

Atlantic sturgeon *Acipenser sturio* L., 1758 restoration and gravel extraction in the Gironde estuary

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ABSTRACT

The Gironde estuary, in the southwest of France, is the last Western European estuary where all diadromous fish still migrate. In addition, the Gironde-Garonne-Dordogne basin is the last system known where the reproduction of the Atlantic sturgeon takes place. The Gironde estuary is an essential habitat for the completion of the life history of this diadromous species. A European recovery plan launched in 1994 has shown the significance of the estuary for feeding and acclimatization of juveniles before their first journey to the sea. The Atlantic sturgeon has been threatened in the last 50 years, mostly by gravel extraction in spawning grounds and unadapted fishing regulations that have led to overfishing. Since the end of the 19th century, several measures connected to navigation (dykes, rockfill, groynes) have been carried out in the Gironde estuary. This estuary, although only industrialised to a slight extent, has suffered from dredging since the creation of the navigation channel in 1875. Although gravel extraction is commonly recognised as causing serious damage to fish habitats, new gravel extraction projects in the Gironde estuary are under consideration. A qualitative risk factor analysis, based on the latest knowledge on the biology and ecology of the Atlantic sturgeon, shows that these projects lead to maximum risk for the survival of this species. Taking into account the present fragility of the sturgeon population, protective measures must be taken as a precaution. These would rule out any further gravel extraction.

Key words: Conservation, France, recovery programme, river habitat.

RESUMEN

Recuperación del esturión atlántico *Acipenser sturio* L., 1758 y extracción de grava en el estuario del Gironda

El estuario del Gironda, en el sudoeste de Francia, es el último estuario de Europa occidental donde todavía migran todos los peces diadromos. Además, la cuenca Gironda-Garona-Dordoña es el último sistema conocido donde tiene lugar la reproducción del esturión atlántico. El estuario del Gironda es un hábitat esencial para la realización del ciclo vital de esta especie diadroma. Un plan de recuperación europeo iniciado en 1994 ha mostrado la importancia del estuario para la alimentación y aclimatación de los juveniles antes de su primer viaje al mar. El esturión atlántico ha sido amenazado en los últimos 50 años, principalmente por la extracción de grava en los frezaderos y por los obsoletos reglamentos que han provocado su sobrepesca. Desde finales del siglo XIX, diversas medidas relativas a la navegación (diques, relleno con piedras, espigón) se han llevado a cabo en el estuario del Gironda. Este estuario, industrializado, aunque sólo de forma ligera, ha sufrido dragados desde la creación de un canal de navegación en 1875. Si bien la extracción de grava se reconoce comúnmente como causante de graves daños en los hábitats de peces, se están considerando nuevos proyectos de extracción de grava en el estuario del Gironda. Un análisis de los factores de riesgo cualitativos, basado en los últimos conocimientos de la biología y ecología del esturión atlántico, muestra que estos proyectos conllevan el máximo riesgo para la supervivencia de esta especie. Teniendo en cuenta la fragilidad actual de la población de esturión, deben tomarse medidas protectoras como precaución. Estas deberían excluir cualquier extracción adicional de grava.

Palabras clave: Conservación, Francia, programa de recuperación, hábitat fluvial.

INTRODUCTION

The Atlantic sturgeon *Acipenser sturio* L., 1758 is a diadromous fish species that spawns in fresh water, but matures in estuaries and at sea. In the past, it was present in almost every large river from the Black Sea to the North Sea, via the Mediterranean Sea and the Atlantic Ocean (Rochard, Castelnaud and Lepage, 1990). Today, its marine distribution is restricted to the French Atlantic coast, with only occasional captures around the United Kingdom and in the North Sea (Rochard, Lepage and Meauzé, 1997). The last known areas for reproduction are in the Garonne and Dordogne Rivers in southwest France. Since 1982, *A. sturio* has been fully protected in France. The species is listed on France's Endangered Species Red Book (Keith, Allardi and Moutou, 1992). On an international level, the species is protected by the Bern convention, the Washington convention (CITES) (Anon., 1997) and is listed in the International Union for the Conservation of Nature Red Book (IUCN) (Lepage and Rochard, 1995). Most European countries have signed these international treaties, and have put a ban on the fishing of this species.

