in winter from there into the sea, where the allis shads mature after 3 to 7 years and complete their life cycle by returning into their natal rivers. The genitors spawn several times per season and vast majority of the adults die at the end of the spawning periode.



Life cycle of the allis shad



Allis shad mating or « bull » (MIGADO)

# How the allis shad from the Gironde help to establish a population in the Rhine

In the 1990s the allis shad population in the Gironde watersheds was estimated to 250,000 to 700,000 adults swimming up the Garonne and Dordogne for spawning each year and the population was the largest remaining in Europe. This is why the idea arose to use the progeny of genitor fish out of the Gironde basin to help reintroducing the allis shad into another large European river system in the species former native range and in which some decades before its extinction even hundreds of thousands of allis shad swam into the river and were also subject of specialized fisheries. Regardless of several anthropogenic factors, the habitat situation seemed promising to maintain a self sustaining population of allis shad after building a founder population. This was the main objective of the EU supported LIFE project "The reintroduction of the allis shad in the Rhine" starting 2007. It was also the first attempt to artificially breed allis shad – the prerequisite for reestablishing a population in a remote location from the current distribution area.

A tank spawning technique and marking protocol were developed by Irstea (former Cemagref) in the early 2000s. This spawning technique was improved by Association Migado with the support of the Region Aquitaine. The principle is to trap nearly reaped allis shad at their spawning run in fish ways of the rivers Garonne and Dordogne and bring these genitor fish into a special adjacent hatchery which was modified and equipped from EU funds. Spawning occurred after hormonal stimulation in big round tanks which can be darkened and provided with a strong current hence simulating the conditions under which the fish spawn in nature. The fertilized eggs are trapped and incubated in special jars in which the larvae hatch after some days. The larvae are marked by exposing them to a special chemical which allows to determining their origin from the hatchery later on. Due to continuous improvements in the different steps of the breeding process the survival rate of the offspring and the efficiency could be increased substantially with regard to the wild spawner stock less than one percent of the shads were trapped for the hatchery. More than 11 Mio larvae have been released in the meanwhile, which has led to a substantial increasing of adult allis shad returnees coming from the stocking measures. As these fish have also reproduced naturally in the Rhine, the project objective seems to be almost reached.



