

## How Illegal Capture of Glass Eel (*Anguilla anguilla*) Affect Biodiversity in Tagus River

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**Abstract.** The eel is a catadromous fish that grows in rivers and spawns in the sea. Every year, between November and the end of March, when glass eels migrate up river, illegal nets catch them in the Tagus River (downstream of the estuary, in Portugal). Every day, authorities organise policing actions to capture illegal nets placed in river specifically intended to capture glass eels. Usually, the seized nets are filled with glass eels and other species, since the net is very narrow (1-2 mm); it therefore captures everything. The mortality rate caused by these is huge and affects the eel's preservation and the river's biodiversity.

**Keywords.** Eel, glass eel, illegal nets, policing actions, biodiversity, Tagus river.

### 1. Introduction

#### 1.1. Species

The European eel, *Anguilla* (L.), is a catadromous fish that grows in rivers and spawns in the sea.

The eel or European eel is found in several environments, such as fresh, brackish and coastal waters.

Several works mention European eels spawning in the Sargasso Sea, in the

Atlantic Ocean, but according to the Workshop on Evaluation Progress with Eel Management Plans of ICES (International Council for the Exploration of the Sea) its life cycle has not been fully determined [1,2]. The larvae, called *Leptocephali*, approach the continent and transform into an unpigmented round-shaped animal, called glass eel, prior to their entrance in continental waters.

When they reach this stage, they start their migration to the rivers and are found near the river mouths. Afterwards, during their first year following their recruitment from the ocean, they become pigmented and are called elvers.

Subsequently, when they are more colourful and longer, they are called yellow eels and live in continental waters (Fig. 1).

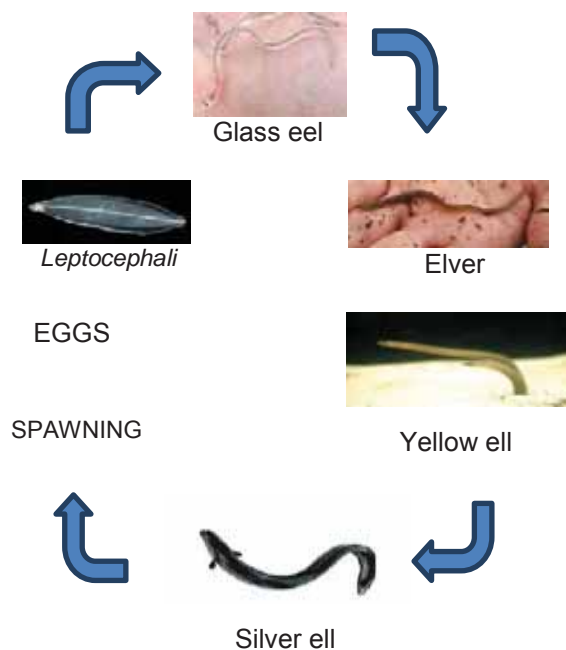


Figure 1. Life cycle of the European eel

ICES (2013) mentioned that the animals can live for up to 20 years or more. When eels mature and migrate into the Atlantic Ocean, a new colour alteration occurs and they are now called silver eels. In this stage, females are longer than males, almost doubling their size.

In Portugal, the Red Book of Vertebrates classifies this specie as a considerably “endangered species” due to their enormous reduction in numbers in the last few years [3].

### 1.2. Legislation

According to Council Regulation (EC) No. 1100/2007, of 18 September 2007 [4], which establishing measures for the recovery of the stock of European eel. Member-States must establish management plans for eels in their territories: “Member-States shall identify and define the individual river basins lying within their national territory that constitute natural habitats for the European eel (eel river basins) which may include maritime waters. (...) Member States shall prepare an Eel Management Plan. (...)The objective of each Eel Management Plan shall be to reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40 % of the silver eel biomass.”.