THREATS

Dams, pollution and overfishing caused the disappearance of *A. sturio* from most of its historical distribution (Williot *et al.*, 1997). In the Gironde estuary, the decrease of the sturgeon population is mainly due to maladapted fishing regulations, which led to continuous overfishing and to the destruction of spawning grounds and nurseries by gravel extraction operations (Castelnaud *et al.*, 1991). The dams are located 210 km from the ocean on the Dordogne River, and 270 km on the Garonne River, and some sites suitable for spawning are still found downstream from both dams (Elie, 1997). Presently, these threats have been largely reduced by the ban on river gravel extraction and the protection measures on national and international levels. Although gravel extraction is commonly recognised as causing serious damage to fish habitats and was believed to be involved in the decline of several sturgeon stocks around the world (Rochard, Castelnaud and Lepage, 1990), new gravel extraction projects in the Gironde estuary are under consideration.

THE STURGEON AND THE ESTUARY

A European recovery plan (1994-1997) has shown the significance of the Gironde estuary for feeding and acclimatization of juvenile sturgeon before their first journey at sea. The estuary is a compulsory passage for the juvenile and represents an essential habitat for the completion of the life history in this diadromous fish (Elie, 1997). Sampling campaigns with trawl nets have shown that sturgeons were present in each of the determined zones (figure 1). Higher proportions of captures, exceeding up to 10 times the catches in other zones, were encountered in zones 1 and 7.

NAVIGATIONAL FEATURES AND UNDERWATER MINING ACTIVITIES

Since the end of the 19th century, several navigational features (embankments, rockfill, groynes) have been built in the Gironde estuary. Although it supports little industry, the estuary has been constantly disturbed by the dredging of the navigation channel since it was first created in 1875. Today, regular dredging is still carried out for its maintenance. Currently two areas of the estuary are authorised for gravel and sand extraction (figure 1) for construction, but exploitation remains relatively limited. In addition to agricultural practices that influence the availability of sediment, all these operations, from the past and present, have contributed to the enrichment of the maximum turbidity zone which moves with the tide between the river and the estuary. The dumping of dredging material, as well as the cleaning of the gravel and the "natural" maximum turbidity itself, can cause, especially during the summer, a sharp decline in dissolved oxygen or even localised total anoxia due to organic matter degradation and poor photosynthesis (Romaña and Thouvenin, 1990). Moreover, there can be activation and accumulation of bacteria and micro-pollutants at the dumping site (Pommepuy *et al.*, 1990).

EXTRACTION IMPACTS

Because of the complex balance between animal populations and their habitats, the impact of gravel and sand extractions on a fish population is of-