*Bruch hatchery in Lot-et-Garonne (RHFV)*



*Transport of larvae from Garonne-Dordogne to the Rhine (RHFV)*

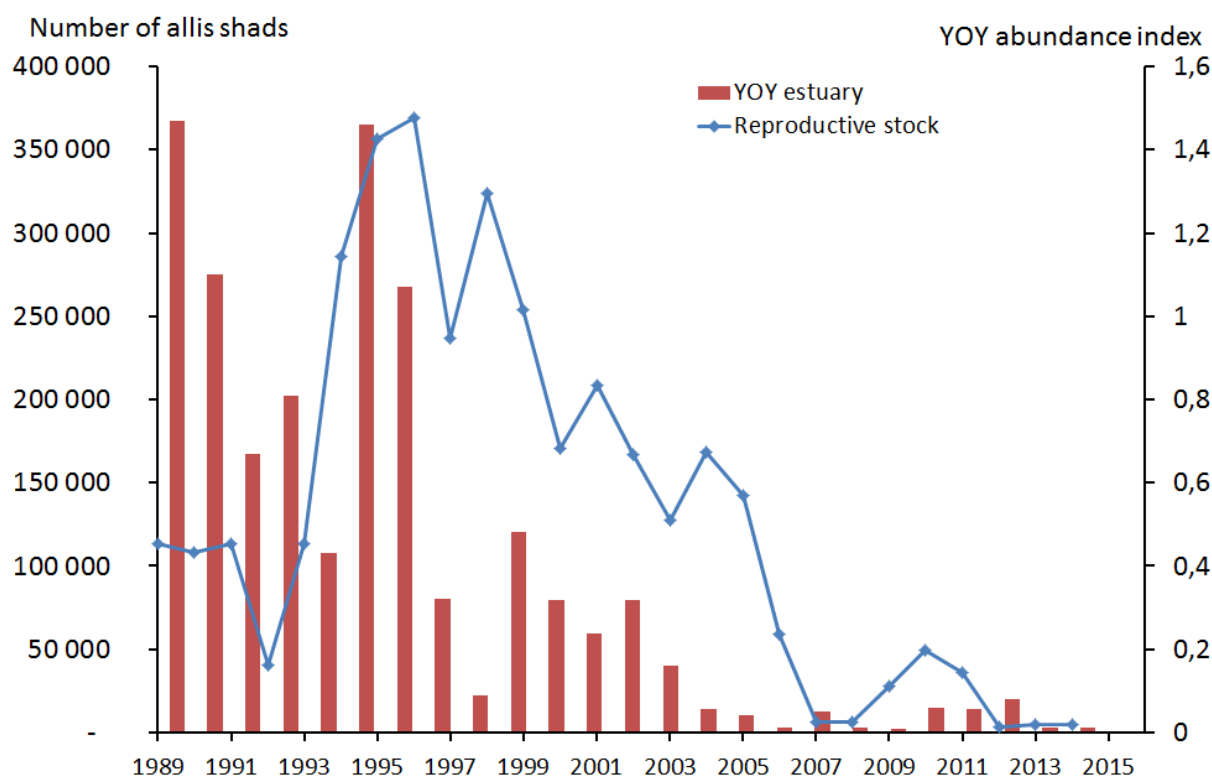


*Public release of shad larvae in the Rhine (RHFV)*

# The happening of the unexpected: the collapse of the Gironde allis shad population

When the idea developed to start the LIFE project aiming for the reintroduction of the allis shad to the Rhine in first years of the 21st century there were still considerably more than one hundred thousand shads striving up the rivers in order to spawning. However, at this time the fisheries yield amounted to the half of entire stock or even more. In 2006 a sharp decreasing of the returnees finally made clear that

the population has been over exploited in the past and despite a fishing ban being in force since 2008 wasn't able to recover by own means. In the recent three years the population was assessed to amount to less than 5,000 spawners which is less than 1% of the population size in the 1990s. The population is currently seriously threatened.



Evolution of the reproductive stock and YOY (Young Of the Year) abundance in the Gironde estuary (MIGADO - IRSTEA). After a record in 1995 and 1996 season, the reproductive stock declines gradually until 2005, while staying at a high level. From 2006 the stock falls brutally reaching in 2007 and 2008 a low level record of about 6 000 genitors. The follow-up of YOY in the estuary shows a decline of the abundance since the middle of the 90s, to reach extremely low levels in the early 2000s. As the number of spawners did not indicate that the population was already threatened, factors acting in the river or the transition zone into the estuary are likely to explain this development.

Although fisheries are assumed to play a major role, additional factors are suspected to have contributed to this development. The following factors are the most probable to at least partially and in addition to others account for the weakening of the population in different phases of the shad life-cycle. It is demonstrated what can be done from a management point of view to lessen their influence.