In December Portugal established the Eel Management Plan 2009-2012 [5], undertaking to implement several actions aimed at studying and preserving the species. One of these actions consists of the control of the illegal catch of glass eels, which is only allowed in the north of the country, in the Minho River. Glass eel capture is allowed in the Minho River due to its international status, divided between

Portugal and Spain; the fact is that Spanish people capture eels for eating. This action stipulates that an inspection must be carried out 2 times per month, between October and March, besides a monthly inspection in April and May.

In 2010 legal restrictions were incorporated in Portuguese law that forbid the catch of eels in the months of October, November and December in continental waters, in order to allow eels to follow downstream and reach the sea for spawning [6].

In June of 2012, it was established that eel professional fishing is only allowed in the areas defined for that purpose [7].

### 1.3. Tagus River

The Tagus River is the longest river on the Iberian Peninsula.

The source of the Tagus is Fuente de García (Spain) and its mouth is near Lisbon (Portugal).

The area of study is just close to the estuary, as can be seen in Fig. 2.

## 2. The Eel in the Tagus River

As to the Tagus River, the literature mentions that every year, between November and the end of March, glass eels migrate up river, and the Tagus River is no exception.

In the past the eel population colonized the entire Tagus River basin, reaching its Spanish portion. Since the construction of the Belver dam, in 1952, eels are limited to the lower 158 km of the river. The eel is now restricted to about 1.250 Km of streams and rivers, corresponding to an area close to one-half of the original one [8].



Figure 2. Area of study (Source: Google maps)

### 3. Inspections by the authorities

Currently, the inspections done by authorities take place 2 to 3 times per week, beginning in November and ending in March.

The authorities responsible for this supervision are GNR (Republic National Guard) and the maritime police.

It is the kind of activity that does not please everyone, so sometimes people break the wheels of the inspection vehicles, so as to avoid the seizing of the nets.

Usually police authorities seize part of the net, and not the net as whole, due to its size and weight. This procedure is designed so as to prevent ghost fishing.

### 4. Gears for illegal fishing of glass eels

In the past, glass eels were not captured in the Tagus River, as can be observed in Baldaque da Silva (1891), who reported on fishing gears in Portugal [9].

Last century, in the 80's, the fishing gear used to illegally capture glass eels was called *rapeta* or mosquito net. This gear was similar to a big, round and narrow shrimping net. This gear was used at night during a 2-3 month-period. The strategy consisted on travelling by boat carrying this fishing gear. People said that, in a good night, the captures could reach 5 Kg [10]. In that period, all the glass eel was sold to Spanish customers that came to buy it locally.

Nowadays amateurs and non-professional fishermen use more complex illegal fishing gears in the river.

The system used by these fishing gears can be seen in Fig.3.

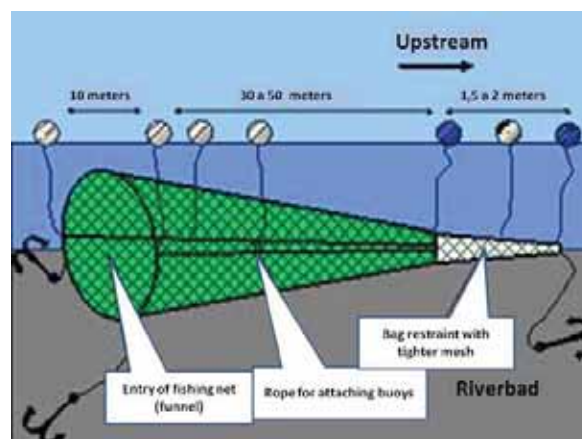


Figure 3. Scheme of illegal fishing gear used to capture glass eels

The nets consist of a green canvas, about 30 to 50 m long (Fig. 4). This canvas is identical to the one used to harvest olives. This net has a very fine mesh, as we can see in Fig. 5. In its extremity a second whitish bag-shaped net is installed, which imprisons all animals that enter its mouth (Fig. 6). This last net is very fine-meshed (1

mm) (Fig. 7) and is about 1.5 to 2 metres long.