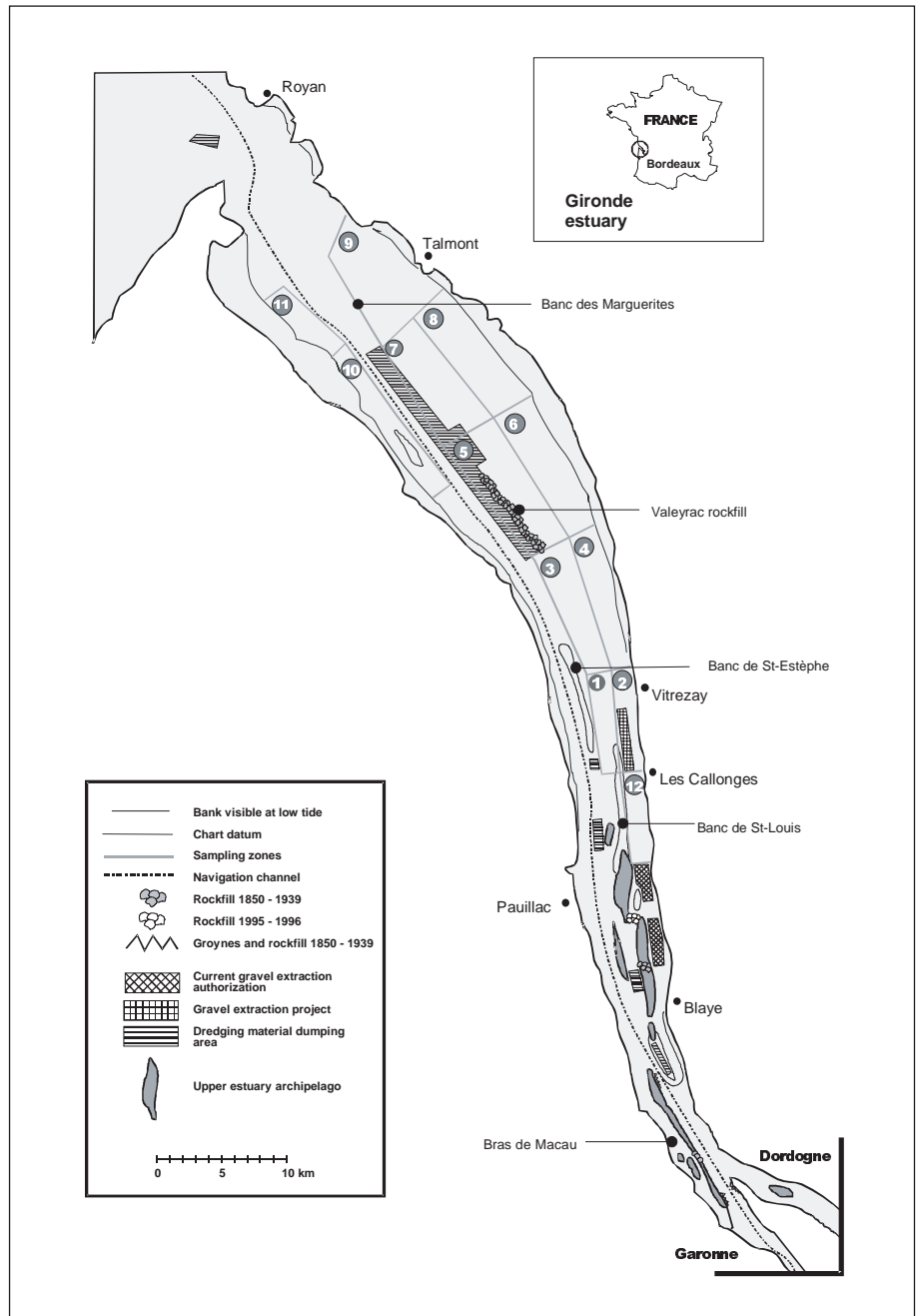


Figure 1. *A. sturio* sampling zone in the Gironde estuary and gravel extraction project

ten estimated *a priori*. There are direct impacts upon populations, but the indirect impacts imply much higher risks because of the impossibility of evaluating the effects of habitat destruction.

There is always a risk for an animal population when man decides to modify its habitat. Beyond the risk to a threatened population, extractions generate a major risk of disturbance to an ecosystem, by modifying the quality of the habitat, on the physical level as well as on a physico-chemical level

(Bouchaud *et al.*, 1979; Malherbe, 1990; Mitchell, 1990; Pommepuy *et al.*, 1990).

Therefore, it seems more appropriate to apprehend the problem by a risk analysis based on current knowledge of the elements describing a population (Akçakaya and Ginzburg, 1991). Interference with the habitat of a threatened population, such as the sturgeon, will involve much higher risks than in a population without any particular problems.

Table I. Grid of risk analysis input for a fish population facing a deterioration of its habitat. The checkmarks indicate the conditions met by *A. sturio*

Condition of risk unknown	Condition involving moderate risk	Condition involving maximum risk
Information not available	Several wild populations	✓ Single wild population
	Wild population that does not exhibit drastic decline	✓ Wild population that is reduced to a crucial minimum threshold
	Balance structure of population	✓ Irregular population structure
	No particular problem with the status of the species in its country of origin	✓ Endangered status of the species in its country of origin
	Several river basins where reproduction takes place	✓ Single river basin where reproduction takes place
	Short life history	✓ Long life history
	No decline in the breeding stock	✓ Sharp decline in the breeding stock
	Little or no reduction observed, deduced or expected in the surface area and/or quality of the habitat	✓ Reduction observed, deduced or expected in the surface area and/or quality of the habitat
	Habitat not highly populated	✓ Essential habitat

In table I, the principal parameters considered are presented. They are inspired by the classification criteria from Appendix I of the Washington convention (CITES) (Anon., 1997), the Red Data Book of the International Union for the Conservation of Nature and Natural Resources (IUCN), and Akcakaya (1997). For each criterion, there are three possibilities to select, whether the information is available or not, and whether it matches one of the two situations described.

According to the criteria given in table I, concerning the risk resulting from damaging essential habitat, it is apparent that the risk is maximised for the sturgeon population.

The sturgeon displays all the aggravating: risk factors related to gravel extraction in the estuary. No factor of knowledge or even of current ignorance is able to balance this degree of risk. Establishing all necessary measures in order to make it possible to restore the population of sturgeon in the Gironde would imply extending the prohibition of gravel extraction for the entire Gironde estuary in order to minimise the risk involved.

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