# Fisheries

## Impacts on the population

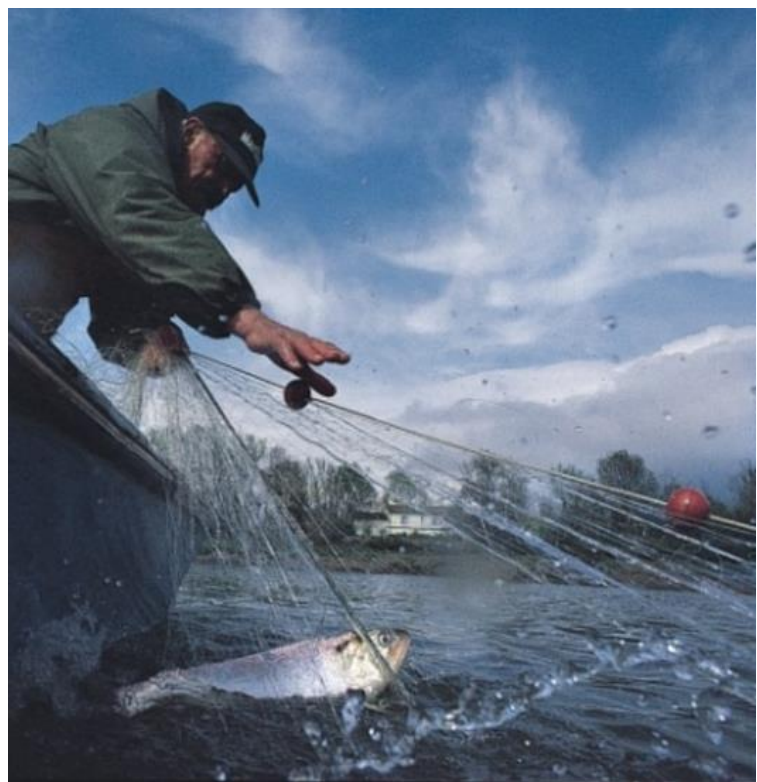
Estuarine and river fisheries are traditionally and economically important in the Southwest of Europe. Around 170 professional fishermen existed along the river courses and the Gironde estuary still in the year 2000 and made their living from fisheries. Yet in the 1990s amongst the targeted species, allis shad was one of the most profitable and made up to 15% of the total income (Year 2000 - Source Irstea). Until 2000, a mean of 240.000 allis shads were landed per year – which corresponds to a share of 45 to more than 85% percent of the total estimated spawner stock. This substantial reduction of the number of genitor fish inevitably leads to a reduced number of offspring. The weaker recruitment makes the population even more sensitive towards other impairments whose direct influences might have been less detrimental before. It is well known from examples of disappearing populations of diadromous fish all over the world, that the exploitation played a crucial role in these developments.

## Stage affected

Adult

## Management tools

In the current situation a reopening of allis shad fisheries would mean to give the final death blow to the population. For the rehabilitation of the allis shad population it will be strictly necessary to prevent a further weakening of the spawner stock in order to maximize the potential recruitment. That means it would be desirable that the fishing ban should be kept in force until there are clear signs for a sustainable recovery of the population. After seeing significant signs of recovery it seems possible to consider a careful reopening of fisheries with low fishery quotes.



*Allis shad fishing with drift net (Bordes)*

# Weir, dams and hydropower stations - longitudinal obstacles and threats for migrating fish

## Impacts on the population

The erection of dams hampers fish from reaching spawning areas upstream. Although many of such transversal obstacles have been equipped with fish ways or fish lifts to enable fish to continue their upstream migration, these passage facilities do often not function adequately, either as the fish are not able to locate the entrance or do not manage to pass through into the upstream section of the dam. As a consequence the fish are cut-off from a great share of the rivers spawning habitat potential and often the traditionally most important reproduction sites and forced to spawn in less suitable habitats henceforth causing a weaker reproductive efficiency.

Furthermore, dams also have secondary effects on fish populations. The reservoir sections upstream the dams do also affect the water chemistry and temperature regime of the downstream sections, i.e. by algal blooms and water quality deterioration. The downstream of deep dams with bottom outlets have temperatures considerably lower than in undisturbed fluvial systems whereas shallow reservoirs heaten in summer. Both outcomes not only affect the behavior of fish but can also act as serious impacts with regard to the survival and the fitness of the offspring. Finally, most dams are equipped with hydro-power stations through which the juvenile stages must pass through on their seaward migration. The turbine passage is known to cause increased mortalities, particularly in larger sized individuals. Although the mortalities of YOY allis shad is assumed to be less problematic due to their smaller size, the emigrating shads are expected to suffer even higher in consideration of direct mortalities by turbine passages than in unobstructed river sections. Even the need to find the way through the nearly stagnant reservoirs with their high abundance of predators is considered to imply additional sources of mortality

## Stage affected

Adult and young in freshwater

## Management tools

The existing fish migration facilities in the Garonne and Dordogne have been demonstrated to not work sufficiently making it impossible for the shads to move upstream in order to reach the historically important and productive spawning sites in the rivers middle and upper reaches. Improving the conditions for upstream migration can be reached by modernizing existing fish passage facilities or installing new or even better additional and alternative types of fish migration helps. These measures are regarded as key tools for the rehabilitation of populations of migratory fish and particularly allis shad.