These nets are fastened on the river bottom using anchors and, at the surface, jerry cans are placed and used as buoys (Fig. 8).



**Figure 4. Part of the fishing gear**



**Figure 5. Mesh of a green net**

### **5. Attitude of the population by the river side**

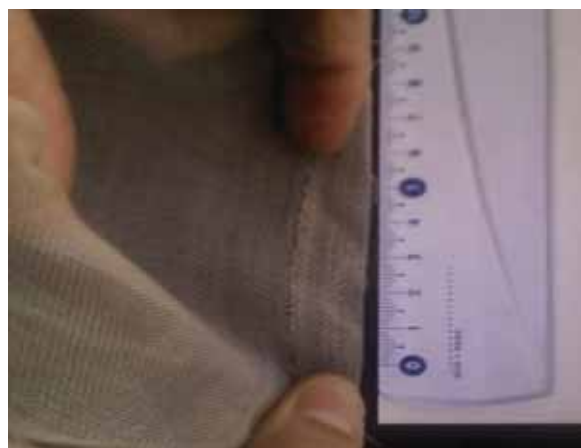
In 1986, the second author carried out interviews among fishermen; these men said

that several fishermen were doing that to complement their income.

Fishermen are not immune to the deep economic crisis and the greed to immediately extract from the river, at any cost, all its profitable resources, leads them to misunderstand the concept of sustainability.



**Figure 6. Bag belonging to fishing gears where glass eels concentrated**



**Figure 7. Mesh of a net where animals are imprisoned**



Figure 8. View of fishing gears in the river

These riverside populations reveal a feeling of possession towards the river and this feeling is passed on from generation to generation.

This feeling is quite patent in the statements an anonymous fisherman shared with the media: *“A fisherman living from the river and who loves the river, born by the river, if he does not profit from that valuable source, then he is probably nuts”*.

## 6. Future of the glass eel

The collection and the transport of the eel is done by intermediaries that contact suppliers/fishermen with equipment for preserving living animals during transport until it reaches Spanish buyers, whether as end consumers, or as intermediaries for exports aimed at Japan (Fig. 9).

Part of the eel is consumed in this stage of its life, and is named the «Portuguese caviar» (Fig. 10).

Another portion is used in aquaculture for growth purposed. There are no reports referring that any part of the eels, after reaching adult age, is released for repopulating waterways.



Figure 9. Capture by authorities of a transportation of glass eel in Portugal



Figure 10. Glass eels for human consumption in other countries

source:

<http://www.camporel.com/productos/edicion/precocinados/surimi-de-angula-en-aceite>

source: <http://www.tienda.com/food/products/se-93.html>

## 7. Loss of biodiversity

The loss of biodiversity is enormous because this fishing gear captures everything: glass eels, little fish, adult protected fish, shrimps, crabs, etc.

When glass eels are captured, its quantities in the population are strongly reduced, jeopardising the future of European eels in the Tagus River.

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Several small unidentified fish are captured, in considerable proportions, as demonstrated in Fig. 11.

The species *Lampetra fluviatilis* is considered to be “very endangered”, according the Red Book of Vertebrates, is also capture Fig. 11.



Figure 11. An exemplar of *Lampetra fluviatilis* in illegal fishing gears in the Tagus River

## 8. Conclusions

The great effort by the police authorities, not only towards the release of the eel and of the remaining species imprisoned due to this illegal craft, but also in identifying its perpetrators, is not duly supported by the law, since it is very difficult to frame this activity as an environmental felony; we are left with the illegal mesh of the nets used, as well as the small size of the fished animals.

These legal frameworks are scarcely meaningful, and are often restricted to small fines.

As long as a harsher criminal framework is lacking, we can only promote a culture of environmental knowledge among all stakeholders in the process, in order to save the *Anguilla anguilla* (L.), along with all other

species harmed by this *modus operandi*. Unfortunately, law enforcement can only capture part of the illegal fishing gears.

## 9. Acknowledgements

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