*Tuilières dam on the Dordogne (Bordes)*

# Spawning sites

## Impacts on the population

The obstruction of the rivers also negatively affects the habitat conditions in the free-flowing parts of the rivers and stretches downstream of the dams as the reservoirs act as sinks for the river bed load. Allis shad eggs are not adhesive and don't stick on the substrate. In natural rivers this spawning behavior works out quite effective as the eggs move with the current and are deposited in the interstices of gravel where they still receive water with high oxygen content and develop well. The rivers Garonne and Dordogne naturally transport tons of gravel and pebbles downstream which are eroded in the headwater regions and moved with current flow. Gravels accumulate in stretches with moderate current are blocked by the dams, which cause a deficit of coarse bottom substrates in the downstream section. Spawned shad eggs can no longer deposit in interstices but are washed out into less suitable micro habitats where they often do not develop. Thus the egg to larva survival is strongly reduced compared to rivers with natural bed load regimes. As the shads also do not reach more suitable spawning sites in the middle reaches as a consequence of damming and outdated fish passage facilities, the proportion of progeny per genitor is much lower. Both factors in combination have very negative effects on the recruitment.

A recent study on the European sturgeon highlighted the influence of spawning habitat quality (organic contaminants and heavy metals) on larvae development and survival. This aspect has not yet been address for allis shad.

## Stage affected

Adult, egg and larvae.

## Management tool

To improve the quality of the spawning habitats particularly in the downstream areas of dams, adding large quantities of coarse substrates downstream is considered to be a useful tool to increase the recruitment in these parts of the rivers. An assessment of spawning habitat quality effect on embryos and larvae seems desirable.



*Two kinds of substratum : pebble suitable for breeding, and bedrock unfavorable (EPIDOR)*



*In many rivers, pebbles have given way to the bedrock (EPIDOR)*

# Habitat situation and environmental demands of the young-of-the-year in the freshwater phase of the life-cycle

## Impacts on the population

Habitats for the sensitive early developmental stages and juveniles have been found to be crucial for the recruitment due to increased mortalities as a consequence of insufficient habitat availability in many species. Both, the larva as well as the juvenile stages prefer open water and pelagic habitats and would present lower level of habitat requirements compared to species which YOY occupy lentic or benthic habitats.

High mortalities of the YOY could partly be explained by changes in fish community and an increased competition (for food or habitats). However, no marked alterations in these respects have become obvious or are likely to explain the reduced recruitment.

As in many other European rivers the organic and nutrient load has decreased significantly as a consequence of the comprehensive installation of sewage treatment plants in wide parts of the river basins, which leads to an improvement of the water quality but also via a reduced primary production to incisions into the rivers food webs. Although this topic has not been addressed in the Gironde basin so far, from other rivers basins, e.g. the Rhine it is well known that this process is accompanied by a decrease of the total fish biomass of 90%, especially in species with low demands to water quality due to reduced abundance of planktonic and benthic prey organisms. Nevertheless, the improvement of water quality has also led to the return of discerning species and overall species richness has increased in rivers all over Europe accordingly. It is not well understood how these alterations affect the recruitment of allis shad.

Further factors under debate to affect the populations of migratory fish are the implications of climate change, e.g. altered temperature or discharge regimes. A preliminary study demonstrates the impact of temperature on embryos until 14 day old larvae.

Temperature and oxygen depletion probably have a negative impact on the survival at younger stages and could partly explain the decrease of recruitment.

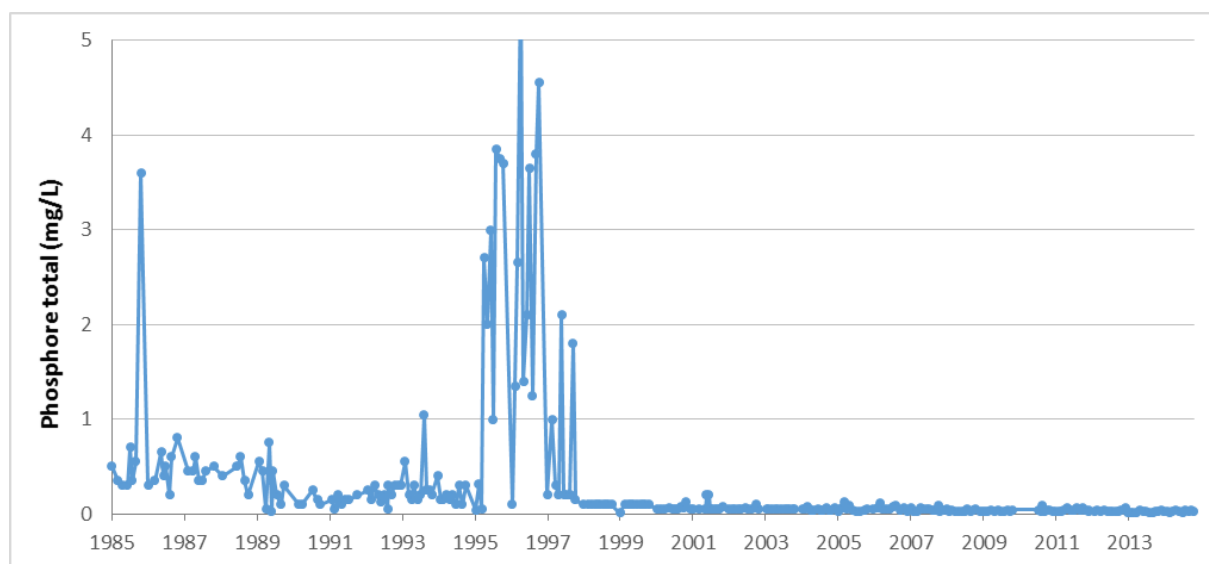
River flows regularly decrease which means an increase of temperature during summer months, and contribute to the maintenance of the mud plug in the tidally influenced river reaches.

## Stage affected

Juvenile in freshwater

## Management tools

The best way to ensure the presence of natural habitats, temperature and flow regimes, is to ensure near natural hydraulic conditions and self-dynamic flow conditions under which besides sewage water treatment, water quality deterioration will also have less effects than in impounded rivers.



Evolution of total phosphorus level on the Dordogne at Gardonne (Système d'information sur l'eau du Bassin Adour-Garonne)

# Deterioration of estuarine conditions

## Impact on the population

In the last years the situation in lowest parts of the rivers in the tidally influenced zone at the transition to the Gironde estuary has undergone a change with presumably drastic consequences for the biocoenosis living in this river part and also species which only temporarily need to pass through these zones – like diadromous fish. Decreasing of annual mean flow recorded for more than 30 years leads to accumulation of large quantities of fine sediments and organic matters which are normally washed out by floods. Particularly at high water temperatures in summer and autumn a great share of dissolved oxygen in the river water is consumed by microorganisms which is causing severe oxygen depletion and thus toxic conditions for most organisms. As the juvenile shads must pass through this zone exactly in this time frame on their seaward migration they probably suffer high mortalities on the transition from freshwater to the estuary, particularly under low flow conditions and high water temperatures.

How could this situation develop? Major parts of the river valleys and of the catchment, particularly of the Garonne are highly productive areas of agriculture. Large areas are subject to corn production and arable farming which is often accompanied by soil erosion and entry of fine sediments and nutrients and increased loads in the rivers. Furthermore, some sewage treatment plants, for example the main wastewater treatment facility of Bordeaux are not the state of the art and large quantities of insufficiently treated wastewater is discharged into Garonne and the organic load accumulates with fine sediments in the river reaches.

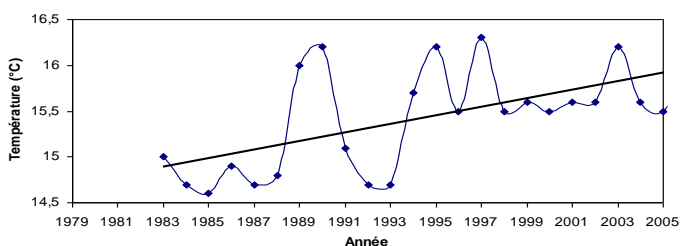
Due to either installing big reservoirs and barrages and water extraction for irrigation purposes, the flow regime has become unnatural in both rivers. As parts of the precipitation in the catchment do not run off via the rivers and potential flood peaks are cut through reservoir management. Consequently, the organically enriched fine sediments are not washed out and act like mud plugs in the river reaches near the estuary.

## Stage affected

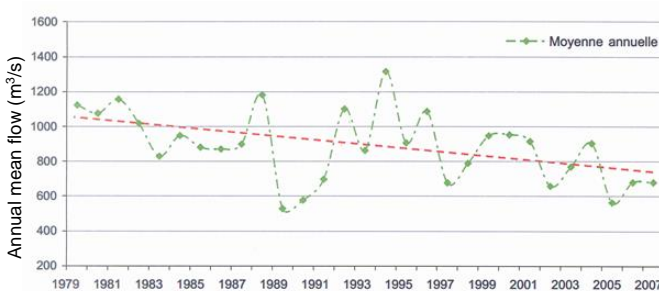
Juvenile on transition to estuary.

## Management tools

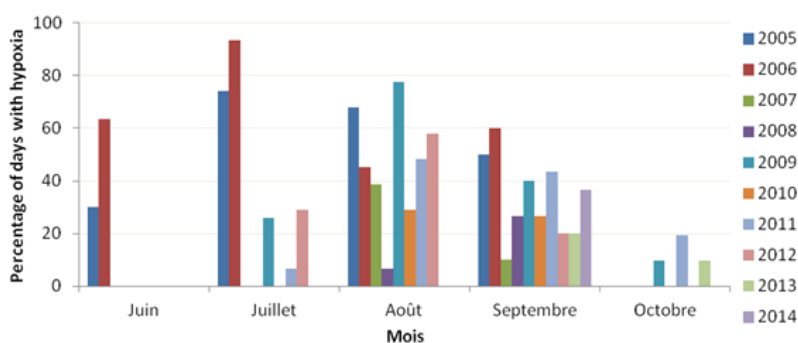
Although the mud plug is assumed to be crucial for the management of the population of allis shad and other diadromous and estuarine species, the management of the mud plug is difficult and requires measures on the catchment level. First the emissions of fine sediments from the agriculture must be reduced, as possible by soil protection and counter measures against erosion. Sewage treatment plants must be modernized and the emissions of oxygen consuming compounds must be prevented. Finally, at least single strong flood peaks are required to wash out the mud plug substantially. As no extreme natural flood events occur, reservoir management measures will be required in addition to natural flood events as no other technical solutions will be found.



Evolution of the annual mean temperature in the Gironde estuary (EDF)



Evolution of the annual mean flow of the Gironde estuary (Port Autonome de Bordeaux)



Proportion of days in hypoxia on the Garonne at Bordeaux (SMEAG)

# Why the collapse occurred ?

## Experimentation

Experimental stocking could be an appropriate tool to address this question. By stocking allis shad larvae the step of spawning and egg development in the life-cycle is skipped. Thanks to the conditions in the hatchery the survival of the eggs and the larvae is considerably higher than in nature as the fertilization is more efficient: The eggs can be better protected against fungal infections and the first feeding of the larvae can be optimized compared to the conditions in the wild. At least the pressures acting on the early developmental stages compared to the naturally spawned conspecifics are suppressed this way. The impacts in the development henceforth should be the same. From a genetically point of view the fish should be similarly equipped, however the behavioural adaptation could theoretically be less established compared to larvae hatched in the river. However, as the larvae are released at an age of a few days the impact of cultures is considered to be negligible. Monitoring measures must be carried out to identify the critical phase during the freshwater phase (embryonic, vs late larvae and juvenile). As the larvae can be marked accordingly, fish coming from the hatchery can be discriminated from wild conspecifics and thus allow to draw conclusions about the survival of the YOY in freshwater, and then determine the impact of the mud plug on survival and migration pattern.

## Management tool

Although the effective result in terms of returnees per larvae for the Rhine is difficult to assess as the first transversal obstacles at which the allis shad can be counted while passing through the fish ways are 700 km upstream of the Mouth into the North Sea, the increasing of recordings of adult allis shad to more than the 70fold of the long term mean in the first year in which returnees from the stocking measures were to expect, clearly demonstrate that the stocking is even under the conditions found in the Rhine are apparently rather effective. The infrastructures (trapping station, hatchery) that had been build in the first Life project for the stocking programme on the Rhine can also easily be used for an experimental stocking programme in the Gironde watersheds. At present the number of genitor fish removed from the wild stocks amounts to approximately 1% of the population and yields 2,000,000 larvae under suitable rearing conditions.

Besides removal of genitor fish from the wild stocks, larvae could also be bred from genitor fish coming from ex situ stocks, which have been stocked with larvae from wild genitor fish bred in the hatchery in Bruch and kept under aquaculture conditions in pilot facilities in France and Germany. It has turned out that the larvae successfully grow into juveniles and grow quite fast in captivity. The first specimens are close from reaching the age at which they mature in the wild. Accompanying studies aim to reveal how the treatment, i.e. the light conditions and the transfer into fresh water, can help to make the fish mature and a potential genitor fish that can reproduce like conspecifics in the wild. Using at least partially genitor fish from ex situ stocks could help to further decrease the pressure on the wild stocks.



Allis shad larvae produced in Bruch hatchery (RHFV)

# How do the populations of the other migratory fish benefit from these measures ?

Improving the conditions for a species of diadromous fish with regard to migration, water quality and habitat will also have effects on the populations of other migratory fish and threatened diadromous fish in particular. The extent of these repercussions will depend on the overlap of habitat use and migration schemes.

	Fisheries	Fish passage facilities	Bed load substratum	Spawning habitat quality	Trophic state	Mud plug
<i>Allis shad</i>	●●●	●●●	●●●	●●●	●●	●●●
<i>Twaite shad</i>	●●	●	0	●●	●●	●●●
<i>European sturgeon</i>	●	●	●●	●●●	●●	●●●
<i>Atlantic salmon</i>	●●	●●●	●	●	●●	●●●
<i>Sea trout</i>	●●	●●●	●	●	●●	●●●
<i>European eel</i>	0	●●	●	●●	●●	●●
<i>Flounder</i>	0	●	●	●●	●●	●●
<i>Mullet</i>	●	●●	●	●●	●●	●●
<i>River lamprey</i>	0	●●●	●●●	●●	●	●●●
<i>Sea lamprey</i>	●●	●●●	●●●	●●	●	●●●

Nature of the measures and effects on different migratory species

○ no effect ● weak effect ●● moderate effect ●●● strong effect

All species targeted by fisheries (which applies to all diadromous species except for river lamprey and sturgeon) are affected by fisheries and will benefit from at least partial closure seasons or adapted fisheries. Except for species which occupy only the nearly estuarine river sections and do not move far upstream nearly all populations will benefit from improvements of the fish passage facilities regarding upstream and also downstream migration (particularly eel and salmonid smolts).. Restoring bed load or gravel addition will improve the spawning conditions for species that reproduce on gravely substrate in the rivers middle or lower reaches, such as lampreys and sturgeon. As all diadromous species must pass through the estuary, improving the oxygen conditions in the tidally influenced river reaches, will affect all populations and particularly these which have to cross this zone when potential severe hypoxia episodes can occur (summer and autumn).

Facing the tasks to maintain the populations of allis shad and other diadromous fish in the basin will require involving the various stakeholders on the catchment scale and along the rivers, e.g. including agriculture for purposes of soil protection and energy producers for improving fish migration and mitigation of hydropower implications. Taking these actions to prevent the formerly biggest remaining allis shad population from extinction is inevitable and must start soon.

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Fish way (EPIDOR)



Pebble intake in river (ECOGEA)





## What is the LIFE+ ?

Life+ is a promotion program of the European Union aiming on supporting Environmental and Nature conservation projects within the community. By means of Life+ Biodiversity and Nature conservation projects like the "Alosa alosa" project are supported, which serve the maintenance and the reestablishment of wild populations of the endangered allis shad as a part of the Natura 2000 network.



LIFE09 NAT/DE/000008

## Partners of the project



Landesamt für Natur,  
Umwelt und Verbraucherschutz  
Nordrhein-Westfalen



Bezirksregierung  
Düsseldorf



Hessisches Ministerium für  
Umwelt, Energie, Landwirtschaft  
und Verbraucherschutz



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